MACROECONOMIC IMPLICATIONS OF HEALTHCARE FINANCING REFORMS: A COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS OF UGANDA

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DECLARATION

I, Judith Kabajulizi, confirm that the work presented in this thesis is my own.

Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signature .... Date: ....

To Roy, Rodney and Roderick

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ABSTRACT

There are a lot of health sector reforms across the spectrum of high to low income countries. There are underlying pressures for reform regarding the role and responsibility of different actors in relation to healthcare financing, production, consumption and regulation. The health sector itself is usually a very significant economic sector in its own right, and thus changes to it have direct impacts on the economy and indirectly through their effect on health, yet there is little consideration of these wider macro effects. The wider macro-economic effects refer to the general equilibrium outcomes of the economy's transmission mechanisms through wages, rents, factor demand and supply, foreign exchange rates and sectoral shares in output, which in turn affect changes at the macro level (including GDP, private and public consumption, investment, imports and exports, and poverty levels). There is an ever increasing attention to the question of how to increase financial resources for healthcare, particularly by governments. This thesis sets out to evaluate the economy wide impacts of healthcare financing reform policies, taking Uganda as a case study.

Using a recursive dynamic computable general equilibrium (CGE) model, calibrated from a health-focused Social Accounting Matrix (SAM), the impact of healthcare financing reform policies is assessed. Three sources of fiscal space for health – prioritisation of the health sector, earmarked taxes for health, and aid for health – are analysed. Results showed that increasing resources to the health sector from any of the three sources of fiscal space for health coupled with the envisaged improvements in the population health status leads to higher GDP growth rates and reduces poverty. The tax for health policy showed the highest GDP growth rates while the aid for health policy achieved the highest reduction in poverty. Therefore, government should increase resources to the health sector in order to achieve the aspirations of the Uganda Vision 2040.

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LIST OF ABBREVIATIONS AND ACRONYMS

AGR	Agriculture
AMR	Antimicrobial Resistance
ANC	Antenatal Care
ASSIA	Applied Social Sciences Index and Abstracts
CAO	Chief Administrative Officer
CE	Cross-Entropy method
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CGE	Computable General Equilibrium
COMESA	Common Market for Eastern and Southern Africa
CPI	Consumer Price Index
DC	District Council
DDHS	District Health Services
DHC	District Health Committee
DHMT	District Health Management Team
DLT	District League Tables
EAC	East African Community
EconLit	Economic Literature
EMBASE	Excerpta Medica database
FDI	Foreign Direct Investment
FGT	Foster-Greer-Thorbecke
GDP	Gross Domestic Product
GFS	Government Finance Statistics Classification
GH	General Hospitals
GHG	Greenhouse Gas
GHI	Global Health Initiatives
GTAP	Global Trade and Policy
HC I	Health Centre 1
HC II	Health Centre 2
HC III	Health Centre 3
HC IV	Health Centre 4
HIMS	Health Management Systems
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
H-O	Hecksher-Ohlin model
HSD	Health Sub District
HSSIP	Health Sector Strategic and Investment Plan
HSSP	Health Sector Strategic Plan
IBSS	International Bibliography of the Social Sciences
ICT	Information and Communications Technology
IFPRI	International Food and Policy Research Institute
IMR	Infant Mortality Rate

IND	Industry
ISCO-08	International Standard Classification of Occupations-08
ISEC-97	International Standard of Education Classification-97
ISIC	International Standard Industrial Classification for All Economic Activities
LC	Local Council
LES	Linear Expenditure System
LMIC	Low and Middle Income Countries
MDG4	Millennium Development Goal 4
MMR	Maternal Mortality Rate
MoFPED	Ministry of Finance, Planning and Economic Development
MoH	Ministry of Health
MRSA	Methicillin- Resistant Staphylococcus Aureus
MTEF	Medium Term Expenditure Framework
NDP	National Development Plan
NGO	Non-Government Organisation
NHA	National Health Accounts
NHP	National Health Policy
NHS	National Health Services
NMS	National Medical Stores
NPSSP	National Pharmaceutical Sector Strategic Plan
NRHs	National Referral Hospitals
ODA	Official Development Assistance
ODI	Overseas Development Institute
OLG	Overlapping Generation
OPD	Out-Patient Department
PEAP	National Poverty Eradication Programme
PFP	Private For Profit Organisations
PHC	Primary Healthcare
PHP	Private Health Practitioners
PNFPs	Private Not For Profit Organisations
PPP	Public-Private Partnerships
RDF	Revolving Drug Fund
RRHs	Regional Referral Hospitals
SAM	Social Accounting Matrix
SARS	Severe Acute Respiratory Syndrome
SERV	Services
SHIS	Social Health Insurance Scheme
SSA	Sub-Saharan Africa
Stata/IC	Statistical Data Analysis Software
SWAps	Sector Wide Approaches
TCMPs	Traditional and Complementary Medicine Practitioners
TFP	Total Fertility Productivity
TFR	Total Fertility Rates

U5MR	Under-5 Mortality Rate
UBOS	Uganda Bureau of Statistics
UDHS	Uganda Demographic and Health Survey
UNCTAD	United Nations Conference on Trade and Development
UNHS	Uganda National Household Survey
UNMHP	Uganda National Minimum Healthcare Package
VAT	Value-added Tax
VHT	Village Health Team
WHO	World Health Organisation

CHAPTER 1: INTRODUCTION

1.1 Introduction

Health sector reform is a subject of much discussion and action across the spectrum of high to low income countries. The underlying pressures for reform are not necessarily the same but there may be elements common to certain groups of countries, as far as questions regarding the role and responsibility of different actors with regard to healthcare financing, production, consumption and regulation are concerned (Creese, 1994). The World Development Report 1993: Investing in Health (World Bank, 1993), formally set the agenda for reforming healthcare in developing countries by requiring borrowing countries to undertake health sector reforms as a precondition for accessing loans.

The global trend in healthcare reform is critical for not just health but also the wealth of populations. Health is a core driver of economic growth (Bloom & Canning, 2000, 2005; Bloom, Canning, & Sevilla, 2004; Fogel, 2004; World Bank, 2004) and the health sector itself is usually a very significant economic sector in its own right. Reforms to healthcare therefore have direct impacts on the economy and indirectly through their effect on health, yet there is little consideration of these wider macro-economic effects. The wider macro-economic effects refer to the general equilibrium outcomes of the economy's transmission mechanisms through wages, rents, factor demand and supply, foreign exchange rates and sectoral shares in output, which in turn affect aggregate changes at the macro level. The macro level changes include growth rates in GDP, private and public consumption, investment, imports and exports, and national poverty levels. There is some literature looking at health as a factor affecting economic growth, but only one study, (Rutten, 2004) tackles the economy wide impact of policy changes in the health sector, based on the United Kingdom. A study attempting to assess healthcare policies in Botswana is related, but here the focus was upon government interventions targeted at reducing the effects of HIV/AIDS (Dixon, McDonald, & Roberts, 2004). Given the fundamental importance of the health sector in low - and middle-income countries (LMICs) this is a significant gap in the literature. It is the aim of this study to address this gap by looking at the macro-economic impact of healthcare financing reforms on the wider macro-economy (including growth in GDP, private and public consumption, investment, imports and exports, as well as country poverty levels) in LMICs, taking Uganda as a specific case study.

The rest of the chapter is structured as follows. Section 1.2 outlines the socio-economic background, describing the unique features that characterise the Ugandan economy as well as summarising the health status of the people of Uganda. Section 1.3 describes the healthcare delivery system in the country. The current healthcare financing mechanism in Uganda is summarised in Section 1.4 while the health sector performance is summarised in Section 1.5. The specific health sector reforms that were initiated and carried out in Uganda are described in Section 1.6 while Section 1.7 reviews literature on the creation of fiscal space for health. Section 1.8 summarises the introductory chapter. The aim and objectives of the study and the organisation of the thesis are presented in sections 1.9 and 1.10 respectively.

1.2 Uganda's socio-economic background

Situated in the eastern part of Africa, Uganda lies astride the equator with an area of 241,550.7 square kilometres (km^2) which is about the same size as the United Kingdom[1]. About 17% of the total area (41,743.2 km^2) is open water and swamps, while the rest is dry land. It is located within the Great Lakes region bordered by Kenya to the east, Democratic Republic of Congo to the west, Tanzania to the south, Rwanda to the South West and Sudan to the North. Figure 1 shows the map of Uganda indicating the territorial borders, the location of Kampala (the capital city) and other major towns.

[1] The total area of the United Kingdom is 244,820 square kilometres.

Figure 1.1 Map of Uganda

Source: Google maps

Uganda is a low income country with a per capita gross domestic product (GDP) of just over US $500 (Uganda Bureau of Statistics, 2010a). Since 1990, the economy has grown markedly achieving annual GDP growth rates over 5%, which is above the Sub-Saharan Africa (SSA) and the World average for the same period. The growth in per capita GDP is attributed in part, to the economic reforms instituted in the early 1990s. However, even though the GDP per capita growth rate has been higher than the Sub-Saharan Africa (SSA) and World average, household incomes remain very low with GDP per capita far below the World average and just about half the SSA average (World Bank, 2010b).

In 2008, 31.1% of the population was estimated to be living below the poverty line (World Bank, 2010b), implying that about a third of Ugandans are unable to meet their daily calorie requirements. Table 1.1 provides detailed statistics on poverty by residence – rural and urban areas defined by the poverty indices. The P_0 indicator reports the incidence of poverty, P_1 the depth of poverty and P_2 the severity of poverty. Although there was a significant decrease in poverty at the national level between the two most recent rounds of the Uganda National Household Survey (UNHS) - UNHS 2005/06 and UNHS 2009/10, the incidence of poverty remains much higher in the rural areas than in urban areas. With a population share of 85%, rural areas contribute 94% to the national poverty.

Table 1.1 Poverty statistics in Uganda

Residence	Population share	Poverty estimates			Contribution to:		
		P0	P1	P2	P0	P1	P2
UNHS 2009/10							
Rural	85.0	27.2	7.6	3.1	94.0	95.9	96.8
Urban	15.0	9.1	1.8	0.6	5.6	4.1	3.2
National	100.0	24.5	6.8	2.8	100.0	100.0	100.0
UNHS 2005/06							
Rural	84.6	34.2	9.7	3.9	93.2	93.8	94.1
Urban	15.4	13.7	3.5	1.4	6.8	6.2	5.9
National	100.0	31.1	8.7	3.5	100.0	100.0	100.0
UNHS 2002/03							
Rural	86.2	42.7	13.1	5.7	94.9	95.5	95.7
Urban	13.8	14.4	3.9	1.6	5.1	4.5	4.3
National	100.0	38.8	11.9	5.1	100.0	100.0	100.0

Source: (Uganda Bureau of Statistics, 2013) Note: UNHS = Uganda National Household Survey

The main sources of GDP include; food crops in the agricultural sector, manufacturing and construction in the industry sector, and wholesale and retail services in the services sector.

The trend in sector share in GDP is presented in Table 1.2 for selected sectors for a period of 10 years. The continuous growth in manufacturing is driven by the expansion in the food processing, beverages and tobacco category while the growth in construction activities is attributed to the increase in the roads, bridges and non-residential buildings construction in the public construction activities (Uganda Bureau of Statistics, 2013). The services sector share in GDP has been on a gradual decline. It is noted that while the share of all the public services (health, education and Public administration and defence) have consistently declined over the period under consideration, the share of Public administration and defence started to rise again from 2009.

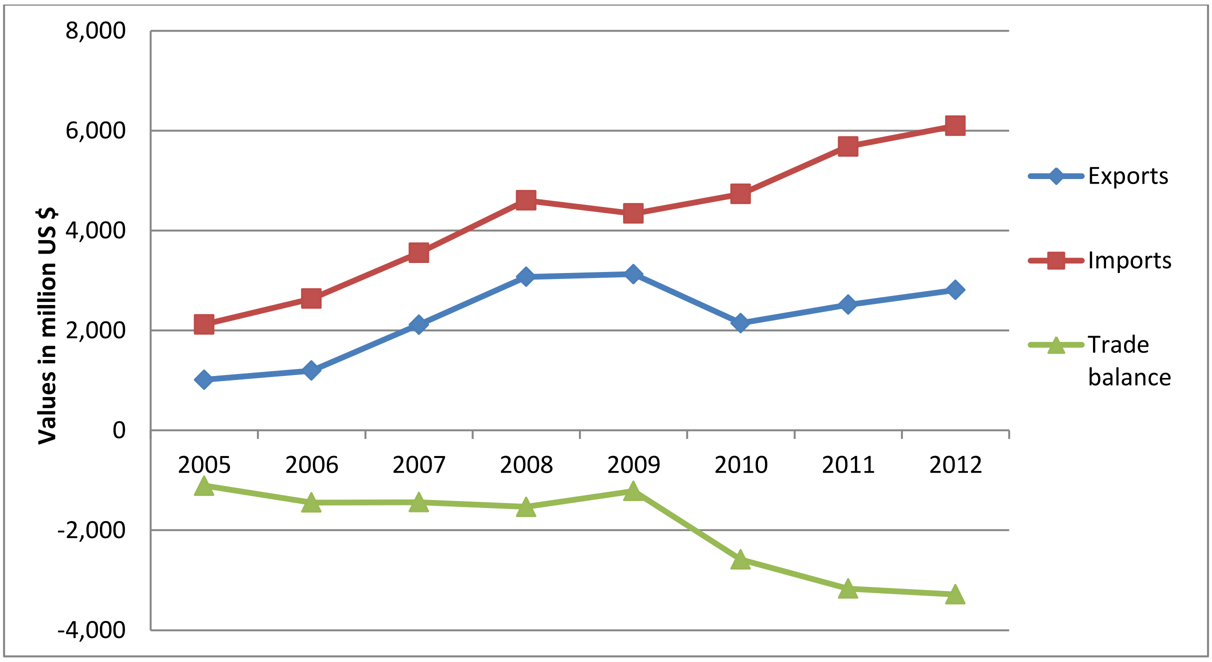
Table 1.2 GDP by economic activity, percent share: 2003 - 2012

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total GDP at market prices	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Agriculture, forestry and fishing; Total	**24.0**	**23.0**	**24.0**	**22.6**	**21.0**	**21.6**	**23.5**	**21.7**	**22.9**	**22.2**
Cash crops	2.0	1.9	1.9	1.7	2.1	2.0	1.6	1.8	2.2	1.6
Food crops	14.8	13.6	14.6	13.4	11.1	11.9	14.3	12.0	12.7	12.4
Livestock	1.7	1.8	1.6	1.5	1.5	1.6	1.7	1.6	1.8	1.9
Forestry	3.4	3.3	3.3	3.2	3.5	3.5	3.6	3.5	3.1	3.5
Fishing	2.1	2.4	2.6	2.7	2.7	2.6	2.3	2.7	3.0	2.7
Industry; Total	**21.9**	**22.6**	**22.9**	**22.3**	**23.3**	**24.0**	**23.8**	**24.4**	**25.4**	**25.7**
Mining & quarrying	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Manufacturing	6.9	7.0	6.9	6.9	7.0	7.2	7.7	7.8	8.4	8.1
Formal	4.9	5.0	5.0	5.0	5.2	5.4	5.9	5.9	6.4	6.1
Informal	2.0	1.9	1.8	1.9	1.9	1.9	1.9	1.9	2.1	2.0
Construction	11.2	11.9	12.1	11.2	11.3	12.3	12.1	12.4	13.2	13.4
Services; Total	**48.0**	**48.1**	**47.0**	**49.1**	**50.1**	**48.0**	**46.3**	**47.6**	**46.0**	**46.6**
Wholesale & retail trade; repairs	12.9	12.7	12.7	13.6	14.3	14.7	15.3	16.2	17.3	16.7
Real estate activities	7.7	7.6	7.2	7.2	7.1	6.6	4.3	4.3	3.9	4.2
Public administration and defence	4.1	3.9	3.7	3.6	3.2	3.0	3.1	3.3	3.0	2.8
Education	7.0	7.0	6.9	7.0	6.8	5.6	5.2	5.2	4.1	4.1
Health	1.7	1.6	1.6	1.5	1.5	1.1	0.9	0.9	0.9	0.8
Other personal and community services	1.7	1.9	1.9	2.1	2.2	2.2	2.2	2.3	2.3	2.4

Source: (Uganda Bureau of Statistics, 2008, 2013)

The country is heavily constrained and burdened by debt. Total external debt to GDP was well above 50% for the years 1990 to 2005 and even rose to 103% in 1992 (World Bank, 2010a). By 2011, the total external debt stood at 23% of GDP, while the total debt outstanding per capita was USD 112. This implies that every Ugandan had to reduce their income per capita of USD 500 by the amount of indebtedness to external lenders of USD 112. Moreover, the trade balance has continued to worsen mainly due to the low value of exports against high value imports. Figure 1.2 shows the trend in the trade balance from 2005 to 2012.

Figure 1.2 Uganda Trade flows: 2005 – 2012



The country's population is estimated at 31.6 million, of which 56.1% are aged below 18 years and 4.6% are aged above 60 years, as of the 2002 census (Uganda Bureau of Statistics, 2012; World Health Organisation, 2012). This implies the country's population is young and largely dependent on a smaller proportion of the total population. Uganda has one of the highest total fertility rates (TFR) in Eastern and Southern Africa (Uganda Bureau of Statistics

& Macro International Inc, 2007). With the fertility rate at 6.7 births per woman and growth rate of 3.3 %, Uganda has one of the fastest growing populations in the world. Uganda's population growth is faster than the whole of Sub-Saharan Africa (SSA) at 2.5 % and the World average at 1.2 % (World Bank, 2010b). The overall life expectancy at birth was reported at 50.5 for both sexes in the 2002 census but males registered a lower life expectancy at 48.8 compared to women at 52 years (Uganda Bureau of Statistics, 2010a).

The labour force in Uganda has been growing mainly because of the young population entering the working age population[2]. A summary of key labour market indicators is presented in Table 1.3. Between UNHS 2005/06 and UNHS 2009/10, the labour force participation rate increased from 81.4% to 91.6% and the number of self-employed declined to 79.5% from 82.3%. The decline in the self-employed rate was attributed partly to the expansion of available business ventures (mainly informal) over the survey years (Uganda Bureau of Statistics, 2013). The agricultural sector has remained the major employer in Uganda although its contribution to employment declined between the two survey periods.

The median monthly wage rate is reportedly higher in the public sector compared to the private sector. Although the median wage rate increased over the two surveys, the benefits of the increase were eroded by inflation. For instance, the public sector monthly real median wage rate declined from 150,000 to 145,935 Uganda shillings. Wages for the paid employee segment of the labour force remain low when compared to other countries in the region. For instance, in Kenya the 2012 paid employee equivalent monthly wage averaged 876,153 and 959,774 Uganda Shillings for the private sector and the public sector respectively (Kenya

[2] The working age population in Uganda is defined as the population aged 14-64 years, as opposed to the International labour Organisation (ILO) definition of persons aged 15-64 years.

National Bureau of Statistics, 2013), compared to Uganda's Shillings 145,935 Uganda Shillings for public and 41,696 Uganda Shillings for private sectors.

Table 1.3 Selected Labour Market indicators for persons aged 14-64

	UNHS 2005/06			UNHS 2009/10		
Indicator category	Total	Male	Female	Total	Male	Female
Size of labour force ('000)	10,883	5,330	5,554	13,367	6,352	7,014
Size of the working force ('000)	10,672	5,238	5,434	12,889	6,193	6,696
Labour force participation rate (LFPR)	81.4	83.1	79.9	91.6	92.2	91.0
Median monthly wages (nominal)						
Total	54,300	70,000	36,200	80,000	90,500	54,300
Public	150,000	150,000	150,000	210,000	220,500	200,000
Private	45,200	54,000	25,000	60,000	80,000	45,250
Median monthly wages (real 2005/2006 = 100)						
Total	54,300	70,000	36,200	55,594	62,891	37,735
Public	150,000	150,000	150,000	145,935	153,231	138,985
Private	45,200	54,000	25,000	41,696	55,594	31,445
Status in employment of the work force						
a) Self employed	82.3	75.6	90.7	79.5	72.1	86.2
b) Paid employee	16.7	24.4	9.3	20.6	27.9	13.8
Sector of Employment (ISIC Rev3)						
a) Primary	74.8	68.1	81.2	69.7	64.5	74.5
b) Service	19.3	22.9	15.9	22.2	24.1	20.5
c) Manufacturing	5.9	9.0	2.9	8.1	11.4	5.0
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: (Uganda Bureau of Statistics, 2013)

The structure of the working population in urban areas is different from the pattern for the whole country. The Urban labour surveys, carried out in the Greater Kampala area – comprising of Kampala City and the highly urbanised sub-counties of Wakiso and Mukono districts, indicate that in urban areas, the agricultural sector ceases to be the main employer and the services sector contributes almost 80% of the employment. Selected labour market indicators from the urban labour survey are summarised in Table 1.4. Nearly half of the work force covered in the surveys is paid employees, compared to 16.7% for the whole country.

This implies that paid employees are concentrated in urban areas. Another important observation from the urban labour survey is that, the informal sector is large and growing. By 2011, the share of informal sector was 91.5% compared to 85% in the previous year.

Table 1.4 Selected labour market indicators from the Urban Labour Surveys

Year of Survey	2009	2010	2011
Indicator category			
Size of the labour force ('000)	920	1,098	1,154
Size of the working population ('000)	797	958	1,051
Labour force participation rate (LFPR)	69.3	72.2	63.4
Median monthly wages - paid employee ('000)	150	152	200
Activity status of the work force (%)			
Self employed	50.2	51.9	54.4
Paid employee	49.8	48.1	45.6
Broad sectors of employment (%)			
Agriculture	6.1	8.1	4.7
Manufacturing	14.9	16.4	17.4
Service	78.6	75.5	77.9
Informal employment	88.6	85	91.5

Source: (Uganda Bureau of Statistics, 2013)

1.2.1 Health status of the people of Uganda

The wide spread poverty in Uganda largely contributes to the relatively poor health status of the population. Uganda's health indicators show a heavy burden of disease, which is disproportionately born by children and women. A summary of selected health status indicators is presented in Table 1.5. Infant mortality rate (IMR) and under-five mortality rate (U5MR) are still high despite being on a declining trend since 1990s. In 2009, the IMR was

79 deaths per 1000 down from 111 in 1990, while the U5MR was 128 deaths per 1000 down from 184 deaths in 1990 (UNICEF, WHO, WORLD BANK, & UNPD, 2010; World Health Organisation, 2012). The observed reduction in the U5MR is insufficient to meet the millennium development goal 4 (MDG4) that calls for reducing under-five mortality by two thirds between 1990 and 2015.

Table 1.5 Health status indicators: 1988/89 - 2011

Indicator	UDHS 1988/89	UDHS 1995	UDHS 2000/01	UDHS 2005/06	UDHS 2011
Infant mortality rate (IMR)	119	85	88	76	54
Under five mortality rate (U5MR)	180	156	152	137	90
Maternal mortality ratio (MMR)	523	506	524	418	438
Deliveries supervised by skilled health worker (%)	38.0	38.0	38.0	42.0	57.4
Total fertility rate (TFR)	7.3	6.9	6.9	6.7	6.2
Contraceptive prevalence rate (CPR) (%)	5.0	15.4	18.6	24.2	30.0
Children nutrition status					
Stunting (%)	43.0	38.8	38.0	38.0	33.0
Wasting (%)				6.0	5.0
Under weight (%)				16.0	14.0

Source: (Uganda Bureau of Statistics & ICF International Inc, 2012; Uganda Bureau of Statistics & Macro International Inc, 2007)
Note: UDHS = Uganda Demographic and Health Survey

Maternal conditions are among the major causes of deaths and disease burden in Uganda. In 2004 more than half of female deaths were due to maternal conditions (World Health Organisation, 2009). The overall maternal mortality ratio (MMR) is high at 438 deaths per 1000 women as of 2011. The appalling maternal mortality is ever present, in spite of an improvement in the rate of births attended by skilled health personnel from 38% in 1995 to 57% in 2011. According to the Uganda demographic and health survey (UDHS), the proportion of pregnant women who attend at least one antenatal care (ANC) session was reported at 93.5% in 2006 and this remained about the same in 2011. But the group is lost in a cascade since just about half of that number is reported to have attended the World Health Organisation (WHO) recommended four ANC sessions. For instance, in 2011/12, only 34.2% of pregnant women attended the 4 ANC sessions, short of the 55% target for the health sector strategic and investment plan (HSSIP) (MoH - Uganda Ministry of Health, 2012). Although contraceptive prevalence has increased since the 1990s, there is a continuing unmet need for family planning – 40.6% in 2006 (Uganda Bureau of Statistics & Macro International Inc, 2007).

1.3 The Uganda Healthcare delivery system

Health services in Uganda are delivered by the public sector as well as the private sector. The government owns 71% of health facilities in Uganda compared to 29% owned by the private sector (MoH - Uganda Ministry of Health, 2010b). The private sector is comprised of not-for-profit organizations (PNFPs), private health practitioners (PHP), the traditional and complementary medicine practitioners (TCMP); and the community. The ratio of public to private health facility ownership emphasizes the vital role of government in the provision of healthcare in Uganda. Table 1.6 shows the number and ownership of health facilities in Uganda. The ownership of health facilities depicted in Table 1.6 also shows that the private sector, particularly the PNFPs, is a major player in healthcare services delivery in Uganda.

Table 1.6 Number and ownership of health facilities in Uganda: 2004 – 2010

Year		Hospitals	Health centre IV	Health centre III	Health centre II	Total
2004	Govt	55	151	718	1,055	1,979
	Pnfp	42	12	164	388	606
	Private	4	2	22	830	858
	Total	101	165	904	2,273	3,443
2006	Govt	59	148	762	1,332	2,301
	Pnfp	46	12	186	415	659
	Private	8	1	7	261	277
	Total	114	161	955	2,008	3,237
2010	Govt	64	164	832	1,562	2,622
	Pfnp	56	12	226	480	774
	Private	9	1	24	964	998
	Total	129	177	1,089	3,006	4,394

Source: (MoH - Uganda Ministry of Health, 2010a) Note: Govt = government, Pnfp = Private-not-for-profit

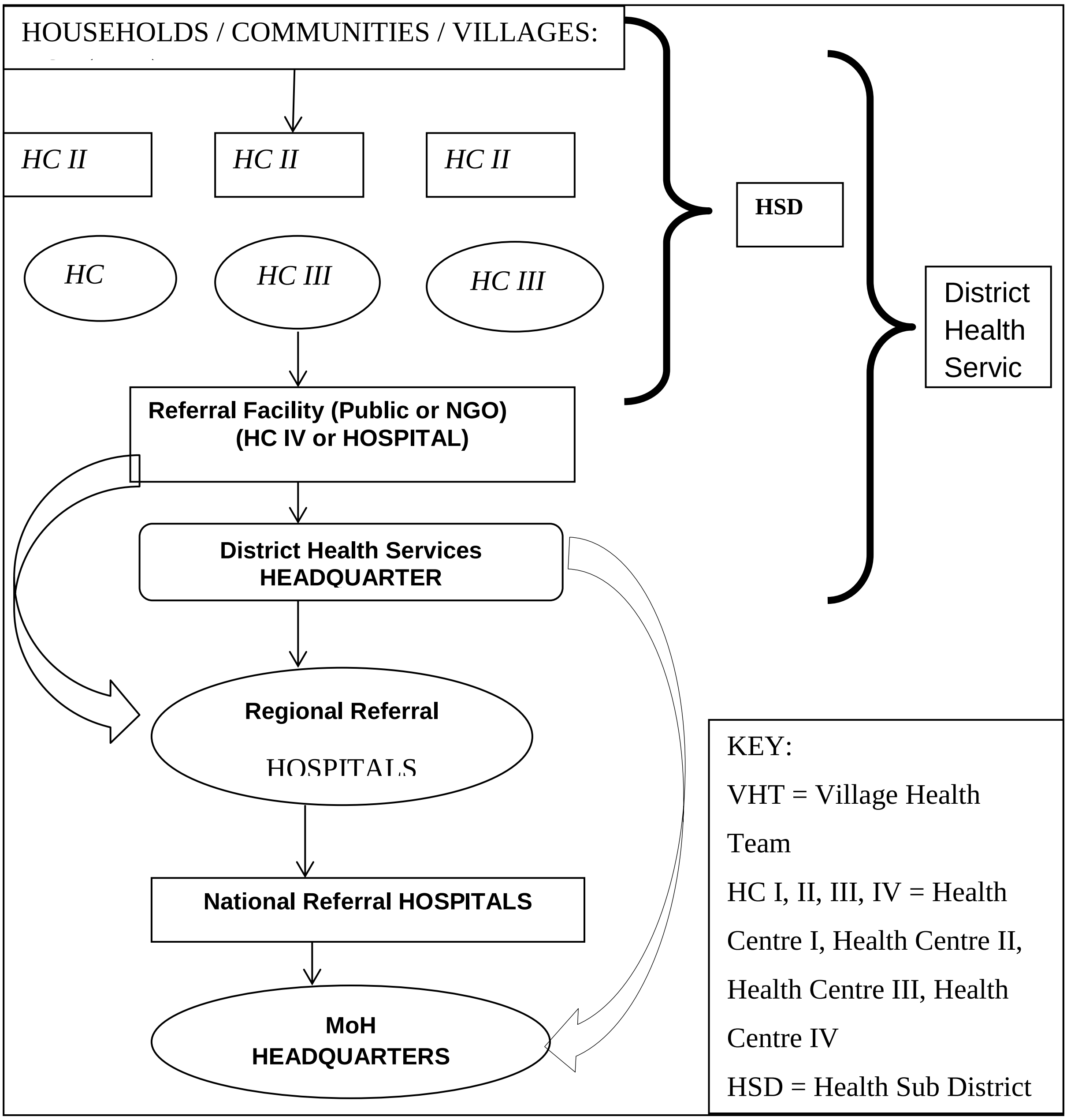
1.3.1 The Public healthcare delivery system

The public health services delivery is structured into health centres (HCs) one to four – health centre one (HCI), health centre two (HCII), health centre three (HCIII), and health centre four (HCIV); general hospitals; regional referral hospitals (RRHs); and national referral hospitals (NRHs), as illustrated in Figure 1.3. Health services are free in all public health facilities, except in the private wings of government hospitals.

The organisation of Uganda's public health system is operated on a six tier infrastructure with the ministry of health (MoH) at the apex of healthcare delivery organisation. The MoH is charged with the responsibility of delivering healthcare services to the people of Uganda in accordance with the health sector strategic plan and the constitution of Uganda. The core functions of the MoH include policy formulation, strategic planning, setting standards and quality assurance, resource mobilisation, coordination of health research, and monitoring and evaluation of the overall health sector performance.

The second and third tier in the health delivery organisation comprises of hospitals which offer a back-up and support function to the district health service delivery. They comprise of general hospitals, RRHs, and NRHs services, provided by the public, PNFPs, and PHPs. The general hospitals offer services that include preventive, promotive, curative care, maternity, and in-patient services; as well as in-service training, consultation and operational research in support of the community-based healthcare programmes.

Figure 1.3 The Uganda National Health System



Source: Uganda MoH (2005) HSSP II

In addition to the services provided by the general hospitals, the RRHs provide specialist services, higher level surgical and medical services, clinical support services such as medical imaging as well as being involved in teaching and health research. The NRHs provide comprehensive specialist services, teaching and health research, in addition to providing services offered by general hospitals and RRHs. The RRHs and NRHs are autonomous government bodies with designated votes in the government finance statistics. They obtain their funding directly from the central government as budgeted for by ministry of finance, planning and economic development (MoFPED). The general hospitals are funded by the central government through block grants to local governments[3]. Funding for district healthcare services is provided for in the local government vote from central government. Healthcare funding is allocated to the districts using a resource allocation formula, which incorporates bed capacity for hospital allocations, population size and child mortality as a proxies for health need; district topography as a proxy for the cost of service delivery, and poverty index of the district as a proxy for deprivation (Orem & Zikusooka, 2010).

The fourth tier is the district local government which oversees the district health service delivery provided by health centres and general public hospitals. The fifth and sixth tiers comprise of the health sub-district level of service delivery, which may be a HC IV or a hospital. The health sub-district is a referral facility directly responsible for planning, organisation, and management of health services at this and lower health centres. The HC IIIs provide laboratory services for diagnosis and maternity care, in addition to basic preventive, promotive and curative care. HC III is the first referral cover for a specified catchment area and also provides support supervision of HC IIs and the community in its jurisdiction. HC II is the first level of formal health service delivery providing only out-patient care and community outreach services. HC I is not housed in physical facilities but is a team of community volunteers, serving as a link between the community and formal health workers.

[3] District local governments are mandated by the 1997 local government Act to plan, budget and implement health policies and health sector plans.

The village health teams (VHTs) facilitate health promotion and service delivery as well as mobilizing community participation and empowerment to access and utilization of health services.

1.3.2 The Private sector healthcare delivery system

The private healthcare services are delivered by the Private-Not-for-Profit (PNFPs) organisations, the Private Health Practitioners (PHPs) and the Traditional and Complementary Medicine Practitioners (TCMPs). The PNFPs have a prominent presence in rural areas and the PHPs are mainly urban based while the TCMPs have a presence in both rural and urban areas. Government subsidizes PNFPs and some PHPs in recognition of the partnership that exists in healthcare delivery. The government specifically subsidises the PNFP training institutions, which are actively engaged in training of healthcare workers to supplement the government's limited effort to build a critical mass of human resources for health.

The PNFPs have both facility based centres providing both curative and preventive services, and non-facility base centres providing preventive, palliative and rehabilitative services. The facility based PNFPs account for 41% of the hospitals and 22% of the lower level health centres mainly in rural areas (MoH - Uganda Ministry of Health, 2010b). The PHPs are mainly urban based offering curative serves with a limited number offering some preventive services. They collaborate with the government through the Public-Private Partnership for Health based in the Ministry of Health. Although TCMPs have no functional relationship with the public or private sector, it is estimated that 60% of Ugandans seek care from them before visiting the formal health system (MoH - Uganda Ministry of Health, 2010b).

1.3.3 Distribution of health facilities and human resources for health

The national standard for availability of health facilities is given in Table 1.7. The lower health centres are beyond capacity when compared to the expected standard. The excessive numbers of people per health centre at the lower level health centres, which are mainly located in rural areas, suggests that access to healthcare services in rural areas is greatly hampered.

Table 1.7 National health facility availability: standard versus 2009 situation

Type of facility	Health facility to population ratio: standard	Health facility to population ratio: 2009 situation
National Referral Hospital	1:10,000,000	1:30,000,000
Regional Referral Hospital	1:3,000,000	1:2,307,692
General Hospital	1:500,000	1:263,157
Health Centre IV	1:100,000	1:187,500
Health Centre III	1:20,000	1:84,507
Health Centre II	1:5,000	1:14,940
Health Centre I/VHT	1:1,000 or 1 per 25 Households	

Source: (MoH - Uganda Ministry of Health, 2010a)

Shortage of human resources for health is a common problem, particularly in low income countries. Table 1.8 presents the staffing position in public health centres as of June 2011. Uganda's ratio of health worker to the population stands at 1.8 per 1000 against the WHO's recommended 2.3 per 1000 (MoH - Uganda Ministry of Health, 2010b).

Table 1.8 Staffing situation in the public health sector: Central government and District levels, June 2011

Cost Centre	Number of units	Total establishment positions	Filled	Vacant	% Filled	% Vacant
Mulago Hospital (national referral)	1	2,801	2,423	433	87	13
Butabika Hospital (national referral)	1	424	393	33	93	7
Regional Referral Hospitals	13	4,331	3,121	1,212	72	28
General Hospitals	39	7,600	4,751	2,849	63	37
District Health Officers Offices	112	1,232	698	532	57	43
Health Centre IV	164	7,920	4,768	3,152	60	40
Health Centre III	803	5,634	3,363	2,271	60	40
Health Centre II	1,321	4,905	2,197	2,708	45	55
Total National Level	**2,454**	**34,847**	**21,714**	**13,190**	**63**	**37**

Source: (MoH - Uganda Ministry of Health, Health Systems 20/20, & Makerere University School of Public Health, 2012)

Ideally, health workers should be distributed to match geographic population and disease burden. In this way, human resources for health would be deployed where there is greatest need and maximum benefit. For lack of recent data, Table 1.9 presents the distribution of health workers in Uganda as of 2002, adapted from a 2011 report assessing the Uganda health system. It is clearly shown that there is a high concentration of health workers in the urban areas and yet less than 10% of the total population live in urban areas (Uganda Bureau of Statistics, 2013). The disproportionate distribution of health workers poses a major barrier to access and utilization of quality healthcare services for the rural population.

Table 1.9 Health worker distributions by skill, 2002

Health Cadres	Total	% Urban	Population per Health Worker	% Self-Employed
Medical doctors	664	70	7,272	14.0
Nurses and midwifery professionals	3,361	58	36,810	17.5
Dentists	98	75	249,409	23.5
Pharmacists	162	80	150,877	22.8
Other Health professionals	3,572	68	6,843	10.2
Allied health clinical	4,378	39	5,583	14.0
Nurses and midwives associate professionals	20,340	41	1,202	14.4
Allied health dental	342	52	71,468	19.3
Allied health pharmacy	600	45	40,737	28.5
Allied health diagnostic	1,622	28	15,069	12.0
Other allied health professionals	5,828	34	4,194	18.0
Nurse Assistant/Aid	16,621	30	1,471	29.6
Traditional medical practitioners	5,430	30	4,501	85.4

Source: (MoH - Uganda Ministry of Health et al., 2012)

Although human resources for health are inadequate to match the needs of a growing population the world over, low income countries face a much bigger dilemma. The burden of disease is highest in low income countries yet these countries have the lowest ratios of health workers per 10,000 of the population. Table 1.10 presents the density of health workers for different regions globally. A comparison with the other low income countries shows Uganda’s human resource deficiency is acute.

Table 1.10 Density of health workers by country/region: 2010

Country/Region	Physicians density (per 10 000 population)	Nursing and midwifery personnel density (per 10 000 population)
Uganda	1.2	13.1
Low income	3.7	9.8
High income	27.9	80.9
Global	13.6	27.5

Source: (World Health Organisation, 2012)

1.4 Healthcare financing in Uganda

Uganda's total expenditure on health, as a percentage of GDP, has been on the increase since the 1990s rising from 5% in 1995 to 9.5% in 2011 (MoH - Uganda Ministry of Health, 2013; World Bank, 2010b; World Health Organisation, 2012). Funding for healthcare in Uganda comes from both private and public sources. Private healthcare funding sources include household out-of-pocket payments (as user fees in private for profit and private-not-for-profit healthcare centres) and, to a lesser extent, healthcare insurance schemes. The government budget allocation from general taxation and donor funds, (both on-budget and off-budget), constitute the public healthcare expenditure which, when combined, together contribute more than two thirds of total healthcare funding. The trend in pubic healthcare financing is presented in Table 1.11.

Table 1.11 Public health sector funding (including donor aid)

Year	GoU funding (UGX bns)	Donor funds and GHIs (UGX bns)	Total (UGX bns)	Donor funds as a % of total	Per capita public health expenditure (US $)	GoU health expenditure as % of total government budget
2000/01	124.23	114.77	239	48.0	5.9	7.5
2001/02	169.79	144.07	313.86	45.9	7.5	8.9
2002/03	195.96	141.96	337.92	42.0	7.3	9.4
2003/04	207.8	175.27	383.07	45.8	7.7	9.6
2004/05	219.56	146.74	366.3	40.1	8.0	9.7
2005/06	229.86	268.38	498.24	53.9	14.8	8.9
2006/07	242.63	139.23	381.86	36.5	7.8	9.3
2007/08	277.36	141.12	418.48	33.7	8.4	9.0
2008/09	375.46	253	628.46	40.3	10.4	8.3
2009/10	435.8	301.8	737.6	40.9	11.1	9.6
2010/11	569.56	90.44	660	13.7	9.4	8.9
2011/12	593.02	206.1	799.12	25.8	10.3	8.3
2012/13	630.77	221.43	852.2	26.0	9.0	7.4

Source: (MoH - Uganda Ministry of Health, 2013)
Note: GoU = government of Uganda, GHI = Global health initiatives, bns = billions, UGX = Uganda Shillings

Although the public health expenditure has been increasing in absolute terms, the share of the health sector in the budget has not changed significantly. The Uganda National Health Accounts (NHA) study for 2009/10 healthcare expenditures estimated the total healthcare expenditure per capita at USD 51. This level of expenditure per capita reflects a below standard healthcare per capita expenditure when compared to the WHO recommended estimate of USD 60 that is required to provide the minimum healthcare package (MoH - Uganda Ministry of Health, 2013; World Health Organisation, 2012).

In Uganda, the official development assistance (ODA) is a major source of external revenue flows to government. The ODA comprises of concessional loans from official agencies and grants. Total donor assistance, as a share of the total budget, declined from 44.6% in 2004/05 to 27% in 2009/10, and declined as a share of GDP from 10.5% in 2004/05 to 5% in 2009/10 (Ministry of Finance Planning and Economic Development, 2010). The grant component of the donor assistance, for the same years, declined from 8.5% to 2.7% of GDP. The total ODA is made up of donor budget support – on-budget aid and off-budget aid. The on-budget donor assistance is allocated to the different sectors according to the budget priorities. For instance, the on-budget allocation of ODA to sectors for the financial year 2012/2013 apportioned 6% to the health sector and 38% to the Works and Transport sector. On the other hand, the off-budget (project) component is disbursed to sectors directly by donors, usually in form of projects that are by nature short term interventions. The health sector is the largest beneficiary of the off-budget aid, largely on account of support for HIV/AIDS relief. According to the background to the budget for the financial year 2011/2012, the health sector was projected to receive 45% of the total off-budget support compared to 12% for the agricultural sector. The total donor assistance for healthcare funding forms about one third of total public healthcare financing in Uganda (MoH - Uganda Ministry of Health, 2012).

The observed large share of donor assistance for healthcare financing in Uganda raises questions of aid-fungibility that has been cited in some developing countries. (Farag, Nandakumar, Wallack, Gaumer, & Hodgkin, 2009) found “fungibility” of aid exists in some donor recipient countries where aid substitutes, instead of supplementing, the domestic government spending. Governments are known to reduce their own expenditures for a particular purpose, if there is donor commitment to fund the same purpose. However, (Sijpe, 2013) disputes (Lu et al., 2010) fungibility coefficient when he considers the “on-budget” and “off-budget” health aid. (Sijpe, 2013) argues that, by assuming that all health aid is on-budget, the degree of health aid fungibility is over-estimated. His findings indicate that only limited displacement of health aid exists, even in the long run, under certain plausible assumptions about the role of off-budget health aid. The off-budget health aid is a significant proportion of health aid in many developing countries. In Uganda the HSSIP 2010/11 – 2014/15 indicated that only 41% of donor healthcare expenditure was reflected in the MTEF[4], and donor project funding in the public healthcare sector was 26% (MoH - Uganda Ministry of Health, 2010a). There is no clear cut evidence on whether health-aid has been fungible in Uganda.

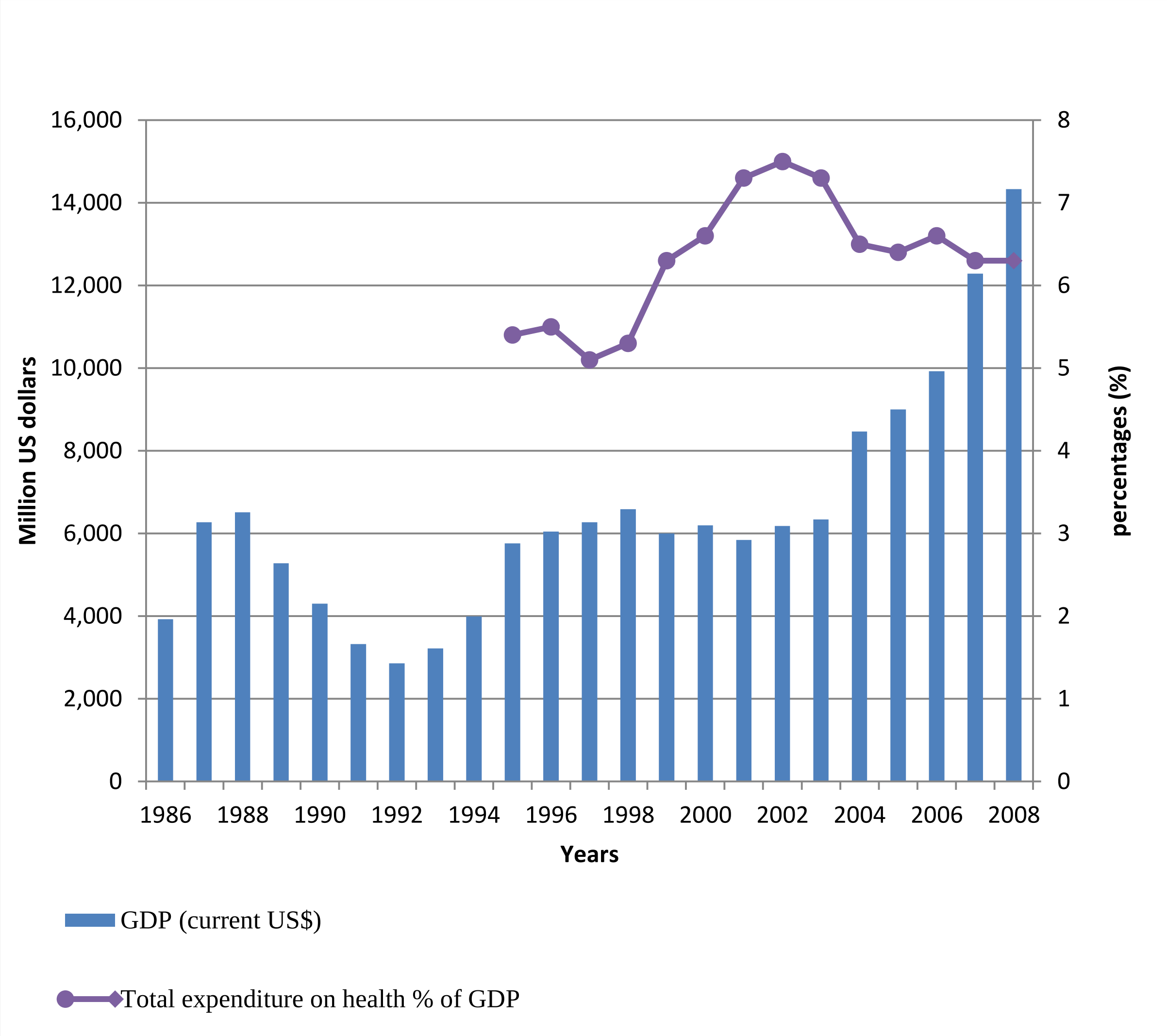
The Ugandan economy has been growing steadily since the late 1980s. Economic growth affects the government's overall budget from which the health sector is financed and the population's ability to pay for health services. However, despite the continuous growth in the economy, health care expenditure as a proportion of GDP has been fluctuating over the years. The health sector budget share in the general government budget is below the 10% HSSIP target and the Abuja declaration target of 15%. Figure 1.4 illustrates the trend in economic growth and health expenditure, as a percentage of GDP. Economic theory tells us that health care is a national luxury although some writers argue against the methods used to arrive at this conclusion[5] (Parkin, Mcguire, & Yule, 1987). Methodological issues not sufficing, at the macro level income elasticity of health expenditure is positive and greater than one. This implies that an increase in income (growth in GDP and GDP per capita) will generate a more than proportionate increase in health expenditure. Empirical estimates of aggregate income

[4] The medium term expenditure framework (MTEF) is a tool adopted by government since the early 1990s to provide a medium term perspective to budgeting. It is thus an integral part of the annual government budget cycle and typically consists of: a top-down resource envelope aligned with macroeconomic stability and broad policy priorities; a bottom-up estimate of the current and medium term cost of existing national programmes and activities; and an iterative process of decision making, matching cost and new policy ideas with available resources over a rolling 3-5 year period (Overseas Development Institute (ODI), 2005).

[5] Some writers such as Parkin et al (1987) argue against this statement claiming that by aggregating health expenditures at the national level to derive the income elasticity is using microeconomic theory in a macroeconomic specification - which is not right. On the other hand however, Getzen (2000) has shown that employing two-level allocative model in determining the income elasticity of health expenditure, health expenditure can be shown to be both a necessity (at micro level) and a luxury (at the macro level).

elasticity of health expenditures ranging from 1.2 to 1.6 have been documented (Getzen, 2000). These elasticity estimates, indicate that at the national level, health expenditure is determined by the amount of money available for a government to spend rather than the disease burden. In the context of Uganda, this is observed to occur in the early years of the health sector reform process, from 1998 to about 2002/2003. However, from 2004, the observed trend in health expenditure violates the theory of a positive aggregate income elasticity of health expenditure. Whereas the economy continued to grow, health expenditure as a percentage of GDP declined instead. The reason cited for the reduced health budget allocation include the emergence of competing sectors especially the energy sector.

Figure 1.4 Relationship between GDP growth and health expenditure as % of GDP



The trend in government healthcare expenditure by levels of care, for the years 2001/2002 to 2010/2011, reveals that the growth rate in spending for primary healthcare is nearly double the growth rate in spending for other levels of care (MoH - Uganda Ministry of Health, 2012; Uganda Bureau of Statistics, 2012). The skewed expenditure towards primary healthcare is likely to continue with the National Development Plan (NDP) prioritization of the health sector and HSSP emphasis on preventive care.

The government fiscal policy affects the level of government resources available for allocation to the health sector. The share of the health budget partly depends on the size of the government budget. Similarly, the ability of government to generate tax revenue from the potential users of public health services is crucial. Uganda's total revenue for the budget (domestic revenue and grants), as a percentage of GDP, has been on the decline: from 22% in 2004/05 to 15.4% in 2009/10 (Uganda Bureau of Statistics, 2010a). Although this has been the case, the share of tax revenue in the total government budget has continued to grow. Table 1.12 shows the trend in proportional contributions of taxes and non-tax revenue (including grants) to total revenue, and health expenditure as a proportion of total government expenditure. The budget deficit, as a share of GDP, has been declining.

Table 1.12 Tax revenue and health expenditure as a share of general government expenditure

	2005/06	2006/07	2007/08	2008/09	2009/10
Total revenue	100	100	100	100	100
Central Government taxes	69.9	69.5	81.4	80.7	82.9
Direct taxes	18.2	17.6	19.5	20.3	20.8
Income	18.0	17.4	19.3	20.1	20.6
Property	0.2	0.2	0.2	0.2	0.2
Indirect taxes	51.7	51.9	61.9	60.4	62.1
Local goods & services	15.4	15.1	16.9	16.0	16.9
International trade	33.3	32.6	41.0	39.7	41.6
others	3.0	4.2	4.0	4.7	3.6
Central Government Non tax revenue	30.1	30.5	18.6	19.3	17.1
Grants	27	27.4	17.8	18.6	16.4
Others	3.1	3.1	0.8	0.7	0.7
Budget deficit/GDP (excl Grants) (%)	-6.8	-7.0	-4.9	-4.6	-5.7
Budget deficit/GDP (incl Grants) (%)	-1.9	-1.9	-1.9	-1.7	-3.0
Government Health expenditure/total Government expenditure (%)	**11.9**	**9.8**	**9.9**	**11.7**	**9.8**
Recurrent expenditure	5.3	3.9	5.5	7.3	6.8
Development expenditure	6.6	5.9	4.4	4.4	3.0
Recurrent expenditure	16.6	14.2	12.0	12.0	12.0

Source: (Ministry of Finance Planning and Economic Development, 2010; Uganda Bureau of Statistics, 2010a)
Notes: excl = excluding, incl = including
Government recurrent expenditure excludes transfers to local governments
Government development expenditure excludes donor funded development component
Local government expenditure includes Local, Government transfers, and Donor funds
Local government expenditure is a summation of Districts and Urban Authorities' expenditure

The tax system is heavily dependent on indirect taxes, largely contributed by taxes from international trade. This makes the economy vulnerable to external shocks. The tax base for income taxes is narrow whereby more than half of the direct tax revenue is collected through pay-as-you-earn, paid by paid-employees in formal employment. The majority of Ugandans operate within the informal sector, as revealed in the labour force market indicators. With an informal sector employment rate at 91%, it means less than 10% of the labour force actually pay income taxes. There is a potential to increase the domestic tax base but the challenge is how to collect it from the existing large informal sector.

The decline in the budget deficit, as revealed in Table 1.12, is an indication that government has relatively more financial resources at its disposal. This would, ideally, be reciprocated by an increase in government spending, including on health. On the contrary, public spending on health did not increase and even declined for some years. While the decline in recurrent health expenditure mainly affects operating expenses of the health sector, such as salary expenses, declining development expenditure affects renovation of existing infrastructure. According to the 2008/09 annual health sector performance report, rehabilitation of buildings and maintenance of medical equipment is not regularly done. Consequently, majority of health facilities and equipment were reported to be in a state of disrepair, with only 40 per cent of equipment in good condition and 17% needed replacement (MoH - Uganda Ministry of Health, 2009a). This negates efforts to improve equity in access and utilization of health services, particularly, for the remote rural locations since health workers are not in position to adequately provide services without the necessary equipment.

1.5 The health sector performance

Healthcare services coverage has been improving over the years by bringing services closer to the population. By the end of the second health sector strategic plan, 72% of the population could access a health service within five kilometres of their residence (MoH - Uganda Ministry of Health, 2010b). The development of the health sector strategic plans involved setting indicators to assess the health services coverage and the health system output performance with respect to service availability, access, quality and safety. The 2012/13 sector performance report showed that 6 out of 8 indicators for the health service coverage were achieved that year (MoH - Uganda Ministry of Health, 2013). The better performing indicators included child immunization rates and the number of eligible persons receiving antiretroviral (ARV) therapy. The underperforming indicators were identified as the number of women attending 4 ANC sessions and the number of deliveries in health facilities. The health system output indicators showed that the percentage of clients expressing satisfaction with health services (waiting time) increased from 45% in 2008/09 to 72% in 2010/11. Similarly, the per capita out-patient department (OPD) utilization rate increased from 0.8 in 2008/09 to 1.1 in 2012/13.

Low productivity in government health centres has been cited as one of the major barriers to services utilization. The low level of productivity has been attributed to high levels of absenteeism and rampant employment dualism. The World Bank estimated the cost of absenteeism in the health sector at 26 billion Uganda shillings per year (World Bank, 2005a). Another source of inefficiency in the health sector relates to the challenge with the off-budget donor funding, which leads to poor alignment with the HSSP priorities and results in expenditures on input outside the HSSP planned targets (MoH - Uganda Ministry of Health, 2010b).

1.6 Health sector reforms in Uganda

The term ‘health sector reform’ has been used to refer to a broad range of policy measures designed to deal with a range of problems in the health system (Gwatkin, 2001). It may be defined as a “sustained, purposeful change to improve the efficiency, equity, and effectiveness of the health sector”(Berman, 1995). A Health system is a combination of resources, actors and institutions relating to the financing, regulation and provision of actions whose primary intent is to improve or maintain health (World Health Organisation, 2000). Taking health as the defining goal[6], a health system performs four standard functions: financing, provision of health services, stewardship and resource generation. According to the WHO guidelines, the overall quality of a health system is mirrored in the overall goal of health attainment and responsiveness (World Health Organisation, 2000). Similarly, the distribution of health system intrinsic goals reflects the overall equity of the system; while the efficiency goal is obtained depending on how well the socially desired mix of the components of the intrinsic goals is achieved, compared to available resources. The rest of this section sets out the healthcare reforms undertaken in Uganda, how and when they were implemented, and some outcomes of the reforms as reported in the literature.

Health sector reforms in Uganda, formally started in 1992; guided by the government White Paper on Health (1992) and the Three Year Rolling Plans for the health sector developed by the Health Policy Review Commission, starting with the 1993-1995 plan (MoH - Uganda Ministry of Health, 1999b). These documents outlined the agenda for health sector reform within a national health policy framework. Prior to 1992, Uganda's health sector underwent four distinct phases of change: expansion of the health sector after independence in 1962; the political turmoil of 1970s coupled with global recession that devastated the economy including shrinking the health sector; the implementation of primary healthcare (PHC)

[6]The World Health Organisation categorises health system goals as intrinsic (goals valued in themselves and raising their value is desirable); or instrumental (goals whose pursuit is a means to an end). The three intrinsic goals identified for any health system are: health improvement for the population; responsiveness of the health system to the legitimate expectations of the population; and fairness in financial contributions to the health system.

(Declaration of Alma-Ata, 1978); and the 1986 to 1993 phase characterised by vertical and fragmented health programmes (Macrae, Zwi, & Gilson, 1996; Okuonzi & Birungi, 2000).

The health sector reform process has evolved and the three year rolling plan documents have since been replaced by a series of policy documents and strategic plans that have guided the health sector reform agenda. The first national health policy (NHP I) of 1999, guided by the National Health Sector Program and the National Poverty Eradication Programme (PEAP) 1997, presented the overall goal of the health sector as "the attainment of a good standard of health by all people in Uganda, in order to promote a healthy and productive life" (MoH - Uganda Ministry of Health, 1999b). The second national health policy (NHP II) of 2010, was guided by the country's national development plan (NDP) for the period 2010/11 – 2014/15 with a mission to provide the highest possible level of health services to all people in Uganda through delivery of promotive, preventive, curative, palliative, and rehabilitative health services at all levels (MoH - Uganda Ministry of Health, 2010c; National Planning Authority, 2010).

Additionally, the health sector strategic plans (HSSP) one, two and three (HSSP I: 2000/01 – 2004/05, HSSP II: 2005/06 – 2009/10, HSSP III: 2010/11 – 2014/15) have been sequentially developed in line with the health policy documents to operationalize the national health policy (MoH - Uganda Ministry of Health, 1999a, 2005, 2010b). The health sector strategic and investment plan (HSSIP) for the period 2010/11 – 2014/15 was developed to…"guide the health sector investment towards achieving medium term goals for health" (MoH - Uganda Ministry of Health, 2010a). Furthermore, the NDP, recognising that poor population health is one of the binding constraints to faster socio-economic transformation in Uganda, included health as one of the investment priorities for the plan period (National Planning Authority, 2010). Moreover, the overall Uganda Vision 2040 recognises that health is instrumental in the social economic development of Uganda and therefore, should be prioritised in all national planning and policy documents (The Republic of Uganda, 2012).

The health sector reforms in Uganda have been undertaken with an overall aim of improving the health of the population, with the intermediate objectives of improving sector efficiency, equity of access and utilization, and the quality of health services (World Bank, 2006). The reforms can be broadly grouped under two categories: healthcare financing reforms, which include introduction of user fees, social health insurance (SHIS), reforms in the pharmaceutical sector, sector wide approaches in health (SWAps); and organisational and policy reforms which include decentralisation of health services delivery, reorganisation of the hospital sector, public-private partnerships in health, and restructuring of the ministry of health.

1.6.1 Healthcare financing reforms

1.6.1(i) User fees

User fees in healthcare were formally introduced in Uganda in 1990 after the health sector review commission HSRC recommended the suspension of the *ad hoc* cost sharing schemes of the 1980s (Okuonzi, 2004; Pariyo et al., 2009) . Although the bill to formalise cost sharing in health units was rejected by the Uganda parliament, the government mandated local governments to start collecting user fees for health services since the World Bank had made it a pre-condition for accessing and obtaining its loans (Kivumbi & Kintu, 2002). Consequently, a fee was charged at the point of use in all public health centres but eventually user fees were officially abolished in 2001.

The user-payment for health services was abolished because it failed to achieve the intended objectives of raising revenue while promoting equity of access to healthcare services, particularly among the poor. A study that evaluated the exemptions and waivers from cost sharing in the districts where service delivery was decentralised, found that the system to exempt the poor was often abused. The study findings found evidence suggesting that exemptions were granted to individuals on grounds other than their socioeconomic criteria and the rich benefited more than the poor (Kivumbi & Kintu, 2002). Moreover, the district authorities embraced the user-fees as a means of raising additional revenue to meet the cost of the devolved services. Therefore, they aimed to maximise revenue collection from user fees rather than promote equity of access to health services.

1.6.1(ii) Social health insurance

Efforts to introduce a compulsory social health insurance scheme (SHIS) recommended in the HSSP I and HSSP II, as an alternative health financing mechanism have not materialised to date. The scheme proposed to start with enrolling all public servants and then bring on board private sector formal employees over a three year period. The scheme's revenue and expenditure plan suggested a 4% of salary payment by formal sector employees (public and private) with an additional 4% contribution by the employer, with an interim provision for private sector employees to take out health insurance with private insurance companies if they so wished. The scheme further proposed that the informal sector be enrolled starting in year seven from the start of the scheme and universal coverage be attained within 15 years of launching the scheme. Independent researchers have reported on the feasibility and equity issues of the proposed scheme as an alternative form of healthcare financing (Orem & Zikusooka, 2010). In this particular study, crucial issues on quantity, quality, and benefit incidence are discussed and recommendations were made which could be considered by policy makers as consultations to introduce the compulsory health insurance scheme. The bill for compulsory health insurance is yet to be passed by the Uganda Parliament.

1.6.1(iii) Reforms in the pharmaceutical sub-sector

Uganda relies heavily on imported pharmaceutical products, with only 10% of medicines and health supplies manufactured domestically (UNIDO, 2010). Enacted by Parliament, the National Drug Policy and Authority Act 1993 was to ensure the availability of essential drugs population-wide (Uganda Government, 1993). The national medical stores (NMS), an autonomous government agency, was established in parallel to procure, store and distribute essential drugs and supplies to the public sector subject to the budgets of the respective health units and NMS. Prior to drug supply market liberalisation in 2000, NMS was the main source for drugs and equipment for public health facilities. The NMS was dogged with supply and logistical problems that resulted in frequent and long drug stock outs, particularly in rural health units. A new comprehensive national drug policy was formulated in 2002 and the first ever national pharmaceutical sector strategic plan (NPSSP) 2002/03-2006/07 was developed to operationalize the policy (MoH - Uganda Ministry of Health, 2002a).

A pharmaceutical baseline survey, carried out in 2001, revealed chronic drug stock-outs in public health facilities, compelling consumers to obtain prescribed drugs from private providers (MoH - Uganda Ministry of Health, 2002b). Benchmarked against the WHO guidelines on drugs accessibility, affordability, quality and rational use, the survey revealed that the cost of drugs from private health providers were sometimes 300 times the public sector price for the same items. This is amidst study findings indicating that availability of drugs strongly influences the perceived quality of care by the users, as observed in the studies in Uganda and Nigeria (Ssengooba, Atuyambe, McPake, Hanson, & Okuonzi, 2002; Uzochukwu & Onwujekwe, 2005).

The NPSSP also proposed schemes such as user fees, drug revolving funds, and health insurance schemes, which would contribute to the sustainable financing of essential drugs. However, the government's proposed revolving drug fund (RDF) floundered because of logistical issues to create it at district level where there were many sources of pharmaceuticals each with a different procurement source (Okuonzi, 2009). Nevertheless, experiences from the Khartoum state of Sudan and Mauritania suggest that, if properly planned, an RDF can increase availability of essential drugs at an affordable cost and greatly improve geographical equity of access to health services (Ali, 2009; Audibert & Mathonnat, 2000). However, RDF ought to be implemented with caution as they have been questioned on their ability to deliver an equitable service to the population since they are premised on "willingness to pay" as opposed to "ability to pay" (Cross, Huff, Quick, & Bates, 1986; Kanji, 1989).

Currently, financing of drugs in Uganda comes from the Central government allocations to the Ministry of Health; Local Government allocations from local taxes and block grants; and development partner support. The drug procurement and distribution is undertaken under three institutional modes: the credit line, the primary healthcare (PHC) funds, and the third-party arrangements. The Credit-line budget is funded by the central government and constitutes over 70% of government funding for medicines (Economic Policy Research Centre, 2010; MoH - Uganda Ministry of Health, 2009b). The funds are released by the

MoFPED to NMS (through the line MoH) and the NMS procures medicines from suppliers, guided by budget ceilings and client needs (hospitals and health centres).

The second institutional mode of funding medicines is the primary healthcare fund. The PHC funding for medicines is also from the central government released by the MoFPED to districts as a conditional transfer or grant under the local government vote. The districts are required to spend a percentage of the PHC funds on medicines for the district healthcare services. The PHC fund was mainly to increase availability of essential healthcare system inputs at healthcare service delivery points (Economic Policy Research Centre, 2010). Therefore, although the NMS is the first point of call for district medicine procurements, PHC drugs can be procured directly from registered private pharmacies after obtaining a "certificate of non-availability" from the NMS. The third arrangement for drug financing and distribution is the "third parties" arrangements (donor development partners, faith-based non-government organisations –NGOs, and private pharmaceutical companies). All third-party procurement is channelled through the NMS and is integrated in the existing drug procurement system. The NMS receives, stores, and distributes all drugs procured by third-parties.

Drugs are distributed free of charge in all public hospitals and health centres. The government of Uganda contributes about one third while development partners contribute two thirds of the total budget for medicines in public health facilities (Economic Policy Research Centre, 2010). This heavy reliance on development partners is precarious, particularly, for the availability of essential medicines and delivery of the minimum healthcare package as outlined in the health sector strategic plan. This study explores a possibility for increasing resources available for healthcare by prioritizing the health sector in the central government budget. A policy to prioritise the health sector in the government budget is designed and presented in Chapter 6, and the economy wide impacts of the proposed healthcare financing policy are reported in the results Chapters 7 and 8.

1.6.1(iv) Sector Wide Approaches (SWAps) in health

In the development literature, Sector-Wide Approach (SWAps) to development is defined as 'a sustained government-led partnership with donor agencies and other groups in civil society, with collaborations in policy, public expenditure, and institutional frameworks' (Peters & Shiyan, 1998). Two key features characterised the health SWAps in Uganda: an obligation by government to steadily increase the health budget, and a commitment by the development partners to increasingly use general or sector budget support as the principal aid modality. Recognising the need for development partners to adjust to the SWAps arrangement, the government maintained three modalities for funding the health sector strategic plan (HSSP): central budget support, district budget, and projects (MoH - Uganda Ministry of Health, 1999a).

Positive outcomes from the SWAps are manifested in donor support, increasingly directed to the government health budget rather than to specific projects. The approach contributed towards improved allocative efficiency, because healthcare funding was increasingly targeted towards the delivery of the Uganda National Minimum Healthcare package (UNMHP) and the district health services (primary healthcare level), relative to hospital services (secondary/tertiary level of care) (Ssengooba, Yates, Cruz, & Tashobya, 2006). Other favourable outcomes of the health SWAps include: the development of a comprehensive performance monitoring system; development of a series of tracking studies that have enabled the sector to overcome implementation constraints; and the creation of the Health Development Partners Group, that has enabled the alignment of project support to HSSP priorities. Effective health SWAps are also reported in Ghana, Zambia, Senegal, Mozambique and Pakistan where SWAps led to increased resource flows to the health sector (Peters & Shiyan, 1998). In Uganda's case, despite the progress towards increasing resource flow to the health sector, government real total health spending increased modestly, suggesting a possibility of "aid fungibility" (aid for health substitutes rather than supplement domestic funding sources). Moreover development partners continued to channel funding through projects outside the central government budget (Örtendahl, 2007).

Donor funding for healthcare is under reported in Uganda. Some donors do not channel their funding through the central government budget and are not keen at providing reports as an account of their full involvement in the health sector (MoH - Uganda Ministry of Health, 2010b). Nevertheless, the donor aid is a significant source of healthcare funding in Uganda hence it is likely to have repercussions on other actors in the economy, outside of the health sector. Given the importance of donor aid for healthcare, this study investigates the economy wide impacts of government efforts to mobilise resources for healthcare through an increase in aid for health. This policy scenario is designed in Chapter 6 and results are reported in Chapters 7 and 8.

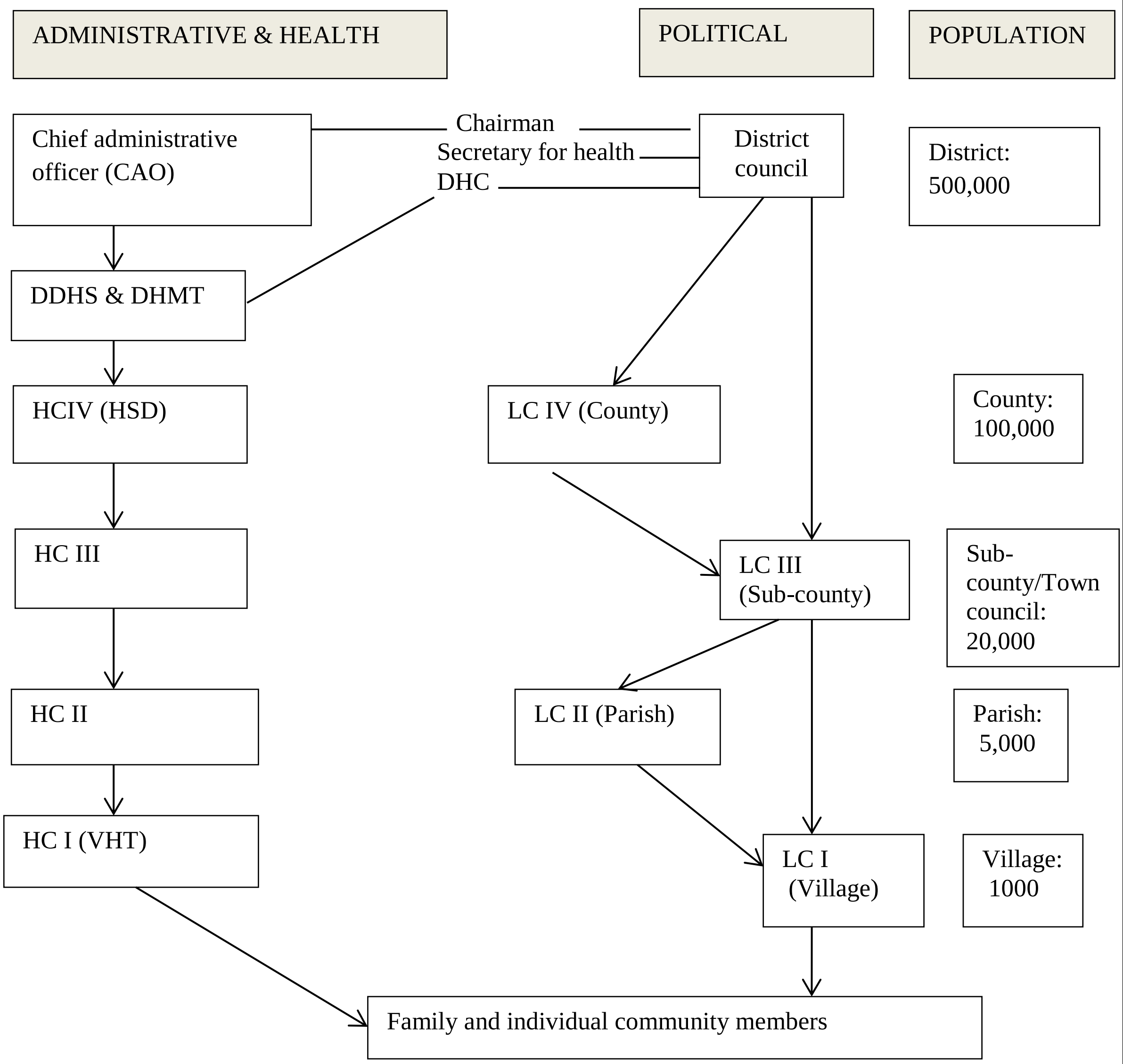
1.6.2 Healthcare service provision reform

1.6.2(i) Decentralization of healthcare services delivery

The health sector reform, started in the early 1990's, was part of the wider economic and political reforms that were taking place at the time (Bossert & Beauvais, 2002; Jeppsson & Okuonzi, 2000; Jeppsson, Ostergren, & Hagstrom, 2003; Kyaddondo & Whyte, 2003; Pariyo et al., 2009). Health service delivery functions were devolved to local governments with varying degrees of local decision space for different categories of functions. The health sector decentralisation follows and uses the administrative and political structures, in line with the 1995 Uganda constitution and the 1997 Local Authorities Act. Figure 1.5 illustrates the linkages between the political, administrative and technical arms of healthcare delivery function at the district level. The district council (DC), through the district health committee (DHC), is at the apex of healthcare service delivery organisation and management at the district (local authority). The DHC comprises of politicians (councillors) and a team of technical people, the district health management team (DHMT) headed by the director of district health services (DDHS). The DC mandate is: the delivery of healthcare services; recruitment and management of personnel for district health services; passing by-laws related to health; and planning, budgeting, additional resource mobilisation and allocation for health services (MoH - Uganda Ministry of Health, 1999a). The health sub-district (HSD) which corresponds to the County (LC IV) in the district political hierarchy is responsible for service delivery to an average 100,000 people. With headquarters at HC IV, the HSD consists of health centres III, II, and the VHT, which correspond to local councils three, two and one – local council three (LC III), local council two (LC II) and local council one (LC I) respectively, in the political organisation.

The decentralisation process led to a complete devolution of the health sector budget to local governments through a block grant system, but the human resource management function remained at the centre. This approach undermined local decision space on financial resources since salaries are a large part of recurrent cost and budget allocations (Bossert & Beauvais, 2002). The participation of service users, through district councillors, in the planning and management process posed a challenge to health workers who were used to being in control of what they gave, when and to whom (Corkery, 2000).

Figure 1.5 Structure for healthcare delivery at the district



KEY:

CAO	= Chief Administrative Officer
DDHS	= Director of District Health Services
DHMT	= District Health Management Team
DHC	= District Health Committee
HSD	= Health Sub-District
HC	= Health Centre
LC	= Local Council

Source: (MoH - Uganda Ministry of Health, 2002a)

Furthermore, health worker performance, remuneration, training and career opportunities were affected by job insecurity, nepotism and clientelism[7] (Bossert & Beauvais, 2002; Kyaddondo & Whyte, 2003; Ssengooba et al., 2007). Several districts, where service delivery was decentralized, did not have the capacity to offer the appropriate work environment for health workers. The health sector performance report, 2008/09, indicated that only 40% of available equipment in public health facilities were in good condition while others needed replacement (MoH - Uganda Ministry of Health, 2010b). Information and computing technologies (ICTs) in health service delivery existed in only 6.4% of the facilities throughout the country and the remote districts health centres did not benefit from the ICT (MoH - Uganda Ministry of Health, 2010b).

The overall performance of local governments in the health sector is assessed annually using a tool developed for reporting to the ministry of health headquarters – the district league tables (DLT). The DLT tool uses twelve indicators, selected with consistency to the HSSIP core indicators; to rank and evaluate district performance. Eight indicators report the coverage and quality of care and are given a collective weight of 75%, and four indicators evaluate the management of healthcare service delivery, accounting for 25% (MoH - Uganda Ministry of Health, 2013). The DLT national average performance for 2012/13 was 63%, indicating an improvement from the previous year's average of 56.8%.

[7] (Hopkin, 2006) defines clientelism as a form of personal exchange where the receiver feels a sense of obligation towards the giver and there is usually unequal balance of power between those involved. In politics, it describes the distribution of benefits to selected individuals or defined groups in return for political support.

It is worthwhile investigating how the local government performance in healthcare translates into economy wide impacts in a general equilibrium setting. For instance, improvements in league tables for access and quality of care indicators imply improvements in the health status of the population and the labour force, in particular. Improved health status of the labour force translates into increased labour productivity, higher outputs and consequently higher GDP growth. To capture these and other consequences of improved local government performance in the health sector, a scenario is designed to mirror the prioritization of the health sector in the government budget and the impacts analysed in Chapters 7 and 8.

1.6.2(ii) Reforms in the Hospital sector

Hospital services in Uganda are provided by public, private not-for-profit (PNFP) and private-for-profit (PFP) healthcare institutions. Depending on services available and the responsibilities of each, public hospitals are grouped into general hospitals (GH); regional referral hospitals (RRH); and national referral hospitals (NRH). The PNFP and PFP hospitals are generally categorised as general hospitals although the services they provide may sometimes qualify them to be referral hospitals. In 1990, the NRHs were granted full autonomy. The general (district) hospitals were decentralized to the respective local government in 1998 while the RRHs were granted self-accounting status in 2001 but are, nevertheless, still managed by the ministry of health headquarters (MoH - Uganda Ministry of Health, 2010b). The PNFP have self-accounting status granted by their legal owners and their management boards are appointed by the respective trustees.

A study that compared performance in public and PNFP hospitals in Uganda cited some attributes to greater PNFP autonomy that accounted for better performance in PNFP hospitals relative to public hospitals (Ssengooba et al., 2002). The attributes include: better ability to manage the personnel function, more efficient use of staff, better drug availability at PNFP hospitals and higher levels of cost recovery. The reliability and capacity of hospital managers was a specific attribute to PNFP better performance that could be replicated in public hospitals if they were made autonomous. The lack of autonomy in making important decisions and inflexibility with regard to deployment and reallocation of staff, as well as line budgets that greatly depended on government grants, were cited as hindrances to achieving efficiency in human resources in public hospitals.

In terms of quality of healthcare services, the same study observed better service quality in PNFP hospitals relative to public hospitals reported in the study's population. This was attributed to drug availability problems in public hospitals since by law they relied on the National Medical Stores (NMS) for drug supplies. However, autonomy does not automatically translate into improved efficiency in delivery of service. For instance, while PNFPs were found to make more efficient use of staff, they were clearly not more efficient in relation to expenditure or bed use compared to public hospitals.

1.6.2(iii) Public-private partnerships (PPP)

The private-not-for profit (PNFP) participation in the health sector dates back to the 1890s when missionary-founded health facilities were established in Uganda. To date, PNFP health units are located throughout the country and, in some areas, they are the only health provider. Government grants to PNFP which had been stopped in the 1970s, were resumed in 1997

(World Bank, 2005a). The objectives of the resumed government grants were twofold: to enable the PNFP sector improve and maintain good quality services, and to reduce or keep user fees low in order to improve access.

While some PNFP facilities were able to reduce the fees charged, the majority did not, citing rising operational cost (Amone et al., 2005). The PNFP facilities argued that the government subsidy covered only about a third of the total cost of providing care while the rest was solicited from external donors[8]. Some hospitals were more successful than others in mobilising resources both from government and outside sources, such that funding levels and hospital costs varied widely among the facilities. It was apparent that the government subsidy could not generate the intended results. The health sector annual performance report, 2013, indicated that the government subsidies to PNFPs continued to grow, with about 80% being in the form of PHC conditional grants and only 6.6% allocated to credit line drugs. The PFP practitioners do not benefit from the government subsidies but are coordinated through umbrella organisations and health professional bodies. The PFPs own 9.2% of total health facilities in the country (compared to 16% for PNFPs and the rest by government). The PHPs facilities, ranging from drug shops to hospitals, have made a significant contribution to the HSSIP 2010/11 – 2014/15 output indicators, particularly, maternal and child health (MoH - Uganda Ministry of Health, 2013).

Uganda's experience of public-private partnerships in healthcare delivery reveals that healthcare policy formulation and implementation are not exclusively a reserve for government. While government seeks to increase resources available to the health sector, the

[8] Note that user fees abolished in 2001 were in respect of public healthcare centres. The PNFPs health facilities which are mainly faith based, charge a subsidized fee for services rendered at their centres.

impacts of any strategies are transmitted to the population via non-government healthcare practitioners as well. Government healthcare strategies will have differential impacts on utilization of services, particularly between rural and urban areas. This is because public healthcare facilities are scarcely available in some rural areas and PNFPs and PFPs have relatively bigger presence there. This raises issues of equity in access and utilization, particularly hinged on availability of affordable and quality care. The impacts are further transmitted to the health status and productivity of a section of the population that cannot access affordable quality care. This has implications for income and poverty levels as well. Several of these issues are investigated in the empirical model and results reported in Chapters 7 and 8.

1.6.2(iv) Restructuring the Ministry of Health

The 1997 restructuring of the ministry of health (MOH) reorganised staff and established broader organisational units, as opposed to the previous vertical staffing structure, in addition to reducing the staff budget (Corkery, 2000; Jeppsson et al., 2003; Okuonzi & Birungi, 2000). Under the restructured MOH, the tehnical functions in the districts formed the basis for a relationship between the Ministry and the districts. An outcome of this devolution is that interaction between the Ministry (policy maker) and the district (implementer) is hampered by inefficient communication. While officials at the Ministry represent modernity where non-personal interaction in communication takes place, the majority of districts, especially remote areas of the country and the health system are still entrenched in the traditional system that requires face-to-face interaction (Jeppsson et al., 2003).

1.7 Creating fiscal space for health

It is a universal challenge for countries to find adequate resources to finance their health systems; such that there is an ever increasing attention to the question of how to increase financial resources for health, particularly by governments (Powell-Jackson, Hanson, & McIntyre, 2012). The challenge is even bigger for low income countries where the burden of disease is greatest and resources are most scarce. Endeavours by governments to mobilise additional resources for a specific spending cause has come to be known as the creation of "fiscal space".

Fiscal space is broadly defined as 'the capacity of government to provide resources for a desired purpose without any prejudice to the sustainability of its financial position or allocations to other sectors' (Heller, 2005, 2006). In creating fiscal space (for health), the aim is for the government to have budgetary room to increase resources available to spend on the desired healthcare activities without prejudice to others. (Heller, 2005, 2006) propose ways by which a government can create fiscal space for health which include: earmarked taxes for health, reallocation of resources to the health sector (prioritization in the budget), increasing external resources and efficiency improvements in service delivery. Whereas each of the proposed sources of fiscal space can be pursued independently, there is scope for interactions between them. For example, the prioritization of health sector spending in the budget can be jointly pursued with efficiency improvements in the sector. A related issue on the creation of fiscal space for health is the absorptive capacity of the health sector. In a paper that reviewed literature on fiscal space for health, (Powell-Jackson et al., 2012) argue that if the absorptive capacity of the health sector is low, the government will be reluctant to allocate more resources to the health sector. It does not pay to expand fiscal resources for health if, at the end of the financial year, a considerably large proportion of the health budget is returned to the Ministry of Finance as unspent.

For a government to adopt any one or a combination of the proposed measures to create fiscal space for health, depends on several factors, which may include both political and socio-economic circumstances. The literature on creating fiscal space suggests that, for governments with high expenditure shares of GDP, a consideration for prioritization of expenditures anchored towards merit goods such as healthcare should be the primary option. Aid is an attractive source of fiscal space for health in many developing countries but external resources in the form of grants are an unreliable source in terms of sustainability. Many donors are increasingly unable to commit to funding beyond the short term (1 to 2 years). Raising taxes to create fiscal space is recommended for settings where the tax share in GDP is low and may be less feasible if the tax burden is already high. The Uganda government total tax revenue has averaged 12.8% of total GDP since 2005/06, of which direct taxes are 3.8% of GDP (Ministry of Finance Planning and Economic Development, 2008, 2011; Uganda Bureau of Statistics, 2012). The low share of tax revenue in GDP in Uganda is an indication that there is scope for creating fiscal space for health from taxation.

It is recognised that economic growth is a necessary condition for expanding fiscal space in any country. Countries with higher per capita GDP are likely to have higher general government expenditure on health per capita, even if the share of general government expenditure over GDP is low. For instance, the African health financing report 2013 indicates that both Gabon and Malawi have general government expenditure at 28%. However, Gabon, with a higher GDP per capita, spends US$ 2410 per capita on health compared to Malawi's US$110 (World Health Organisation, 2013). It is also evident that some countries in resource poor settings, are able to transform the higher economic growth into bigger health expenditure shares while others are unable to do so (Durairaj & Evans, 2010). Uganda has been in the position to transform the benefits of a growing economy into higher absolute health expenditures. However, the health share in the budget has not increased at the pace of the economic growth. There is scope for increasing the health share in the budget in Uganda since the economy is projected to continue growing.

External funding for health features prominently in low income countries, as an option for healthcare financing. The flow of external resources for health to resource poor countries increased, since 2000, when the millennium development goals were set. However, the flow could not keep up the pace, partly due to the financial crises in donor countries. The recipient countries also faced challenges of low absorptive capacity, especially, from the funding by global health initiatives (GHIs) for HIV/AIDS and other infectious diseases. The rigid, and often parallel, project funding by the GHIs failed to translate the funding into health system improvements in recipient countries. In such cases, the earmarked aid for health through project funding, such as the GHIs, posed more threats than opportunities (Prakongsai, Patcharanarumol, & Tangcharoensathien, 2007). A study of the Paris Declaration practices in three districts in Zambia showed that resources from GHIs were unpredictable and there was low level of involvement by district health directors' managers in planning for the resources (Sundewall, Forsberg, Jönsson, Chansa, & Tomson, 2009). However, some studies have shown evidence suggesting GHIs have had positive impacts on health systems and some health outcomes (Biesma et al., 2009; Ravishankar et al., 2009). They argue that participants in the GHIs learned lessons from initial experiences and began to post positive impacts in later years. However, a WHO report on maximizing positive synergies between GHIs and country health systems noted that no rigorous studies existed that prospectively examined the interaction between GHIs and country health systems and recommends that new efforts be launched into data gathering and methods design to assess the overall impact on country health systems given that GHIs have greatly contributed to an increase in resources for global health (World Health Organisation Maximising Positive Synergies Collaborative Group, 2009).

Recognizing some of the setbacks of the project-funding mechanism in the health sector, the sector wide approaches (SWAps) for health was proposed in Uganda, as outlined in the previous section on health sector reforms. The government of Uganda advocates for general budget support funding from which resources can be channelled to the health sector, according to the health sector strategic plan priorities. Findings from a recent paper that assesses whether health SWAps have increased recipient control of health aid through the general sector support suggests that for the period 1990 -2010, health SWAps have indeed influenced development assistance flows via the recipient controlled mechanisms (Sweeney & Mortimer, 2015). What has not been broadly studied, however, is the wider implication to the economy of the health SWAps. Increased flows of development assistance for health via the health SWAp implies that government can implement the priorities spelt out in the health sector strategic plan such as availing the minimum healthcare package to the population. Meeting this objective entails expansion of health services delivery which requires a larger volume of production inputs for healthcare. Increased demand for healthcare labour has implications for labour supply to other sectors in the economy. Similarly, the increased demand for intermediate inputs to healthcare has implications for the pharmaceutical sector, for example. In order to capture these and other indirect effects of health aid flows, this study proposes to analyse the effects in a general equilibrium using a CGE model.

Innovative healthcare financing mechanisms have featured prominently in recent literature on creating fiscal space for health. Some African countries have adopted some of the methods for innovative financing to fund their universal health coverage. Gabon and Ghana have been cited as good practices for earmarked taxes for health. Ghana raises additional funding for the national health insurance scheme by imposing an additional 2.5% health tax on value-added tax while Gabon imposes a special levy on large profitable companies and a levy on currency and other financial transactions (World Health Organisation, 2013).

Given the small tax base in Uganda, there is room for levying a tax earmarked for health. Earmarked taxes for health are advantageous in several ways[9]. The taxpayer is provided with an intrinsic accountability for government spending; they encourage transparency as people become aware of the cost of healthcare services thus making informed decisions on the balance between the tax burden and the level of services; and they are seen as a way to protect resources for healthcare from competing sectoral investments instigated by political interests (Doetinchem, 2010; Prakongsai et al., 2007).

While Ghana has successfully implemented the VAT for additional health funding, the VAT option may not be an attractive option for Uganda. The current VAT rate is 18%, which is already high by Ugandan standards. Moreover, a modelling exercise for healthcare financing affordability and distribution implications for South Africa, revealed that, VAT was a regressive form of healthcare financing while a proportional surcharge on household income was progressive (McIntyre & Ataguba, 2012). Additionally, there is need to bring on board

[9] Common earmarked taxes for healthcare include levies on tobacco and alcohol. However, they are criticised for limiting the scope of government to allocate budgets as they see appropriate; and are usually linked to macroeconomic circumstances (how much revenue a tax can raise) rather than the population's health needs. For a deeper discussion on tax earmarking, see Carling (2007).

the untaxed income in a large informal sector into the ambit of income taxation and this can be done through an appealing health tax on household income. Currently, direct taxes on income constitute only 25.2%, of total tax revenue of which 13.4% is personal income tax (pay-as-you-earn - PAYE) (Uganda Bureau of Statistics, 2013). PAYE tax is collected at source, levied on wage income of individuals in formal employment, and yet the labour force indicators in Section 1.2 showed that less than 10% of the labour force is in formal employment. This scenario therefore calls for widening the income tax base beyond the narrow formal-employment contributors. This study employs the CGE modelling technique to examine the wider impact on the economy and poverty levels in Uganda of levying a tax to raise revenue for additional funding for health; the design of which is outlined in Chapter 6 and the results reported in Chapters 7 and 8.

1.8 Summary

Uganda made big strides towards improving her population's health during the past two decades. However, the progress made is not sufficient to achieve any of the health MGDs by 2015. Health outcomes are still poor, falling behind similar low income countries. Overall, health sector reforms in Uganda have had impacts that have been traced to the health sector and the health status of the population at the micro level. The impact on quality of health services, both technical quality and quality assessed by consumers; the efficiency in resource mobilization, allocation and utilization in the health sector; and equity in access and utilization of health services is mixed. While there are improvements in some health system performance indicators attributable to reforms in the health sector, there is also notable poor performance in some of the system indicators throughout the reform period. There is evidence to suggest that similar healthcare reforms have been effective in some developing countries leading to improved health outcomes for sections of populations (Bossert & Beauvais, 2002; Cross et al., 1986).

The small domestic resource base, coupled with competing sectors, has hindered growth in per capita health expenditure in Uganda. Innovative healthcare financing mechanisms have worked in some African countries, suggesting that there is scope for Uganda to mobilise resources for health using some of the tested tools. It is the aim of this study to demonstrate the extent to which creating fiscal space for health impacts macroeconomic variables and poverty levels in Uganda. Specifically, three sources of fiscal space for health – prioritizing the health sector, earmarked taxes for health and external resources for health – are modelled. The economy-wide impacts at the intermediate level (changes in wages and rents, sectoral factor demand and outputs, and exchange rate dynamics) and the aggregate level (growth rates in GDP, consumption, exports imports and investment) as well as poverty levels, of the proposed policies are reported in Chapters 7 and 8.

1.9 Aim and objectives of the study

The main objective of the study is to assess prospectively, the macroeconomic effects of possible further changes in policies and strategies for healthcare financing reform policies in Uganda. Specifically the study aims to:

(i) Develop a health-focussed Uganda social accounting matrix (SAM), with a disaggregated health sector and labour inputs, to capture the demand and supply-side impacts of healthcare financing reforms.

(ii) Design a dynamic CGE model for Uganda calibrated from the health-focussed SAM

(iii) Design healthcare financing reform scenarios to mirror the creation of fiscal space for health in Uganda

(iv) Simulate the impact of government efforts to create fiscal space for health in a dynamic CGE model and predict the impacts on: a) structure of the economy b) macroeconomic variables and c) poverty rates

(v) Assess how policies aimed at improving healthcare financing compare.

The study is expected to contribute to the healthcare policy evaluation literature in two main ways. Firstly, the CGE modelling approach employed in the study to evaluate healthcare financing reforms in Uganda is a move from the narrow internal focus on the health sector to wider national effects. The dynamic model with highly disaggregated sectors, households and labour, has not thus far been used in macroeconomic assessment of health policy impacts outside of the UK. Model results explicitly report the prospective impacts of the healthcare financing policies on the structure of the economy, macroeconomic variables and reduction in poverty rates.

Secondly, the study setting is in a developing country and hence there are lessons to draw on the likely macroeconomic impacts of healthcare reform policies for low- and middle-income countries in general. To my knowledge, only (Rutten, 2004) has applied a static computable general equilibrium to explicitly model the economy wide impact of healthcare policy. However, the study was set in the United Kingdom, where the economic effects of healthcare policy changes are likely to differ from developing countries like Uganda. For instance, the informal (unregulated) sector is a significant employer in Uganda. The informal sector has implications for the wages structure, sector output composition as well as poverty rates in the country, which the Ugandan model will capture.

1.10 Organisation of the thesis

The thesis contains nine other chapters in addition to the introductory chapter. The relationship between health and the macro economy is presented in Chapter 2 with two main parts. First, an overview of the health and economic growth nexus is presented. This is augmented with a graphical presentation of a conceptual framework to evaluate the interactions of the health sector with the wider economy. It shows the possible mechanisms for the interrelationship of the health sector and the rest of economy. Second, a theoretical analysis of the simple general equilibrium model of production is presented and discussed with particular reference to health and healthcare. Chapter 3 provides a critical review of literature of studies applying CGE methodology to assess the economy-wide impacts of health and healthcare. Chapter 4 describes the structure of the dynamic CGE model for Uganda with particular attention to key characteristics of the economy and how they are modelled. The chapter also explicitly displays the functional forms paying particular attention to the model areas where the shocks are to be located. The model is linked to a household micro-simulation model for poverty analysis. The linking of the two modules and how it works is explained in detail. Chapter 5 provides a detailed analysis of the updating the Uganda 2007 SAM, disaggregating the health sector into three new accounts. The cross-entropy method of balancing the SAM is explained in this chapter and the derived SAM shares of the relevant accounts are reported.

Policy scenarios for modelling the impact of healthcare financing reforms are designed in Chapter 6. The policy scenarios are designed to mimic three sources of fiscal space for health: the prioritization of the health sector, earmarked taxes for health and external resources in the form of aid for health. Chapter 7 presents and discusses the adjustment mechanism in the economy and the macroeconomic impacts from the simulation results. Chapter 8 presents and discusses the results from the micro simulation poverty module. The policy impact on the incidence, depth and severity of poverty at the national level and by population residence, is reported. The robustness of model results is tested in a sensitivity analysis undertaken in Chapter 9. The sensitivity analysis pertains to model parameters and model closure rules. Chapter 10 concludes and provides recommendations, both for policy and further research.

CHAPTER 2: HEALTH, HEALTHCARE AND THE MACROECONOMY

2.1 Introduction

The contribution of health to economic growth has been the subject of substantial research (Bloom & Canning, 2000; Bloom et al., 2004; Fogel, 2004). The health effects on economic growth are both direct and indirect. Direct effects arise from the health status of a population which impacts the population growth rate and the supply of labour to the economy. In addition, health status affects the productivity of labour and as a result, economic growth; on the basis that a fitter and larger workforce produces greater economic growth than a smaller and less fit one (Mushkin, 1962). Indirect effects arise from the linkages between the health sector and other sectors in the economy. A healthcare delivery system is a major sector of the economy in any country. Therefore, changes within it have direct effects on those employed and wider multiple effects, especially on local economies. For example, in a government funded healthcare system where government uses general tax revenue to fund healthcare activities, an increase in the share of healthcare expenditure in the budget could have two implications. Firstly, tax rates would have to be raised in order to generate the additional revenue required to fund healthcare activities. An increase in tax rates implies less disposable income for households, which may in turn affect savings rates and eventually the overall investment in the economy. Secondly, if tax rates are fixed, increasing healthcare budget share means the government has to reduce budget shares for other government functions. This translates to a reduction in resources available to other sectors which may impact growth especially if the reduced shares are for productive sectors.

Studies that have investigated the macroeconomic impact of health and healthcare have mainly focused upon the effects of health on economic growth via labour productivity and labour participation rates (Bloom & Canning, 2000; Bloom et al., 2004; Cai & Kalb, 2006; Shariff, 2004). This approach takes a narrow focus, highlighting the direct effects of health and healthcare on the growth of the economy, but remains partial as it is unable to capture the lagged indirect effects of improvements in health and/or increases in healthcare activity. It is argued that a typical partial equilibrium analysis is ill-equipped to estimate the cascade effects resulting from certain public healthcare interventions since the implicit assumption of partial equilibrium within the health sector or the economy are violated by such interventions (Beutels, Edmunds, & Smith, 2008). The suggestion is to combine the information from estimated cost-effectiveness of healthcare interventions with macroeconomic data, such as social accounting matrices in a computable general equilibrium (CGE) model, to estimate the shocks to the economy of various policy interventions.

This chapter, therefore, seeks to provide an analytical framework that captures the full range of interactions of health and the rest of the economy. The chapter presents an overview of the empirical evidence on health and economic growth in Section 2.2. The evidence on the connection between public health expenditure and health outcomes, and the health impact on labour participation rates, is explored in Section 2.2.2 and 2.2.3 respectively. Section 2.3 describes a health system and provides a diagrammatical illustration of the interconnectedness between a health system functions, the health status of a population and the micro- and macro-economic variables. Section 2.4 provides a theoretical analysis of the simple general equilibrium model of production with healthcare in a Heckscher-Ohlin (H-O) framework. The use of a computable general equilibrium (CGE) modelling approach for policy evaluation is presented in Section 2.5 while Section 2.6 summarises the chapter and points out some of the theoretical model predictions that could be tested empirically in the dynamic CGE model of Uganda.

2.2 The health and economic growth nexus: an overview

Understanding the link between population health and economic growth is important for policy guidance. For a country that is concerned with having a healthy population to engage in productive activities and bolster economic growth then policymakers should be concerned with ensuring that the population has adequate access to quality health inputs such as availability of quality medical care and adequate nutrition at various points in life, among others. Policymakers should also be concerned with economic growth rates on the premise that health is a 'normal good' so that higher growth rates present opportunity for higher healthcare expenditure [10]. The aim of this thesis is to guide policymakers on the scale and prioritising between competing government spending priorities versus healthcare and within the financing mechanisms, reflect measures that reduce poverty in Uganda. Therefore, it is imperative to review the health and growth literature. The current state of the literature is discussed in Section 2.2.1 for health and economic growth, Section 2.2.2 for public health expenditure and health outcomes, and Section 2.2.3 for health status and labour force participation.

2.2.1 Effect of health on economic growth

[10] The assumption is that higher health expenditure translates into better health outcomes. The literature on this presumption is explored in Section 2.2.2 below.

There is a large body of literature on the relationship between health and economic growth both at the micro and the macro level[11]. Microeconomic studies examine the impact of varying health inputs on health outcomes, and show that health inputs such as nutrition at various points in life, eradication of disease and availability of medical care have a positive impact on education outcomes, household living standards and life expectancy (Alderman, Hoddinott, & Kinsey, 2006; Bleakley, 2003; Maluccio et al., 2009; Miguel & Kremer, 2004; Psacharopoulos & Patrinos, 2004). The microeconomic estimates are often used to calibrate the aggregate effect of health on the economic growth trajectory of a given country.

The usual partial equilibrium macroeconomic studies employ the microeconomic health effect estimates to calibrate the size of the health effect at the aggregate level and examine the extent to which differences in health contribute to differences in economic growth rates between countries. Such studies have shown that rising life expectancy is positively associated with increased savings and higher economic growth rates (Hurd, McFadden, & Gan, 1998; Lee, Mason, & Miller, 2000). The argument here is that as people expect to live longer, they may be encouraged to save and invest for later years or even choose to work longer, all of which may increase investment, the physical capital per worker and eventually produce higher rates of economic growth. For example, differences in adult survival rate[12] as a proxy for health, were found to account for 19% of variances in income per capita (Shastry & Weil, 2003). Countries with higher levels of life expectancy were found to experience faster economic growth (Bloom & Canning, 2000; Bloom et al., 2004; Marcella, Bloom,

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[11] For example, a collection of some papers on the debates about health and economic growth was published in a book by the Commission on Growth and Development (Spence & Lewis, 2009).

[12] Adult survival rate used in this paper referred to the probability that a fifteen year old will survive to age sixty, which is an appropriate measure to reflect changes in productivity of workers.

Canning, & Jamison, 2007). For example, it was found that a one year increase in life expectancy raises output by 4% (Bloom et al., 2004). Other cross-country comparisons have shown that variation in health inputs accounts for a sizeable percentage in differences in income growth where, for instance, eliminating health gaps among countries would reduce the variance of log output per worker by between 9.9% and 12.3%, depending on what is used as the proxy for health[13] (Weil, 2007)[14]. At low levels of health, the effect of health improvements on economic growth is large. This is particularly the case in developing countries where communicable diseases form a larger part of the burden of disease and a large proportion of the workforce is engaged in manual labour, so that the return on health improvements is higher compared to developed countries (Bhargava, Jamison, Lau, & Murray, 2001).

On the other hand, a body of literature, using similar methods of partial equilibrium analysis, is emerging to challenge the growing consensus that improving health and the ensuing health effects can accelerate economic growth (Acemoglu & Johnson, 2007, 2014). This strand of literature argues that the debate for the health impact on economic growth is not yet conclusive because the cross-country studies linking the two have only shown a strong correlation between measures of health and economic growth but have not established the casual effect. The contra finding that GDP per capita and GDP per working population declined in countries experiencing larger increases in life expectancy exposes the inadequacy of partial equilibrium methods to assess the impact of health on economic growth. Acemoglu

[13] The authors use adult survival rate and the age of menarche as proxies for health.
[14] This result considers only the direct effect of health on GDP per worker. When the indirect effects of health are added into the analysis (specifically the effect of improved health in raising the level of education attainment and the quantity of physical capital per worker), the health effect is higher -19.3% (compared to 9.9%) when the adult survival rate is used as a measure of health. Incorporating more indirect effects will raise the health effect even higher.

and Johnson (2007) contend that countries experiencing low life expectancy and ill-health are often disadvantaged in other ways so that poor health outcomes are a reflection of these disadvantages. Consequently, the macro studies of the link between health and economic growth could be capturing the negative effects of these "other disadvantages", which are often omitted in the analysis. The contra finding is a reflection that these studies are unlikely to have established a linear relationship between health and economic growth and also not have established unidirectional causality; the picture is likely to be a more complex one –of non-linear correlation and bidirectional causality. This highlights the need to assess impact of health shocks in an iterative manner as proposed in this study.

In general, the partial equilibrium approaches used to analyse the effects of health on economic growth are incapable of capturing simultaneously, the direct and indirect effects of health. For instance, the health improvement effect on education outcomes has implications for the return to labour, household income and expenditure, poverty rates, sectoral production and GDP growth rates in Uganda. Therefore, adopting the partial equilibrium analysis may underestimate the total benefits from health improvement and lead to sub-optimal policy implementation. The dynamic general equilibrium method employed in this study uses microeconomic estimates of health improvements in the form of growth in supply and productivity of the labour force, and evaluates the health effects implication for growth in economic variables at the intermediate and aggregate level of analysis. The design of health effects and the parameter values used in the model are presented in Chapter 6.

The contra finding has been dismissed on methodological grounds (Bloom, Canning, & Fink, 2014). Nevertheless the suggestion for improvement of methods by Bloom et al (2014) is still within the partial equilibrium analysis. A similar controversy arose when a study published findings showing that HIV/AIDS was not necessarily an economic disaster because the epidemic would kill off large populations and thus raise income per capita for the survivors (Young, 2005). This assertion, for instance, ignores the equilibrium effects of a reduction in consumption quantity as people (consumers) die and the implication for production. These contra findings on the association of health and economic growth raise serious policy concerns and ought to be explored further. However, the method of investigation should incorporate the general equilibrium effects of health and healthcare because these are interlinked with the rest of the economy. For example, the health sector buys inputs for medical care (a backward linkage); to produce the health output (as treatments) for a healthy labour force that is employed by all sectors of the economy (forward linkage). The current study is designed to capture the impact of the forward and backward linkages of health and healthcare shocks in the economy of Uganda using a dynamic general equilibrium model.

Proponents of the theory of negative correlation between health and economic growth argue that improvements in health coupled with decline in mortality rates could stimulate a transition from high to low rates of fertility and mortality, consequently creating a "baby boom" generation. The theoretical argument is that population explosion will lead to lower income per capita as it puts pressure on scarce resources and dilutes the capital-labour ratio. For the finite natural resources more people means less natural resources available per person. For the expandable resources such as plant and equipment used in production, social institutions, and school systems for children's education, there is a period of dependency when children do not contribute to the production but draw on these resources for sustenance and development. This implies that if there are more children being born resources will be spread more thinly, at least in the short term. Also, assuming constant returns to scale in the production process, a rate of growth in population and labour supply that is above the growth rate in the stock of physical and human capital will lead to a decline in the capital per worker, referred to as “capital dilution”. In the absence of technical progress, capital dilution may result in declining wages and ultimately lower per capita income.

However, it is also argued that the changing age structure of the population will have a strong effect as the “baby boomers” enter the workforce and that the potential effect of the increasing labour supply on economic growth will depend on the prevailing policy environment (Bloom et al., 2004). In a similar vein it has been shown that analysis of the population growth impact is complex, involving the physical capital dilution effect, the altruism utility effect and the human capital effect, and not the simple comparative statistics often employed to study the impact of demographics on long-run economic growth (Boucekkine, Martinez, & Ruiz-Tamarit, 2011)[15].

This thesis recognises the inadequacy of these partial equilibrium techniques to analyse the complex relationship of population growth impact on economic growth. It is crucial that the overall potential impact of population growth and labour supply be analysed in a general equilibrium setting where the interaction between all economic agents are captured. This study employs a CGE model to evaluate the population and labour supply implications through health improvement and different healthcare funding mechanisms, on growth rates in GDP and other macroeconomic variables as well as changes in poverty levels in Uganda.

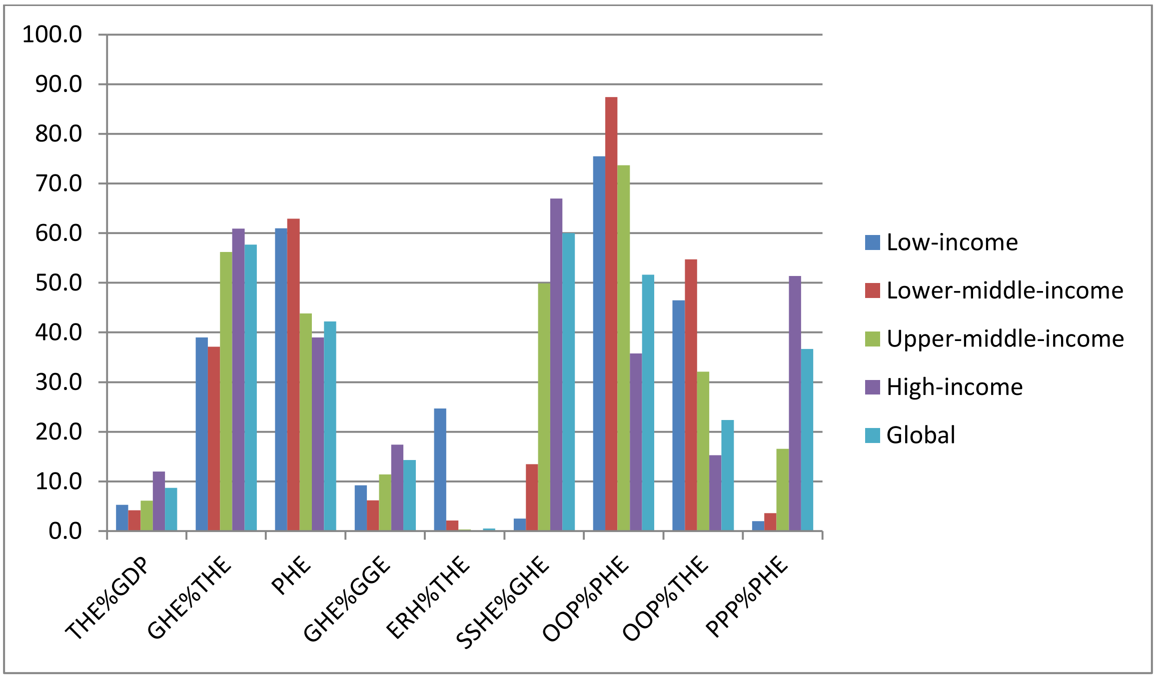
[15] The authors investigate three causation mechanisms from population growth to long-run level of economic growth - the physical capital dilution mechanism premised on a larger population growth that increases the size of the dilution effect and is thus detrimental to the income per capita level, the altruism utility mechanism that is connected to the share of time devoted to work to produce goods compared to leisure time, and the level of human capital mechanism premised on the new-borns that enter the word uneducated and so reduce the stock of human capital per capita

2.2.2 Public health expenditures and health outcomes

For the purposes of this study it is important to understand the composition of national health expenditure according to the global standard of national health accounts. National health expenditure is the sum of both public and private spending on health goods and services. Public health expenditure is disaggregated according to sources of finance which include general taxation, mandatory insurance contributions such as social insurance contributions, and external agencies including both grants and loans. Private outlays, on the other hand, are comprised of private insurance premiums and prepaid schemes, mandated enterprise health expenditure, not-for-profit health services expenditure and out-of-pocket payments.

Statistics show that total health expenditure (THE) as a share of GDP, and government health expenditure (GHE) as a share of general government expenditure (GGE), is low for low-income countries compared to middle-income and high-income countries (World Health Organisation, 2014). Although there are variations within regions, for most countries in Sub-Saharan Africa health expenditure is lower than the $86 per capita suggested as the minimum required to provide basic health services (McIntyre & Meheus, 2014). The statistics also show that countries with lower per capita income have considerably higher proportions of private expenditures on health, particularly out-of-pocket payments (OOP). Moreover, the reliance on external resources for health as a significant source of total health expenditure in low-income countries, as depicted in Figure 2.1, is precarious for health services delivery since sustainability of external resource flows is not guaranteed. For this reason, this study examines the possibility of domestic resources mobilisation for funding healthcare and evaluates the impact of such measures on growth in macro variables as well as poverty reduction rates.

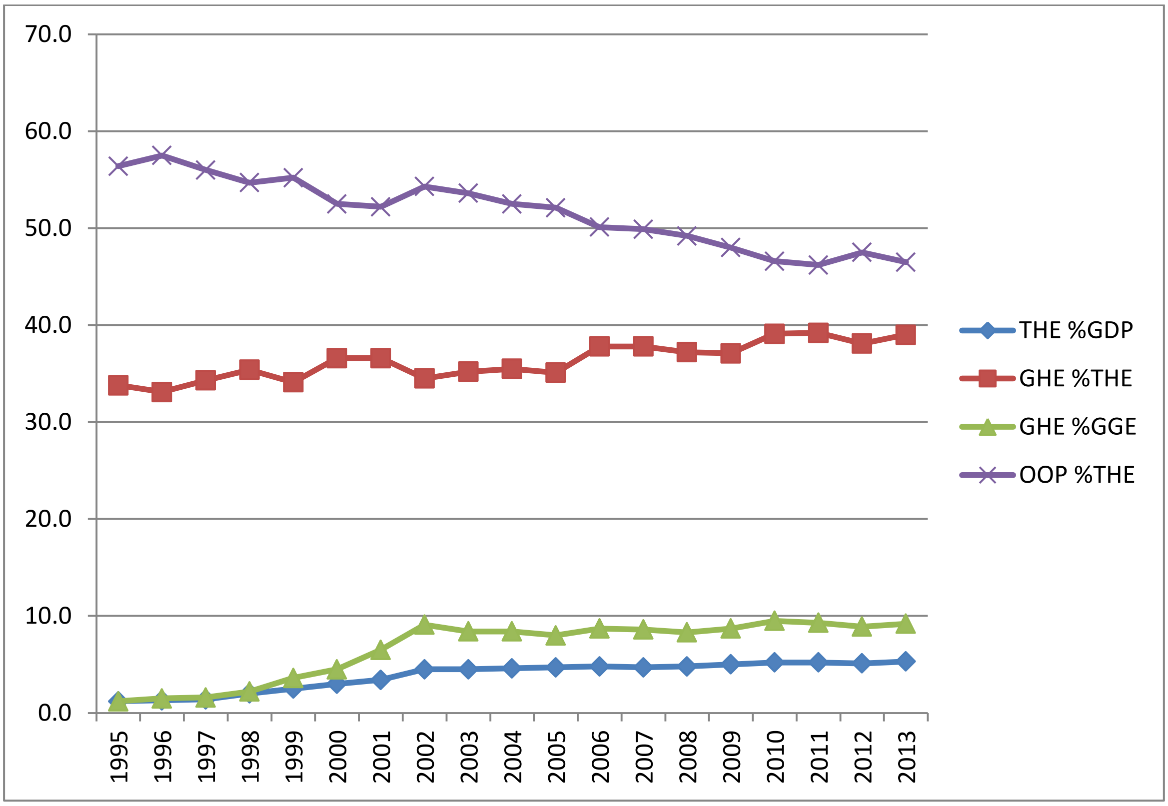
Figure 2.1 Health expenditure ratios by World Bank income-groups: 2013



Note: THE – total health expenditure, GHE = government health expenditure, PHE = private health expenditure, GGE – general government expenditure, ERH = external resources for health, SSHE = social security expenditure on health, OOP = out-of-pocket payments for health, PPP = private prepaid plans for health

The trend in low-income countries depicted in Figure 2.2 shows that, as THE share in GDP increases, the OOP payments share in THE is declining more rapidly compared to increase in the GHE share. The situation could be different for individual countries within the low-income group. This is because the determinants of total health expenditure – the country's income (GDP per capita), overall government's fiscal capacity, demographic structure, disease pattern and health system characteristics, particularly the design of the health financing functions, – suggest that country health spending patterns could be different between countries.

Figure 2.2 Health expenditure ratios for low-income countries: 1995 - 2013



Note: THE%GDP = total health expenditure as a percentage of GDP, GHE%THE = government health expenditure as a percentage of total health expenditure, GGE = government general expenditure, OOP %THE= out-of-pocket payments as a percentage of total health expenditure

The rest of this section focuses on literature that examines the impact of government health expenditure on population health outcomes. Empirical literature on the linkage between public health expenditures and health outcomes is sparse and particularly so for developing countries where appropriate data for analysis is sparse. The studies found here use objective indicators such as mortality rates and life expectancy as proxies for the healthcare performance of public expenditure, arguing that such indicators are preferred to subjective indicators that are based on health feeling self-assessment and self-reported. However, using objective indicators such as under-five mortality rate or maternal mortality ratio, as proxies for the public expenditure healthcare performance is inadequate because, not only do they fail to capture the quality of life of individuals, they do not reflect the crucial point of impacts from interactions of the health system with the rest of the economy. It is therefore important that the impact of public healthcare expenditure should be analysed using a method that captures both the direct and indirect linkages of the health system in a general equilibrium setting, as proposed in this study.

Some of the studies that exist have found a positive correlation between government health expenditure per capita and specific health outcomes. In a panel dataset for African countries (1999 to 2004) it was found that both total and government health expenditure were significant in reducing child mortality. In the African dataset a 10% increase in per capita public expenditure leads to a reduction of 25% in under-five mortality rate or 21% in infant mortality rate (Anyanwu & Erhijakpor, 2007). This study examines only the direct impact of health spending on health outcomes but the results could be different if the indirect effects are taken into account as well. For instance, if the spending is targeted at different levels of healthcare such as primary level as opposed to tertiary level of care, the impact results could reflect the different demands on resource inputs and costs by the different levels of care. Such effects will be mirrored in the production output for sectors that are major suppliers of the health sector. Additionally, higher allocations to primary healthcare compared to tertiary level of care, are more likely to benefit the poor segments of society (as opposed to the urban elite), and thus improve child health outcomes for the poor and increase their potential to participate in productive activities. In a general equilibrium setting, these effects are, for instance, reflected in poverty reduction rates, higher private consumption levels, and growth in sectors that supply the consumption goods. Developing country studies found a positive impact of public health spending on health outcomes that it is more significant for the poor compared to the non-poor (Anand & Ravallion, 1993; Bidani & Ravallion, 1997).

Other studies that document significant and negative association between public health expenditures and under-five and maternal mortality rates confirm that expanded healthcare coverage through higher levels of publicly funded health expenditure leads to lower child and adult mortality (Bokhari, Gai, & Gottret, 2007; Cevik & Tasar, 2013; Moreno-Serra & Smith, 2015). The positive impact of government health spending on health outcomes is shown to be even higher in countries with high levels of good governance (Farag et al., 2013). Declining government health spending is associated with significantly higher infant mortality with the largest increases occurring in low-income countries (Maruthappu, Ng, Atun, Williams, & Zeltner, 2015). High rates of infant mortality could translate into economic loss through the lost potential for consumption power which could have implications for the sectors producing commodities for that segment of society. Moreover, when children die at a young age, there is a loss of potential labour input particularly in developing countries where production is largely labour intensive. Although the population theorists could argue that higher mortality rates may lead to higher GDP per capita and physical capital per worker, the overall effect of increased health expenditures on health outcomes is best ably captured by an analysis technique that considers the general equilibrium effects. This study proposes and applies such a technique using the CGE model.

Despite the recent literature on the positive contribution of government spending on health outcomes, there is a counter argument that public health spending has not had the desired strong effect on reducing mortality. Using global child mortality data of 1992 and country level health expenditure data, it is suggested that variation in public spending explains less than one-seventh of 1% of the observed differences in mortality across countries (Filmer &

Pritchett, 1999). The authors argue that there is a chain of elements[16] that must exist in order for public health spending to improve health outcomes and that the total impact depends on all the elements. The narrow focus on the direct impact of health spending on health outcomes maintains that missing any of the elements in the chain could render public health spending ineffective. However, the CGE model is capable of capturing the back and forth linkages and would be more appropriate to report the whole picture of health spending in the economy both at the intermediate and aggregate levels.

2.2.3 Health and labour force participation

Labour is a crucial production input particularly in developing countries where a proportionately large part of production is labour intensive. According to Grossman (1972) illness prevents people from working such that the cost of illness is the lost labour time. Moreover, ill-health negatively impacts on individual productivity. The direct effect of health is premised on the fact that healthier people are better workers in as far as they can work harder and longer, in addition to the ability to think clearly. In addition to their role in production, healthier people are likely to be more prolific consumers. Health also affects labour wages indirectly by raising the education attainment levels. Evidence suggests that, in developing countries, wages rise by about 10% for one year of education (Psacharopoulos & Patrinos, 2004). This means that health is important for both accumulating a critical mass of skilled workers and for the higher wages paid to skilled workers. Higher wages for a mass of skilled labour means more income for households that own the labour who may then

[16] The three elements are: (i) public spending must create effective health services, (ii) the new public health services have to change the total amount of effective health services consumed by the population, and (iii) the additional services consumed have to be cost-effective in improving health.

consume more and/or save and invest more, all of which could transform the economy for the better. Generally, the transmission of the indirect health effects can best be captured in general equilibrium analysis such as the CGE model used in this study.

Health, in the form of human capital, is valued by both the employer and employee because healthy workers lose less time and are more productive when working (Grossman, 1972). Additionally, it is observed that health status influences an individual's labour supply decision. For instance, when faced with a health shock, an individual may place a higher value to leisure compared to work days. The choices made by an individual impact the rest of the economy through the direct contribution of the individual to the level of production (output), household level of income, consumption and poverty rates, and then consumption levels are linked to production levels. All these linkages may not be directly observed if the health effects analysis does not capture the equilibrium setting of the economy. Similarly, some individuals may choose to postpone retirement and work longer, when compelled by the prospect of declining mortality rates and the consequent higher life expectancy. Such decisions may translate in higher savings and investment and increasing physical capital per worker, all of which are likely to accelerate economic growth.

Studies that have examined the effect of health status on labour force participation for working-age men and women find that health has a positive and significant effect on labour force participation (Cai, 2010; Cai & Kalb, 2006). Although a Canadian study argues that a large health impact on labour supply is an overstatement, due to endogeneity of health, the authors still find a positive health impact on labour supply of 4-6% for all age groups, after accounting for endogeneity and unobserved effects (Hum, Simpson, & Fissuh, 2008). Other studies have shown that child health is positively correlated with mother's labour participation rate (Baird, Hicks, Kremer, & Miguel, 2012; Dunkelberg & Spiess, 2007; Frijters, Johnston, Shah, & Shields, 2008). Furthermore, a ten year follow-up of a deworming program in a selection of primary schools in Kenya, found that investing in deworming increased work hours for the treatment group, with a high of 16.7% increase for males (Baird et al., 2012).

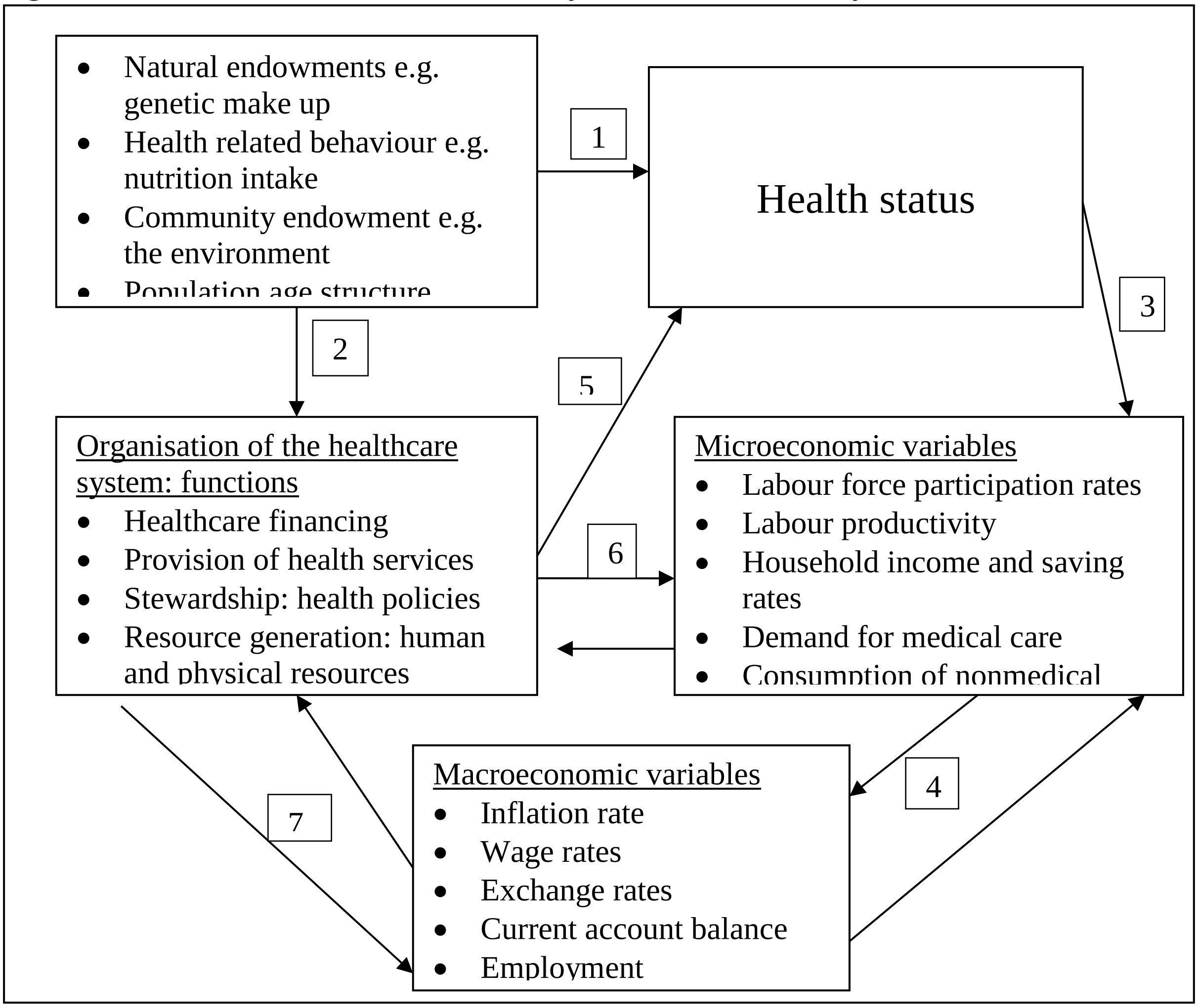
Overall, health affects labour directly through mortality and morbidity rates as well as indirectly through, for example, education attainment levels. The health effects on labour are further transmitted in the economy through wage rates, household income and consumption levels, output levels, investment and poverty levels. In order to capture the direct and indirect effects of health status on labour, this study employs the CGE modelling technique which generates intermediate impacts such as wage rates and sectoral output levels, and aggregate impacts in terms of growth rates for GDP, investment, consumption, imports and exports, as well as poverty rates in Uganda. This study draws on the microeconomic estimates of health effects on labour participation rates to populate the CGE model and evaluate the overall effect at the intermediate and aggregate levels of analysis for the Ugandan economy.

2.3 A healthcare system and the economy

A Health system is a combination of resources, actors and institutions related to the financing, regulation and provision of actions whose primary intent is to improve or maintain health (World Health Organisation, 2000). Health is the defining goal of a health system which performs four standard functions: financing, provision of health services, stewardship and resource generation (World Health Organisation, 2000). An analytical framework of the health sector interplay with other sectors should capture all the features that characterise the interactions of the health sector and the rest of the economy. The WHO standard framework for assessing performance of health systems (Murray & Frenk, 2000) and (World Health Organisation, 2010); and the macroeconomics and health framework (Shariff, 2004) provide a starting point.

The WHO framework is extended to illustrate a symbiotic relationship between the economy and the health status of the population. However, this addition to the framework concentrates on the health system effects on macroeconomic variables through the direct impact on health status. There are other health policy effects on the economy that do not necessarily come through the impact on health status of the population. Healthcare investment will also impact the structure of the economy through various mechanisms such as wage rates, exchange rates, employment, and sector composition, among others. Therefore, the pathway through which the health system influences macroeconomic variables is added to the framework (Hsiao & Heller, 2007). Figure 2.1 is an illustration of some of the many pathways through which the healthcare system interacts with the economy generating direct and indirect effects. The direction of the arrows indicates the direction of the flow of influence between the variables, which are then numbered for ease of reference.

Figure 2.3 Interaction between a healthcare system and the economy



Source: Adapted from (Hsiao & Heller, 2007)

The interactions displayed in Figure 2.1 are briefly explained as follows. The health status[17] of a population is invariably determined by initial conditions such as genetic makeup of individuals, age structure of the population, demographic characteristics, and the environment, among others (Channel 1). The initial conditions will also influence the demand for healthcare thus determining the organisation of a healthcare system (Channel 2). For

[17] The WHO definition of health…. "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity", (World Health Organisation, 1948), is the departing point from which health status is deduced to imply the incidence of illness, and prevalence of disease. It is argued that although the WHO definition of health has been widely supported, few have operationalized it so as to provide a measure that can be used to assess the level of health for a given group of people (Bergner & Rothman, 1987). Hence the term health status has eluded a simple definition mainly because of the lack of an agreed-upon definition of health that can be operationalized.

example, a considerably large proportion of people living in a less affluent environment are likely to be afflicted by communicable diseases which calls for investing in preventive and curative health services, while an older population will require investment in strategies to reduce the effects of non-communicable/chronic diseases. Health status affects microeconomic variables (Channel 3), by impacting on labour productivity. Consequently, household earnings, savings rates, poverty rates, demand for medical care as well as demand and consumption of non-healthcare goods, are affected. These factors ultimately impact on output and GDP growth, and commodity and factor prices (Channel 4). Furthermore, the organisation of the health system will directly affect the status of a population (Channel 5) through government policies such as healthcare financing (general taxation, donor funding, private funding) which determines the quantity and quality of health services available to the population.

Additionally, resource generation policies such as training of health workers, and investment in physical capital, are critical issues in delivery of healthcare services and as a result influence the health status of a population. Further still, the implementation of healthcare policies and healthcare financing strategies will impact directly upon the macroeconomic variables (Channel 6), depending on the size and significance the health sector. For instance publicly financed healthcare provision through general tax revenue has implications for tax rates and household income. Increasing the government healthcare budget implies that the government has to find additional resources that may be in the form of higher taxes to address the fiscal imbalance. It may also reduce the resources available to other sectors and/or reduce transfers to households thereby affecting household income. Donor funded healthcare raises issues about the quantity of aid and its impact on the macroeconomic variables of the country, as well as absorption capacity (Martins, 2006). Additionally, donor funded healthcare often entails increased hiring of skilled personnel and health workers in particular, in order to accelerate the achievement of the desired targets for healthcare delivery. This tends to increase wages for skilled labour, including health workers in the health sector, as they are highly sought after, which creates pressures for higher wages for skilled workers in other sectors, particularly other government departments (Bourguignon & Sundberg, 2006).

Expansion of health service delivery is likely to entail increased allocation of resources to the health sector. The reallocation naturally creates a disturbance in the economy with a fixed set of resources. If, for instance, there is a fixed pool of labour, increasing labour supply to the health sector implies that less is available to other sectors, which may drive up wages in the rest of the economy. The role of the pharmaceutical sector as a provider of inputs to healthcare has implications for the current account balance, given that Uganda is a net importer of pharmaceutical products. Increased pharmaceutical supplies will mean increased foreign exchange requirements. Additionally, an increase in the world price of pharmaceutical products would generate a reciprocal rise in the domestic consumer price of pharmaceuticals thus reducing the real income of households. In the event that the health system encourages the export of domestic health workers; this may be a source of foreign exchange impacting the current account. In the case of Uganda export of domestic health workers is an indirect outcome of the poor remuneration for health workers. They leave the country in search of greener pastures abroad.

It is imperative that a framework to analyse the impacts of investing in healthcare takes into account the general equilibrium setting of an economy. A general equilibrium analysis deals explicitly with the interactions between different actors in the economy. Furthermore, since some of the effects of the inter-relationship occur in short periods while others manifest over longer periods, a dynamic analysis is inevitable. Therefore, a dynamic computable general equilibrium modelling approach is most suited to capture the economy-wide impacts of healthcare reforms in Uganda.

2.4 The simple general equilibrium model of production with health and healthcare

This section attempts to explain the simple general equilibrium model of production for an open small economy and extend it to health and healthcare. The presentation in this section is not an innovation of the thesis but is borrowed from existing theory and, to a great extent, draws from the applications of the Heckscher – Ohlin (H-O) model to health and healthcare by (Rutten, 2004), as well as the standard applications in (Dinwiddy & Teal, 1988) and (Jones, 1965). The aim of this theoretical analysis is twofold: (i) to show how health and healthcare influence the relationship between factor endowments and commodity outputs in an economy comprising of both tradable and non-tradable sectors, and (ii) to draw policy options from the analysis of health and healthcare in the simple production model. The ultimate goal is to inform the empirical model for Uganda in establishing the extent to which the empirical results conform to the established theoretical outcomes.

All major branches of applied economics have made use of the simple general equilibrium model of production (two-sector, two-factor, two-country) in one way or another (Jones, 1965). This is because the basic properties and theorems of the 2 x2 x 2 case, are in some sense, capable of generalisation (Jones & Scheinkman, 1977). Commonly referred to as the

H-O model, after the seminal work of Heckscher and Ohlin, it focuses on the relationships between a country's factor endowments and patterns of trade in commodities as well as the impact of free trade on factor payments.

2.4.1 Overview of the low dimension H-O model with Uganda as the case study

The model assumes a perfectly competitive economy with two factors, two goods and two countries – Uganda and the rest of the world. The economy is set in Uganda, which is assumed to be a small country[18], trading with the rest of the world where Ugandan consumers can sell any quantity of goods at fixed world prices. For purposes of illustrating the health and healthcare impact on factor endowments and sector outputs in a later section of this chapter, it is assumed the two factors of production are skilled labour and unskilled labour. The factor endowments are fixed and are assumed to be owned by one representative household. Factors are not mobile across borders but are perfectly mobile between domestic sectors. The single household maximises utility subject to the income earned from the factors it owns. There are two sectors with many producers who seek to maximise profits. In equilibrium, producers earn zero profit[19]. Producers' production functions in each of the sectors exhibit a constant return to scale which implies that in the long run (when all inputs

[18] The small country assumption in international trade theory means that a country's volume of imports is a very small share of the world market and therefore cannot affect the world price of the commodities. This means Uganda's export supply curve is horizontal at the world market price, and it takes the import price as exogenous since it cannot affect it. Ugandan exporters are willing to export as much products as the importer is willing and able to buy at the given world price.

[19] Zero profit (sometimes called normal profit) is used in economics to describe the relationship between a firm's output and production costs. In a perfectly competitive market, there is free entry and exit of firms so that in the long run every competitive firm will produce where its commodity price (P) equals the marginal cost (MC) of producing that commodity. This is also the point where the short run average cost ($SRAC$) and long run average costs ($LRAC$) are at the minimum. At this point every firm is earning zero economic profit and no identical firm will want to enter or exit the industry: $P = MC = minSRAC = minLRAC$

are variable), increasing production inputs will increase output by the same proportional change.

The consumer seeks to maximise utility subject to a budget constraint. Therefore, using the Cobb-Douglas utility functions, the consumer's optimization problem is described as

Maximise $U = U(C_1, C_2)$

Subject to $P_1C_1 + \mathrm{P}_2C_2 = Y$

where U denotes the utility of the representative consumer, C_i the consumption of quantity of good $i(i = 1{,}2)$, p_i the product price of good i, Y is the income of the representative consumer.

Solving the consumer's constrained optimisation problem yields the following solution:

$$\mathrm{C}_1 = C_1(P_1, P_2, Y) \quad (2.1)$$

$$\mathrm{C}_2 = C_2(P_1, P_2, Y) \quad (2.2).$$

Equations (2.1) and (2.2) indicate that consumption depends on commodity prices and income.

On the supply side, the producers' optimisation problem is in two stages. In the first stage, each firm in sector i requires a certain combination of factor inputs to produce a given output level, in a production function of the form:

$$X_i = X_i(S_i, L_i)$$

where S_i and L_i denote the quantities of skilled labour and unskilled labour respectively, employed by sector i . The costs of production are determined by the factor input prices so that each producer's cost minimizing input combination is the solution to the cost-minimisation problem of the form

minimise $TC(X_i) = w_S S_i + w_L L_i$

subject to $f(a_{Si}, a_{Li}) = 1$

where $TC(X_i)$ denotes the total cost of producing the output in sector i, X_i is the output of sector i, S_i and L_i are the quantities of skilled labour and unskilled labour used by sector i $(i = 1, 2)$, w_q denotes the return to factor q $(q = S, L)$, and a_{Si} and a_{Li} are input-output coefficients defined as $a_{Si} = S_i/X_i$ and $a_{Li} = L_i/X_i$ denoting the quantities of skilled and unskilled labour used in sector i to produce output X . It is assumed that Sector 1 uses skilled labour more intensively relative to Sector 2, so that $S_1/L_1 > S_2/L_2$. In terms of the input-output coefficients the skill intensity ranking also implies $a_{S1}/a_{L1} > a_{S2}/a_{L2}$.

Under full employment and given the constant returns to scale assumption, it is possible to derive the factor demand functions and unit cost equations. Therefore, the cost-minimisation solution yields unit factor demands by each sector in the following formulation:

$$a_{Si} = a_{Si}(w_S/w_L) \qquad (2.3), (2.4)$$

$$a_{Li} = a_{Li}(w_S/w_L) \qquad (2.5), (2.6)$$

Each producer's total factor demands are then derived by multiplying the sector output, X_i , by the unit factor demands in equations (2.3) to (2.6) to obtain

$$S_i = a_{Si}(w_S/w_L) = a_{Si}X_i \qquad (2.7), (2.8)$$

$$L_i = a_{Li}(w_S/w_L) = a_{Li}X_i \qquad (2.9), (2.10)$$

In the second stage of the producer's optimisation problem, each producer is assumed to maximise profits, defined as the difference between total revenue and total costs. Therefore,

maximise $\pi_i = p_i X_i - (w_S S_i + w_L L_i) = p_i X_i - w_S S_i - w_L L_i$

where π_i denotes the profit of producer i.

Substituting the conditional factor demands equations (2.7) – (2.10) into the profit expression becomes:

maximise $\pi_i = p_i X_i - w_S \,.\, a_{Si} X_i - w_L . a_{Li} X_i$.

It is not possible to solve for the profit maximising output, X_i by setting the derivative of the profit maximising expression $\frac{\delta\pi}{\delta X_i} = p_i - w_S \,.\, a_{Si} - w_L . a_{Li}$ equal to zero because it does not contain the term X_i on the right hand side. It only shows that the rate of change of profit with respect to output is a function of only the commodity price p_i , and factor prices, w_S , w_L (and not the level of output). However, equating the partial derivative for the profit maximizing expression to zero yields the unit cost equation for the producer[20]:

$$P_i = w_S a_{Si} + w_L a_{Li} \qquad (2.11), (2.12)$$

The unit costs in each sector mirror the market prices in a competitive equilibrium setting. The left hand-side of equation (2.11) and (2.12) represents the price, P_i per unit of output X_i , while the right-hand-side represents the quantities of the two factors demanded per unit of output X_i produced. This result highlights the dual relationship between factor endowments and commodity output on the one hand, and commodity prices and factor prices on the other.

[20] This analysis demonstrates that for production functions with constant returns to scale there is no supply function.

In equilibrium, all markets must clear. So far, the representative household's consumption decision and the producer's production decision pertain to domestic demand and domestic output. Since it was assumed that Uganda, the country of interest in this analysis, is an open small economy, the product market clears when the export and imports are incorporated in the model. Therefore, market clearing equations are added:

$$C_1 = X_1 - E_1 \tag{2.13}$$

$$C_2 = X_2 + M_2 \tag{2.14}$$

where E_1 and M_2 are exports of Good 1 and imports of Good 2 respectively. Imports and exports are traded on the world market and therefore a link must be established to relate domestic prices with world prices. As a result an exchange rate is introduced to convert world prices to domestic prices by the following equation

$$p_i = F\mu_i \qquad \text{(2.15), (2.16)}$$

where F is the price of one unit of foreign currency, in terms of the domestic currency, μ_i is the world price of good i.

In equilibrium, the trade balance is represented as:

$$\mu_1 E_1 - \mu_2 M_2 = 0 \tag{2.17}$$

In the factor market, it is assumed the supply of factors to each sector of production is exogenously fixed[21], hence equilibrium is given by the following equations:

$$S_1 + S_2 = \bar{S} \tag{2.18}$$

$$L_1 + L_2 = \bar{L} \tag{2.19}$$

where $\bar{S}$ and $\bar{L}$ denote fixed factor endowments of skilled labour and unskilled labour respectively.

The household's ownership of factors generates income to the consumer which is given by

$$Y = w_s(S_1 + S_2) + w_l(L_1 + L_2) \tag{2.20}$$

It is important to note that in a general equilibrium model only relative prices can be determined (and not absolute prices). This proposition means that, if all prices in the economy increase by the same proportion but relative prices remain unchanged, the real relationship in the economy remains unchanged. In other words, all the demand and supply functions in the model are homogenous of degree zero, so that if prices increase by the same proportion the quantities demanded and supplied will remain unchanged. It is, therefore, necessary to choose a commodity whose price is set to equal one, in a process known as

[21] This assumption holds for a simple production equilibrium model such as the one under consideration here. In more complex models however, the supply of factors to each sector by an individual is determined by the household preference and the relative prices in the system (Dinwiddy & Teal, 1988).

normalisation, so that the model solves for equilibrium prices in terms of that commodity, known as the numeraire.

Another important aspect of general equilibrium models is that they must satisfy Walras' Law. The Law states that for a given set of prices, the sum of the excess demands over all markets must be equal to zero. In other words, in a general equilibrium model with m economic agents and n markets, if all economic agents are satisfying their budget constraints and $n-1$ markets are in equilibrium, with quantity demanded equal to quantity supplied, then the $n\text{th}$ market will automatically also be in equilibrium. In a general equilibrium model, the Walras variable will be equal to zero essentially because producers plan to sell that value of goods which will enable them to afford their purchases. A short fall in their actual sales (excess supply) results in an equal shortfall between their actual and desired consumption (excess demand). The equations for a simple production model of a small open economy are summarised in Table 2.1.

Table 2.1 Equations of a two-sector open small economy model

COMMODITY MARKETS		
Demand	$C_1 = C_1(P_1, P_2, Y)$	(2.1)
	$C_2 = C_2(P_1, P_2, Y)$	(2.2)
Unit price equations $(i = 1, 2)$	$P_i = w_S a_{Si} + w_L a_{Li}$	(2.11), (2.12)
Market clearing	$C_1 = X_1 - E_1$	(2.13)
	$C_2 = X_2 + M_2$	(2.14)
FACTOR MARKETS		
Demand $(i = 1, 2)$	$a_{Si} = a_{Si}(w_S/w_L)$	(2.3), (2.4)
	$a_{Li} = a_{Li}(w_S/w_L)$	(2.5), (2.6)
	$S_i = a_{Si}(w_S/w_L) = a_{Si}X_i$	(2.7), (2.8)
	$L_i = a_{Li}(w_S/w_L) = a_{Li}X_i$	(2.9), (2.10)
Market clearing	$S_1 + S_2 = \bar{S}$	(2.18)
	$L_1 + L_2 = \bar{L}$	(2.19)
HOUSEHOLD INCOME		
	$Y = w_S(S_1 + S_2) + w_L(L_1 + L_2)$	(2.20)
FOREIGN SECTOR		
Price equations	$p_i = F\mu_i$	(2.15), (2.16)
Balance of Payments constraint		
	$\pi_1 E_1 - \pi_2 M_2 = 0$	(2.17)
Endogenous variables		
$C_1, C_2, X_1, X_2, S_1, S_2, L_1, L_2, a_{S1}, a_{S2}, a_{L1}, a_{L2}, p_1, p_2, w_s, w_l, Y, E_1, M_2, F$		
Exogenous variables		
$\bar{S}, \bar{L}, \mu_1, \mu_2$.		

Source: Adapted from (Dinwiddy & Teal, 1988)

2.4.2 Factor endowments, illness and health in a low dimension H-O model

The analysis of a health status impact on sector output, which is generated indirectly through health effects on effective labour supplies, is analogous with analysing the impact of a factor endowment shock on sectoral production, as developed in the Rybczynski theorem. (Rybczynski, 1955) investigated the effect of an increase in the quantity of a factor on production, consumption and the terms of trade in a simple production model and found that an increase in the quantity of one factor leads to a worsening in the terms of trade or the relative price, of the commodity using relatively much of that factor. This conclusion, that came to be known as the Rybczynski theorem, is generalized to deriving the impacts of an endowment shock on sectoral production. For the rest of this chapter, the Rybczynski theorem is referred to as the 'R theorem'.

To contextualize the analysis, the equations of change demonstrating the 'R theorem' are formally derived first and then a factor endowment shock, in the form of improvements in the health status of the labour force, is analysed. From equations (2.3) to (2.6), the input-output coefficients are a function of relative factor prices only and from equation (2.11) and (2.12) factor prices solely depend on relative product prices. This means in equilibrium, factor prices and product prices can be solved given the zero profit conditions. Given the full employment conditions, the equations of change are derived following a formulation similar to the one in (Jones, 1965). Therefore, the fraction of skilled labour used in Sector 1 and the fraction of skilled labour used in Sector 2 must add up to unity. As a result, equations (2.18) and (2.19) are written in terms of input-output coefficients (the unit factor demands):

$$a_{s1}X_1 + a_{s2}X_2 = \bar{S} \tag{2.21}$$

$$a_{l1}X_1 + a_{l2}X_2 = \bar{L} \tag{2.22}$$

From equations (2.3) to (2.6), $a_{qi} = a_{qi}\left(\frac{w_S}{w_L}\right)$, for $q = S, L$ and $i = 1, 2$ and total differentiation of (2.21) yields:

$$da_{S1}X_1 + da_{S2}X_2 + a_{S1}dX_1 + a_{S2}dX_2 = d\bar{S} \tag{2.23}$$

Further manipulation of (2.23) yields:

$$\hat{a}_{S1}\lambda_{S1} + \hat{a}_{S2}\lambda_{S2} + \lambda_{S1}\hat{X}_1 + \lambda_{S2}\hat{X}_2 = \hat{S} \tag{2.24}$$

where the accent ^ denotes the relative change, $\lambda_{Si} = S_i/S$ is the proportion of factor S used in sector i, and $\sum_i \lambda_{Si} = 1$.

Considering the small country assumption for Uganda, commodity prices do not change and factor prices remain constant so that $\hat{a}_{qi} = 0$ for all q, i . Therefore, equation (2.24) becomes

$$\lambda_{S1}\hat{X}_1 + \lambda_{S2}\hat{X}_2 = \hat{S} \tag{2.25}$$

Similar derivation is done for unskilled labour that yields the following equation:

$$\lambda_{l1}\hat{X}_1 + \lambda_{l2}\hat{X}_2 = \hat{L} \tag{2.26}$$

where $\lambda_{li} = L_i/L_i$ is the proportion of factor L used in sector i , and $\sum_i \lambda_{li} = 1.$

Changes in sector output can thus be derived as:

$$\hat{X}_1 = \frac{\lambda_{L2}\hat{S} - \lambda_{S2}\hat{L}}{|\lambda|} \tag{2.27}$$

$$\hat{X}_2 = \frac{\lambda_{S1}\hat{L} - \lambda_{L1}\hat{S}}{|\lambda|} \tag{2.28}$$

where $|\lambda| = \lambda_{s1}\lambda_{l2} - \lambda_{l1}\lambda_{s2} = \lambda_{s1} - \lambda_{l1} > 0,$ assuming that Sector 1 employs skilled labour more intensively relative to Sector 2. Therefore, the share of skilled labour in Sector 1 is greater than skilled labour share in Sector 2 and the percentage of skilled labour in Sector 1 exceeds the percentage of total unskilled labour employed in Sector 1.

To solve for proportional changes in factor endowments, equations (2.27) and (2.28) are expressed as:

$$\hat{X}_1 - \hat{S} = \frac{\lambda_{S2}(\hat{S} - \hat{L})}{|\lambda|} > 0 \tag{2.29}$$

$$\hat{L} - \hat{X}_2 = \frac{\lambda_{L1}(\hat{S} - \hat{L})}{|\lambda|} > 0 \quad (2.30).$$

Equations (2.29) and (2.30) suggest that at constant commodity prices, if the endowment of skilled labour is expanding more rapidly than unskilled labour ($\hat{S} > \hat{L}$), output intensive in the use of skilled labour, that is to say, (X_1) expands at a greater rate than either factor and the output from Sector 2 (X_2) will grow more slowly (if at all) than either factor. This relationship is captured by the following inequalities:

$$\hat{X}_1 > \hat{S} > \hat{L} > \hat{X}_2 \tag{2.31}$$

Similarly, if the endowment of unskilled labour expands more rapidly than skilled labour ($\hat{L} > \hat{S}$), the resulting inequalities will be:

$$\hat{X}_2 > \hat{L} > \hat{S} > \hat{X}_1 \tag{2.32}$$

This is what is commonly referred to as the *magnification effect* of factor endowments on commodity outputs at constant commodity prices.

If both factor endowments expand at the same rate, that is to say, ($\hat{S} = \hat{L}$), both sector commodity outputs will increase at identical rates hence the following equation:

$$\hat{X}_2 = \hat{L} = \hat{S} = \hat{X}_1 \tag{2.33}$$

Equations (2.31) and (2.32) illustrate that expanding one factor more than the other will increase the output of the sector that uses the rapidly expanding factor intensively relative to other sectors.

The case where only one factor expands while the other remains constant, that is to say, where $(\hat{S} > 0, \hat{L} = 0)$ so that $X_1 > \hat{S}$ and $\hat{X}_2 < 0$, illustrates a different result from the above case. Therefore, at constant commodity prices, an increase in one factor, while the other factor is held constant, results in an absolute decline in the commodity intensive in the use of the constant factor. In this case, if only the pool of skilled labour rises while that of unskilled labour remains constant, the commodity output intensive in skilled labour will expand while the output intensive in unskilled labour will decline.

The standard 'R theorem' assumes all labour is well and healthy and thus fully employed. Therefore, assuming all other factors remain constant[22], a change in the health status of a population is positively correlated with the endowment of effective labour. Consequently, the effect of a change in population health status on output is consistent with the derived impacts of a change in factor endowment in the 'R theorem'. If health improves for skilled labour (unskilled) relative to unskilled (skilled) labour types, the magnification effects in equations (2.31) and (2.32) are observed. Similarly, if the health improvement is uniform for all labour types, balanced growth effects are obtained, as in equation (2.33).

However, in the real world, there will always be a section of the labour force that is unwell and unable to work at a given time. The theoretical foundation of the health effects on labour force participation rates and labour productivity is grounded in Grossmans model of health production (Grossman, 1972). He argues that an individual's stock of health determines the total amount of time that individual can spend producing money earnings and commodities. Assuming that illness (unwell) prevents people from engaging in productive activities while

[22] At this point we ignore the cost of reaching the given health status and resource claims made by the health sector as will be demonstrated later in this section.

healthy (well) promotes wellness so that people engage in productive activities. This means that $Q_L = f(U_L, H_L)$, where Q_L is fixed total labour in the economy, U_L is labour that is unwell (ill and unable to work effectively), and H_L is well (healthy) labour.

Introducing the impact of illness on effective labour endowments generates results that differ from the standard 'R theorem'. The standard 'R theorem' implies that a change in factor endowment leads to a corresponding change in value of output and, presumably has a negligible effect on per capita income when factor endowments changes are similar across factors. Alternatively, if factor endowment changes are identical (at given world prices), factor incomes (given the wage rates) and the value of output will change in the same proportion, so that per capita incomes remain unchanged.

However, if an illness strikes a section of the labour force so that they are unable to work, it means the illness reduces the number of people able to work so that the factor income for the un-well and the value of output will fall. Although some of the un-well are unable to work and therefore not earning an income, they are, nevertheless, consuming commodities for which they have to pay. Assuming a re-distribution mechanism so that income of the able-to-work is partly transferred to the un-well to cater for their consumption, the per capita income will fall eventually. In this respect, the standard 'R theorem' results differ[23]. The analysis shows that whereas a uniform improvement in health across all labour types does not affect the ratio of per capita income changes among sections of the working population, it generates an overall increase in per capita income. Moreover, selective treatment of ill health among different categories of labour will increase or decrease the per capita income. If, for instance,

[23] Refer to (Rutten, 2004) for a derivation of the discrepancy between the standard 'R theorem' and the analysis of the impact of illness on effective endowment changes with respect to per capita income.

the health improvement is higher for skilled labour relative to unskilled labour, that is to say, $\hat{S}_H > \hat{L}_H > 0$ the per capita income of the working population will rise. On the other hand, when $(\hat{L}_H > \hat{S}_H > 0)$, the per capita income of the working population will fall. Although this result suggests that if the government aims to raise the per capita income, it could improve the health of the entire population but with a bias towards skilled labour; it raises an ethical question as to whether it is morally correct to target a section of the population relative to the other.

2.4.3 Public healthcare provision in the low dimension H-O model

In this analysis, healthcare is considered to be provided by the government as a public good. In order for the government to provide healthcare it must produce it using government income to purchase the inputs for production. Therefore, the consequences of government production of healthcare and the imposition of a tax to fund healthcare provision are analysed.

Since the health sector is not tradable, the healthcare output enters the model to represent an expansion of the health sector (G) which competes for resources with the tradable sectors (skill intensive Sector 1 and unskilled intensive Sector 2). As a result, when government expands healthcare production it uses the factor inputs in the economy so that quantities of these factors available to other sectors are reduced. Introducing the health sector entails modification of the standard HO model to account for the consumption of a government provided public good. In the commodity markets, healthcare consumed is equivalent to the quantity of healthcare that government provides with a given approved health budget so that:

$$C_G = X_G \tag{2.34}$$

where C_G is the consumption of the healthcare good from health sector G and X_G is the quantity of healthcare output that can be purchased by government at a given health sector budget[24].

On the production side, a representative producer of the healthcare output X_G minimises costs and assuming constant returns to scale in the production process, the input-output coefficients for healthcare are represented as:

$$a_{SG} = a_{SG}(w_S/w_L) \tag{2.35}$$

$$a_{LG} = a_{LG}(w_S/w_L) \tag{2.36}$$

where $a_{SG} = S_G/X_G$, $a_{LG} = L_G/X_G$, S_G and L_G are the quantities of skilled and unskilled labour respectively, employed by the health sector whose skilled to unskilled ratio is higher than Sector 1 and Sector 2 i.e. $a_{SG}/a_{LG} > a_{S1}/a_{L1} > a_{S2}/a_{L2}$. Note that the assumption for the health sector as the most skill intensive of the three sectors implies that the ordering of the

[24]Although the healthcare budget is exogenously determined, for the purpose of this analysis it is assumed that the government has no control over the prices of the general equilibrium system so that it employs its factors at the market wage/rental rate and provides the healthcare output at the market prices. The market price pertains to the government and represents the cost of producing a unit of healthcare output (and not the price to the consumer because healthcare is free of charge to the consumer). The cost of healthcare is transmitted through a lump-sum tax on the consumer, considered in the section analysing the second part of the analysis of the consequences of government provision of healthcare in the general equilibrium.

factor intensities is contrary to the standard H-O model which assumes that the non-traded sector factor intensity lies between that of the two tradable sectors.

The total demands for skilled and unskilled labour by the government health sector are given by the product of the input-output coefficients and the health sector output:

$$S_G = a_{SG} X_G \tag{2.37}$$

$$L_G = a_{LG} X_G \tag{2.38}$$

The price of healthcare to the government is given by the cost of producing a unit of healthcare output. Therefore, the equivalent zero-profit condition for government healthcare is given as:

$$P_G = w_S a_{SG} + w_L a_{LG} \tag{2.39}$$

The full employment condition with the government health sector introduced in the model, in addition to the tradable Sectors 1 and 2 is given as:

$$S_G + S_1 + S_2 = S_H = S - S_U \tag{2.40}$$

$$L_G + L_1 + L_2 = L_H = L - L_U \tag{2.41}$$

where S_H and L_H are the endowments of skilled and unskilled labour that are healthy and able to work while S_U and L_U are unwell (waiting to be treated) and unable to work.

Consequently,

$$S_U = S_U(S_G,\ S_U^0, \beta_S S) \qquad \partial S_U/\partial S_G = S'_U(S_G,\ S_U^0,\ \beta_S S) < 0 \qquad (2.42)$$

$$L_U = L_U(L_G, L_U^0, \beta_L L) \qquad \partial L_U/\partial L_G = L'_U(L_G, L_U^0, \beta_L L) < 0 \qquad (2.43)$$

where S_U^0 and L_U^0 refer to initial numbers of the un-well skilled and unskilled labour respectively, β_S and β_L are the given illness rates for skilled and unskilled labour respectively, and S'_U and L'_U are decreasing functions of healthcare output. Note that the decreasing function in healthcare output implies the proportion of the un-well reduces at a decreasing rate, but it does not necessarily become negative.

2.4.4 The impact of a lump-sum tax in the H-O model with the health sector

The second part in the analysis of the consequences of government healthcare provision in the two-sector model pertains to how government raises its revenue to finance the health expenditure and balance the budget. Assume the government healthcare subsidy is financed by a non-distortionary lump-sum tax[25] on the consumer's income. This means the household income, derived from the three sectors, and after payment of the lump-sum tax is given by:

[25] A lump-sum tax does not change the relative prices of the model implying that although the consumer's disposable income is reduced, the prices of the factor services a consumer is to offer, and the prices of the commodities a consumer can buy, are not affected by the tax. It is non-distortionary because imposing the tax will not lead to substitution of one good for another in the consumer's expenditure decisions. Although it can contextually be referred to as an income tax, income taxes can sometimes be distortionary if they lead individuals to substitute work for leisure and vice versa. However, since this analysis assumes full employment, so that quantities of factor endowments are fixed, the term lump-sum tax can be used synonymously with income tax.

$$Y = w_S(S_1 + S_2 + S_G) + w_L(L_1 + L_2 + L_G) - T \qquad (2.44)$$

where T corresponds to the level of tax revenue required by the government to finance healthcare expenditure and t_y is the tax rate, that is to say, $T = t_y$.

The health subsidy is, in effect, a government transfer of resources from households in the form of taxation and it represents the cost of providing public healthcare. It is, therefore, the product of the quantity of healthcare output (X_G) and the unit cost of healthcare provision(P_G) denoted as:

$$T = P_G \,.\, X_G \qquad (2.45)$$

Table 2.2 The equations of the H-O Model with healthcare

COMMODITY MARKETS		
Demand	$C_1 = C_1(P_1, P_2, Y)$	(2.1)
	$C_2 = C_2(P_1, P_2, Y)$	(2.2)
	$C_G = X_G$	(2.34)
Unit price equations $(i = 1, 2, G)$	$P_i = w_S a_{Si} + w_L a_{Li}$	(2.11), (2.12), (2.39)
Market clearing	$C_1 = X_1 - E_1$	(2.13)
	$C_2 = X_2 + M_2$	(2.14)
FACTOR MARKETS		
Demand $(i = 1, 2,\ G)$	$a_{Si} = a_{Si}(w_S/w_L)$	(2.3), (2.4), (2.35)
	$a_{Li} = a_{Li}(w_S/w_L)$	(2.5), (2.6), (2.36)
	$S_i = a_{Si}(w_S/w_L) = a_{Si}X_i$	(2.7), (2.8), (2.37)
	$L_i = a_{Li}(w_S/w_L) = a_{Li}X_i$	(2.9), (2.10), (2.38)
Market clearing	$S_G + S_1 + S_2 = S_H = S - S_U$	(2.40)
	$L_G + L_1 + L_2 = L_H = L - L_U$	(2.41)
Waiting lists	$S_U = S_U(S_G,\ S_U^0,\ \beta_S S)$,	(2.42)
	$\partial S_U/\partial S_G = S_U'(S_G,\ S_U^0,\ \beta_S S) < 0$	
	$L_U = L_U(L_G,\ L_U^0,\ \beta_L L)$	(2.43)
	$\partial L_U/\partial L_G = L_U'(L_G,\ L_U^0,\ \beta_L L) < 0$	
HOUSEHOLD INCOME		
	$Y = w_S(S_1 + S_2 + S_G) + w_L(L_1 + L_2 + L_G) - T$	(2.44)
	$T = P_G \,.\, X_G$	(2.45)
FOREIGN SECTOR		
Price equations	$p_i = F\mu_i$	(2.15), (2.16)
Balance of Payments constraint		
	$\pi_1 E_1 - \pi_2 M_2 = 0$	(2.17)

Endogenous variables

$C_1, C_2, C_G, X_1, X_2, X_G, S_1, S_2, S_U, S_G, L_1, L_2, L_U, L_G, a_{S1}, a_{S2}, a_{SG}\ a_{L1}, a_{L2}, a_{LG}\ p_1, p_2, p_G,$

$w_s, w_l, w_G, Y, E_1, M_2, F$

Exogenous variables

$\bar{S}, \overline{L},\ \mu_1,\ \mu_2,\ \ \beta_S,\ \beta_L\ S_U^0, L_U^0,\ T$

2.4.5 The 'R theorem' and the H-O model with the health sector

Given factor prices, the quantity of each factor employed per of unit output, a_{qi} in a given sector i will be determined by the ratio of the factor prices (w_S) and w_L for skilled and unskilled labour respectively so that, if (X_i) is the output (X) of sector (i), then the full employment equations (2.40) and (2.41) can be rewritten for the three sectors $(G, 1, 2)$ as:

$$a_{SG}.X_G + a_{S1}.X_1 + a_{S2}.X_2 = S_H = S - S_U \quad (2.46)$$

$$a_{LG}.X_G + a_{L1}.X_1 + a_{L2}.X_2 = L_H = L - L_U \quad (2.47)$$

where $a_{qi} = a_{qi}(w_S/w_L)$ for $q = S, L$ and $i = 1, 2, G$

Adopting the small country assumption so that factor prices (w_S) and (w_L) hence factor intensities, are exogenously determined and totally differentiating (2.46) and (2.47) yields:

$$\lambda_{SG} \cdot \hat{X}_G + \lambda_{S1} \cdot \hat{X}_1 + \lambda_{S2} \cdot \hat{X}_2 = \hat{S}_H \quad (2.48)$$

$$\lambda_{LG} \cdot \hat{X}_G + \lambda_{L1} \cdot \hat{X}_1 + \lambda_{L2} \cdot \hat{X}_2 = \hat{L}_H \quad (2.49)$$

where $\lambda_{Si} = a_{Si} \cdot {}^{X_i}/_{S_H}$, $\lambda_{Li} = a_{Li} \cdot {}^{X_i}/_{L_H}$, $\sum_i \lambda_{Si} = \sum_i \lambda_{Li} = 1$ and $\hat{X}_i = dX_i/X_i$.

The effect of introducing the non-tradable health sector is that it expands the factor endowments available for the tradable sectors by reducing the units of labour that are unwell (ill and unable to work) thereby expanding the effective labour supply in the economy. Assume, for simplicity, that the skill ratio in the health sector is synonymous with the skill mix in the rest of the economy. Further, assume that the marginal benefit from healthcare is uniform for all types of labour. Healthcare-specific labour is fixed in the short run because it takes a relatively longer time to acquire the healthcare-specific skills. This means that health sector expansion in the short run, using domestic labour, is only possible by expanding the unskilled labour employment in the health sector. Consequently, the marginal product of skilled labour in the health sector and, therefore, skilled labour wages rise relative to unskilled labour wages.

While health sector expansion means that unskilled labour will be drawn away from the tradable sectors to the health sector, it also means that higher outputs of healthcare are made available so that both skilled and unskilled labour expand and become available to the tradable sectors. The overall skilled labour available to tradable sectors will increase and consequently the skill-intensive sector outputs will expand. Supply of unskilled labour to the tradable sectors will increase if the rate of change in health status (from healthcare treatment) is greater than the rate of employment of unskilled labour in the health sector. Consequently, the output from the unskilled intensive sectors will increase (decrease) depending on the extent to which the supply of unskilled labour can offset the reducing effects of increased supply in skilled labour. Therefore, if H_L increases (i.e., improved health for both skilled and unskilled labour), as a result of expanding the health sector in the short run using domestic labour, the result is synonymous with equation (2.31), where output increase from the unskilled labour intensive sectors is slower than either factor.

On the other hand, if the health sector expansion occurs over a long run period so that the use of both skilled and unskilled labour can be increased from the domestic resource base, the healthcare output increases the factor endowments of skilled labour while unskilled labour does not change. Assume the expansion of the health sector does not change the skill mix. An increase in skilled labour endowment in the health sector implies an increase in availability of healthcare services. Conversely, if the input mix in the healthcare sector does not change, the only way to employ the additional skilled labour endowment is to expand the healthcare services delivery. Consequently, the factor endowment change from the health effect will be larger for skilled labour while unskilled labour remains unchanged. As a result, commodity output for the skilled intensive sectors will increase faster while that of unskilled intensive factor sectors declines. This is synonymous with the result in equation (2.32).

2.4.6 The impact of increasing public healthcare expenditure in the H-O model

From equation (2.45) a change in government health expenditure is represented as:

$$\hat{T} = \hat{P}_G \, . \hat{X}_G .$$

The unit cost of healthcare production is determined by the ratio of factor prices so that:

$$P_G = w_S \, . \, a_{SG} + w_L \, . \, a_{LG} \qquad (2.51)$$

Since wages are exogenously determined, $\hat{P}_G = 0$ so that the equation of change for government health expenditure becomes $\hat{T} = \hat{X}_G$. Substituting the health expenditure output change equation into the factor employment equations (2.48) and (2.49) we can solve for the full employment output changes as:

$$\hat{X}_1 = \frac{1}{|\lambda|}\left(\lambda_{L2}\,.\hat{S}_H - \lambda_{S2}\,.\hat{L}_H\right) + (\lambda_{LG}\,.\lambda_{S2} - \lambda_{SG}\,.\lambda_{L2}).\frac{\hat{T}}{|\lambda|} \qquad (2.52)$$

$$\hat{X}_2 = \frac{1}{|\lambda|}\left(\lambda_{S1}\,.L_H - \lambda_{L1}\,.\hat{S}_H\right) - (\lambda_{S1}\,.\lambda_{LG} - \lambda_{SG}\,.\lambda_{L1}).\frac{\hat{T}}{|\lambda|} \qquad (2.53)$$

where $|\lambda| = \lambda_{S1}.\lambda_{L2} - \lambda_{S2}.\lambda_{L1} > 0$ given that Sector 1 uses relatively more skilled labour compared to Sector 2.

A change in government health expenditure will generate changes in the healthcare output so that there will be changes in the healthy component of both skilled and unskilled labour factors. Since the total factor endowment of skilled (unskilled) labour is fixed, a health output change generates a change in "healthy" labour that is negatively correlated with a change in the "un-well" labour component. For a given endowment of skilled labour, the healthy and able to work are given by the residual after accounting for the unwell and unable to work $S_H = S - S_U$, so that $dS = 0$ and a change in health output, dX_G leads to a change in S_H in the form $dS_H = -dS_U$. This means that as healthcare output increases, more people are treated and are able to join the healthy and able to work while the number of the un-well declines. An implicit assumption is that healthcare is effective in treating and curing the unwell so that they can return to work.

The contribution of the healthcare output to changes in the quantity of healthy skilled workers will depend on the rate of change in the number of the un-well skilled workers brought about by changes in healthcare. Therefore, $dS_H = \frac{-\partial S_U}{\partial X_G}.dX_G = \left(-\frac{\partial S_U}{\partial X_G}.\frac{X_j}{S_U}\right).\frac{dX_G}{X_G}.S_U$ where the term in brackets denotes the rate of change in the unwell skilled labour with respect to changes in health output, that is to say, the elasticity of skilled labour waiting to be treated, σ_G^S . A similar treatment for unskilled labour yields the elasticity of unskilled labour waiting to be treated, σ_G^L , so that the equations of change in healthy skilled (unskilled) labour are obtained by dividing through by S_H (and L_H) and presented in equations (2.54) and (2.55):

$$\hat{S}_H = \sigma_G^S.\partial_{SU}.\hat{X}_G \qquad (2.54)$$

$$\hat{L}_H = \sigma_G^L.\partial_{LU}.\hat{X}_{jG} \qquad (2.55)$$

where $\partial_{SU} = S_U/S_H > 0$ and $\partial_{LU} = L_U/L_H > 0$ denotes the ratio of unwell to healthy labour for skilled and unskilled labour respectively. The term, ∂_{iU} (for $i = S, L$), is referred to as the "dependency ratio" (borrowing from (Rutten, 2004)). The dependency ratio signifies the proportion of labour that is on the "waiting list" for treatment. Therefore, the elasticity of effective (healthy) labour endowments available in the economy will depend on the waiting list parameter for labour $(i = S, L), \sigma_G^i,$ and the dependency ratio $\partial_{iU},$ as well as changes in healthcare output.

Substituting the equations of change for healthy and effective labour (2.54) and (2.55) into the output equations of change (2.52) and (2.53), and maintaining the small country assumption so that $\hat{T} = \hat{X}_G$ we obtain:

$$\hat{X}_1 = (\lambda_{L2} . \sigma_G^S . \partial_{SU} - \lambda_{S2} . \sigma_G^L . \partial_{LU} + \lambda_{LG} . \lambda_{S2} - \lambda_{SG} . \lambda_{L2}) . \frac{\hat{T}}{|\lambda|} \qquad (2.56)$$

$$\hat{X}_2 = (\lambda_{S1} . \sigma_G^L . \partial_{LU} - \lambda_{L1} . \sigma_G^S . \partial_{SU} - \lambda_{S1} . \lambda_{LG} + \lambda_{SG} . \lambda_{L1}) . \frac{\hat{T}}{|\lambda|} \qquad (2.57)$$

If, in the extreme event, the healthcare output does not affect the proportion of the un-well labour at all (that is, treatment is not effective in healing the unwell), so that $\left|\sigma_G^S . \partial_{SU}\right| = |\sigma_G^L . \partial_{LU}| = 0$, then the health sector affects the labour market only via the resource claims it makes. Consequently, the equations of change in (2.56) and (2.57) become:

$$\hat{X}_1 = (\lambda_{LG} . \lambda_{S2} - \lambda_{SG} . \lambda_{L2}) . \frac{\hat{T}}{|\lambda|} \qquad (2.58)$$

$$\hat{X}_2 = (\lambda_{SG} . \lambda_{L1} - \lambda_{S1} . \lambda_{LG}) . \frac{\hat{T}}{|\lambda|} \qquad (2.59).$$

The expressions in (2.58) and (2.59) identify the "factor-bias-effect" of increasing healthcare output which is ineffective in treating people. The expressions represent the impact of a healthcare subsidy on output assuming the health sector impacts the labour market only through the resource claims it makes in the economy. The rest of the expressions in equations (2.56) and (2.57) represent the "scale-effect" of a change in healthcare output which is directly dependent on the factor intensities in the tradable Sector 1 and Sector 2 represented as:

$$\hat{X}_1^R = (\lambda_{L2} \,.\, \sigma_G^S . \partial_{SU} - \lambda_{S2} \,.\, \sigma_G^L . \partial_{LU}) \frac{\hat{T}}{|\lambda|} \tag{2.60}$$

$$\hat{X}_2^R = (\lambda_{S1} \,.\, \sigma_G^L . \partial_{LU} - \lambda_{L1} \,.\, \sigma_G^S . \partial_{SU}) \frac{\hat{T}}{|\lambda|} \tag{2.61}$$

where the superscript R denotes a change brought about by the scale-effects of healthcare output.

The extent of the impacts on output generated by the derived factor effect and scale-effect in the HO model with non-tradable health sector is influenced by the factor intensities in the health sector and the skill intensive sector relative to the effective factor endowment in the economy. Two cases of relative factor intensities are identified for illustration. Case 1 describes a situation where the health sector is the most skill intensive in the economy and the economy-wide endowment ratio of skilled labour is less than the skill intensity in both the health sector and Sector 1, that is to say, $S_G > S_1 > S > S_2$. Case 2 describes a situation where the health sector is the most skill intensive but skilled labour endowment is relatively higher than the skill intensity in Sector 1 and Sector 2, that is to say, $S_G > S > S_1 > S_2$. The factor-bias-effect is first derived for the two cases of factor intensities to illustrate the factor effect of a health sector expansion on the production of other sectors in the economy. The combined effect (factor bias and scale-effect) is then derived as the overall impact of increasing the health budget.

2.4.7 Factor bias impacts of health sector expansion

When government increases healthcare expenditure so that $\hat{T} > 0$, the health sector, which is assumed to be the most skill intensive in the economy, draws skilled labour from the economy so that the output for the traded skill labour intensive Sector 1 will fall while that of tradable unskilled labour intensive Sector 2 will increase. The extent of the factor-bias-effect of healthcare output will depend on whether the tradable goods sector intensive in the use of skilled labour, has a skilled-unskilled labour ratio greater or less than the effective endowment ratio.

Case 1: $\boldsymbol{S_G} > \boldsymbol{S_1} > S > \boldsymbol{S_2}$

This case assumes the health sector is the most skill intensive sector implying that $\frac{\lambda_{SG}}{\lambda_{LG}} > \frac{\lambda_{S2}}{\lambda_{L2}}$ or $(\lambda_{SG}\lambda_{L2} - \lambda_{S2}\lambda_{LG}) > 0$, and $(\lambda_{SG}\lambda_{L1} - \lambda_{S1}\lambda_{LG}) > 0$ so that from equation (2.56) $\hat{X}_1 < 0$ and from equation (2.57) $\hat{X}_2 > 0$.

This means that when the health sector expands (given that it is the most skill intensive), the output for the skill intensive Sector 1 declines while output increases for the sector that is intensive in the use of unskilled labour (Sector 2). Subtracting $\hat{X}_2$ from $\hat{T}$ yields:

$$\hat{T} - \hat{X}_2 = \hat{T}\left[\frac{\lambda_{S1}(\lambda_{LG}+\lambda_{L2})-\lambda_{L1}(\lambda_{SG}+\lambda_{S2})}{|\lambda|}\right] \quad (2.62).$$

Recall that $\lambda_{LG} + \lambda_{L2} = 1 - \lambda_{L1}$ and $\lambda_{SG} + \lambda_{S2} = 1 - \lambda_{S1}$ so that equation (2.62) can be simplified to:

$$\hat{T} - \hat{X}_2 = \hat{T}\ (\frac{\lambda_{S1} - \lambda_{L1}}{|\lambda|}) \qquad (2.63).$$

Since $S_G > S$ implies that $\lambda_{S1} - \lambda_{L1} > 0$, it follows that $\hat{T} > \hat{X}_2$. Therefore, if $S_G > S_1 > S_E > S_2$ an increase in government healthcare budget, $\hat{T} > 0$, implies that $\hat{T} > \hat{X}_2 > 0 > \hat{X}_1$.

Intuitively, as the health budget increases more units of both skilled labour and unskilled labour are drawn from the available pool in the economy into the health sector to produce the expanding healthcare services. This means the amount of labour available to other sectors in the economy falls and the skilled to unskilled labour ratio falls since the health sector is taking relatively higher units of skilled labour. Consequently, the output of skill intensive sectors declines while the output of sectors intensive in unskilled labour grows slowly. This case of factor intensity ordering is a likely reflection of developing country economies like Uganda where skilled labour is generally scarce. In a situation of scarce skilled labour, the factor-bias-effect demonstrates that increasing the healthcare budget, thus expanding healthcare delivery may lead to a reduction in the overall output in the economy since the skilled intensive sectors output declines while the unskilled intensive sectors output grows slowly.

Case 2 $S_G > S > S_1 > S_2$

This case assumes the health sector is the most skill intensive but differs from Case 1 in that the economy wide endowment of skilled labour is greater than the skill intensity in Sector 1.

If the skilled labour endowment is deemed greater than the skill intensity in Sector 1, that is to say, $S > S_1$, then $\lambda_{S1} - \lambda_{L1} < 0$ so that from equation (2.62) $\widehat{X}_2 > \widehat{T}$ and that an increase in the government health budget will imply $\widehat{X}_2 > \widehat{T} > 0 > \widehat{X}_1$.

As the health sector expands it draws labour from the relatively abundant skilled labour endowment and less units of the unskilled labour so that more quantities of unskilled labour units are available to the rest of the economy compared to Case 1. In other words, an increase in the healthcare budget leads to a more than proportionate change in the output of the sector relatively intensive in unskilled labour if the skilled labour endowment is greater than the skill intensity in the Sector 1. This case of factor intensity ordering is likely to mirror developed countries where skilled labour is relatively abundant.

2.4.8 Factor-bias and scale-effects: homogenous health and treatment

The overall effect of health sector expansion on the outputs of the tradable Sector 1 and Sector 2 combines the factor effect and the scale-effects as depicted in equations (2.56) and (2.57). To incorporate the scale-effects, assumptions are made about the health status, consumption of the healthcare output and the effectiveness of the treatment for the different categories of labour. For simplicity, it is assumed that all labour types are homogenous in health and treatments. This assumption means that all labour types may be afflicted by the same illness and the proportion of the un-well is the same across all labour types.

Consequently, the un-well require the same type of healthcare treatment and the treatment is equally effective in treating all the un-well[26].

The simplifying assumptions have implications for the specified H-O model with health effects and the derivation of the 'R theorem'. The H-O model with health effects specification in equations (2.42) and (2.43) are simplified to reflect the illness rate and the number of the un-well as equal, for unskilled and skilled labour, i.e., $\beta_S S = \beta_L L$ and $S_U = L_U$. Similarly for the derivation of the R theorem $|\sigma_G^S| = |\sigma_G^L| = \sigma > 0$ and $\partial_{SU} = \partial_{SU} = \partial > 0$ so that equations (2.56) and (2.57) become:

$$\hat{X}_1 = [\partial\sigma(\lambda_{L2} - \lambda_{S2}) + (\lambda_{LG} \,.\, \lambda_{S2} - \lambda_{SG} \,.\, \lambda_{L2})]\frac{\hat{T}}{|\lambda|} \qquad (2.64)$$

$$\hat{X}_2 = [\partial\sigma(\lambda_{S1} - \lambda_{L1}) + (\lambda_{SG} \,.\, \lambda_{L1} - \lambda_{S1} \,.\, \lambda_{LG})]\frac{\hat{T}}{|\lambda|} \qquad (2.65)$$

Consequently the factor-bias effect and scale-effects of health sector expansion are respectively given by:

$$\hat{X}_1^F = [(\lambda_{LG} \,.\, \lambda_{S2} - \lambda_{SG} \,.\, \lambda_{L2})]\frac{\hat{T}}{|\lambda|} \qquad (2.66)$$

[26] The assertion of labour being homogenous in health and treatment is a simplifying assumption to allow for the derivation of scale-effects in the HO model. Otherwise, it is likely that different types of labour possess different levels of health. For instance, in Uganda, unskilled labour is more likely to suffer from disease ailments compared to skilled labour, and also the effectiveness of treatments is likely to be higher among skilled labour compared to unskilled labour.

$$\hat{X}_2^F = [(\lambda_{SG} \, . \, \lambda_{L1} - \lambda_{S1} \, . \, \lambda_{LG})] \frac{\hat{T}}{|\lambda|} \qquad (2.67)$$

$$\hat{X}_1^R = [\partial\sigma(\lambda_{L2} - \lambda_{S2})] \frac{\hat{T}}{|\lambda|} \qquad (2.68)$$

$$\hat{X}_2^R = [\partial\sigma(\lambda_{S1} - \lambda_{L1})] \frac{\hat{T}}{|\lambda|} \qquad (2.69)$$

where $\hat{X}_1 = \hat{X}_1^F + \hat{X}_1^R$ and $\hat{X}_2 = \hat{X}_2^F + \hat{X}_2^R$.

Using the full employment factor intensity specification for skilled and unskilled labour in the health sector, $\lambda_{SG} = 1 - \lambda_{S1} - \lambda_{S2}$ and $\lambda_{LG} = 1 - \lambda_{L1} - \lambda_{L2}$, and recalling that $|\lambda| = \lambda_{S1}.\lambda_{L2} - \lambda_{S2}.\lambda_{L1} > 0$ for the assumption that skill intensity is relatively higher in Sector 1 compared to Sector 2, equations (2.64) and (2.65) can be simplified to:

$$\hat{X}_1 = [(\partial\sigma - 1)(\lambda_{L2} - \lambda_{S2}) + |\lambda|] \frac{\hat{T}}{|\lambda|} \qquad (2.70)$$

$$\hat{X}_2 = [(\partial\sigma - 1)(\lambda_{S1} - \lambda_{L1}) + |\lambda|] \frac{\hat{T}}{|\lambda|} \qquad (2.71)$$

In terms of proportionate changes in the government health budget, the equivalent equations are given as:

$$\hat{X}_1 = \frac{\hat{T}}{|\lambda|}(\partial\sigma - 1)(\lambda_{L2} - \lambda_{S2}) + \hat{T} \qquad (2.72)$$

$$\hat{X}_2 = \frac{\hat{T}}{|\lambda|}(\partial\sigma - 1)(\lambda_{S1} - \lambda_{L1}) + \hat{T} \qquad (2.73)$$

The intuition behind these equations is that an increase in the government healthcare budget $\hat{T} > 0$, in an HO model with healthcare generates a combined effect as follows. An expansion of the health sector, given that it is the most skill intensive sector, reduces the effective skilled labour units available to the rest of the economy so that the economy-wide skilled-unskilled labour ratio declines, while, at the same time, the proportion of the healthy and able to work labour increases uniformly for both skilled and unskilled labour. According to the 'R theorem', the skill intensive Sector 1 output and the other Sector 2 output may expand or shrink depending on whether the scale-effect dominates the factor-bias-effect or not.

There are several cases that can be evaluated to depict the dominating effect. These case will depend on the sign and magnitude of the elasticity parameter (representing change in the un-well labour brought about by a change in healthcare output), and the ranking of the skill intensities in the three sectors[27]. Two cases are presented here to highlight the probable production equilibrium outcomes given factor intensities and variation in the magnitude of the healthcare impact. That is to say, Case 1 identifies factor intensities where the health

[27] See (Rutten, 2004) for an elaborate presentation of different combinations of the factor intensities with the different values of the elasticity parameter (i.e. the elasticity of effective endowment with respect to healthcare). The author demonstrates that given factor intensity ordering between the health sector and the tradable sectors, and the effective labour endowment, an increase in the healthcare budget with very small values of the elasticity of effective labour endowment with respect to healthcare, generates a factor-bias-effect dominated output expansion (i.e. leads to smaller proportionate changes in total output of the tradable sectors). However, as the elasticity value increases, proportionate changes in total output of the tradable sectors increase to the extent that large elasticity values generate proportionate changes in output that are larger than the proportionate change in the healthcare budget.

sector is the most skilled sector in the economy and the skill intensive Sector 1 factor intensity is greater than the economy-wide skilled labour endowment, and the magnitude of elasticity of effective labour endowment brought about by changes in healthcare output is small (that is to say, positive but less than one). In Case 2, the ordering of the factor intensities is similar to Case 1 but the magnitude of elasticity of effective labour endowments with respect to healthcare output is greater than one.

The magnitude of the health impact in Case 1 identifies with developed countries where the burden of disease is low and the healthcare system, in addition to the health status of the population, is relatively small given that the starting point is already high (that is to say, well-developed health systems). On the other hand, Case 2 elasticity of effective labour endowment with respect to healthcare identifies with developing countries, like Uganda, where the burden of disease is high and life expectancy is low. There is evidence suggesting that, for developing countries like Uganda, an increase in public healthcare services is likely to generate large improvements in the health status of the population and the labour force in particular (see, for example, Bokhari et al (2007), Maruthappu et al (2015) Bidani & Ravallion (1997) and Anand & Ravallion (1993)[28]. Bokhari et al (2007) find that government spending contributes significantly to health outcomes and for Uganda, the elasticity of under-five mortality and maternal mortality with respect to government health expenditures is -0.3189 and -0.4979 respectively.

[28] Despite the recent evidence, some writers have argued against the positive impact of public health expenditure and the subsequent health services expansion on health outcomes (see, for example, Filmer & Pritchet (1999)). The critiques argue that all elements of a chain in public health expenditure must exist in order for government health spending to be effective in improving health outcomes. They contend that missing any of the elements in the chain, for example if the public spending does not create effective health services, could render the public spending ineffective. Nevertheless, no studies have yet refuted the growing recent evidence of the positive impact of government health services expansion on health outcomes. Moreover, this study does not take into account the general equilibrium effects of such public health expenditure.

Case 1: $\boldsymbol{S_G} > \boldsymbol{S_1} > S > \boldsymbol{S_2}$ and $1 - \frac{|\lambda|}{(\lambda_{L2} - \lambda_{S2})} = \frac{\lambda_{SG}.\lambda_{L2} - \lambda_{S2}.\lambda_{LG}}{\lambda_{L2} - \lambda_{S2}} < \partial\sigma < 1$[29]

The first condition in Case 1 specifies the factor intensity indicating that the health sector uses skilled labour more intensively compared to Sector 2, so that $\frac{\lambda_{SG}}{\lambda_{LG}} > \frac{\lambda_{S2}}{\lambda_{L2}}$ or $(\lambda_{SG}\lambda_{L2} - \lambda_{S2}\lambda_{LG}) > 0,$ and from equation (2.66) $\hat{X}_1^F < 0.$ Similarly, the health sector skill intensity is greater than Sector 1 so that $\frac{\lambda_{SG}}{\lambda_{LG}} > \frac{\lambda_{S1}}{\lambda_{L1}}$ or $(\lambda_{SG}\lambda_{L1} - \lambda_{S1}\lambda_{LG}) > 0,$ and from equation (2.67) $\hat{X}_2^F > 0.$ Furthermore, the skill intensity in Sector 1 is greater than the economy-wide effective skilled-unskilled ratio, implying that $\lambda_{S1} - \lambda_{L1} > 0$, and from equation (2.69) $\hat{X}_2^R > 0$. Consequently, the change in output of Sector 2 is positive, that is to say, $\hat{X}_2 = \hat{X}_2^F + \hat{X}_2^R > 0.$

On the other hand, the skill intensity in Sector 2 is smaller than the skilled-unskilled effective endowment ratio of skilled labour, implying that $\lambda_{L2} - \lambda_{S2} > 0$, and from equation (2.68) $\hat{X}_1^R > 0.$ Given the factor intensity rankings (the first condition in Case 1), the output for Sector 2 increases while the change in output of Sector 1 will depend on the whether the scale-effect dominates the factor-bias-effect. The magnitude of the elasticity of effective labour with respect to healthcare output (the second condition in Case 1), determines the change in output of the skill intensive Sector 1.

[29] Note that derivation of the lower bound for $\partial\sigma$ can be derived from either equation (2.64) or (2.70) by setting $\hat{X}_1 > 0$).

The proportionate changes in government healthcare expenditure relative to the proportionate changes in output of Sector 2 are compared to assess whether the former exceeds the later. Therefore, using equation (2.73) $\hat{X}_2$ is subtracted from $\hat{T}$ to obtain:

$$\hat{T} - \hat{X}_2 = \hat{T}\ \left[\frac{(1-\partial\sigma)(\lambda_{S1}-\lambda_{L1})}{|\lambda|}\right] \qquad (2.74).$$

From the factor intensity specification in case 1, $(\lambda_{S1} - \lambda_{L1}) > 0$ and from the elasticity specification in the second condition of Case 1, $\partial\sigma < 1$ implying that equation (2.74) yields a positive result, that is to say, $\hat{T} - \hat{X}_2 > 0$.

From equation (2.73), the elasticity parameter in the second condition of Case 1 defines the direction of change in output of Sector 1. That is to say, given equation (2.70),

$\partial\sigma > 1 - \frac{|\lambda|}{(\lambda_{L2}-\lambda_{S2})}$, implies that $\hat{X}_1 > 0$.

Furthermore, to assess whether the proportionate change in Sector 2 is greater than the proportionate change in Sector 1, the former is subtracted from the latter. Therefore, using equations (2.72) and (2.73), the resultant equation is:

$$\hat{X}_2 - \hat{X}_1 = \frac{\hat{T}}{|\lambda|}(1 - \partial\sigma)[(\lambda_{L2} - \lambda_{S2}) - (\lambda_{S1} - \lambda_{L1})] \qquad (2.75).$$

Given the proportionate shares of factor intensities, $\lambda_{Sj} = 1 - \lambda_{S1} - \lambda_{S2}$ and $\lambda_{LG} = 1 - \lambda_{L1} - \lambda_{L2}$, then equation (2.75) can be simplified to:

$$\hat{X}_2 - \hat{X}_1 = \frac{\hat{T}}{|\lambda|}(1 - \partial\sigma)(\lambda_{SG} - \lambda_{LG}) \qquad (2.76).$$

Since the factor intensity condition in Case 1 is such that the skill intensity in the health sector is greater than the economy-wide effective skilled-unskilled labour ratio, $S_G > S$, then $\lambda_{SG} - \lambda_{LG} > 0$. Consequently, for equation (2.76), a $\partial\sigma < 1$, implies $\hat{X}_2 > \hat{X}_1$. Therefore, the factor intensity ranking and the elasticity magnitude in Case 1, $S_j > S_1 > S > S_2$ and $1 - \frac{|\lambda|}{(\lambda_{L2} - \lambda_{S2})} = \frac{\lambda_{SG}.\lambda_{L2} - \lambda_{S2}.\lambda_{LG}}{\lambda_{L2} - \lambda_{S2}} < \partial\sigma < 1$, implies $\hat{T} > \hat{X}_2 > \hat{X}_1 > 0$.

Intuitively, when the government healthcare budget increases $\hat{T} > 0$, the health sector expansion increases its demand for and employment of labour. Since the health sector is skill intensive, its demand for skilled labour is relatively higher compared to unskilled labour. Therefore, the factor-bias-effect increases output of Sector 2 while that of Sector 1 falls. At the same time the healthcare expansion reduces the number of un-well labour on the waiting lists, and increases the total number of effective labour available in the economy. Consequently the scale-effect increases the output of both Sector 2 and Sector 1. The scale-effect outweighs the factor-bias-effect. The expansion in output of Sector 1 will happen even for small values of the elasticity parameter. As long as the healthcare provision is effective in treating the un-well at the margin, thus reducing the waiting lists, the outputs of all sectors will rise, and the unskilled intensive sectors will experience relatively larger output increases because of the abundance of unskilled relative to skilled labour.

Case 2: $S_G > S_1 > S > S_2$ and $\partial\sigma > 1$

The factor intensity ranking in Case 2 is similar to that of Case 1 but the effectiveness of healthcare in Case 2 is assumed to be large so that the elasticity parameter value is greater than one. Therefore, from equation (2.74), and given that $(\lambda_{S_1} - \lambda_{L1}) > 0$, and $\partial\sigma > 1$, it follows that $\hat{X}_2 > \hat{T}$. Similarly, the elasticity value condition in Case 2, $\partial\sigma > 1$ also implies that $\partial\sigma > 1 - \frac{|\lambda|}{(\lambda_{L2} - \lambda_{S2})}$ so that using equation (2.70) it can be deduced that $\hat{X}_1 > 0$. Furthermore, using equation (2.76) the ranking of sector output changes is determined, considering the factor intensity ranking condition in Case 2. That is to say, $S_G > S$ implies $(\lambda_{SG} - \lambda_{LG}) > 0$, and given the elasticity value condition $\partial\sigma > 1$, it follows that $\hat{X}_1 > \hat{X}_2$.

Thus $S_G > S_1 > S > S_2$ and $\partial\sigma > 1$ leads to $\hat{X}_1 > \hat{X}_2 > \hat{T} > 0$. At large values of the elasticity parameter, the scale-effect is very strong so that an increase in the government healthcare budget generates expansion in outputs of both Sector 1 and Sector 2 that are larger than the proportionate increase in the health budget.

Intuitively, when healthcare provision is very effective in curing the sick, an expansion in healthcare service delivery improves the effective labour endowment to the extent that both skilled labour and unskilled labour are available in large quantities. Assuming that skilled workers are relatively more productive so that the output per worker is higher for skilled workers relative to unskilled workers, the expansion in output of the skill-intensive sectors is proportionately larger than the output in the unskilled-intensive sectors.

2.5 Application and use of CGE modelling

CGE models are an attempt to convert the Walrasian general equilibrium theory that represents an abstract economy into realistic models of actual economies[30]. The models seek to determine numerically the characteristics of an observable general equilibrium. CGE modelling provides a logical and consistent way to analyse policy issues which involve several economic agents. For instance, an increase in healthcare expenditure in a publicly funded health system will generate increased demand for inputs in the provision of healthcare, which must be drawn from elsewhere in the economy. Assuming factors of production are mobile across sectors, labour will be drawn from other sectors to the healthcare sector. Similarly, there is likely to be a reduction in the government transfers and hence a fall in income of households, change in welfare, and revised tax rates to offset the fiscal imbalance. The impact of these interactions can be determined using a CGE model. By contrast more usual partial equilibrium analysis undertaken to evaluate healthcare policy is only suitable for estimating effects that are limited to within a particular sector. This is appropriate if the effects arising from other sectors are small[31] and therefore can be ignored when arriving at conclusions.

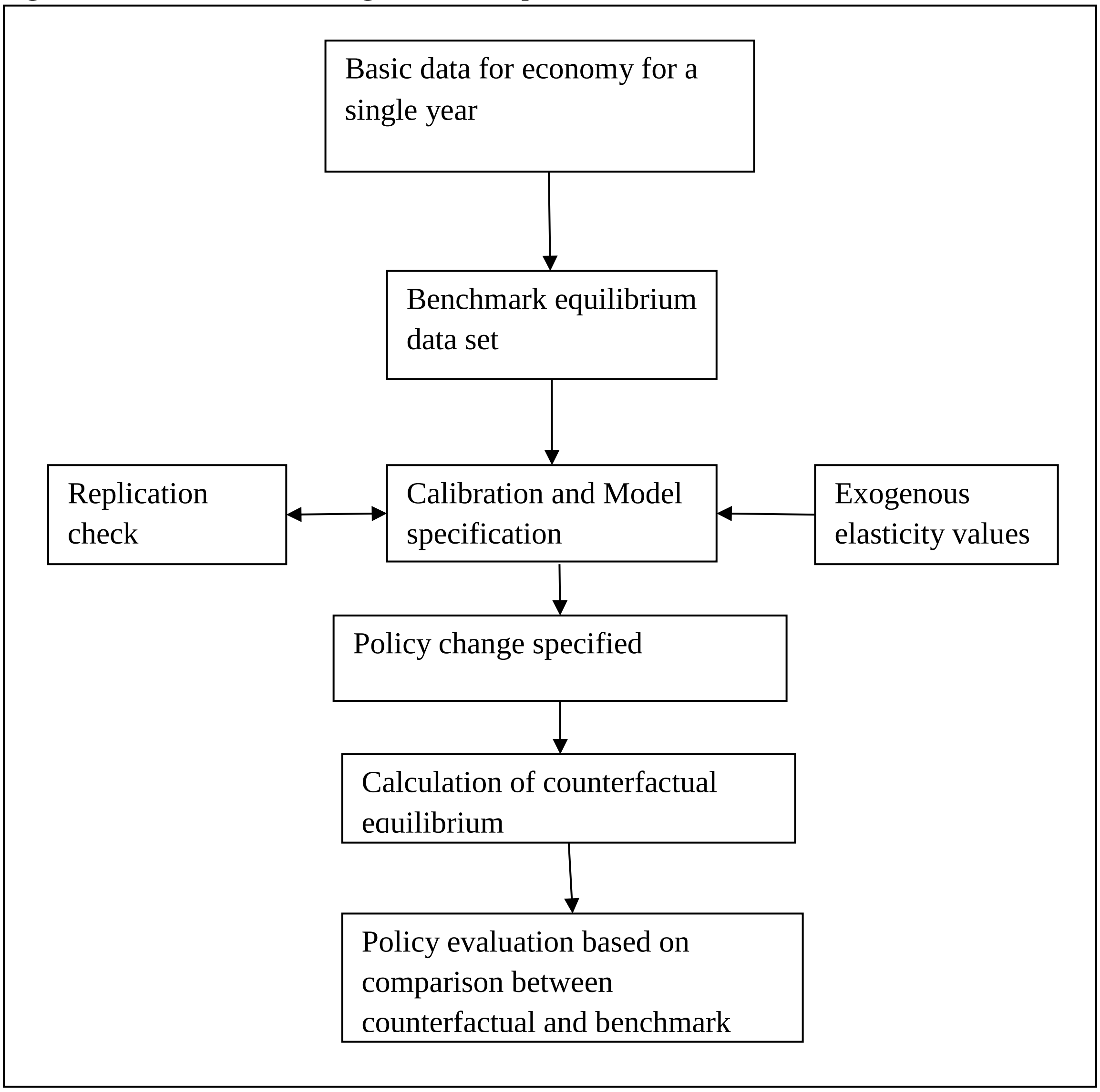
Furthermore, CGE models provide quantitative analysis based on empirical data as opposed to analytical proofs in more theoretical general equilibrium analysis. Therefore, they provide information suitable for policy makers. CGE modelling is also able to analyse several policy

[30] For an overview of CGE modelling and its application see (Dervis, Jaime de Melo, & Robinson, 1982; Lofgren, Harris, & Robinson, 2002; Shoven & Whalley, 1984) .

[31] Although what is ‘small’ and how it can be determined *ex ante* are moot points.

shocks simultaneously to capture their combined impact, and to investigate effects of policy changes from internal or external shocks on macroeconomic variables. Econometric analysis as an alternative approach normally requires an enormous set of time series data on the variables to be modelled, which is often unavailable. Figure 2.2 illustrates how the CGE modelling approach works, with arrows indicating the direction of the step-by-step method for benchmark data requirements, establishing the counterfactual equilibrium and policy evaluation.

Figure 2.4 Flow chart showing calibration procedure and the use of a CGE model



Source: Adapted from (Shoven & Whalley, 1984, 1992)

Criticisms against CGE modelling include the inability to statistically test model results, relying upon sensitivity analyses to solve the problem of potential errors from using parameters that are not obtained using econometric techniques. CGE modelling is also challenged on the choice of parameter values, choice of functional forms (McKitrick, 1998); and quality of data sets (Iqbal & Siddiqui, 2001). It is worth noting that such criticisms are more general challenges encountered by any model, and addressed according to the economic problem being investigated. CGE modellers recognize the challenges and therefore tend to emphasize the broad themes of the results rather than the precise numbers they produce. As a result CGE models are validated as a form of approximate numerical investigation to explore the size of particular policy effects and signing the net outcome where different effects come into play (Whalley, 1985).

2.6 Summary

This chapter reviews the relationship between health and economic growth and discusses the concepts of health and healthcare in a general equilibrium context. An analytical framework graphically presented the interaction of health and healthcare systems with other sectors, showing the various channels through which the linkages take place. The chapter also presents the theoretical simple general equilibrium model of production to evaluate analytical proofs with regard to health and healthcare in the Ugandan economy. An expansion in the non-tradable health sector may result in a decline in overall output in the economy if consideration is made of only the factor-bias effect of health sector expansion. When the factor-bias effect is considered together with the scale-effect of health sector expansion, the scale-effect is seen to dominate. The dominance of the scale-effects of an expanding health sector results in higher outputs for both the tradable and non-tradable sectors and consequently expansion and growth in the economy.

The derived impacts on overall economy-wide output of a healthcare sector expansion in the low dimension H-O model will be explored empirically in a CGE model and results reported in Chapters 7 and 8. The CGE modelling technique provides the framework for systematically evaluating the healthcare expansion policy. The step-wise method of obtaining the benchmark and counterfactual equilibriums, before and after the healthcare policy intervention enables us to identify the contribution of the health effects in the economy.

CHAPTER 3: A CRITICAL REVIEW OF LITERATURE OF STUDIES APPLYING CGE MODELLING IN HEALTH AND HEALTHCARE

3.1 Introduction

The use of computable general equilibrium (CGE) modelling in health and healthcare is under represented in the literature compared to its application in trade and environmental policy analysis. This chapter reviews the literature on CGE models applied to health and healthcare including health care policy analysis. The studies applying CGE modelling techniques in the health and healthcare literature are hereunder classified according to the type of research problem modelled: healthcare sector policy shock; disease shock, and those that evaluate the impact of a healthcare problem. Other CGE applications such as those that exclusively study the role of health insurance are not reviewed in this thesis. This chapter is organised in four sections including the introduction. Section 3.2 presents the literature search strategy and explains criteria for inclusion/exclusion of articles for review. Section 3.3 presents the review of the selected articles with sub-headings to distinguish the group under which a particular article belongs as per the inclusion criteria. The chapter is summarised and conclusions drawn in Section 3.4.

3.2 Literature search strategy

The relevant literature was obtained from electronic databases in the field of economics and public health as well as key journals. Data bases that were searched included Applied Social

Sciences Index and Abstracts (ASSIA), International Bibliography of the Social Sciences (IBSS), Economic Literature (EconLit), and biomedical literature from PubMed, Medline, EMBASE, and Global health. ASSIA subject coverage includes health, social services, economics, politics and education, and dates back to 1987 with monthly updates. IBSS core subjects' coverage is sociology, politics, economics and anthropology. IBSS data base includes articles from 1951 and is updated weekly. The EconLit data base is the world's leading source of references to economic literature including articles from 1969 and is updated on a monthly basis. PubMed, Medline and EMBASE are general medicine data bases with a subject coverage that includes clinical medicine, biomedicine, nursing, dentistry, allied health, health policy, and genetics; and articles published since the 1950s with daily updates. Global health data base covers issues of international public health and contains information published since 1910. It is updated on a monthly basis. The search key terms included concepts defining computable general equilibrium and related key words, which were combined with health, health status, and healthcare; and search words describing health and health status such as disease, and those relating to healthcare such as healthcare policy. The specific search string was "macroeconomic model* adj3 (health or healthcare or health service* or health polic* or health system* or health reform*) or macroeconomic evaluation adj4 (health or healthcare or health service* or health polic* or health system* or health reform*) or economic impact adj4 (health or health care or health service* or health polic* or health system* or health reform*) or computable general equilibrium model* adj3 (health or healthcare or health service* or health polic* or health system* or health reform* or disease*) or CGE model* adj3 (health or healthcare or health service* or health polic* or health system* or health reform* or disease*) or economic impact adj3 (health or healthcare or health service* or health polic* or health system* or health reform*)". However, while some databases allowed the use of truncation, others only accepted the option of wild cards so the search string was edited accordingly.

Only records written in English were considered. Record selection and exclusion was guided by the three items for review outlined in the introduction to this chapter. Papers were included if the study applied a CGE modelling approach, and health or healthcare is introduced in the model as either a healthcare sector policy shock; a disease shock, a healthcare problem shock or a combination of the three. The studies focussing on healthcare sector policy as a shock in the model were selected on the basis of evaluating the economy-wide impact of a healthcare policy emanating from within the health sector and/or pertaining to the health sector. The disease shock studies are selected on the basis of evaluating the wider impacts of the disease in addition to the direct impacts to the health sector. The disease impact studies comprised of studies evaluating the impact of infectious diseases and non-communicable/chronic diseases. Also included were studies assessing the impact of a healthcare problem and the associated policies to combat the problem, such policies could be designed outside of the healthcare sector. Other records were retrieved from reference lists of included articles and the internet which provided information from international organisations such as the World Bank, World Health Organisation (WHO), United Nations Conference on trade and Development (UNCTAD), and Non-Governmental Organisations (NGOs), and the Government of Uganda documents.

3.3 Empirical studies applying CGE modelling to health and healthcare

3.3.1 CGE application to health system policy interventions

Three CGE studies were found that assess the impact of healthcare policy in the health sector. (Rutten, 2004; Rutten & Reed, 2009*)* are similar studies of the macroeconomic impact of healthcare provision in the UK, based on the PhD work of (Rutten, 2004). Using a static CGE model of an open economy (UK), healthcare provision is modelled by exploring the interaction of the health sector with the rest of the economy through its differential impact across different labour skill categories and households. The model specifies two factors of production: capital and labour, five categories of households, and 11 sectors/commodities that include healthcare, the pharmaceutical sector and a medical equipment producing sector. The model is savings-driven with foreign savings fixed in foreign exchange; the government expenditures on goods is fixed in foreign exchange at benchmark levels, but transfers to households adjust to equate government income with expenditures on commodities and the trade surplus. Alternative model specifications are experimented when performing simulations.

Simulations performed include: an increase in government expenditure on healthcare with mobile factors and with fixed factors; an increase in the domestic consumer price of pharmaceuticals with exogenous budget and exogenous healthcare provision; government policy aimed at encouraging foreign healthcare-specific skilled workers i.e. doctors and nurses under an exogenous NHS budget and a given wage rate; improvement in productivity of factors employed in healthcare, modelled via technical change: factor-neutral and skill-biased technical change; and a technical change in the pharmaceuticals (Rutten, 2004; Rutten & Reed, 2009).

With the exception of a technical change in pharmaceuticals, policy changes are shown to promote growth in domestic production to varying degrees in the pharmaceutical sector and medical equipment producing sector, the principal suppliers of the health sector. The pharmaceutical industry adjusts downwards when the price and productivity of pharmaceuticals are increased due to the rise in the domestic consumer price owing it to increased world price of imports, and the use of more cost effective pharmaceuticals leading to a fall in demand. Policies aimed at expansion of healthcare provision improve the health status of the working population thereby increasing labour participation rates and reducing waiting lists. This is particularly so, if the expansion is undertaken in the NHS where the majority of unskilled labour seeks public healthcare as opposed to private healthcare that mainly provides for skilled labour. A policy linkage that reduces public healthcare via the NHS impacts negatively on the health levels of the population; lowers labour participation rates and increases waiting list. Similarly, a very large expansion of the public healthcare sector crowds out private sector providers therefore reducing the health levels of skilled labourers, lowering their participation rates and increasing waiting lists for this category.

The impact of policies on household income is reportedly mixed depending on the household type and the factors owned by the households, and whether the factors are mobile across sectors or specific to the health sector. Households that rely on government transfers for income always lose out whenever the policy reduces government budget in terms of loss of tax revenue or increased expenditure on health. The result for welfare changes measured by equivalent variation depends on the category of households in question. Different household categories are rendered better-off or worse-off to varying degrees by the different policies. While pensioners and non-working households become worse-off with an increase in government health expenditure with fully mobile factors of production, all categories of households are made better-off if the government health budget is increased with fixed factors (i.e. labour and capital are specific to the health sector). However, overall four of the policies are welfare-improving but increasing the domestic consumer price worsens the households' welfare.

The UK CGE model (Rutten, 2004) was the first to assess the endogenous impact of changes in healthcare provision on the population. Three limitations to the model are identified by the authors: the modelling of health effects in terms of the size of effective labour endowments and using a static model; the level of disaggregation in healthcare and related sectors and markets; and data constraints. The study presented in this thesis for Uganda will address these three constraints through: using a dynamic model to capture the longer-term population growth; disaggregating the health sector into private and public healthcare, and primary and other-healthcare; further categorizing labour skills, and where data permits, by residence (rural and urban). Although the impact on macroeconomic variables is not identified by the author as a missing link from the work, it is an important model outcome for a study in a low income country like Uganda. The (Rutten, 2004) work does not explicitly address the impact of the healthcare policies on broader macroeconomic variables such as growth in investment, imports and exports. The model presented for Uganda in this thesis will address the changes in the structure of the economy such as factor returns, factor substitution, sectoral shares, and exchange rate adjustments and how these adjustment mechanisms feed into growth in GDP, private consumption, investment, imports and exports, as well as the impact on poverty reduction.

A related study in this category of health system intervention studies modelled the impacts of healthcare interventions due to HIV/AIDS in Botswana (Dixon et al., 2004). This study is included in this category because two of the scenarios designed propose HIV/AIDS interventions that aim to strengthen the health system service delivery to mitigate the spread of the pandemic. The authors endogenously modelled the impact of the pandemic on effective labour supply using parameters from an epidemiological model describing the prevalence of HIV/AIDS and the population effects. They used a recursive dynamic model with stylized policy experiments in an open economy structure, in contrast to (Rutten, 2004). A dynamic model is critically needed when looking at HIV/AIDS because of the slow nature in the progression of the disease and hence long duration of the epidemic. The probability of HIV transmission and the number of sexual relationships were introduced in the CGE from the epidemiology model. The epidemic is hypothesized to reduce the workforce and in order to quantify its effects and the impacts from government interventions the authors design 5 scenarios in addition to the baseline scenario. They combine reduction in the workforce with government strategies to mitigate the effects of the epidemic: increased government healthcare expenditure per infected person, from expenditure relating to palliative care only; increased provision of treatment for sexually transmitted diseases (STDs); education program that targets to reduce the number of new sexual relationships; and a combination of the government interventions in one package.

While the epidemic is estimated to reduce potential consumption by about 70% and disposable income by between 13 - 53%, interventions combining treatment of sexually transmitted disease with education that reduces the number of new sexual partners can offset 50% of the projected welfare losses. The result demonstrates that government interventions are critical in the fight against HIV/AIDS as they can offset more than half of the associated welfare losses.

3.3.2 Studies applying disease shock to the model

Other CGE studies were obtained which, in contrast to the health system studies; assessed the macroeconomic impact of a disease. The articles in this category comprised of CGE application to both infectious disease and non-communicable/chronic disease. Those studies applying CGE to HIV/AIDS disease in Africa were also singled out as a distinct group.

3.3.2 (i) CGE application to infectious diseases

The papers in this category reviewed here include five studies that have evaluated the impact of an infectious disease: studies of pandemic influenza in European countries (Keogh-Brown, Smith, Edmunds, & Beutels, 2009; Smith, Keogh-Brown, & Barnett, 2011; Smith, Keogh-Brown, Barnett, & Tait, 2009); one study of H1N1 Influenza in Australia (Verikios, McCAW, McVernon, & Harris, 2010); a study that evaluated the impact of a mild influenza pandemic in Thailand, South Africa and Uganda (Smith & Keogh-Brown, 2013) and one study of an evaluation of SARS in Taiwan (Chou, Kuo, & Peng, 2004).

Specifically, (Smith et al., 2009) used a static CGE model of the UK to evaluate the economy-wide impacts of pandemic influenza on the UK economy. The authors assumed the economic impact of the pandemic to occur through the labour supply, as both the quantity and productivity of labour is reduced by illness and deaths due to the disease. The authors further considered the impact of mitigation policies which may reduce available labour if people are advised to keep away from work to avoid infections. This may increase labour supply when compared to non-mitigation scenarios, by reducing illness incidence and deaths.

Results indicate GDP losses increase with mitigation effects accounting for large losses. For example GDP declines by 5.8% due to school closure effect compared to 1.5% due to disease only effects, for a high clinical attack rate and low case fatality rate. Similarly, school closures increase the value consumers' are willing to pay to avoid the economic cost of the disease (7% of GDP compared to 5.1% of GDP for the mild disease case scenario). The main contribution of this study is to show that disease, in itself, will not cause unprecedented economic losses even in high cases of fatality. The major loss to the economy arises from the courses taken to mitigate the disease, such as school closures and prophylactic absenteeism which reduce labour supply to the economy. The study, however, does not show whether the impact is the same for all sectors considering that some sectors are less people-oriented compared to others.

In a related study, (Keogh-Brown et al., 2009) estimated the impact of pandemic influenza in the UK, France, Belgium and The Netherlands. The single country static model of an economy comprising 11 sectors is shocked with the impact of a disease on the working population. The impact on labour supply, inputs productivity and healthcare delivery cost is evaluated. While the economic impacts of the disease are shown to be small, for instance ranging between 0.5% for a mild pandemic to about 2% of GDP for a severe pandemic in the UK, the importance of the effectiveness and economic impact of policies is highlighted. It is estimated that during a severe pandemic, school closure for four weeks at the peak of a pandemic would cost the UK economy £27 billion and could double the cost of the pandemic. The GDP impacts for France, Belgium and Netherlands are proportional to those of the UK but greater than the UK impacts by varying factors. Similarly, domestic output, particularly in the labour intensive sectors would suffer large losses with the least impact in the agricultural sector which, however, suffers the largest losses in the tradable sector.

The study by (Smith et al., 2011) uses an earlier developed model in (Keogh-Brown et al., 2009) but with an addition of a disaggregated financial sector to capture elements of financial services, to assess the impact of pandemic influenza on the UK. The results indicate that an episode of pandemic influenza is not the greatest concern for losses but the resultant school closures and prophylactic absenteeism that lead to colossal sums of money lost in declining outputs for the economy as a whole.

For all the CGE studies of European countries (with a disease as an exogenous shock to the model), the main contribution is highlighting the labour supply impacts resulting from illness and absenteeism identified in all the sectors to provide an aggregate picture of the economy, in contrast with impacts to an individual or impacts confined to the health sector. However, the studies can be criticized on three points. Firstly, they employ a static model highlighting the short-term effects on GDP but do not capture the long term effects of a disease on the economy. Secondly, using prophylactic absenteeism in modelling the impact on the working population underestimates the loss because it omits absenteeism due to caring for the sick affected by the disease. For instance, with illness rates estimated at 35% of the working population for the mild case and 50% for the severe case of pandemic influenza in the UK, there is potentially high absenteeism due to caring for the sick. For example, while modelling the macroeconomic impact of HIV/AIDS on the Botswana economy[32], (MacFarlan & Sgherri, 2001) found that working time losses due to increased time off for sick leave and to care for the sick, would reduce total factor productivity, and increasingly, the impact on GDP growth. The effect was more significant in the labour intensive informal sector where GDP

[32] This study is not reviewed in this thesis because it was based on a Solow growth model, which is outside the scope of the literature review in this chapter

growth rate was estimated to decline from 1.42 % in 1999 to -0.36 % in 2010 (MacFarlan & Sgherri, 2001). Thirdly, by summing up all labour skills in one category of labour supply, as in this model, it misses the point of identifying the impact of disease on particular labour-skill intensiveness in specific sectors. The importance of labour disaggregation by skill is demonstrated by (Kambou, Devarajan, & Over, 1992) in the Cameroon study of the impact of HIV/AIDS whereby the resulting shortage of urban-skilled labour has the strongest adverse impact on the economy as a whole compared to urban-unskilled and rural labour supply (Kambou et al., 1992).

Another application of CGE in the evaluation of an infectious disease is a study of the macroeconomic effects of H1N1 Influenza in Australia (Verikios et al., 2010)**.** Using a dynamic CGE model for Australia (MONASH model[33]), they simulate the economic effects of two influenza epidemic episodes in Australia: the actual outbreak of 2009 and a more severe episode. The authors developed the MONASH-Health model with a detailed health sector specifying 18 treatments as health sector industries in addition to the traditional industries. Two scenarios representing influenza episodes are shocked with four economic consequences of the epidemics: (i) a surge in demand for hospital and other medical services; (ii) a temporary upsurge in sick leave and school closures requiring withdrawal of parents from labour force; (iii) some deaths with a related permanent reduction in the labour force; and (iv) temporary reductions in inbound and outbound international tourism and business travel (Verikios et al., 2010). In formulating the scenarios the authors describe the shocks to take account of the dynamics of the epidemic outbreak which showed that 87% of all new

[33] MONASHI model developed by Centre of Policy Studies, Monash University; is a dynamic CGE model of the Australian economy designed for forecasting and for policy analysis.

infections occurred in the third quarter of 2009. Results show reductions in GDP and employment, and the magnitude of reductions are presumably larger for a severe epidemic. In addition, the highest negative effects are observed during the peak quarter in each of the scenarios where, for instance, GDP and employment decline by 6.2% and 4.1% respectively for the severe epidemic scenario.

A major contribution of this study is the disaggregation of the healthcare sector by types of treatments which are then classed as sectors in themselves. This level of disaggregation allows for a deeper analysis of the supply and demand of specific health treatments brought about by a specific disease outbreak. The study, however, does not indicate the distributive impact of the epidemic in terms of household incomes and welfare. To what extent is the welfare of different types of household categories affected by such an epidemic? For example, (Keogh-Brown et al., 2009; Smith et al., 2011; Smith et al., 2009) have shown that a pandemic influenza outbreak can have high societal costs with estimates for UK consumers' willingness to pay to avoid the economic impacts of the diseases estimated to range from £2bn to £131bn for mild to severe illness cases.

One study that assesses the impact of a mild influenza pandemic on low-income countries is also reviewed. A static CGE model of an open economy, previously developed in (Smith et al., 2009), is applied to the economies of Thailand, South Africa, and Uganda (Smith & Keogh-Brown, 2013). The authors design scenarios to capture the effects of changes in labour supply (and not behavioural changes) resulting from the disease outbreak. The overall results indicate small impacts resulting in less than 1% GDP loss for all scenarios, across all countries. The sectoral impacts, however, differ in absolute magnitudes across countries, depicting the differences in the structure of the economies under study. For example the capital intensive sectors (mining and extraction) suffer the smallest losses in Thailand while there are positive gains for Uganda for the same sectors. This is attributed to the small contribution of the labour factor to these sectors: 25% for Thailand and 8% for Uganda. Results for household consumption also depict similar results across the countries showing small changes in consumption, particularly, for goods that are of a subsistence consumption nature such as grains and crops. There are large reductions in consumption of non-essential products as well as luxury items, services such as health and public administration also decline because these sectors are predominantly labour-intensive, and therefore suffer from reduced labour supply to the economy.

Overall, the study highlights the impacts of an influenza epidemic on the economies of developing countries showing that the economic effects to a large extent arise from morbidity and mortality, and that these countries may not suffer from the larges losses due to behavioural effects such as prophylactic absenteeism observed in developed countries studies. The setback in this study is that it does not differentiate labour categories for example, by skill, which is necessary to understand the extent of the economic effect by intensity of labour factor in the production of various sectors. Furthermore, the study does not indicate the distribution effects of the labour supply shocks for different household categories, which, for example, would be relevant to understand the impact on poverty rates for Uganda.

Another study of infectious disease has evaluated the impact of severe acute respiratory syndrome (SARS) on the Taiwan economy (Chou et al., 2004). The authors indicate that the SARS epidemic outbreak hit the Asian region in 2003 and lasted for approximately six months. Among the countries worst hit by the SARS epidemic, China had the highest reported cases, followed by Hong Kong and Taiwan in the third place. The authors used a multiregional CGE model to account for Taiwan's strategic location and close trade relations with mainland China and Hong Kong. At the time of the study, the authors indicated that one third of Taiwan's trade happened with the Mainland China and Hong Kong, and Taiwan's largest foreign direct investment (FDI) targeted these two neighbouring countries.

The authors designed scenarios for the short run period - assuming the epidemic would last for one year or less, and long run period – assuming the epidemic lasts for more than one year, to predict the impact on GDP in the regional countries and on sector outputs in Taiwan. In the short run simulations, the impact is transmitted through the effects on the services sector mainly affecting the tourism and trade services segments (scenario 1) and the combined effect on the services and manufacturing sectors (scenario 2). In the long run simulations, the impacts on capital accumulation and total factor productivity are evaluated for the combined effect on services and manufacturing sectors, with transparent reporting of SARS outbreak by China (scenario 3) and without transparent reporting of SARS outbreak by China (scenario 4). The authors used an investment coefficient to represent the transparent reporting of SARS outbreak by China, which was deemed important because it was found to affect investor perception and FDI in mainland China, the main destination for Taiwan's FDI.

The results indicated a decline in GDP for China (0.13%), Taiwan (0.55%), and Hong Kong (1.68%) in the short run, and the negative impacts on GDP would rise if the epidemic lasted for more than one year. The main impact occurred in the services sector but it was also predicted that the loss to China would be considerably higher if the Chinese government did not improve its disclosure of the SARS outbreak, whereas there were no corresponding losses for Taiwan and Hong Kong. Within Taiwan, manufacturing was predicted to suffer losses in most sectors in the short run, and in all sectors in the long run. Overall, the study made a contribution towards understanding the global impacts of an infectious disease.

The study, however, does not explicitly model the impact of SARS on labour supply. In studying the impact of globalisation and disease, and an infectious disease in particular, one cannot ignore the consequences on labour supply, both in local economies and across borders. Since SARS is reported as a highly contagious disease, its impact on labour supply is inevitable, in terms of absences from work due to illness and prophylactic absence. The effect of prophylactic absenteeism on GDP via the reduction in labour supply has been demonstrated in a study to evaluate the economy wide impact of pandemic influenza in the UK (Smith et al., 2009). The study suggests that a 5.8% reduction in GDP would occur due to mitigation measures such as school closures and prophylactic absenteeism. Additionally, a forward looking dynamic model would be an appropriate tool of analysis to capture the long term SARS effect on investor attitude and FDI location in the region. For instance, the G-cubed model which incorporates rational expectations and forward looking inter-temporal behaviour by the economic agents was used to evaluate the impact of SARS in Asia (Lee & McKibbin, 2003). However, this study is not extensively reviewed here since, despite being a macro model, it's not a CGE application[34].

3.3.2 (ii) CGE application to HIV/AIDS in Africa

[34] The G-cubed model is "designed to bridge the gap between computable general equilibrium models and macroeconomic models by integrating the more desirable features of both approaches"(McKibbin & Wilcoxen, 1998).

Four studies were found that have modelled the impact of a disease in an African setting. The reviewed studies evaluated the economic impact of HIV/AIDS in an African country, through its effects on labour supply, total factor productivity, and the cost of healthcare. (Kambou et al., 1992) and (Arndt & Lewis, 2000, 2001; Thurlow, 2007). An application of CGE to Cameroon modelled the economy comprising of 11 sectors; two factors of production – labour (rural, urban-unskilled and urban-skilled) and capital, that is sector specific and fixed in the short run; and a single household sector (Kambou et al., 1992). The model is savings-driven and represents a small open economy. The authors begin with a static model of Cameroon adjusting to a lower supply of labour (and with no AIDS) to determine the effects of a general labour shortage, and the shortage by the different labour categories. This is then extended to a dynamic model with no AIDS as the base run, and the AIDS shock as a reduction in labour supply under the assumption of no changes in government policies. The study introduces dynamics into the model to account for lagged effects of the pandemic. In Cameroon AIDS halves economic growth rate; the rural labour force expands at a slower pace; and the urban-skill growth of labour is insufficient to match the AIDS shock hence the devastating consequences on savings and investment which lead to decline in GDP growth.

In South Africa, the economy comprising 14 sectors, five factors of production (professional, skilled, unskilled, informal labour, and physical capital); five household categories, and seven government functional spending categories is modelled (Arndt & Lewis, 2000, 2001). The AIDS scenario depicts a decline in economic growth as well as per capita GDP while the unemployment rates are reportedly the same between the "AIDS" and "no-AIDS" scenarios (Arndt & Lewis, 2000, 2001).

A dynamic CGE micro-simulation model is applied to Botswana to assess the impact of HIV/AIDS on the economy (Thurlow, 2007). The study identifies three mechanisms through which AIDS impacts the economy: population, labour supply, productivity and fiscal expenditure. Consequently, three scenarios are designed to depicting the working of the economy: with AIDS, without AIDS, and AIDS with treatment. The comparison of model scenarios shows that the country experiences low rates of population growth per year for the AIDS scenario but the rate of growth increases when treatment is introduced (the treatment scenario) and is highest when its assumed there is no AIDS (no AIDS scenario). The trend is the same for labour supply and input productivity. Government expenditure on health is highest when treatment is considered and lowest when there is no AIDS in the country.

The resulting macroeconomic and growth impacts indicate that treatment programs increase the annual GDP growth rate by 0.4% relative to the no treatment AIDS scenario. Similarly, the treatment program reduces poverty by 0.5% relative to the no treatment AIDS case. The distribution of household expenditure shows that all households benefit either directly from the treatment received or indirectly through the positive economy-wide growth brought about by the treatment program. Although inequality is also seen to increase under the treatment program scenario, the authors suggest that it is attributed to the geographic, demographic and occupational distribution of the AIDS infection rather than the treatment intervention.

The CGE micro-simulation model approach used in this study was an advance over previous methodologies to better capture, at a detailed level, the interactions between producers, markets, households and government (Thurlow, 2007). The overall results demonstrate that a government intervention in a treatment program can mitigate the adverse effects of HIV/AIDS on the Botswana economy.

3.3.2 (iii) CGE application to non-communicable disease

Another category of CGE models in health and healthcare have addressed the impacts of non-communicable diseases and the associated policies to combat their effects. Two studies are reviewed in this category. First is a study to evaluate the impact of strategies to reduce the burden of non-communicable disease in the UK and Brazil, (Lock et al., 2010). The study shows how the adoption of a healthy diet affects population health and the potential effects of such a policy on the economy, particularly, agricultural production and trade, and livelihoods. The authors used a one country static CGE model with a single aggregated representative household, for each country: Brazil and the UK, and designed shocks to mirror possible health strategies in line with the WHO dietary guidelines for saturated fat intake. The model was shocked with three possible strategies to reduce consumption: of all foods from animal sources, only meat products, or only dairy products; designed to affect labour supply to the economy. Estimates from the literature on reduction in mortality in working-age population and reductions in years-of –life lived with disability were used to estimate labour supply effects and labour productivity respectively. Consumption shocks were implemented by reducing the household budget shares of the commodities of interest, for example, meat, while export shocks aimed to force a reduction in exports.

The shocks in the model were implemented with an overall aim to reflect four possible economic effects: UK domestic effect (an effect only on UK domestic demand for food from animal sources), Brazil domestic effect (an effect only on Brazilian domestic demand for food from animal sources), Brazil international effect (an effect only on export demand for Brazilian food from animal sources), and Brazil combined domestic and export demands for food from animal sources). The effects of dietary change on the economies of the two countries differed by dietary strategy and effect scenario. For both countries, the reduction in dietary intake of foods from all animal sources has little effect while the effects from changes in dairy product consumption is quite substantial, which represents the necessary cuts required in dairy production to achieve the health policy objectives. The result showed GDP effects being much larger for Brazil than the UK, consistent with the observed household expenditure shares for animal products (less than 0.08% in the UK and 0.17% in Brazil). Sector analysis indicates that effects of the dietary strategy differ between the two countries. For instance, while reducing meat consumption strategies is associated with the largest effects in Brazil, it's the diary product consumption reducing strategies that have the greatest effect in the UK.

Overall, the study serves to highlight the interactions between policies and strategies aimed at reducing the effects of non-communicable diseases with the non-health sectors, producing a combined effect on the economy. The analytical framework is, however, limited in application as it considers an aggregated single household. Disaggregating households is necessary to isolate the impacts of the strategies on different household categories either by socio-economic grouping or by income. Dietary effects from reduced dairy product consumption, for instance, are likely to differ if a household budget share of dairy products consumption is small for the poorest quarter relative to the richest quarter of the households distributed by income levels; or smaller for households of retirees compared to young family households, if grouped by to socio-economic status.

The second study for application of CGE to assess the impacts of non-communicable diseases is set in Australia (Verikios, Dixon, Rimmer, & Harris, 2013), in which the economy-wide impact of chronic disease is assessed. Using a dynamic CGE model for Australia, Monash-

Health; the authors illustrate the effects of improving the health status of the workforce, and how these improvements diffuse into the labour market, sectoral outputs and the macro economy. The study specifies five age groups (15 to 61+ years) and using probabilities of changes in health status, the age groups are assigned health statuses (ranging from H1 for excellent health and H5 for poor). The dynamic nature of the model assumes that people improve from lower health status (e.g. H4 and H5) such that a given health status improvement shock (e.g. 10% of A49-60, H4) would mean that people who were destined to become H5 in the next period instead become H4. Similarly, the health sector is disaggregated into 18 treatments and 6 commodities to reflect the variations in demands on the sector by different age groups and other sectors. Two scenarios are designed portraying reduction in the rate of health decline for: (i) older workers (49-60), and (ii) younger workers (29-38), distinguishing between working and non-working persons. The authors use a rate of decline of health status for the younger workers for illustrative purposes so as to distil the differential impact of improvements in health status.

The effects of a health improvement on workers by health status shows the distribution of the work force is altered towards higher health statuses (H1-H3) for both age groups, and the proportional increase is bigger for older workers since this category initially has less numbers in higher health statuses. Consequently, labour supply of the older persons rises over the model period. Similarly growth in GDP relative to the base is higher in simulation 1 (older workers) compared to simulation 2 (younger workers). Overall, the study demonstrates the relevance of incorporating age and health of labour market dynamics in order to adequately assess the economy-wide impacts of chronic disease. The study could have benefited from a disaggregation of the household sector so that the effects of changes in labour supply, resulting from improved health status, can be seen diffusing to household income and income distribution. The impact on household income is relevant to inform targeted policy for the improvement of health status for categories of households.

3.3.3 CGE application to a healthcare problem and associated policies

Three studies were included that applied CGE to a healthcare problem. In an evaluation of a healthcare problem in a general equilibrium setting, a study estimated the economy-wide impacts of antimicrobial resistance (AMR) with specific reference to methicillin-resistant *staphylococcus aureus* (MRSA) in the UK (Smith, Yago, Millar, & Coast, 2005). The authors used a static CGE model of the UK to determine the effects of resistance on the economy through its impact on changes in labour supply, inputs productivity, and healthcare delivery cost. Parameter values for the impact of MRSA on labour supply and productivity losses in the UK were assumed, based on studies outside of the UK, of drug resistance and productivity losses from infectious diseases. Similarly, the impact on cost of healthcare delivery was based on estimates from other countries. The impact of MRSA on the UK economy was found to be substantial as it prolongs treatment time, as well as increasing morbidity and mortality. A 4% drug resistance and the associated increase in morbidity and mortality results in lower production outputs, which lead to higher unemployment rates and government transfers, in form of employment benefits. Overall, GDP declines and consumers are worse-off as indicated by the decline in welfare as a proportion of national income.

Although this study used a basic model, the authors were able to demonstrate the importance of undertaking a general equilibrium analytical framework to assess a healthcare problem such as MRSA, as it is likely to generate wider economy impacts beyond those identified in the health sector only. Nevertheless, this basic model could have benefited from using more accurate data for the UK to improve the parameter estimates. Additionally, a disaggregated labour factor by skill is more appropriate, so as to determine the differential impacts of drug resistance on the supply and productivity of different categories of labour, and subsequently, to household income.

In a related study, the CGE modelling framework is used to evaluate the macroeconomic impacts of policies to contain antimicrobial resistance (AMR) (Smith, Yago, Millar, & Coast, 2006). Taking the case of methicillin resistant staphylococcus aureus (MRSA) in the UK, the authors employed a static model of the UK to assess three macro policies to contain AMR: regulation, taxation, and permits. MRA is modelled as an exogenous shock to the economy which reduces the quantity and quality of labour inputs (through increased morbidity and mortality), while increasing the cost of healthcare (from additional and/or prolonged treatment courses). These mechanisms eventually generate a loss in GDP, the cost of unemployment and government transfers (in form of unemployment benefits) increases, and welfare declines. The policy options aimed at limiting the use of antimicrobials: regulation, taxation and tradable permits, were designed to reduce prescriptions of antimicrobials by certain percentages. The results indicate that such policies would reduce the costs of MRSA to the UK economy as they produce a net benefit to the economy compared to effects of MRSA. Overall, GDP increases, unemployment rates fall, and consumer welfare improves.

Notwithstanding the simplistic assumptions made throughout the model construction such as one representative household, the study highlights the importance of considering effects of AMR beyond the healthcare sector. Clearly, any policies that contain MRSA do affect the wider economy as demonstrated by the linkages to non-health sectors and the subsequent economic impacts. The model could benefit from incorporating a disaggregated labour factor, in addition to disaggregating the household sector. Such disaggregation is relevant for assessing income levels as well as income (re)distribution of a given policy option.

The third study applying CGE to a health problem evaluates the impact of health co-benefits associated with climate change strategies. The economy wide impacts of health-oriented greenhouse gas (GHG) reduction strategies are evaluated using a single-country dynamic CGE model for the UK (Jensen et al., 2013). Informed by earlier documented evidence that GHG interventions result in substantial health co-benefits, the study implements scenarios based on the established strategies: food and agriculture strategy scenario (‘healthy diet’); urban transport scenarios (‘cleaner cars’ and ‘active travel’); and household energy efficiency strategy scenario (‘household energy’) to measure the health-related net cost reductions over a 20 year period. Using a food tax and road tax as demand-constraining interventions for health diet and active travel scenarios, and investment in improved housing insulation and ventilation as a technology intervention for household energy scenario, the study evaluates the impacts on GDP and per capita GDP, specifying the relative difference in results when health co-benefits are incorporated in the model.

These model results indicate that implementing the health diet scenario is the most costly strategy, particularly, as it creates tax distortions that raise the gross UK costs above £100bn over the 20 year period, or £96bn net of health co-benefits (i.e., health co-benefits mitigate the loss by only 5%). The tax distortions and increased survival rates lead to decline in per capita incomes for the same scenario. The active travel scenario also creates costly distortions to the economy because of the road tax, but by internalising the congestion externality and incorporating the benefits from increased walking and cycling, the loss in GDP is mitigated by 38% and per capita GDP increases in the long term. For the household energy scenario, the required investment expenditure for housing insulation and ventilation crowds out investment that would be used relatively more productively elsewhere, thus leading to a loss in GDP of £49bn. However, the loss in GDP could have been higher if the health co-benefits and energy efficiency gains are excluded. These two combined cover around 50% of gross societal costs.

The main contribution of this study is highlighted in the result, suggesting that the high distortionary costs of GHG reduction strategies can be reduced when health co-benefits and efficient technology interventions are incorporated in the assessment. The health related benefits modelled in this study emanate from strategies and policies outside of the health sector. This is in contrast to what my study intends to do; model healthcare policies intended for the health sector but are likely to have repercussions for the wider economy. Secondly, although the results show the changes in household income tax rates generated by the scenarios, the impact of these changes on different household groups is not reported. It is worthwhile to isolate the differential impacts on household groups so as to capture the distributive and welfare impacts of the suggested policy interventions. Thirdly, having been set in the UK, the study is limited in its relevance to developing countries like Uganda. For instance, effects on factor returns are likely to differ for a country like Uganda which is abundant in land and unskilled labour factors relative to the UK.

3.4 Summary

This chapter has surveyed literature focusing on CGE application to health and healthcare. Three studies were found that assessed the economy-wide impacts of health sector policies with two similar ones set in the UK while one was in Botswana. Each of these studies extensively modelled the impact of increasing government healthcare expenditure, which is a central theme in the CGE for Uganda presented in this thesis.

The majority of the studies found and reviewed here have applied the CGE framework to evaluate the impact of a disease. Four of these have evaluated the impact of an infectious disease on economies of developed countries in Europe and Australia and one of them studied the impact on developing countries that included Uganda. The Australian study adopted a detailed disaggregation of the health sector considering specific treatments as sectors interacting with other sectors in the model so as to distinctly quantify the impact of resource claims (consumer demand) made on specific treatments. This was a departure from the usually aggregated health sector often grouped under government services or health and social services. An earlier attempt at disaggregating the health sector was made by (Smith et al., 2005) but this only stopped at identifying cost centres in hospital, health administration, and family health services, and not necessarily the treatments. In the category of infectious disease studies, the developed country studies differed from the one set in developing countries as the latter considered the economic effects of changes in labour supply largely arising from morbidity and mortality caused by an influenza epidemic, rather than behavioural effects such as prophylactic absenteeism observed in the developed countries. The four HIV/AIDS studies in Africa highlighted important issues for policy consideration in countries with similar resource settings. Besides the fact that treatment interventions are likely to offset welfare losses, (Thurlow, 2007) also showed that there is likely to be increased inequality that is attributable to demographic and occupation distribution of infected people.

The studies evaluating the impact of chronic diseases and associated policies to mitigate their effects reviewed here in this chapter have indicated that it is imperative that population health status need to be improved, and specifically so if it is to increase labour supply and productivity in the economy. Additionally, the studies highlight the need for trade-offs that have to be made when introducing policies aimed at mitigating and/or reducing certain chronic diseases. For example, (Lock et al., 2010) showed that in Brazil the agriculture sector (which is large and of big importance to the economy), would suffer losses from a policy to reduce fat intake by reducing demand for food from animal sources. The category of studies evaluating a healthcare problem are also reviewed and have shown that costs of a healthcare problem, such as drug resistance and the associated policy interventions to reduce the effects of drug resistance, cannot be confined to the health sector only. There are a multiplicity of effects and consequences to the rest of the economy beyond the health sector that necessitate consideration by policy makers. In a similar regard, the study that incorporated health co-benefits in the evaluation of interventions to reduce the effects from greenhouse gas showed that policies that affect peoples' health, though indirectly, are bound to offset the economy wide costs associated with the introduction of such policies.

In conclusion, a consensus emerging from these studies is that it is important and necessary for economic studies evaluating health and health care to consider a general equilibrium analytical framework to account for effects outside of the health sector, but occur indirectly due to linkages of this important sector with the rest of the economy. It is quite clear now, that economic studies of a partial equilibrium nature are inadequate to guide policy on matters of economic impacts of health and healthcare. Furthermore, the surveyed literature has revealed research gaps in the application of the CGE modelling approach to evaluating health and healthcare in the following respects. Firstly, healthcare reforms exhibit economy wide impacts, beyond the health sector and the population health status which, hitherto, have not been investigated in Uganda. Secondly, although there is growing interest in assessing economy wide effects of health and healthcare policy changes, the majority of the studies are focussed on developed countries and very few in low- and middle- income countries. Thirdly, the developed country studies evaluating healthcare policy impacts employ static models which do not account for lagged effects of health and health care. Fourthly, the dynamic models such as those evaluating the impact of HIV/AIDS in Africa are highly aggregated and in some instances, they do not report comparatives of different policy shocks.

The core lessons for building and applying CGE to health and healthcare can be classified under the following four aspects. First and foremost, the model should be dynamic in order to appropriately capture the lagged effects of health and healthcare policy changes in the economy. Secondly, in the factor markets, labour should be disaggregated by skill level to reflect the unique nature (in terms of skill composition) of the healthcare sector labour, and to capture the response of different labour types to changes in health status. Thirdly, the health sector account in the SAM should be disaggregated to reflect the study question – for instance, by levels of care or by treatments – because the resource claims on the health sector by each category of care differ. Fourthly, in order to appropriately evaluate the welfare impact of a given healthcare policy, the household sector should be disaggregated, as much as available data can allow, into relatively homogenous categories. It is the aim of this study to address the research gaps by developing a dynamic CGE model for Uganda calibrated from a disaggregated health sector-focussed social accounting matrix and to report the economy-wide impacts of healthcare financing reforms.

CHAPTER 4: THE CGE AND MICROSIMULATION MODEL TO EVALUATE THE IMPACT OF HEALTHCARE FINANCING REFORMS IN UGANDA

4.1 Introduction

The CGE model adopted for this study is a recursive dynamic model and it explicitly models the health sector disaggregated as non-government-healthcare, government primary healthcare, and government other-healthcare. The disaggregated health sector is interlinked with the rest of the economy, to predict the effects of healthcare financing reforms, using standard CGE technology. It is based upon the neoclassical standard CGE model developed by the International Food and Policy Research Institute (IFPRI) and documented in (Lofgren et al., 2002). This study draws from the extensions of the model to recursive dynamics as applied to the South African economy by (Thurlow, 2004, 2005, 2008b). The CGE model is linked to the IFPRI 2007 Uganda household micro simulation model to analyse the healthcare policy impact on income distribution and poverty rates in Uganda. Both the standard CGE model and the microsimulation model are existing analytical methods developed by other researchers. The contribution made in this thesis is in adapting the existing models to apply to the context of the research questions being addressed in this study. Specifically, the models are adapted to the Ugandan economy in the following ways. First, the Uganda SAM is updated and balanced including the disaggregation of the health sector account into three new health accounts as described in Chapter 5. Second, the model equations pertaining to the health sector production, commodity consumption and factors of production for health are modified according to the newly created health sector accounts and all the linked activity, commodity, factor and institutional accounts in the SAM. This includes specifying the updating equations described in Section 4.3.10 to reflect the scenarios designed in Chapter 6. Third, the model closure rules are designed to suit the research questions. Fourth, the microsimulation model is updated to include the newly created health sector accounts and all the linked activity, commodity, factor and institutional accounts in the SAM.

The recursive dynamic model is a suitable alternative (compared to a static CGE model) for evaluating the economic impact of health and healthcare financing policy reforms for the following reasons. First, health and healthcare effects in the wider economy may have long term lags. For instance, there is evidence suggesting that early childhood health has positive effects on cognitive and physical development, which affect productivity as an adult (see literature review in Section 2.2). The updating equations specifying labour force and labour productivity growth in the dynamic model enable the capture of the long-term health effects of the population health status on labour supply and labour productivity in all sectors of the economy. Also included in the model are processes characterising underlying growth in total factor productivity across sectors of the economy, associated with health and healthcare improvements.

Second, the dynamic model analyses the path of a transitional dynamic toward a new steady state after an initial shock. Changes in economic indicators during the adjustment process such as sectoral factor demand and output, wage rates and GDP can be retrieved. In contrast to the one-period sectoral reallocation of resources in a static model, this feature of the dynamic model allows for the comparison of the impact of various implementation schemes for the health financing policy reforms. Third, the dynamic model generates results not only for the final equilibrium, but also for the evolution path of the economic system from the initial to the final state. In this way, it is capable of capturing the costs associated with the adjustment to changes in healthcare financing policies. Fourth, the dynamic model allows other dynamic effects such as capital accumulation, to be included in the analysis. The capital updating process enables the model to capture the impact of healthcare financing policies on capital accumulation in Uganda. Additionally, the dynamic model captures the exogenous growth in population and labour force as well as government functional expenditures. The specific updating processes and equations are described and discussed in Section 4.3.10.

Incorporating dynamic factors and adapting the model to critically encompass health sector disaggregation, as above, in an updated social accounting matrix (SAM) and the micro-simulation for poverty analysis distinguishes the approach used in this thesis from previous applications of the model. The model is designed to specifically assess the most critical issues pertaining to increasing resources available to the health sector, through a variety of means, and mapping their dispersed impacts. It is tailored to derive the impacts of healthcare financing policies on production in various sectors, sector market shares, factor demands and income of the various labour skills and different household types. Consequently, through these channels the model predicts growth rates in GDP, private consumption, investment, exports and imports, and poverty reduction rates. The model is calibrated from the Uganda SAM of 2007, which is augmented with a disaggregated health sector and detailed in Chapter 5.

This study adopts the approach that links a macro (CGE) model and a micro-simulation model to evaluate the impact of the healthcare financing reforms on income distribution and poverty in Uganda. Micro-simulation models are essentially partial equilibrium analyses that evaluate the impact of a policy on individual units of observation, such as households or individuals, and so are unable to capture the indirect price and demand effects arising from a policy change. Macro-models, on the other hand, are widely used to provide a snapshot of the workings of the whole economy after a policy shock. However, macro models are limited by the inability to provide an insight on how the aggregate changes and the post-shock equilibrium affect individuals in the economy. Recognising the set back with each of these individual approaches, researchers have since devised methods linking the micro models to macro models to capture the income distribution impacts of a policy shock. There are various ways by which these links can be made (discussed in Section 4.4) but the ultimate result of the linking is that output from one model feeds into the other, in a manner determined by the modeller and depending on the study question. The method adopted for this study is the top-down approach where the models are implemented sequentially so that aggregate results from the CGE model are inputs into the micro simulation model for poverty analysis.

The rest of this chapter proceeds as follows. Section 4.2 provides a brief theoretical exposition of the association between healthcare, health status and labour outcomes and clarifies how health and healthcare are introduced in the model for this study. Section 4.3 presents the model equations, with specific reference to the Ugandan context and the study question, and elaborates the recursive dynamics, model calibration and parameters. Section 4.4 presents the linking of the core CGE model and the micro-simulation model and explains the poverty indices used in the analysis of poverty effects after a policy shock. Section 4.5 summarises and concludes the chapter.

4.2 Health status and labour outcomes

In this study, the healthcare effects on labour outcomes are introduced in the model as exogenous parameters. Although this is the case, it is worthwhile explaining the household labour supply model that underlies the relationship between healthcare and effective labour supplies in the economy. In the household labour supply model, the relationship between healthcare and labour outcomes is specified as:

$$L = L(H, X, \theta) \tag{4.1}$$

$$H = H(HC) \tag{4.2}$$

where L represents labour outcomes (which may be labour participation rates or labour productivity rates), H is the health status of an individual, itself a function of a health composite HC , X are observable household characteristics that affect productivity and θ are other unobservable household characteristics that may affect labour outcomes.

From the theoretical model of production equilibrium, extended to health and healthcare, in Chapter 2, it was established that the elasticity of effective labour endowments available in the economy would depend on the actual proportion of the labour waiting to be treated, the elasticity of labour waiting to be treated, and changes in healthcare output. From the healthcare point of view, it is recognised that the effective labour supplies are dependent, not only on the quantity of healthcare but the quality (effectiveness) of healthcare, as well. Assuming that households are uniformly afflicted by illness so that the number of un-well labourers is the same across households, the proportion of labourers unable to work (non-participation rate) can be defined by a constant elasticity function of a healthcare composite:

$$\alpha_{f\epsilon l} = \alpha_{0f} HC_f^{-\varepsilon_f} \tag{4.3}$$

where $\alpha_{f\epsilon l}$ represents the non-participation rate for labour l , $\varepsilon_{f\epsilon l}$ is a waiting list elasticity parameter and $\alpha_{0f\in l} > 0$ is a scale parameter which is calibrated so that $\alpha_{f\in l} < 1$. This specification suggests that increasing healthcare will increase treatments and curing of the sick and eventually lead to a reduction in the labour non-participation rate. Therefore, as HC_f tends to infinity the non-participation rate tends to zero. When the healthcare provision is undertaken by both government and the private healthcare sector, the health status of the labour force is determined by a health composite of private and public healthcare. The health composite is given by the formulation:

$$HC_l = (C_{Hg})^{\rho l}(C_{Hng})^{(1-\rho_l)} \tag{4.4}$$

where HC_l is a healthcare composite for labour l , C_{Hg} and C_{Hng} are government and non-government healthcare consumption respectively, for labour l , and $0 \leq \rho_l \leq 1$ is the share of government healthcare in the health status of labour l .

In order to determine the impact of healthcare on labour outcomes using the formulation above, data on three important parameters is required: the share of public and private healthcare consumption in the health status of the different labour categories, ρ_l , the waiting list elasticity parameter ε_f , and a basis for calibrating the scale parameter α_0. This suggests that the impact of a healthcare financing reform policy which generates health outcomes that impact on the household labour supply module could be more precisely captured, if data on the effectiveness of healthcare were available.

Given that policy guidance is often required even for those settings where data is scarce, such as Uganda; this study undertakes to model the health effects as exogenous parameters. The envisaged healthcare effects of increased public health expenditure are modelled as growth in labour supply, labour productivity and total factor productivity. The health effects considered enter the model exogenously and the parameter values for the health effects are obtained from literature on health and economic growth, some of which is reviewed in Section 2.2. The description and assumptions pertaining to the health effect parameter values used and the specific literature sources cited, are presented in detail in Chapter 6 - Design of model scenarios. Careful consideration of the literature on the relationship between health, healthcare and the labour force as well as labour market indicators documentation from Uganda is undertaken to select the health effects parameter values for modelling the healthcare policy impact.

4.3 Description of the CGE model for Uganda

The dynamic CGE model of Uganda is built on microeconomic principles derived from neoclassical theory. The model is written as a set of simultaneous equations which define the behaviour of the different actors in the economy (Dervis et al., 1982; Lofgren et al., 2002); and is solved using the *General Algebraic Modelling System (GAMS)* software (http://www.gams.com/). Representative producers and consumers maximise profits and utility respectively, and the government collects tax to fund its expenditure and redistribute income. In addition, there is a set of constraints that pertain to factor and commodity markets, and macroeconomic aggregates (balances for savings-investment, the government, and the current account of the rest of the world), which must be satisfied by the system as a whole. This is required as the model seeks to find the solution at which all markets (commodity, factors, government sector, and foreign sector) are simultaneously in equilibrium – that is to say, it seeks the set of prices at which 'general equilibrium' is achieved. For the between-period adjustment, this solution for period n then forms the basis for the next model run for period $n + 1$, the solution to which forms the basis for model run $n + 2$, etc., to form a recursive dynamic model. The general functional form of model equations is presented in detail with emphasis, wherever feasible, to the specific features pertaining to Uganda as the country modelled and the health sector as a public sector. Variables and parameters are defined explicitly when they first appear in the text while sets are implied. Symbols with a bar on top signify exogenous variables.

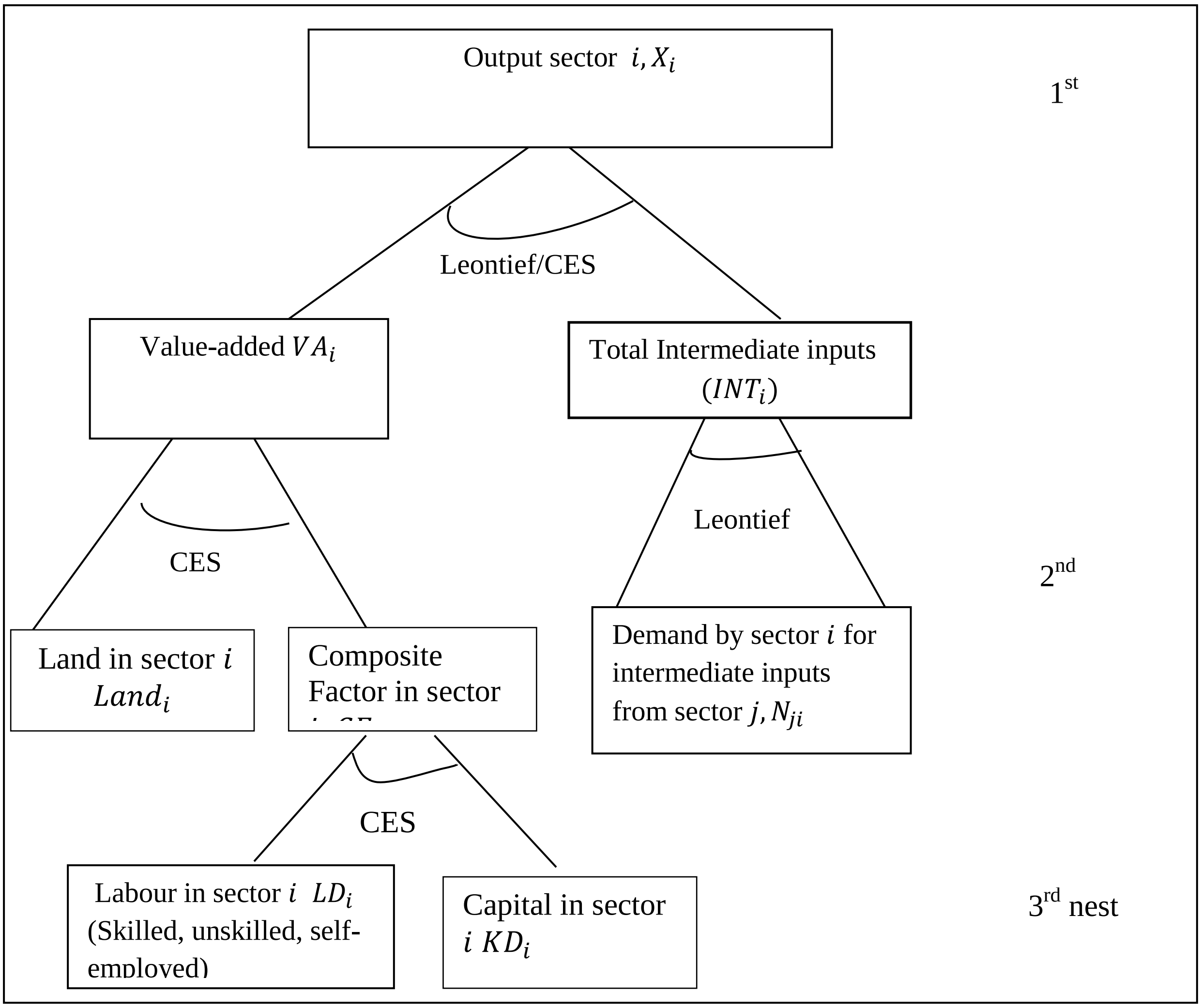
4.3.1 Production by sectors

The model for Uganda distinguishes production across nine sectors (activities) purposefully aggregated from the micro SAM and grouped into agriculture and non-agriculture (industry and services) sectors. The sectoral distinction allows for the capture of sector growth impacts resulting from healthcare reform policies. Each economic activity is defined by a production function and the producers are assumed to maximise profit by choosing quantities of inputs and output, given the input and product prices and subject to technological feasibility. Producers are assumed to sell their output at their cost of production, earning zero profits (in the economic sense). That is, individual producers cannot influence the market price of the output or inputs. The production is assumed to exhibit constant returns to scale implying that a proportional increase in all inputs leads to an increase in the output by the same proportion.

Figure 4.1 illustrates the production technology in a nested structure. The nested production function is particularly useful in this analysis for two reasons. First, the technologies of the component processes are different in that while it is possible to substitute within the value-added bundle such as between healthcare labour and capital in the healthcare value-added bundle, it is not be possible to substitute between the value-added and the intermediate bundle, such as between healthcare labour and medicines for curing a particular ailment. Second, the nested production structure allows for the distinction of different subsets of input combinations in the production process. For example, input combination in the agricultural sector may differ from input combinations for non-agricultural sectors like the health sector.

At the top level (1st nest), value-added in sector i, VA_i is combined with total intermediate inputs from other sectors, INT_i, within a fixed coefficient (Leontief function) or a constant elasticity of substitution (CES) function to produce the output for sector i, X_i.

Figure 4.1 Production technology



Source: Adapted from Lofgren, Harris et al. (2002)

The CES technology specifies the quantity of aggregate activity as a CES function of demand for value-added and demand for aggregate intermediate input (equation 4.5).

$$QA_i = A_i.\left[\alpha_i.QVA_i^{-\rho_i} + (1-\alpha_i).QINTA_i^{-\rho_i}\right]^{-\frac{1}{\rho_i}} \qquad (4.5)$$

where, for (sector) activity i , QA_i is quantity (level) of activity, QVA_i is quantity of (aggregate) value-added, $QINTA_i$ is quantity of aggregate intermediate input used in activity, A_i is shift parameter for top level CES function, α_i is a share parameter for top level CES function and ρ_i is a top level function exponent.

In the CES technology, the ratio of aggregate value-added to intermediate input quantity is a function of the intermediate input to value-added price ratio specified as follows:

$$\frac{QVA_i}{QINTA_i} = \left[\frac{PINTA_i}{PVA_i} \cdot \frac{\alpha_i}{1-\alpha_i}\right]^{\frac{1}{1+\rho_i}} \tag{4.6}$$

where $PINTA_i$ and PVA_i are intermediate input price and value-added price respectively.

The Leontief function for the demand for aggregate value-added is defined as:

$$QVA_i = iva_i . QA_i \tag{4.7}$$

where iva_i is quantity of value-added per unit of activity i.

Similarly, the Leontief technology for the demand for aggregate intermediate input is given by:

$$QINTA_i = inta_i . QA_i \tag{4.8}$$

where $inta_i$ is quantity of aggregate intermediate input per unit of activity i.

The second nest specifies the combination of production factors in all sectors subdivided into agriculture (agr) and non-agriculture (nag). This sector division is necessary because factor intensities differ markedly between these two categories of sectors. The agricultural sector is relatively intensive in its use of land, unskilled and self-employed labour compared to the non-agriculture sectors. The non-agriculture sectors refer to industry and services including government services such as healthcare[35]. Therefore, at the bottom of the nest is a one-level or two-level constant elasticity of substitution (CES) function for sector i's demand for primary inputs, to produce value-added, VA_i, defined in equations (4.10) – (4.12). The agriculture sector factor combination is defined by a composite factor, comprised of an optimal mix of labour and capital (defined at the third nest), and land to produce value-added.

$$QVA_i = A_{va_i}\left[\sum_f \alpha va_{f,i} \,.\, (QF_{f,i})^{-\rho va_i}\right]^{-\frac{1}{\rho va_i}} \tag{4.9}$$

$$VA_{nag} = A^{kl}_{nag}\left[\alpha^{kl}_{nag} LD_{nag}^{-\rho^{kl}_{nag}} + \left(1-\alpha^{kl}_{nag}\right)\overline{KD}_{nag}^{-\rho^{kl}_{nag}}\right]^{-1/\rho^{kl}_{nag}} \tag{4.10}$$

$$VA_{agr} = A^{cl}\left[\alpha^{cl} CF^{-\rho^{cl}} + (1-\alpha^{cl})\overline{LAND}^{-\rho^{cl}}\right]^{-1/\rho^{cl}} \tag{4.11}$$

$$CF = A^{kl}_{agr}\left[\alpha^{kl}_{agr} LD^{-\rho^{kl}_{agr}} + \left(1-\alpha^{kl}_{agr}\right)\overline{KD}_{agr}^{-\rho^{kl}_{agr}}\right]^{-1/\rho^{kl}_{agr}} \tag{4.12}$$

[35] Note that, although the quantities produced by the government sector are exogenously determined according to the sector budgets approved by Parliament, this model assumes that government employs its factors at the market rental and wage rates. Therefore, the provision of services such as education, healthcare and administration is modelled as representative firms which use the same production structure described in Figure 4.2, and government buys most of the output of these firms. In Uganda's case, only a small proportion of public healthcare is purchased by households from the private wings of general hospitals.

where LD_i is the quantity of labour demand in activity i , $\overline{KD}_i$ is the quantity of capital demand in activity i , CF is the quantity of the composite factor demand in agriculture, $\overline{LAND}$ is quantity of land demand in agriculture, A^{kl}_{nag}, A^{cl} are scale coefficients for the CES functions combining labour with capital (in sectors nag) and composite factor with land (in sectors agr), respectively; $\alpha^{kl}_{nag}, \alpha^{cl}$ are share parameters for CES functions linking labour to capital (in sectors nag) and composite factor to land (in sectors agr), respectively; and $\rho^{kl}_{nag}, \rho^{cl}$ are substitution parameters for CES functions between labour and capital (in sectors nag) and between the composite factor and land (in sectors agr), respectively and $(-1 < \rho < \infty)$.

The second nest of the production function also specifies the demand for individual intermediate inputs which are combined in fixed proportions according to a Leontief function to form the intermediate consumption bundle. That is to say, the substitution parameter between intermediate inputs takes a zero value. Hence:

$$QINT_{c,i} = ica_{c,i}.QINTA_i \tag{4.13}$$

where $ica_{c,i}$ is quantity of commodity c as intermediate input per unit of aggregate intermediate in activity i.

4.3.1.1 Factor-specific productivity

Labour-specific productivity is captured in the model by including a term for factor-specific productivity in the value-added equations (4.9) and (4.12). Therefore:

$$QVA_i = A_{va}\left[\sum_f \alpha va_{f,i} . (fprd_{f,i}. QF_{f,i})^{-\rho va_i}\right]^{-\frac{1}{\rho va_i}} \qquad (4.14)$$

$$VA_{nag} = A_{nag}^{kl}\left[\alpha_{nag}^{kl}(fprd_{la}^{val}.LD)_{nag}^{-\rho_{nag}^{kl}} + \left(1-\alpha_{nag}^{kl}\right)\overline{KD}_{nag}^{-\rho_{nag}^{kl}}\right]^{-1/\rho_{nag}^{kl}} \qquad (4.15)$$

$$CF = A_{agr}^{kl}\left[\alpha_{agr}^{kl}(fprd_{la}^{val}.LD)^{-\rho_{agr}^{kl}} + \left(1-\alpha_{agr}^{kl}\right)\overline{KD}_{agr}^{-\rho_{agr}^{kl}}\right]^{-1/\rho_{agr}^{kl}} \qquad (4.16)$$

$$LD = fprd_{la}^{val}.\left(\frac{\alpha^{kl}}{1-\alpha^{kl}}\right)^{\sigma^{kl}}\left(\frac{r}{w}\right)^{\sigma^{kl}}\overline{KD} \qquad (4.17)$$

where $fprd_{la}^{va}$ is a productivity measure for value-added by labour factor l in activity a . In the initial year or base equilibrium the value of the labour specific productivity is set to one.

The specific factor productivity parameter is crucial for modelling the health effects of increasing the health sector budget share. The health effects scenario design in Chapter 6 explores the possibility of growth in labour productivity resulting from the increased public healthcare budget and the consequent expansion in healthcare delivery in Uganda.

4.3.2 Factor markets

The supply of factors is the sum of all institutional endowments. In markets with same set of factors, quantities demanded and supplied are set to equal. Factor demand is constrained by the producer's profit maximization objective. Each factor is hired up to the point where its marginal revenue product equates its marginal cost (i.e. the factor wage).

$$WF_f.\overline{WFDIST_{f,i}} = PVA_i.(1 - tva_i).$$
$$QVA_i.\left[\sum_f \alpha va_{f,i}.(fprd_{f,i}.QF_{f,i})^{-\rho va_i}\right]^{-1}.\alpha va_{f,i}.fprd_{f,i}^{-\rho va_i}.QF_{f,i}^{-\rho va_i - 1} \quad (4.18)$$

where tva_i is rate of value-added tax for activity i and $\alpha va_{f,i}$ is CES value-added share of factor f in activity i, WF_f is the average price of factor and $WFDIST_{f,i}$ is wage distortion factor for factor f in activity i.

The Uganda model specifies five primary factors: three labour types [36] (self-employed agricultural workers, unskilled workers employed in agricultural and non-agricultural sectors and skilled labour in non-agricultural sectors), capital, and land. Labour is assumed to be fully employed and mobile across sectors[37]. The full employment assumption is consistent with the shortage of skilled workers in Uganda. The mobility of labour across sectors means that workers who are laid-off by declining sectors can move to get employment in the

[36] It has not been possible to disaggregate labour skills by sex although it would be a useful addition for improving the analysis. There was no adequate data to disaggregate the SAM labour skills by gender. In terms of the model specification, inclusion of the gender dimension to labour would only serve to increase the number of labour types/accounts modelled. However, it would enrich results of the impact transmitted through the labour and wages variables and aid in the analysis of outcomes. The need for a sex disaggregated labour profile is presented in Section 10.4.2.

[37] The full-employment assumption is plausible because the question at hand is to study the impacts of increased labour supply induced by improvements in health status of the working population, so that results are distinctively clear. And not to study unemployment per se, which would necessitate assuming factors are not fully employed in the model.

growing sectors thus maintaining the economy-wide full employment level. Equilibrium in the labour market is obtained through flexible real wages which adjust to ensure that the sum of labour demands from all activities equals the quantity supplied. Land and capital, on the other hand, are assumed to be fixed (immobile), earning a sector-specific rent that is variable.

4.3.3 Commodity markets

The structure of the Ugandan economy is such that each activity produces one or more outputs and any commodity may be produced and marketed by more than one activity. Consequently, decisions have to be made regarding production and supply for the domestic market versus the export market, and the demand and consumption of the domestically produced goods versus the imported goods. On the supply side, the allocation of domestic output between exports and domestic sales is determined using the assumption that domestic producers maximize profits, subject to imperfect transformability between these two alternatives. The production possibility frontier of the economy is defined by a constant elasticity of transformation (CET) function between domestic supply and export. Thus:

$$X_{tr} = B_{tr}^{e}\left[\beta_{tr}^{e} E_{tr}^{\gamma_{tr}^{e}} + (1-\beta_{tr}^{e}) D_{tr}^{\gamma_{tr}^{e}}\right]^{\frac{1}{\gamma_{tr}^{e}}} \qquad (4.19)$$

where the subscript tr denotes tradable sectors, X_{tr} is total production in tradable sectors E_{tr} is exports, D_{tr} is domestic sales, B_{tr}^{e} is a scale coefficient of the CET function, β_{tr}^{e} is a share parameter (relative to exported volume) of the CET function, and γ_{tr}^{e} is a transformation parameter of the CET function[38] $(1 < \gamma_{tr}^{e})$.

The CET parameter is restricted to a positive but determinate value to reflect the case that a sector's domestic sales and export sales may not necessarily be identical products. As a result, output is not perfectly substitutable across domestic and foreign markets. That is to say, one sector may produce different products for the domestic market and the export market. In Uganda, for example, the agricultural sector produces bananas for domestic consumption while it produces coffee for the export market. Given the concave production possibility frontier, a determinate elasticity of transformation between bananas and coffee serves to highlight the fact that it becomes increasingly difficult, with a given fixed land acreage (and/or capital), to produce more bananas and less coffee or vice versa. Therefore, a producer maximizes total profit in the following formulation:

$$E_{tr} = \left[\left(\frac{Pe_{tr}}{P1_{tr}}\right)\left(\frac{1-\beta_{tr}^{e}}{\beta_{tr}^{e}}\right)\right]^{\tau_{tr}^{e}} D_{tr} \qquad (4.20)$$

where Pe_{tr} is domestic price received by local producers for exported products, $P1_{tr}$ is domestic price of the tradable good excluding taxes (price at factor cost), D_{tr} is demand for domestic tradable good, and τ_{tr}^{e} is transformation elasticity defined as $\tau_{tr}^{e} = 1/(\gamma_{tr}^{e} - 1)$.

[38] Values for the transformation parameter γ can range theoretically from zero to infinity. If $\gamma = \infty$ it means output is perfectly substitutable across domestic and foreign markets. If $\gamma = 0$ it means production is not substitutable across domestic and foreign markets, or among export markets. A positive but finite value suggests that exports are imperfectly substitutable across markets.

From the producer's point of view, equation (4.17) identifies the optimal mix for the quantity of output production supplied to the domestic market and to the foreign market. Given a positive elasticity of transformation the ratio of exports to domestic sales (E_{tr}/D_{tr}) depends on the relative price for sales in the foreign market($Pe_{tr}/P1_{tr}$). Consequently, the ratio of exports to domestic sales increases (decreases) if the relative price for sales in the foreign market rises (falls). Since the world market price of exports is fixed for Uganda, it means Ugandan producers face an infinite price elasticity of world demand so that they can sell unlimited quantities of their output at the world market price.

On the demand side of the commodity market, a composite commodity is made up of domestic demand and final imports and it is consumed by households, enterprises and the government, as illustrated in Figure 4.2. The Armington assumption [39] is adopted to distinguish between domestically produced goods and imports. For each good, the model assumes imperfect substitutability in a CES function between imports and the corresponding composite domestic goods. Therefore:

$$Q_{tr} = A_{tr}^{m}\left[\alpha_{tr}^{m} M_{tr}^{-\rho_{tr}^{m}} + (1-\alpha_{tr}^{m}) D_{tr}^{-\rho_{tr}^{m}}\right]^{-\frac{1}{\rho_{tr}^{m}}} \qquad (4.21)$$

[39] The (Armington, 1969) assumption postulates that imports are differentiated from each other by country of origin and these form a group that is distinguishable from the domestically produced product. Thus, a consumer's utility function is separable in types of goods according to preferences, and then the Armington assumption in a CES form is adopted for the sub-functions of each type of good distinguished into demand for the domestic product originating from the home country and the demand for the products originating from foreign countries. Thus, goods produced in different countries are imperfect but close substitutes with their domestic counterparts. Although not considered in the current study the Armington CES form can be adopted at a third level of household budget allocation, where demand for foreign products is a function of the demand for each type of good supplied by each of the foreign countries. This is particularly important when there are several sources of imports and the aim is to evaluate the gains from trade such as the regional disaggregation in international trade in a South African model (Thurlow, 2008b).

where Q_{tr} is demand for composite tradable good, M_{tr} is imports of the tradable good, A_{tr}^{m} is a scale coefficient of the CES function, α_{tr}^{m} is a share parameter for the CES function, and ρ_{tr}^{m} is a substitution parameter for the CES function.

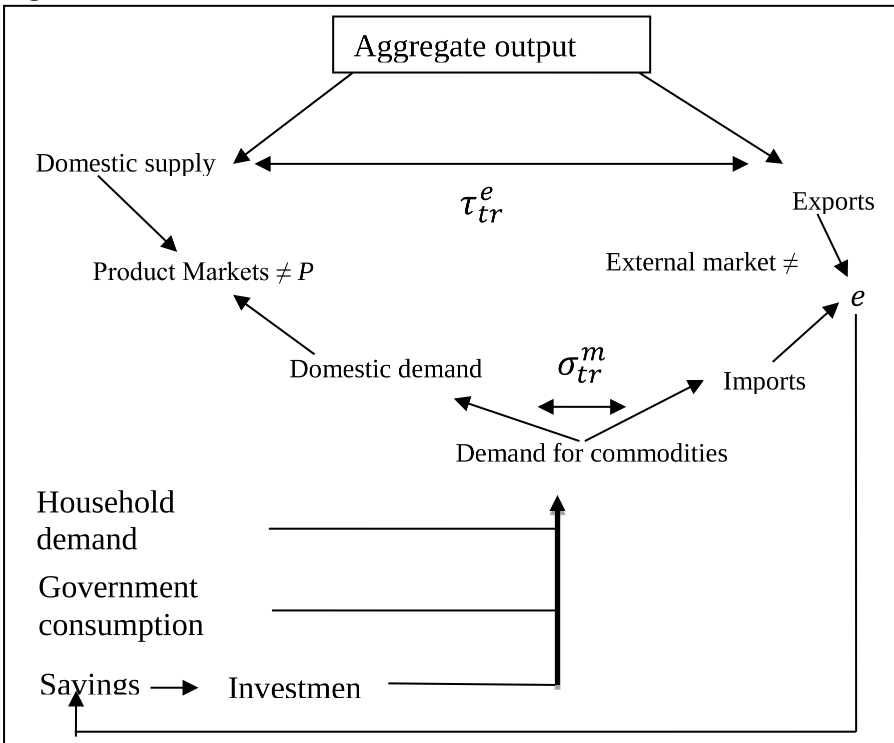
The expenditure minimization yields equation (4.22) describing import demand for the tradable good:

$$M_{tr}^{m} = \left[\left(\frac{Pd_{tr}}{Pm_{tr}}\right)\left(\frac{\alpha_{tr}^{m}}{1-\alpha_{tr}^{m}}\right)\right]^{\sigma_{tr}^{m}} D_{tr} \qquad (4.22)$$

where σ_{tr}^{m} is substitution elasticity and $\sigma_{tr}^{m} = 1/(\rho_{tr}^{m} + 1)$.

Equation (4.20) shows that the ratio of imports to domestic sales (M_{tr}/D_{tr}) depends on the domestic product price relative to the import substitute price (Pd_{tr}/Pm_{tr}).

Figure 4.2 Flows of marketed commodities



The Symbol $\neq P$ represents a market mechanism with equilibrium price P.

σ_{tr}^{m} is elasticity of substitution between imports and domestic goods

τ_{tr}^{e} is elasticity of transformation between exports and domestic goods

Source: Adapted from (Sadoulet & Janvry, 1995)

Aggregate domestic market demand for a commodity is composed of private and public demand. Private demand comprises of consumption by households, intermediate consumption by activities, and investment. Public demand consists of government consumption and public investment. Therefore:

$$Q_{Dj} = \sum_h C_{jh} + \sum_i DI_{ji} + C_{jG} + INV_j \qquad (4.23)$$

where Q_{Dj} is total domestic demand for commodity j , $\sum_h C_{jh}$ is total household consumption demand for commodity j , DI_{ji} is total intermediate demand for commodity

j by activity i, C_{jG} is government consumtion demand for commodity j, and INV_j is investment demand (private and public) for commodity j .

4.3.4 Prices

The model encompasses a system of price equations that guide decisions in production, commodity supply and demand. In production, the value-added-price is given by each activity's total revenue less the value of intermediate inputs. Therefore:

$$PVA_i = \frac{P_i X_i - \sum Pc_i DI_{ji}}{VA_i} \qquad (4.24)$$

where VA_i and PVA_i are value-added and price for value-added for activity i, P_i is producer price of good i, X_i is output of activity i, Pc_i is consumer price of composite good i, and DI_{ji} is intermediate demand of good *j* by activity i. Recall the earlier assumption that government employs its factors at the market rental and wage rates. This assumption implies that the definition of value-added price also defines the government services value-added such as healthcare and the consumer price pertains to the unit cost of healthcare to the government.

Capital is assumed to be fixed, earning a sector-specific wage while labour is mobile across sectors, so that the rate of return to factors is given by:

$$\mathrm{r}_{nag} = \frac{PVA_{nag}VA_{nag} - wLD_{nag}}{\overline{KD}_{nag}} \qquad (4.25)$$

where w is the wage rate, LD_{nag} and KD_{nag} are demand for labour and capital by non-agricultural activity, nag.

$$r_{agr} = \frac{rc.CF - wLD_{agr}}{\overline{KD}_{nag}} \qquad (4.26)$$

$$rc = \frac{PVA_{agr}\,.VA_{agr} - rl\,.\overline{LAND}}{CF} \qquad (4.27)$$

The domestic market producer price is augmented by indirect taxes so that the market price is given as:

$$Pd_i = (1 + t_i)P1_i \qquad (4.28)$$

where Pd_i is the domestic market price of good i (including taxes), $P1_i$ is the domestic price at factor cost of good i (excluding taxes) and t_i is tax rate on good i .

In international markets, the small country assumption is adopted for the Ugandan economy. As a consequence prices for imports and exports are determined on the world market and fixed for Uganda. The nominal exchange rate transforms the world prices into local currency so that Ugandan consumers pay a domestic market price for imported commodities, including tariffs and domestic taxes. Therefore:

$$Pm_i = (1 + t_i)(1 + tm_i). \bar{e} . \overline{Pwm_i} \quad (4.29)$$

where Pm_i is the domestic price of imported good i, tm_i is tariff rate on imported good i , $\bar{e}$ is exchange rate and Pwm_i is international price of import good i in foreign currency.

Similarly the price received by domestic producers for their exports is converted into local currency by the exchange rate and discounted by the export tax rate. Therefore:

$$Pe_i = \frac{\bar{e} . \overline{Pwe_i}}{1+te_i} \quad (4.30)$$

where $\overline{Pwe_i}$ is the world price of export i in foreign currency. The export tax rate (te_i) reduces the price received by domestic producers compared to the world market price for their product.

The composite consumer price is a weighted average of domestic prices and import prices, taking into account compensatory sales tax (t_s);

$$Pc_{tr}Q_{tr} = (1 + t_s). [Pd_{tr}D_{tr} + Pm_{tr}M_{tr}] \quad (4.31)$$

where Q_{tr} and D_{tr} are demand for composite good tr and domestic good tr, respectively.

Similarly the average producer price is a weighted average of the local price at factor cost and export prices;

$$P_{tr}X_{tr} = P1_{tr}D_{tr} + Pe_{tr}E_{tr} \tag{4.32}$$

The price of investment is based on the model assumption that value shares of individual goods in total investment demand is fixed. Therefore:

$$Pinv = \prod_i \left(\frac{Pc_i}{\mu_i}\right)^{\mu_i} \tag{4.33}$$

where $Pinv$ is price of investment, μ_i is share of the value of good i in total investment demand and Pc_i is consumer price of composite good i .

The general price index (also known as the GDP deflator) is the sum of value-added prices weighted by the shares of value-added of each activity in total GDP. Therefore:

$$Pindex = \sum_i \partial_i PVA_i \tag{4.34}$$

where ∂_i is the share of activity i in total value-added.

The price relationships presented above imply that any exogenous change in the price of a variable will generate secondary effects on the price of output in the economy. For instance, an increase in the public healthcare budget which raises the wage rates in the health sector implies that the price of value-added in health increases and ultimately, the cost of healthcare output increases. This result has two different implications for healthcare in Uganda. For private healthcare, a higher price for healthcare may reduce the welfare improvement for categories of households consuming private healthcare. On the other hand, a higher price for healthcare output means the cost of bringing public healthcare to the market rises, which may necessitate increasing the healthcare budget in order to provide the same level of care as before the policy implementation. Increasing the health budget implies fewer resources are available for other government functions. The net effect of the increased public healthcare expenditure is, however, deduced after incorporating the health effect on effective labour supplies arising from the healthcare provision.

4.3.5 Household income, savings and expenditure

The Ugandan model specifies five groups of household categorised according to residence (rural and urban) and whether they are farming or non-farming (household head engaged in non-agricultural activities). The households receive income from the users of their factors of production namely labour, capital and land; dividends from enterprises; and transfers from other households, the government and the rest of the world.

Thus, household income is given by:

$$YH_h = \lambda_h^w \,.\, w \sum_i LD + \lambda_h^r \sum_i r_i \overline{KD}_i + \lambda_h^l \,.\, rl \,.\, \overline{LAND} + \overline{DIV}_h + TR_{ng} + TR_g + \bar{e}.TR_{ROW} \quad (4.35)$$

where YH_h is income of household h , $\overline{DIV}_h$ is dividend paid to household h, TR_{ng} is transfer from domestic non-government institutions to household h such as transfers from other households, TR_g is government transfer to household h , TR_{ROW} is transfers from the rest of the world to household h converted into local currency by the exchange rate $\bar{e}$, λ_h^w is share of total labour income in received by household h , λ_h^r is share of total capital income received by household h , and λ_h^l is share of total land income received by household h .

Equation (4.35) shows that wage earnings are linked to household income through ownership of factors of production. This means that any change in wage rates, for instance, brought about by increased public healthcare expenditure, will cause total factor earnings, and therefore household income, to change.

Households use their income to pay taxes to government and for commodity consumption expenditure[40]. The household consumption preference function includes both private and public goods such as public healthcare[41]. The remainder of the household income, after

[40] Household commodity consumption comprises both marketed goods and services valued at market prices, and own produced goods that are valued at activity-specific producer prices.

[41] Note that public healthcare does not have a market price. It is provided freely by government but rationed using non-price mechanisms. The cost to the consumer is represented by his willingness to pay to obtain the public health care, given the non-price rationing. This implies that, even if the direct purchase price of healthcare is zero to the consumer, consumer welfare will be affected by a policy intervention that alters a consumer's willing to pay to obtain the free healthcare. Illustratively, a household utility at time t is a function of non-healthcare consumption z , private healthcare consumption s and public healthcare consumption h so

consumption expenditure, is saved according to the households' marginal propensities to save. Therefore, household disposable income and household saving are given by equations (4.36) and (4.37) respectively:

$$YDH_h = YH_h - DTH_h \tag{4.36}$$

$$SH_h = ADJ.\psi_h.YDH_h \tag{4.37}$$

where YDH_h is household h disposable income, DTH_h is direct tax on household h income, SH_h is household h savings, ADJ is an adjustment variable for household h savings, and ψ_h is household h marginal propensity to save.

Equation (4.37) suggests that household disposable income levels will change if household income changes therefore providing a relevant linkage to assess changes in welfare and poverty rates brought about by the healthcare financing policy reform. Specifically, the disposable income is shown as the net of taxes and savings implying that a tax (such as the earmarked health tax) reduces disposable income, which in turn, is directly linked to the level

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that $u(t) = u(z, s, h)$. For an illustration of the non-price public rationing and consumer utility, see (Grassi & Ma, 2010). Given this proposition, the welfare impact of a public healthcare policy can be modelled by assuming that, it is either a purely a free-good to the consumer (so that you differentiate welfare impacts with and without the public good) or a public good for which a consumer incurs an indirect cost to obtain it. In this model, the latter is chosen because it reflects the reality in Uganda where public healthcare is rationed through waiting times, which, in some instances, has been cited as a barrier to equity in access for care. Thus, the evaluation of the policy intervention on the overall welfare impact is observed from the overall equilibrium effects of the policy intervention as it alters the prices of goods in the consumer's consumption basket including the cost of obtaining public healthcare.

of household consumption demand. Since prices are explicitly modelled in this CGE, disposable income can be expressed in real terms so that the policy impact through the disposable income linkage with household consumption demand is expressed as changes in real consumption expenditure by households.

A household's disposable income is allocated to consumption by maximizing a Stone-Geary utility function under a linear expenditure system (LES)[42]. Therefore, household $h's$ demand for product i is given by:

$$Pc_i C_{i,h} = Pc_i C_{i,h}^{min} + \omega_{i,h}\left(CTH_h - \sum_h Pc_i C_{i,h}^{min}\right) \qquad (4.38)$$

where $\omega_{i,h}$ is marginal share of good i in total household consumption, $C_{i,h}^{min}$ is minimum consumption of good i , $C_{i,h}$ is household h consumption of good i (volume), and CTH_h is household h total consumption (value). Total household consumption is given by the difference between a household's disposable income and savings:

$$CTH_h = YDH_h - SH_h \qquad (4.39).$$

The first term on the right hand side of equation (4.38) describes the minimum consumption quantity of each product that a consumer must consume to maintain a minimum standard of living. This minimum volume of consumption is indexed to h to allow for differences in

[42] The LES for household consumption is preferred to CES functions because it does not imply unitary income elasticities, and thus provides an opportunity to capture the impact of changes in income on the structural adjustment of the economy due to health policy changes for instance (Blonigen, Flynn, & Reinert, 1997) .

minimum consumption by different household categories. The second term in the equation represents the discretionary consumption expenditure and is determined endogenously as the difference between total consumption and the minimum consumption volume. Given the LES expenditure assumption, if the healthcare financing policy reform generates changes in relative prices, the effect on households will depend on the households' spending patterns. An empirical investigation of the impact of increasing the healthcare budget on welfare and poverty is performed for individual households in a micro-simulation model described in Section 4.4 of this chapter and results reported in Chapter 8.

4.3.6 Enterprises

Enterprises earn their income solely from returns to capital and land given as:

$$YF = \lambda^{rf} \sum_{tr} r_{tr} \overline{KD}_{tr} + \lambda^{lf} . rl. \overline{LAND} \qquad (4.40)$$

where YF is firm income, λ^{rf} is share of total capital income received by firms, λ^{lf} is share of total land income received by firms.

Enterprises pay dividends to households and the rest of the world, direct taxes to the government and the residual income is saved. Therefore:

$$SF = YF - \sum_{h} \overline{DIV}_{h} - \bar{e}. \overline{DIV}^{row} - DTF \qquad (4.41)$$

where SF is firm savings, DTF is direct tax revenue paid by firms, $\bar{e}$ is exchange rate, and $\overline{DIV}^{row}$ is dividends paid to the rest of the world.

Although dividends are modelled as exogenously determined, other cases may arise where dividends could be determined endogenously as a residual. For instance if a firm decided to re-invest profits and increase the capital stock and if that firm does not have the opportunity to borrow from the financial market it could opt to save a substantial part of the operating surplus and redistribute the residual as dividends.

4.3.7 Government income and expenditure

The government receives revenue from direct taxation of factors of production such as wage income tax, indirect taxation from domestic production and commodity outputs and import tariffs, and transfers from the rest of the world. Therefore:

$$Y_G = \sum_i TI_i + \sum_i TE_i + \sum_i TM_i + \sum_i DTH_h + DTF + \sum_i TRG_{ROW} \qquad (4.42)$$

where Y_G is government income, TI_i is revenue from indirect taxes, TM_i is revenue from import tariffs, TE_i is revenue from export taxes, on good i, and TRG_{ROW} is transfer to the government from the rest of the world, such as international aid.

Income taxes (on household and firms), export and import taxes are modelled as a fixed proportion of the value of income, exports and imports respectively (equations 4.44 - 4.47) and indirect taxes on sales on local production are evaluated at producer prices just as imports are evaluated at domestic prices, which include tariffs (equation 4.43). Therefore:

$$TI_i = t_i[P_iX_i - Pe_iE_i + (1 + tm_i).\bar{e}.\overline{Pwm_i}M_i] \quad (4.43)$$

$$TM_i = tm_i.\bar{e}.\overline{Pwm_i}M_i \quad (4.44)$$

$$TE_i = te_iPe_iE_i \quad (4.45)$$

$$DTH_h = TYR_h.tyh_h.YH_h \quad (4.46a)$$

$$TYR_h = 1 + \overline{TINSADJ}_h.tyh_h \quad (4.46b)$$

$$DTF = tyf.YF \quad (4.47)$$

where t_i is tax rate, tm_i is tariff rate and te_i is export tax rate on good i respectively, tyh_h is direct tax rate on income of household h , tyf is direct tax rate on firm income, TYR is uniform compensatory tax rate on household income and $\overline{TINSADJ}_h$ is direct tax scaling factor for households, an exogenous variable, $P_i, Pe_i, \overline{Pwm_i}$ are producer price, domestic export price, international import price in foreign currency, of good i; and E_i, M_i are the volume of exports and imports of good i.

Government revenue is used for expenditure (E_G) on commodity consumption (service provision such as healthcare), $\overline{QG_c}$, and transfers TR_G, and the remainder is saved, S_G.

$$Y_G = E_G + S_G \tag{4.48}$$

$$E_G = Pindex.\overline{QG_c} + TR_G \tag{4.49}$$

The total government commodity consumption, $\overline{QG_c}$, is exogenously determined and fixed in real terms (relative to the numeraire). The real government consumption demand for a commodity is determined by the previous year's real government consumption of commodity $QG_{c,t-1}$ and a consumption demand adjustment factor $\overline{GADJ}$.

$$QG_{c,t} = \overline{GADJ}.\overline{QG}_{c,t-1} \tag{4.50}$$

The fiscal balance is a flexible residual denoted as:

$$S_G = Y_G - E_G \tag{4.51}$$

The foregone presentation of government income and expenditure suggests that any changes in production, exports and imports and household incomes will affect the government budget. For instance, if the government health budget leads to an expansion in the health sector (a service sector) but a decline in some sectors such as construction, it implies a reduction in output from the declining sectors, less revenue from output tax, and possibly a lay-off of some workers in the declining sectors so that household incomes decline and therefore, less revenue is obtained from direct household tax. However, from a healthcare point of view the direct impact of an expansion in the health sector budget is offset by the benefits of the expanding healthcare provision to the health status of the population. The net outcome of increasing the health budget is investigated empirically for Uganda and the results reported in Chapters 7 and 8 of this thesis.

Total savings in the economy are a sum of domestic savings and foreign savings. Therefore:

$$S = \sum_h SH_h + \sum_f SF + S_G + \overline{e}.S_x \qquad (4.52)$$

where $\overline{e}.S_x$ is foreign capital inflow converted to local currency by the exchange rate. Domestic savings and foreign savings are used to finance current investment.

4.3.8 Investment

Sector investment demand is a fixed share of total investment. Investment by sector i is given by the sector's share indexed by the price of investment (see equation 4.29) in that sector. Therefore:

$$INV_i = \frac{\mu_i IT}{Pc_i} \qquad (4.53)$$

$$IT = \overline{ITvol}\,.Pinv \qquad (4.54)$$

where μ_i is the share of the value of good i in total investment demand, INV_i is investment demand for good i, IT is total investment (value), $ITvol$ is total investment (volume), and $Pinv$ is investment price index. It is assumed that $\sum_i \mu_i = 1$ and the substitution elasticity between different commodities in the investment total is unity.

Since the applied model incorporates dynamic features investments influence the capital stock of the various activities. The specification for capital accumulation in the dynamic model is presented in section 4.3.9 on recursive dynamics.

In equilibrium the economy's total savings equal total investment. Therefore:

$$S = I \tag{4.55}$$

4.3.9 Model closure

The model includes a set of system constraints to capture the equilibrium in all markets. These constraints pertain to model closure rules, which entail specifying exogenous variables that will ensure that the number of the unknowns is equal to the number of equations so as to obtain a solution. The macroeconomic closures, that must be specified for the model to find an equilibrium solution include: the fiscal balance, the external trade balance and the savings-investment balance.

For fiscal balance, Equation (4.51) must always be balanced. The model for this study assumes government savings are flexible while all tax rates and real government consumption are fixed. That is to say, government savings adjust if revenue receipts change. For government expenditure, the government commodity consumption demand scaling factor is fixed while the government function shares and transfers are endogenously determined. This specification of the government account allows for modelling an increase in the share of government healthcare consumption within the available government expenditure.

The adopted external balance closure specifies fixed foreign savings while the real exchange rate is flexible to clear foreign exchange markets. The nominal exchange rate is indexed to the consumer price index (CPI) (which is the numeraire) fixed at its base. The fixed foreign savings closure is necessary to allow for the modelling of increased foreign inflows in the form of aid for healthcare.

For savings-investment balance, the model assumes a savings-driven economy to align with the chosen government function closure above. As a result, the marginal propensities to save for households and enterprises are fixed and real investment expenditure adjusts to equal the volume of savings available to finance it. Alternative closure rules are experimented with and discussed in Section 9.4 of the sensitivity analysis Chapter 9.

4.3.10 Recursive Dynamics

The foregone model description has specified the within-period interactions of different actors in the Ugandan economy – the static model. However, the impact of healthcare financing policy changes will have effects spanning more than one period, such as the intertemporal effects of investment and capital accumulation as well as the health effects that take long to manifest. The intertemporal and lagged effects need to be captured in a dynamic set up of the model over the model horizon – a between-period model. The model is solved for a single period and the solution for that period forms the basis for next model run, and the process continues, forming a recursive dynamic.

The relevant between-period adjustments include capital accumulation and sectoral capital allocation, population and labour force growth, factor productivity growth and changes in government consumption expenditure. The updating process for each of these variables is described in detail in the following sub-sections[43]. The updating equations in this section do not apply to the first year, and the subscript t – denotes time periods, f denotes factor[44] and a denotes activity. Values for the variables in the initial year are fixed.

4.3.10.1 Capital accumulation

Capital accumulation is modelled endogenously whereby investments in the current period build on the new capital stock for the next period (Equation 4.56).

$$K_{i,t+1} = K_{i,t}(1 - \partial) + k_i INVTOT_t \quad (4.56)$$

[43] The updating process described here is an extension of the IFPRI static model to a dynamic model in Thurlow (2004).

[44] The current Ugandan model specifies only one type of capital. However, for generality, the subscript f is maintained in the capital updating equations in this model because there is a possibility of disaggregating capital accounts in the SAM when data availability permits.

where ∂ is the depreciation rate of the capital, $INVTOT_t$ is the total investment in the current period (t), and k_i is the share of each sector in total capital in the initial year. This feature enables the model to capture the impact of healthcare reform policies on capital accumulation.

The pertinent issue with the treatment of capital in the dynamic model is how the new capital stock is distributed across the production sectors in Uganda. A simplified step-wise sectoral capital updating process is presented in the following narrative. First, the model calculates the average economy-wide rental rate for capital $(AWF_{f,t}^{a})$ for a given period of time, based on the aggregate value-added specification, (Equation 4.14). The average capital rental rate is given by the total of the rental rates of each sector weighted by the sector's share of total capital factor demand (Equation 5.57).

$$AWF_{f,t}^{a} = \sum_{a}\left[\left(\frac{QF_{f\,a\,t}}{\sum_{\acute{a}} QF_{f\,\acute{a}\,t}}\right).WF_{f\,t}.WFDIST_{f\,a\,t}\right] \qquad (4.57)$$

Second, the each sector's share in the new capital investment, $(\eta_{f\,a\,t}^{a})$, is calculated in the following formulation:

$$\eta_{f\,a\,t}^{a} = \left[\frac{QF_{f\,a\,t}}{\sum_{\acute{a}} QF_{f\,\acute{a}\,t}}\right].\left[\beta^{a}.\left(\frac{WF_{f\,t}.WFDIST_{f\,a\,t}}{AWF_{f\,t}^{a}} - 1\right) + 1\right] \qquad (4.58)$$

where β^{a} is capital sectoral mobility.

Equation (4.58) shows that the sector's new share of capital will depend on both the productivity of capital in the sector and the level of inter-sectoral mobility of capital. If a sector's rental rates are above average, it would imply that the marginal revenue product of capital in that sector is above one. The converse is true if the sector's rental rates are below the average economy-wide rates. If β^{a} is non-zero, higher capital productivity sectors attract new levels of capital. However, if β^{a} is zero (an extreme case), the assumption is that all new capital investment in sectors with higher than average rental rates, is funded by retained profits. Third, the quantity of new capital is calculated as the value of gross fixed capital formation divided by the price of capital ($PK_{f\,t}$). This is further multiplied by each sector's share of new capital to obtain a final quantity allocated to each sector ($\Delta K^{a}_{f\,a\,t}$), as follows.

$$\Delta K^{a}_{f\,a\,t} = \eta^{a}_{f\,a\,t}.\left(\frac{\sum_{c} PQ_{c\,t}.QINV_{c\,t}}{PK_{f\,t}}\right) \tag{4.59}$$

The unit price of capital is a weighted market price of investment commodities.

$$PK_{f\,t} = \sum_{c} PQ_{c\,t}.\frac{QINV_{c\,t}}{QINV_{\dot{c}\,t}} \tag{4.60}$$

Finally, the new sectoral quantities of capital ($QF_{f\,at+1}$) are updated from previous levels to include new additions to the capital stock while taking account of the depreciation rate of capital (∂_{f}) as a reducing factor.

$$QF_{f\,at+1} = QF_{f\,a\,t}.\left(1 + \frac{\Delta K^{a}_{f\,a\,t}}{QF_{f\,a\,t}} - \partial_{f}\right) \tag{4.61}$$

The new aggregate quantity of capital ($QFS_{f\,t+1}$) is adjusted in a similar way.

$$QFS_{f\,t+1} = QFS_{f\,t}.\left(1 + \frac{\sum_{a} \Delta K_{f\,a\,t}}{QFS_{f\,t}} - \partial_{f}\right) \tag{4.62}$$

4.3.10.2 Population growth

Population growth rates are exogenously supplied from a linked demographic model for Uganda[45]. It is assumed that consumption demand increases due to a growing population thus raising the supernumerary income level of households[46]. Specifically, the updating process for population growth works through total household consumption value. Ugandan households allocate income to consumption under a linear expenditure system, as described in Section 4.3.4. The consumption allocation, Equation (4.38) - ($\boldsymbol{Pc_i C_{i,h} = Pc_i C_{i,h}^{min} + \omega_{i,h}\left(CTH_h - \sum_h Pc_i C_{i,h}^{min}\right)}$ – shows that there is a consumption quantity that is independent of income, $\boldsymbol{Pc_i C_{i,h}^{min}}$, and therefore unaffected by changes in disposable income. It is assumed that as the population grows the minimum household consumption ($\boldsymbol{C_{i,h}^{min}}$) demand for a given commodity increases. In the model dynamics, therefore, household commodity consumption increases by the minimum consumption quantity of each commodity, which is set to grow at the same rate as the population growth rate. Given the linear relationship between income and consumption under the LES specification, the marginal consumption share remains constant even as population grows. It is assumed that growth in population affects average consumption and not marginal consumption demand and new consumers have the same preferences as existing consumers.

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[45] The IFPRI model links population growth based on the UN demographic model for Uganda.

[46] This derives from the consumers consumption expenditure as represented in a linear expenditure system (LES): $C_i = \alpha_i + \beta_i(Y - \sum P_i\,\alpha_i) \quad (i = 1, 2, \ldots\ldots, n)$, where Y is total nominal income, α_i is the committed expenditure for the i^{th} item, $(Y - \sum P_i\,\alpha_i)$ is the supernumerary income, and β_i is the marginal budget share that determines the allocation of the supernumerary income (Dervis et al., 1982). With a given level of income, after securing the minimum subsistence level, of say food or healthcare, consumers buy more of healthcare according to a fixed rate of supernumerary income. The more consumption increases the more the standard of living increases. In the Ugandan healthcare context, after buying medicines from a drug shop for instance (subsistence minima), consumers may increase healthcare consumption by moving to a higher level such as visiting a clinic to seek care and consult with a doctor or specialist.

4.3.10.3 Labour force growth

The updating equations for the labour force supply depend on the labour market closure adopted in the model. The Uganda model described in this study assumes that labour supply is fixed and the real wage adjusts to equate demand and supply. Therefore, for the dynamic baseline, the fixed level of labour supply adjusts exogenously from a linked demographic model for Uganda[47] while the scenarios design described in Chapter 6 describes the growth rates for policy simulations.

4.3.10.4 Total Factor - and Factor specific - Productivity growth

The updating process for factor productivity includes specifying a growth adjustment factor which is multiplied by the total factor productivity term or the factor-specific productivity term, in the value-added equations. Factor productivity rates are updated according to observed trends from previous studies, as elaborated in Chapter 6.

4.3.10.5 Government consumption growth

Government consumption expenditure is an important variable in this modelling exercise of the Ugandan economy. The single-period model specifies the government (re)current expenditure to include commodity consumption, which is fixed in real terms, and government transfers - (Equations (4.49) - $E_G = Pindex.\overline{QG_c} + TR_G$). The real government commodity consumption demand (which includes public services such as healthcare), is determined by

[47] The linked demographic model is based on the UN population growth and demographic model for Uganda.

the previous period's consumption and a consumption demand adjustment factor (Equation (4.50) - $QG_{c,t} = \overline{GADJ}.\overline{QG}_{c,t-1}$). The updating process therefore involves increasing government spending value QG_c through the exogenous adjustment of government demand $GADJ$.

4.3.11 Calibration and model parameters

CGE models are not estimated but rather they are "calibrated". Calibration involves specifying values for parameters of model equations such that the model solution replicates the benchmark data set of the economy represented in the SAM (Sadoulet & Janvry, 1995; Shoven & Whalley, 1984). The Uganda CGE model is initially calibrated from the Uganda SAM, purposefully built with a disaggregated health sector (as indicated earlier, and detailed in Chapter 5). Share parameters are directly derived from the SAM following the Harberger convention (Dervis et al., 1982; Sadoulet & Janvry, 1995). That is to say, all physical units are defined so that all prices equal to one in the base year of the model, implying that sectoral flows in the SAM measure both real and nominal magnitudes. This normalisation rule allows for the computation of initial quantities and prices[48]. In addition to the SAM parameters, values of parameters for behavioural relationships that go beyond the fixed values or fixed shares - production, consumption, and import and export decisions are specified exogenously. These can be estimated if data is available but it is common practice in CGE modelling to use values from previous studies of countries with similar characteristics or approximate values which are then tested in a sensitivity analysis. Table 4.1 presents the elasticity values used in

[48] Normalising prices in CGE models refers to translating value data as presented in the SAM into price and quantity data for reporting purposes. The procedure converts most of the initial or base prices into one unit of the currency used in the model so that quantities of goods and factors of production are interpreted as per the unit of currency. The procedure is attributed to (Harberger, 1964) who first used it when analysing the general equilibrium effects of the U.S. income tax.

the model. In Uganda, government services including healthcare are neither exported nor imported and therefore ordinarily, have no trade elasticity values.

Table 4.1 Elasticity values for model calibration

	Trade elasticities		Production elasticities	
	Armington	Transformation	Factor substitution between factors	Factor substitution between aggregate factors and intermediate inputs
Agriculture	3.3	3.3	0.7	0.7
Mining	0.9	0.9	0.7	0.7
Food processing	3.9	3.9	0.7	0.7
Non-food processing				
Fuel	2.1		0.7	0.7
Chemicals	3.3	3.3	0.7	0.7
Machinery	3.8	3.8	0.7	0.7
Utilities	2.8		0.7	0.7
Private services				
Government services				
Administration			0.7	0.7
Education			0.7	0.7
Health			0.7	0.7
Government Expenditure elasticities				
Government function	*Elasticity*			
Administration	5.28			
Education	2.03			
Primary healthcare	1.23			
Other healthcare	1.19			

Source: (Dimaranan & McDougall, 2002) and government expenditure values are computed from (Uganda Bureau of Statistics, 2013)

The GTAP data base is the main source of the trade and production elasticity values used to calibrate the model in this study (Dimaranan & McDougall, 2002). These are complemented by other elasticity values sourced from the literature on developing countries compiled by (Annabi, Cockburn, & Decaluwé, 2006). For the locally produced tradable commodities the substitution and transformation elasticity parameter values, (σ^{m}) and τ^{e}) are assumed to be the same as presented in Table 4.1. Elasticity of factor substitution parameters $(\sigma^{kl}, \sigma^{cl})$ – at the bottom of technology nest - take the value 0.7, which means a change in relative factor prices will lead to relatively small changes in factor proportions. Elasticity of government expenditure values are calculated from government functional expenditure shares obtained from the national accounts for the year 2010/11. A demand elasticity parameter value of 0.9 is imposed for all commodities for the household demand elasticity implying that household consumption patterns respond less than proportionately to changes in commodity prices. The representative demand elasticity value used here corresponds to the food demand elasticity estimated using the 2005/06 Uganda national household survey (UNHS) (Boysen, 2012)[49]. The Frisch parameter[50] (η) is set to 1 which implies that when income levels increase by 10%, the marginal utility of income declines by 10%. Conversely, with increasing levels of income the satisfaction derived from spending an extra unit of income declines. The representative income elasticity value used here is corroborated by Boysen (2012) findings, which indicated that all households were willing to adjust their food consumption when incomes change, although the urban households were, on average, more likely to reduce the food share in the consumption basket relative to rural households. These expenditure patterns by households can be insightful when it comes to evaluating a healthcare policy that impacts earnings and therefore income levels, through increased healthy days and consequently, higher labour productivity.

[49] Boysen (2012) estimated a household demand system for Uganda with a focus on food demand. The work involved estimating a two-stage demand system where in the first stage households allocate their consumption budget to food and non-food items, and in the second stage households allocate the food budget to different food item groups. The first stage estimation is represented by a Working-Laser type Engel curve and the second stage by a Quadratic Almost Ideal Demand System (QUAIDS).
[50] The Frisch parameter measures the elasticity of the marginal utility of income with respect to income. In the LES, the Frisch parameter is equal to the ratio of total expenditure to supernumerary expenditure.

4.3.12 Welfare

Welfare is one of the criteria commonly used to evaluate the impacts of a given policy. In CGE, the Hicksian compensating and equivalent variations, CV and EV[51]; are commonly preferred measures of welfare change compared to other measures (e.g. change in utility, consumer surplus, and real income)[52]. This is because both CV and EV relate to demand for a commodity, its own price, and a constant level of utility (as opposed to constant level of income in the Marshallian demand curve). In this regard, they are path independent in relation to multiple prices and income changes such that a unique measure of impact of any combined price and income changes can be derived. CV and EV are defined as:

$$CV_h = \frac{U_h^1 - U_h^0}{U_h^1} Y_h^1 \tag{4.63}$$

$$EV_h = \frac{U_h^1 - U_h^0}{U_h^0} Y_h^0 \tag{4.64}$$

where the superscripts 0 and 1 denote the consumer utility and income before and after the policy change respectively. The economy-wide welfare is the sum of household EV computed as:

$$EV = \sum_h EV_h \tag{4.65}$$

[51] CV is the amount of money which, when taken away from the consumer after the policy change, leaves the consumer with the same level of utility as before the policy change. EV is the amount of money that achieves the same level of utility to the consumer as would happen if the policy change occurred.

[52] Other measures are limited in the following respects: change in utility is defined by ordinal functions (as opposed to cardinal) that only rank preferences and therefore cannot give a measurable indicator for welfare; consumer surplus measure is dependent on the adjustment path if there are multiple price and income changes and therefore does not give a unique monetary measure for welfare change; real income measure is limited by the choice of a true price index to use in the computation. Similarly, EV and CV are limited as a measure of welfare because they fail to reflect welfare changes when utility is altered as a result of price and income changes.

If the economic policy change would increase welfare, CV represents the amount that an individual or household will be willing to pay to accept the change, while EV represents the minimum amount that the individual or household requires accepting to forego the change.

Given the provision of a public good such as healthcare, an additional qualification may be incorporated in the computation of EV to capture the direct change in well-being resulting from the consumption of the public good. Suppose each household consumes a share of the publicly provided healthcare, $\alpha_{G_{ih}}$ (G_i may be Primary healthcare or other-healthcare). Since each household takes a share of the public healthcare, $0 \leq \alpha_{G_{ih}} \leq 1, \sum_h \alpha_{G_{ih}} = 1$ and the total equivalent variation for each household is given by:

$$EV_{T_h} = EV_h + \sum_h \alpha_{G_{ih}} \cdot \left(\frac{G_i^1 - G_i^0}{G_i^0}\right). E_{Gi}^0 \quad (4.66).$$

The sum of all households' equivalent variations (including the provision of the public healthcare) is then given by:

$$EV_T = \sum_h EV_{Th} \quad (4.67).$$

4.4 The CGE-Micro simulation (CGE-MS) model for poverty analysis

Health and poverty is a topic of concern, not only to developing countries but also to the developed economies of the world. Poverty and ill-health co-exist, although sometimes the arguments for this co-existence have been divided along the direction of the causal link: poverty is a cause of ill-health or ill-health is a cause of poverty.

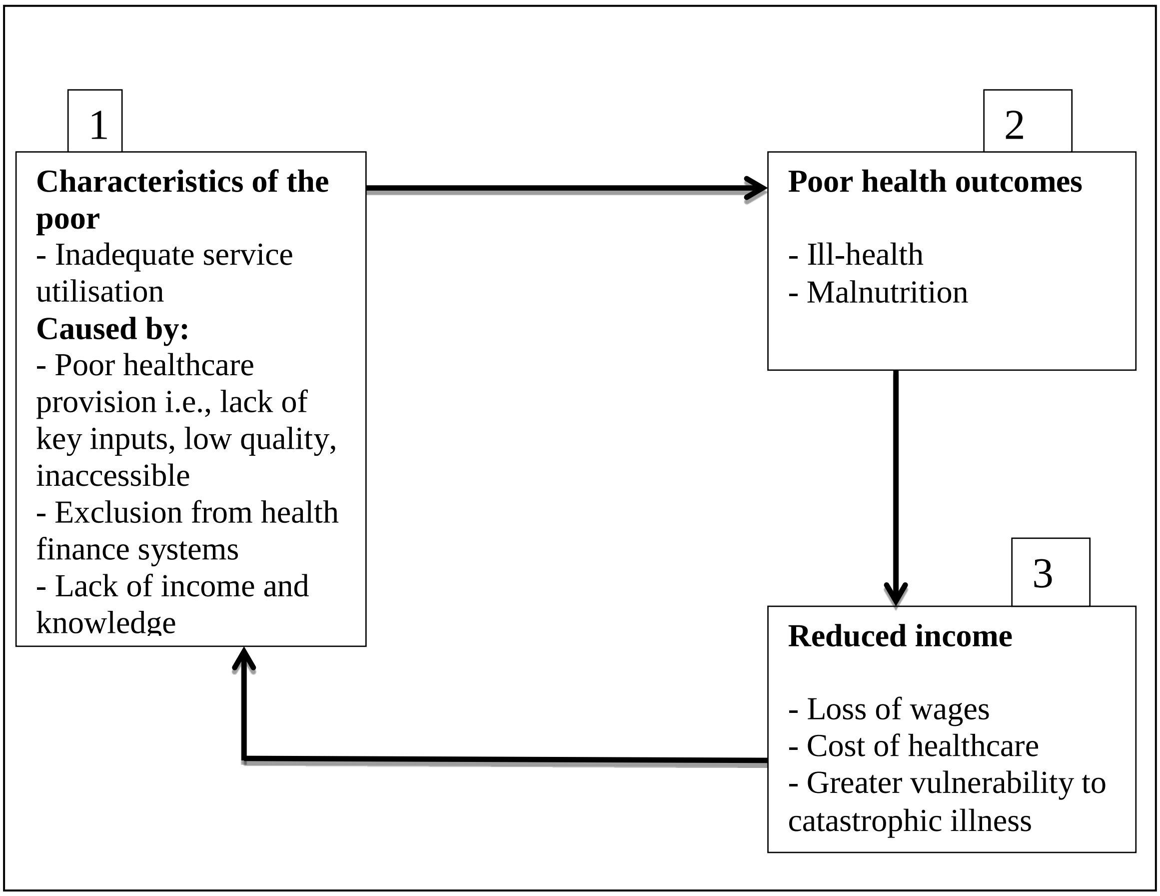
The World Bank poverty manual defines poverty as pronounced deprivation in well-being (World Bank, 2005b). However, what is meant by well-being? Several approaches have been devised to articulate the meaning of well-being. Perhaps the broadest approach to well-being and poverty is the "capability" approach advanced by the renowned welfare economist, Amartya Sen (Sen, 1983, 1992). The capability approach postulates that well-being emanates from a "capability" to function in society. Consequently, poverty is regarded as a multidimensional phenomenon encompassing the lack of key capabilities, so that people are considered poor when they have inadequate income or education, or poor health, or insecurity, or low self-confidence, or a sense of powerlessness, or the absence of rights such as freedom of speech.

Another approach is to think of well-being as the ability of an individual or households to command resources. This approach focuses on whether individuals or households have adequate resources to meet their needs. Poverty analysis would then compare the individual's or household's income or consumption to a predetermined threshold so that those that fall below the threshold are regarded as poor. It is this approach that is used for this study to analyse poverty changes after implementing an increase in the government health budget.

Yet another dimension of well-being and poverty relates to specific welfare measures such as the ability to obtain a specific consumption good. This approach goes beyond the income dimension of poverty to consider the non-income measures of well-being. For example, one may consider whether a category of people have adequate healthcare, or shelter, or education, or food. Analysis of education poverty, for instance, would consider whether an individual is illiterate or the years of formal schooling for an individual. Similarly, health poverty could consider whether individuals have access to basic healthcare.

Household level of income directly impacts on health as it provides the means to obtain the essential prerequisites for health such as food, clothing and shelter. Lack of adequate income for households to meet the basic needs, therefore, implies that there is susceptibility to ill-health, as families cannot afford to purchase necessities like a healthy diet, or afford appropriate housing. The health poverty nexus is illustrated in Figure 4.3. The (income) poor households experience low levels of healthcare service utilisation for reasons such as inadequate and/or inaccessibility to services, lack of knowledge, and or merely low quality of care provided by the health system (Box 1). Inadequate service utilisation reinforces the ill-health among the poor (Box 2), which affects their capacity to actively participate in productive activities and often it leads to a decline in their wages (Box 3). Ultimately, their incomes decline and they return to Box 1 and the cycle repeats itself.

Figure 4.3 The health-poverty nexus



Source: Adapted from (Claeson et al., 2001)

Given the health poverty nexus, this study focuses on the income poverty dimension to analyse the impact of increased government health expenditure and the envisaged health effects on poverty levels in Uganda using a household micro-simulation model. Before delving into the link between the CGE and micro simulation model for Uganda, it is important to first be clear on the poverty (welfare) measure to be used in the analysis since the results will be indicating the changes from an established minimum standard or poverty line.

There are several indicators that are widely used to evaluate consumer welfare, poverty and distributional effects of a given policy shock in CGE modelling (Burfisher, 2011; Cloutier, Cockburn, Decaluwe, Raihan, & Khondker, 2008). Firstly, change in household welfare and the overall welfare in the economy, is commonly measured by the Hicksian compensating and equivalent variations (CV and EV), as described in Section 4.3.11. Secondly, an inequality/distributional indicator commonly measured by the Gini coefficient or Theil index, but sometimes the Atkinson indicator is also used. Thirdly, there is the real consumption welfare measure used to measure the money equivalent of changes in the "real", or quantity of, consumption of goods and services (Burfisher, 2011). Finally, linked to the money measure, are the Foster-Greer-Thorbecke (FGT) poverty indices, frequently used to measure policy impact on poverty rates (Foster, Greer, & Thorbecke, 1984).

This study adopts the FGT poverty indices to analyse the impact of the healthcare financing policy reforms on changes in welfare in terms of poverty reduction rates. The FGT indices are particularly suited to measure the policy impact on consumer welfare in Uganda because they capture how policy induced economic growth trickles down to households. This is important in the Ugandan context because the GDP growth rate is often reported to be increasing but many non-technical stake holders (including legislators) claim not to comprehend the implication of GDP growth when a third of the total population continues to wallow in poverty. These indicators explicitly indicate how households are better- or worse-off by showing the changes in welfare in relation to an established minimum requirement – the official poverty line. Moreover, the FGT indices have been incorporated in the IFPRI household micro simulation model for Uganda, which is linked to the CGE model adopted for use in this study.

4.4.1 The Poverty indices

The advantage with FGT poverty indices is that they are additively decomposable which allows for a more in-depth analysis of poverty. The FGT decomposes into three indices, all of which depend on the nationally defined poverty line. Firstly, the head count index, simply measures the proportion of the population living below the poverty line, often denoted as P_0,

Mathematically, it is expressed as: $P_0 = \frac{N_p}{N}$ (4.68)

where N_p is the number of poor and N is the total population. Equation (4.68) can be rewritten as:

$$P_0 = \frac{1}{N}\sum_{i=1}^{N} I(y_i < z) \tag{4.69}$$

Where $I(.)$ is an indicator function that takes on a value of 1 if the bracketed expression is true, and 0 otherwise; so that if expenditure (y_i) is less than the poverty line (z), then $I(.)$ equals to 1 and the household is poor. N_p is the total number of the poor.

The headcount index is lauded for its simplicity to construct and is easy to understand. It is by far, the most commonly used poverty indicator. However, it is flawed on grounds that it does not take into account the intensity of poverty (does not indicate how poor the poor are and so, it does not change if people below the poverty line become poorer), and it is calculated for households and not individuals (World Bank, 2005b). It is argued that measures of poverty should be calculated for individuals and not households since even within households poverty rates may differ by gender or age (World Bank, 2005b). However, it is also important to bear in mind that individual consumption expenditure data are seldom available, since the household surveys which are a common source of consumption expenditure data, collect consumption expenditure information at the household level and not the individual level.

The second popular measure of poverty is the poverty gap index. It adds up the extent to which individuals on average fall below the poverty line and expresses it as a percentage of the poverty line. Commonly denoted by P_1, it is calculated as:

$$P_1 = \frac{1}{N}\sum_{i=1}^{N}\frac{G_i}{z} \tag{4.70}$$

where the poverty gap G_i is given as the poverty line (z) less actual income (y_i) for poor individuals. P_1 is expressed as a percentage between 0 and 100% (or a fraction between 0 and 1) so that a value of 0 theoretically means that all the extremely poor people are exactly at the poverty line while a value of 100% (1) theoretically means all the extremely poor people have zero income. By definition, it is a measure of the depth of poverty for people below the poverty line hence its calculation does not include the non-poor.

The third index is the squared poverty index which measures the severity of poverty. It is a weighted sum of poverty gaps, where the weights are the proportionate poverty gaps themselves. It is expressed as:

$$P_2 = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{G_i}{z}\right)^2 \tag{4.71}$$

By squaring the poverty gap index, the measure appears to put more weight on observations that are far below the poverty. However, the measure is not easily interpretable therefore not widely used.

4.4.2 The Top-Down CGE-Micro-simulation model

The poverty indicator evaluated by the FGT poverty indices are used in this study in a micro simulation model linked to the CGE model. This type of macro-micro modelling approach has become increasingly popular for policy impact analysis of household income distribution and poverty changes, departing from the representative household approach commonly used in CGE models. The approach has been applied to trade policy and income distribution analysis, for instance, by (Cockburn, 2002) in a model for Nepal, by (Cororaton, 2003; Cororaton & Cockburn, 2005; Savard, 2003) in the Philippines and in models for Botswana and South Africa (Thurlow, 2007, 2008b) and (Pauw, 2009). Micro-simulation has also been applied to health and health policy related studies. Micro models of health have been linked to macro models through a labour supply model, to study the economy-wide impact of a particular health problem. For instance, (Brown et al., 2009) linked a diabetes model to a CGE model of the Australian economy (MONASH), through an intermediate labour supply model, to study the impact of diabetes and the associated diabetes reduction interventions.

The use of representative groups as commonly used in CGE models has been criticised mainly on two grounds. First, the representative group assumes homogenous behaviour within the group implying that any positive or negative policy impact is distributed evenly among the group members. For instance, when analysing the policy impact on household groups, for which only the total and average household income is known, without the knowledge of within-group income distribution, it means the aim is to determine the impact of a policy shock on the group as a whole and not individual households. However, the reality may suggest otherwise, since each household may be affected differently by the policy shock and also households may not necessarily be at the same distance from the poverty line.

Second, in the CGE model, the factor market-household linkage is specified at a group level. This group specification implies that any factor income gains or losses from a policy shock are distributed to the household groups according to the proportions specified by the functional distribution of factor income in the SAM (the base data set). This kind of redistributing gains or losses to factor income is, in fact not, realistic as it ignores the actual changes incurred by individual households in the group. The micro-simulation analysis is advantageous in that it incorporates the heterogeneity of income sources and consumption patterns directly in the model. This is so that we can model the impacts of a healthcare financing policy intervention on each household.

There are variants of the micro simulation models within the CGE macro-micro modelling approaches[53]. This study adopts the IFPRI micro-simulation model which is in the category

[53] The micro-simulation literature distinguishes four possible approaches to CGE-Micro modelling. First, is to disaggregate further the representative groups in the CGE model. This can be done by simply increasing the number of representative groups in the CGE model, to as much as the data available can permit to develop the underlying SAM. Alternatively the proposal is to integrate all the survey households as individual accounts in the SAM. Second, is the category of the top-down macro-micro ‘incidence’ models - a sequential macro-micro modelling approach that combines the CGE generated aggregate changes in the income of a representative household group with information about the underlying income distributions within those representative household groups. This approach assumes individual behaviour remains the same as before the policy shock. Third, the top-down macro-micro ‘simulation’ models, the basic principles of which are similar to the macro-micro incidence models described above, except that the micro-simulation model is a behavioural model with behaviour effects estimated econometrically. In this approach, the within-group distribution of income is endogenously determined. Fourth, is the top-down/bottom-up approach proposed to tackle the problem of convergence/coherence between the micro and macro models that is often not guaranteed when linking the household model and the CGE model. For a comprehensive discussion of the advantages and shortcomings of these approaches see (Pauw, 2009) chapter 4 and (Savard, 2003)

of top-down macro-micro ‘incidence’ models. Essentially, the IFPRI version adopted for this study is a non-behavioural micro-level model linking household income changes at the aggregate level as reported in the CGE model to individual households in the micro-model. The household micro model is embedded in the 2005/06 Uganda national household survey (UNHS) data, which underlies the 2007 SAM data set, from which the CGE model is calibrated.

The CGE model and the micro simulation model are implemented sequentially. Technically, each of the households in the 2005/06 UNHS are linked directly to their corresponding representative household in the CGE model. The CGE model is implemented first and generates changes in representative households’ consumption and prices which are then passed on to the micro model. The micro model is implemented next, incorporating the changes from the CGE representative households and which are passed on to the corresponding households in the household survey, where total consumption expenditures are recalculated. A new level of per capita expenditure for each household in the survey is generated and compared to the official poverty line. This measure of poverty is the same as the official poverty estimates. The changes in poverty generated from this modelling exercise of a healthcare policy shock draw on the consumption patterns, income distribution and poverty rates captured from the UNHS 2005/6.

Note that with the IFPRI type of micro-simulation model adopted for this study any change in the aggregate income of the representative household category is shared equally among the individual households in the category. This is because the intra-household group income distribution is assumed to be fixed in the CGE model. This means that the post-simulation group distribution does not change shape but when plotted against a poverty line, the distribution will shift to the right or left depending on the size of change in income and the distribution of income within the group relative to the poverty line. This exogenous within-group income distribution function presents as a shortcoming for poverty analysis which can be improved by adopting a micro-simulation model where the income distribution is endogenously determined[54]. The extension to endogenously determine the within group income distribution has not been undertaken in this study because the current IFPRI micro-simulation model would require additional data and time to model the behavioural effects of the policy shock. However, since it is a valuable improvement to poverty analysis, the method will be adopted in the future to improve the results from the current research.

4.5 Summary

This chapter has presented the description of the CGE-Micro-simulation model for evaluating the healthcare financing reforms in Uganda. The unique characteristics pertaining to the Ugandan economy and how they are infused into the standard model are explained. The model distinguishes production across 9 production sectors purposefully aggregated from the micro SAM. The model closure rules relevant to the study question are explicitly presented. In the factor market, labour is fully employed and mobile across sectors. The government balance is maintained by fixing government consumption and taxes so that government

[54] See for example (Pauw, 2009) , (Herault, 2005) and (Robilliard, Bourguignon, & Robinson, 2001). In this case, household level CGE results that are likely to influence a household's income such as wages for labour market and returns to capital, are linked to a specified behavioural micro model which is run separately. For instance, the micro simulation model for the labour market behaviour is specified to model the labour participation decisions, the allocation of job gains and losses, and earnings. In the labour market micro model key labour market changes generated by the CGE model are linked to individuals in the micro simulation, in contrast to the micro 'incidence' model where the changes in the real household income generated by the CGE model are linked to households in the micro simulation model. This type of micro-simulation does not only provide an endogenous within-group distribution function but could also produce a different distribution altogether when compared with the CGE model.

savings are a flexible residual. The model is savings driven with a flexible exchange rate to balance the external account. Additionally, the description of the household micro-simulation model and how it is linked with the CGE model for poverty analysis is presented. It is noted that the top-down micro 'incidence' model used adopted by this study could be extended to a behavioural micro-simulation model that allows for the endogenously determined with-in group income distribution function to improve the poverty analysis module.

CHAPTER 5: THE SOCIAL ACCOUNTING MATRIX FOR UGANDA AND THE DISAGGREGATION OF THE HEALTH SECTOR

5.1 Introduction

This chapter describes the 2007 Social Accounting Matrix (SAM) for Uganda and the steps taken to disaggregate the health sector in that SAM. A SAM is a comprehensive, economy-wide data framework representing the economy by capturing the financial value of transactions and transfers between all economic agents in the system, for a given period of time, usually a year. It is a square matrix with each account represented by a row (income) and a column (expenditure), that is to say, the double entry system of accounting. The sources of data for the construction of a SAM are diverse but a country's national accounts are usually the starting point for most SAMs constructed (Lofgren et al., 2002; Robinson, Cattaneo, & El-Said, 2000). The periods for which data is available may also vary within a given source. Therefore, it is usually necessary to readjust the initial SAM entries in order to fulfil the principle of double entry accounting that underlies SAM construction. The process of readjustment is known as "SAM balancing" for which standard balancing methods have been developed (Robinson et al., 2000).

The rest of the chapter is organised as follows. In Section 5.2 the structure of the 2007 Uganda SAM is presented and analysed while Section 5.3 presents the disaggregation of the health sector in the 2007 SAM, describing the treatment of entries in the SAM that are linked to the health sector along with data sources. The cross entropy method is one of the SAM balancing techniques widely used by researchers, and is adopted in this study as described in

Section 5.4. Section 5.5 concludes with insights and lessons learned from updating and disaggregating the SAM.

5.2 Description of the Uganda SAM 2007

The Uganda micro SAM 2007[55] is a 122 by 122 matrix representing 50 sectors, 6 factors, and 8 institutions; with a GDP of 21 billion shillings comprised of 21.4% agriculture, forestry and fishing; 25.8% industry; and 46.9% services including healthcare (as of 2010 the total healthcare expenditure as a percentage of GDP was 9%)[56]. Table 5.1 presents the macro SAM, which is an aggregation of the micro SAM accounts into activities, commodities, factors, institutions and taxes accounts. The economy largely produces for domestic consumption. Specifically, 41% of domestically produced goods and services are purchased by households for final consumption, 26% are used by enterprises as intermediate inputs, 11% for investment, and 8% are exported while the government consumes about 6%. Almost all household income accrues from factor payments either directly or indirectly through enterprises. The government earns a considerably large share of its income (35%) from foreign transfers indicating the significance of foreign aid to the Ugandan economy. Similarly, it earns 27% from import tax compared to 17% from commodity tax and 18% from direct taxes (by households and enterprises). This further reveals the economy's vulnerability to external shocks and a narrow domestic tax base. Moreover, government domestic investment is only 24% compared to 42% from foreign sources and 34% from households.

[55] Original SAM was constructed under a project by IFPRI details of which can be found in (Thurlow, 2008a) .
[56] (World Health Organisation, 2012)

Table 5.1 The Macro SAM (Million Uganda Shillings)

	ACT	COM	FAC	HOU	GOV	ROW	S-I	INSTAX	IMPTAX	COMTAX	TOTAL
ACT		33,598									33,598
COM	12,316	4,197		18,732	2,689	3,631	5,191				46,756
FAC	21,283										21,283
HOU			21,283	12,385	-125						33,543
GOV						1,386		693	1,045	659	3,783
ROW		7,256									7,256
S-I				1,733	1,219	2,239					5,191
INSTAX				693							693
IMPTAX		1,045									1,045
COMTAX		659									659
TOTAL	33,598	46,756	21,283	33,543	3,783	7,256	5,191	693	1,045	659	

Source: Uganda SAM 2007
Note: ACT = activities, COM = commodities, FAC = factors, HOU = households, GOV = government, ROW = rest of the world, S-I = savings-investment, INSTAX = institutional tax, IMPTAX = import tax, COMTAX = commodity tax

5.2.1 Classifications in the SAM

The sector/commodity mapping in the SAM is aggregated into agriculture, industry and services and presented in Table 5.2. The aggregation of accounts from the micro SAM is purposefully done and the accounts that interact with the health sector are maintained and/or grouped accordingly, so as to aid in the analysis of policy simulations in later chapters. Additionally, the factors of production: labour (self-employed, unskilled, and skilled) and capital are maintained while land is an aggregation of land and cattle. Household sector categorisation, by residence (rural/urban) and main economic activity (farming/non-farming) is maintained as an adequate classification for answering the question about income distribution and welfare effects of the proposed healthcare policy interventions. Nevertheless, factors and household classifications in the SAM as well as their SAM shares are further discussed in the following section to give further insight into their relationship with the health sector.

Table 5.2 Classification and aggregations in the Uganda SAM 2007

PRODUCTION SECTORS		FACTORS
Agriculture	**Services**	**Labour**
Industry	Trade	Self-employed labour
Mining	Transport	Unskilled labour
Food processing	Real estate	Skilled labour
Fuel	Other private services	Capital
Chemicals	Administration	Land
Machinery	Education	
Utilities	Health	
Construction	Other government services	
Other manufacturing		
HOUSEHOLDS		
Rural households	**Urban households**	**Kampala households**
Rural farming	Urban farming	Kampala non-farming
Rural non-farming	Urban non-farming	

Source: Uganda SAM 2007

5.2.1 (i) Factors of production in the 2007 SAM

In using the CGE approach for policy analysis, it is vital to disaggregate factors with an aim of capturing the diffusion of sectoral shocks to household income (Decaluwe, Patry, Savard, & Thorbecke, 1999). The existing Uganda 2007 SAM differentiates factor endowments across household categories where labour is differentiated as self-employed agricultural workers, unskilled workers employed in agricultural and non-agricultural sectors and skilled labour in non-agricultural sectors. It is also important to differentiate factors across production activities so as to capture the factor intensities in branches of production which might transmit differential impacts on different sectors, such as the importance of skilled labour intensity in the healthcare sector. In addition to the existing SAM differentiation of factors across production activities, factors in healthcare production are further split according to the health sector disaggregation in Section 5.3.2 of this chapter.

5.2.1 (ii) Households in the 2007 SAM

Given the objective to evaluate the welfare impact of a given policy shock on different categories of households, the disaggregation of households is paramount in the CGE model developed here. The commonly used criteria for household disaggregation are income level and socio-economic group. Although the income criterion is used by many modellers, it suffers from problems of heterogeneity within income groups, therefore the model results may not reflect the true impact of a policy shock on different types of households (Decaluwe et al., 1999).

The 2007 SAM uses the socio-economic categorisation of households, which clusters households according to similarity in some essential characteristics, in terms of their income sources and underlying physical and human capital endowments. The households are categorised by residential status (i.e. rural and urban), and within their residence by main economic activity as a source of income (i.e. farming and non-farming). With this household categorisation, it is possible to trace the effects of healthcare policy interventions through the various income and consumption channels and the relationship to poverty.

Heterogeneity, in terms of income levels, exists in social economic groupings so that policy impacts on the welfare of a given household category and the incidence of poverty within the category are not distinguishable (Decaluwe et al., 1999; Maio, Stewart, & Hoeven, 1999). The heterogeneity problem in both the socio-economic grouping and the income criterion is resolved by use of micro simulation analysis. This type of analysis integrates a representative survey of households within the CGE model. First applied by (Cockburn, 2002) in a model for Nepal, (Thurlow, 2007) applied this approach in a model for Botswana, and (Cororaton, 2003) applied it to the Philippines. The IFPRI 2007 Uganda CGE micro simulation model, developed by IFPRI, is employed in this study[57]. It is based on the 2005/2006 household survey data, which underlies the 2007 SAM data base, itself constructed from the 2002/03 supply-use tables for Uganda. Each household in the survey is mapped onto a household category in the SAM so that impacts of a healthcare policy intervention on individual households can be modelled.

The income channels for each household category in the 2007 SAM are presented in Table 5.3. Enterprise is the largest source of income for all household types and, whereas 33% of urban-farming-household income is from skilled labour, their rural counterparts earn a paltry 7% from skilled labour implying that there are not many skilled workers in rural areas engaged in farming. Another observation is that self-employed labour is only engaged in farming activities and contributes 1% and 5% to urban-farming and rural-farming household income respectively. When the source of household income data is pitched against the factor income distribution to households, the observation for self-employed labour is consistent in

[57]The application and merits of the micro-simulation model are discussed in section 4.4 of Chapter 4.

that self-employed labour income is shared between rural-farming households (95%) and urban-farming households (5%).

Table 5.3 Sources of household income

	Share of factor income by households						Distribution of factor payments to households				
	Lab-self	Lab-unskll	Lab-skll	lnd	ent	Total	Lab-self	Lab-unskll	Lab-skll	lnd	ent
hhd-r-f	0.05	0.11	0.07	0.23	0.54	1.00	0.95	0.43	0.23	0.96	0.44
hhd-r-nf	0.00	0.14	0.17	0.00	0.69	1.00	0.00	0.16	0.18	0.00	0.17
hhd-k-nf	0.00	0.14	0.18	0.00	0.68	1.00	0.00	0.22	0.24	0.00	0.21
hhd-u-f	0.01	0.10	0.33	0.06	0.49	1.00	0.05	0.07	0.20	0.04	0.07
hhd-u-nf	0.00	0.14	0.20	0.00	0.66	1.00	0.00	0.11	0.15	0.00	0.11
Total							1.00	1.00	1.00	1.00	1.00

Source: Uganda SAM 2007.
Note:
1. hhd-r-f = rural farming households, hhd-r-nf = rural non-farming households, hhd-k-nf = Kampala non-farming households, hhd-u-f = urban farming households, hhd-u-nf = urban non-farming households; Lab-self = self-employed labour, Lab-unskll = unskilled labour, lnd = land, ent = enterprise

On the expenditure side, the household expenditure shares in Table 5.4 reveal that rural-farming households spend twice as much on healthcare, compared to all other household categories. Moreover, 68% of the total health services is consumed is by rural farming households. Since this consumption represents healthcare services that are paid for at point of use, tit may have implications for equity in healthcare service access and utilization, particularly, when there is a high population density per health centre in rural areas. The lower level health centre, which are mainly in rural areas, have only 60% of the required staff capacity, as revealed in Chapter 1. Additionally, the SAM household healthcare demand shares pertain to actual money payments for the healthcare services, and a high out of pocket expenditure by rural households suggests a disproportionate burden of healthcare financing because the poverty incidence is also highest in rural areas.

Table 5.4 Uses of household income

	Share of commodity in household budget					Share of household budget in commodity consumption					
Commodity	hhd-r-f	hhd-r-nf	hhd-k-nf	hhd-u-f	hhd-u-nf	hhd-r-f	hhd-r-nf	hhd-k-nf	hhd-u-f	hhd-u-nf	Total
Agriculture	0.32	0.25	0.14	0.18	0.15	0.64	0.15	0.10	0.06	0.06	1.00
Mining	0.00	0.00	0.00	0.00	0.00	0.65	0.19	0.06	0.05	0.05	1.00
Food processing	0.21	0.26	0.23	0.20	0.24	0.47	0.17	0.18	0.07	0.11	1.00
Fuel	0.02	0.05	0.01	0.04	0.02	0.42	0.27	0.10	0.13	0.08	1.00
Machinery	0.01	0.01	0.01	0.02	0.01	0.52	0.10	0.18	0.11	0.09	1.00
Utilities	0.05	0.04	0.05	0.04	0.04	0.50	0.14	0.20	0.08	0.09	1.00
Construction	0.02	0.03	0.01	0.03	0.01	0.48	0.24	0.07	0.13	0.09	1.00
Other manufacturing	0.13	0.12	0.14	0.11	0.15	0.50	0.13	0.18	0.07	0.11	1.00
Trade	0.00	0.00	0.00	0.01	0.01	0.54	0.06	0.08	0.15	0.17	1.00
Transport	0.04	0.05	0.07	0.05	0.07	0.40	0.13	0.25	0.08	0.14	1.00
Real estate	0.06	0.08	0.15	0.11	0.13	0.34	0.13	0.29	0.10	0.14	1.00
Other private services	0.02	0.04	0.07	0.06	0.07	0.28	0.14	0.28	0.13	0.17	1.00
Education	0.05	0.04	0.07	0.10	0.06	0.43	0.09	0.22	0.14	0.11	1.00
Health	0.03	0.02	0.01	0.01	0.01	0.68	0.11	0.09	0.05	0.06	1.00
Other government services	0.02	0.02	0.03	0.03	0.02	0.47	0.12	0.22	0.09	0.10	1.00
Total	1.00	1.00	1.00	1.00	1.00						

Source: Uganda SAM 2007.

Note: hhd-r-f = rural farming households, hhd-r-nf = rural non-farming households, hhd-k-nf = Kampala non-farming households, hhd-u-f = urban farming households, hhd-u-nf = urban non-farming households

5.3 Disaggregation of the health sector in the Uganda SAM 2007

The primary innovation in this analysis is the addition to the pre-existing 2007 SAM of a disaggregated health sector with three new accounts: non-government healthcare, government primary healthcare, and government other-healthcare. The health sector SAM 2007 value represents total healthcare expenditure which is the sum of government (public) healthcare and non-government (private) healthcare expenditures. Government healthcare expenditure consists of recurrent and capital spending from general taxation as well as external borrowings and grants from international organisations. Non-government healthcare expenditure consists of direct household (out-of-pocket) spending as well as private insurance and direct service payments by private corporations.

The rationale for disaggregating the health sector is to isolate the impact of a healthcare policy shock transmitted through the different types and levels of care because the resource claims by each type and level of healthcare differ. Non-government healthcare is paid for by the consumer at the point of use while government healthcare is (mostly) free of charge to the consumer. Additionally, inputs and costs are different for the production of government healthcare by levels of care. For instance, government primary healthcare comprises of preventive and curative services at lower level health centres and sometimes at district general hospitals while government other-healthcare mainly comprises of specialist services at regional referral hospitals and advanced tertiary care at national referral hospitals, as well as general hospital services. Furthermore, the different socio-economic conditions between rural and urban households may imply different patterns of consumption of healthcare by levels of care. Consequently, the impacts of a healthcare policy shock are likely to differ for different types and levels of care.

While creating the new health sector accounts, aggregate totals from the original SAM are preserved (shares are used from other sources rather than actual numbers). The following section describes the entries in the SAM that pertain to the health sector and how they are treated to obtain the disaggregated SAM with three new accounts representing the health sector. Specifically, the section describes entries and data sources for shares of intermediate inputs and factor inputs for healthcare production and shares for the consumption of healthcare output by households and government. The row column convention of the SAM matrix is followed throughout.

5.3.1 Healthcare production activities

The sectors, whose output is supplied to healthcare sector as intermediate inputs in the production of healthcare services, are explicitly modelled. These are represented by the values at the intersection of commodity rows and health activity column in the SAM. The cell number represents the value of intermediate inputs used in the production of health services. This aggregate value in the original SAM represents both government and non-government expenditure on health inputs, and thus is split into non-government, government primary-healthcare, and government other-healthcare using the shares specified below.

Intermediate input shares for the production of a government health good are derived from the government health expenditure data set for 2007/08 collected by the Uganda bureau of statistics (UBOS)[58]. The data set contains health expenditure information coded according to economic and function classification. The classification of expenditure data is published in the Uganda Government Finance Statistics Classification (GFS) manual, 2011, and the Classification and Chart of Accounts, 2011 (Chart of accounts) (Uganda Bureau of Statistics, 2011a, 2011b). The economic classification of outlays specifies the end-use accounts structured in a 6 digit format specifying the account class (e.g. expenses: 2), item (e.g. employee cost: 21), sub-item (e.g. wages and salaries: 211), sub-sub item (e.g. wages and salaries – cash: 2111) and sub-sub-sub item (e.g. general staff salaries: 211101, contract staff salaries: 211102, etc.). On the other hand, the functional classification gives information on

[58] The Uganda Bureau of statistics is a government agency established by an act of parliament, responsible for coordinating, monitoring and supervising the National Statistical System.

the purpose for which an expense is incurred and is structured in groups (e.g. health affairs and services: 05); sub-groups (e.g. hospital affairs and services: 051); and class (e.g. hospital services -general: 0511, mental health institution: 0512, health research: 0513, etc.). Additionally, the International Standard Industrial Classification of All Economic Activities - (ISIC) revision 4 (United Nations, 2008) is used for clarity of definition of various items/services as well as the Uganda supply-use table 2002/03 (Uganda Bureau of Statistics, 2007).

The healthcare intermediate inputs descriptions in the SAM 2007 are mapped onto the respective descriptions in the Chart of accounts. For instance the SAM description for commodity utility (cutil) comprises of electricity- 223005, water - 223006, and other utilities – 223007 in the Chart of accounts[59]. Similar specifications are done for all the health intermediate inputs SAM entries. The item description and the corresponding government expenditure item codes that constitute the item value as well as the ISIC classification codes are as used in this section are presented in the Appendix Table A5.1.

The health expenditure data is reported in a cross classification of expenditure format which facilitates data sorting of the relevant variables for analysis. The data set presents three health expenditure centres: central government, district and urban authorities. The central government expenditure data is distinguished between recurrent and capital expenditure. In addition donor development expenditure is distinctly presented by project code, project name, vote and function. To obtain the share of government healthcare expenditure on health

[59] The Uganda SUT of 2002/03 does not specify other utilities like gas, charcoal, and firewood as being used by health. But these were included in computing the value for utility because it is a substantial expenditure in healthcare service delivery mainly due to the inadequate and unreliable electricity supply which often calls for use of other fuels.

intermediate inputs, data was manipulated as follows. The 2007/08 health expenditure was considered for central government, district and urban authorities because it is closer to the SAM year (2007) and also it had the most consistent and complete data set among the years for which data was available (2006/07, 2007/08, 2008/09, 2009/10, 2010/11). For each expenditure centre, data was sorted by function and by item and then summed up to obtain a value for the SAM entry description. For example, Central government recurrent health expenditure was sorted by function such as hospital services, mental health institution, etc. to obtain information on the purpose of a particular expense. For each function, data was sorted by item of expenditure which made it possible to map the expense onto the SAM. Similar manipulation was done for central government capital expenditure, Urban Authorities and District expenditures.

To split the intermediate health inputs for the production of a government healthcare good into shares for primary healthcare and Other healthcare, all expenditure at the central government level (including donor funds earmarked for central government) was sorted and summed up as “other healthcare”[60], while the Urban Authorities and District data was sorted by functional class item description e.g. primary healthcare, district hospitals, etc. For Urban Authorities and Districts, all inputs expenditure under primary healthcare heading were constituted into the share for primary healthcare input expenditure, and the rest of the expenditure functions were summed up with all Central government and Donor expenditure to get the share for other-healthcare input expenditure. The shares obtained for government intermediate healthcare inputs are applied to the existing SAM figures and using the residual

[60] The central government expenditure (including donor money) constitutes direct expenses on functions at the central government level. It does not include transfers to local governments (Districts and Urban Authorities), whose budgets are catered for under their respective votes from the Ministry of Finance, or donor expenditures to local governments.

method, intermediate input values for both government and non-government health goods are obtained. The derived intermediate input shares are presented in Table 5.5.

Table 5.5 Intermediate input shares for the production of healthcare

	Non-government healthcare	Government Primary healthcare	Government Other healthcare
Fuel	0.00	0.08	0.13
Chemicals	0.31	0.37	0.53
Machinery	0.07	0.01	0.01
Utilities	0.04	0.01	0.07
Construction	0.00	0.05	0.08
Trade	0.00	0.17	0.07
Transport	0.06	0.05	0.02
Communication	0.06	0.01	0.01
Real estate	0.19	0.00	0.01
Other services	0.00	0.11	0.04
Education	0.26	0.13	0.03
Total	1.00	1.00	1.00

Source: Computations from the updated health-focussed SAM

It is observed from Table 5.5 that for all types and levels of care, medical supplies (classified as chemicals in the SAM, are a major component in the production of healthcare. Within government healthcare, medical supplies are more than half of total health inputs for the production of other-healthcare compared to about one third for production of primary healthcare. Although it might be justifiable for this level of care (secondary and tertiary), that mainly provides specialist services and advanced tertiary care, to utilise such a big proportion of medicines, it also points to the ineffective referral system that exists in the country. Due to inadequate resources at some health facilities as well as the lack of and poor transport infrastructure, it is common for patients to bypass lower level facilities and refer themselves to a higher facility. This reason has been cited as a common cause of congestion at Mulago National Referral Hospital (MoH - Uganda Ministry of Health et al., 2012) .

The cost of educating health workers is a major component in the production of non-government healthcare. This is possibly related to the ownership of the health-worker training institutions by the PNFPs. As of 2010, 70% of the health training institutions were operated by the PNFPs (MoH - Uganda Ministry of Health, 2010b). Moreover, the government education policy of 2000, which privatised higher education, meant that government health training had to operate as private entities (MoH - Uganda Ministry of Health et al., 2012). Whereas the government policy may suggest a relatively lower share of the education cost as an input to public healthcare production, it resulted in a high end-user cost of training health workers and an obstacle to achieving the human resources for health policy objectives.

5.3.2 Factors in healthcare production

There are five factors of production in the SAM: 3 types of labour (self-employed, unskilled and skilled), capital and land (aggregated from cattle and land). The value at the intersection of factor and activity-health represents the health sector value-added. It is the value-added to the health sector generated by labour, land and capital. In the Uganda SAM 2007, the value-added to the health sector is generated by labour and capital only. Therefore, it is these two factors that are further disaggregated to the desired level in the health sector.

5.3.2 (i) Labour

Only two of the labour categories (un-skilled and skilled) in the SAM generate value added in the health sector. Using a statistical data analysis software (Stata/IC version 10) (http://www.stata.com/), the labour survey module in the UNHS 2005/06 data set is analysed to obtain shares of health sector labour by skill, and by employment status (private/non-government and public/government). The international standard classification of occupations (ISCO-08) is used to augment the classifications in the labour survey module. To maintain consistency with the existing SAM, skilled labour comprises of managers, professionals, and technician and associate professionals. Unskilled labour comprises of all the other classes specified in the ISCO-08, including clerical support workers and elementary occupations. The above categorisation is further adjusted for education level, to correct any misclassification of persons that might have been grouped as unskilled when they possess a vocational qualification or university degree and above. To put the labour classification into context, Table 5.6 shows the mapping of ISCO occupations and skills to the international standard of education classification-97 (ISEC-97) levels of education which are in turn correlated with the Ugandan education levels.

Table 5.6 Mapping of labour classification in the SAM

ISCO code	Occupation/Classification	ISCO Skill level	ISCED-97 level of education	Ugandan level of education
	SKILLED LABOUR			
1	Managers	3+4	6, 5a, 5b	University degree and above
2	Professionals	4	6, 5a	University degree and above
3	Technicians and associate professionals	3	5b	Vocational education
	UNSKILLED LABOUR			
4	Clerical support workers	2	4, 3, 2	Secondary level education
5	Service and sales workers	2	4, 3, 2	Secondary level education
6	Agricultural, forestry and fishery workers	1+2	1, 2, 3,	Primary/Secondary level
7	Craft and related trades workers	1+2	1, 2, 3,	Primary/Secondary level
8	Plant and machine operators, and assemblers	1+2	1, 2, 3,	Primary/Secondary level
9	Elementary occupations	1	1	Primary level
0	Armed forces occupations	1+2+4	1, 2, 3,4,	

Source: ISCO-08 and UNHS 2005 Labour survey module

The public/government health sector labour is further divided into those working in the primary healthcare and those employed in other-healthcare sub-sectors using shares from the health expenditure on compensation of employees for 2007/08. The data clearly distinguishes wages and salaries expenditure for primary healthcare in the District and Urban Authority expenditure centres. As a result, this has made up the share for primary healthcare while the rest, including wages and salaries from Central government; were classified to constitute the share for other-healthcare. However, it is important to note from this data, that the wages and salaries accounts do not distinguish between skill levels hence, the same shares were applied to both skilled and unskilled categories.

5.3.2 (ii) Capital

Shares for private and public capital were obtained by taking the total government capital formation derived from the health expenditure data 2007/08 as a ratio of the existing SAM value. The shares obtained were comparable to the national accounts' private and public shares of capital formation for the same year (Uganda Bureau of Statistics, 2010a). Shares for government primary healthcare and government other-healthcare were derived from the detailed itemised government health expenditure data 2007/08. Factor shares for the enhanced health sector SAM are represented in Table 5.7.

Table 5.7 Factor input shares for the production of healthcare

	Non-government healthcare	Government Primary healthcare	Government Other healthcare
Unskilled labour	0.07	0.02	0.01
Skilled labour	0.60	0.56	0.23
Capital	0.33	0.42	0.76
Total	1.00	1.00	1.00

Source: Computations from the updated health-focussed SAM

In general, production of both government and non-government healthcare is relatively skill-intensive as observed by the input shares of skilled labour compared to unskilled labour, as observed from the factor share results in Table 5.7. Furthermore, the share of capital input in the production of government other-healthcare is more than three quarters of total healthcare inputs. This is because healthcare service delivery at secondary and tertiary levels requires hospital infrastructure and sophisticated medical equipment.

5.3.3 Healthcare commodity out put

The SAM cell value at activities- health and commodities- health represents gross output, which is derived as the sum of intermediate demand and GDP at factor cost. Therefore, it is the value of total marketed health sector output. The SAM distinguishes between activities and commodities thus facilitating interactions between single/multiple activities and single/multiple commodities. The cell is split into the desired health sector levels resulting into single entries along the main diagonal of the activity-commodity sub-matrix. It is a one-to-one mapping between health activities and health commodities. The healthcare output is consumed by households and government.

5.3.3 (i) Households' healthcare consumption

The SAM cell value commodity-health-households, is the payment from households for healthcare commodities and it is equal to the household consumption of marketed production of health services. The Uganda SAM 2007 does not distinguish between home consumption, which is activity based and household's marketed consumption, which is commodity based. As a result the value in this cell represents both home and marketed consumption.

Household healthcare consumption shares are computed from the household survey (UNHS 2005/06) using a statistical data analysis software (Stata/IC version 10). The 2005/06 household survey data set underlies the construction of the 2007 social accounting matrix. The Household Roster and Section 9 of the survey questionnaire were used to group households by residence (rural and urban) and by main economic activity (farming and non-farming). If a household member operated a non-agricultural enterprise or activities that produced goods or services, such a household was classified to be non-farming. Section 5 of the survey contains questions that sought answers about household members' healthcare seeking behaviour when they fell sick and the cost of consultation. Any response that did not indicate government hospital and/or government health unit was assumed to be a visit to a private health unit. Consequently, shares were obtained for people who sought healthcare from private and public health units. Similarly, to obtain household healthcare utilisation by levels of healthcare, any response that indicated hospital government or NGO, was characterized as other-healthcare while the rest were taken to be primary healthcare. Consequently, shares were obtained for household healthcare consumption by type of provider and by levels of care. Note that the shares for non-government health by levels of care were added back in order to maintain a single account for the non-government health. Although the consumption of non-government healthcare could be disaggregated by levels of care, there was insufficient data to disaggregate the non-government healthcare production by levels of care. Therefore, the shares for the non-government health utilisation in Table 5.8 reflect the total for primary healthcare and other-healthcare consumption. Moreover, since the shocks in the model pertain to increasing public health expenditure by levels of care, it was deemed sufficient to disaggregate the government healthcare account by levels of care.

Table 5.8 Household healthcare demand shares

	Share of each type of care in total healthcare demand					
	hhd-r-f	hhd-r-nf	hhd-k-nf	hhd-u-f	hhd-u-nf	Total
Non-Government Healthcare	0.9208	0.8821	0.9080	0.9025	0.9035	0.9132
Government Primary healthcare	0.0004	0.0007	0.0021	0.0015	0.0016	0.0007
Government Other healthcare	0.0788	0.1173	0.0899	0.0960	0.0949	0.0861
Total	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	Share in total demand of each type of healthcare					
	hhd-r-f	hhd-r-nf	hhd-k-nf	hhd-u-f	hhd-u-nf	Total
Non-Government Healthcare	0.69	0.11	0.09	0.05	0.06	1.00
Government Primary healthcare	0.36	0.11	0.27	0.11	0.15	1.00
Government Other healthcare	0.63	0.15	0.09	0.05	0.07	1.00

Source: Computations from the updated health-focussed SAM
Note: hhd-r-f = rural farming households, hhd-r-nf = rural non-farming households, hhd-k-nf = Kampala non-farming households, hhd-u-f = urban farming households, hhd-u-nf = urban non-farming households

The top panel of Table 5.8 represents the share of each type of care in total healthcare demand that is paid for while the bottom panel shows the distribution of the demand for each type of care across households. The main message from Table 5.8 is the pattern of private healthcare consumption by households. The Government healthcare consumption demand is not fully represented in Table 5.8 because it is (mostly) free of charge to the consumer[61]. Therefore, the money flows from households' accounts to the government health accounts do not reflect the full range of the public healthcare consumption by households. The numbers in Table 5.8 should be interpreted in terms of health services that had to be paid for. For instance, the top panel indicates that 91% of the total health services paid for by households

[61] Besides the payments for healthcare in the private wings of government health facilities, under the counter payments have been reported in some government health units. It is likely that such payments for healthcare are captured in the survey responses, even if the individuals are reported to have sought care from a government health facility.

were provided by the private healthcare providers. Similarly, the bottom panel indicates that, of the total private health services consumed by households, 69% is paid for by rural farming households.

5.3.3 (ii) Government healthcare consumption

The SAM cell value for commodity-health-government, is government consumption spending on health services. In this regard, the government is both a sector producing health services as well as a demander of these services. The shares for government consumption spending in the primary healthcare and other-healthcare are taken from the government medium term expenditure framework (MTEF). The MTEF data categorizes government expenditure by sector and votes within the functional classification, and includes donor project funds. As a result, in the health sector the vote for district NGO hospital/primary healthcare and district primary healthcare were considered to constitute the government consumption spending for primary healthcare services while all the other expenditure votes were considered to constitute consumption spending for other-healthcare.

5.4 Balancing the SAM using Cross-Entropy method[62]

It is necessary to balance the SAM because data sources to SAM entries are diverse and represent different time periods. The SAM is balanced using the cross-entropy (CE) method

[62] The description of SAM balancing techniques in this section is mainly based on (Robinson et al., 2000).

(Robinson et al., 2000) in a GAMS program for balancing a SAM (Fofana, Lemelin, & Cockburn, 2005).

Given that a SAM is a square matrix of income (rows) and expenditure (columns) of all economic agents in the economy, we can define a matrix of SAM transactions, T, where t_{ij} is a payment from column account j to row account i. Following the conventional accounting principle of double entry that underlies SAM entries, a row sum must be equal to a column sum:

$$y_i = \sum_j t_{ij} = \sum_j t_{ji} \tag{5.1}$$

where y_i is total receipts and expenditure of account i.

A SAM coefficient matrix, A**,** is derived from the transaction matrix by dividing the cells in each column of T by the column sums:

$$a_{ij} = \frac{t_{ij}}{y_i} \tag{5.2}$$

By definition, all column sums of $\boldsymbol{A}$ must equal to one so that the matrix is singular, and also since row sums must equal column sums, it follows that:

$$y = Ay \tag{5.3}$$

The typical problem in SAM estimation lies with the updating a coefficient matrix when we have new information on row and column sums, but do not have new information on the input-output flows. In general, the problem is to find a new SAM coefficient matrix, A^*, that is close to an existing coefficient matrix, $\bar{A}$, but yields a new SAM transaction matrix, T^*, with the new row and column sums. That is to say,

$$t^*_{i,j} = a^*_{i,j} y^*_j \qquad (5.4)$$

$$\sum_j t^*_{i,j} = \sum_j t^*_{j,i} = y^*_i \qquad (5.5)$$

where y^*_i are known new row and column sums.

While the RAS method[63] may be used to estimate the new coefficient matrix, the CE method is best suited for balancing the SAM particularly when we seek to use the updated SAM to estimate column coefficients and provide share coefficients for use in a CGE model. The CE formulation for the estimation problem is that, for an n-by-n SAM, identify n^2 unknown non-negative parameters (the cell values for T or A), but have only $2n - 1$ independent row and column adding-up restrictions.

In balancing the SAM the CE method seeks to maintain the coefficient structure.

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[63] The RAS approach to the estimation problem is to generate a new matrix $\boldsymbol{A}^*$ from the old matrix $\bar{\boldsymbol{A}}$ by use of "biproportional" row and column operation s$a^*_{ij} = r_i \bar{a}_{ij} s_j$ or in matrix notation: $A^* = \hat{R}\ \bar{A}\ \hat{S}$, where the hat indicates a diagonal matrix of elements r_i and s_j. It is most desirable if the primary interest is in nominal flows, or if row coefficients are as important as column coefficients. RAS method is considered a special form of CE method that uses a particular cross-entropy minimand and assuming only knowledge of row and column sums.

(Robinson et al., 2000) explain that CE method is grounded in the information theory developed by (Shannon, 1948). The notion behind the theory is that we can find the expected information value of additional data expressed as a (Kullback & Leibler, 1951) cross-entropy distance $I(p{:}\,q)$ between the prior (q) and posterior (p) probability distributions of a set of n events:

$$-I(p{:}\,q) = -\sum_{i=1}^{n} p_i \, ln \frac{p_i}{q_i} \qquad (5.6).$$

In SAM estimation or updating, the problem is to find a new set of A coefficients which minimises the entropy distance between the prior $\bar{A}$ and the new estimated coefficient matrix. Thus:

$$min \left[\sum_i \sum_j a_{i,j} \, ln \frac{a_{i,j}}{a_{i,j}} \right] \qquad (5.7)$$

subject to:

$$\sum_j a_{i,j} \, y_j^* = y_i^* \qquad (5.8)$$

where $\sum_j a_{i,j} = 1$ and $0 \leq a_{i,j} \leq 1$.

The problem (5.7) – (5.8) is solved numerically[64] after setting up a Lagrangian formulation. The optimal solution a_{ij} is expressed as a function of both the Lagrangian multiplier λ_i associated with the row and column sums, and the coefficient $a_{i,j}$ from the prior:

$$a_{ij} = \frac{\bar{a}_{ij} exp\left(\lambda_i y_j^*\right)}{\sum_{i,j} \bar{a}_{i,j} \exp\left(\lambda_i y_j^*\right)} \quad (5.9)$$

It is recognised that often modellers grapple with extracting results from data that is measured with error. In this regard, (Robinson et al., 2000) have extended the estimation methodology to incorporate measurement errors and generalise two cases of sources of errors: (i) where row and column sums involve errors in measurement; and (ii) the estimate of the initial coefficient matrix, $\bar{\boldsymbol{A}}$ is not based on a balanced SAM. The estimation equation is:

$$y = \bar{x} + e \quad (5.10)$$

where y is a vector of row sums, x is the known vector of column sums measured with error, e. The error is given as a weighted average of known constants as follows:

$$e_i = \sum_w w_{i,w} \bar{v}_{i,w} \quad (5.11)$$

subject to $\sum_w w_{i,w} = 1$ and $0 \leq w_{i,w} \leq 1$ (5.12)

[64] The problem is solved numerically because it does not have an analytic (closed-form) solution.

The weights are treated as probabilities to be estimated while the constants, $\bar{v}$, define a prior for the distribution.

While applying the CE procedure to the initial 2007 SAM, the cell values for government consumption were fixed so as to obtain as near as possible the original SAM coefficients for government allocation. The disaggregated health-focussed SAM appears in the Appendix Table A5.3.

5.5 Summary

This chapter presented the Uganda social accounting matrix of 2007, which is the benchmark data set from which the CGE model is calibrated. The SAM 2007 is first described and the rationale and value to the study question of the existing factor and household disaggregation is explained. Income and expenditure shares are computed from the SAM and analysed. The novelty in the SAM 2007 is the disaggregation of the health sector into three new accounts: non-government healthcare, government primary healthcare, and government other-healthcare. The rationale for this disaggregation is that the resource claims of each type and level of healthcare differ. Non-government healthcare is paid for by the consumer while government healthcare is (mostly) free of charge to the consumer. Additionally, inputs and costs are different for the production of government healthcare by levels of care. Similarly, the consumption of healthcare differs by household category at different levels of care. Consequently, the impacts of a healthcare policy shock differ for types and levels of care.

The disaggregated SAM shares indicated that education as an intermediate healthcare input had a relatively bigger share in private healthcare production compared to government healthcare production. Medical supplies form the largest healthcare input for all types and levels of care. Whereas skilled labour was employed more intensively relative to unskilled labour for all types and levels of care, government other-healthcare was found to be relatively capital intensive. The non-government household healthcare expenditure shares were interpreted to indicate high out-of-pocket expenses on healthcare. The computed SAM shares are a transmission mechanism and therefore, give an insight into the impacts of the policy simulations on sector output as well as poverty and income distribution presented in Chapters 7 and 8.

CHAPTER 6: DESIGN OF HEALTHCARE FINANCING REFORM POLICY SCENARIOS

6.1 Introduction

There are several possible healthcare reform scenarios within the ambit of healthcare financing, production, consumption and regulation that can be studied. This study focuses on healthcare financing reforms. The choice of healthcare financing scenarios designed in this study has been prompted by the glaring challenge for countries to find adequate resources to finance their health systems and the ever increasing attention to the question of how to increase financial resources for health, particularly by governments (Powell-Jackson et al., 2012). The challenge to increase financial resources for healthcare is even bigger for low income countries where the burden of disease is greatest and resources most scarce. It is, therefore, imperative that as the government of Uganda formulates policies that facilitate mobilisation of the fiscal resources required to finance the expansion of the health sector, the wider impacts of such policies are evaluated.

Various ways have been proposed as a means to create fiscal space for health, as discussed in Section 1.7. They include earmarked taxes for health, prioritisation of the health sector in the government budget, increasing external resources for health and efficiency improvements in the health sector. It is also noted that the proposed sources of fiscal space could be pursued independently or simultaneously. In this study it is assumed that each alternative source of additional healthcare funding is undertaken independently. The assumption aims to facilitate a display of distinct impact results from each funding options so that policy makers are guided through the comparison across alternatives.

The motivation to evaluate the impact of creating fiscal space for health lies with the need for additional resources for healthcare particularly in developing countries. An analysis of the relationship between government health spending and coverage indicators related to the universal health coverage component of access to and use of health services for all citizens, suggests government spending of more than 5% of GDP to achieve a target of 90% coverage (Commission on Macroeconomics and Health (CMH), 2001; McIntyre & Meheus, 2014)[65]. Other estimates indicate a minimum of $86 per capita (in 2012 terms) is required to fund universal primary healthcare services in low-income countries (HLTF - High Level Task Force on Innovative Financing for Health Systems, 2009)[66]. This means that some countries will require additional resources, over and above the 5% UHC target, in order to meet the required minimum health expenditure per capita. The Uganda national health accounts study for 2009/10 showed that public health spending was $51 per capita. Moreover, Uganda health sector reports (discussed in Chapter 1) indicate that the health sector share in the general government budget is below the 10% HSSP target and the Abuja Declaration target of 15%. It is therefore clearly evident that additional financial resources for health must be mobilised

[65] Although this target was adopted by the Commission on Macroeconomics and Health (CMH 2001), there is an argument that the two coverage indicators – deliveries performed by a skilled birth attendant and immunisation coverage rates – do not provide a good indication of overall health service coverage. McIntyre and Meheus (2014) argue that a more widely used indicator is that of health workers per 10,000 people, for which the WHO has set targets. The WHO set the government health expenditure target at 3% of GDP to reach the minimum 23 core medical professionals per 10,000 population and over 5% of GDP to achieve the global average of 44 per 10,000

[66] The High-level Task Force (HLTF) estimated that by 2015 the per capita resource requirement for providing a minimum level of key health services in low-income countries would total $54 (expressed in 2005 terms). This figure translates into $86 in 2012 terms.

to meet the targets enumerated above. The pertinent issue in this thesis is to assess the general equilibrium effects of pursuing the various options of mobilising addition financial resources for health.

The aim of the this chapter is to design scenarios where additional financial resources for health could be raised given the feasibility of the possible options for creating fiscal space for health in Uganda. Specifically, three possible options are selected – prioritization of the health sector in the budget, earmarked taxes for health and external resources for health. The level of implementation for each policy option scenario is restricted to achieving the Abuja Declaration target of 15% health share in the general government budget. That is, for each option the source of additional funding for health is increased annually at a given rate, simultaneously with the government consumption demand for health (which is increased at an annual rate until the 15% share of the health budget is achieved). Section 6.3 describes how the specific annual rates of growth of the source of funding and the government consumption demand are arrived at. Note that the parameter for government consumption demand for health is exogenous while the government function (health) share parameter is endogenously determined.

The comparability between the selected three health financing options arises when the model, through the equilibrium effects, generates the results of the adjustment mechanisms and the overall macroeconomic effects of the process of achieving the targeted share of the health sector. The size of each alternative is capped at the level that achieves the desired 15% target share of the health sector budget. For example, the model is designed to determine the size of the tax by generating the effective rates of tax necessary to achieve the targeted 15% share of the health sector in the government budget; but not greater than 15%. The feasibility of each health financing option is discussed in detail in Chapter 10, Section 10.3.

Overall, this chapter presents policy scenarios designed to mimic three methods for creating fiscal space for health, in line with the health sector reform agenda in Uganda. Specifically, scenarios are designed to increase resources to the health sector through the prioritisation of the health sector, increased aid for healthcare and earmarked taxes for health. The ultimate goal is to model the potential future economic and health effects of these policy options; to guide future reform development and provide insights into the methods used and results obtained for other countries in similar positions. This is even made more critical as the global community increasingly moves towards specifying and seeking to achieve some form of universal health coverage.

The policy scenarios are designed to depict the functioning of the economy, from 2008 to 2020. The model horizon is selected to begin in 2008 in order to relate to the most recently available benchmark data set (Uganda SAM 2007) constructed in 2007. The existing 2007 SAM coefficients are not overtaken by time, and therefore reflect the true picture of the functioning of the economy at the start of 2008. Additionally, the most consistent and complete data sources for updating and disaggregating the health sector in the SAM are available for the period 2005/2006, 2006/07 and 2007/08 (described in Chapter 5). Furthermore, the various reforms initiated and implemented more than a decade ago should ostensibly have some results captured in the national household surveys and the health expenditure data sets used to update the SAM. The model end period of 2020 is purposefully selected to align with the five year health sector strategic and investment plans and the national development plans for the period 2010/11-2014/15 and 2015/16-2019/2020. These plan documents are embedded within the aspirations of the Uganda vision 2040 (The Republic of Uganda, 2012), which directs that all national planning documents should prioritise the health sector. The remainder of the chapter is organised as follows. Section 6.2 describes the baseline scenario which portrays the economy's business-as-usual status. The design of policy options for the creation of fiscal space for health: (i) prioritizing the health sector, (ii) earmarked taxes for health, and (iii) external resources for health; are elaborated in Section 6.3. The health effects accruing from the increased healthcare investments are substantiated in section 6.4. Section 6.5 summarises and concludes the chapter.

6.2 The baseline scenario

The baseline simulation acts as a benchmark against which the impacts of healthcare financing reform policies are measured. It serves to portray how the economy would have performed from 2008 to 2020 in the absence of effects accruing from healthcare financing reform policies. It assumes business continues as usual for internal and external factors, and policies that underpin the economy's rate of growth remain as in 2008. The model is calibrated with a capital growth rate that emulates the historical growth path. The average GDP growth has been about 6.5% since the year 2000 and is predicted to continue growing at that average (Uganda Bureau of Statistics, 2004, 2012). Macroeconomic and sectoral policies, prevailing by the end of 2007, are assumed to remain throughout the model period.

The government functional expenditure shares for the health sector and other sectors are assumed to follow the 2008 levels. However, the aggregate government consumption expenditure is set to grow at an average of 3% per annum in the baseline based on data from the national accounts (Uganda Bureau of Statistics, 2012). The baseline tax rates for households are assumed to grow at 3% per annum. This is based on calculation from the historical trend which, using the marginal tax rate for individuals as the benchmark, indicate the lowest personal income tax as 30% (2004 – 2011) and the highest as 40% (2012-2014) (Ministry of Finance Planning and Economic Development, 2008, 2014).

Uganda is an open small economy, and therefore its growth performance is affected by world market commodity prices and access to international capital markets. For the baseline, the world demand and world prices for Ugandan products' and net capital inflows are unchanged from their 2007 levels. However, foreign savings have been observed to grow at an average 3% since 2000/2001 (Uganda Bureau of Statistics, 2012), and this growth is reflected in the baseline.

According to the United Nations population statistics, Uganda's population is projected to grow at 3% per annum. This rate of growth in population is reflected in the baseline. In Uganda the labour force comprises of persons aged 14-64 years. Evidence shows that between the two recent Uganda national household survey (UNHS) years, 2005/06 and 2009/10; the economically active population (15-64 years) increased at an average of 5% per year (Uganda Bureau of Statistics, 2010b). This growth in labour force is attributed in part, to the healthcare expenditure in the baseline. Therefore, the baseline labour factor supply is assumed to increase recursively at a rate of 5% per annum for each of the labour categories in the model. Additionally, since the government aggregate consumption expenditure is assumed to increase annually in the dynamic baseline, it is hoped that there will be some level of improvement in the population health status from the government healthcare consumption so that labour productivity and total factor productivity will improve. Therefore, in order to account for the baseline health improvement, labour productivity and total factor productivity are assumed to increase by 0.5% per annum in the baseline.

6.3 Alternative sources of fiscal space for healthcare scenarios

All the healthcare financing scenarios designed here aim to achieve a 15% health share in the government budget by 2020. This target is selected to reflect the African Union recommendation in the Abuja Declaration which calls for all African governments to commit 15% of their budgets to health (African Union, 2001). Additionally, the HSSIP 2010/11-2014/15 proposes an ideal financing scenario that would facilitate implementation of all the sector interventions for the plan period which requires 2,485.26 billion shillings in 2010/11, increasing to 3,710.04 billion shillings in 2014/15 (MoH - Uganda Ministry of Health, 2010a)[67]. This is against the backdrop of 735.7 billion shillings which was approved for 2009/10 health sector spending under the MTEF. This implies that a jump of 238% was required to reach the HSSIP ideal healthcare spending in 2010/11. The HSSIP proposed ideal expenditure scenario takes into account the desired salary scales for health workers to match those within the region as one of the key interventions to minimise human resources for health attrition (MoH - Uganda Ministry of Health, 2010a). The underlying assumption in all the scenarios designed here is that the increased health sector budget share will be allocated in the health sector activities according to the health sector strategic plan priorities. It is further assumed that the allocation will be in accordance with the prevailing technologies and factor uses in the public health sector.

[67] The estimated total cost of package for healthcare expenditure includes both recurrent and capital costs.

6.3.1 Prioritisation of the health sector in the government budget

The simulation to prioritise the health sector in the model is to increase the health sector share in the government budget while taxes remain unchanged and government expenditure is fixed in real terms. The immediate effect of this government action is to reduce resources available to other government functions. The proposed intervention is implemented in the model by allowing the parameter for the government demand scaling factor for healthcare to increase by a rate desired to achieve the targeted value of the government share parameter for healthcare. Note that the government demand scaling factor for health is exogenous while the government share parameter for health is endogenously determined. From the fiscal balance equation (4.51): $S_G = Y_G - E_G$, both the government income Y_G and aggregate government expenditure E_G levels grow at baseline levels, under the prioritisation scenario. The shock is implemented in the government expenditure equation (4.49) - $E_G = Pindex.\overline{QGC} + TR_G$, targeted at the specification for real government consumption equation (4.48) - $QG_{c,t} = \overline{GADJ}.\overline{QG}_{c,t-1}$. Specifically, in order to achieve the desired 15% health sector share in the budget by 2020, the growth rate in government health consumption demand – the parameter $\overline{GADJ}$ is set to 10% per annum for the government primary healthcare and 5% per annum for the government other-healthcare. The 10% and 5% growth rates are arrived at, by setting the model to achieve the desired target share of 15% by 2020. Since the government functional share is endogenous the model set up produces the annual growth rate in government healthcare spending necessary to achieve the desired target. Recall that this is a recursive dynamic model, such that the variable values for the end of each period (year) form the base for the next period.

The annual growth rates in government healthcare expenditure used in this model resonate with the HSSIP proposed ideal healthcare financing scenario for the period 2010/11 to 2014/15. In order to achieve the planned targets in the ideal financing scenario, the HSSIP proposes an initial jump of 238%, from the 2009/10 expenditure total. Thereafter, the Plan proposes a 25% increase for the year 2011/12 and 8% per annum by 2014/15. The healthcare expenditure shock in the model is implemented simultaneously with the health effect shocks described in Section 6.4.

6.3.2 Earmarked taxes for health

The share of direct taxes in GDP is low, an indication that the domestic tax base is narrow. Given the narrow domestic tax base, the proposal in this model is to levy the earmarked tax for health as a direct tax on households' income. In principle, the revenue from the proposed earmarked tax would be used to supplement the general budget healthcare expenditure share from general taxation. If at all there is a bounty during expansionary periods, the earmarked tax revenue could be encroached on for spending elsewhere. There is no readily available data on earmarking taxes in Uganda. However, lessons can be drawn from experiences of similar schemes in countries such as South Africa, Ghana and Tanzania (Ataguba & Akazili, 2010; Carling, 2007; McIntyre et al., 2008), and Australia's experience where a 1.5% levy raises about 25% of public healthcare resources (Carling, 2007).

The simulation in the model is to increase government expenditure on healthcare and increase taxes to raise revenue for the additional funding. The scenario is designed to achieve a 15% health share in the government budget by 2020 as described in Section 6.3.1. Therefore, the shock in the model becomes twofold: to increase the public healthcare expenditure share from the baseline allocation level to 15% by 2020, and to increase direct taxes on households to raise revenue to finance the additional healthcare expenditure.

Therefore, from the fiscal balance equation $S_G = Y_G - E_G$, the government income, Y_G , increases by the additional tax revenue from households so that government has more resources to spend on healthcare rather than reducing what is available for other government functions. Given the government income equation (4.42),

$$Y_G = \sum_i TI_i + \sum_i TE_i + \sum_i TM_i + \sum_i DTH_h + DTF + \sum_i TRG_{ROW},$$

the government income source of interest in this model is the direct tax on households, $\sum_i DTH_h$. This is defined in equation (4.46): $DTH_h = TYR_h.tyh_h.YH_h$.

Recall that $TYR_h = 1 + \overline{TINSADJ}_h.tyh_h$, where $\overline{TINSADJ}$ is an exogenously determined rate of income tax increase. Therefore, in order for government to raise the additional revenue so that it is able to spend 15% of the budget on healthcare by 2020, without compromising expenditure allocations to other sectors, the model allows for growth in direct tax on households by adjusting the household tax rates. The desired growth in direct tax on households is achieved by setting the direct tax adjustment factor for households, $\overline{TINSADJ}_h$, at 11% per annum.

Given the annual growth rate for the household income tax adjustment parameter, the model endogenously generates the individual household tax rates in such a way that each household tax rate increases in proportion to the initial tax rate. The tax adjustment rate is applied uniformly to all the households who are eligible to pay income taxes, as per the 2007 social accounting matrix. This means that tax exempt households, as of the 2007 social accounting matrix, are not burdened by the imposed tax. The growth in government expenditure share for healthcare is modelled as described in Section 6.3.1. Note that the proposed growth rate in household tax rates is an additional 8% from the baseline growth rate of 3%. The combined expenditure and taxation shocks are implemented simultaneously with the health effect shocks described in Section 6.4.

6.3.3 Aid for health

Donor funding for healthcare is modelled as an increase in the inflow of foreign savings designated as ODA for budget support. Note that the model does not explicitly distinguish between the share of the ODA that is in form of grants or concessional loans. The assumption made in this regard is that the share of each component of ODA follows the historical trend depicted in the national accounts. The aim is to assess whether aid for health, as a source of additional funding for healthcare, is beneficial to the economy. Whether the interest payments on the concessional loans part of ODA could negate the benefits of health aid is a matter for another study.

When modelling aid for health, it is assumed that any foreign savings inflow over and above the baseline growth rate is channelled to the health sector and that government does not withdraw its share of funding. From the model description in Chapter 4, it is clear that current investment is financed by total savings in the economy, which comprise of domestic and foreign savings as in equation (4.52): $S = \sum_h SH_h + \sum_f SF + S_G + \bar{e}.S_x$. The foreign savings component, $\bar{e}.S_x$, is what is modelled in this scenario. It indicates that foreign savings inflow is an extra resource from outside the economy, unlike the tax revenue which is a mere transfer of resources from one economic agent to another within the economy. The foreign savings inflow is converted to local currency by the exchange rate.

The growth rate in foreign savings inflow is set to the level that will increase resources available to government to finance additional healthcare expenditure to the desired 15% budget share by 2020. Therefore, the foreign savings growth parameter is set to 5% per annum, which generates the necessary annual growth in absolute foreign savings inflow required to meet the targeted health sector budget share by 2020. This is an additional 2% from the baseline growth rate of 3%. The growth in the desired health sector share in the budget is treated in the same way as elaborated in Section 6.3.1 above.

The current account closure imposes a flexible exchange rate that balances the current account when foreign savings are fixed. This means that an increase in foreign aid inflows has an impact on the exchange rate leading to the appreciation of the local currency thus widening the trade deficit. This is a necessary condition to allow for an increase in private absorption as government absorption increases through spending the additional resources from aid inflows. It is assumed that aid for health resources are effectively used by government for healthcare delivery activities. In this way the increase in government healthcare expenditure does not crowd out the private sector, as would be the case if it is domestically financed. The model simulations to increase the health budget share and the aid for health are implemented simultaneously with the envisaged health impacts described in Section 6.4.

6.4 Health effects in the model

In order to portray a complete picture of the impacts of the healthcare financing reforms, the policy proposals described in the simulations are implemented simultaneously with the anticipated health impacts on the population. The health effects are modelled as growth in economy-wide labour supply, labour productivity and total factor productivity. The pathways of health investment and the values for the health effects parameters used in the model are described here. The healthcare reform policies modelled in this study are assumed to encompass health improvement investments. Consequently implementing the policies has a direct and indirect health impact on labour supply, labour productivity and total factor productivity in the economy. Data on the direct link between increased public healthcare expenditure and the impact on effective labour supplies in Uganda is not readily available. However, studies have shown that investing in health improvement has direct impacts on labour market participation rates, worker productivity, and indirect impacts on investment in physical capital, fertility and population age structure (Baird et al., 2012; Bloom & Canning, 2000, 2005; Bloom, Canning, & Sevilla, 2003; Dunkelberg & Spiess, 2007; Frijters et al., 2008). The discussion of the evidence concerning the health impact on the output level of a country in Section 2.2.1 revealed that the debate on the causal link between health improvements and economic growth is not conclusive. Whereas a large body of literature is in line with the general consensus that a positive correlation between health improvements and economic growth exists, and is significant for a number of cross country studies, evidence is emerging to refute this assertion. Acemoglu and Johnson (2007, 2014) have argued that the demographic impact of improvements in health could have weighed in heavily, so that the GDP per capita and GDP per working population actually declined over the period of the study. Similarly, the discussion on public health spending and health outcomes in Section 2.2.2 also revealed that whereas public health expenditure may improve health outcomes, there is a possibility that it can be ineffective if certain conditions in the public health spending chain are not met.

In view of the above discussions on health improvements and economic growth, and public health spending and health outcomes, the following assumptions are followed throughout this study. It is assumed that health improvement is positively correlated to economic growth, particularly for developing countries like Uganda. Additionally, it is assumed that increasing public health spending and expansion in health services generates: (i) services that are effective in treating and curing the people, (ii) increases in the total amount of effective services consumed by the people and, (iii) the services consumed are cost-effective in improving health.

6.4.1 Health impact on labour supply in the economy

The impact of health investment on labour supply is introduced in the model as an exogenous shock. Labour supply growth rates are based on the Ugandan demographic model and evidence from empirical studies. Growth in labour force supply has been associated with investing in child health through the increased proportion of the population that survives to working age (Bloom, Canning, & Sevilla, 2003). There is evidence to suggest a positive association between labour supply growth, a decline in child mortality and growth in GDP (Bloom & Williamson, 1998). Other studies have shown that child health is positively correlated with mother's labour participation rate (Baird et al., 2012; Dunkelberg & Spiess, 2007; Frijters et al., 2008). Furthermore, evidence on investment in reproductive health services has shown that family planning services save resources that would have been spent on complications of unplanned pregnancies, and reduces fertility rates (Moreland & Talbird, 2006). Declining fertility rates counteract the effects of a baby boom resulting from improved child health thus reducing the dependency ratio that would wipe away the benefits and increase per capita income. Additionally, in a ten year follow-up of a deworming program in a selection of primary schools in Kenya, it was found that investing in deworming increased work hours for the treatment group, with a high of 16.7% increase for males (Baird et al., 2012).

Therefore, based on the findings from research on health and labour force participation in Cai & Kalb (2006), Hum et al (2008), and Cai (2010), Baird et al (2012), and the Uganda population dynamics, the overall economically active labour supply in the model is assumed to increase by 7% per annum. That is, the labour factor growth parameter in the model is set to 7% per annum. The proposed labour supply growth rate modelled is 2% higher than the 5% baseline growth rate, to reflect the additional benefits from extended healthcare service delivery when the proposed health sector share in the budget is implemented.

6.4.2 Health impact on labour productivity

Labour productivity is an important determinant of a country's per capita income. The labour productivity shock is captured in the model via the factor-specific productivity equations (4.13), (4.14) and (4.15). From these equations, the shock in the model is to impose an annual growth rate in the labour productivity parameter, $fprd_{la}^{va}$ - the growth in the productivity measure for value-added by labour factor l in activity $a.$ The modelled growth rate in the labour productivity parameter is attributed to the expansion of healthcare delivery as a result of the proposed health sector budget share. Since there is no specific data relating healthcare service delivery and labour productivity in Uganda, the applied value for the labour productivity growth parameter is based on literature from elsewhere (some of which has been discussed in Section 2.2). Specifically, the research on health and human capital lends strong support to the positive relationship between health and worker productivity. Empirical studies have shown that investment in health at various stages in life enhances human capital as it improves worker's productivity (Bleakley, 2003; Bloom & Canning, 2005; Bloom et al., 2004; Case, Fertig, & Paxson, 2005; Weil, 2007). Health enhances the physical and mental wellbeing of the workers, and increases labour market participation rates because workers suffer fewer lost days due to illness or caring for the sick. Using adult survival rates as a proxy for population health, it has been estimated that a 1% increase in adult survival rates increases labour productivity by about 2.8% (Bloom & Canning, 2005). This finding was found to be consistent with the calibrated result of around 1.7% (Weil, 2007).

Based on findings in Bloom et al (2004), Bloom & Canning (2005) and Weil (2007) and cognizant of the fact that labour productivity also depends on the presence of other factors, the proposed healthcare financing reforms are assumed to increase labour productivity in all sectors by 1.5% per year. That is, a 1% annual growth in labour productivity, over the 0.5% assumed in the baseline. It is attributed to the expansion in healthcare services delivery brought about by the proposed health sector budget share.

6.4.3 Health impact on total factor productivity

The other health effect modelled relates to total factor productivity (TFP) growth. Total factor productivity is an indicator of the long term performance of the sectors in the Ugandan economy as it relates the volume of sector outputs to the volume of inputs. Growth in TFP means less quantity of factors of production is used to produce the same level of output in all sectors. Conversely, when holding all factor inputs at the same quantity level, more output is generated. The TFP shock is modelled by imposing a growth rate on the value of the scale coefficients A_{nag}^{kl} , A^{cl}, A_{agr}^{kl} specified in equations (4.9), (4.10) and (4.11). The modelled growth rate for the scale coefficients is attributed to improvements in health, alluded to in the literature on health and growth, discussed in Section 2.2. Specifically, there is evidence suggesting that health improvements may lead to expectations of longer life and consequently higher savings which raise the level of investment and physical capital per worker (Bloom, Canning, & Graham, 2003; Hurd et al., 1998; Weil, 2007).

Using life expectancy as a proxy for health, it has been shown that physical capital improves as healthy people's perception that they will live much longer leads to higher savings rate and increases investment as a proportion of GDP, (Bloom, Canning, & Graham, 2003). The authors found that on the whole, health impacts the length of working life and that a ten year increase in longevity was associated with a 4.5% increase in savings rates. It is also postulated that a healthier workforce, that supplies more efficient units also attracts more physical capital (Weil, 2007). This is further evidence of the effect of health and healthcare in raising physical capital per worker and consequently total factor productivity.

Based on the findings in Bloom et al (2003, 2004) and Bokhari et al (2006), the modelled proposed health sector budget share is assumed to generate a 2% growth rate in TFP across all sectors. That is, an additional 1.5% from the 0.5% TFP growth rate assumed in the baseline. Note that TFP growth rate is uniformly applied across all sectors, which could be an under/over estimation of the actual TFP growth generated in some sectors. This concern is dealt with in the sensitivity analysis, Chapter 9, where the rate of TFP growth is varied below and above the 2% applied in the model. A summary of the proposed simulations is presented in Table 6.1.

Table 6.1 Summary of scenarios for simulation

Exogenous updating parameter	Prioritisation scenario		Ear marked Tax scenario		Aid for health scenario	
	Without health effects	With health effects	Without health effects	With health effects	Without health effects	With health effects
Government consumption expenditure growth by function	Government healthcare consumption expenditure increases	Government healthcare consumption expenditure increases	Government healthcare consumption expenditure increases	Government healthcare consumption expenditure increases	Government healthcare consumption expenditure increases	Government healthcare consumption expenditure increases
Growth in direct taxes	Baseline taxes	Baseline taxes	Direct tax rate on households increases	Direct tax rate on households increases	Baseline taxes	Baseline taxes
Growth in foreign savings inflow	Baseline aid	Baseline aid	Baseline aid	Baseline aid	Positive foreign savings growth rate	Positive foreign savings growth rate
Labour force growth	Baseline labour force rate	Economy wide labour factor supply increases	Baseline labour force rate	Economy wide labour factor supply increases	Baseline labour force rate	Economy wide labour factor supply increases
Factor-specific productivity growth rate	Baseline labour productivity	Labour productivity increases in all sectors	Baseline labour productivity	Labour productivity increases in all sector	Baseline labour productivity	Labour productivity increases in all sectors
Total factor productivity (TFP) growth rate	Baseline TFP	TFP increases in all sectors	Baseline TFP	TFP increases in all sectors	Baseline TFP	TFP increases in all sector

6.5 Summary

The chapter provides an understanding of the scenarios by explaining what is entailed in the proposed policy scenarios. The chapter first explains the working of the economy in the baseline scenario which is meant to portray a "business-as-usual" picture of the economy.

The rationale for selecting the healthcare financing reforms to be analysed is provided as well as the justification for the model horizon. An in-depth relational analysis of healthcare investment, growth in labour supply, labour productivity and total factor productivity is presented from empirical studies, forming a basis for the health effects parameter values used in the model. A prima facie case for increased healthcare expenditure positively impacting economic growth through the health effect parameters is established. The model is set to test, empirically, the established links between healthcare expenditure and the rest of the economy; and report results in Chapters 7 and 8.

CHAPTER 7: IMPACTS OF HEALTHCARE FINANCING REFORMS ON MACROECONOMIC VARIABLES IN UGANDA

7.1 Introduction

The dynamic CGE model of Uganda is designed to capture the impacts of increasing resources to the health sector by creating fiscal space for health from three different sources: prioritization of the health sector, earmarked taxes for health, and increased external grants. The simulation results focus primarily on economy-wide adjustments mechanisms – wage rates, factor demand by sectors, sector composition, and exchange rate; changes in macroeconomic variables; and welfare changes (captured through poverty reduction rates). For each of the proposed healthcare financing mechanisms modelled, results are distinguished between different scenarios - by source of fiscal space and with and without the envisaged health effects. Overall, results are presented for five simulations of the baseline budget share with and without health effects, and fifteen simulations of the proposed budget share, with additional funding from either the prioritisation of the health sector, taxes or aid for health, with and without health effects. For ease of reference, the simulation results headings are summarised and defined in Table 7.1 alongside with a description of the frequently occurring terms used in the analysis.

The simulations for the proposed health budget share, without health effects, assume the baseline health status prevails throughout. The simulations of the proposed health budget share with health effects assume new health status in the model, defined, either individually by growth in labour supply, labour factor productivity, total factor productivity or by simultaneous growth (combination) of all the three health effect parameters. Throughout the results analysis, new health is used to mean the simultaneous (or combined) growth in all the three health effect parameters. If, however, in the analysis new health is used to refer to only one of the health effect parameters, the intended health effect parameter will be explicitly stated.

The dynamic baseline (business as usual) simulation is characterised by the baseline health budget share and baseline health effect parameters, described in the baseline scenario design in Chapter 6, and denoted as SIM5 in the results. The counterfactual simulations are characterised by a given source of fiscal space for health, and either the proposed health budget share without health effects or the proposed budget share with new health. Therefore, for the prioritisation scenario, the proposed budget share, without health effects is PSIM1, with labour supply growth is PSIM2, with labour productivity growth is PSIM3, with total factor productivity growth is PSIM4 and with combined growth in all the health effect parameters is PSIM5. Similarly, for the tax scenario, the simulation for the proposed health budget share is indicated by PSIM6 – without health effects, PSIM7- with labour supply growth, PSIM8 – with factor productivity growth, PSIM9 – with total factor productivity growth, and PSIM10- with combined growth in all health effect parameters. Finally, the aid scenario simulations for the proposed health budget share are denoted as PSIM11 – without health effects, PSIM12 – with labour supply growth, PSIM13 – with labour productivity growth, PSIM14 – with total factor productivity growth, and PSIM15 – with combined growth in all the health effects parameters. For each of the simulations, results are first presented as changes in the relevant variable relative to the initial year (2008) or annual growth rates where applicable.

In using the CGE technique for policy evaluation the gist of the analysis lies not with the magnitude of the numbers produced in the results but with the direction (sign) of the effect produced by the policy change compared to the baseline. Therefore, an analysis of the simulation results is presented as deviations from the baseline. Different simulations are also compared throughout the analysis to identify the incremental effect of the proposed policy and to identify possible benefits that might accrue if a policy could be pursued with different assumptions. Most importantly, the counterfactual simulations are compared to the dynamic baseline results and presented as deviations from the baseline. Therefore, under the prioritisation scenario deviation one (Deviation1) refers to the difference between the baseline and the proposed budget share without health effects. Deviation two (Deviation2) pertains to the difference between the proposed budget share, with and without health effects while deviation three (Deviation3) refers to the difference between the baseline and the proposed budget share with new health. Similarly, under the tax scenario, Deviation1 refers to the difference between the baseline and the proposed budget share, plus the proposed tax without health effects, Deviation2 refers to the difference between the proposed budget share and the proposed tax, with and without new health while Deviation3 refers to the difference between the baseline and the proposed budget share with new health. Lastly, under the aid scenario, Deviation1 refers to the difference between the baseline and the proposed budget share, plus the proposed aid inflow without health effects. Deviation2 refers to the difference between the proposed budget share and the proposed aid inflow, with and without new health. Deviation3 refers to the difference between the baseline and the proposed budget share, plus the proposed aid inflow with new health. Note that in all the scenarios Deviation2 describes the net effect generated by the combined health effects that accrue when the proposed healthcare financing policy is implemented.

In this chapter the results are organised in two main sections – structural adjustments and macroeconomic impact- defined by the overall impacts of the healthcare financing policy scenarios evaluated in the study. For each section, the results will be presented and discussed. Section 7.2 focuses on the structural changes in the economy, emanating from implementing the policy shocks. Under this section, results are presented for the impact of each policy adopted to create fiscal space for health, on wages, factor substitution, sector composition, and exchange rate. Section 7.3 concentrates on changes in macroeconomic variables, particularly discussing changes in GDP, private consumption, investment, imports and exports, for each one of the proposed policies. Section 7.4 summarises and concludes the chapter. Note that the welfare impacts of the policy simulations from the poverty module are distinctly presented and discussed in the proceeding Chapter 8.

Table 7.1 Simulation acronyms and symbols

Simulation	Abbreviation
Base budshr with baseline parameters: tax, aid, and initial health	SIM1
Base budshr with baseline parameters: tax, aid and health (LFGR)	SIM2
Base budshr with baseline parameters: tax, aid and health (FPRDGR_FLAB)	SIM3
Base budshr with baseline parameters: tax, aid and health (TFPGR)	SIM4
Base budshr with baseline parameters: tax, aid and health (growth in ALL)	SIM5
Proposed budshr with baseline parameters: tax, aid and health-ALL	PSIM1
Proposed budshr with baseline parameters: tax and aid, plus new health (LFGR)	PSIM2
Proposed budshr with baseline parameters: tax and aid, plus new health (FPRDGR_FLAB)	PSIM3
Proposed budshr with baseline parameters: tax and aid, plus new health (TFPGR)	PSIM4
Proposed budshr with baseline parameters: tax and aid, plus new health (growth in ALL)	PSIM5
Proposed budshr with new tax, baseline parameters: aid and health (growth in ALL)	PSIM6
Proposed budshr with new tax, baseline aid plus new health (LFGR)	PSIM7
Proposed budshr with new tax, baseline aid plus new health (FPRDGR_FLAB)	PSIM8
Proposed budshr with new tax, baseline aid plus new health (TFPGR)	PSIM9
Proposed budshr with new tax, baseline aid plus new health (growth in ALL)	PSIM10
Proposed budshr with new aid, baseline parameters: tax and health (growth in ALL)	PSIM11
Proposed budshr with new aid, baseline tax plus new health (LFGR)	PSIM12
Proposed budshr with new aid, baseline tax plus new health (FPRDGR_FLAB)	PSIM13
Proposed budshr with new aid, baseline tax plus new health (TFPGR)	PSIM14
Proposed budshr with new aid, baseline tax plus new health (growth in ALL)	PSIM15
Other simulation acronyms	
Labour factor growth parameter	LFGR
Labour factor productivity growth parameter	FPRDGR_FLAB
Total factor productivity growth parameter	TFPGR
Combined growth in all three health status parameters	growth in ALL
Budget share	budshr
Definition of deviations	
Prioritisation scenario	
Deviation1	PSIM1-SIM5
Deviation2	PSIM5-PSIM1
Deviation3	PSIM5-SIM5
Tax scenario	
Deviation1	PSIM6-SIM5
Deviation2	PSIM10-PSIM6
Deviation3	PSIM10-SIM5
Aid scenario	
Deviation1	PSIM11-SIM5
Deviation2	PSIM15-SIM11
Deviation3	PSIM15-SIM5

7.2 Structural changes in the Ugandan economy

The proposed healthcare financing structure facilitates health system improvement investments which in turn lead to increased labour supply to the economy as well as growth in labour productivity and total factor productivity, as described in Chapter 6. The economy adjusts in order to absorb the increasing labour supply and improvements in labour productivity and total factor productivity. In the dynamic CGE model designed for Uganda, these adjustments are transmitted through wages, rents, factor substitutions, sector composition and the external account mechanisms. The impact of increased healthcare expenditure on each of these transmission channels is outlined and discussed in detail below.

7.2.1 Wage/rent adjustments

In the CGE model, factor markets clear through relative factor price changes. The factor market closure in the Uganda model set up for this study assumed quantity supplied of each factor to be fixed while the economy-wide wage was allowed to vary, to assure that the sum of factor demands from all activities equals the quantity of factor supplied. This section presents the results for the impacts of factor payments, firstly, showing the changes at the end of 2020, relative to the initial year and secondly, the deviations from the baseline growth path, and discusses the underlying factors behind the observed changes. Therefore, Table 7.2 presents the results for the percentage change in wages and rents at the end of the model period (2020) relative to the initial year (2008). The results indicate that factor market equilibrium is obtained at various levels of the economy-wide wage rate for all labour categories and capital rents, depending on the assumptions made in the simulation. The baseline (SIM5) growth in factor prices shows that wage rates increase by 12.9% for self-employed, 18.7% for unskilled, and 16.4% for skilled labour while capital rents decline by 0.2% and land rents increase by 20.7%.

Table 7.2 Change in economy wide wages/rents: 2020 relative to 2008, for different scenarios (%)

	Labour			Capital	Land
	Self employed	Unskilled	Skilled		
SIM1	78.9	94.9	266.4	-23.4	1.1
SIM2	22.0	29.2	11.9	7.8	35.0
SIM3	25.8	37.0	41.0	-2.3	39.0
SIM4	17.9	27.7	32.3	-5.6	33.3
SIM5	12.9	18.7	16.4	-0.2	20.7
PSIM1	12.1	17.3	19.5	23.4	19.5
PSIM2	14.7	15.3	-10.8	23.7	21.3
PSIM3	26.7	37.4	29.4	55.9	47.7
PSIM4	45.3	59.5	40.4	76.9	66.6
PSIM5	31.9	35.8	-8.8	50.2	45.3
PSIM6	11.7	21.0	18.4	21.7	18.5
PSIM7	12.6	14.9	-18.4	17.5	16.9
PSIM8	26.3	41.8	28.3	54.0	46.6
PSIM9	45.0	64.8	39.5	75.1	65.7
PSIM10	29.4	35.7	-15.8	42.8	40.0
PSIM11	13.4	19.6	21.6	26.1	21.9
PSIM12	13.8	13.2	-16.0	21.3	19.5
PSIM13	28.3	40.0	31.7	59.2	50.6
PSIM14	47.1	62.5	42.9	80.5	69.8
PSIM15	30.7	33.3	-13.5	47.1	42.9

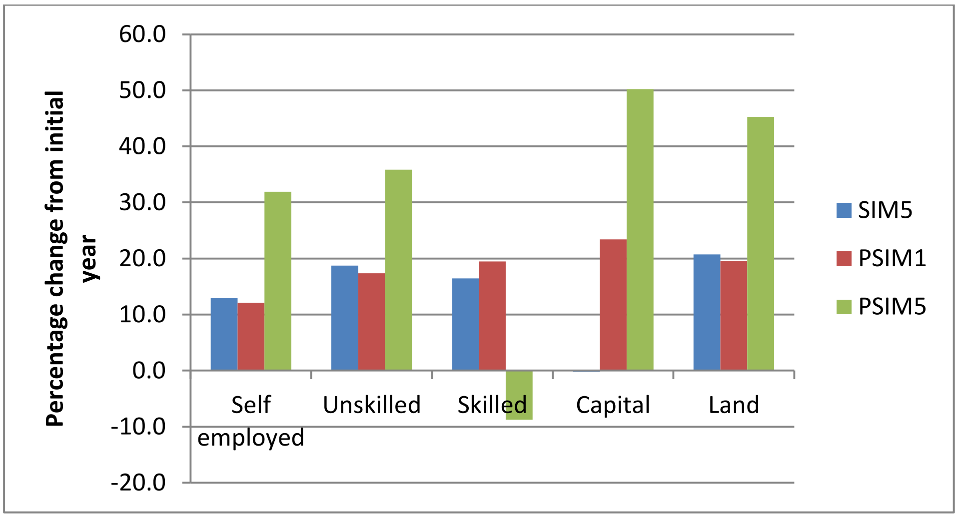
For the proposed budget share with new health, the price for skilled labour declines while prices for all other factors increase under the three financing scenarios. Specifically, wages decline by 8.8% for skilled labour but increase for self-employed (31.9%) and unskilled (35.8%) while rents increase by 50.2% and 45.3% for capital and land respectively, under the prioritisation scenario (PSIM5). Similarly under the tax scenario (PSIM10), wages decline by 15.8% for skilled labour but increase for self-employed (29.4%) and unskilled (35.7%) while rents increase by 42.8% and 40% for capital and land respectively. A similar trend is observed under the aid scenario (PSIM15) where wages for skilled labour decline by 13.5% but increase for self-employed (30.7%) and unskilled (33.3%) while capital and land rents increase.

It is noticeable that when new health is defined by growth in labour supply (PSIM2, PSIM7 and PSIM12), wage rates increase by smaller percentages and the decline in wages for skilled labour is larger, when compared to the combined health effect, in each scenario. For instance, under the prioritisation scenario, the labour supply growth simulation (PSIM2) predicts wages to grow by 14.7% (self-employed), 15.3% (unskilled) and -10.8% (skilled) compared to 31.9% (self-employed), 35.8% (unskilled) and -8.8% (skilled) predicted growths under the combined health effect simulation (PSIM5). A similar trend of the labour supply growth impact is observed for the tax and aid scenarios. This result demonstrates that when labour supply growth is combined with growth in labour productivity and total factor productivity, the adverse impact of increasing labour supply on skilled labour wages is reduced.

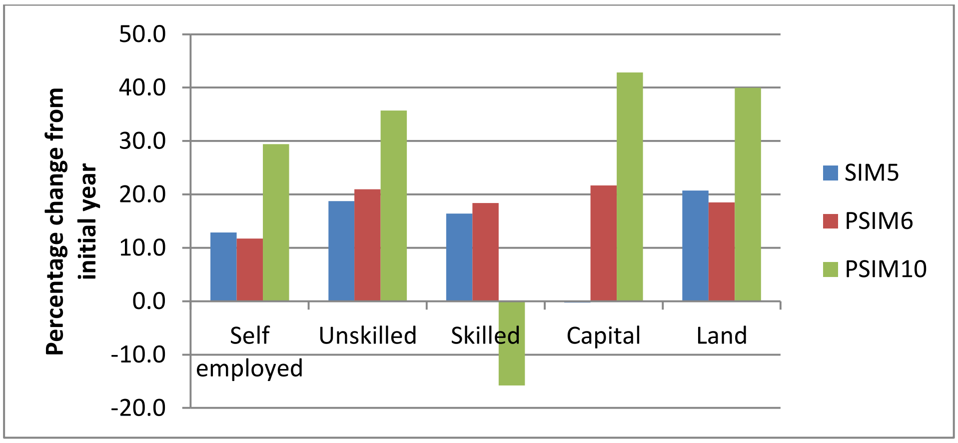
The results also show that, when new health is defined by individual growth in labour productivity (PSIM3, PSIM8 and PSIM13) or total factor productivity (PSIM4, PSIM9 and PSIM14), all factor prices are predicted to generate large and positive increases compared to the effect of combined health effects under all the scenarios. It is therefore evident that growth in labour productivity and total factor productivity will lead to increases in factor prices, since factors are paid according to their marginal productivity. However, a sustained increase in supply of effective labour to the economy serves to mitigate the upward pressure on wages and thus reduce the overall economy wide cost of production. Figure 7.1 illustrates the wage/rent adjustments under the different scenarios.

Figure 7.1 Economy wide wages/rents adjustment under differenct scenarios

7.1a Prioritisation scenario



7.1b Tax scenario



7.1c Aid scenario

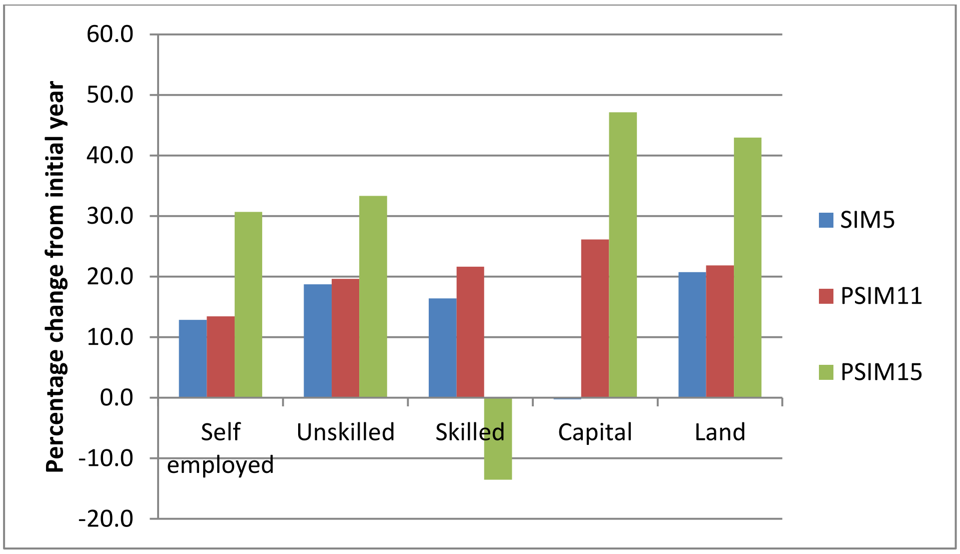


Figure 7.1 clearly illustrates the decline in wage rates for skilled labour when the proposed budget share is combined with new health under all scenarios. The decline in skilled labour wages rates is brought about by the increase in supply of the labour factor as seen in the simulations that incorporate labour factor growth (PSIM2, PSIM7, and PSIM12). Although the increase in labour productivity leads to increased wages rates for all labour categories, when combined with increased labour supply in the case of skilled labour, the incremental productivity effect is counteracted by the ever increasing supply of skilled labour brought about by increased healthcare service delivery. Moreover, credence can be lent to the argument that sustained long term skilled labour productivity may lead to decline in relative wages for skilled labour (Autor, Katz, & Krueger, 1998; Card & DiNardo, 2002). As the health sector policy interventions increase the healthcare output in the economy, the pool of skilled workers is likely to expand faster than the unskilled workers because skilled workers have a relatively higher ability to partake of the availability and diversity of the healthcare output to improve their health. This is in addition to the labour productivity growth for all the labour types imposed in the model. Effectively, the healthcare policy increases the supply of effective skilled labour and at the same time improves the skilled labour productivity which, if combined, increases the availability of skilled labour relative to unskilled labour which may drive down relative wages for skilled labour.

According to the skills premium theory of labour wages, an increase in the relative supplies of skilled workers to unskilled workers lowers the skilled worker wages in two ways. First, where both categories of labour are assumed to be producing the “same goods” – such as healthcare services in the health sector; an increase in the supply of skilled workers will cause a reassignment of tasks formerly performed by unskilled workers to skilled workers, which lowers the marginal productivity and therefore the skilled workers’ wages. This proposition is permissible in the current model setup since the factor market closure assumes that the factors are mobile across sectors. Secondly, for the rest of the economy, where the labour categories produce “different goods”, the output of skilled labour will rise; consumption of that output will increase, lowering the marginal utility of consuming it and therefore its price, and consequently the wages decline.

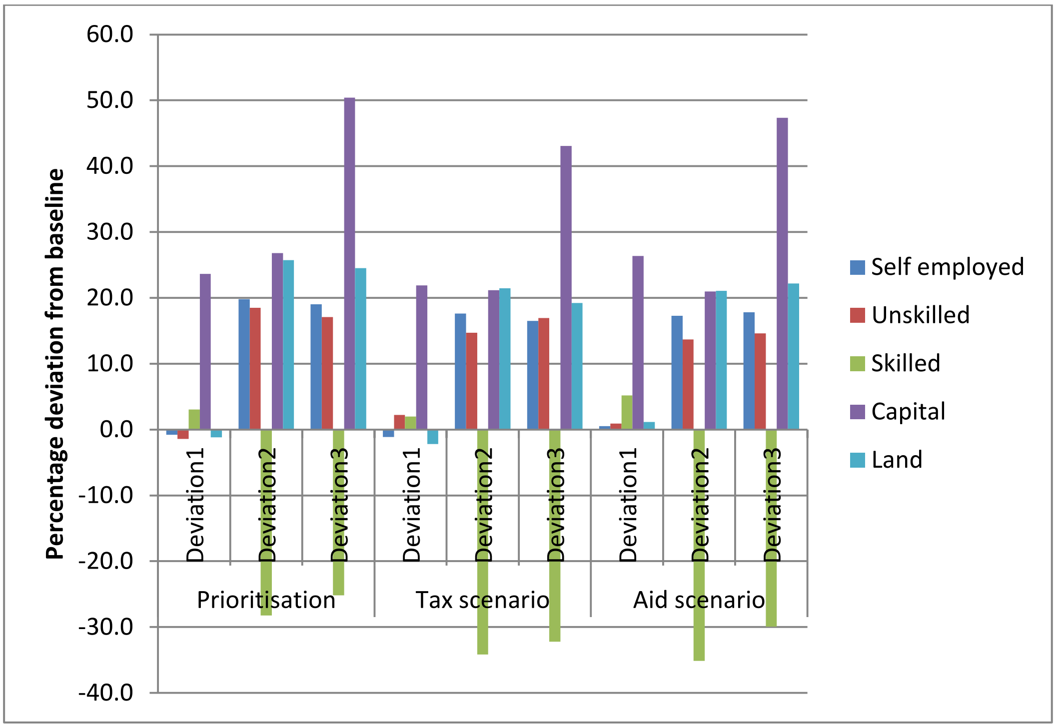
In more general terms, when the elasticity of substitution between skilled and unskilled workers is less than one, (as is the case in Uganda) an increase in productivity of more skilled workers will cause their wages to fall. In effect, an increase in supply of skilled workers under such settings creates an “excess in supply” for a given number of unskilled workers, so that the excess skilled workers bid down wages of other skilled workers. The other option would be that extra skilled workers remain unemployed. But this is not an option for Uganda, partly due to the existence of a large informal (unregulated) sector with a capacity to absorb all labour categories. Wages for unskilled workers are predicted to rise in the model, conforming to the theory on relative skill supplies and skill premium, which predicts a rise in wages for unskilled labour when there is relative increase in supply of skilled labour.

A further observation from the simulations is that, if the labour factor supply growth is ignored, growth in labour productivity and total factor productivity individually lead to increases in wage rates for all labour categories under all scenarios. Specifically, the aid scenario generates the highest increases in wage rates for skilled labour when the health effects are considered individually. In this case the aid impact on wages for skilled labour resonates with an observation alluded to by (Bourguignon & Sundberg, 2006), that aid tends to increase salaries of skilled workers (in this case healthcare workers). The higher wages for health workers signal a price rise for the skilled labour factor throughout the economy, since available skilled labour is limited.

In terms of comparisons of the impact on factor payments under the different scenarios relative to the baseline, the magnitude and direction of change are varied as illustrated in Figure 7.1d. Under the prioritisation scenario, Deviation1 shows that when the proposed budget share is implemented without health effects, wage rates decline by 0.8% (self-employed), 1.4% (unskilled) and increase by 3.4% for skilled labour while capital rents increase 23.7% and land rents decline by 1.2%, compared to the baseline. On the other hand, when the proposed budget share is implemented with health effects under the same scenario, Deviation3 shows higher factor price changes relative to the baseline, except for skilled labour wages rates, which are predicted to decline.

The net effect of new health on factor prices (Deviation2) shows that health effects are responsible for nearly 100% of the increase in wages for self-employed and unskilled labour as well as land rents, while they account for more than 50% of the price increase for capital. Additionally, the decline in skilled labour wage rates relative to the baseline is solely due to the health effects. Whereas the proposed budget share without health effects increases skilled labour wages by about 3%, when health effects are included in the analysis wage rates decline by 25% relative to the baseline. This implies that the health effects are responsible for about 28% decline in wage rates for this category of labour. The net health effect on wage rates for skilled labour is a manifestation of the impact of labour supply growth observed in the results for factor price changes from the initial year (Table 7.2), and explained in the earlier part of this section.

Figure 7.1d Economy wide wages/rents (growth for the period 2008 – 2020): deviation from the baseline



Under the tax scenario, Deviation1 shows that the proposed budget share and the proposed tax without health effects will lead to growth in factor prices for unskilled, skilled labour and capital while prices for self-employed and land will decline relative to the baseline. Note that in this case, additional healthcare expenditure without health effects generates an increase in wages for unskilled labour unlike the prioritisation scenario. This could be attributed to the government's increased healthcare expenditure given a fixed budget. The additional health expenditure draws resources from other sectors so that, as the skill-intensive public service sector expands and attracts skilled labour, other sectors are contracting and laying off workers such that unskilled labour wages decline.

When health effects are included in the analysis, Deviation3 show that all factor prices will increase relative to the baseline, except for skilled labour wages. It is also evident that the growth in factor prices is attributed largely to the impact of health effects, as seen by the magnitude of the net health effect (Deviation2). The aid scenario deviations also show a similar trend as in the tax scenario. The exception is seen in Deviation1 where all factor prices are predicted to increase relative to the baseline (as opposed to the decline in prices for self-employed and land in the tax scenario). This is attributed to the fact that increased aid inflow constitutes external resources injected into the economy. This leads to an expansion in the economy such that all factors share in the additional resources, albeit to different degrees, irrespective of which sector is receiving the additional external resources.

7.2.2 Factor demand

The model predicts an overall increase in demand for all the factors of production when the proposed budget share is implemented combined with new health in all the scenarios. The factor prices observed in the previous section are reflected in the factor demands whereby the simulations with the labour factor growth and declining wage rates, also depict the greatest increase in factor demand as seen in Table 7.3. The baseline simulation predicts growth in total factor demand for self-employed, unskilled, skilled labour and land relative to the initial year.

Table 7.3 Change in total factor demand: 2020 relative to 2008, for different scenarios (%)

	Labour			Capital	Land
	Self employed	Unskilled	Skilled		
SIM1	0.0	4.885E-12	4.2E-13	72.2	0.0
SIM2	80.0	80.0	79.6	111.7	80.0
SIM3	60.0	59.1	60.1	103.4	60.0
SIM4	60.0	59.5	60.1	101.9	60.0
SIM5	80.0	79.3	79.6	104.5	80.0
PSIM1	80.0	79.6	79.6	102.1	80.0
PSIM2	113.0	112.9	112.9	116.2	113.0
PSIM3	60.0	60.1	60.1	106.8	60.0
PSIM4	60.0	60.1	60.1	113.4	60.0
PSIM5	113.0	112.9	112.9	127.3	113.0
PSIM6	80.0	79.6	79.6	110.3	80.0
PSIM7	125.0	125.2	125.2	127.0	125.0
PSIM8	60.0	60.1	60.1	115.4	60.0
PSIM9	60.0	60.1	60.1	122.8	60.0
PSIM10	125.0	125.2	125.2	138.9	125.0
PSIM11	80.0	79.6	79.6	108.2	80.0
PSIM12	125.0	125.2	125.2	124.5	125.0
PSIM13	60.0	60.1	60.1	113.1	60.0
PSIM14	60.0	60.1	60.1	119.7	60.0
PSIM15	125.0	125.2	125.2	135.6	125.0

When the proposed budget share is implemented with new health, the changes in total factor demand are larger than the observation in the baseline simulation for all the scenarios. Under the prioritisation scenario (PSIM5), total factor demand is predicted to grow by 112.9% for unskilled and skilled labour, 113% for self-employed and land, and 127.3% for capital. The tax scenario simulation (PSIM10) predicts total factor demand to grow by 125% for self-employed, unskilled, skilled labour and land, and 138.9% for capital. The aid scenario simulation predicts similar results for the growth in total factor demand – 125% for self-employed, unskilled, skilled and land, and 135.6% for capital. Figure 7.23 illustrates the factor demand changes by showing the percentage change in factor demand, 2020 relative to 2008, under the different scenarios.

The growth in total factor demand predicted by the baseline and the counterfactual simulations is generated by the individual sector demands as seen in Table 7.4. The results for factor demand by sectors indicate that all sectors will have increased demand for factors by 2020, both in the baseline and the counterfactual simulations. Whereas some sectors' contribution to the overall factor demand is predictably smaller than others, the overall picture is that all sectors are expanding their production albeit at varying degrees, for all scenarios. For instance, when the proposed budget share is implemented and new health incorporated, demand for labour in the construction sector is predicted to increase by 80.5% (unskilled) and 138.5% (skilled) under the prioritisation scenario (PSIM5), 117.2% (unskilled) and 203.3% (skilled) under the tax scenario (PSIM10), and 103.1% (unskilled) and 175% (skilled) under the aid scenario (PSIM15). The prioritisation scenario predicts the health sector demand for labour to increase by 95.6% (unskilled) and 158.4% (skilled) for private healthcare, 167.5% (unskilled) and 253.4% (skilled) for public primary healthcare, and 77.7% (unskilled) and 134.8% (skilled) for public other healthcare.

Figure 7.2 Growth in total factor demand: 2020 relative to 2008

Figure 7.2a Prioritisation scenario

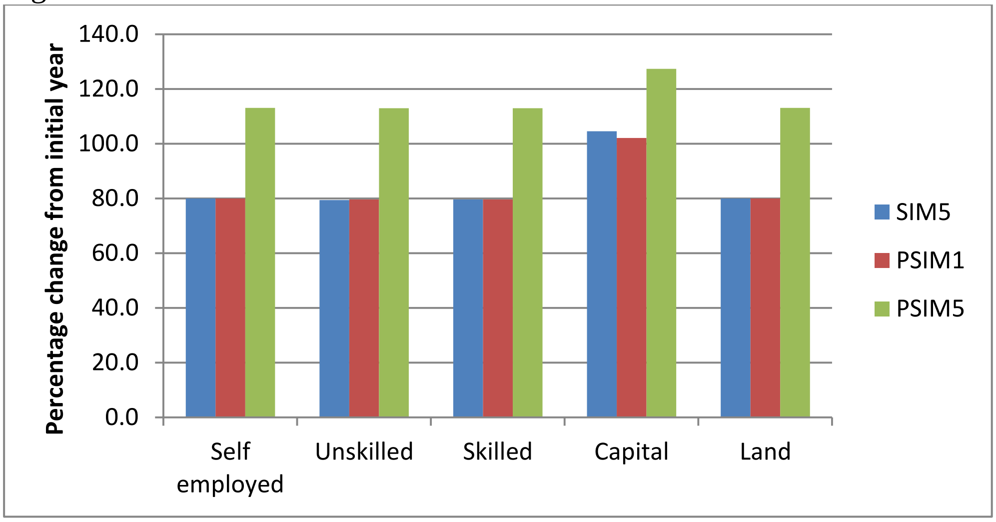


Figure 7.2b Tax scenario

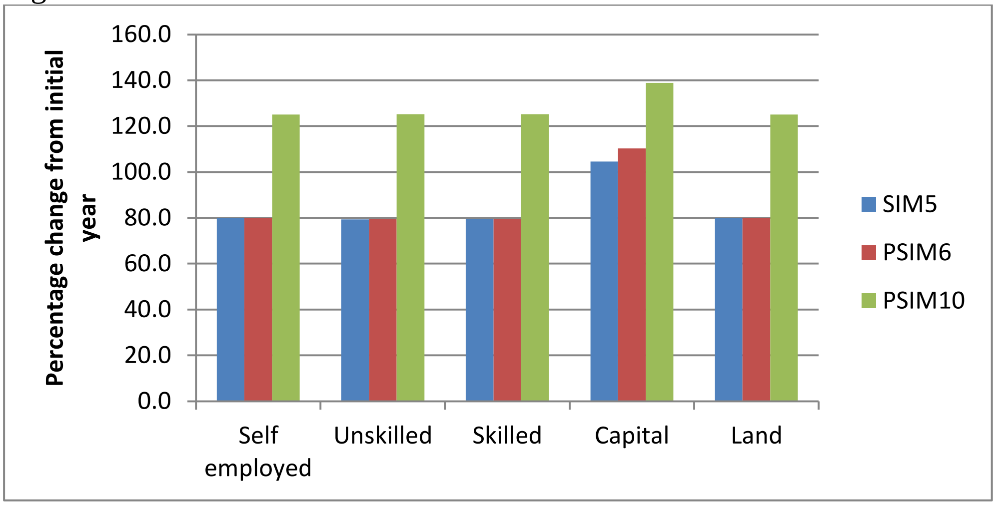


Figure 7.2c Aid scenario

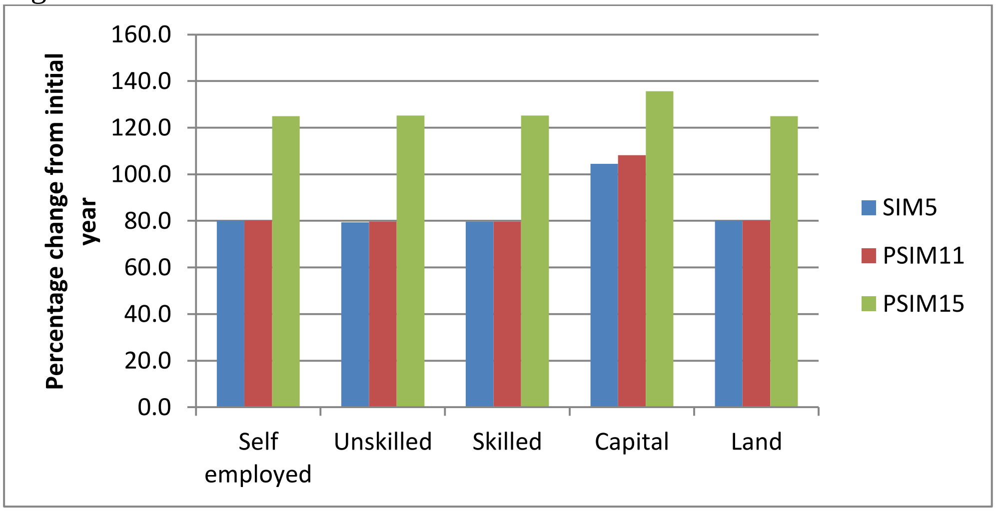


Table 7.4 shows the change in factor demand by sectors at the end of 2020 relative to the initial year (2008), for the different scenarios. The projections for skilled labour demand are even higher under the tax and aid scenarios, particularly for the industry sector and the health sector. This is because a relatively large decline in the wage rates for skilled labour is reported in the wage impacts results for these two scenarios. This means that, sectors find it cheaper to hire skilled labour and substitute away the relatively more expensive factors such as capital, whose rental price is predicted to rise.

The health sector is predicted to expand because the increase in the government healthcare expenditure spurs a large increase in the demand for all factors of production in the healthcare sector. This level of factor demand in the health sector is in line with the proposed government efforts to increase health sector funding implemented in the model. In the model, government is a producer and at the same time a demander of health services. Therefore, as the government increases the share of healthcare budget and demands more healthcare services, it simultaneously expands production to meet the required demand. In order to expand production of healthcare services, the health sector requires a larger quantity of factor inputs, particularly, skilled labour since the sector is inherently skill intensive. Moreover, as labour productivity and total factor productivity in the healthcare service sector increase, the importance of high-skilled labour at high levels of productivity will increase as well and lead to further expansion and growth in the healthcare services sector.

There is an implicit assumption that the increased demand for healthcare labour will be met in part, by an increase in the time devoted to healthcare service delivery by the existing healthcare work-force. It is assumed that increasing the health sector budget share will improve the working conditions of health workers and job satisfaction to match those in the region, which will eventually reduce healthcare worker attrition and employment dualism that have plagued the healthcare sector in Uganda. This will also address some of the concern over labour mobility in that there might well be healthcare workers not currently in health care that could be drawn back in the short-term. Evidence in organisational behaviour literature shows motivation and work environment are critical factors which affect job satisfaction (Adeyinka, Ayeni, & Popoola, 2007; Elnaga, 2013). Studies have also shown that healthcare professionals tend to be motivated more by intrinsic rewards and to a lesser extent, extrinsic rewards[68] for job satisfaction (Dieleman, Cuong, Anh, & Martineau, 2003; Franco, Bennett, Kanfer, & Stubblebine, 2004; Lambrou, Kontodimopoulos, & Niakas, 2010; Manongi, Marchant, & Bygbjerg, 2006; Mathauer & Imhoff, 2006; Smith et al., 2012). If the additional health funding is allocated to the HSSP and HSSIP priorities (as assumed in this study), the conditions that prevent health-workers from achieving their intrinsic goals, including treating and healing people, will be reduced (or even eliminated). Demotivating factors revealed in Chapter 1 include poor working conditions such as the chronic drug stock-outs in public health facilities, medical equipment in a state of disrepair with only 40% of equipment in good condition and relatively low pay for health workers (see discussion in Chapter 1).

The HSSIP investment focus entails priorities that are critical for health workers' motivation and job satisfaction. These are: medical products investment which includes availability of essential drugs in all public health facilities throughout the year, health infrastructure investment which includes buildings, equipment, ICT and transport, human resources for

[68] Intrinsic rewards derive from within the individual such as taking pride and feeling good about a job well done (like treating and healing a person) while extrinsic rewards derive from rewards given by another person.

health investment which includes attainment of 100% of the expected establishment norms, and strengthening the productivity of the existing and new health workforce, as well as management support which includes planning, supervision, training and monitoring. If implemented, these investment pillars will facilitate health-workers to achieve their intrinsic goals and consequently job satisfaction and, implicitly, increase number of hours worked in the health sector.

Although a wage rise for health workers does not necessarily mean workers will increase the hours worked, the case for healthcare workers in Uganda is particularly interesting. From the labour supply theory, the overall impact of a wage change will depend on the dominance of either the substitution or income effect, given the labour-leisure trade-off. In the case of healthcare labour in Uganda, the costly absenteeism in public health units, as reported in the World Bank study, is partly due to employment dualism where health workers take up additional jobs that are not necessarily in the health sector. Therefore, the trade-off is between working in the health sector for which they are professionally trained and working in other sectors, such as shop keeper, where they engage purely to diversify income sources given the meagre salary paid in public service. The assumption in the analysis of healthcare labour in this study is that the shop-keeper job is an "inferior good" so that an increase in the wage rate in the health sector increases hours devoted to the health sector job by the doctor or nurse through both the substitution effect and the income effect. It is worth noting, however, that salary is just one of the elements in the remuneration factor for job satisfaction of healthcare workers. Therefore, in order to attain the health objectives of the Ugandan population, public health expenditure on human resources for health should be anchored towards all aspects of job satisfaction including both intrinsic and extrinsic rewards.

Additionally, there is a forward linkage from the health sector expansion as it provides treatments (and cure) for the ill and unable to work to re-join the labour force. In this way the health sector contributes to a mass of healthy input labour to other sectors such as agriculture and utilities among others. These sectors expand in tandem with the health sectors, and further increase their demand for factors of production.

Table 7.4 Percentage change in factor demand by sectors: 2020 relative to 2008, under different scenarios

	Labour		Capital	Labour		Capital	Labour		Capital	Labour		Capital	Labour		Capital
	Unskilled	Skilled		Unskilled	Skilled		Unskilled	Skilled		Unskilled	Skilled		Unskilled	Skilled	
	SIM1	**SIM1**	**SIM1**	**SIM2**	**SIM2**	**SIM2**	**SIM3**	**SIM3**	**SIM3**	**SIM4**	**SIM4**	**SIM4**	**SIM5**	**SIM5**	**SIM5**
Agriculture	3.0	0.0	86.2	80.5	0.0	116.7	59.1	0.0	99.3	59.5	0.0	100.8	79.3	0.0	107.8
Industry	-45.3	-42.3	5.4	59.3	94.8	85.5	32.7	48.1	69.8	34.6	48.6	71.0	55.2	77.3	76.7
Utilities	-0.3	-35.9	98.5	75.7	94.2	106.6	56.3	53.2	101.7	56.9	53.0	100.9	76.3	78.8	102.8
Construction	-73.5	-82.9	-47.2	45.7	61.1	71.4	17.3	14.9	51.3	19.8	16.8	53.4	39.3	41.2	60.2
Services	17.7	4.8	118.4	87.8	78.1	129.9	72.8	61.4	128.2	71.6	61.4	124.3	90.4	80.0	124.2
Private healthcare	15.2	-25.9	129.5	73.3	91.5	103.8	59.7	56.5	106.1	58.7	54.8	103.3	77.1	79.6	103.7
Public Primary healthcare	69.9	9.2	238.4	48.8	64.5	75.0	58.8	55.6	104.9	63.5	59.5	109.4	73.1	75.5	99.1
Public Other healthcare	18.8	-23.6	136.7	54.6	70.9	81.8	49.1	46.2	92.4	55.7	51.9	99.4	70.3	72.6	95.8
Other public services	18.8	16.9	246.3	54.6	72.2	85.4	49.1	62.5	113.0	55.7	62.9	112.7	70.3	79.2	103.3
	PSIM1	**PSIM1**	**PSIM1**	**PSIM2**	**PSIM2**	**PSIM2**	**PSIM3**	**PSIM3**	**PSIM3**	**PSIM4**	**PSIM4**	**PSIM4**	**PSIM5**	**PSIM5**	**PSIM5**
Agriculture	79.7	0.0	106.6	121.3	0.0	145.2	60.4	0.0	107.5	59.5	0.0	107.8	125.7	0.0	166.1
Industry	52.4	73.2	71.7	95.3	163.5	94.5	36.8	60.7	75.8	36.0	66.5	79.2	96.6	192.6	104.9
Utilities	77.2	75.0	101.9	109.4	150.6	111.9	57.0	63.8	103.6	56.1	70.6	107.2	107.5	174.2	120.0
Construction	34.1	32.4	52.8	78.3	113.4	80.5	22.6	27.8	58.9	22.4	33.7	62.4	80.5	138.5	91.4
Services	91.4	80.5	123.3	114.9	108.2	127.7	70.1	60.1	129.2	71.1	59.4	138.8	111.2	105.2	137.9
Private healthcare	78.1	75.8	102.9	100.3	139.8	102.7	55.9	62.6	102.1	56.1	70.6	107.2	95.6	158.4	107.4
Public Primary healthcare	287.8	282.9	341.7	234.3	300.2	238.4	213.3	226.7	306.1	178.0	203.9	269.0	167.5	253.4	183.7
Public Other healthcare	110.6	107.9	139.9	109.2	150.4	111.7	74.1	81.6	125.7	55.2	69.6	106.0	77.7	134.8	88.4
Other public services	80.1	77.9	105.0	60.4	92.0	66.7	48.9	55.3	94.2	39.0	51.9	86.9	37.7	81.9	52.4

Table 7.4 continued

	Labour		Capital	Labour		Capital	Labour		Capital	Labour		Capital	Labour		Capital
	Unskilled	Skilled		Unskilled	Skilled		Unskilled	Skilled		Unskilled	Skilled		Unskilled	Skilled	
	PSIM6	**PSIM6**	**PSIM6**	**PSIM7**	**PSIM7**	**PSIM7**	**PSIM8**	**PSIM8**	**PSIM8**	**PSIM9**	**PSIM9**	**PSIM9**	**PSIM10**	**PSIM10**	**PSIM10**
Agriculture	75.2	0.0	106.4	132.5	0.0	158.8	56.4	0.0	107.1	55.3	0.0	107.7	137.8	0.0	182.4
Industry	63.0	75.7	89.0	121.4	196.8	116.7	46.1	63.0	93.3	45.2	68.8	97.5	121.8	228.2	127.8
Utilities	71.3	73.9	99.6	114.4	172.2	112.4	51.8	62.7	101.4	50.8	69.5	105.5	112.3	196.4	121.2
Construction	55.7	58.1	81.5	116.6	175.1	114.6	41.6	51.8	87.9	41.2	58.8	92.5	117.2	203.3	126.3
Services	89.8	80.3	126.3	121.9	118.6	129.8	68.8	59.9	132.6	69.9	59.1	143.2	118.1	115.4	140.6
Private healthcare	73.5	76.1	102.2	104.6	159.8	102.7	52.0	62.9	101.7	52.2	71.1	107.4	99.8	179.0	108.2
Public Primary healthcare	278.2	283.9	340.7	227.2	315.6	224.2	205.4	227.5	305.3	170.7	204.3	268.9	162.2	266.0	173.2
Public Other healthcare	105.5	108.6	139.5	110.6	167.5	108.7	69.8	82.1	125.4	51.1	69.9	105.9	78.7	149.5	86.2
Other public services	74.6	77.2	103.0	56.4	98.6	59.6	44.3	54.7	92.3	34.6	51.3	85.5	34.7	88.1	47.0
	PSIM11	**PSIM11**	**PSIM11**	**PSIM12**	**PSIM12**	**PSIM12**	**PSIM13**	**PSIM13**	**PSIM13**	**PSIM14**	**PSIM14**	**PSIM14**	**PSIM15**	**PSIM15**	**PSIM15**
Agriculture	78.9	0.0	108.0	134.3	0.0	154.5	59.7	0.0	108.9	59.0	0.0	110.0	139.6	0.0	177.6
Industry	58.5	72.9	83.8	115.9	189.7	110.2	41.8	60.3	87.6	40.4	66.2	90.4	115.5	220.2	119.6
Utilities	77.4	75.4	107.2	122.0	173.6	119.1	57.3	64.1	109.0	56.2	70.9	112.7	119.9	197.7	127.5
Construction	45.2	43.5	69.5	103.7	151.0	101.0	31.8	37.5	75.1	30.4	42.7	77.6	103.1	175.0	110.2
Services	89.3	80.4	125.9	123.1	119.0	130.5	68.3	60.0	132.1	69.5	59.3	142.3	119.6	115.9	141.1
Private healthcare	78.7	76.7	108.7	111.2	160.3	108.4	56.5	63.4	108.0	56.6	71.3	113.2	106.2	179.2	113.4
Public Primary healthcare	283.6	279.2	348.0	233.1	310.4	228.7	210.0	223.5	311.9	175.0	200.9	274.5	167.2	261.7	176.5
Public Other healthcare	107.2	104.8	142.0	113.3	162.9	110.5	71.4	78.9	127.7	52.7	67.1	108.0	81.4	145.6	87.7
Other public services	79.9	77.9	110.0	62.1	99.7	65.0	48.8	55.3	99.0	38.8	51.9	91.6	39.9	89.4	51.9

Whether the proposed policy changes are desirable for stimulating growth and therefore the increased factor demand throughout the economy depends on the direction of the change in the predicted factor demands relative to baseline predictions. Figure 7.3 illustrates the deviations from the baseline in overall factor demand while Table 7.5 presents the deviations in individual sector demand for factors. Overall, Deviation1 shows that, increasing the healthcare budget without health effects has minimal impact on total factor demand relative to the baseline, except for the health sector. The magnitude in labour demand for Deviation1 is contributed, largely, by the expansion in the health sector. Demand for unskilled and skilled labour increases by over 200% for the public primary healthcare and by over 30% for the public other-healthcare, compared to the baseline under all scenarios. The contribution of the health sector labour demand in the total demand for labour masks the depicted declining demand in other individual sectors. For instance, the agricultural sector demand for labour declines relative to the baseline under the tax and aid scenarios. Similarly, labour demand in the industry sector and specifically in the construction sector, declines relative to the baseline in the prioritisation scenario. This suggests that these sectors actually contract when the proposed budget share is implemented without incorporating health effects.

The predicted increase in demand for labour in the health sector is premised on the model assumption that labour is mobile across sectors. However, the extent to which the observed surge in healthcare labour demand can be met in Uganda is debatable. Healthcare labour is largely specific to the health sector and there are not many healthcare workers, doctors and nurses, elsewhere in the economy. There is a general shortage of health workers in Uganda as discussed in Chapter 1. In 2010 the Physician and Nursing and midwifery density (per 10,000 population) was reported at 1.2 and 13.1 respectively compared to the global average of 13.6

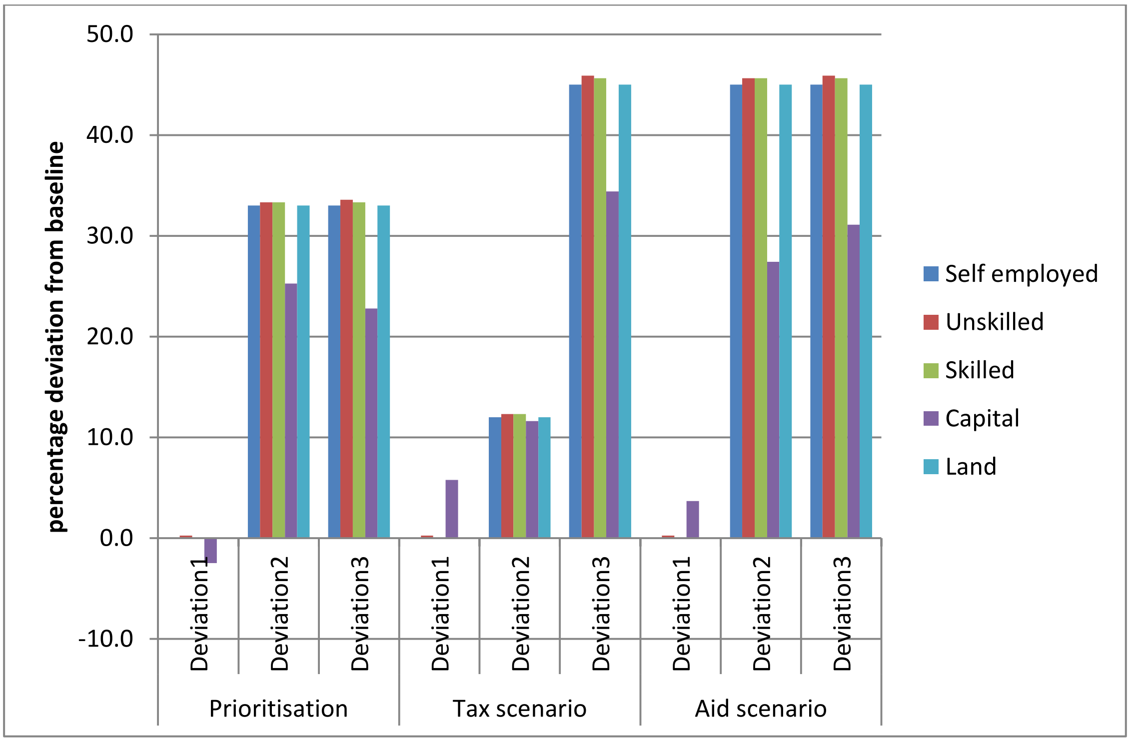
and 27.5. A 2011 report showed that 38% of establishments in the public health units were vacant.

The shortage of health workers in Uganda could be overcome through the following proposals. First, the government could put in place policies that encourage importation of health-specific labour[69]. Second, the government could increase investment in education and training facilities for health-specific professions. The contention with the training option to increase healthcare labour is that healthcare labour requires relatively longer time to train and so would not be available in the short run. In the short run, it is likely that there will be a shortage of health workers compared to the predicted demand. However, the mid- to long-term (as assumed in this model) offers flexibility, through training. The level of flexibility over time would depend on the cadre of health workers. For example, the availability of community health workers or nurses can be increased in a couple of years whereas specialised heart surgeons could take 10 years or more. The current model, however, is not detailed enough to capture the speed of transition for different forms of labour. Instead, the model is taking effectively an average across labour types in healthcare with an assumption of a transition from the short run (say the first 2 years) where the quantity of healthcare labour is fixed, through the medium term (3 - 5 years) where training increases the quantity of some healthcare cadres such as nurses, to the long run (5+ years) where everything is flexible and therefore mobile. Third, policies geared towards the substitution between doctors and nurses could increase the availability of professional care per given population. For example, the health sector strategic plan (2010 - 2015) proposal to establish, operationalise

[69] This proposal is not modelled in the current study but is an attractive policy option for government and therefore a future research question to assess the macroeconomic impact of imported healthcare labour in Uganda.

and sustain a regional tier in health service delivery in Uganda is one way to realign the available health professionals with the population. The tier system aims to strengthen the referral system in service delivery with more nursing labour per physician.

Figure 7.3 Total factor demand (% growth: 2008 -2020), deviation from the baseline under different scenarios



The relatively larger contraction in the construction sector is because, under the proposed budget share, increasing the healthcare expenditure reduces resources available to other sectors that are huge spenders on construction, such as the energy and road construction sectors. Moreover, the healthcare sector service delivery is, to a large extent, people-oriented implying that a considerable portion of the health budget goes to finance the wage bill. Therefore, although the health sector is expanding in all aspects including rehabilitation and construction of health units, the overall expansion in service delivery translates into a proportionately larger increase in recurrent expenditure relative to capital expenditure.

Inevitably, this means relatively fewer resources are available for construction even in the health sector.

In all the three scenarios, the constrained expansion in the industry sector when the proposed budget is implemented without health effects is shown by Deviation1. This is reflected in the declining demand for all factors under the prioritisation scenario and decline in demand for skilled labour under the tax and aid scenarios. The decline in the industry sector is partly a reflection of the limitations of the sector to reap from linkages with the rapidly expanding health sector. For instance, one of the most critical healthcare inputs is medicines and pharmaceuticals and yet according to a UNIDO report[70], only 10% of these are manufactured domestically. This means that, even if there is increased demand for healthcare inputs such as medicines, the existing low supply capacity for the critical inputs by the industry sector will curtail a commensurate expansion which would occur in the industry sector.

The predicted results in Deviation1 are consistent with the theoretical factor-bias effect of expanding the health sector presented in Chapter 2. The factor-bias effect postulates that, given a fixed endowment of labour, expanding the non-tradable health sector will reduce the quantity of the labour factor available to the tradable sectors so that the tradable sectors' output will decline and consequently the sectors shrink. Therefore, from the observed results in Deviation1, the factor-bias effect dominates because the simulations have only considered an increase in the healthcare budget while the envisaged health effects, and therefore the scale-effect of the health sector expansion, are excluded from the analysis.

[70] (UNIDO, 2010)

Table 7. 5 Change in total factor demand by sectors, deviation from the baseline (%)

	Deviation1			Deviation2			Deviation3		
	Labour		Capital	Labour		Capital	Labour		Capital
Prioritisation scenario	Unskilled	Skilled		Unskilled	Skilled		Unskilled	Skilled	
Agriculture	0.3	0.0	-1.2	46.1	0.0	59.5	46.4	0.0	58.3
Industry	-2.8	-4.0	-5.0	44.2	119.4	33.1	41.4	115.3	28.2
Utilities	0.9	-3.8	-0.9	30.2	99.1	18.1	31.2	95.4	17.2
Construction	-5.2	-8.8	-7.5	46.4	106.1	38.7	41.2	97.3	31.2
Services	1.0	0.5	-0.9	19.8	24.7	14.6	20.8	25.2	13.7
Private healthcare	1.0	-3.7	-0.8	17.5	82.6	4.6	18.5	78.9	3.7
Public Primary healthcare	214.6	207.3	242.6	-120.3	-29.4	-158.1	94.4	177.9	84.5
Public Other healthcare	40.3	35.3	44.1	-32.9	26.9	-51.5	7.4	62.1	-7.4
Other public services	9.9	-1.4	1.7	-42.5	4.0	-52.6	-32.6	2.6	-50.9
Tax scenario									
Agriculture	-4.1	0.0	-1.4	62.6	0.0	76.1	58.4	0.0	74.6
Industry	7.8	-1.6	12.3	58.7	152.5	38.8	66.6	150.9	51.1
Utilities	-5.0	-4.9	-3.2	41.0	122.6	21.6	36.0	117.7	18.4
Construction	16.4	16.8	21.3	61.5	145.2	44.9	77.9	162.0	66.1
Services	-0.6	0.2	2.1	28.3	35.1	14.3	27.7	35.4	16.5
Private healthcare	-3.6	-3.4	-1.5	26.3	102.9	6.0	22.7	99.5	4.5
Public Primary healthcare	205.1	208.4	241.6	-116.1	-17.9	-167.6	89.0	190.5	74.0
Public Other healthcare	35.3	36.0	43.7	-26.8	40.9	-53.3	8.4	76.9	-9.6
Other public services	4.4	-2.0	-0.3	-39.9	10.8	-56.0	-35.6	8.8	-56.3
Aid scenario									
Agriculture	-0.4	0.0	0.2	60.7	0.0	69.6	60.3	0.0	69.8
Industry	3.2	-4.4	7.1	57.1	147.3	35.7	60.3	143.0	42.9
Utilities	1.1	-3.4	4.4	42.5	122.3	20.3	43.6	118.9	24.8
Construction	5.8	2.2	9.3	58.0	131.5	40.7	63.8	133.7	50.0
Services	-1.1	0.4	1.7	30.3	35.5	15.2	29.2	35.9	17.0
Private healthcare	1.6	-2.9	5.1	27.5	102.6	4.7	29.2	99.7	9.8
Public Primary healthcare	210.5	203.7	248.9	-116.4	-17.5	-171.5	94.0	186.2	77.4
Public Other healthcare	36.9	32.2	46.2	-25.8	40.8	-54.2	11.2	73.0	-8.1
Other public services	9.7	-1.4	6.7	-40.1	11.5	-58.1	-30.4	10.1	-51.4

It suffices to note that when health effects are included in the analysis, the scale-effect of expanding the health sector dominates the factor-bias effect as depicted in results for Deviation3, under all the scenarios. When the health effects are incorporated in the analysis as new health combined with the proposed budget share, demand for all factors increases relative to the baseline. In this case, the expanding health sector increases its output (treatments) thereby reducing the non-participation rates of the labour force due to illness. Consequently, economy wide labour supply increases as well as increasing the population's well-being hence higher productivity of the labour force. Therefore, effective healthcare treatments work together to exceed the negative impact on economy-wide factor endowments caused by expanding the non-tradable health sector. Consequently the tradable sectors in the economy expand in tandem with the health sector expansion, and generate demand for factors of production required to produce the expanding output.

The Deviation3 results show that the sectors which are reported to contract in Deviation1, expand and increase their demand for factors when new health is incorporated in the analysis. Specifically, in Deviation3, the construction sector demand for labour is predicted to increase by 41.2% (unskilled) and 97.2% (skilled) under the prioritisation scenario compared to a decline of 5.2% (unskilled) and 8.8% (skilled) in Deviation1. Similarly, under the tax scenario demand for labour in construction increases by 77.9% (unskilled) and 162% (skilled) in Deviation3 compared to an increase of 16.4% (skilled) and 16.8% (skilled) in Deviation1. The aid scenario in Deviation3 depicts demand for labour in construction to increase by 63.8% (unskilled) and 133.7% (skilled) compared to an increase of 5.8% (unskilled) and 2.2% (skilled) in Deviation1.

Furthermore, for the comparison of the proposed budget share with health effects in Deviation3, the health sector relative demand for skilled labour is higher and unskilled labour is lower when compared to Deviation1, for all scenarios. This is because incorporating health effects in the analysis implies a further expansion of the health sector, which requires relatively more skilled labour to produce the required output. It is also assumed that, since the analysis spans over a relatively long period (over ten years), it allows for the health sector expansion to overcome the constrained supply of skilled health workers in the short term because they require long periods for training.

Under the sectoral factor demand, it is observed that the overall demand for skilled labour increases within the public service sector (other public services) and public other healthcare while demand for unskilled labour and capital declines. This is because, both capital and unskilled labour are substituted away as they become relatively expensive, as seen in the increase in wages for unskilled labour and capital rents in Section 7.2.1. Therefore, as the public service sector expands it demands more of the relatively cheaper and more productive skilled labour to produce the required output, since most of the public services would necessarily require skilled labour.

Relatively larger deviations in factor demand are observed under the tax and aid scenario when compared to the prioritisation scenario. This is because, under the tax and aid scenarios, the government is in a position to increase healthcare budget using additional resources without necessarily penalizing the other sectors, as is the case with the prioritisation scenario.

7.2.3 Sector composition

This section presents the predicted results for the sector shares in GDP. The results are presented as deviations from the baseline. Firstly, Deviation1 is discussed to show the performance of sector shares in GDP when the proposed budget is implemented without health effects and compared to the baseline. Secondly, Deviation3 is discussed, showing the deviation from the baseline when the proposed budget is implemented with health effects. The pattern of change in sector share in GDP is similar across all the three policy scenarios, as shown in Figure 7.4. However, within each policy scenario, relative wage changes, factor demand and factor substitution play into the sector composition and alter the sector shares in GDP. From Figure 7.4, Deviation1 shows that when the new budget proposal is implemented without health effects, the sectors' share in GDP is varied depending on the source of the additional healthcare funding.

The agricultural sector share in GDP declines relative to the baseline under all scenarios. However, under the prioritisation scenario, the agricultural sector share in GDP begins to grow faster in 2017 compared to the baseline, and continues on a positive trend until 2020. The trend in agricultural sector share in GDP follows from the observed factor demand under the same scenarios in the previous section. The agricultural sector, which is intensive in the use of unskilled labour, was predicted to increase demand for unskilled labour by 0.3% under the prioritisation scenario while demand for the same factor would decline under the tax and aid scenarios. This is an indication that the agricultural sector would expand (although by a small margin) relative to the baseline under the prioritisation scenario, when government increases the health budget, even if health effects are not incorporated. This is particularly because the agricultural sector supplies food stuffs to the expanding healthcare market (and a healthier population) and therefore would benefit from the health sector's backward linkage. On the other hand, the agricultural sector share in GDP declines under the tax scenario because, under the same scenario unskilled labour demand declines by 4.1% relative to the baseline. This suggests that the imposed tax reduces households' savings that would have otherwise been invested in maintaining as well as opening up new areas for crop cultivation. Similarly, the aid scenario penalises the agricultural sector as unskilled labour demand declines by 0.4% resulting in declining share in GDP, particularly as unskilled labour is attracted to the expanding health sector.

The industry sector share in GDP declines in Deviation1 under the prioritisation scenario but is positive under the tax and aid scenarios. Again, the performance of the industry sector is mirrored in the factor demands in Deviation1 for the same scenarios. The prioritisation scenario depicts a decline in demand for all factors of production suggesting that the industry sector is contracting relative to the baseline, thus the declining share in GDP. Under the prioritisation scenario, the government reallocates resources from productive sectors to the health sector thereby constraining the expansion capability of the industry sector. However, when the additional funding for the health sector is raised from taxation or aid, the industry sector is able to expand while employing more of the unskilled labour and capital relative to the baseline, even if health effects are not incorporated.

The services sector share in GDP increases in the prioritisation scenario but declines under the tax and aid scenarios. Service delivery in Uganda is largely people-oriented. The prioritisation scenario factor demand Deviation1 shows that demand for both skilled and unskilled labour increases relative to the baseline. This suggests that the services sector is expanding compared to the baseline and therefore the services sector share in GDP increases. On the other hand, the tax and aid scenarios predict a decline in demand for unskilled labour relative to the baseline while skilled labour demand increases modestly by 0.2% and 0.4%

respectively. The net impact of the factor demand adjustments is that of a contracting services sector and consequently declining share in GDP.

Figure 7.4 Sector share in GDP, deviation from baseline (%)

Figure 7.4a Prioritisation scenario

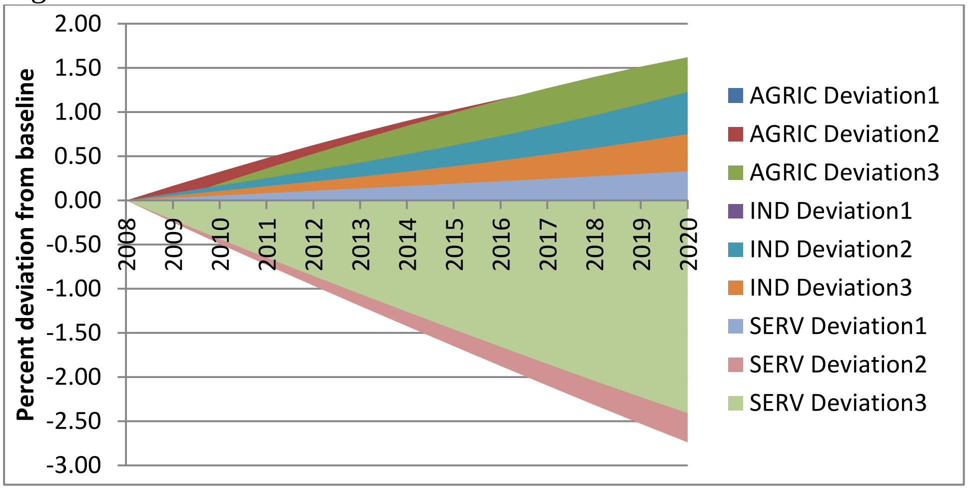


Figure 7.4b Tax scenario

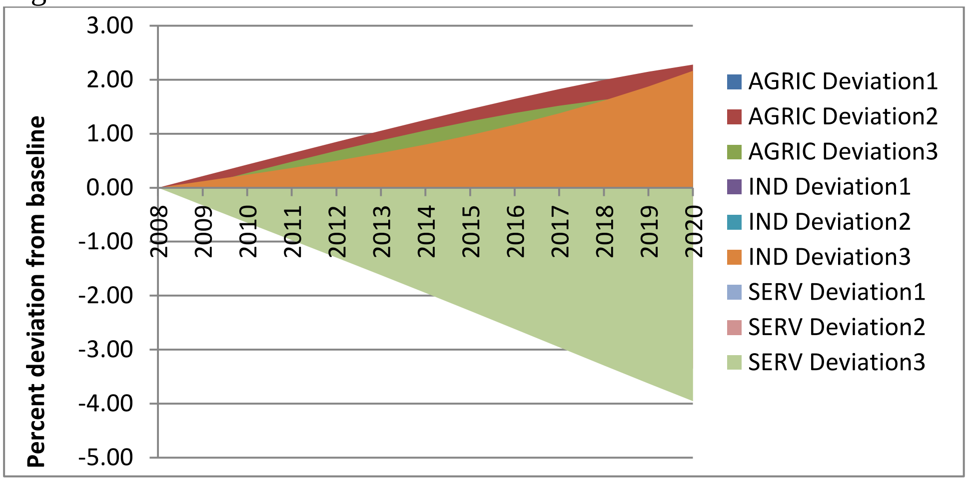
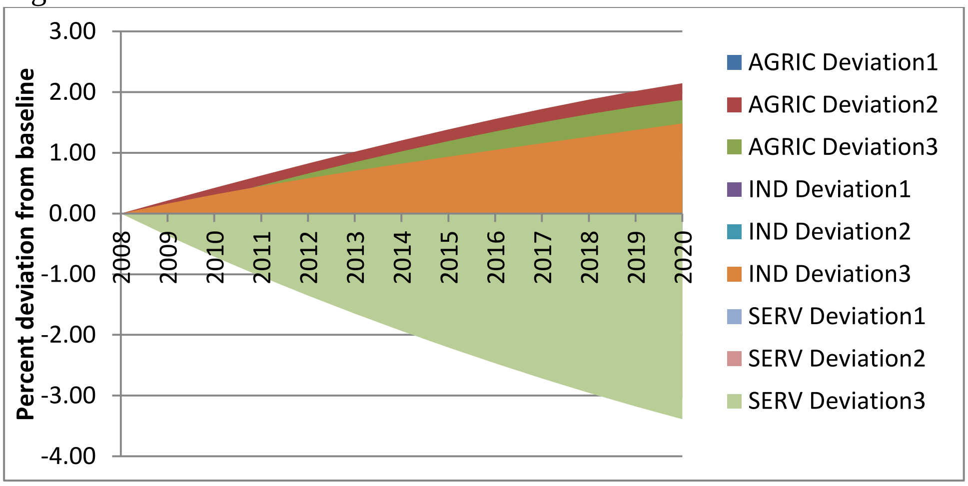


Figure 7.4c Aid scenario



Note: AGRIC = agriculture, IND = industry, SERV = services

When health effects are incorporated in Deviation3, the predicted results of the proposed budget implemented with new health relative to the baseline indicate a reversal in the trend in sector share in GDP from that observed in Deviation1. Agriculture share in GDP increases cumulatively under all scenarios. By 2020, the agricultural share in GDP has increased by 1.62%, 1.76% and 1.87% under the prioritisation, tax and aid scenarios respectively compared to the baseline. A similar trend is observed for the industry sector where the relative share in GDP increases by 0.75%, 2.17% and 1.48% under the prioritisation, tax and aid scenarios respectively by 2020. The services sector share declines under all scenarios.

The growth in agricultural and industry sectors' share in GDP is contributed largely by the positive impact of health effects as observed by net health effect in Deviation2. Although the services sector is boosted by the rapid expansion in the health sector, its significance in the economy is reduced as the more productive agricultural and industrial sectors gain importance. With the proposed budget share, there are health improvement investments which directly benefit self-employed and unskilled labour which are relatively intensively employed in the agriculture and industry sector. These categories of labour largely depend on their well-being to participate in productive activities and earn an income. They are mainly employed in the informal sector without entitlements to sick leave. The improved health status of this category of the labour force increases productivity in the agricultural and industrial sectors, and consequently the sectors expand production and increase their share in GDP more rapidly. The trend in sectors' share in GDP for 2008 to 2020 is presented in Table 7.6 for different scenarios where tables 7.6a, 7.6b and 7.6c indicate the sector shares while 7.6d presents the sectors' contribution to annual growth rates in GDP.

Table 7.6 Sector share in GDP (%): Agriculture, industry and services under different scenarios: 2008 - 2020

Table 7.6a Agricultural sector share in GDP (%)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM1	22.6	22.6	22.4	22.1	21.9	21.8	21.7	21.7	21.7	21.8	21.9	22.1	22.5
SIM2	22.6	22.6	22.5	22.3	22.2	22.1	22.0	21.9	21.8	21.7	21.6	21.5	21.4
SIM3	22.6	22.6	22.4	22.1	21.9	21.7	21.5	21.3	21.2	21.0	20.9	20.7	20.6
SIM4	22.6	22.6	22.4	22.2	21.9	21.7	21.6	21.4	21.2	21.1	21.0	20.8	20.7
SIM5	22.6	22.6	22.5	22.3	22.2	22.1	22.0	21.9	21.8	21.8	21.7	21.6	21.6
PSIM1	22.6	22.5	22.3	22.2	22.1	22.0	21.9	21.9	21.8	21.8	21.7	21.7	21.7
PSIM2	22.6	22.6	22.6	22.7	22.7	22.7	22.8	22.9	22.9	23.0	23.1	23.2	23.3
PSIM3	22.6	22.4	22.2	22.0	21.8	21.6	21.4	21.2	21.1	20.9	20.8	20.6	20.5
PSIM4	22.6	22.4	22.2	21.9	21.7	21.5	21.3	21.1	20.9	20.6	20.4	20.2	20.1
PSIM5	22.6	22.6	22.7	22.7	22.7	22.8	22.8	22.9	23.0	23.0	23.1	23.2	23.2
PSIM6	22.6	22.5	22.3	22.2	22.0	21.9	21.8	21.7	21.6	21.4	21.3	21.2	21.1
PSIM7	22.6	22.7	22.7	22.8	22.8	22.9	23.0	23.1	23.2	23.2	23.3	23.4	23.4
PSIM8	22.6	22.4	22.1	21.9	21.7	21.5	21.2	21.0	20.8	20.6	20.4	20.1	19.9
PSIM9	22.6	22.4	22.1	21.9	21.6	21.4	21.1	20.9	20.6	20.3	20.0	19.7	19.4
PSIM10	22.6	22.7	22.7	22.8	22.9	23.0	23.1	23.1	23.2	23.3	23.3	23.4	23.4
PSIM11	22.6	22.5	22.3	22.2	22.0	21.9	21.8	21.7	21.6	21.5	21.5	21.4	21.3
PSIM12	22.6	22.7	22.7	22.8	22.8	22.9	23.0	23.0	23.1	23.2	23.3	23.4	23.5
PSIM13	22.6	22.4	22.1	21.9	21.7	21.5	21.3	21.1	20.9	20.7	20.5	20.3	20.1
PSIM14	22.6	22.4	22.1	21.9	21.6	21.4	21.2	20.9	20.7	20.4	20.2	20.0	19.7
PSIM15	22.6	22.7	22.7	22.8	22.9	22.9	23.0	23.1	23.2	23.3	23.3	23.4	23.5

Table 7.6b Industrial sector share in GDP (%)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM1	27.2	26.7	26.2	25.6	25.0	24.4	23.7	22.9	22.0	21.1	20.0	18.8	17.4
SIM2	27.2	27.0	26.7	26.4	26.2	26.0	25.7	25.5	25.4	25.2	25.0	24.9	24.8
SIM3	27.2	26.9	26.6	26.3	26.0	25.7	25.4	25.2	24.9	24.7	24.4	24.2	24.0
SIM4	27.2	26.9	26.6	26.3	26.0	25.8	25.5	25.2	25.0	24.8	24.5	24.3	24.1
SIM5	27.2	26.9	26.6	26.3	26.1	25.8	25.5	25.3	25.1	24.8	24.6	24.4	24.3
PSIM1	27.2	26.9	26.6	26.2	25.9	25.6	25.3	25.1	24.8	24.5	24.3	24.0	23.8
PSIM2	27.2	27.0	26.7	26.4	26.2	25.9	25.7	25.5	25.3	25.1	25.0	24.8	24.7
PSIM3	27.2	26.9	26.6	26.3	26.1	25.8	25.5	25.3	25.1	24.9	24.7	24.5	24.3
PSIM4	27.2	26.9	26.6	26.3	26.0	25.8	25.5	25.3	25.1	24.9	24.7	24.6	24.4
PSIM5	27.2	27.0	26.7	26.5	26.3	26.1	25.9	25.7	25.5	25.4	25.2	25.1	25.0
PSIM6	27.2	27.0	26.7	26.4	26.2	26.0	25.8	25.7	25.6	25.5	25.4	25.4	25.4
PSIM7	27.2	27.0	26.8	26.6	26.5	26.3	26.2	26.1	26.1	26.0	26.0	26.1	26.1
PSIM8	27.2	27.0	26.8	26.5	26.3	26.2	26.0	25.9	25.8	25.8	25.8	25.8	25.8
PSIM9	27.2	27.0	26.7	26.5	26.3	26.2	26.0	25.9	25.9	25.8	25.8	25.9	26.0
PSIM10	27.2	27.1	26.9	26.7	26.6	26.4	26.3	26.3	26.2	26.2	26.3	26.3	26.4
PSIM11	27.2	27.0	26.8	26.5	26.3	26.1	25.9	25.7	25.5	25.4	25.2	25.0	24.8
PSIM12	27.2	27.1	26.9	26.7	26.6	26.4	26.3	26.1	26.0	25.9	25.8	25.7	25.6
PSIM13	27.2	27.0	26.8	26.6	26.5	26.3	26.1	25.9	25.8	25.7	25.5	25.4	25.3
PSIM14	27.2	27.0	26.8	26.6	26.4	26.2	26.1	25.9	25.8	25.6	25.5	25.4	25.3
PSIM15	27.2	27.1	26.9	26.8	26.6	26.5	26.4	26.2	26.1	26.0	25.9	25.8	25.7

Table 7.6c Services sector share in GDP (%)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM1	50.1	50.9	51.7	52.4	53.2	53.9	54.7	55.4	56.2	57.0	57.8	58.7	59.6
SIM2	50.1	50.6	51.0	51.4	51.7	52.1	52.4	52.7	53.0	53.2	53.5	53.7	53.9
SIM3	50.1	50.7	51.3	51.8	52.3	52.8	53.2	53.7	54.1	54.5	54.9	55.2	55.5
SIM4	50.1	50.7	51.2	51.7	52.2	52.7	53.1	53.5	53.9	54.3	54.6	54.9	55.3
SIM5	50.1	50.6	51.0	51.5	51.9	52.2	52.6	52.9	53.2	53.5	53.7	53.9	54.2
PSIM1	50.1	50.6	51.1	51.5	52.0	52.4	52.7	53.1	53.4	53.7	54.0	54.2	54.5
PSIM2	50.1	50.4	50.7	50.9	51.1	51.3	51.5	51.6	51.7	51.8	51.9	52.0	52.0
PSIM3	50.1	50.7	51.2	51.7	52.2	52.6	53.1	53.5	53.9	54.2	54.6	54.9	55.2
PSIM4	50.1	50.7	51.2	51.8	52.3	52.7	53.2	53.6	54.0	54.4	54.8	55.2	55.5
PSIM5	50.1	50.4	50.6	50.8	51.0	51.2	51.3	51.4	51.5	51.6	51.7	51.7	51.8
PSIM6	50.1	50.6	51.0	51.4	51.7	52.1	52.4	52.6	52.9	53.1	53.3	53.4	53.6
PSIM7	50.1	50.3	50.5	50.6	50.7	50.8	50.8	50.8	50.8	50.7	50.6	50.5	50.4
PSIM8	50.1	50.6	51.1	51.5	52.0	52.4	52.7	53.1	53.4	53.6	53.9	54.1	54.3
PSIM9	50.1	50.6	51.1	51.6	52.0	52.5	52.8	53.2	53.5	53.9	54.1	54.4	54.6
PSIM10	50.1	50.3	50.4	50.5	50.6	50.6	50.6	50.6	50.6	50.5	50.4	50.3	50.2
PSIM11	50.1	50.5	50.9	51.3	51.6	52.0	52.3	52.6	52.8	53.1	53.4	53.6	53.8
PSIM12	50.1	50.3	50.4	50.5	50.6	50.7	50.8	50.8	50.9	50.9	50.9	50.9	50.9
PSIM13	50.1	50.6	51.0	51.5	51.9	52.3	52.6	53.0	53.3	53.7	54.0	54.3	54.6
PSIM14	50.1	50.6	51.1	51.5	51.9	52.4	52.8	53.2	53.6	53.9	54.3	54.6	55.0
PSIM15	50.1	50.2	50.3	50.4	50.5	50.6	50.6	50.7	50.7	50.7	50.8	50.8	50.8

Table 7.6d Sector contribution to annual growth rate in GDP at factor cost (%)

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM5	AGR	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
	IND	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3
	SER	3.9	3.9	3.8	3.8	3.7	3.7	3.6	3.6	3.6	3.5	3.5	3.5
PSIM1	AGR	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
	IND	1.5	1.5	1.4	1.4	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.2
	SER	4.0	3.9	3.9	3.8	3.8	3.7	3.6	3.6	3.6	3.5	3.5	3.4
PSIM2	AGR	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
	IND	1.9	1.9	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
	SER	4.4	4.4	4.3	4.3	4.3	4.2	4.2	4.2	4.2	4.1	4.1	4.1
PSIM3	AGR	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.2
	IND	1.7	1.6	1.6	1.6	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.4
	SER	4.2	4.2	4.2	4.1	4.1	4.1	4.0	4.0	4.0	4.0	3.9	3.9
PSIM4	AGR	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.4
	IND	1.9	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
	SER	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
PSIM5	AGR	2.1	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.3	2.3
	IND	2.3	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.3	2.3	2.3
	SER	5.0	5.0	5.0	5.0	5.0	4.9	4.9	4.9	4.9	4.9	4.9	5.0
PSIM6	AGR	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2
	IND	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.6
	SER	3.9	3.9	3.8	3.8	3.7	3.7	3.7	3.6	3.6	3.6	3.6	3.6
PSIM7	AGR	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1
	IND	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.2	2.2	2.3	2.3
	SER	4.4	4.4	4.3	4.3	4.3	4.3	4.2	4.2	4.2	4.2	4.2	4.2
PSIM8	AGR	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.2
	IND	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.9
	SER	4.2	4.2	4.1	4.1	4.1	4.1	4.1	4.0	4.0	4.0	4.1	4.1
PSIM9	AGR	1.6	1.6	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.3
	IND	2.0	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.1	2.1	2.2	2.3
	SER	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.8	4.8	4.9
PSIM10	AGR	2.2	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4	2.4
	IND	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.8	2.8
	SER	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.1
PSIM11	AGR	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2
	IND	1.6	1.6	1.6	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.4
	SER	3.9	3.8	3.8	3.8	3.7	3.7	3.7	3.6	3.6	3.6	3.6	3.5
PSIM12	AGR	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1
	IND	2.1	2.1	2.1	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	SER	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.2	4.2
PSIM13	AGR	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.2
	IND	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.6
	SER	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.0	4.0	4.0	4.0
PSIM14	AGR	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.4
	IND	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.0
	SER	4.6	4.6	4.6	4.7	4.7	4.7	4.7	4.7	4.7	4.8	4.8	4.8
PSIM15	AGR	2.2	2.2	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4
	IND	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5
	SER	4.9	4.9	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.1	5.1	5.1

AGR = agriculture, IND= industry, SERV= services

7.2.4 External adjustment

The exchange rate dynamics are also captured in the model for the various simulations. The baseline simulation indicates that by 2020 the exchange rate is predicted to depreciate by 6.2% when compared to the 2008 value. The baseline depreciation in exchange rate can be traced to the baseline predicted sector composition observed in Section 7.2.3, which shows the service sector expanding its share in GDP while the industry sector contracts. The growth in the baseline services sector share in GDP also implies a shift in resources from the tradable sectors (industry) to the expanding non-tradable sectors (services) which triggers exchange rate depreciation in order for the current account to balance and restore the equilibrium. Table 7.7 presents results for the exchange rate movements for different simulations under the projected scenarios.

Table 7.7 Exchange rate value: percentage change from 2008, under different scenarios

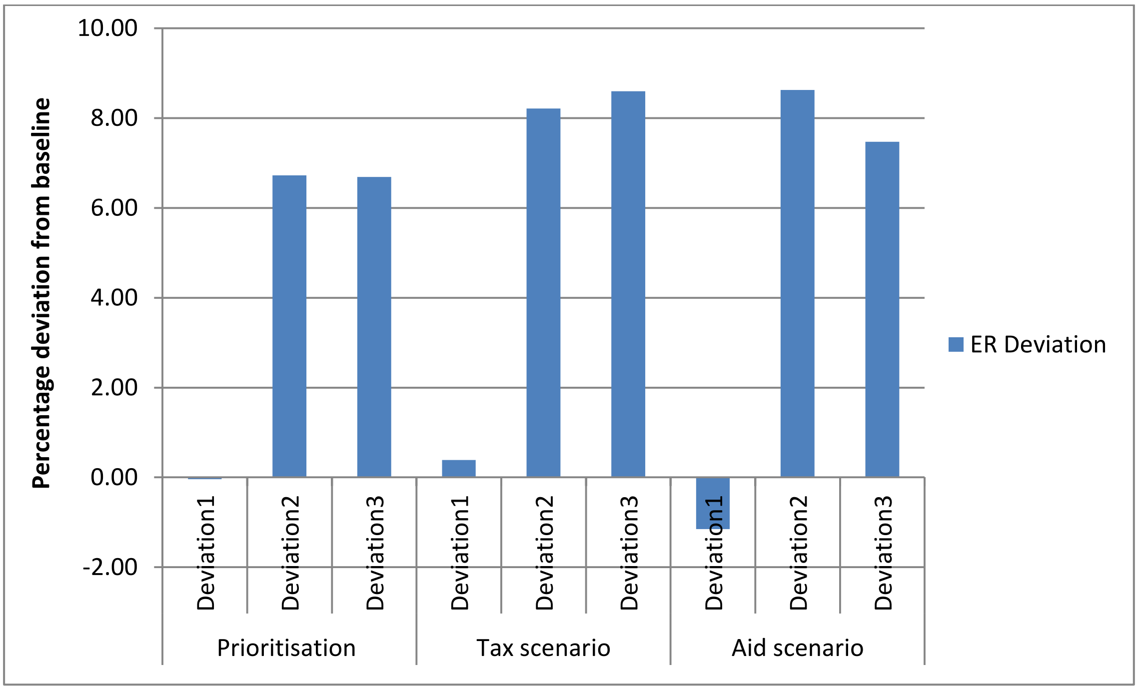
SIM1	-18.8
SIM2	-1.7
SIM3	-7.1
SIM4	-6.3
SIM5	-2.4
PSIM1	-2.4
PSIM2	4.3
PSIM3	-5.4
PSIM4	-6.3
PSIM5	4.3
PSIM6	-2.0
PSIM7	6.4
PSIM8	-5.1
PSIM9	-6.1
PSIM10	6.2
PSIM11	-3.6
PSIM12	5.1
PSIM13	-6.6
PSIM14	-7.4
PSIM15	5.1

When the proposed budget share is implemented with new health the exchange rate appreciates by 5.8%, 6.2% and 5.1% under the prioritisation, the tax and the aid scenarios respectively. When new health is taken separately, the effect of each health effect parameter on the exchange rate value is different from the combined new health effect. For instance, the exchange rate depreciates with growth in labour productivity and growth in total factor productivity while it appreciates with growth in labour supply for all the scenarios. However, when all the three health effect parameters are combined the growth in labour supply impact dominates so that the overall impact is that of an appreciating exchange rate.

The net effect of the improvement in health on the exchange rate dynamics is captured in the deviations from the baseline for different scenarios, illustrated in Figure 7.5. When the proposed budget share is implemented without health effects and compared to the baseline, (Deviation1), the exchange rate value declines minimally by about 0.04% under the prioritisation scenario and a larger decline of 1.2% under the aid scenario, while it increases by 0.4% under the tax scenario. On the other hand, when the proposed budget share incorporating new health is compared to the baseline (Deviation3) the exchange rate value increases by 6.7% under the prioritisation scenario, 8.6% under the tax scenario, and 7.5% under the aid scenario.

These exchange rate movements reflect the adjustments in the sector factor demand and consequently sector share in GDP observed in the previous sections when the proposed budget share is implemented with new health. For all the scenarios, the tradable sectors (agriculture and industry) are predicted to expand and increase their share in GDP. As the agriculture and industry sectors expand, there is a reallocation of resources towards the tradable sectors and subsequently appreciation of the exchange rate relative to the baseline.

Figure 7.5 Exchange rate deviations relative to the baseline under different scenarios



When new health is defined by growth in labour productivity and total factor productivity, the exchange rate value declines and exporters gain since export prices are fixed at the world market. A depreciation of the exchange rate implies higher returns for exporters which raises the profitability of the export sectors relative to other sectors. However, it is also observed that labour factor growth negates the benefits of a depreciating exchange rate which might be detrimental to the export sector. Furthermore, the exchange rate mechanism is transmitted to the share of exports to imports because the exchange rate depreciation increases their nominal values. The extent of the exchange rate adjustments and specific impact of the predicted exchange rate dynamics on imports and exports in Uganda is explored further in Section 7.3.4.

7.3 Macroeconomic impact

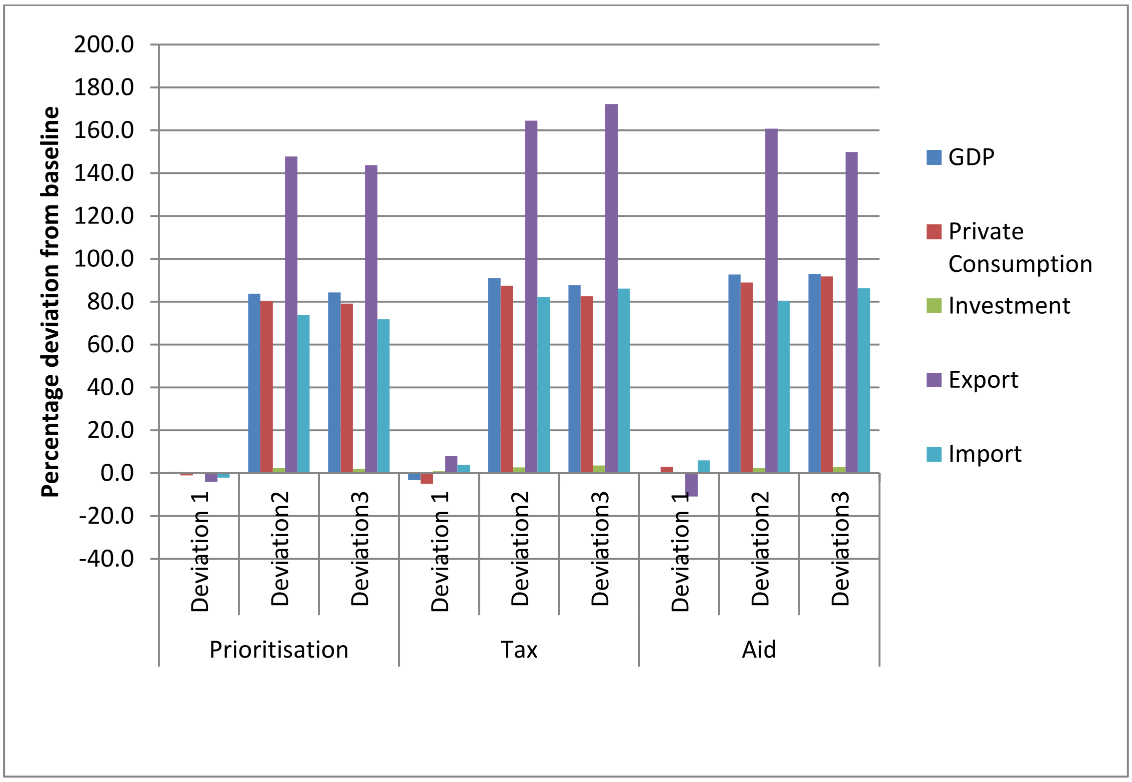
The impact of the proposed policies on the macroeconomic variables is an aggregation of the effects generated by the adjustment mechanisms discussed in the previous section. The proposed healthcare financing policies have varied impacts on growth in GDP, private consumption, investment, imports and exports. This section presents results on the performance of selected macroeconomic variables, exploring the growth paths of individual macro variables in detail. The results are presented as, first, changes in the variables at the end of the model period (2020) relative to the initial year (2008) for all scenarios and secondly, the deviations from the baseline. Table 7.8 presents results for the predicted performance of the selected variables at the end of the model period (2020) relative to the initial year (2008). It is observed that increasing the government healthcare budget coupled with the anticipated health effects leads to relatively higher growth rates in all the macroeconomic variables.

Table 7.8 Growth in value of selected macro variables, percentage change from initial year, under different scenarios

	GDP, at market prices	Private Consumption	Investment	Export	Import
SIM1	104.6	90.7	-2.1	104.7	65.5
SIM2	143.3	127.9	2.2	210.0	118.2
SIM3	127.2	112.4	1.4	182.9	104.6
SIM4	116.2	101.9	1.3	162.9	94.7
SIM5	123.2	108.5	1.5	171.3	98.9
PSIM1	123.8	107.4	1.3	167.3	96.8
PSIM2	162.9	144.8	2.6	234.7	130.6
PSIM3	136.2	119.3	1.7	197.2	111.8
PSIM4	165.8	147.6	2.4	252.9	139.7
PSIM5	207.5	187.6	3.6	315.0	170.7
PSIM6	119.9	103.6	2.3	179.1	102.8
PSIM7	165.4	147.2	3.8	258.5	142.5
PSIM8	132.3	115.5	2.8	210.3	118.4
PSIM9	161.8	143.8	3.6	269.0	147.7
PSIM10	210.9	191.0	5.0	343.5	185.0
PSIM11	123.4	111.4	1.8	160.4	104.8
PSIM12	169.7	155.8	3.3	238.1	143.7
PSIM13	136.0	123.5	2.3	191.2	120.2
PSIM14	166.0	152.3	2.9	248.2	148.7
PSIM15	216.1	200.3	4.3	321.1	185.2

The predicted performance for the selected variables under the proposed budget share with new health compared to the baseline is illustrated in Figure 7.6 which maps the deviations.

Figure 7.6 Growth in value of selected macro variables, percentage deviation from baseline



7.3.1 GDP impact

The GDP growth path over the years for select simulations under different scenarios is illustrated in Figure 7.7 while Table 7.9 provides the specific percentage points for GDP growth rates for the different simulations. Under the baseline (SIM5), GDP growth rate gradually declines from 6.5% in 2009 to 6.0% in 2020. When the proposed budget share is implemented without health effects (PSIM1) GDP grows at a slightly higher rate than the baseline (6.9% in 2009), but eventually the growth rate declines to 5.8% in 2020. The higher GDP growth rate in early years of PSIM1 reflects the expansion of the health sector boosted by the additional government funding. However, further GDP growth is hampered by the contraction of other sectors such as construction, mining and non-food processing, particularly because resources to these sectors are reduced when the healthcare budget share is increased.

When the proposed budget share is implemented with new health, the growth rate in GDP at factor cost increases cumulatively and by 2020 the rate of growth reaches 9.5% for the prioritisation scenario, 10.3% for the tax scenario, and 10.0% for the aid scenario. The observed trend in GDP growth suggests that gains from increased labour force supply, labour productivity and total factor productivity reinforce the initial increase and fuel further growth.

Figure 7.7 Annual GDP growth rates (%) for selected simulations: 2009 -2020

Figure 7.7a Prioritisation scenario

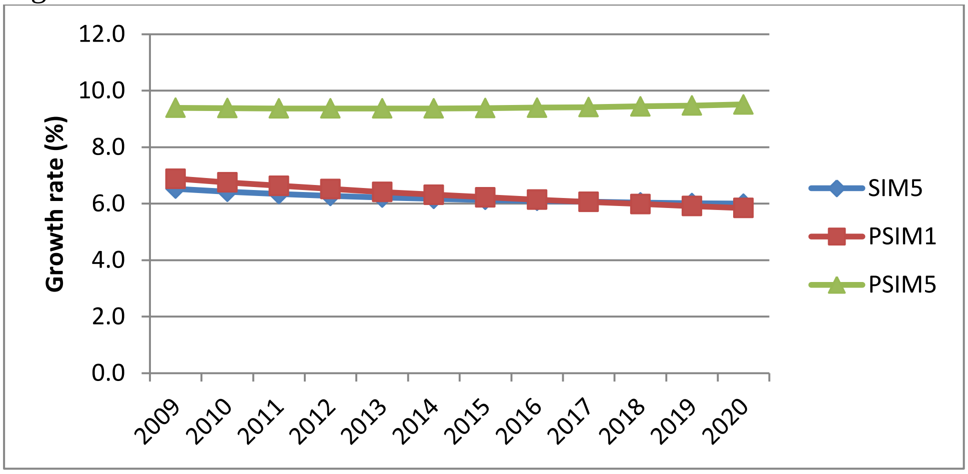


Figure 7.7b Tax scenario

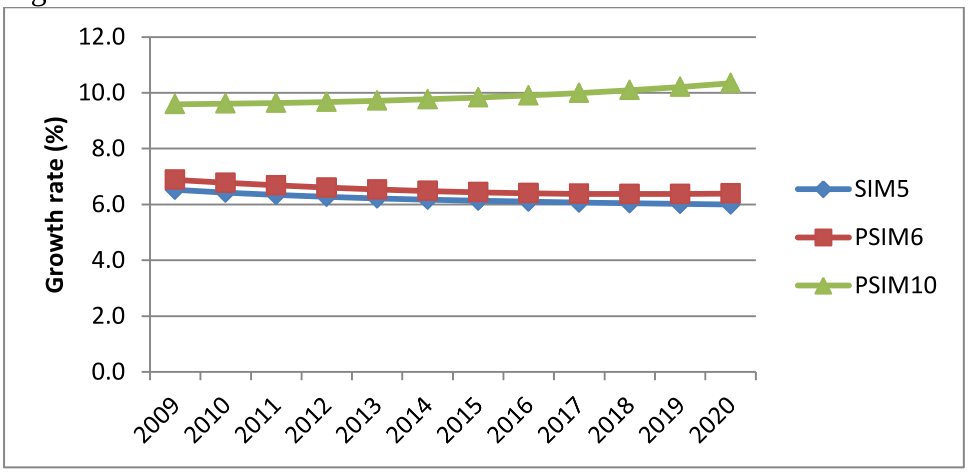


Figure 7.7c Aid scenario

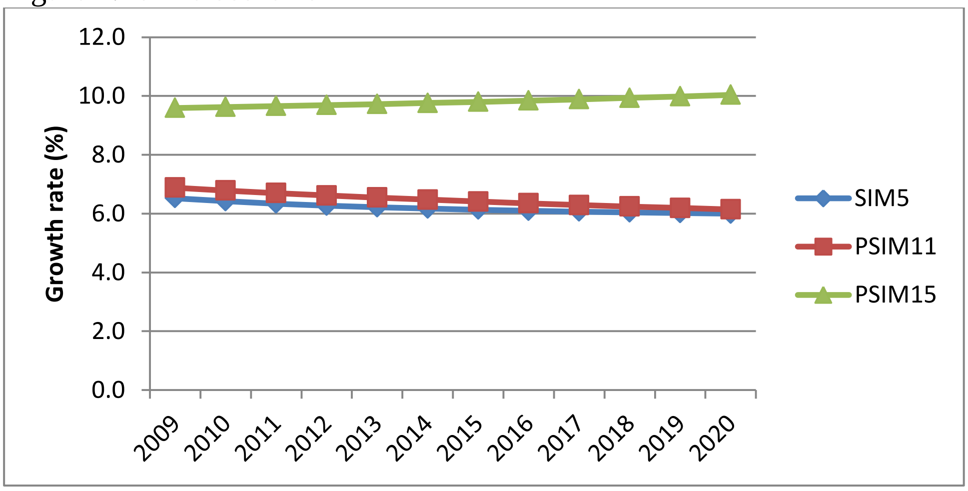


Table 7.9 Annual GDP growth rates under different scenarios: 2009 – 2020

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM1	2.2	1.7	1.3	1.0	0.6	0.2	-0.2	-0.6	-1.1	-1.5	-2.1	-2.6
SIM2	7.8	7.7	7.7	7.6	7.5	7.5	7.5	7.4	7.4	7.4	7.4	7.4
SIM3	6.1	6.0	5.9	5.8	5.7	5.7	5.6	5.6	5.6	5.5	5.5	5.5
SIM4	5.9	5.8	5.7	5.6	5.6	5.5	5.5	5.4	5.4	5.4	5.4	5.3
SIM5	6.5	6.4	6.3	6.3	6.2	6.2	6.1	6.1	6.1	6.0	6.0	6.0
PSIM1	6.9	6.8	6.6	6.5	6.4	6.3	6.2	6.1	6.1	6.0	5.9	5.8
PSIM2	8.2	8.1	8.1	8.0	8.0	7.9	7.9	7.9	7.8	7.8	7.8	7.8
PSIM3	7.3	7.2	7.1	7.0	6.9	6.9	6.8	6.7	6.7	6.6	6.6	6.5
PSIM4	8.2	8.1	8.1	8.0	8.0	7.9	7.9	7.9	7.8	7.8	7.8	7.8
PSIM5	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.5	9.5
PSIM6	6.9	6.8	6.7	6.6	6.5	6.5	6.4	6.4	6.4	6.4	6.4	6.4
PSIM7	8.4	8.3	8.3	8.3	8.3	8.3	8.3	8.4	8.4	8.4	8.5	8.6
PSIM8	7.3	7.2	7.2	7.1	7.1	7.0	7.0	7.0	7.0	7.0	7.1	7.1
PSIM9	8.2	8.2	8.1	8.1	8.1	8.1	8.1	8.2	8.2	8.3	8.4	8.5
PSIM10	9.6	9.6	9.6	9.7	9.7	9.8	9.8	9.9	10.0	10.1	10.2	10.3
PSIM11	6.9	6.8	6.7	6.6	6.5	6.5	6.4	6.3	6.3	6.2	6.2	6.1
PSIM12	8.4	8.4	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
PSIM13	7.3	7.2	7.2	7.1	7.1	7.0	7.0	7.0	6.9	6.9	6.9	6.8
PSIM14	8.2	8.2	8.2	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
PSIM15	9.6	9.6	9.7	9.7	9.7	9.8	9.8	9.8	9.9	9.9	10.0	10.0

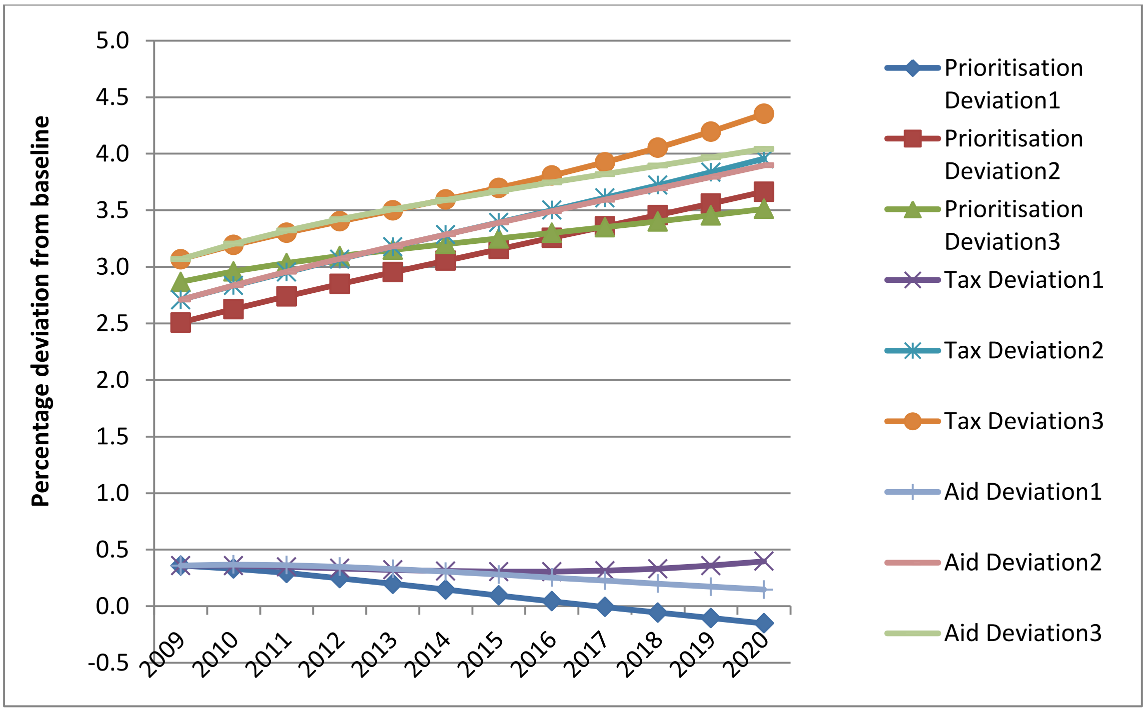
It is instructive to consider the underlying sector growth rates under the different scenarios in order to understand the basis for the total GDP growth rates. Table 7.10 presents the percentage change in sector value-added, 2020 relative to 2008, for the various sectors, which underlie the GDP growth paths depicted in Figure 7.7. It can be deduced from the sectoral performance that the healthcare output expansion (treatments) is particularly valuable in the primary sectors and the informal sector at large, which are the biggest employers of the self-employed and unskilled labour. The agricultural sector, for instance, is predicted to increase demand for unskilled labour by more than 100% in all scenarios which explains the higher GDP growth rates. From Table 7.9, the baseline sector value-added in all sectors is predicted to increase relative to the initial year for all scenarios. This is because the economy actually expands in the baseline as observed from the total factor demand results.

Table 7.10 Sector value-added, percentage change from the initial year, for different scenarios

	SIM1	SIM2	SIM3	SIM4	SIM5	PSIM1	PSIM2	PSIM3	PSIM4	PSIM5
Overall GDP	65.3	131.3	112.3	102.5	109.9	108.3	149.9	122.0	150.6	194.0
Agriculture	67.5	118.4	92.0	84.6	100.1	99.9	157.8	101.1	122.2	201.9
Industry, Total	5.7	110.1	87.1	79.2	86.9	81.8	126.3	97.7	124.5	170.0
Mining	17.0	116.9	94.7	86.5	93.2	88.5	131.0	105.6	133.4	175.0
Food processing	79.1	132.1	110.2	100.8	110.5	109.5	159.2	120.1	147.1	208.3
Non Food processing	23.1	124.9	99.0	91.7	99.6	96.3	144.5	113.8	140.8	192.4
Fuel	75.1	135.1	116.0	108.0	114.1	114.4	154.7	128.8	153.9	198.7
Machinery	-21.2	125.3	87.4	82.8	93.7	87.1	150.9	107.9	134.1	207.4
Chemicals	60.9	134.4	112.9	104.1	111.0	113.9	157.9	130.0	158.1	205.1
Utilities	85.3	134.7	119.3	108.1	113.0	111.5	149.0	127.8	159.3	195.3
Construction	-44.0	92.4	67.3	60.9	68.9	61.1	105.5	77.7	102.9	145.7
Services, Total	96.7	148.7	135.1	123.2	126.8	126.4	159.1	144.5	177.6	203.6
Trade	68.1	127.9	105.6	97.0	106.5	106.1	156.0	117.0	142.6	203.9
Transport	85.7	136.9	121.0	110.9	116.3	115.2	151.6	130.0	158.3	195.4
Communication	63.2	132.5	111.0	102.6	109.4	107.8	152.9	123.4	150.6	200.8
Private healthcare	29.8	136.8	100.9	94.9	106.6	103.8	172.2	121.2	148.2	234.0
Government services	75.0	114.7	101.0	99.8	103.8	109.0	134.5	115.4	123.5	156.7
Education	57.6	121.6	99.6	97.6	104.1	103.2	144.1	113.4	126.3	179.8
Public Primary healthcare	103.1	103.4	103.3	103.3	103.3	346.8	346.9	346.8	346.9	347.1
Public Other healthcare	100.9	107.5	105.5	103.9	104.5	149.5	154.6	151.8	156.3	161.0
	PSIM6	**PSIM7**	**PSIM8**	**PSIM9**	**PSIM10**	**PSIM11**	**PSIM12**	**PSIM13**	**PSIM14**	**PSIM15**
Overall GDP	113.5	162.7	127.8	157.7	209.2	112.2	161.1	126.1	155.3	206.9
Agriculture	99.0	172.1	100.1	121.0	219.3	100.0	171.5	101.2	122.4	218.4
Industry, Total	98.7	152.1	115.8	145.6	199.9	93.5	145.0	109.7	137.1	190.0
Mining	104.3	154.9	122.7	153.1	202.8	99.2	148.2	116.9	145.3	193.5
Food processing	106.5	166.4	117.1	144.0	217.9	111.6	170.9	122.3	149.7	222.6
Non Food processing	107.0	164.4	125.4	154.1	215.5	104.5	160.7	122.5	150.0	210.1
Fuel	113.2	160.4	127.6	152.8	205.7	117.2	164.4	131.9	157.6	210.1
Machinery	107.6	185.9	130.2	159.2	248.2	97.6	172.6	119.2	145.7	230.9
Chemicals	114.2	165.4	130.4	158.8	214.0	118.1	169.6	134.6	163.2	218.4
Utilities	109.2	152.3	125.5	157.2	199.7	116.2	159.4	133.0	165.2	207.4
Construction	91.0	144.9	109.8	139.9	191.1	78.4	129.5	95.4	121.3	170.5
Services, Total	128.2	164.1	146.7	180.8	209.7	127.8	165.2	146.3	180.0	210.8
Trade	106.9	168.0	117.9	143.9	218.7	109.1	168.8	120.2	146.3	219.0
Transport	115.0	157.3	129.8	158.4	202.6	119.0	160.8	134.3	163.3	206.4
Communication	104.8	156.9	120.4	147.6	205.9	111.4	164.7	127.4	155.1	214.5
Private healthcare	103.4	185.2	120.9	148.1	249.5	106.4	189.1	123.9	151.1	253.8
Government services	107.7	137.6	114.0	122.0	160.4	109.7	140.7	116.2	124.3	164.0
Education	101.0	149.2	111.0	123.8	185.8	104.2	154.1	114.6	127.5	191.6
Public Primary healthcare	346.8	346.9	346.8	346.9	347.1	346.8	347.0	346.8	346.9	347.1
Public Other healthcare	149.4	155.2	151.7	156.2	161.7	150.2	156.1	152.6	157.1	162.7

When the proposed budget share is implemented with new health, the sectors' value-added grows by different rates, depending on the source of the addition healthcare financing. In order to appreciate the contribution of the proposed health budget share in GDP growth, the predicted changes are presented as deviations from the baseline in Figure 7.8 for the overall GDP growth and Table 7.11 for the growth in sector value-added.

Figure 7.8 GDP growth rate, deviations from the baseline



It can be seen from Figure 7.8 that implementing the proposed budget share without accounting for health effects of increased healthcare funding (Deviation1), will reduce the GDP growth rates under the prioritisation and aid scenarios while it may improve slightly under the tax scenario. The reason behind the observed Deviation1 trend lies with the sectoral performance deviations presented in Table 7.11. From Table 7.10, Deviation1 shows that all sectors (except fuel, chemicals, public primary-healthcare and public other-healthcare) are predicted to be worse off when the proposed budget share is implemented without health effects compared to the baseline. The poor performance of some sectors under the proposed budget share (PSIM1) is predictable because increasing the health budget share reduces resources available to other government functions such as the energy and road sectors, which could provide forward linkages to productive sectors such as agriculture and food processing.

It is also predictable that the public health sector will be much better off under the proposed budget share without effects, because of the additional government funding injected into the sector. The other sectors that are predicted to expand relative to the baseline are also major input suppliers to the health sector so that expansion in the health sector is transmitted to the input sectors through the backward linkages. For instance, the intermediate input shares computed in chapter five showed that medical supplies (classified as chemicals) constituted 53% and 37% of the input requirement to produce a unit of public other-healthcare and public primary healthcare respectively. Therefore, as the health sector expands the health production input supply sectors expand in tandem.

The Deviation3 result shows that when the proposed healthcare budget is implemented with health effects, GDP growth rates are higher relative to the baseline for all scenarios. Besides the public primary healthcare sector whose value-added expands rapidly, other sectors such as agriculture and machinery are also predicted to more than double their growth in output compared to the baseline. The relatively high growth in value-added by the health sector is attributed to growth in both the quantity of factor demand and quality (value) of the factors demanded, since it is intensive in the use of skilled workers whose value is relatively higher.

Table 7.11 Growth in sector value-added, deviation from the baseline (%)

	Prioritisation scenario			Tax scenario			Aid scenario		
	Deviation 1	Deviation 2	Deviation 3	Deviation 1	Deviation 2	Deviation 3	Deviation 1	Deviation 2	Deviation 3
Overall GDP	-1.6	85.8	84.2	3.7	95.7	99.3	2.3	94.7	97.0
Agriculture	-0.2	102.0	101.8	-1.1	120.3	119.2	-0.1	118.4	118.3
Industry, Total	-5.0	88.1	83.1	11.8	101.2	113.0	6.6	96.5	103.1
Mining	-4.8	86.6	81.8	11.0	98.6	109.6	6.0	94.3	100.3
Food processing	-1.0	98.9	97.8	-4.0	111.5	107.4	1.1	111.1	112.1
Non Food processing	-3.2	96.0	92.8	7.5	108.5	115.9	4.9	105.6	110.5
Fuel	0.3	84.3	84.6	-0.8	92.5	91.6	3.1	93.0	96.1
Machinery	-6.6	120.3	113.7	13.9	140.6	154.6	3.9	133.4	137.3
Chemicals	2.8	91.2	94.0	3.1	99.9	103.0	7.0	100.4	107.4
Utilities	-1.5	83.8	82.4	-3.8	90.5	86.8	3.2	91.2	94.4
Construction	-7.7	84.6	76.9	22.2	100.1	122.2	9.5	92.1	101.6
Services, Total	-0.3	77.2	76.8	1.4	81.5	82.9	1.0	83.0	84.1
Trade	-0.4	97.8	97.4	0.3	111.8	112.1	2.6	109.9	112.5
Transport	-1.1	80.2	79.1	-1.2	87.6	86.3	2.7	87.4	90.1
Communication	-1.7	93.0	91.4	-4.6	101.1	96.4	2.0	103.1	105.1
Private healthcare	-2.8	130.2	127.4	-3.2	146.1	143.0	-0.2	147.4	147.2
Government services	5.2	47.7	52.9	3.9	52.7	56.6	5.9	54.3	60.2
Education	-0.9	76.7	75.8	-3.1	84.8	81.7	0.2	87.3	87.5
Public Primary healthcare	243.5	0.3	243.8	243.5	0.3	243.8	243.5	0.4	243.9
Public Other healthcare	45.0	11.4	56.5	44.9	12.4	57.2	45.7	12.4	58.2

Agriculture being the backbone of the Ugandan economy, it is worthwhile to expound on the predicted growth in value-added by the agricultural sector. The predicted expansion in agriculture follows from the fact that at an employment rate of 67% of the total labour force in Uganda, the agricultural sector directly benefits from an increase in labour force supply and increased labour productivity resulting from investment in health improvement activities. Through forward linkages the predicted expansion in the agricultural sector provides inputs and spurs growth in the food-processing segment of manufacturing. As the food-processing sector expands, it creates market and increases effective demand for the manufactured goods that it uses as inputs. This in turn posits higher growth rates in the input supply sectors such as chemical and utilities. Additionally, the expanding labour force increases effective demand and market for manufactured goods which results in further growth for the manufacturing sectors.

The growth in sector value-added in Deviation3 shows that when the government expenditure in the healthcare sector increases coupled with health effects, the private healthcare service sector also grows faster compared to the baseline. One of the possible explanations for the growth in production of private healthcare is that, as the productivity of labour in the public sector rises, the cost per unit of output in public healthcare declines and cost-saving spills over to the private healthcare sector. This is partly because of the established public-private partnerships in healthcare delivery where the government subsidizes the private healthcare providers, particularly the PNFPs. Moreover, the literature suggests that people, particularly rural inhabitants, were more likely to seek healthcare from private providers relative to public healthcare providers. This is in spite of a monetary user fee attached to the private healthcare services utilisation while public healthcare services are provided free of charge[71]. This is mainly because the perceived quality of care is found to be better in private healthcare centres. The opportunity cost of seeking public healthcare has been found to be higher relative to private healthcare because public healthcare centres are dogged with frequent drug stock-outs, absent healthcare workers, long distances to the health centre and sometimes unanticipated under-the-counter charges (Pariyo et al., 2009; Ssengooba et al., 2002). In terms of the model results, this suggests a growing demand for private healthcare services delivery that leads to further growth in provision of private healthcare services. Whether this

[71] See paper by Pariyo, Ekirapa-Kiracho, et al. (2009)

has implications for households' welfare, in terms of increased out-of-pocket payments for private healthcare, is reflected in the poverty analysis for the same scenarios (Chapter 8). The poverty impact results indicate that the percentage of poor people is more than halved in both rural and urban areas. This implies that, although the suggested healthcare financing scenarios lead to an expansion in production of private healthcare where user fees are charged, the overall welfare impacts are positive.

Furthermore, the predicted performance by sectors has indicated that when the proposed budget share is implemented without incorporating health effects, the construction sector experiences the biggest decline in value-added relative to the baseline under the prioritisation scenario. The dismal performance in the construction sector is attributed to the increased public healthcare expenditure which is service oriented and tends to draw resources away from the construction oriented sectors such as the energy and road construction. Under the tax scenario however, the proposed budget without health effects Deviation1 shows that the construction sector still thrives as the sector's value-added grows by 22.2% relative to the baseline. The performance of the construction sector in this instance suggests that government taxation does not, after all, crowd out private sector investment.

For all the scenarios, the proposed budget with health effects Deviation3 shows that an increase in healthcare expenditure that improves the population health status and therefore growth in labour factor supply, labour productivity and total factor productivity boosts production and growth in GDP. For instance, at an employment rate of 67%[72], the primary sectors' expansion (agriculture, forestry, fishing, and quarrying) and their increasing demand

[72] UBOS, Statistical Abstract 2012 defines the agricultural sector to include forestry and fishing.

for labour, as predicted by the model results, is readily met by the improvement in the health status of the labour force. The primary sectors do not require highly skilled labour and absorb most of the unskilled labour in the economy implying that at the onset, as people get treated and cured of illness, they set off to work in the agricultural fields and contribute to output growth.

Furthermore, the proposed healthcare budget facilitates expansion in healthcare service provision, providing opportunity for increased access and utilization of healthcare. This results in improved health status of the population and the labour force thereby reducing the number of sick days off work, both for the labourers themselves and as carers for the sick. This translates into growth in labour productivity and higher output per worker. The improved productivity per worker from improved health is further reinforced by the art of kinaesthetic learning as healthy workers spend more time at work, making further increases in labour productivity and total factor productivity and consequently higher sector outputs.

The relatively higher GDP growth rate under the tax scenario is suggestive of a progressively imposed tax that is aggregately beneficial to the economy. It is an indication that there is an untapped resource potential which could be mobilised by widening the tax base to increase government tax revenue that could benefit the entire Ugandan population. This is particularly so, if the additional revenue is put to beneficial public use such as improving the health of the population. The proposed health tax modelled translates into direct tax rates increasing gradually over the model period. By 2020, the household tax rates increase from 0.5% to 1.7% for rural farming, 1.1% to 3.9% for rural non-farming, 6.0% to 21.1% for Kampala non-farming, 2.1% to 7.2% for urban farming and 2.0% to 7.0% urban non-farming households (Table 7.12). The resultant tax rates for the different households are an indication of a progressive tax. The proposed tax redistributes incomes and is, overall, beneficial to the economy, particularly if the additional revenue is used to improve the health status of the population resulting in increased labour supply and labour productivity. For instance, a health tax that goes to finance healthcare interventions that bring health services closer to the people is a direct and immediate benefit to the working population; they save time taken travelling long distances to seek healthcare for themselves or their dependants. The time saved is reallocated to productive activities that increase output and spur higher GDP growth rates.

Table 7.12 Final year (2020) household tax rates under the tax scenario

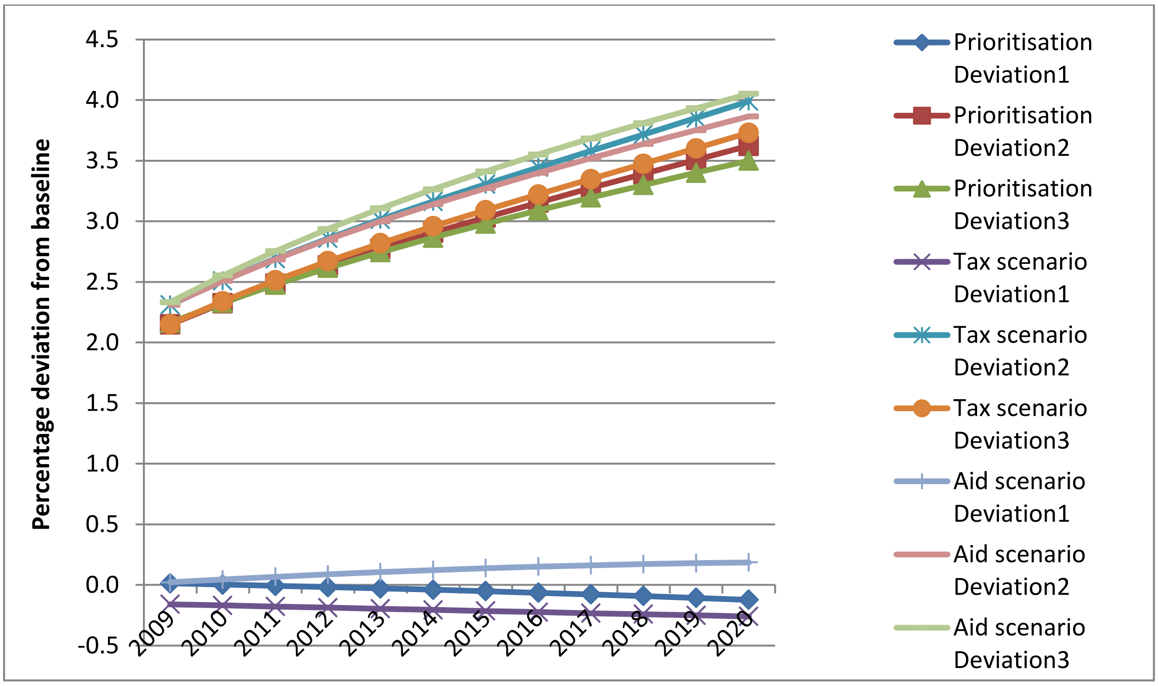
Household type	Initial tax rate	Baseline tax rate	Proposed tax rate
Rural farming	0.5%	0.7%	1.7%
Rural non-farming	1.1%	1.6%	3.9%
Kampala non- farming	6.0%	8.6%	21.1%
Urban farming	2.1%	3.0%	7.2%
Urban non-farming	2.0%	2.8%	7.0%

The tax rate for Kampala non-farming households, which is predicted to rise to 21.1% by 2020, falls mainly on skilled workers (including healthcare workers), since this category of labour forms a proportionately larger percentage of Kampala residents. It might, therefore, be argued that if the tax rate for skilled labour more than tripled then it could lead to skilled labour such as health workers to migrate to other countries to avoid paying the high tax. Such a move could aggravate the scarcity of healthcare labour. However, such fears are allayed by the fact that the health sector investments are predicted to lead to general improvements in population health and improvements in the working conditions of healthcare workers which are likely to prevent migration of healthcare workers. Moreover, the whole economy is predicted to be growing which is a further attraction for skilled workers not to migrate.

7.3.2 Private consumption

The trend in private consumption value resulting from the implementation of the proposed healthcare financing policies is depicted in Figure 7.9 as deviations from the baseline, and Table 7.13 for the specific simulation values underlying the deviations. The result in Deviation1 shows that implementing the proposed budget share without health effects does not change the status in private consumption for the first few years, but from 2015, the consumption value begins to decline for all scenarios. When the proposed budget share is implemented with health effects the growth in private consumption value increases cumulatively. By 2020, the rate of growth in consumption value is higher than the baseline rate by 3.1% under the prioritisation scenario, 3.4% under the tax scenario and 3.7% under the aid scenario.

Figure 7.9 Annual growth rates in private consumption value, percentage deviation from the baseline



The predicted growth in consumption value can be traced back to the sector performance and factor demand analysis which showed that incorporating health effects would lead to expansion and growth in the productive sectors. Specifically, the huge expansion in sectors, such as agriculture, food processing and utilities, in addition to the expanding services sector all serve to ensure that all labour categories are able to find some form of employment so that households have a diversity of sources of income. Consequently, households are able to increase their incomes and consumption expenditures. Moreover, households with working members benefit from the reduced days of illness and increased well-being rendering them more productive, and able to earn higher incomes.

Table 7.13 Annual growth rate in private consumption value under different scenarios: 2008 - 2020

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM1	6.5	6.3	6.1	5.9	5.8	5.6	5.4	5.3	5.1	5.0	4.8	4.6
SIM2	7.4	7.3	7.3	7.2	7.2	7.1	7.0	7.0	7.0	6.9	6.9	6.9
SIM3	7.0	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.2	6.2	6.1	6.0
SIM4	6.6	6.5	6.4	6.3	6.1	6.0	5.9	5.9	5.8	5.7	5.6	5.6
SIM5	6.8	6.7	6.6	6.5	6.4	6.3	6.2	6.2	6.1	6.0	6.0	5.9
PSIM1	6.9	6.7	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.9	5.8
PSIM2	7.9	7.9	7.8	7.8	7.8	7.7	7.7	7.7	7.7	7.7	7.7	7.6
PSIM3	7.2	7.1	7.0	6.9	6.8	6.8	6.7	6.6	6.6	6.5	6.5	6.4
PSIM4	8.1	8.0	8.0	7.9	7.9	7.8	7.8	7.8	7.7	7.7	7.7	7.7
PSIM5	9.0	9.1	9.1	9.1	9.2	9.2	9.2	9.2	9.3	9.3	9.4	9.4
PSIM6	6.7	6.6	6.4	6.3	6.2	6.1	6.0	5.9	5.9	5.8	5.7	5.6
PSIM7	7.9	7.9	7.9	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
PSIM8	7.0	6.9	6.8	6.8	6.7	6.6	6.5	6.5	6.4	6.4	6.3	6.3
PSIM9	7.9	7.9	7.8	7.8	7.7	7.7	7.6	7.6	7.6	7.6	7.6	7.6
PSIM10	9.0	9.1	9.1	9.2	9.2	9.3	9.3	9.4	9.4	9.5	9.6	9.6
PSIM11	6.9	6.8	6.7	6.6	6.5	6.4	6.4	6.3	6.3	6.2	6.1	6.1
PSIM12	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.2	8.2	8.2	8.2	8.2
PSIM13	7.2	7.1	7.1	7.0	7.0	6.9	6.9	6.8	6.8	6.8	6.7	6.7
PSIM14	8.1	8.1	8.1	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
PSIM15	9.2	9.3	9.4	9.4	9.5	9.6	9.6	9.7	9.8	9.8	9.9	10.0

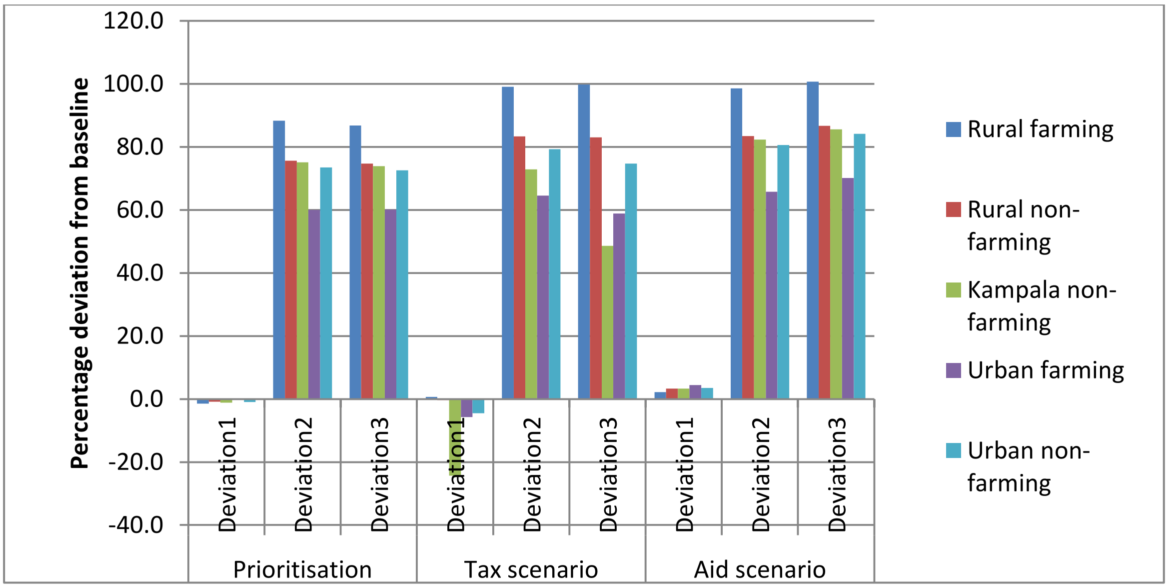
Private consumption, as used in this thesis, is synonymous with household final consumption expenditure. Evaluating the policy impact on private consumption is appropriate in that it captures changes in household consumption, thus reflecting the extent to which changes in GDP growth are translated into household incomes. Table 7.14 presents results for the impact on different household categories under the different simulations. From the results in Table 7.14, it is observed that both the baseline and the proposed budget simulations predict increases in consumption expenditure for all households. For the baseline (SIM5), household consumption is predicted to increase by 108.2% for rural farming, 109.9% for rural non-farming, 106.7% for Kampala non-farming, 109.6% for urban farming and 110.3% for urban non-farming. When the proposed budget share is implemented with new health incorporated in the analysis, the increase in household consumption expenditure is even higher for all households under all scenarios (PSIM5, PSIM10 and PSIM15).

Table 7.14 Growth in household consumption expenditure value, relative to the initial year (%) for different scenarios

	Rural farming	Rural non-farming	Kampala non-farming	Urban farming	Urban non-farming
SIM1	74.9	99.2	98.9	132.1	108.0
SIM2	129.2	128.3	125.5	124.0	128.6
SIM3	109.8	114.7	112.9	117.6	116.8
SIM4	99.8	103.9	101.8	106.3	105.5
SIM5	108.2	109.9	106.7	109.6	110.3
PSIM1	106.7	109.0	105.6	109.7	109.4
PSIM2	150.1	143.0	138.6	133.6	141.4
PSIM3	118.5	120.6	118.6	119.6	121.9
PSIM4	146.8	148.8	147.6	146.3	150.9
PSIM5	195.0	184.5	180.6	169.7	182.9
PSIM6	108.9	109.5	82.4	103.8	105.9
PSIM7	161.0	149.5	116.5	131.5	142.6
PSIM8	120.9	121.5	94.2	113.8	118.4
PSIM9	150.0	150.2	120.3	140.3	147.4
PSIM10	208.0	192.9	155.3	168.4	185.1
PSIM11	110.4	113.2	110.0	114.0	113.9
PSIM12	162.2	153.3	148.6	142.0	151.3
PSIM13	122.4	125.0	123.3	124.1	126.6
PSIM14	151.1	153.7	152.8	151.4	156.1
PSIM15	208.9	196.5	192.3	179.8	194.5

To alienate the health effects as a contributing factor to the increasing consumption expenditure, as opposed to a mere increase in the budget share without health effects, the relative changes are presented in the deviations from the baseline and illustrated in Figure 7.10. When the proposed budget share without health effects is compared to the baseline (Deviation1), consumption expenditure declines for all household categories (except for the urban farming) under the three scenarios. Since households earn income from the ownership of factors of production the observed result for declining household consumption is not surprising given the observed adjustments in factor prices and factor demand under the same simulations presented in the earlier section of this chapter. The deviation analysis for factor prices showed that for Deviation1, the economy-wide wages/rents are predicted to decline, except for skilled labour and capital, for all scenarios. Since the economy is predicted to be contracting under the proposed budget without health effects as seen in Deviation1 of the sectoral performance, labour demand either declines or increases by small percentages relative to the baseline for most of the sectors, except for health sector. The agricultural sector, which is the biggest employer, is predicted to decline (in Deviation1 of the sectoral performance analysis) hence the adverse effects on majority of households' income and consumption expenditure.

Figure 7.10 Growth in household consumption expenditure value, deviation from baseline



On the other hand, when the proposed budget share is combined with the health effects, all households are observed to be better-off compared to the baseline for all scenarios (Deviation3). It should be noted however, that the size of the increment in consumption expenditure brought about by the health effects differs by source of additional funding for health. Specifically, the proposed budget with health effects Deviation3 shows that household under the prioritisation scenario, consumption expenditure value increases by 86.8% for rural farming, 74.7% for rural non-farming, 73.9% for Kampala non-farming, 60.1% for urban farming and 72.6% for urban non-farming. In the same order, consumption expenditure increases by 99.8%, 83.0%, 48.6%, 58.8% and 74.7% under the taxation scenario; and 100.7%, 86.7%, 85.6%, 70.2%, and 84.2% under the aid scenario.

Under the tax scenario, Kampala households experience the least growth in consumption expenditure value. This is because Kampala is the capital city of Uganda and the city dwellers have relatively higher incomes so that the model imposed the highest rate of the tax levy on Kampala households compared to all household categories. This means that a relatively bigger proportion of their total income is taken by the government as tax, thereby reducing their disposable income for consumption purposes. The rural households had the smallest tax rate from the imposed health tax thus preserving a proportionately larger component of their income for consumption purposes.

The aid scenario brings about the largest improvements in the household consumption expenditure value across all households. This is partly due to the fact that increased aid inflow appreciates the exchange rate so that imported goods become relatively cheaper and consequently consumers of imported goods are relatively better-off. Perhaps more critical, is the observation from the factor prices and factor demand adjustments when the proposed health budget is implemented with additional funding from aid inflow. When the envisaged new health is defined to be growth in labour productivity, the aid scenario posts the highest increase in wages rates for self-employed and skilled labour and rents for capital and land.

This means that households owning these factors are positioned to earn relatively higher incomes and thus become better-off compared to the baseline levels.

7.3.3 Investment

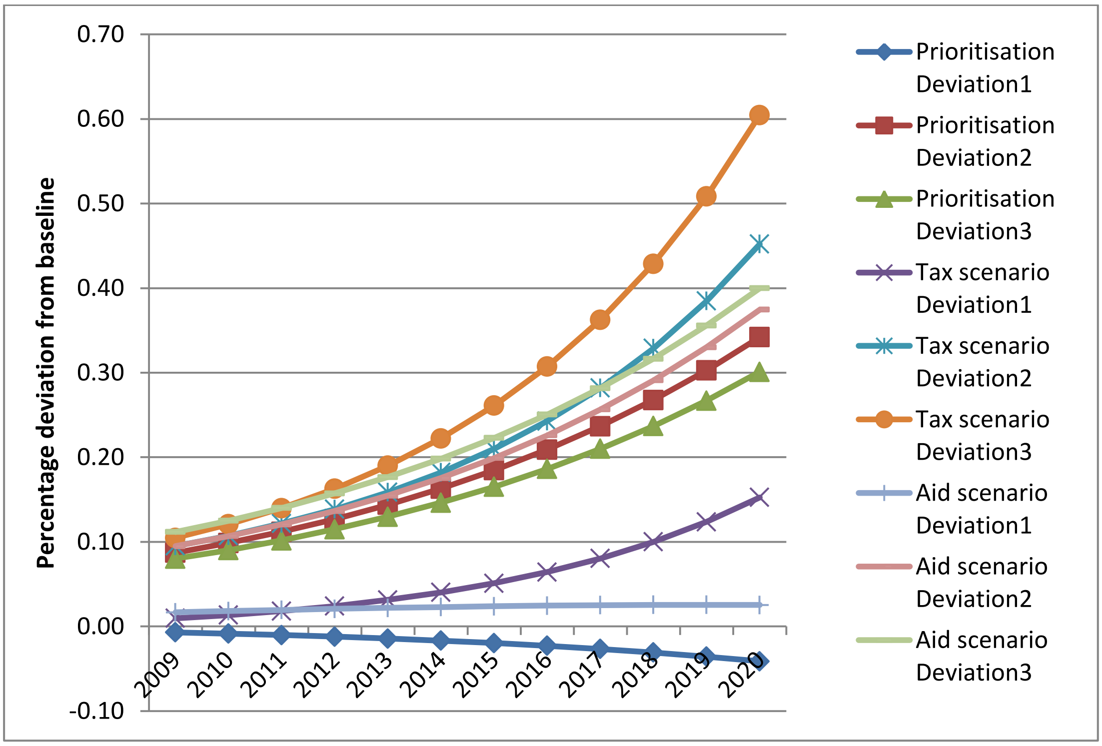
The results for the impact on investments are presented for the different scenarios, firstly, as changes from the initial year and secondly, as deviations from the baseline. The predicted result for the impact on investment shows that both the baseline and proposed budget share lead to higher investment rates over the years. The results for the growth rate in investment value for different scenarios, for the period 2009 to 2020, are specified in Table 7.15. The baseline (SIM5) rate of growth in investment increases cumulatively from 0.10% in 2009 to 0.16% by 2020. Similarly, the proposed budget share without health effects (PSIM1) predicts the investment value to grow at an average 0.1% per year throughout the model period.

Table 7.15 Annual growth rate in investment value (%) under different scenarios

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM1	0.03	0.01	-0.01	-0.03	-0.07	-0.10	-0.15	-0.20	-0.26	-0.34	-0.43	-0.54
SIM2	0.13	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.21	0.22	0.24	0.25
SIM3	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.13	0.13	0.14	0.14
SIM4	0.09	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.12	0.12	0.12
SIM5	0.10	0.11	0.11	0.11	0.12	0.12	0.13	0.13	0.14	0.15	0.15	0.16
PSIM1	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.12	0.12
PSIM2	0.14	0.15	0.16	0.17	0.18	0.20	0.21	0.23	0.24	0.26	0.28	0.30
PSIM3	0.11	0.12	0.12	0.13	0.13	0.14	0.14	0.15	0.16	0.17	0.17	0.18
PSIM4	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.21	0.22	0.24	0.26	0.28
PSIM5	0.18	0.20	0.21	0.23	0.25	0.27	0.29	0.32	0.35	0.38	0.42	0.46
PSIM6	0.11	0.12	0.13	0.14	0.15	0.16	0.18	0.20	0.22	0.25	0.28	0.31
PSIM7	0.17	0.18	0.20	0.22	0.24	0.27	0.30	0.33	0.38	0.42	0.48	0.54
PSIM8	0.13	0.14	0.15	0.16	0.18	0.20	0.22	0.24	0.27	0.31	0.35	0.40
PSIM9	0.15	0.16	0.18	0.20	0.22	0.25	0.28	0.31	0.36	0.41	0.47	0.54
PSIM10	0.21	0.23	0.25	0.28	0.31	0.34	0.39	0.44	0.50	0.57	0.66	0.76
PSIM11	0.12	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.16	0.17	0.18	0.18
PSIM12	0.18	0.19	0.20	0.22	0.23	0.25	0.27	0.29	0.31	0.34	0.36	0.39
PSIM13	0.14	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.24	0.25
PSIM14	0.16	0.17	0.18	0.19	0.21	0.22	0.24	0.26	0.28	0.30	0.33	0.35
PSIM15	0.21	0.23	0.25	0.27	0.29	0.32	0.35	0.38	0.42	0.46	0.51	0.56

When the proposed budget is implemented with health effects, the rate of growth in investment value increases cumulatively and is higher than the baseline level for all scenarios. The cumulative increase in growth of investment value reflects the contribution of healthcare investment effects in form of growth in the labour supply, labour productivity and total factor productivity, as illustrated by the deviation paths in Figure 7.11.

Figure 7.11 Growth rate in investment value, deviation from baseline



From Figure 7.11, it is observed that implementing the proposed health budget share without health effects leads to a decline in investment value compared to the baseline (Deviation1). The decline in investment, depicted in Deviation1, reflects the reallocation of resources from productive sectors to a non-productive services sector. When the government increases the health budget share it reduces resources available for investment in other productive sectors such as road construction and energy. On the other hand, Deviation3 shows that when the proposed health budget share is implemented with health effects included in the analysis, the rate of growth in investment value increases cumulatively for all scenarios compared to the baseline.

A comparison between the scenarios shows that, the tax scenario posts the highest growth rate relative to the base - 0.61% compared to 0.36% for the aid scenario and 0.26% for the prioritisation scenario, by 2020. The higher growth rate in investment value under the tax scenario is also confirmed by the relatively higher demand for factors of production by the industry sector (particularly the construction sector) when the proposed budget is implemented with new health relative to the baseline (see Table 7.5). The relative growth in industry sector demand for factors is highest under the tax scenario suggesting that the industry sector is expanding faster under the tax scenario hence the observed higher rate of growth in investment value under the same scenario.

7.3.4 Imports and Exports

The performance of exports and imports as a share of GDP is varied across scenarios. For the baseline simulation, both exports share and imports share in GDP are predicted to increase relative to the initial year, as seen in Tables 7.16 and 7.17. These baseline results suggest an improvement in the trade account. Similarly, when the proposed budget share is implemented with new health, both exports and imports share in GDP increase compared to the baseline for all scenarios. The extent to which the health effects contribute to growth in imports and exports shares in GDP is given by the growth deviations from the baseline, illustrated in Figure 7.12.

Comparison between the baseline and the proposed budget share without health effects, Deviation1, shows that export share in GDP will begin to decline in 2011 and by 2020; it will have declined by 0.4% under the prioritisation and tax scenarios, and 1.0% under the aid scenario. For the imports, Deviation1 shows that imports share in GDP will be rising under the prioritisation and the tax scenario while it will decline under the aid scenario. These results suggest that implementing the proposed budget share without health effects will bring about a worse trade balance under the prioritisation and tax scenarios while the trade balance may improve under the aid scenario. The decline in export share in GDP follows from the decline in the agriculture and industry sector shares in GDP observed when the proposed budget is implemented without health effects. Uganda's exports comprise of mainly agricultural cash crops, food processing industry products and simple manufactured goods, destined to the East African community (EAC) and the common market for Eastern and Southern African (COMESA) region. Therefore, if the agricultural sector is depicted to contract then automatically the export share in GDP will decline.

On the other hand, when the proposed budget share with new health effects is compared to the baseline (Deviation3), the growth in share of exports in GDP is higher than the baseline level for all scenarios. By 2020, the growth in exports share in GDP is predicted to be higher under the prioritisation and tax scenarios compared to the aid scenario. The imports share in GDP is predicted to follow a declining trend over the years under all scenarios. The share of imports in GDP begins to decline from 2013 for the prioritisation and tax scenarios while the declining trend begins in 2011 for the aid scenario.

Figure 7.12 Share of imports and exports value in GDP deviation from the baseline

Figure 7.12a Prioritisation scenario

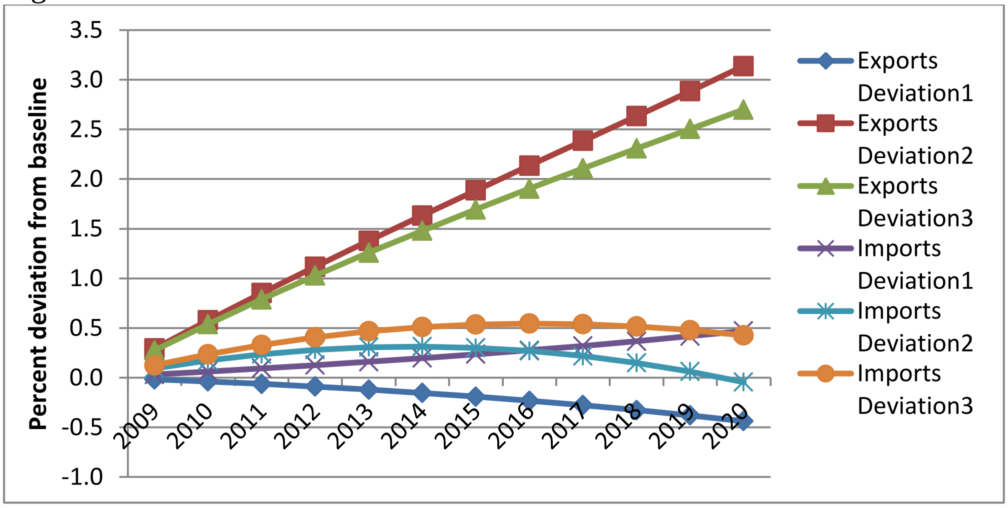


Figure 7.12b Tax scenario

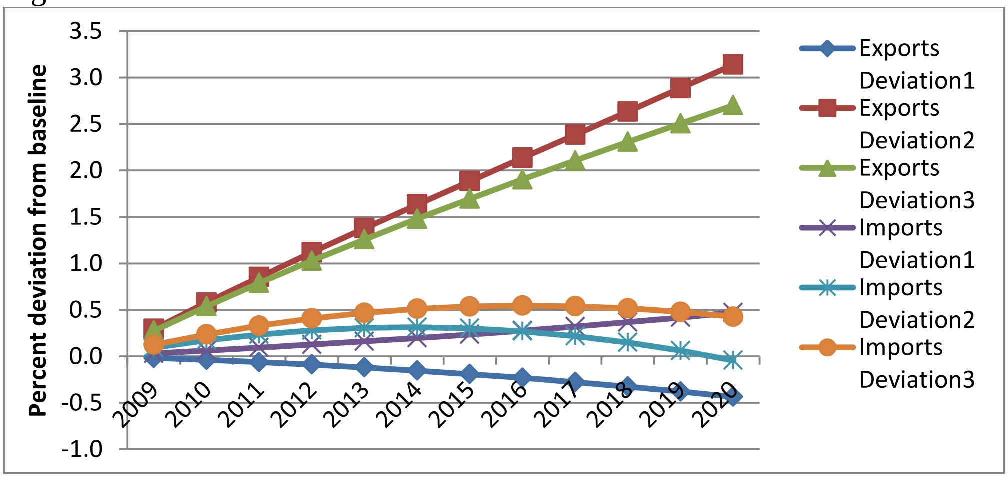


Figure 7.12c Aid scenario

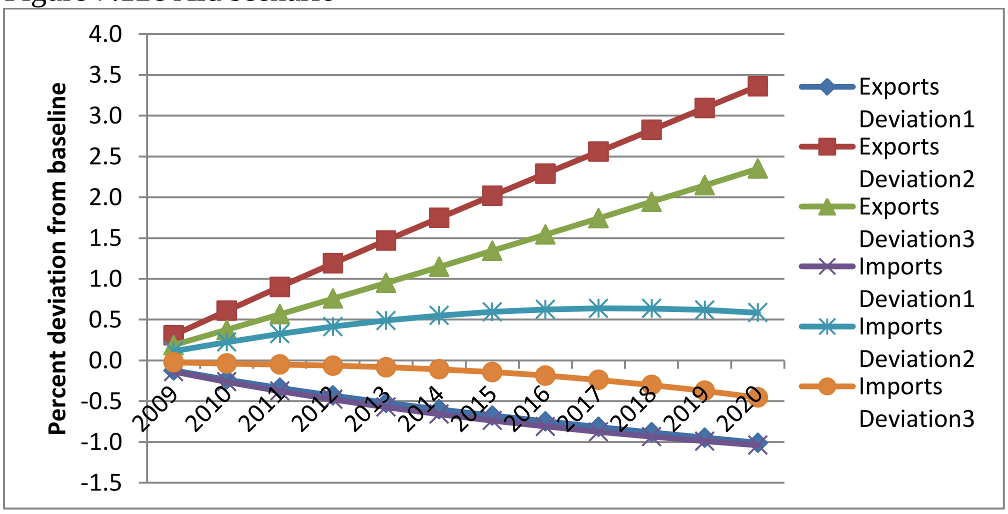


Table 7.16 Exports share in GDP (%) under different scenarios: 2009 - 2020

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM1	20.6	21.0	21.3	21.6	21.8	21.8	21.9	21.8	21.6	21.2	20.8	20.2
SIM2	20.8	21.4	22.0	22.5	23.0	23.4	23.9	24.3	24.7	25.0	25.4	25.7
SIM3	20.8	21.3	21.8	22.3	22.8	23.2	23.6	23.9	24.3	24.6	24.9	25.1
SIM4	20.7	21.2	21.7	22.1	22.5	22.9	23.2	23.5	23.8	24.1	24.3	24.5
SIM5	20.7	21.2	21.7	22.1	22.5	22.9	23.2	23.5	23.8	24.1	24.3	24.5
PSIM1	20.7	21.2	21.6	22.0	22.4	22.7	23.0	23.3	23.5	23.7	23.9	24.1
PSIM2	20.8	21.5	22.0	22.5	23.0	23.5	23.9	24.3	24.7	25.0	25.4	25.7
PSIM3	20.8	21.4	21.9	22.4	22.9	23.3	23.7	24.1	24.5	24.8	25.1	25.4
PSIM4	20.9	21.6	22.3	22.9	23.5	24.0	24.6	25.0	25.5	26.0	26.4	26.8
PSIM5	21.0	21.8	22.5	23.2	23.8	24.4	24.9	25.4	25.9	26.4	26.8	27.2
PSIM6	20.7	21.3	21.8	22.2	22.7	23.1	23.6	24.0	24.4	24.8	25.2	25.6
PSIM7	20.9	21.6	22.2	22.8	23.4	24.0	24.5	25.1	25.6	26.2	26.7	27.3
PSIM8	20.8	21.5	22.1	22.6	23.2	23.7	24.3	24.8	25.3	25.9	26.4	27.0
PSIM9	21.0	21.7	22.4	23.1	23.8	24.5	25.1	25.8	26.4	27.1	27.7	28.4
PSIM10	21.1	21.9	22.7	23.4	24.1	24.8	25.5	26.2	26.8	27.5	28.1	28.8
PSIM11	20.6	21.0	21.4	21.7	22.0	22.3	22.5	22.8	23.0	23.2	23.4	23.5
PSIM12	20.8	21.3	21.8	22.3	22.7	23.1	23.5	23.9	24.3	24.6	25.0	25.3
PSIM13	20.7	21.2	21.6	22.1	22.5	22.9	23.3	23.6	24.0	24.3	24.6	24.9
PSIM14	20.8	21.4	22.0	22.6	23.1	23.6	24.1	24.6	25.1	25.5	26.0	26.4
PSIM15	20.9	21.6	22.3	22.9	23.5	24.0	24.6	25.1	25.5	26.0	26.5	26.9

Table 7.17 Imports share in GDP (%) under different scenarios: 2009 - 2020

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM1	-39.8	-39.2	-38.7	-38.2	-37.7	-37.1	-36.5	-35.9	-35.2	-34.5	-33.6	-32.6
SIM2	-39.8	-39.3	-38.8	-38.4	-38.0	-37.7	-37.4	-37.1	-36.8	-36.6	-36.4	-36.2
SIM3	-39.8	-39.3	-38.9	-38.5	-38.2	-37.9	-37.6	-37.3	-37.0	-36.8	-36.5	-36.3
SIM4	-39.8	-39.4	-39.0	-38.6	-38.2	-37.9	-37.6	-37.3	-37.1	-36.8	-36.5	-36.3
SIM5	-39.8	-39.3	-38.9	-38.4	-38.1	-37.7	-37.4	-37.0	-36.7	-36.5	-36.2	-35.9
PSIM1	-39.8	-39.2	-38.8	-38.3	-37.9	-37.5	-37.1	-36.8	-36.4	-36.1	-35.8	-35.5
PSIM2	-39.7	-39.1	-38.6	-38.1	-37.7	-37.3	-36.9	-36.5	-36.2	-35.9	-35.6	-35.4
PSIM3	-39.8	-39.3	-38.9	-38.5	-38.1	-37.7	-37.4	-37.1	-36.9	-36.6	-36.4	-36.2
PSIM4	-39.7	-39.2	-38.8	-38.4	-38.0	-37.7	-37.4	-37.1	-36.9	-36.7	-36.5	-36.4
PSIM5	-39.7	-39.1	-38.5	-38.0	-37.6	-37.2	-36.8	-36.5	-36.2	-35.9	-35.7	-35.5
PSIM6	-39.8	-39.4	-39.0	-38.6	-38.3	-38.0	-37.8	-37.6	-37.4	-37.3	-37.2	-37.2
PSIM7	-39.8	-39.2	-38.8	-38.4	-38.0	-37.7	-37.4	-37.2	-37.1	-36.9	-36.9	-36.9
PSIM8	-39.9	-39.4	-39.1	-38.8	-38.5	-38.3	-38.1	-38.0	-37.9	-37.9	-37.9	-37.9
PSIM9	-39.8	-39.4	-39.0	-38.7	-38.4	-38.2	-38.1	-38.0	-37.9	-38.0	-38.0	-38.2
PSIM10	-39.7	-39.2	-38.7	-38.3	-37.9	-37.6	-37.4	-37.2	-37.0	-37.0	-36.9	-37.0
PSIM11	-39.9	-39.6	-39.2	-38.9	-38.6	-38.4	-38.1	-37.9	-37.6	-37.4	-37.2	-37.0
PSIM12	-39.9	-39.4	-39.0	-38.6	-38.3	-37.9	-37.6	-37.4	-37.1	-36.9	-36.7	-36.5
PSIM13	-40.0	-39.6	-39.3	-39.1	-38.8	-38.6	-38.4	-38.2	-38.0	-37.9	-37.8	-37.6
PSIM14	-39.9	-39.5	-39.2	-38.9	-38.7	-38.5	-38.3	-38.1	-38.0	-37.9	-37.8	-37.7
PSIM15	-39.8	-39.3	-38.9	-38.5	-38.1	-37.8	-37.5	-37.2	-37.0	-36.8	-36.6	-36.4

The performance under the aid scenario differs from the other two scenarios in that resources are flowing into the economy from outside as opposed to an adjustment using resources within the economy (as in the reallocation and tax scenarios). An increase in government healthcare expenditure financed by increases in foreign aid inflow necessitates corresponding adjustment in factors of production available to produce the enlarged healthcare service delivery. The exception would be the government using the aid exclusively for imports of healthcare inputs so that the domestic production is circumvented. In the case of Uganda, the foreign aid component of government expenditure exhibits a sizeable non-tradable element and this is assumed to be the case in this analysis. Aid inflow affects resource allocation adjustments primarily through exports production and import volumes. The exchange rate adjustment is the mechanism through which the trade balance influences reallocation of resources. It is therefore worthwhile to explain how this mechanism impacts on Uganda exports and imports, particularly under the aid scenario.

7.3.4(i) Exports

Under the aid scenario, availability of external resources underpins the possibility of an increase in government absorption without crowding out the private sector. Theoretically, external resources inflow serve to widen the trade deficit by appreciating the exchange rate which makes imports comparatively cheaper while exports become more expensive. The transmission mechanism works to shift resources between the tradable and non-tradable sector which causes a disturbance in the balance of trade resulting in an appreciation of the real exchange rate in order to balance the current account. The real exchange rate, fixed in terms of the domestic producer price index, further appreciates due to the increase in foreign savings inflow. This dampens the profitability of the export sector while imports become dearer and the balance of payments deficit widens. Ordinarily, with the small country assumption, the Ugandan economy would be deemed less competitive on international markets.

However, the health effects resulting from the increase in government healthcare expenditure serve to mitigate the adverse effects of aid inflows on the exchange rate. Since the increased resources from aid inflows are assumed to be spent on health improving activities, there is an economy wide increase in labour supply, labour productivity and factor productivity which facilitate increased production in all sectors. Hence the observed higher growth rates in exports value relative to the baseline despite the appreciation of the exchange rate, as illustrated in the deviations Figure 7.13. Although the exchange rate appreciation is said to dampen export profitability, it is not large enough to wipe out the benefits from health induced growth in total factor productivity in all sectors and increased labour supply and labour productivity that have enabled the economy to flourish. Table 7.1 presents the results for the growth rates in export value under simulations of the individual health effects as well as the combined health effects. It can be seen that total factor productivity growth generates the highest growth rate in exports followed by labour factor growth and then labour productivity growth for all the scenarios. A similar trend in the contribution of labour supply growth and total factor growth is observed for the GDP growth rates in Section 7.3.1 (Table 7.9), confirming the consistency in the positive impact of the two health parameters on the macroeconomic variables.

Figure 7.13 Growth rate in exports value, deviation from baseline

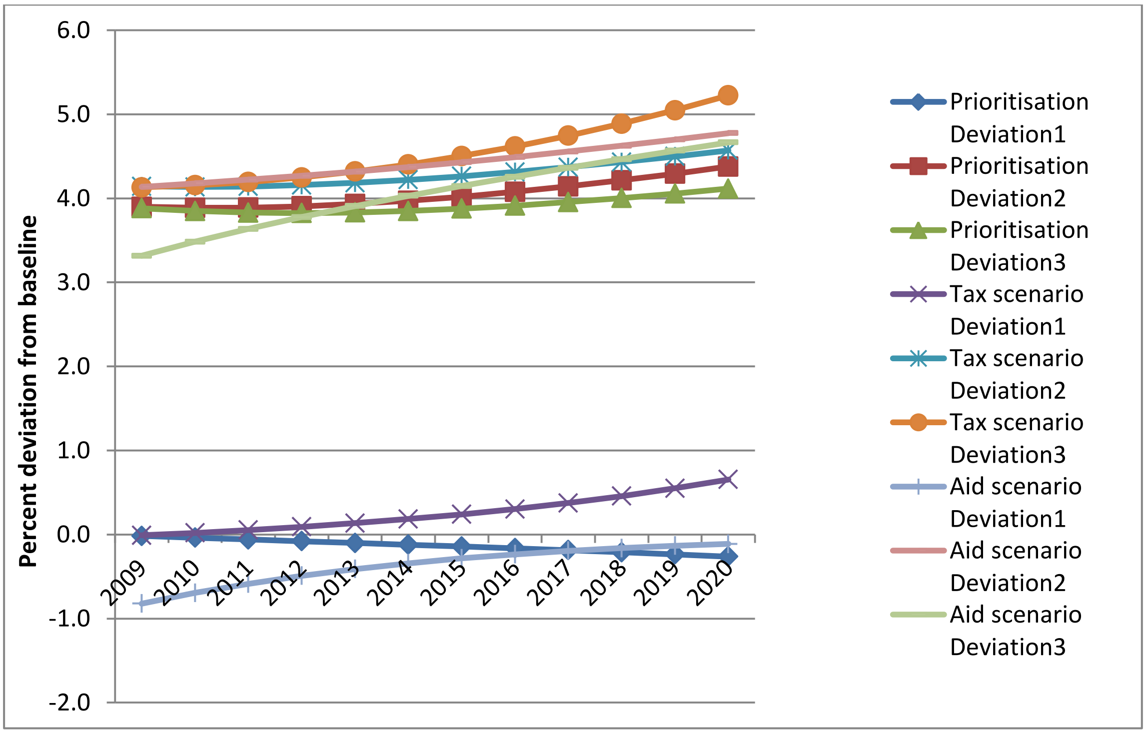


Table 7.18 Annual growth rate in exports value (%) under different scenarios: 2008 - 2020

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM1	9.6	9.0	8.4	7.9	7.3	6.7	6.0	5.4	4.7	3.9	3.1	2.1
SIM2	11.7	11.2	10.8	10.4	10.1	9.8	9.6	9.3	9.1	9.0	8.8	8.7
SIM3	11.0	10.5	10.1	9.7	9.4	9.0	8.7	8.5	8.2	8.0	7.8	7.6
SIM4	10.3	9.8	9.4	9.0	8.7	8.4	8.1	7.8	7.6	7.4	7.2	7.0
SIM5	10.6	10.1	9.7	9.3	8.9	8.6	8.4	8.1	7.9	7.7	7.5	7.3
PSIM1	10.6	10.1	9.6	9.2	8.8	8.5	8.2	8.0	7.7	7.5	7.3	7.1
PSIM2	12.4	11.9	11.5	11.1	10.8	10.5	10.3	10.1	9.9	9.7	9.5	9.4
PSIM3	11.4	10.9	10.5	10.1	9.8	9.5	9.2	8.9	8.7	8.5	8.3	8.2
PSIM4	13.1	12.5	12.1	11.7	11.3	11.0	10.7	10.5	10.3	10.1	9.9	9.8
PSIM5	14.5	13.9	13.5	13.1	12.8	12.5	12.2	12.0	11.8	11.7	11.6	11.5
PSIM6	10.6	10.1	9.7	9.4	9.1	8.8	8.6	8.4	8.3	8.1	8.1	8.0
PSIM7	12.6	12.2	11.9	11.6	11.3	11.1	10.9	10.8	10.7	10.6	10.6	10.5
PSIM8	11.4	11.0	10.6	10.3	10.0	9.8	9.6	9.4	9.3	9.2	9.1	9.1
PSIM9	13.1	12.6	12.2	11.9	11.6	11.3	11.1	11.0	10.9	10.8	10.8	10.8
PSIM10	14.7	14.3	13.9	13.5	13.3	13.0	12.9	12.7	12.6	12.6	12.6	12.6
PSIM11	9.8	9.4	9.1	8.8	8.5	8.3	8.1	7.9	7.7	7.5	7.4	7.2
PSIM12	11.8	11.5	11.3	11.0	10.8	10.6	10.5	10.3	10.2	10.1	10.0	9.9
PSIM13	10.6	10.3	10.0	9.7	9.5	9.3	9.1	8.9	8.8	8.6	8.5	8.4
PSIM14	12.2	11.9	11.6	11.3	11.1	10.9	10.7	10.6	10.4	10.3	10.2	10.1
PSIM15	13.9	13.6	13.3	13.1	12.9	12.7	12.5	12.4	12.3	12.2	12.1	12.0

The trend in the growth rate of export value in Table 7.18 also indicates that, although there are high rates of growth in export value over the years, by 2020, these rates of growth will have fallen to below the 2009 levels under all scenarios. Again the trend can be inferred from the sector contribution to GDP growth rates under the different simulations. For instance, it is noticeable from Table 7.6d that when new health is defined by growth in labour productivity, the rate of agricultural sector contribution to annual growth rate in GDP at factor cost is high for the first few years but gradually reduces over the years. Agricultural exports constitute more than half of all exports (excluding re-exports) from Uganda (Uganda Bureau of Statistics, 2013). Therefore, it is likely that the pattern of growth in agriculture will be reflected in the pattern of growth in export value over the same period.

7.3.4(ii) Imports

Imports value is also depicted to increase throughout the model period when the proposed budget share is implemented with health effects. This is illustrated by the deviations from the baseline in Figure 7.14 and the specific contribution to the growth in imports value by individual factors isolated in Table 7.19. The increase in imports in Uganda is largely spurred by the private sector as opposed to the government. This is because public services ("commodities" consumed by the government) mostly require highly trained labour which is locally sourced. An expanding imports sub-sector triggers a reassignment of factors such that factors are freed from the import competing sectors and non-tradable service sectors towards the tradable sectors. Conventional theory stipulates that an increase in private sector imports is fuelled by an appreciation of the exchange rate, which also acts to shift production factors. The effect of an appreciation of the exchange rate in shifting production factors can happen in two ways. Firstly, an appreciation of the exchange rate makes imports cheaper relative to domestic tradable goods thus rendering the domestic tradable sectors less competitive and consequently downsizing. The downsizing of import-competing sectors frees up factors in the tradable sectors. Secondly, an appreciation of the exchange rate leads to substitution of the non-tradable goods for the relatively cheaper tradable commodities. The expenditure-switching effect implies that as aggregate consumer demand shifts to the tradable sectors, production factors in the non-tradable sectors are freed up.

In the case of Uganda, both these channels have minimal effect. This is particularly so, because in the Uganda CGE model specification used in this study, the elasticity of substitution between imports and domestic output in domestic demand is quite small. This is an indication of the low level of manufacturing in Uganda to the extent that large scale non-food manufacturing, such as machinery and motor vehicles has no counterpart domestic competition. Even the existing domestic food processing industry offers little competition for imported products as it is ineffectively developed. Therefore, the extent to which production factors will shift from domestic production to imports is limited. However, since the expanding health sector is skill intensive, unskilled labour is freed from the non-tradable public service sectors and is absorbed by the tradable sectors (agriculture, food processing, non-food manufacturing) where it is used relatively intensively. Moreover, the increased government expenditure in the health sector raises the profitability of the sector relative to other sectors. This implies that for producers in the health sector, as well as the source sectors that are suppliers of intermediate health inputs, the marginal revenue products exceed the marginal revenue costs which results in expanding production and employment in those sectors, as observed in the factor demand and sector production results.

Furthermore, there is a large difference in factor composition between sectors which does not permit easy movement of factors between sectors. This factor composition rigidity can only be overcome by large changes in the real exchange rate. The increase in foreign savings inflows under the aid scenario for instance, is not large enough to cause big changes in the nominal appreciation of the real exchange rate. Therefore, we do not observe a shrink in export sectors, resulting from the theoretical assertion that they would become less competitive. Instead the domestic tradable sectors that absorb unskilled labour are seen to expand. Not only is growth experienced in the high demand healthcare sector, it is spread all over other sectors due to the aggregate increase in labour supply throughout the economy as well as growth in labour productivity and total factor productivity which result from the healthcare improvement investments.

Figure 7.14 Growth rate in imports value, deviation from the baseline

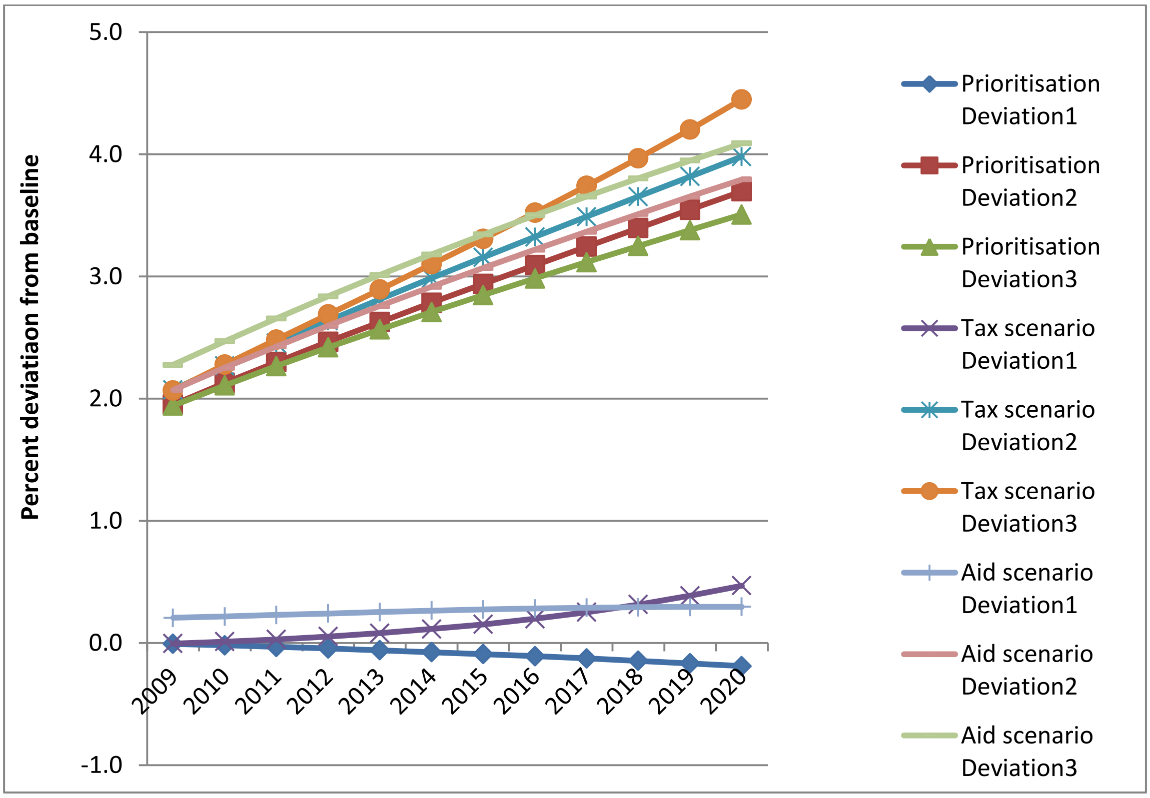


Table 7.19 Annual growth rate in imports value (%) under different scenarios: 2008 - 2020

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SIM1	5.7	5.6	5.4	5.2	4.9	4.7	4.4	4.0	3.6	3.2	2.7	2.1
SIM2	6.8	6.8	6.8	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
SIM3	6.4	6.4	6.3	6.3	6.2	6.2	6.1	6.1	6.0	6.0	5.9	5.9
SIM4	6.1	6.0	6.0	5.9	5.8	5.7	5.7	5.6	5.5	5.5	5.4	5.3
SIM5	6.2	6.2	6.1	6.0	6.0	5.9	5.9	5.8	5.7	5.7	5.7	5.6
PSIM1	6.2	6.1	6.1	6.0	5.9	5.8	5.8	5.7	5.6	5.6	5.5	5.4
PSIM2	7.1	7.1	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.3	7.3	7.3
PSIM3	6.6	6.6	6.6	6.5	6.5	6.5	6.4	6.4	6.4	6.3	6.3	6.3
PSIM4	7.5	7.5	7.5	7.5	7.5	7.5	7.6	7.6	7.6	7.6	7.6	7.7
PSIM5	8.2	8.3	8.4	8.5	8.5	8.6	8.7	8.8	8.9	8.9	9.0	9.1
PSIM6	6.2	6.2	6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.0	6.0	6.1
PSIM7	7.3	7.3	7.4	7.4	7.5	7.6	7.7	7.7	7.8	7.9	8.1	8.2
PSIM8	6.6	6.6	6.6	6.6	6.7	6.7	6.7	6.7	6.8	6.8	6.9	7.0
PSIM9	7.5	7.5	7.6	7.6	7.7	7.8	7.8	7.9	8.0	8.1	8.3	8.4
PSIM10	8.3	8.4	8.6	8.7	8.9	9.0	9.2	9.3	9.5	9.7	9.9	10.1
PSIM11	6.4	6.4	6.3	6.3	6.2	6.2	6.1	6.1	6.0	6.0	5.9	5.9
PSIM12	7.5	7.5	7.6	7.6	7.6	7.7	7.7	7.8	7.8	7.9	7.9	7.9
PSIM13	6.9	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.7
PSIM14	7.7	7.7	7.8	7.8	7.8	7.9	7.9	7.9	8.0	8.0	8.1	8.1
PSIM15	8.5	8.6	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7

7.4 Summary

The chapter set out to present and discuss the model results from the dynamic CGE model specified for the Ugandan economy, analysing the impacts of healthcare financing policy reforms on macroeconomic variables. The performance of the adjustment mechanisms (wages, factor substitution, sectoral shares, and the foreign exchange rate) through which the macro variables are influenced are presented and discussed. When the proposed budget share is implemented without health effects, the economy shrinks as observed from negative growth rates in GDP because all sectors contract, except the healthcare sector. However, when the healthcare budget is increased and the health effects accruing from the increased healthcare expenditure are incorporated in the analysis, the results indicate higher growth in GDP, private consumption, investment, exports and imports. The sector performance analysis has shown that the productive sectors (agriculture, food processing and non-food manufacturing) and the services sectors expand at a faster rate as the healthcare investments increase the labour supply, labour productivity and total factor productivity in the economy. The model results have also indicated that including health effects in the model greatly reduces the factor-bias effect particularly in the industry sectors – construction and mining, which would otherwise shrink and demand less of all the factors of production.

The conclusion from these results is that, overall, a healthy population is essential for a sustained effective labour force supply, growth in labour productivity and total factor productivity in the economy. These health effects, in turn, propel growth in and expansion of the economy. Therefore, the government should increase the healthcare expenditure which will improve the population health status and bolster economic growth. Further still, the source of additional resources for government health expenditure is critical. The results demonstrate that an earmarked tax for health could potentially generate the much needed government revenue, particularly for expanding healthcare services. The tax scenario suggests a potential to achieve higher GDP growth rates while mitigating against unprecedented slow growth in investment, compared to the prioritisation and aid-for-health sources of financing healthcare.

CHAPTER 8: IMPACTS OF HEALTHCARE FINANCING REFORMS ON POVERTY REDUCTION IN UGANDA

8.1 Introduction

This chapter presents and discusses the poverty impact of the proposed healthcare financing policies. The poverty impact results are generated from the poverty micro-simulation module linked to the dynamic CGE model. The welfare implications of the proposed healthcare financing policies are assessed and results reported in terms of poverty reduction rates. The proposed healthcare budget facilitates an expansion in healthcare services delivery which, consequently, improves the population's health status. A healthier population ensures a continuous flow of effective labour supply as well as higher labour productivity and total factor productivity. These health effects translate into higher growth rates in the production output and expansion in all the sectors of the economy. The ensuing sectoral growth means increased demand for factors of production, higher incomes for the owners of the factors and consequently welfare improvements and poverty reduction. The model employed the FGT indices to report the impact of healthcare financing policies on income poverty in Uganda. For each simulation, the impact on poverty incidence (P_0) , depth of poverty (P_1) and severity of poverty, (P_2) is reported at the national level and by residence (rural and urban). Furthermore, since agriculture is the mainstay for the Ugandan population, the poverty impact is assessed according to whether households engage in farming as the main economic activity. The rest of this chapter is structured as follows. Section 8.2 presents results for the dynamic baseline poverty impact at national level, which is further decomposed into impacts on national farming and national non-farming households. The baseline poverty impact on households by residence, rural and urban, is also presented while the rural-urban divide is further decomposed into: urban-farming, urban non-farming, rural farming and rural non-farming households. Section 8.3 presents results for the poverty impact of alternative healthcare financing scenarios, also highlighting poverty at national level, rural and urban, and farming and non-farming households. More importantly, this section reports the impact of increasing healthcare expenditure on poverty reduction rates compared to the baseline. Section 8.4 summarises and concludes the chapter.

8.2 Baseline poverty

The poverty impacts from the dynamic baseline simulation are presented in Table 8.1. The baseline results indicate that national poverty incidence will decline cumulatively from 31.3% in 2008 to 12.6% in 2020. With a projected population growth of 3% per annum the baseline policies reduce the absolute number of poor people from 8.46 million, in 2008, to 4.87 million in 2020. Although the national farming poverty is initially high, the results suggest that baseline policies are in favour of farming households compared to non-farming households at the national level. The proportion of farming households at national level that is below the poverty line reduces from 32.3%, in 2008 to 12.0% in 2020, compared to the non-farming 26.2% , in 2008, reducing to 14.9% by 2020.

The presented national poverty statistics are a reflection of the trend in rural and urban, and farming and non-farming poverty impacts which are in turn related to the earlier predicted economy-wide adjustment mechanisms in Chapter 7. Households earn income from ownership of factors. The baseline factor payments and factor demand by sectors are predicted to rise by the end of 2020. The SAM sources of household income showed that rural farming households earn 5% of income from self-employed labour, 11% from unskilled labour, 7% from skilled labour and 23% of income from land. This implies that an increase in the prices of these factors would definitely translate into higher incomes for households that own them thus raising their standard of living and getting them out of poverty.

Table 8.1 Baseline poverty indicators: 2008 – 2020

	National, total			National farm			National non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	31.1	8.8	3.6	32.3	8.7	3.4	26.2	9.4	4.4
2009	27.6	7.6	3.0	28.3	7.4	2.8	25.0	8.5	3.9
2010	24.5	6.5	2.5	24.8	6.2	2.3	23.4	7.6	3.4
2011	21.3	5.5	2.1	21.3	5.2	1.9	21.2	6.8	2.9
2012	18.9	4.6	1.7	18.7	4.3	1.5	19.4	6.0	2.5
2013	15.8	3.8	1.4	15.4	3.5	1.2	17.6	5.2	2.1
2014	13.4	3.2	1.1	12.8	2.9	0.9	16.0	4.6	1.8
2015	11.6	2.6	0.9	10.9	2.3	0.7	14.6	3.9	1.5
2016	9.9	2.1	0.7	9.1	1.8	0.6	13.1	3.3	1.2
2017	8.3	1.7	0.5	7.4	1.4	0.4	11.8	2.8	1.0
2018	6.7	1.3	0.4	5.9	1.1	0.3	9.9	2.3	0.8
2019	5.4	1.0	0.3	4.7	0.8	0.2	8.1	1.9	0.7
2020	4.0	0.8	0.2	3.4	0.6	0.2	6.7	1.5	0.5
	Rural, total			Rural, farm			Rural, non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	34.3	9.8	4.0	33.2	8.9	3.5	42.6	16.3	7.8
2009	30.4	8.4	3.3	29.0	7.6	2.9	41.4	14.9	6.9
2010	26.9	7.2	2.8	25.3	6.4	2.3	39.1	13.4	6.1
2011	23.4	6.1	2.3	21.8	5.3	1.9	36.6	12.0	5.3
2012	20.8	5.1	1.9	19.2	4.4	1.5	33.8	10.7	4.5
2013	17.4	4.2	1.5	15.7	3.6	1.2	30.8	9.4	3.9
2014	14.6	3.5	1.2	13.0	2.9	1.0	28.0	8.3	3.3
2015	12.8	2.9	1.0	11.1	2.3	0.7	26.0	7.1	2.7
2016	10.9	2.3	0.8	9.3	1.9	0.6	23.4	6.1	2.3
2017	9.1	1.9	0.6	7.6	1.4	0.4	21.3	5.1	1.8
2018	7.4	1.5	0.5	6.1	1.1	0.3	18.3	4.2	1.5
2019	6.0	1.1	0.3	4.8	0.8	0.2	15.0	3.5	1.2
2020	4.4	0.9	0.3	3.4	0.6	0.2	12.4	2.8	1.0
	Urban, total			Urban, farm			Urban, non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	13.8	3.7	1.5	19.7	5.5	2.1	10.4	2.7	1.1
2009	12.3	3.2	1.2	17.9	4.8	1.8	9.1	2.3	0.9
2010	11.5	2.8	1.0	17.3	4.2	1.5	8.3	2.0	0.8
2011	9.3	2.4	0.9	14.4	3.6	1.3	6.4	1.7	0.7
2012	8.2	2.0	0.7	13.0	3.0	1.1	5.5	1.4	0.5
2013	7.2	1.7	0.6	11.4	2.5	0.9	4.9	1.2	0.5
2014	6.5	1.4	0.5	10.1	2.1	0.7	4.4	1.0	0.4
2015	5.5	1.1	0.4	8.8	1.7	0.6	3.6	0.8	0.3
2016	4.5	0.9	0.3	6.7	1.4	0.5	3.2	0.7	0.3
2017	3.5	0.7	0.3	5.2	1.1	0.4	2.6	0.5	0.2
2018	2.7	0.6	0.2	4.3	0.9	0.3	1.9	0.4	0.2
2019	2.3	0.5	0.2	3.8	0.7	0.2	1.4	0.4	0.2
2020	1.9	0.4	0.2	3.3	0.6	0.2	1.2	0.3	0.1

The baseline depth of poverty is also reduced in the dynamic baseline simulation because of the assumptions that were incorporated about the prevailing conditions in the economy. The baseline predicts some improvement in welfare so that even those below the poverty line gain a level of income to improve their standard of living. The baseline national poverty level indicates that, by 2020, farming households living below the poverty line will require 2.6% of the threshold income (down from 8.7% in 2008) while non-farming households will require 4% (down from 9.4% in 2008) of the threshold income level to be lifted out of poverty. The income required to reach the threshold level is substantially reduced for rural farming households compared to the rural non-farming households. This is because the rural non-farming households do not earn income from self-employed labour and land as depicted in the SAM sources of household income, suggesting that non-ownership of land in rural areas is a hindrance to improving welfare for rural households.

Although absolute poverty is reduced in the baseline, it still fails to meet the millennium development target of halving poverty by 2015, and the absolute number of poor people remains high by 2020. Given the baseline poverty statistics, poverty remains a challenge in Uganda and the government ought to seek further opportunities to reduce the poverty. One such opportunity explored in this study is to increase healthcare expenditure.

8.3 Poverty impacts of alternative healthcare financing scenarios

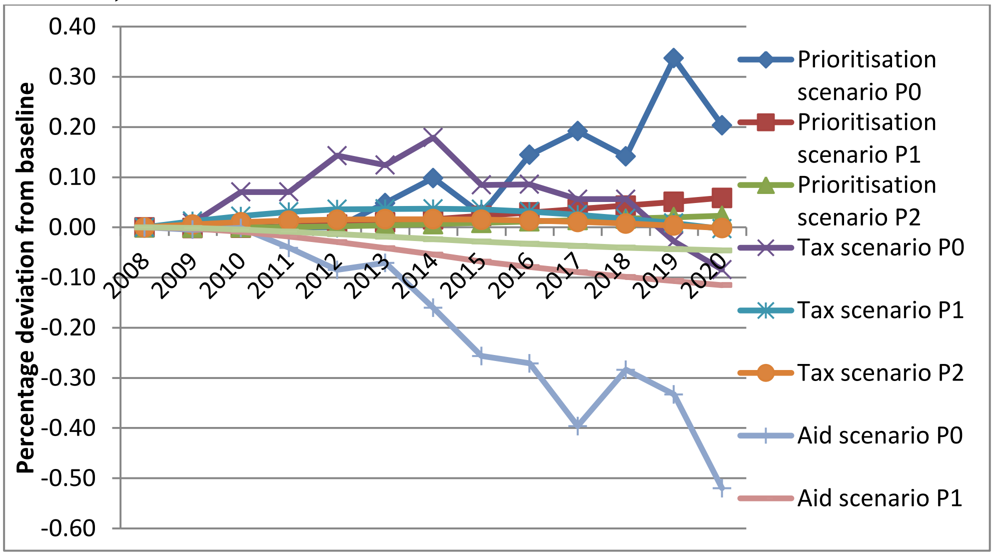
8.3.1 National Poverty

The model results for the policy impact on poverty indicate that investing in healthcare leads to faster decline in national poverty rates relative to the baseline, for all scenarios. Firstly, the national poverty impact results are presented as deviations from the baseline for the proposed budget share without health effects and secondly, with health effects. A similar format is followed when presenting and discussing the rural versus urban poverty impacts. Figure 8.1 illustrates the national poverty deviation from the baseline when the proposed budget is implemented without health effects. Excluding health effects from the analysis shows that the national incidence, depth and severity of poverty increase gradually through to 2020, under the prioritisation and tax scenario. This suggests that given a fixed government budget the annual increase in the government demand scaling factor for the healthcare function translates into an annual proportionate reduction in resources available to the other government functions to support productive sectors. Consequently, all sectors in the economy except the health sector shrink and demand less of factors of production as reported in the adjustment mechanisms in Chapter 7. The declining demand for factors of production implies less and less income for the owners of the factors and consequently, poverty rates increase. Moreover, under the taxation scenario, households have less disposable income and therefore reduced consumption expenditure compared to the baseline.

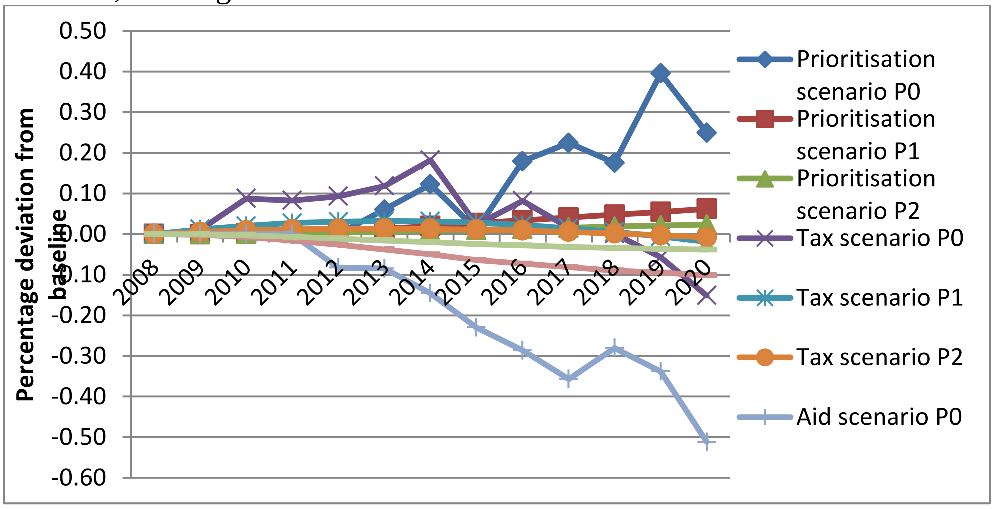
When national poverty is decomposed by type of the main economic activity, the farming households are worst hit by the proposed policy when compared to the non-farming households. This is mainly due to the farming households' dependence on, to a greater extent, the income from land and self-employed labour which are intensively used in agriculture. A contracting agricultural sector is detrimental to farming households because it deprives them of their source of livelihood.

Figure 8.1 National poverty under the proposed budget share without health effects, deviation from baseline

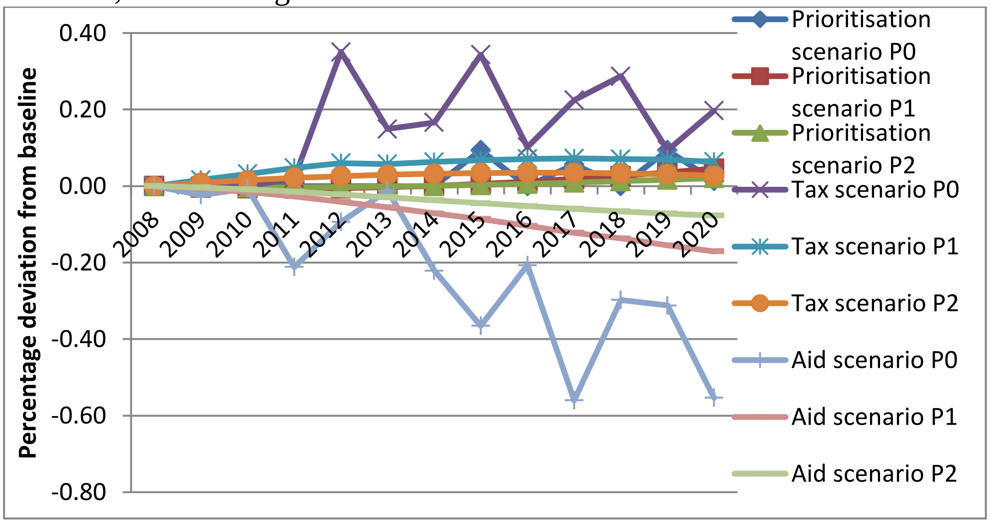
National, total



National, farming



National, non-farming



The aid scenario, on other hand, reflects a reduction in national poverty rates beginning in 2011 even when health effects are excluded from the analysis. And when decomposed by type of economic activity, poverty among farming households begins to decline in 2012 while it begins to decline in 2009 among non-farming households. The decline in poverty rates under the aid scenario is explained by the fact that the healthcare financing scenario involves injecting resources into the economy in form of increased foreign savings inflow. Not only does the government have additional resources to spend, but the additional resources are mobilised from outside the economy, in contrast to the tax scenario where additional resources are simply a transfer of resources from one economic agent (households) to another economic (government). The aid impact is also reflected in the factor demand where, for instance, demand for capital increases in all sectors relative to the baseline. This suggests that increased aid inflow can be a stimulus to investment even if it is directed to the health sector.

Although the proposed budget implementation without health effects drives down poverty rates by 2020 when compared to 2008 levels, the policy performs badly under the prioritisation and tax scenario when compared with the baseline. In this instance, the proposed budget without health effects actually increases poverty rates when compared to the baseline poverty levels. The impact from the aid scenario, though positive, is underestimated since higher reduction rates are indeed predicted when health effects are incorporated in the analysis. Overall, given the modelled population growth rate of 3% per year, by 2020, the proposed budget share without health effects would generate a larger absolute number of poor people - 4.94 million and 4.83million under the prioritisation and tax and aid scenarios respectively, compared to 4.86 million for the baseline. The aid scenario generates an absolute number of 4.66 million poor people.

When the proposed budget is implemented with health effects, the national poverty reduction rates are higher when compared to the baseline levels. Figure 8.2 shows the national poverty deviation from the baseline when the proposed budget share is implemented with health effects. National poverty declines cumulatively and, by 2020, the number of people living below the poverty line is reduced to 4% under the prioritisation scenario, 3.6% under the tax scenario and 3.5% under the aid scenario (see Tables 8.2, 8.3 and 8.4).

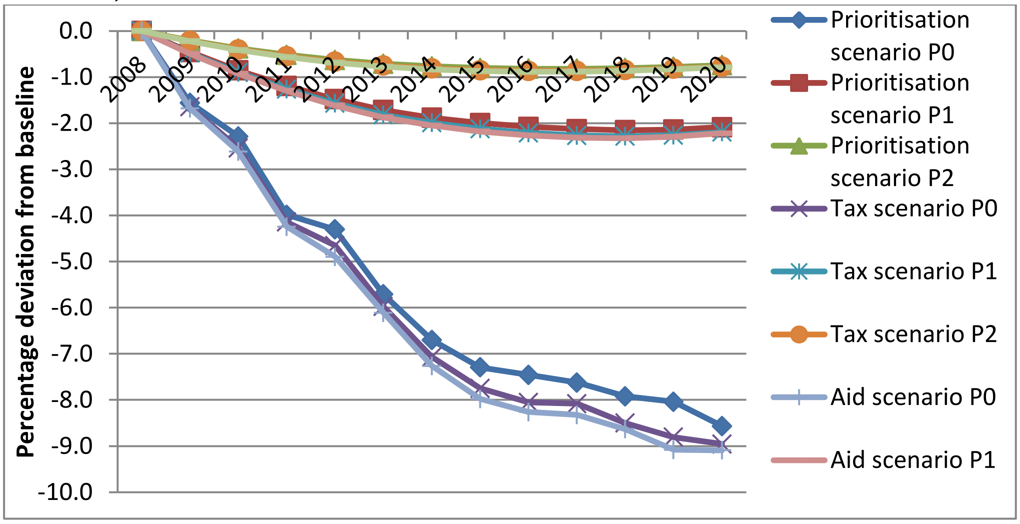
The driving force behind the poverty reduction rates are the health improvement parameters, modelled as labour supply growth, labour productivity growth and total factor productivity growth. The reduction in national poverty rates is a reflection of overall improvement in all households' welfare brought about by the government's deliberate policy to expand healthcare services delivery. The healthcare expansion translates to growth in effective labour supply, labour productivity and total factor productivity, as described in the scenario design Chapter 6. The growth in the health effect parameters is an enabling factor for growth in economy wide output, as reported in the higher GDP growth rates in Chapter 7. The economy-wide expansion provides avenues for households to sell their factors and consequently, higher household income earnings. Sectors in the economy are interlinked, either as suppliers or demanders, and therefore an expansion in the production output reverberates throughout the economy so that all categories of labour are able to find some form of employment, both in the formal and the informal (unregulated) sectors[73]. The household survey (UNHS 2009/10) estimated that 67% of the working persons in the non-

[73] The informal sector employment in the Ugandan context refers to the unregulated sector. Informal employment identifies persons who are in precarious employment situations irrespective of whether or not the entity for which they work is in the formal or informal sector. Persons in informal employment therefore consist of all those in the informal sector; employees in the formal sector; and persons working in private households who are not entitled to basic benefits such as pension/retirement fund, paid leave, medical benefits, deduction of income tax from wages and whose employment agreement is verbal (Uganda Bureau of Statistics, 2010b).

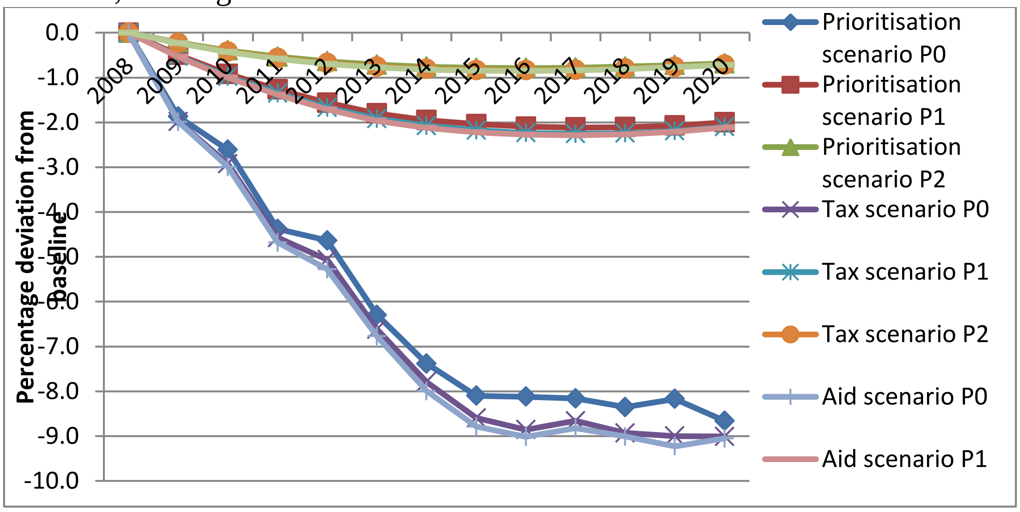
agricultural sector were in informal employment. Although the informal sector wages are relatively low, the sector is expanding and absorbing all labour categories that are nevertheless, engaged in productive activities therefore earning income so that households are relatively better-off.

Figure 8.2 National poverty under the proposed budget share with health effects, deviation from baseline

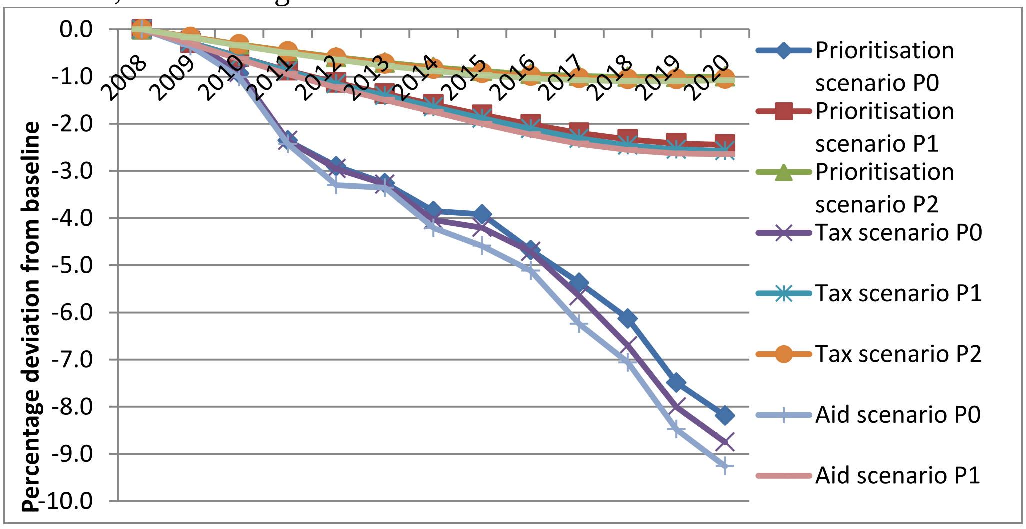
National, total



National, farming



National, non-farming

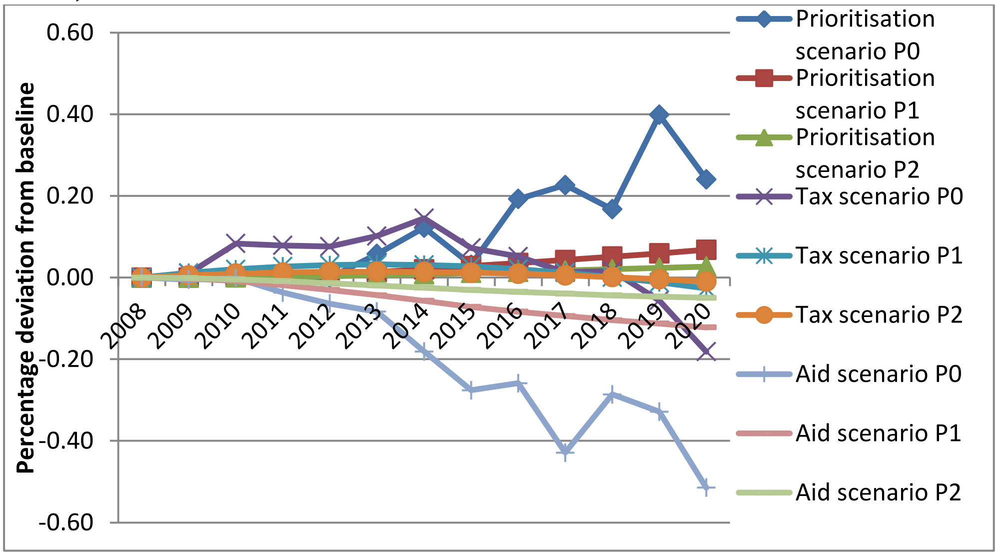


8.3.2 Rural versus urban poverty

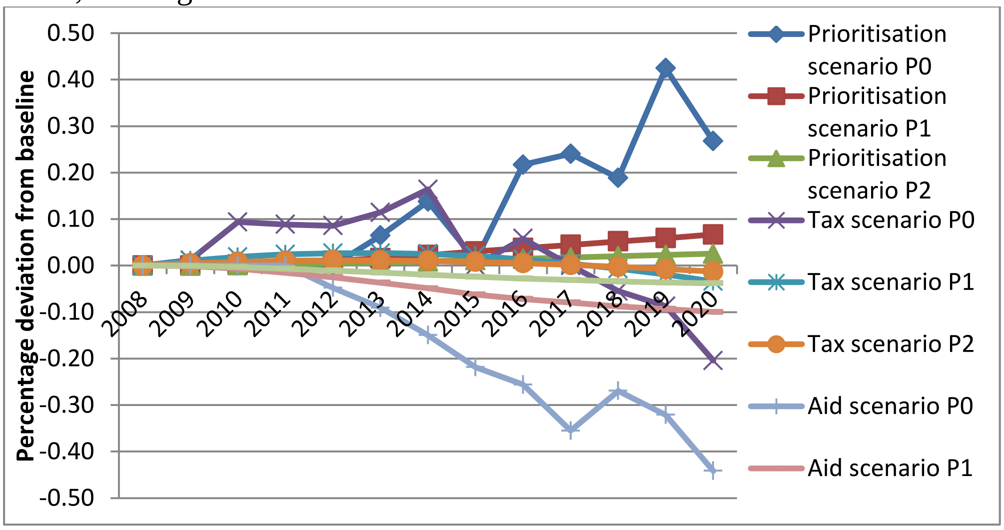
In Uganda, poverty is a rural phenomenon hence it is imperative to delve into the poverty dynamics by population residence. Figures 8.3 and 8.4 illustrate the deviations from the baseline when the increased government healthcare expenditure is assessed without health effects, for rural and urban poverty respectively. When health effects are excluded from the analysis, the trend in poverty rates is similar to that of the national poverty rates reported above. Rural poverty increases under the prioritisation and tax scenarios relative to the baseline, although it begins to decline again in 2018 for the tax scenario. The aid scenario differs in that poverty begins to decline in 2009. When decomposed by economic activity, the rural farming households are worse-off under the prioritisation scenario while the tax and aid scenarios indicate that the proportion of poor people begins to decline in 2018 and 2012 respectively. On the other hand, the rural non-farming households remain consistently worse-off under the prioritisation and tax scenarios while the proportion of poor people begins to decline in 2012.

Figure 8.3 Rural poverty under the proposed budget share without health effects, deviation from baseline

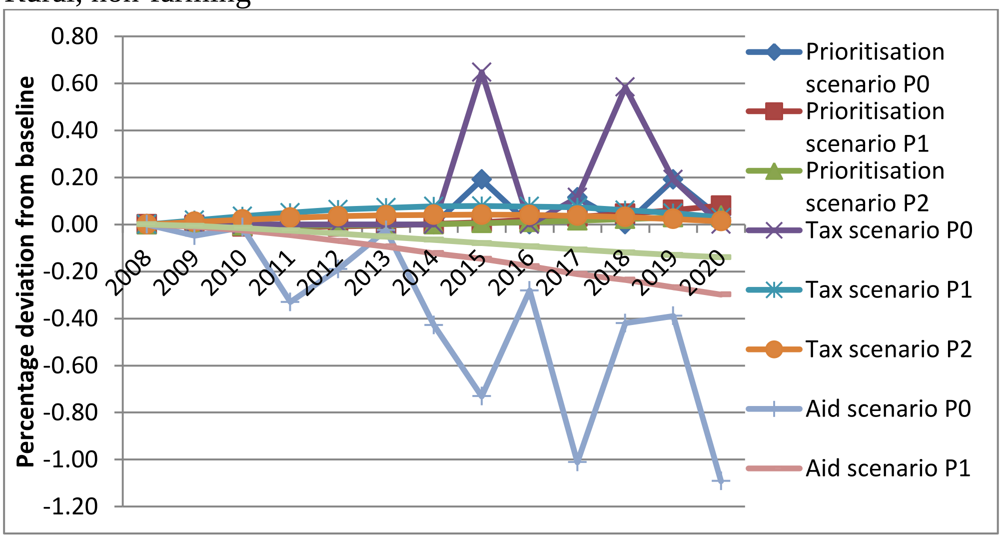
Rural, total



Rural, farming



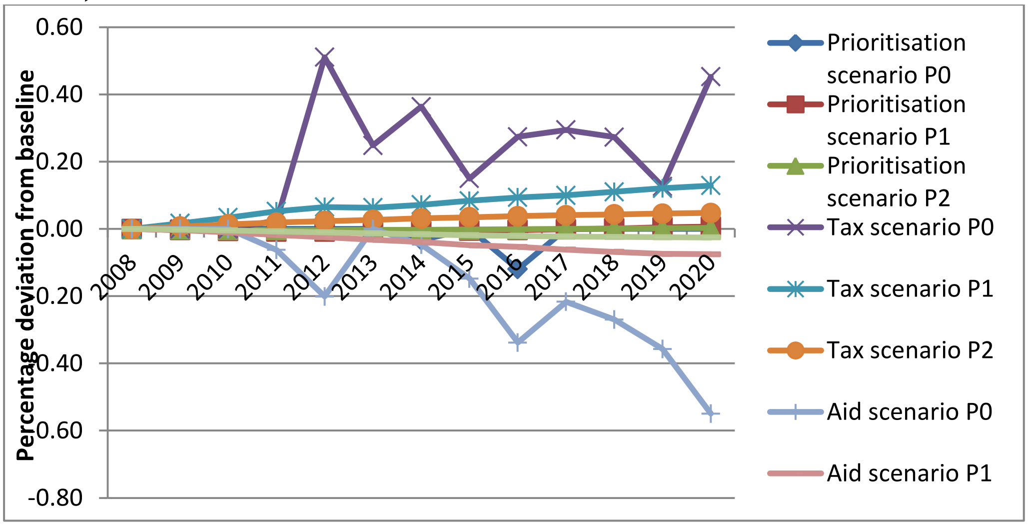
Rural, non-farming



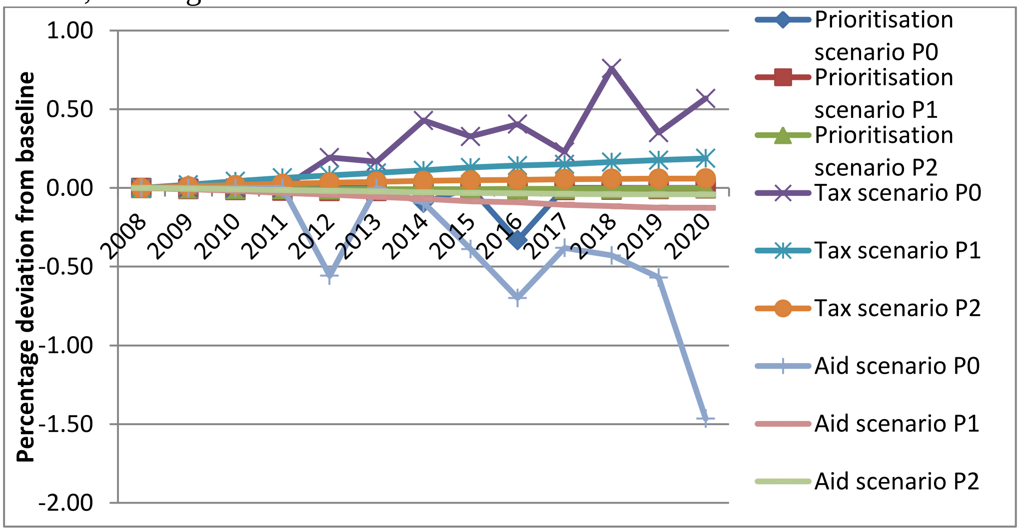
For the urban households under the proposed budget share without health effects, the worst impact happens under the tax scenario. It indicates that the proportion of poor people will begin to increase in 2011 relative to the baseline and the number increases cumulatively until 2020. The incidence of poverty is larger among urban farming households when compared to urban non-farming households. This is partly due to the higher rate of tax for the urban farming households, which increases to 3.0% by 2020 (as imposed in the model) compared to the 2.8% for the urban non-farming households. A higher tax rate means less income for consumption purposes.

Figure 8.4 Urban poverty under the proposed budget share without health effects, deviation from baseline

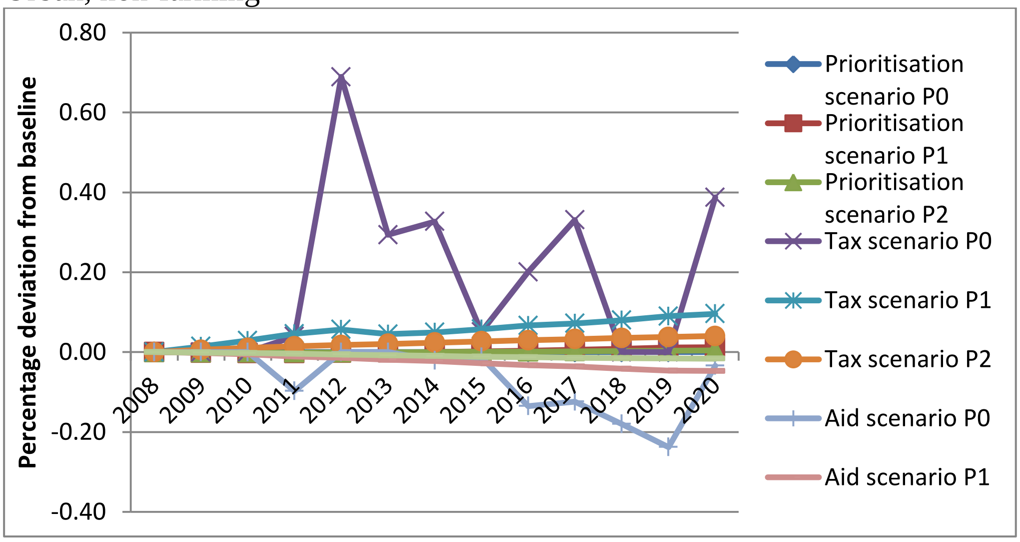
Urban, total



Urban, farming



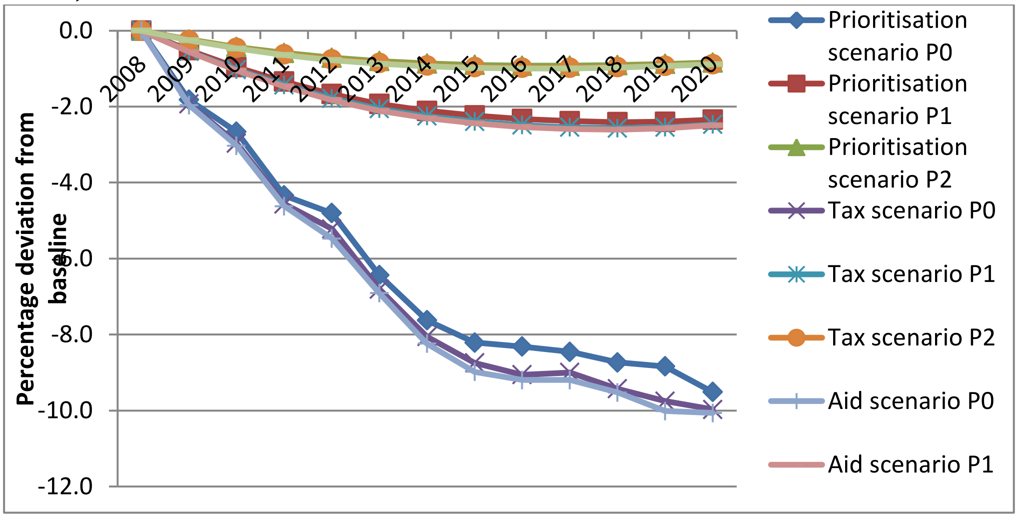
Urban, non-farming



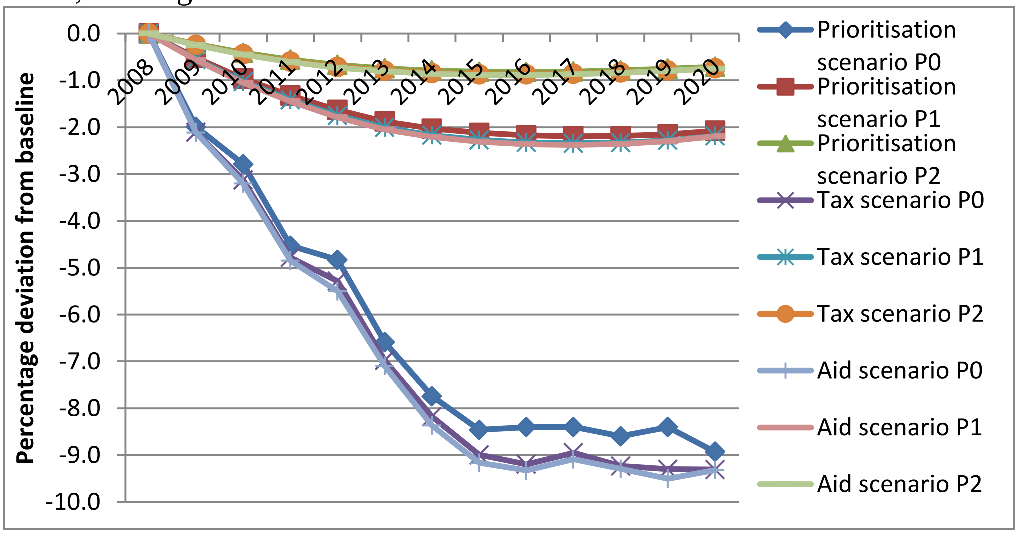
When the proposed budget share is implemented with health effects, the poverty impact results indicate that both rural and urban poverty decline consistently throughout the model period, for all scenarios. Figures 8.5 and 8.6 illustrate deviations from the baseline, when health effects are incorporated in the analysis. The aid scenario is the most beneficial policy for healthcare financing in this regard, because it achieves the highest poverty reduction rates. Rural poverty incidence declines to 4.4%, 3.9% and 3.8% under the prioritisation, tax and aid scenario respectively. Similarly, the urban poverty incidence is reduced to 1.9%, 1.9% and 1.6% under the prioritisation, tax and aid scenarios respectively (see Tables 8.2, 8.3 and 8.4). With the health effects incorporated in the analysis and the 3% population growth rate considered in the model, the absolute number of poor people is reduced to 1.55 million under the prioritisation scenario, 1.40 million under the tax scenario and 1.34 million under the aid scenario.

Figure 8.5 Rural poverty under the proposed budget share with health effects, deviation from baseline

Rural, total



Rural, farming



Rural, non-farming

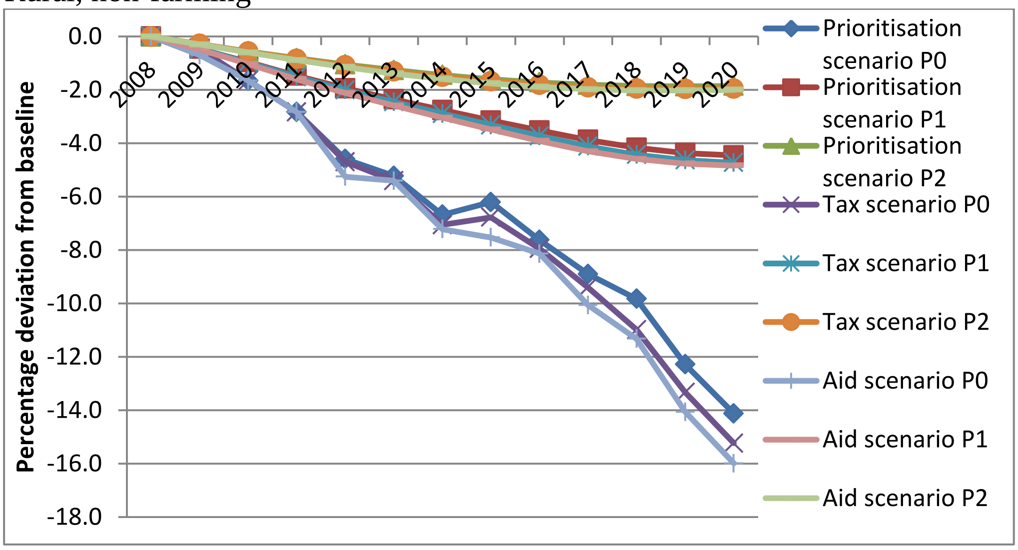
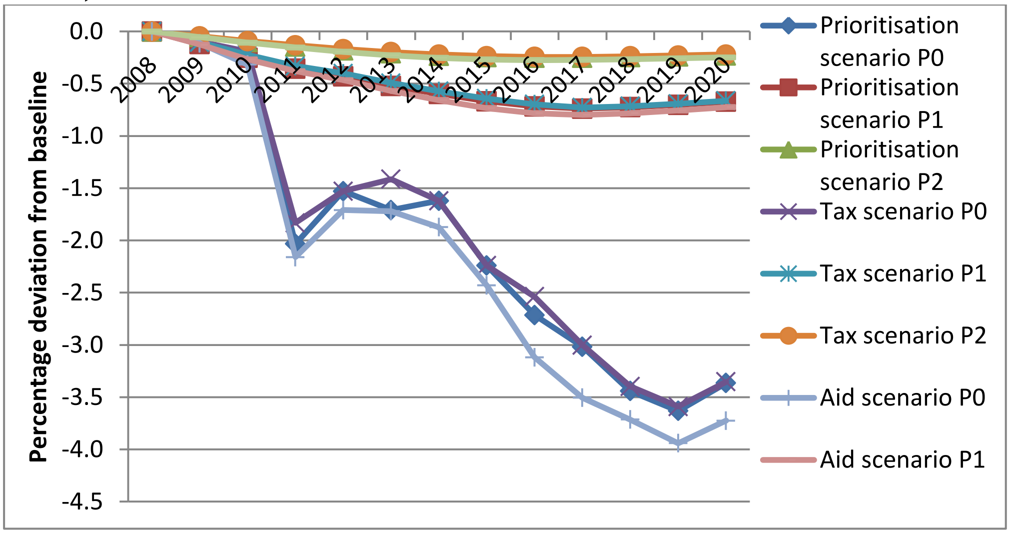
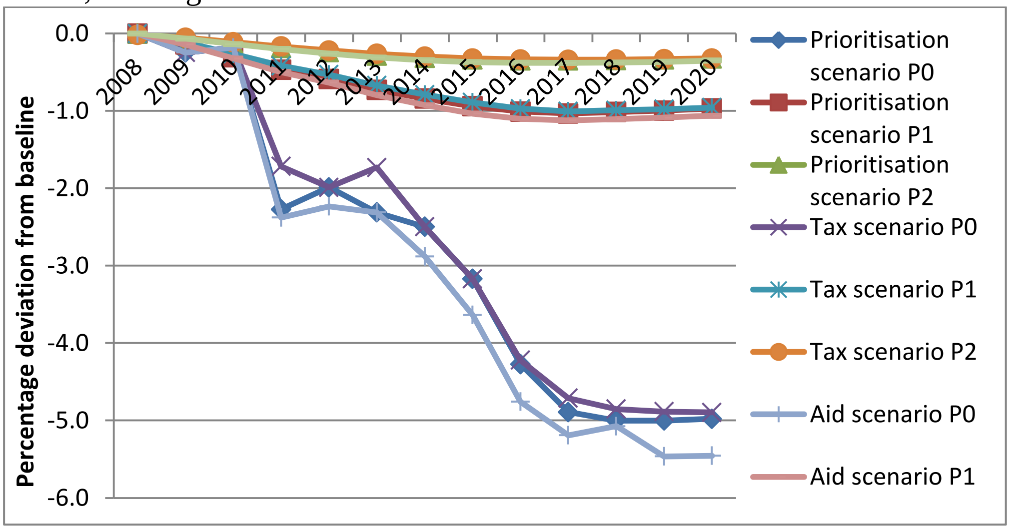


Figure 8.6 Urban poverty under the proposed budget share with health effects, deviation from baseline

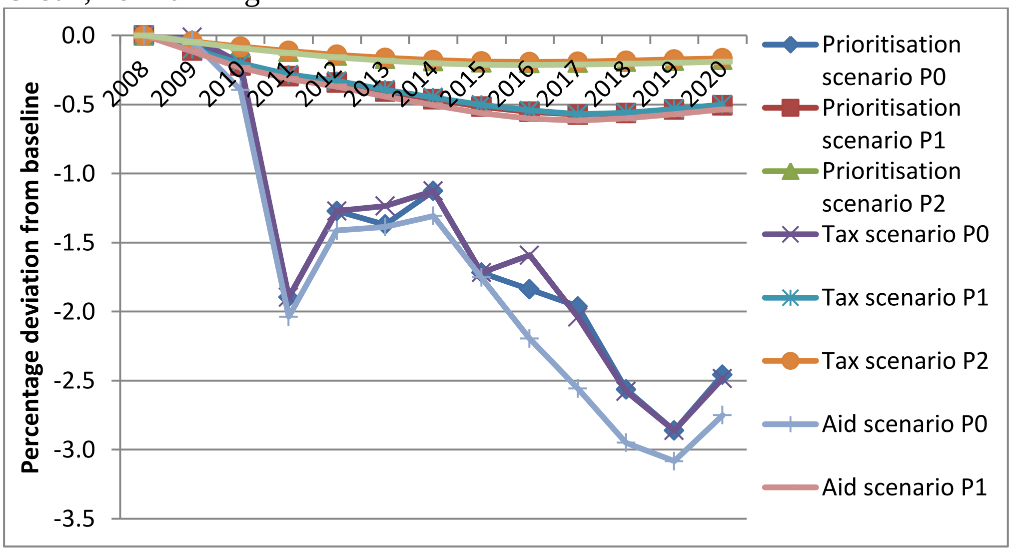
Urban, total



Urban, farming



Urban, non-farming



When the proposed health budget share is implemented with health effects, the urban poverty reduction rates fluctuate and the trend is more pronounced among the urban non-farming households. On the contrary, rural poverty reduction is consistently declining throughout the model period. The trend in rural poverty reduction rates suggests that an increase in the government healthcare expenditure budget which, in turn, improves population health is particularly beneficial to reducing rural poverty. This is specifically so, when new health in the model is defined individually, by growth in labour productivity or total factor productivity.

This result is simply a confirmation of the capacity of the majority of rural inhabitants who are mainly self-employed in the agricultural sector to benefit from any improvement in land and labour productivity. Growth in factor productivity translates to higher returns to the owners of land and self-employed labour, as depicted in the model results in Chapter 7, thus more income for the rural households. These results demonstrate that investing in health improvement activities has the potential to boost productivity and output in the agricultural sector which, in turn, spurs economic growth and accelerates poverty reduction.

Similarly, urban poverty is reduced when compared to the baseline poverty levels because the urban-poor mainly engage in the informal (unregulated) sector, largely preoccupied with casual labour activities. Therefore, any measure that improves the health and productivity of this category of population directly impacts on their ability to increase their earnings, particularly selling their labour.

Furthermore, the trend in poverty reduction rates in rural and urban areas and farming and non-farming households is also explained by the incidence of poverty in Uganda. The incidence of poverty is highest among the category of the working population engaged in primary sector activities[74] followed by the working population in manufacturing sector, while poverty is least likely for the population in the service sector (Uganda Bureau of Statistics, 2012). Primary sector activities are mainly rural based while manufacturing sector activities are mainly among the urban informal sector segment of the economy. These sectors are largely labour intensive and majority of workers in these sectors are self-employed and/or unskilled. Therefore, an increase in public healthcare expenditure for health improvement investments that improve labour and total factor productivity in all sectors directly improves labour earnings and highly benefits the income levels of households engaged in primary and manufacturing sectors.

[74] Primary sector activities include agriculture (including fishing and forestry), mining and quarrying

Table 8.2 Poverty rates under the proposed budget share with health effects: Prioritisation

	National, total			National farm			National non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	31.1	8.8	3.6	32.3	8.7	3.4	26.2	9.4	4.4
2009	27.6	7.6	3.0	28.3	7.4	2.8	25.0	8.5	3.9
2010	24.5	6.5	2.5	24.8	6.2	2.3	23.4	7.6	3.4
2011	21.3	5.5	2.1	21.3	5.2	1.9	21.2	6.8	2.9
2012	18.9	4.6	1.7	18.7	4.3	1.5	19.4	6.0	2.5
2013	15.8	3.8	1.4	15.4	3.5	1.2	17.6	5.2	2.1
2014	13.4	3.2	1.1	12.8	2.9	0.9	16.0	4.6	1.8
2015	11.6	2.6	0.9	10.9	2.3	0.7	14.6	3.9	1.5
2016	9.9	2.1	0.7	9.1	1.8	0.6	13.1	3.3	1.2
2017	8.3	1.7	0.5	7.4	1.4	0.4	11.8	2.8	1.0
2018	6.7	1.3	0.4	5.9	1.1	0.3	9.9	2.3	0.8
2019	5.4	1.0	0.3	4.7	0.8	0.2	8.1	1.9	0.7
2020	4.0	0.8	0.2	3.4	0.6	0.2	6.7	1.5	0.5
	Rural, total			Rural, farm			Rural, non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	34.3	9.8	4.0	33.2	8.9	3.5	42.6	16.3	7.8
2009	30.4	8.4	3.3	29.0	7.6	2.9	41.4	14.9	6.9
2010	26.9	7.2	2.8	25.3	6.4	2.3	39.1	13.4	6.1
2011	23.4	6.1	2.3	21.8	5.3	1.9	36.6	12.0	5.3
2012	20.8	5.1	1.9	19.2	4.4	1.5	33.8	10.7	4.5
2013	17.4	4.2	1.5	15.7	3.6	1.2	30.8	9.4	3.9
2014	14.6	3.5	1.2	13.0	2.9	1.0	28.0	8.3	3.3
2015	12.8	2.9	1.0	11.1	2.3	0.7	26.0	7.1	2.7
2016	10.9	2.3	0.8	9.3	1.9	0.6	23.4	6.1	2.3
2017	9.1	1.9	0.6	7.6	1.4	0.4	21.3	5.1	1.8
2018	7.4	1.5	0.5	6.1	1.1	0.3	18.3	4.2	1.5
2019	6.0	1.1	0.3	4.8	0.8	0.2	15.0	3.5	1.2
2020	4.4	0.9	0.3	3.4	0.6	0.2	12.4	2.8	1.0
	Urban, total			Urban, farm			Urban, non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	13.8	3.7	1.5	19.7	5.5	2.1	10.4	2.7	1.1
2009	12.3	3.2	1.2	17.9	4.8	1.8	9.1	2.3	0.9
2010	11.5	2.8	1.0	17.3	4.2	1.5	8.3	2.0	0.8
2011	9.3	2.4	0.9	14.4	3.6	1.3	6.4	1.7	0.7
2012	8.2	2.0	0.7	13.0	3.0	1.1	5.5	1.4	0.5
2013	7.2	1.7	0.6	11.4	2.5	0.9	4.9	1.2	0.5
2014	6.5	1.4	0.5	10.1	2.1	0.7	4.4	1.0	0.4
2015	5.5	1.1	0.4	8.8	1.7	0.6	3.6	0.8	0.3
2016	4.5	0.9	0.3	6.7	1.4	0.5	3.2	0.7	0.3
2017	3.5	0.7	0.3	5.2	1.1	0.4	2.6	0.5	0.2
2018	2.7	0.6	0.2	4.3	0.9	0.3	1.9	0.4	0.2
2019	2.3	0.5	0.2	3.8	0.7	0.2	1.4	0.4	0.2
2020	1.9	0.4	0.2	3.3	0.6	0.2	1.2	0.3	0.1

Table 8.3 Poverty rates under the proposed budget share with health effects: Tax scenario

	National, total			National farm			National non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	31.1	8.8	3.6	32.3	8.7	3.4	26.2	9.4	4.4
2009	27.6	7.6	3.0	28.2	7.4	2.8	25.0	8.5	3.9
2010	24.3	6.4	2.5	24.4	6.2	2.3	23.4	7.6	3.4
2011	21.1	5.4	2.0	21.1	5.1	1.8	21.2	6.7	2.9
2012	18.5	4.5	1.7	18.3	4.2	1.5	19.4	5.9	2.5
2013	15.5	3.7	1.3	15.1	3.4	1.1	17.6	5.2	2.1
2014	13.0	3.1	1.1	12.4	2.7	0.9	15.8	4.5	1.8
2015	11.2	2.5	0.8	10.4	2.2	0.7	14.3	3.8	1.5
2016	9.3	2.0	0.6	8.4	1.7	0.5	13.1	3.2	1.2
2017	7.8	1.6	0.5	6.9	1.3	0.4	11.5	2.7	1.0
2018	6.1	1.2	0.4	5.4	1.0	0.3	9.4	2.2	0.8
2019	4.6	0.9	0.3	3.9	0.7	0.2	7.6	1.8	0.6
2020	3.6	0.7	0.2	3.0	0.5	0.1	6.1	1.4	0.5
	Rural, total			Rural, farm			Rural, non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	34.3	9.8	4.0	33.2	8.9	3.5	42.6	16.3	7.8
2009	30.3	8.4	3.3	28.9	7.5	2.8	41.4	14.9	6.9
2010	26.6	7.1	2.7	25.0	6.3	2.3	39.1	13.4	6.0
2011	23.2	6.0	2.2	21.5	5.2	1.9	36.6	12.0	5.2
2012	20.4	5.0	1.8	18.7	4.3	1.5	33.7	10.6	4.5
2013	17.0	4.1	1.5	15.3	3.4	1.2	30.6	9.3	3.8
2014	14.2	3.4	1.2	12.5	2.8	0.9	27.6	8.1	3.2
2015	12.2	2.7	0.9	10.6	2.2	0.7	25.4	7.0	2.7
2016	10.1	2.2	0.7	8.5	1.7	0.5	23.1	5.9	2.2
2017	8.6	1.7	0.5	7.1	1.3	0.4	20.8	4.9	1.7
2018	6.7	1.3	0.4	5.4	1.0	0.3	17.1	4.0	1.4
2019	5.0	1.0	0.3	3.9	0.7	0.2	13.9	3.2	1.1
2020	3.9	0.7	0.2	3.0	0.5	0.1	11.3	2.6	0.8
	Urban, total			Urban, farm			Urban, non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	13.8	3.7	1.5	19.7	5.5	2.1	10.4	2.7	1.1
2009	12.3	3.2	1.2	17.9	4.9	1.8	9.1	2.3	0.9
2010	11.6	2.8	1.1	17.3	4.2	1.5	8.3	2.0	0.8
2011	9.5	2.4	0.9	15.0	3.6	1.3	6.4	1.7	0.7
2012	8.2	2.0	0.7	13.0	3.1	1.1	5.5	1.4	0.6
2013	7.5	1.7	0.6	12.0	2.6	0.9	5.0	1.2	0.5
2014	6.5	1.4	0.5	10.1	2.2	0.7	4.4	1.0	0.4
2015	5.5	1.2	0.4	8.8	1.8	0.6	3.6	0.8	0.3
2016	4.6	0.9	0.3	6.8	1.4	0.5	3.4	0.7	0.3
2017	3.5	0.7	0.3	5.4	1.1	0.4	2.5	0.5	0.2
2018	2.8	0.6	0.2	4.5	0.9	0.3	1.8	0.4	0.2
2019	2.3	0.5	0.2	3.9	0.7	0.2	1.4	0.4	0.2
2020	1.9	0.4	0.2	3.3	0.6	0.2	1.1	0.3	0.2

Table 8.4 Poverty rates under the proposed budget share with health effects: Aid scenario

	National, total			National farm			National non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	31.1	8.8	3.6	32.3	8.7	3.4	26.2	9.4	4.4
2009	27.5	7.6	3.0	28.2	7.3	2.8	24.9	8.5	3.9
2010	24.2	6.4	2.5	24.4	6.1	2.3	23.3	7.6	3.3
2011	21.0	5.4	2.0	21.0	5.1	1.8	21.1	6.7	2.9
2012	18.3	4.5	1.6	18.1	4.1	1.4	19.0	5.9	2.5
2013	15.4	3.7	1.3	14.9	3.3	1.1	17.5	5.1	2.1
2014	12.8	3.0	1.0	12.2	2.7	0.9	15.7	4.4	1.7
2015	11.0	2.4	0.8	10.2	2.1	0.7	13.9	3.7	1.4
2016	9.1	1.9	0.6	8.2	1.6	0.5	12.7	3.1	1.2
2017	7.6	1.5	0.5	6.8	1.2	0.4	10.9	2.6	0.9
2018	6.0	1.2	0.4	5.3	0.9	0.3	9.0	2.1	0.7
2019	4.3	0.9	0.3	3.7	0.7	0.2	7.1	1.7	0.6
2020	3.5	0.7	0.2	3.0	0.5	0.1	5.6	1.3	0.5
	Rural, total			Rural, farm			Rural, non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	34.3	9.8	4.0	33.2	8.9	3.5	42.6	16.3	7.8
2009	30.3	8.3	3.3	28.9	7.5	2.8	41.2	14.9	6.9
2010	26.5	7.1	2.7	24.9	6.3	2.3	39.1	13.4	6.0
2011	23.2	5.9	2.2	21.5	5.2	1.8	36.6	11.9	5.2
2012	20.1	4.9	1.8	18.5	4.2	1.5	33.1	10.5	4.4
2013	16.9	4.1	1.4	15.2	3.4	1.1	30.6	9.2	3.8
2014	14.0	3.3	1.1	12.3	2.7	0.9	27.5	8.0	3.1
2015	12.0	2.7	0.9	10.4	2.2	0.7	24.7	6.8	2.6
2016	10.0	2.1	0.7	8.4	1.7	0.5	22.9	5.7	2.1
2017	8.4	1.6	0.5	6.9	1.3	0.4	20.1	4.7	1.7
2018	6.6	1.3	0.4	5.4	0.9	0.3	16.8	3.8	1.3
2019	4.8	1.0	0.3	3.7	0.7	0.2	13.2	3.1	1.0
2020	3.8	0.7	0.2	3.0	0.5	0.1	10.5	2.4	0.8
	Urban, total			Urban, farm			Urban, non-farm		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
2008	13.8	3.7	1.5	19.7	5.5	2.1	10.4	2.7	1.1
2009	12.3	3.2	1.2	17.9	4.8	1.8	9.1	2.3	0.9
2010	11.4	2.8	1.0	17.3	4.2	1.5	8.1	2.0	0.8
2011	9.2	2.3	0.9	14.3	3.5	1.3	6.3	1.6	0.6
2012	8.0	2.0	0.7	12.8	3.0	1.0	5.4	1.4	0.5
2013	7.2	1.6	0.6	11.4	2.5	0.8	4.9	1.2	0.4
2014	6.2	1.3	0.5	9.7	2.0	0.7	4.2	1.0	0.4
2015	5.3	1.1	0.4	8.3	1.6	0.5	3.6	0.8	0.3
2016	4.1	0.8	0.3	6.2	1.3	0.4	2.8	0.6	0.2
2017	3.0	0.7	0.3	4.9	1.0	0.3	2.0	0.5	0.2
2018	2.5	0.6	0.2	4.2	0.8	0.3	1.5	0.4	0.2
2019	1.9	0.4	0.2	3.3	0.6	0.2	1.2	0.3	0.2
2020	1.6	0.4	0.1	2.8	0.5	0.2	0.9	0.3	0.1

8.4 Summary

This chapter presents results showing the impact of healthcare financing policy reforms on poverty reduction in Uganda. All the healthcare financing scenarios modelled demonstrate that when health effects are incorporated in the analysis, poverty will decline relative to the baseline. The aid for health policy scenario however, yields the largest welfare improvements in terms of higher poverty reduction rates compared to the prioritisation and tax scenarios. The results for poverty impact under the proposed budget share without health effects also reveals that benefits of expanding healthcare services would be under estimated if the health effects are excluded from the analysis. Given these results, it is commendable to increase the healthcare budget so as to expand healthcare service delivery. This will subsequently improve the population health status, accelerate economic growth and reduce poverty.

CHAPTER 9: SENSITIVITY ANALYSIS

9.1 Introduction

Sensitivity analysis is a crucial part of any modelling exercise as a way of testing the validity of results of numerical model simulations. In economic modelling, as well as other model based sciences, it is recognised that there are uncertainties and assumptions which may affect the output of a model. Therefore model inferences should be subjected to organised sensitivity analyses to assess their robustness (Leamer, 1985). A sensitivity analysis is the study of how variations in model results can be attributed to different sources of variation in model input parameters and/or the model structure (Hermeling & Mennel, 2008; Walker & Fox-Rushby, 2001).

In CGE modelling, it is paramount to test the sensitivity of results to assumptions made, for example, with regard to behavioural parameters and the choice of parameter values, as well as model closures. In CGE models, results are usually interpreted in reference to benchmark equilibrium such that a sensitivity analysis explores the extent to which the chosen parameter values lead to a stable equilibrium for selected economic variables such as GDP. The choice of parameters and model closure rules to be tested is dependent upon the context of and relevancy to the study question. However, if the model does not generate an equilibrium solution for parameter values close to the ones chosen as benchmark values, the model results are unstable and are deemed worthless (Hermeling & Mennel, 2008).

In this study, therefore, sensitivity analysis is conducted for selected parameter values and macroeconomic closure rules that are justified for the context of analysis. The stability of initial results is tested and the focus is on the outcomes for macroeconomic variables. The rest of the chapter is organised as follows. Section 9.2 presents the sensitivity analysis to parameter values, Section 9.3 the model closure rules variations and Section 9.4 summarises and concludes the chapter.

9.2 Sensitivity analysis of model parameters

Sensitivity analyses are performed for production elasticity and health effect parameters relating to growth rates for total factor productivity, labour productivity and labour supply. The production elasticities are selected for sensitivity analysis because they are important in determining the sectoral outputs, as the intermediate level outcome variable of interest from the CGE model. The sectoral output analysis underlies the aggregate impacts reported at the macro level. The health effects parameters, on the other hand, are selected for variation because of the need to affirm the plausibility of the claims made in the health and economic growth literature that health and economic growth are positively correlated. In the absence of reliable data on the actual values of the health effect parameters from Uganda, it is necessary to present an argument for a worst case scenario as well as a best case scenario for the impact of additional healthcare expenditure on effective labour supplies and total factor productivity. It is important to project the health effects for a range of values to confirm that model results reflecting the values used to generate the counterfactual equilibrium are not accidental but rather are a reflection of a real connection between healthcare and the rest of the economy.

For the production elasticity parameter variation, values for variation consist of a 50% decrease and 100% increase from the initial values of the benchmark equilibrium. On the other hand, the health effect parameter values are increased systematically taking into account values used in the initial, baseline and the counterfactual simulations.

9.2.1 Production elasticity

The sensitivity analysis here pertains to the value-added technology in the production nest and the factor aggregation and output production, premised on the constant elasticity of substitution (CES) technology. It does not include the parameters for the intermediate inputs aggregation, assumed to follow the Leontief technology. A Leontief technology for intermediates implies that the fixed proportions are determined in the Ugandan SAM. Changing the fixed proportions would require changing the structure of the SAM and reconstructing it anew, a task not undertaken in this study.

Results in Table 9.1 indicate that varying the production elasticity does not significantly change the growth rates in the macro- economic variables for all scenarios. It is also observed that when there is growth in labour supply and labour productivity, the economy will be constrained to expand if the elasticity of substitution between factors falls below the benchmark elasticity value. This is observed from the relatively smaller GDP growth generated when the benchmark elasticity value is halved. Similarly, given growth in the same health effect parameters, doubling the benchmark elasticity value generates a relatively smaller GDP growth. This means that if factors can be substituted relatively easily, hiring them could pose a problem to the extent that GDP growth will slow down.

Table 9.1 Variation in production elasticity and growth in macroeconomic variables relative to the initial year (%)

	Lower bound elasticity value (0.35)					Bench mark elasticity value (0.7)					Upper bound elasticity value (1.4)				
	GDP	Pr Cons	Inv	Exp	Imp	GDP	Pr Cons	Inv	Exp	Imp	GDP	Pr Cons	Inv	Exp	Imp
PSIM1	123.7	107.3	1.2	166.9	96.7	123.8	107.4	1.3	167.3	96.8	123.9	107.4	1.3	167.3	96.8
PSIM2	140.8	123.6	2.1	194.9	110.7	162.9	144.8	2.6	234.7	130.6	141.3	124.2	1.9	194.6	110.5
PSIM3	131.6	114.9	1.9	185.4	105.9	136.2	119.3	1.7	197.2	111.8	132.2	115.4	1.7	184.3	105.3
PSIM4	174.3	155.8	2.6	263.1	144.8	165.8	147.6	2.4	252.9	139.7	174.6	156.1	2.6	261.4	144.0
PSIM5	207.4	187.5	3.8	315.8	171.2	207.5	187.6	3.6	315.0	170.7	200.1	180.5	3.3	303.3	164.9
PSIM6	119.8	103.5	2.2	178.9	102.7	119.9	103.6	2.3	179.1	102.8	120.0	103.7	2.3	179.0	102.7
PSIM7	142.8	125.6	3.2	216.6	121.5	165.4	147.2	3.8	258.5	142.5	143.4	126.1	3.0	216.6	121.5
PSIM8	127.8	111.1	2.8	197.1	111.8	132.3	115.5	2.8	210.3	118.4	128.3	111.6	2.7	196.2	111.3
PSIM9	170.1	151.8	3.8	279.4	152.9	161.8	143.8	3.6	269.0	147.7	170.7	152.3	3.8	277.6	152.0
PSIM10	201.8	177.1	4.3	337.1	168.7	210.9	191.0	5.0	343.5	185.0	203.5	183.8	4.7	331.9	179.2
PSIM11	123.4	111.3	1.7	160.3	104.8	123.4	111.4	1.8	160.4	104.8	123.4	111.4	1.9	160.2	104.7
PSIM12	146.6	133.7	2.8	197.2	123.3	169.7	155.8	3.3	238.1	143.7	147.3	134.3	2.6	197.0	123.1
PSIM13	131.4	119.0	2.4	178.5	113.9	136.0	123.5	2.3	191.2	120.2	131.8	119.5	2.2	177.2	113.2
PSIM14	174.6	160.5	3.2	258.5	153.9	166.0	152.3	2.9	248.2	148.7	175.0	160.9	3.1	256.2	152.8
PSIM15	215.9	200.1	4.5	321.8	185.6	216.1	200.3	4.3	321.1	185.2	200.7	185.5	3.9	298.0	173.7

Prv cons = Private Consumption, Inv = Investment, Exp = Exports, Imp = Imports

9.2.2 Health effect parameters

The magnitude of individual mechanisms of the health effects in the model is, to a large extent already portrayed in the simulation results of Chapter 7. The initial path without health effects (SIM1) implies zero growth in the health effect parameters. The health effect parameter values are gradually increased to the baseline growth values and then to the proposed budget share values in the three scenarios. In this section, a further variation of the health effect parameters is considered by simulating an additional increase in the growth rate values, beyond what is already considered. The aim of the additional simulation is to establish whether there is a point beyond which the GDP growth rate will start to decline compared to the growth rate achieved with the benchmark parameter values. If GDP growth starts to decline, it serves to underscore the fact that health effect parameters cannot be increased infinitely under the current assumptions of the model. The additional simulations are performed for the prioritisation scenario and the results for all the variations under the prioritisation scenario are presented in Table 9.2. The results illustrate the impact in varying the health effect parameters with the progression from zero growth in labour supply, labour productivity and total factor productivity to the baseline growth values as the lower bound, and the additional simulation values as the upper bound.

Table 9.2 Variation in health effect parameters and growth in macroeconomic variables relative to the initial year (%)

	Growth rate	GDP	Private Consumption	Investment	Exports	Imports
Labour supply	0.0%	104.6	90.7	-2.1	104.7	65.5
	5.0%	123.8	107.4	1.3	167.3	96.8
	7.0%	162.9	144.8	2.6	234.7	130.6
	8.0%	159.1	143.0	2.7	227.9	127.2
Labour productivity	0.0%	104.6	90.7	-2.1	104.7	65.5
	0.5%	123.8	107.4	1.3	167.3	96.8
	1.5%	136.2	119.3	1.7	197.2	111.8
	2.5%	139.8	124.5	2.4	206.4	116.4
Total factor productivity	0.0%	104.6	90.7	-2.1	104.7	65.5
	0.5%	123.8	107.4	1.3	167.3	96.8
	2.0%	165.8	147.6	2.4	252.9	139.7
	3.5%	138.9	123.6	2.0	200.9	113.7

9.2.2.1 Total factor productivity growth

Total factor productivity (TFP) has a large effect on the model results and yet assumptions about the extent of healthcare impact on total factor productivity improvement can be questionable, as observed from the diverse literature in the scenario design Chapter 6. Therefore, the model is run for identical simulations in the prioritisation scenario but with total factor productivity growth varied above and below the benchmark equilibrium values, as indicated in Table 9.2. Under these alternative assumptions the GDP growth is relatively smaller compared to that for the benchmark parameter value. While the benchmark TFP growth value generates a 165.8% growth in GDP, the lower bound value generates 123.8% growth while the upper bound value generates 138.9%. The trend is similar for the rest of the macroeconomic variables. This suggests that, while lower TFP growth rates may not generate faster economic growth rates, increasing total factor productivity while labour supply and labour productivity are at baseline levels may actually curtail the pace of economic growth. Overall, the TFP sensitivity results confirm that increased healthcare spending has a positive impact on the economy's growth and development strategy even under less stringent assumptions for health impact on TFP.

9.2.2.2 Labour supply growth

Labour supply assumptions in the model are more robust when compared to TFP, because they are based on more reliable projections and based on the demographic projections of the country. Nevertheless, there is need to demonstrate the reliability of the estimates used in this model since they are premised on increased healthcare expenditure. As is the case for TFP results, the impacts on macroeconomic variables indicate growth rates that increase symmetrically when the annual labour supply growth rate increases up to the benchmark growth value, as shown in Table 9.2. At the upper bound of the labour supply growth rate, GDP growth is smaller when compared to what is achieved with the benchmark growth rate value. However, the rate of growth in investment continues to rise even at higher levels of labour supply growth. The results from the labour supply growth rate variation confirm that increasing healthcare expenditure which increases the quantity of labour supply in the economy has positive outcomes for growth and welfare improvement.

9.2.2.3 Labour productivity growth

Varying the labour productivity growth rates indicates a positive and continuous growth in all macroeconomic variables. The growth in the macroeconomic variables is higher for the benchmark labour productivity growth values compared to the lower bound growth values. Similarly higher growth is achieved at the upper bound labour productivity growth values when compared to what is achieved with the benchmark growth values. This suggests further increases in labour productivity growth are beneficial to the economy.

9.3 Sensitivity analysis of model closure rules

The model closure rule of interest pertains to the equilibrium conditions in the factor market. Firstly, it is necessary to understand why the other model closure rules are not varied in this study. The government balance closure is not randomly changed for sensitivity analysis. This is because the selected closure in the benchmark equilibrium is what is required to achieve the objectives set out in the study. It must conform to the policy simulations performed specifically to achieve the desired health expenditure goal given the workings of the Ugandan economy. The fiscal balance is a flexible residual.

The external balance is not explored in this sensitivity analysis because the alternative closure does not reflect the reality of the workings of the Ugandan economy. The foreign market closure in the benchmark equilibrium allowed for fixed foreign savings and flexible exchange rate which adjusts to balance the trade account. The alternative external balance closure provides for flexible foreign savings under a fixed exchange rate. The alternative closure does not mirror the foreign exchange market situation in Uganda. The exchange rate policy in Uganda provides for a flexible and market determined exchange rate regime[75]. Moreover, the fixed foreign savings closure is necessary for specifying the aid for health simulation which proposes an increase in foreign savings inflow. The assumption of flexible foreign savings does not allow for simulations where the rate of foreign savings inflow would be exogenously determined.

9.3.1 Factor market closures

Factor market closures determine the mechanisms that equilibrate the demand and supply of factors. In the benchmark equilibrium, all labour was assumed to be fully employed and mobile across sectors. Under this assumption, the quantity of each labour category supplied is fixed and the economy-wide wage rate varies to equate the supply to demand for labour. Capital, on the other hand, was assumed to be fixed and earning a sector-specific wage that is variable. These assumptions are plausible in Uganda's case, particularly for the case of skilled labour which is in short supply. It is, therefore, reasonable to assume (skilled) labour is fully employed and mobile across sectors (although for other factors unemployment is possible). A sensitivity analysis is proposed for an alternative factor market closure which assumes factors are fully employed and sector specific. This is a plausible assumption to explore on the ground that some healthcare inputs, such as doctors and nurses, are a unique

[75] Occasionally the central bank intervenes, to sell in a phased manner, some of the foreign exchange that government receives from donors in form of budget support, in accordance with the monetary policy operation procedures (Ego & Sebudde, 2003; Katarikawe, 2001).

labour category and specific to the health sector. Some capital equipment may also be specific to the healthcare sector. This assumption limits factor movements between the healthcare sector and other sectors and eventually creates an upward pressure on specific factor remunerations.

Under the alternative factor market specification, the current set up of the Ugandan model did not find a feasible solution. A possible explanation for the model failure to solve is that as the healthcare sector is expanding, the model could not find enough healthcare-specific labour in the economy to meet the required health sector demand. The solution would be to specify the model so that healthcare-specific labour can be imported to meet the required demand. This option is not explored in the present study but it is future work to be done when assessing the impact of a government policy that aims to attract foreign healthcare workers to Uganda.

9.4 Summary

The chapter discusses the variability of model results with respect to changes in some critical model parameters and model closures. Overall, the importance of isolating the individual health effect mechanisms in the sensitivity analysis highlights the magnitude of the contribution of health effects and the critical need to include them in policy analysis. The healthcare effects parameters: labour supply, labour productivity and total factor productivity growth were found to significantly influence the results. Varying the parameter values for the health effects has shown that even small values for growth in the health effects parameters will lead to positive outcomes. This implies that modest improvement in the population health will generate positive outcomes in the economy. It is generally feasible to improve the economic growth and people's living standards by raising the health sector budget share and expand healthcare service delivery in Uganda. There is a need, however, to estimate the extent to which an increase in public healthcare expenditure can lead to changes in labour participation rates, labour productivity and total productivity in Uganda, so as to have more accurate results. The sensitivity of the health effects parameters implies that results cannot be generalised. However, countries with similar settings like Uganda can draw lessons from these findings.

CHAPTER 10: CONCLUSION AND RECOMMENDATIONS

10.1. Introduction

There has been widespread health sector reform across the spectrum of high to low income countries. The recognition, that changes in the health sector have direct effects on the economy (and indirect effects through health), has gradually spread through the policy arena. The direct health sector reform impacts have been widely studied in the classic partial equilibrium analysis, whereas the wider macro-economic impacts have scarcely been studied outside of developed countries. Even within developed countries, the general equilibrium context of health and healthcare studies has concentrated on evaluating the economy-wide impacts of a disease outbreak. This thesis has provided a general equilibrium approach to better capture the impact of changes in the healthcare sector financing policies to the rest of the economy, taking Uganda as a case study.

The approach, adopted in this study, employs a dynamic computable general equilibrium modelling technique to predict the economy-wide impact of healthcare financing policies. The model is calibrated to a purposefully updated social accounting matrix for Uganda with the health sector disaggregated into private healthcare, government primary healthcare and government other-healthcare. The CGE model is linked to a Uganda household micro-simulation model to analyse the policy impact on poverty rates in Uganda. The study results are reported in the form of healthcare financing policy impacts on: the structure of the economy (wages, factor substitution, sector composition, and exchange rate adjustments);

macroeconomic variables (GDP, private consumption, investment, imports and exports); and welfare effects measured by poverty reduction rates. The updated health-focussed SAM and the reported healthcare financing policy impacts constitute the main contributions of the thesis. The remainder of this chapter presents a summary of the main findings in Section 10.2, the policy recommendations in Section 10.3, and study limitations and direction for future research in Section 10.4.

10.2 Summary of main findings

The theoretical simple general equilibrium model of production presented in Chapter 2 was extended to health and healthcare to demonstrate the impact of expanding the skill intensive non-tradable health sector on the output of the tradable sectors. As the health sector expands, it draws labour from the tradable sectors whose output may decrease depending on the relative intensity in the use of the different labour skills compared to the health sector – the factor-bias-effect. However, since the expanding health sector output is used to treat people so that they can participate effectively in the production process, then an expansion of the health sector output translates into growth in the availability of effective labour. The growth in effective labour supplies means more labour available to all sectors in the economy. Consequently, the overall economy output will increase – the scale-effect. Therefore, given fixed factor endowments, the output of other sectors will increase or decrease depending on the magnitude of the factor-bias effect and the scale-effect of the health sector expansion. If the factor-bias effect dominates then overall output in the economy will decline following an expansion of the health sector. On the other hand, if the scale-effect dominates, the health sector expansion will lead to growth in economy-wide output. For the scale-effects of expanding the health sector, the change in effective labour supplies will depend on the effectiveness of the health sector output in treating and curing the sick and unable to work. Overall the theoretical derivations for the impacts of expanding the non-tradable health sector on the rest of the sectors' outputs were found to be intuitively comparable to the empirical results presented and discussed in Chapter 7.

From the survey of the literature in Chapter 3, the emerging consensus was that it is important and necessary for economic studies evaluating health and health care to consider a general equilibrium analytical framework. This is necessary in order to account for effects outside of the health sector that occur indirectly, due to linkages of this important sector with the rest of the economy. It is quite clear that economic studies of a partial equilibrium nature are inadequate to guide policy on matters of economic impacts of health and healthcare. Furthermore, the surveyed literature revealed research gaps in the application of the CGE modelling approach to evaluating health and healthcare in the following respects. First, the economy wide impacts of healthcare policy reforms have not been adequately investigated outside of the developed countries. The few studies that can be traced to developing countries have studied the impact of a disease. Second, the developed country studies evaluating healthcare policy impacts employ static models which do not account for lagged effects of health and healthcare. Third, the dynamic models such as those evaluating the impact of HIV/AIDS in Africa; are highly aggregated and in some instances they do not report comparatives of different policy shocks. The identified research gaps were addressed by developing a recursive dynamic CGE model for Uganda calibrated from a disaggregated health sector-focussed social accounting matrix, to assess the economy-wide impacts of healthcare financing reforms.

The model employed in this study was contextualised to the Ugandan case study in Chapter 4. The linking of the CGE model with the household micro simulation revealed the importance of adapting the macro-micro models for poverty analysis. This is specifically useful to capture a relatively more accurate transmission effect of a policy change, since price and income changes in the CGE are linked directly to the individual households in the household survey through the micro simulation module. The same household survey underlies the household grouping in the social accounting matrix.

The updating of the Uganda SAM and the disaggregation of the health sector into three new accounts - non-government healthcare, government primary healthcare, and government other-healthcare - the novelty of this study, were presented in Chapter 5. The disaggregation of the health sector by type and level of care provided important insight into the input requirements for the production of healthcare in Uganda. The revelations are an important consideration for the policy makers, particularly as they seek to improve the healthcare function for the benefit of the entire country. The disaggregated SAM shares indicated that medical supplies form the largest healthcare input for all types and levels of care. Additionally, education as an intermediate healthcare input was relatively more important to the private healthcare production when compared to the government healthcare production. This revelation has implications for the cost of training healthcare workers and the eventual end user cost of training health workers. A high cost of training health workers is potentially an obstacle to achieving a critical mass of health workers in Uganda. This further hinders the equitable access and utilisation of healthcare services, particularly in the hard-to-reach rural areas of the country. Given this result and its implications, the government should undertake to repossess the health worker education component from the previously privatised higher education.

The factor inputs requirement for healthcare production is varied by type and level of care. Skilled labour is employed more intensively relative to unskilled labour, for all types and levels of care. However, the government other-healthcare production was found to be relatively capital intensive, requiring less than 25% of the total factor inputs as labour. On the contrary, the public primary healthcare production is more people oriented, requiring nearly 60% of the total factor inputs as labour. The high share of the labour factor in the production of public primary healthcare has implications for the government wage bill as the government seeks to expand healthcare services delivery. But more critical for the high share of the labour factor, is the shortage of health workers in Uganda as revealed in Chapter 1. The high density of the population per health worker is evidence that the need is surpassed far beyond the acceptable standard of the health worker to population ratio. Therefore, if the government is to improve the healthcare services delivery at the primary care level, it must invest in the training and retaining of health workers. Healthcare worker retention entails improving the working conditions of the health workers so that they deliver services effectively. It is therefore, recommended that the health sector budget, as a share of the general government budget, be increased to facilitate healthcare investment, particularly to meet the critical need of healthcare worker availability.

A major objective of this study was to design healthcare financing reform policy scenarios, to mirror three sources of fiscal space for health and incorporate the envisaged health effects of the proposed policies. The baseline scenario was designed to reflect the working of the economy in a business-as-usual style. The scenario design suggested a gradual increase in the health expenditure as a share of the general government expenditure to attain a 15% share by 2020. The prioritisation scenario was designed to reflect an increase in the health sector budget share in general government expenditure, given a fixed government budget. The scenario aimed to project a reduction of resources available to the rest of the government functions when the health budget share increases. The tax scenario aimed to increase the health sector budget share and raise revenue, for the additional healthcare funding, from households. The aid scenario was designed to increase external resource inflows to finance the additional healthcare expenditure. The proposed healthcare financing policies were assumed to generate improvements in the population health. The improved health status was captured in the form of growth in labour supply, labour productivity and total factor productivity. The designed scenarios were implemented in the dynamic CGE model and the main findings presented in Chapter 7, for the macroeconomic impact and Chapter 8 for the poverty impact.

The empirical chapters constitute the contributions of this study. The sectoral output analysis showed that the proposed health sector budget share with health effects would lead to higher growth in all sectors relative to the baseline. The agriculture and industry sectors increasingly contribute to the annual GDP growth rate under all the scenarios while the services contribution to GDP growth rate declines under the prioritization scenario. Since all sectors are seen to expand, the total factor demands by sectors also increases, even when the price for the factors is increasing in the same period (the exception being that of the skilled labour wages which decline relative to the base when new health is assumed to affect growth in labour supply). Since factors are hired in big numbers even when the cost of hiring them is higher than the baseline, it suggests that production in all sectors is profitable and the returns are high enough to offset the costs. A study that modelled the impact of future government revenues in Uganda also found that increased government expenditure with productivity spill overs would lead to higher growth rates in sectoral outputs (Wiebelt, Pauw, Matovu, Twimukye, & Benson, 2011). Therefore, since it is evident that growth in productivity enhances sector output growth in Uganda, it is advisable that the government increases the health sector budget share so as to promote growth in labour productivity and total factor productivity. Consequently, the dominating scale-effects of the health sector expansion will cause growth in the economy-wide output.

The results for the macroeconomic variables indicated that an increase in healthcare budget share and the envisaged health effects accruing from the increased healthcare expenditure lead to higher rates of growth in GDP, private consumption, investment, exports and imports. GDP growth rates are predictably higher under the proposed budget share with health effects. The additional benefit in the GDP growth is largely attributed to the improvements in the health status of the population, which lead to overall growth in economy wide labour supply, labour productivity, as well as growth in total factor productivity. In a Ugandan study that modelled the impact of investing in metropolitan Kampala, it was shown that a 1.5% annual growth in total factor productivity for non-agricultural sectors raises Kampala's GDP growth rate from 10.4% to 12.7% per year (Dorosh & Thurlow, 2009). Given that Kampala is a quarter of the Ugandan economy, this raises national GDP growth by an additional 0.7%.

This study further confirms that growth in productivity causes higher growth rates in the economy of Uganda.

The increased foreign savings inflows to fund public expenditure on health leads to an appreciation of the exchange rate making imports dearer to the domestic consumer. The lower import commodity prices translate into a gain in the consumers' welfare, particularly, the urban households whose share of imports in total consumption is relatively higher. It is argued that the appreciation of the exchange rate could potentially hurt the export sector as Uganda exports become less competitive on the world market. Income earned from exports is potentially less, implying that those engaged in the export sector production could suffer losses. This would further imply that domestic producers allocate a larger share of their output to the domestic market. This trend of events is observed in a modelling exercise based on the 1999 Uganda social accounting matrix, where a 20% increase in foreign savings inflow leads to a 3% appreciation in the exchange rate, higher sales of domestic output, a 1.6% increase in imports and a 3.7% decline in exports (Dorosh, El-Said, & Lofgren, 2002).

The model results from this study however, indicate that increased foreign savings inflow with health effects incorporated in the analysis, leads to an overall increase in the growth rate of exports and the share of export value in GDP, when compared to the baseline. Under the aid scenario, the exchange rate depreciates by 6.6% when health is assumed to increase labour productivity growth and by 7.4% when it is assumed to increase total factor productivity growth. Although growth in labour supply leads to an appreciation in the exchange rate, the results suggest that the benefits from the public healthcare investments –

labour productivity and total factor productivity- spill over to the non-health sectors, including the export sector, and dampen the adverse effects of an appreciating exchange rate. The health effects lead to higher growth rates in the export output, rising to levels that mitigate the adverse effects of an appreciating exchange rate. The overall effect is that of increased share of export value in GDP. The conclusion from these results on the macroeconomic impacts is that a healthy population is critical for a sustained labour force supply to, and increased factor productivity in the economy. Therefore, the government should increase healthcare expenditure to both improve population health status and economic growth.

The poverty impact results indicate that the proposed healthcare expenditure with health effects causes poverty to decline compared to the baseline scenario. Growth in labour supply, labour productivity and total factor productivity lead to expansion and growth in all sectors of the economy. The expanding sectors inevitably hire more factors of production, which translates to higher incomes for households hence the reduction in poverty. For instance, growth in agricultural labour productivity means that farming households have higher output using the same quantity of labour input. The higher output per unit of labour input means that subsistence households have more for home consumption and a larger excess for the market. This translates to welfare improvements and higher poverty reduction rates, particularly among farming households as indicated in the results. The accelerated growth in agriculture benefits urban farming nearly as much as rural farming households, as observed in the poverty impact results. Since poverty is initially higher among rural farming households, the poverty incidence is reduced by an additional 0.3% for rural farming households when compared to urban farming households' poverty reduction.

The poverty module involved recalculating the per capita household expenditure after the policy shock. The new household consumption expenditure was then compared with the official poverty line, derived from the household survey underlying the construction of the SAM. The poverty impact result reflects the widely held expectation in Uganda (and other developing countries) that in order to improve the standard of living for rural inhabitants, investment should focus on the main source of their livelihood (which is agriculture in Uganda's case). Therefore, since the majority of rural inhabitants are self-employed in the agricultural sector, healthcare investment that improves factor productivity as well as higher returns to factors, directly improves the incomes received by the rural households. This is because they own the factors of production (self-employed labour, unskilled labour, and land).

The results are also consistent with the findings from a study on agricultural growth and investment options for poverty reduction in Uganda (Benin, Thurlow, Diao, Kebba, & Ofwono, 2008). The study results indicate that accelerating growth in agriculture by 6% per year and the spill over effects in non-agriculture activities causes a decline in poverty by an additional 7.6% when compared to the baseline. Another study that modelled the welfare and production effects of technical change, market incentives and rural outcomes in Uganda found that a 5% increase in agricultural productivity could increase rural households' consumption expenditure by 2.1% relative to the baseline (Dorosh et al., 2002).

Therefore, since the agricultural sector is an important driver in poverty reduction and it is demonstrated that investment in healthcare impacts the agricultural sector output growth through the inter-sectoral linkages; it is recommended that the government should increases the health sector budget share. In order to accelerate poverty reduction in Uganda, there is need for integrating the health service in the poverty reduction strategies, as demonstrated in the poverty reduction and health framework paper by the World Bank (Claeson et al., 2001). Similarly, urban poverty is reduced substantially because the urban poor mainly engage in the informal (unregulated) sector, largely preoccupied with casual labour activities. Therefore, any measure that improves the health and productivity of this category of population directly impacts on their ability to increase their earnings particularly selling their labour.

The sensitivity analysis in Chapter 9 revealed that conclusions from model results are heavily influenced by the health effects parameters. Specifically, the healthcare attributes of labour supply, labour productivity and total factor productivity growth were found to significantly influence the results. Therefore, there is a great need to estimate the extent to which an increase in public healthcare expenditure can lead to changes in labour participation rates, labour productivity and total productivity in Uganda. The sensitivity of the health effects parameters implies that results cannot be generalised. However, countries with similar settings like Uganda can draw lessons from these findings. Although the sensitivity of the modelling results is a limitation on the robustness of derived conclusions, extensive empirical evidence was used to guide the assignment of values to the parameters, and the implications of such variables were explicitly reported throughout.

Overall, the impact analysis has revealed that results differ by source of fiscal space for health. The prioritisation scenario assumes the additional health expenditure is increased from a fixed government budget. This means that increasing resources to the health sector penalises the other government functions whose budget share is reduced to accommodate the proposed health budget share. The consequence is that of limited expansion in the economy when compared to the other scenarios, even when health effects are considered.

The tax scenario on the other hand, generates larger expansion of the economy because the government has relatively more income from the tax revenue, for the additional healthcare expenditure. There is a transfer of resources from one economic agent (the households) to another economic agent (the government). Since this scenario generates higher benefits to the economy, when compared to the prioritisation scenario, it implies that government expenditure does not crowd out private investment. In this instance, the government is a preferred investment agent; in as far as the resources from the households are deployed to expand the healthcare service function. The expansion of the healthcare services which promotes growth in labour supply, labour productivity and total factor productivity is beneficial to the whole economy.

The aid scenario brings resources to the economy from outside. This means that additional resources are available to the government, and to the economy as a whole. This is unlike the tax scenario, where the resources are a mere transfer from one economic agent to another. It is observed that when external resource flow increases, the economy can afford to grow modestly when health effects are excluded. This is in contrast to the observed contraction under the prioritisation and tax scenarios, when health effects are excluded.

10.3 Policy implications

The policy simulations and model results presented and discussed point to two issues. First, they affirm the notion (already existing in the literature) that good health of a population significantly contributes to human capital and economic productivity, both of which are paramount in uplifting people's standard of living in any country. Second, and most importantly, they highlight the methodological issues surrounding the analysis of health and healthcare in the policy arena. Excluding health effects from the analysis of a policy that exhibits inter-linkages between different sectors in the economy, as demonstrated by the healthcare financing policies, serves to underestimate the policy impact. Therefore, it may lead to sub-optimal policy implementation. The feasibility of the proposed scenarios for Uganda is discussed below.

The economy of Uganda has been growing steadily over the past decade, as observed from the background information in Chapter 1. A steady growth of the economy reveals the potential for the government to increase funding to the health sector. The general government health expenditure as a share of general government expenditure gradually increased, reaching a high of 12% in 2010. This suggests there is scope for re-prioritizing the health sector within the government budget and increasing the health sector budget share to 15%. Domestic revenue as a percentage of GDP has been on a steady increase and was projected to reach 15.1% in 2014/15 fiscal year (Ministry of Finance Planning and Economic Development, 2011). Growth in domestic revenue is an indication that government has a relatively "bigger cake" to distribute to its sectors. In addition, the country is in the process of finalising oil exploration, and commercial oil production is projected to begin by the end of

2017 (Ministry of Finance Planning and Economic Development, 2014). This is expected to further expand public resources from which the health sector share can be increased.

Furthermore, a greater collaboration between the ministries of health and finance could increase resource flow to the health sector because such collaboration could demystify the wrongly held notion that the health sector is an unproductive sector. African countries acknowledged, in a report on the state of health financing in Africa, that the misconception about the unproductivity of the health sector is a hindrance to increasing the budget allocation for the health sector (World Health Organisation, 2013). Involving finance ministries in planning, budgeting and reviews in the health sector; public engagement in health sector achievements and challenges; as well as developing evidence-based dialogue and position papers to show the contribution of health in overall development, are some of the suggested ways to overcome the misconception about the health sector. This thesis is one such study that will go a long way to demystify the misconceptions about the health sector being unproductive.

Although there are competing sectors for the limited resources, empirical evidence from this study has shown that increasing the health sector share in the budget is, in fact, beneficial to the whole economy. Moreover, for the same year (2010), similar countries in the region committed more money to health in terms of the government health expenditure as a share of general government expenditure – 20% for Rwanda, 16% for Zambia 14% for Tanzania and 13% for Ethiopia (World Health Organisation, 2013). Health expenditure performance in countries of similar settings is a further suggestion that Uganda is in a position to increase the health sector share in its budget.

The feasibility of the proposed health tax is underscored by the fact that Uganda's revenue base is small and therefore, efforts must be made to increase domestic revenue. The tax proposal on households is progressive, as observed from the resultant tax rates for the different households. It places a proportionately bigger burden of healthcare financing on higher income households compared to lower income households. In addition, it provides an opportunity for the government to raise tax revenue from the large informal sector, which to date remains untaxed. The observed progressivity of the proposed health tax resonates with similar findings of progressive tax on income for additional revenue to fund healthcare in South Africa and Tanzania.

In a study that modelled the affordability and distribution implications of healthcare financing options, the universal health coverage system financed from general tax revenue with additional funding from a progressive surcharge on taxable income was the most progressive healthcare financing system in South Africa (McIntyre & Ataguba, 2012). The same study found that using value-added tax (VAT) to raise the required additional revenue for the universal health coverage would result in a disproportionately higher burden of healthcare financing for the poor[76]. In Tanzania, a study that modelled the implications of moving

[76] Universal coverage was found to be the most progressive system of healthcare financing if the additional funding was raised through a proportional surcharge on taxable income (Kakwani index of 0.09) or through a progressive surcharge (Kakwani index of 0.10) but not if VAT was used to raise the additional funding (Kakwani index of 0.04). The Kakwani index, originally devised to measure progressivity of taxes, is also used in healthcare expenditure analysis such as determining equity in healthcare expenditure. In this case, the index is the difference between the Gini-coefficient for incomes and concentration index for out-of-pocket healthcare

towards a universal coverage found that imposing an income tax on segments of the informal sector would provide additional funding for healthcare in a progressive way (Borghi, Mtei, & Ally, 2012). Given the proposed tax outcomes modelled in this thesis and the results from other countries, the policy implication is that earmarked taxes for healthcare are a sufficient and sustainable source of fiscal space for health in Uganda. However, it should be noted that tax matters are largely of a political nature and the intricacies of taxing the informal sector should not be under estimated.

The aid scenario presupposes that additional external aid for healthcare would be in the form of general budget support. Such aid for health can be monitored through policy linked disbursement agreements regularly reviewed and discussed through policy dialogue meetings between donors and the government. The disbursements may not necessarily be conditional on achieving the set policy targets but can be aligned with the objectives of the health sector strategic plan. The general budget support system in Uganda was first fully implemented in 2001 and is linked to the poverty reduction strategy programme. In order to increase the share of health from the budget support, it is necessary for health sector policy makers to actively engage in the poverty reduction strategy discussions and the general budget support negotiations to ensure that the policy targets adopted at the dialogue meetings are beneficial to the health sector. The suggestion is that the Minister of Health should understand how the general budget support works and how to influence the decisions on the allocation of the resources from the pool (Antunes et al., 2010). Ghana introduced the budget support system in 2003, consequently raising the profile of social services provision with health and education having major increases in budget allocation (Overseas Development Institute

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payments. Index values range from negative two (for severe regressivity) to positive one (for strong progressivity).

(ODI), 2007). The Vietnam experience shows that even when some sectors' policy targets were reported as unmet, such as the classification of private health facilities, or delayed for the reporting period, it did not affect the level of budget support for poverty reduction (Dodd, James, & Phuong, 2010). This suggests there is commitment by donors to the budget support contract. In addition, Uganda can take lessons from other countries to maximise the effectiveness and efficiency of the budget support system in increasing resources to the health sector.

In terms of selecting the best option from the suggested healthcare financing policy scenarios, using the same model specifications, Table 10.1 provides an overview of the ranking of the policy options. The ranking serves to provide the best option to achieve the selected variable outcome, where Rank 1 is given to the policy option that achieves the highest growth rate in GDP or highest reduction in poverty, among the three options. The aid-for-health policy emerges as the most beneficial policy for improving welfare. The aid scenario generates higher growth in household consumption expenditure and leads to higher poverty reduction rates compared to the tax-for-health and prioritization of the health sector policies. Increasing foreign savings inflows targeted towards the health sector results in an increase in the availability of external resources for government expenditure, specifically in the services sector. The aid-for-health policy leads to relatively higher growth rates in labour wages particularly when there is growth in labour productivity with the proposed health budget share. Higher wages mean higher incomes for households and ultimately more people are lifted out of poverty.

Table 10.1 Ranking of key variable outcomes by policy option

Outcome variable	Proposed Policy	Policy ranking
GDP growth	Prioritisation of the health sector	3
	Tax for health	1
	Aid for health	2
Poverty reduction	Prioritisation of the health sector	3
	Tax for health	2
	Aid for health	1

The aid scenario predicts GDP growth rates that are lower than the growth rates observed under the tax scenario. Although not explicit in the model, the relatively lower GDP growth rates under the aid scenario points to structural bottlenecks that exist in the country. This suggests that continuous additional foreign aid inflow channelled to a service sector becomes less effective without commensurate expansion in enabling economy-wide infrastructure networks. It is important to bear in mind that while investing in health is crucial, it is also important to invest in infrastructure networks so that producers and consumers are better integrated into national and international markets, thus expanding opportunities and accelerating growth.

Although aid-for-health is projected as a good source of fiscal space for health in Uganda, in terms of improving welfare, there is a challenge of sustainability of aid inflows. As the rich countries grapple with financial crises and eventual recession, there is a growing worry as to whether these countries can continue to meet their foreign aid commitments while making major domestic budget cuts. Moreover, foreign aid sustainability in the recipient countries has also been criticised for trapping developing countries in a vicious cycle of “aid dependency” and leaving countries in need of more aid as opposed to being “weaned off aid” (Moyo, 2009). Therefore, it is imperative that consideration be made of the policy options that propose creating fiscal space for health premised on domestic resources mobilisation.

Relatedly, the aid scenario assumed no fungibility of aid in Uganda. The model works on the assumption that the health sector share in the aggregate government expenditure from general taxation would be maintained and the increased aid in flow would be in addition to the government share. However, given that in some countries aid has been found to be fungible, the expected results could be different if aid was fungible in the case of Uganda. The government could choose to divert the earmarked aid for health to other sectors deemed to be more productive, especially if the policy makers are not convinced that the health sector is not unproductive. Alternatively, the government could choose to reduce its health sector financing component from the general taxation revenue, on the grounds that the health sector is, after all, receiving earmarked aid for its expenditures. In both cases, the original purpose of earmarking the health aid would not be achieved and it is likely that the targeted health sector budget share would not be attained during the model period.

On the other hand, the tax scenario performs better at GDP growth rates compared to the aid and prioritisation scenarios. The tax scenario performs best at expanding the construction sector, as observed from the predicted levels of growth in total factor demand by sectors and sector GDP value for the construction sector. The development of enabling infrastructure networks, such as roads and energy, is crucial to harness the productivity gains produced by the improvement in population health. The need for a supporting framework for development is affirmed in a study that demonstrated how public investments, that aim to raise productivity in specific sectors in the economy can have growth and poverty reduction implications for Uganda (Wiebelt et al., 2011). Comparing the tax scenario with the prioritisation scenario, for sources of fiscal space for health modelled in this study, the option to levy a tax on households earmarked for health performs better at welfare improvements and GDP growth compared to a policy prioritising the health sector. The Kampala non-farming and urban households are seen to be hit hard by the health tax, such that growth in their consumption expenditure is much lower compared to other household categories. This less desirable outcome for the Kampala households is overshadowed by the relatively larger magnitudes in poverty reduction rates at the national level, under the earmarked health tax policy when compared to the prioritisation policy. The health tax is seen to be progressive in that the richest Kampala non-farming households pay a proportionately higher tax compared to the lower income households.

Furthermore, the earmarked tax policy is beneficial because it proposes a progressive tax on all households which are eligible for taxation, as per the 2007 Uganda social accounting matrix. The government recognises the need to expand the tax base in Uganda but government proposals, such as a tax on land and a tax on agriculture, have been met with a lot of criticism and resistance forcing government to shelve the ideas. It should be noted that the existence of a large informal sector in Uganda complicates the ability to collect direct taxes as most of the individuals and businesses involved in informal sector activities are not registered and if they were registered, they do not keep records.

While it may be argued that informal sector activities are usually a reserve for poor households, in Uganda there is a relatively large proportion of households operating informal businesses and are not taxed. It is not uncommon to find that a teacher who earns a salary of Uganda shillings four hundred thousand (400,000=) per month, is taxed at source while a sole proprietor with an informal sector business making a profit of Uganda shillings one million (1,000,000=) per month goes untaxed, or at best pays a presumptive tax, which is not progressive. Overall, an earmarked tax for health levied on household income is likely to be appealing to the citizens of Uganda for the reasons and advantages explained earlier in Chapter 6.

The proposed health tax may have connotations with the abolished graduated-tax (G-Tax) which was levied on the majority of adult Ugandans, and was a major source of revenue for rural and town councils. A study on rural taxation in Uganda and the implications for growth, shows that by 2003, the G-Tax bands in the government personal income had been greatly simplified to a progressive schedule and despite the politicization of the tax it did not pose a significant burden on households, rich or poor (Bahiigwa, Ellis, Fjeldstad, & Iversen, 2004). The authors argued that the graduated tax was a form of bringing into the system income that was not covered by the pay-as-you-earn tax that is deducted at source and therefore, mainly in the formal sector. Given the politicisation of taxes in Uganda, it is highly desirable that a positive relationship between taxation and service delivery is explicitly established.

10.4 Limitations and directions for future research

The limitations of this research and recommendations for improvement are grouped into to three key areas: the model structure (specification) and its application to address policies specific to health and healthcare; the data for populating the model; and alternative and/or additional healthcare policy design.

10.4.1 Model structure

The first key area of limitations is associated with the model structure and suggestions for further research are in two aspects. First, the model could be extended to include intertemporal dynamics, and ultimately, to the overlapping generations (OLG) model. The recursive dynamic model used in this study typically involves solving a static model, one period at a time. Specifically, the model solves after a shock and then uses the values for the current period as initial variable values for the next period, and then solves again, and so on. In this type of model, producers and consumers are assumed to be myopic. As such, producers maximize profit and consumers maximize utility only for the current period while they assume the currently prevailing economic conditions will persist for all future periods. This type of dynamic model also assumes adaptive expectations behaviour for economic agents[77]. The recursive dynamic features of the model, for instance, presuppose that the

[77] Adaptive expectations may be defined as ….”the way of forming expectations in which the future value of the variable of interest is solely dependent on its past values”(Mlambo, 2012). Thus, taking price as the variable of interest for instance, $P_t^e = P_{t-1}^e + \delta(P_t - P_{t-1}^e)$ where P_t is actual current price, P_t^e is the future expected price (price expectations) held in the current period (t) and δ is the coefficient of revision of expectations (or just coefficient of expectations) which is assumed to lie between 0 and1. From this equation, it means that the expected value is a sum of the immediate past expectation and the weighted expectation error. The formulation

investment decision is solely dependent on adaptive expectations, ignoring the possibility of future expectations in influencing the current capital allocation decision.

These assumptions about the behaviour of economic agents are a limitation that curtails the reliability of policy guidance from a recursive dynamic model, particularly, when the model horizon spans over years, as is the case with health and healthcare CGE models. Such models are dynamic in nature, as they aim to capture the lagged effects of health and healthcare policies. This shortcoming of the behaviour of economic agents in the model could be overcome by applying a dynamic CGE that is inter-temporal.

10.4.1.1 Intertemporal CGE models

Inter-temporal dynamic CGE models assume that producers and consumers have rational expectations, which means that they make decisions in the current period with anticipation and taking into account prices and income in all time periods. The inter-temporal dynamic CGE model solves for prices and quantities in all time periods, a feature that distinguishes it from the recursive dynamic CGE.

The theoretical foundation of intertemporal models is built on early presentations that sought to characterise the dynamic behaviour of the optimal growth model with adjustment costs (Abel & Blanchard, 1983). In these models, consumption decisions are made by

demonstrates that new expectations are formed by using current observed expectation errors to revise previous expectations. The implication of adaptive expectation is that if there was perfect foresight (i.e. zero expectation error) in the previous period's forecast of a variable value (e.g. price), the previous forecast would be maintained throughout the period of interest until there are exogenous factors affecting actual variable value (in the example above, the actual price).

intertemporal optimising households, and savings and investments decisions are separated. The firms' investment decision depends on adjustment costs and the tax-adjusted Tobin's q (Tobin, 1969). Early application of the forward-looking agent behaviour models focussed on analysing the effects of trade shocks in national economies (Devarajan & Go, 1998; Go, 1994). More recently, they have been applied to multiregional trade policy analysis (Diao & Somwaru, 2000; Lecca, McGregor, & Swales, 2013) as well as analysing the impact of fiscal policy in South Africa (Mabugu, Robichaud, Maisonnave, & Chitiga, 2013). To illustrate some of the salient features that distinguish an intertemporal dynamic model from a recursive dynamic, an overview of how decisions are made by households and firms in a forward-looking model, is presented and discussed in relation to the myopic-agent recursive model used in this study[78].

Households and consumption/savings

Households optimise utility across all time periods to maximize lifetime welfare over a life time budget constraint. Households are assumed to "exhibit perfect foresight". This implies that they can see changes in future prices and adjust their behaviour accordingly. A consumer maximizes his discounted utility of the temporal sequence of aggregate consumption as follows: $maxU_0 = \sum_{t=0}^{\infty}\left(\frac{1}{1+\rho}\right)^{t+1}\frac{1}{1-v}(C_t)^{1-v}$ subject to the following budget constraint: $W_t = Y_t + r_t^c W_t - PC_t C_t$ where C_t is aggregate consumption at time t, v is constant elasticity of marginal utility and ρ is constant rate of time preference, PC_t is price of aggregate consumption, Y_t is flow of current income and savings are in the form of W_t, the interest earned on existing wealth $r_t^c W_t$, and r^c is the interest rate facing the consumers.

[78] This presentation here mainly follows that in Go (1994) and Devarajan and Go (1998) where detailed specifications can be found.

By solving the optimization problem, the representative household determines the optimal paths for consumption expenditures. The forward change of consumption between two adjacent periods is derived as follows: $\frac{C_{t+1}}{C_t} = \left(\frac{PC_{t+1}(1+\rho)}{PC_t(1+r_{t+1}^c)}\right)^{-\frac{1}{v}}$. The household's consumption optimal solution shows that, for an inter-temporal problem formulated in discrete time, the forward change in consumption between two periods is a function of relative prices of the two periods, the rate of time preference and the demand discount rate r_t^c by which current consumption is transformed into future consumption. The intertemporal demand discount rate $r^c$is determined by the opportunity cost of savings.

A larger demand discount rate implies future consumption is cheaper and therefore future consumption will increase. The demand discount rate is affected by the world interest rate and a change in exchange rate that affects the consumer. If, for example, the healthcare financing policies modelled in this study impact the exchange rate, the effect on growth in consumption will be transmitted through the discount rate for consumption. These transmission effects are not captured in the recursive dynamic model where the consumption decision is dependent on current prices (See Section 4.3.9.2). The recursive dynamic model assumed that aggregate commodity consumption increases by the population growth factor which raises the household consumption minima for each household. The minimum household consumption is dependent on current commodity prices. The specification of the forward-looking intertemporal model implies that in some periods households may consume more than they earn (dis-save), while in other periods they may consume less than they earn (save).

Firms and Investment

The dynamic decision problem of the firm is to choose a time path of investment that maximises the value of the firm V_t, defined as the present value of net income: $\max V_0 = \sum_{t=0}^{\infty} \mu\,(t) R(t)$ subject to the familiar capital accumulation equation $K_{t+1} - K_t = I_t - \delta K_t$, where $R(t)$ is gross profit less investment expenditures, $\mu(t)$ is discount factor, $K_t$is capital stock, I_t is investment. Investment expenditures are a function of the replacement cost of capital PK_t, investment tax credits tc_t and adjustments costs $\theta(x_t)$ where $x_t = \frac{I_t}{K_t}$ – the adjustment costs are an increasing function of the investment to capital ratio: $\theta(x_t) = \left(\frac{\beta}{2}\right)\frac{(x_t-\alpha)^2}{x_t}$ where α and β are parameters of a quadratic function. Consequently, the adjustments cost is treated as external to the firm which implies that production does not adjust instantaneously to price changes and that desired capital stocks are only attained gradually over time.

The solution to the dynamic problem is an investment sequence dependent on the tax-adjusted Tobin's q and the parameters of the adjustment cost function:
$\frac{I_t}{K_t} = h(Q_t^T) = \alpha + \frac{1}{\beta} Q_t$ where $Q_t^T = \frac{q_t}{PK_t} - (1 - tc_t)$. Or in a simple case without taxes, $Q_t = \frac{q_t^a}{PK_t} - 1$ so that the solution is given by $\frac{V_t}{PK_t K_t} - 1$, where $V_t$is value-added, PK_t is price of capital and K_t is capital stock. For each firm, the asset market equilibrium at all times requires that the return to the firm be the market discount rate $\frac{R(t)}{V_t} \equiv r_t^p$, where $V_t$is value-added and r^p is the interest rate affecting the producer.

For an open economy, (as assumed for Uganda in this study), the interest rate faced by producers is in turn affected by the world interest rate and the rate of change in the exchange rate affecting producers. This means, for example, that an increase in flows of foreign-aid for health in Uganda that impacts the exchange rate, would affect the discount rate used by Ugandan firms and hence the level of investment. The results for investment levels in an intertemporal model might differ from those depicted in the recursive dynamic model where capital allocation decision is dependent on the previous period allocations and current prices (as discussed in Section 4.3.9.1). Overall, the growth rate in a forward-looking intertemporal model is endogenously determined by the savings and investment behaviour of households and firms. This is contrary to the saving behaviour assumed in the myopic-agent recursive dynamic model employed in this study, where households and enterprises savings rates are fixed and real investment expenditure adjusts to equal the volume of savings available to finance it.

10.4.1.2 Overlapping generations (OLG) CGE models

The modelling approach could further be extended to a dynamic inter-temporal model that accounts for intergenerational processes such as the overlapping generations (OLG) model. In addition to assuming rational expectation for economic agents, the OLG-CGE type of model assumes agents live a finite length of time, long enough to overlap with at least one period of another agent's life. On the other hand, the intertemporal models (and the myopic agent recursive dynamic model) assume an infinitely-lived agent.

In the OLG-CGE framework, a demographic model is linked to an economic model in order to capture the equilibrium effects of changes in population size and structure. The link is important because the changes in size and composition of a population will have direct demand and supply-side effects which in turn generate endogenous economic adjustment mechanisms such as wage rates, labour participation rates, price competitiveness and public expenditure shares. The adjustment mechanisms generate aggregate responses such as changes in consumption, GDP, and investment. The application of OLG-CGE model includes the study of the impact of an ageing population in Scotland (Lisenkova et al., 2010; Lisenkova, Merette, & Wright, 2012, 2013) and the impact of an ageing population on energy use in Italy (Garau, Lecca, & Mandras, 2013).

An extension of OLG-CGE to health and healthcare could, for instance, entail the ageing process modelled as a shock that increases resource claims on the health sector by the non-working pensioners. In the OLG-CGE model, the long impact of population ageing on the economy is explicitly modelled. This is captured through the impact on consumption patterns by different age-groups, returns to labour as well as government expenditures on social services including health. Considering a population projection formulation, (as in Lisenkova et al (2013)), the age-related dynamic consumption and government expenditure illustrate some of the salient features of the OLG-CGE which distinguish it from the recursive dynamic and intertemporal CGE models.

The demographic change enters the model as an exogenous shock,[79] with population cohorts differentiated by age groups. The population is divided into generations or age-groups such as 0-4, 5-9… 100-104 and every cohort is described by two indices: "t" which denotes time and

[79] This is a simplifying assumption used in the model for Scotland but the authors acknowledge that the demographic variables such as mortality (life expectancy), fertility and net-migration could be endogenous affected by, for example, levels of economic growth (see Lisenkova et al (2013)).

"g" which denotes a specific generation or age group. According to the laws of motion, the size of a cohort "pop" belonging to generation "$g+k$" in period "t" is given by:

$$Pop_{t,g+k} = \begin{cases} Pop_{t-1,g+k+5} fr_{t-1} & for\ k=0 \\ Pop_{t-1,g+k-1}(sr_{t-1,g+k-1} + mr_{t-1,g+k-1}) & for\ k \in [1,20] \end{cases}$$

where fr is fertility rate, sr is conditional survival rate and mr is net migration rate. The first adult age group is $g+k+5 = g+5$ – age-group 20-24 and the final generation age group is 100-104. The conditional survival rate for the oldest age group is zero implying that at the end of the period everyone dies with certainty.

In contrast, population dynamics in the recursive dynamic and the intertemporal dynamic models enter the model exogenously through a uniform growth rate. The uniform population growth rate obscures the differential impact of different age groups and therefore may not give optimal prediction of private consumption and savings as well as public expenditure on social services. For example, the supply-side response to a demographic shock in an OLG model is an anticipation of the negative impact of a rise in the old-age dependency ratio. The ageing population, particularly the ageing labour force will have an effect on per-worker productivity. On the contrary, for the infinitely-lived agent models, (the perfectly forward-looking intertemporal model and the myopic expectations agent model) output declines from a reduction in total labour supply to the economy as a result of the population projection.

The population dynamics are captured by the behaviour of economic agents in the OLG-CGE model as follows[80]. Three features characterise the household behaviour. First, the younger generations are fully dependent on their parents and are therefore not active in the model

[80] This is an overview of the treatment of some economic agents in the model. For a detailed discussion and treatment of investors in the OLG model, see Garau et al (2013) and Lisenkova et al (2013).

although they affect the age-dependent government expenditures (discussed later in the government account). Second, the adult generations' consumption problem consists of maximising a CES type of intertemporal utility over a lifetime budget constraint. Thus an individual maximises intertemporal utility as follows:

$$U = \frac{1}{1-\theta} \sum_{k=4}^{20} \left\{ \left[\frac{1}{1+\rho} \right]^k usr_{t+k,g+k} \left(\left(C_{t+k,g+k} \right)^{1-\theta} \right) \right\} \qquad 0 < \theta < 1$$

where C is consumption, ρ is the pure rate of time preference and θ is the inverse of the constant intertemporal elasticity of substitution and usr is unconditional survival rate defined as the probability of survival up to age $g+k$ and $usr_{t+k,g+k} = \prod_{m=0}^{k} sr_{t+m,g+m}$ where $sr_{t+m,g+m}$ denotes the age/time-variable conditional survival rate between the periods $t+m$ and $t+m+1$ and between ages $g+m$ and $g+m+1$.

Third, the household is not altruistic but it leaves unintentional bequests due to uncertainty of life duration which are distributed equally among survivors. The household dynamic budget constraint includes redistributed assets of those who die at any given time t.

The first-order condition for consumption (commonly referred to as Euler's equation) is given by: $C_{t+1,g+1} = \left[\frac{[1+(1-\tau_{t+1}^K)Ri_{t+1}]}{(1+\rho)} \right]^{\frac{1}{\theta}} C_{t,g}$ where Ri is the rate of return on physical assets and τ^K is effective tax rate on capital.

The consumption equation defines the life-time consumption profile of the cohort born at time t. On the contrary, the equation for the optimal path of consumption across time in the infinitely-lived agent intertemporal model is simply the consumption profile of each generation across time. The equation governing the optimal path of consumption over time is significant because changes in the age composition of the population will lead to changes in consumption structure. Consumption patterns significantly differ between the young and the old (age groups) but also may exhibit cohort-specific effects.

Another salient feature of the OLG-CGE is the government expenditure constraint. The government account distinguishes public expenditures that depend on the size of the total population and expenditures that are age-dependent – health and education. For example, the model can specify public expenditure on health that is fixed per person of a specific age - $GovH_t = \sum_g Pop_{t,g} ASHEPC_g$, where $ASHEPC_g$ denotes age-specific health expenditure per person. This means the total health expenditure depends on both the size of the population and the age structure. This distinction is significant for predicting the overall impact of government health expenditure per capita. In Uganda, for example, maternal and childhood diseases form a proportionately larger burden of disease. Specifying the age-dependent health expenditure in the model could adequately capture the impact of relatively large expenditures on childhood illnesses.

Additionally, the time period variable is also a distinguishing feature between the infinitely-lived agent models and the OLG model. Whereas one time period in the infinitely-lived agent model refers to one year, this is not necessarily the case with the OLG model. For example, in the study for the impact of ageing on energy use in Italy, one period refers to ten years (Garau et al 2013). In this application the model is solved numerically over 50 periods which corresponds to 360 years. It may not be possible to computationally solve the infinitely-lived agent model for a comparable number of years.

The complexities of building intertemporal models together with data requirements have limited the use of such models in policy analysis. The forward-looking behaviour could complicate the computational exercise tremendously since some variables in the current period could be affected by variables in the future. Constructing an inter-temporal CGE model is challenging in the sense that it is essential to keep it computationally tractable without compromising on the type or degree of economic detail modelled. The challenge is even bigger for OLG-CGE where, for instance, data for consumption and asset ownership per age-group is seldom available, and so it becomes necessary to specify the model such that the rate of time preference is endogenously generated during the calibration procedure. This procedure can be challenging and time consuming as it involves specifying an extended number of equations for the household optimisation problem and the equilibrium condition in the asset and goods markets. The time allowed to complete this PhD could not accommodate the use of a more complex model like the OLG-CGE for analysis.

10.4.1.3 Production technology

The model structure and specification limitations relate to the assumption of the production technology in Uganda. The current model assumes a CES/Leontief production function with constant returns to scale which means, for instance, that skilled labour is substitutable by capital in the same way as unskilled labour. This type of assumption is rather abstract from the reality of the working of factor markets in Uganda. An extension of the production technologies to reflect a more flexible specification to better reflect the realities of the economy is appropriate. In addition, research into the parameter values, for instance, the production elasticity between factors, and between aggregate factors and intermediate inputs, in Uganda is needed. Furthermore, the assumption of constant return to scale could be improved by research to estimate the production functions at sector level which would be appropriate in determining the scale-effects of various industries.

Additionally, the simplifying model assumption that labour is fully employed implies that labour supply is perfectly inelastic and a flexible wage adjusts to ensure equilibrium in the labour market. In many classic CGE models the treatment of the labour market and adoption of the simplifying assumption is motivated by the research question which in turn determines the location of the initial policy shock and the outcome variable of interest. The choice of the labour market assumption adopted in this study is plausible for the current study question because the initial policy shock only affects the labour market indirectly through a shift in labour demand. Specifically, the shocks implemented in this study affect the labour market through the impact on the real wages that can potentially be paid to workers at a given level of employment. Additionally, the outcome variables of interest in this study are at an aggregate level - the impact of the policy shock on macroeconomic variables. At the intermediate disaggregation level, sectoral effects – sector output, sector shares and factor demand by sectors are also reported while the labour market variable of interest at this level is the wage rates for the different groups of labour.

It is noted that the full employment assumption does not reflect the reality of the labour market in Uganda. The adopted model set up does not allow an investigation of the impact of healthcare financing reforms on unemployment. If the outcome variable of interest is unemployment, the model could be adjusted to a fixed wage rate and flexible labour supply. Introducing unemployment as an endogenous variable would, for instance, facilitate the capture of adjustment costs when some people move from employment to unemployment. Consequently the results of the healthcare financing policy may differ from what is reported by a model where labour supply is exogenous. Adopting the endogenous labour supply assumption would enable assessment of the impact of higher demand for labour, induced by the healthcare financing policy, on wages and determine the extent to which higher wages translate into unemployment (or the reverse for lower labour demand). This is not possible in the current model set up.

10.4.2 Data limitations

The second key area of limitations and further research is in the area of data availability. Specifically, the limitations in this study relate to availability of data for parameter values. It is recognised that factor productivity and labour supply are a major driver of results in the model. The values for productivity growth were obtained from the literature and using assumptions, they were assigned to be healthcare induced productivity changes in Uganda. These values were justified for this model on the basis that the model aims to highlight the direction and relative magnitude of changes to the economy brought about by the proposed healthcare financing policies and the envisaged health effects. However, it is appropriate to undertake a study in Uganda to estimate direct impact of health and healthcare improvements on labour supply, labour productivity, and total factor productivity. Consequently, the values obtained can be used for the respective health effects parameters in the Ugandan CGE model.

Another area of data requirements pertains to disaggregation of labour by sex in the SAM. A sex disaggregated labour market profile, in addition to the differentiation of population groups according to residence, is important because the profile of men and women within an economy tends to be different in terms of the positions they occupy and the activities they undertake. In many societies, the majority of women are actively involved in both consumption and production. In Uganda for instance, women are extensively engaged in subsistence production and the informal sectors. A sex disaggregated labour factor in the social accounting matrix would capture the major sectors where women and men are concentrated and what levels men and women participate in the labour force. This labour disaggregation would facilitate the analysis of economic trends such as wages and poverty rates arising from the healthcare financing policies and how the trends are likely to impact men and women working in the same sector. A gender analysis of the impact of healthcare financing policies would provide policy makers with the necessary information to promote equal opportunities for men and women as participants and beneficiaries of development. It is therefore recommended that data be collected to disaggregate the labour factor by sex in the SAM for Uganda.

10.4.3 Further policy options

The third key area for further research relates to further policy options that could improve the performance of the health sector and the analysis of such policy options. The present study limits the scope of analysis to an inward looking labour policy. There is an implicit assumption that the increase in labour demand in the health sector is met, not only by the increase in actual numbers, but also by the increase in time devoted to healthcare service delivery by the existing healthcare work-force.

It should be noted, however, that the specificity of health sector labour – doctors, nurses, and specific allied medical workers – and the scarcity of healthcare workers in Uganda as discussed in Chapter 1, are constraining factors to achieving the desired results, as presented in this modelling exercise. It could mean the economy does not have the required numbers of health professionals that would move to the health sector to boost healthcare production; certainly in the short-term. Furthermore, the assumption in the analysis that an increase in the wage rate in the health sector increases hours devoted to the health sector job by the doctor or nurse, through both the substitution effect and the income effect, may not hold for all jobs held by the health professionals outside the health sector. It is possible, for example, for a trained medical doctor not to give up a political office for full time medical practice. Therefore, regardless of policy developments it is highly likely that, at least in the short- to medium-term, the shortage of health workers in Uganda will remain critical and needs to be addressed further in order to realise the full economic impact results of expanding healthcare services through additional healthcare financing, as reported in this study.

One option is for government to frontload investment in training and retaining health professionals to mitigate the long run negative impact of health worker attrition. Over time this should improve the health-worker to population ratio in order to achieve the population health goals and the economic impact results reported in this study. There is an existing science policy in Uganda that targets an increase in the teaching and study of science subjects at secondary and tertiary levels. This policy could be further refined to target medical sciences in order to increase the number of qualifying medical professionals. More importantly, government should invest to retain graduating health workers within the health sector. It would be an explorative exercise to evaluate the economy-wide impact of increasing government investment in healthcare professionals' education in the model and the implications for the labour supply dynamics, particularly to the health sector[81].

Another proposed policy to overcome the shortage of health workers that could be modelled relates to importation of healthcare labour. The study results would be further enriched if, in addition to the healthcare financing policies, a consideration of a deliberate government policy that encourages importation of healthcare workers (doctors and nurses) is modelled. While a policy that encourages importation of healthcare labour would be appropriate to overcome the shortage of skilled labour in the country, it would be interesting to know the overall net impact if the foreign workers remit a proportion of their salaries to their countries of origin.

In conclusion, the general message from this thesis is that evaluating the contribution of resource flows to the health sector, without taking into account the indirect health effects of such resource investments in the health sector, is an understatement of the wider benefits from investing in healthcare. Health is an important driver of economic growth and higher standards of living of any country. It is, therefore, crucial for governments to invest in the health of its people by increasing resources to the health sector. The health sector is a productive sector in as far as it facilitates the well-being of the people and indirectly boosts the productive capacity of the economy. The productivity of the health sector should be

[81] The Maquette for MDG Simulations (MAMS) model developed by the Word Bank group and documented in (Lofgren, Cicowiez, & Diaz-Bonilla, 2013) would be a suitable workhorse in this exploration because it distinguishes institutional investment accounts from capital accounts and the education function can be distinguished by levels of education attainment. This is a future research work to be undertaken when the necessary data for the required disaggregation is collected.

assessed in relation to the healthcare effects (growth in labour supply, labour productivity and total factor productivity) arising out of the expansion in the healthcare investments.

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APPENDICES

Appendix 4. 1: CGE model sets, parameters, and variables

Symbol	Explanation	Symbol	Explanation
SETS			
$a \in A$	Activities	$c \in CMN(\subset C)$	Commodities not in *CM*
$a \in ALEO(\subset A)$	Activities with a Leontief function at the top of the technology nest	$c \in CT(\subset C)$	Transaction service commodities
$c \in C$	Commodities	$c \in CX(\subset C)$	Commodities with domestic production
$c \in CD(\subset C)$	Commodities with domestic sales of domestic output	$f \in F$	Factors
$c \in CDN(\subset C)$	Commodities not in *CD*	$i \in INS$	Institutions (domestic and rest of world)
$c \in CE(\subset C)$	Exported commodities	$i \in INSD(\subset INS)$	Domestic institutions
$c \in CEN(\subset C)$	Commodities not in *CE*	$i \in INSDNG(\subset INSD)$	Domestic non-government institutions
$c \in CM(\subset C)$	Aggregate imported commodities	$h \in H(\subset INSDNG)$	Households
PARAMETERS			
$cwts_c$	Weight of commodity c in the CPI	$qdst_c$	Quantity of stock change
$dwts_c$	Weight of commodity c in the producer price index	$\overline{qg}_c$	Base-year quantity of government demand
ica_{ca}	Quantity of c as intermediate input per unit of activity a	$\overline{qinv}_c$	Base-year quantity of private investment demand
$icd_{cc'}$	Quantity of commodity c as trade input per unit of c′ produced and sold domestically	$shif_{if}$	Share for domestic institution in income of factor f
$ice_{cc'}$	Quantity of commodity c as trade input per exported unit of c′	$shii_{ii'}$	Share of net income of i′ to i (i′ ∈ INSDNG′; i ∈ INSDNG)
$icm_{cc'}$	Quantity of commodity c as trade input per imported unit of c′	ta_a	Tax rate for activity a
$inta_a$	Quantity of aggregate intermediate input per activity unit	$\overline{tins}_i$	Exogenous direct tax rate for domestic institution i
iva_a	Quantity of aggregate intermediate input per activity unit	$tins01_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
$\overline{mps}_i$	Base savings rate for domestic institution i	tm_c	Import tariff rate
$mps01_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates	tq_c	Rate of VAT tax
pwe_c	Export price (foreign currency)	$trnsfr_{i\,f}$	Transfer from factor f to institution i
pwm_c	Import price (foreign currency)		

Source: Thurlow (2008b)

Appendix 4.1 CGE model sets, parameters, and variables (continued)

Symbol	Explanation	Symbol	Explanation
Greek Symbols			
α_a^a	Efficiency parameter in the CES activity function	δ_{cr}^t	CET function share parameter
α_a^{va}	Efficiency parameter in the CES value-added function	δ_{fa}^{va}	CES value-added function share parameter for factor *f* in activity *a*
α_c^{ac}	Shift parameter for domestic commodity aggregation function	γ_{ch}^m	Subsistence consumption of marketed commodity c for household h
α_c^q	Armington function shift parameter	θ_{ac}	Yield of output c per unit of activity a
α_c^t	CET function shift parameter	ρ_a^a	CES production function exponent
β^a	Capital sectoral mobility factor	ρ_a^{va}	CES value-added function exponent
β_{ch}^m	Marginal share of consumption spending on marketed commodity c for household h	ρ_c^{ac}	Domestic commodity aggregation function exponent
δ_a^a	CES activity function share parameter	ρ_c^q	Armington function exponent
δ_{ac}^{ac}	Share parameter for domestic commodity aggregation function	ρ_c^t	CET function exponent
δ_{cr}^q	Armington function share parameter	η_{fat}^a	Sector share of new capital
υ_f	Capital depreciation rate		
EXOGENOUS VARIABLES			
$\overline{CPI}$	Consumer price index	$\overline{MPSADJ}$	Savings rate scaling factor (= 0 for base)
$\overline{DTINS}$	Change in domestic institution tax share (= 0 for base; exogenous variable)	$\overline{QFS}_f$	Quantity supplied of factor
$\overline{FSAV}$	Foreign savings (FCU)	$\overline{TINSADJ}$	Direct tax scaling factor (= 0 for base; exogenous variable)
$\overline{GADJ}$	Government consumption adjustment factor	$\overline{WFDIST}_{fa}$	Wage distortion factor for factor f in activity a
$\overline{IADJ}$	Investment adjustment factor		
ENDOGENOUS VARIABLES			
AWF_{ft}^a	Average capital rental rate in time period t	QG_c	Government consumption demand for commodity
$DMPS$	Change in domestic institution savings rates (= 0 for base; exogenous variable)	QH_{ch}	Quantity consumed of commodity c by household h
DPI	Producer price index for domestically marketed output	QHA_{ach}	Quantity of household home consumption of commodity c from activity a for household h
EG	Government expenditures	$QINTA_a$	Quantity of aggregate intermediate input
EH_h	Consumption spending for household	$QINT_{ca}$	Quantity of commodity c as intermediate input to activity a
EXR	Exchange rate (LCU per unit of FCU)	$QINV_c$	Quantity of investment demand for commodity
$GSAV$	Government savings	QM_{cr}	Quantity of imports of commodity c
QF_{fa}	Quantity demanded of factor f from activity a		

Source: Thurlow (2008b)

Appendix 4.1 CGE model sets, parameters, and variables (continued)

Symbol	Explanation	Symbol	Explanation
ENDOGENOUS VARIABLES Continued			
MPS_i	Marginal propensity to save for domestic non-government institution (exogenous variable)	QQ_c	Quantity of goods supplied to domestic market (composite supply)
PA_a	Activity price (unit gross revenue)	QT_c	Quantity of commodity demanded as trade input
PDD_c	Demand price for commodity produced and sold domestically	QVA_a	Quantity of (aggregate) value-added
PDS_c	Supply price for commodity produced and sold domestically	QX_c	Aggregated quantity of domestic output of commodity
PE_{cr}	Export price (domestic currency)	$QXAC_{ac}$	Quantity of output of commodity c from activity a
$PINTA_a$	Aggregate intermediate input price for activity a	RWF_f	Real average factor price
PK_{ft}	Unit price of capital in time period t	$TABS$	Total nominal absorption
PM_{cr}	Import price (domestic currency)	$TINS_i$	Direct tax rate for institution i (i ∊ INSDNG)
PQ_c	Composite commodity price	$TRII_{ii'}$	Transfers from institution i' to i (both in the set INSDNG)
PVA_a	Value-added price (factor income per unit of activity)	WF_f	Average price of factor
PX_c	Aggregate producer price for commodity	YF_f	Income of factor f
$PXAC_{ac}$	Producer price of commodity c for activity a	YG	Government revenue
QA_a	Quantity (level) of activity	YI_i	Income of domestic non-government institution
QD_c	Quantity sold domestically of domestic output	YIF_{if}	Income to domestic institution i from factor f
QE_{cr}	Quantity of exports	ΔK^{a}_{fat}	Quantity of new capital by activity a for time period t

Source: Thurlow (2008b)

Appendix 4. 2: CGE model equations

PRODUCTION AND PRICE EQUATIONS	
$QINT_{c\,a} = ica_{ca} \cdot QINTA_a$	(1)
$PINTA_a = \sum_{c \in C} PQ_c \cdot ica_{ca}$	(2)
$QVA_a = \alpha_a^{va} \cdot \left(\sum_{f \in F} \delta_{f\,a}^{va} \cdot \left(\alpha_{f\,a}^{vaf} \cdot QF_{f\,a} \right)^{-\rho_a^{va}} \right)^{-\frac{1}{\rho_a^{va}}}$	(3)
$W_f \cdot \overline{WFDIST}_{fa} = PVA_a \cdot QVA_a \cdot \left(\sum_{f \in F'} \delta_{f\,a}^{va} \cdot \left(\alpha_{f\,a}^{vaf} \cdot QF_{f\,a} \right)^{-\rho_a^{va}} \right)^{-1} \cdot \delta_{f\,a}^{va} \cdot \left(\alpha_{f\,a}^{vaf} \cdot QF_{f\,a} \right)^{-\rho_a^{va}-1}$	(4)
$QF_{f\,a} = \alpha_{f\,a}^{van} \cdot \left(\sum_{f' \in F} \delta_{f\,f'\,a}^{van} \cdot QF_{f'\,a}^{\;-\rho_{f\,a}^{van}} \right)^{-\frac{1}{\rho_{f\,a}^{van}}}$	(5)
$W_{f'} \cdot WFDIST_{f'\,a} = W_f \cdot WFDIST_{f\,a} \cdot QF_{f\,a} \cdot \left(\sum_{f'' \in F} \delta_{f\,f''\,a}^{van} \cdot QF_{f''\,a}^{\;-\rho_{f\,a}^{van}} \right)^{-1} \cdot \delta_{f\,f'\,a}^{van} \cdot QF_{f'\,a}^{\;-\rho_{f\,a}^{van}-1}$	(6)
$QVA_a = iva_a \cdot QA_a$	(7)
$QINTA_a = inta_a \cdot QA_a$	(8)
$PA_a \cdot (1 - ta_a) \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a$	(9)
$QXAC_{a\,c} = \theta_{a\,c} \cdot QA_a$	(10)
$PA_a = \sum_{c \in C} PXAC_{ac} \cdot \theta_{ac}$	(11)
$QX_c = \alpha_c^{ac} \cdot \left(\sum_{a \in A} \delta_{a\,c}^{ac} \cdot QXAC_{a\,c}^{\;-\rho_c^{ac}} \right)^{-\frac{1}{\rho_c^{ac}-1}}$	(12)
$PXAC_{a\,c} = PX_c \cdot QX_c \left(\sum_{a \in A'} \delta_{a\,c}^{ac} \cdot QXAC_{a\,c}^{-\rho_c^{ac}} \right)^{-1} \cdot \delta_{a\,c}^{ac} \cdot QXAC_{a\,c}^{-\rho_c^{ac}-1}$	(13)
$PE_{cr} = pwe_{cr} \cdot EXR - \sum_{c' \in CT} PQ_c \cdot ice_{c'c}$	(14)
$QX_c = \alpha_c^t \cdot \left(\sum_r \delta_{cr}^t \cdot QE_{cr}^{\rho_c^t} + (1 - \sum_r \delta_{cr}^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}}$	(15)
$\frac{QE_{cr}}{QD_c} = \left(\frac{PE_{cr}}{PDS_c} \cdot \frac{1 - \sum_r \delta_{cr}^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}}$	(16)

Source: Thurlow (2008b)

Appendix 4.2: CGE model equations (continued)

$QX_c = QD_c + \sum_r QE_{cr}$	(17)
$PX_c \cdot QX_c = PDS_c \cdot QD_c + \sum_r PE_{cr} \cdot QE_{cr}$	(18)
$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'} \cdot icd_{c'c}$	(19)
$PM_{cr} = pwm_{cr} \cdot (1 + tm_{cr}) \cdot EXR + \sum_{c' \in CT} PQ_{c'} \cdot icm_{c'c}$	(20)
$QQ_c = \alpha_c^q \cdot \left(\sum_r \delta_{cr}^q \cdot QM_{cr}^{-\rho_c^q} + (1 - \sum_r \delta_{cr}^q) \cdot QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}}$	(21)
$\frac{QM_{cr}}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1 - \sum_r \delta_{cr}^q} \right)^{\frac{1}{1+\rho_c^q}}$	(22)
$QQ_c = QD_c + \sum_r QM_{cr}$	(23)
$PQ_c \cdot (1 - tq_c) \cdot QQ_c = PDD_c \cdot QD_c + \sum_r PM_{cr} \cdot QM_{cr}$	(24)
$QT_c = \sum_{c' \in C'} \left(icm_{cc'} \cdot QM_{c'} + ice_{cc'} \cdot QE_{c'} + icd_{cc'} \cdot QD_{c'} \right)$	(25)
$\overline{CPI} = \sum_{c \in C} PQ_c \cdot cwts_c$	(26)
$DPI = \sum_{c \in C} PDS_c \cdot dwts_c$	(27)

Institutional Incomes and Domestic Demand Equations

$YF_f = \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{fa} \cdot QF_{fa}$	(28)
$YIF_{if} = shif_{if} \cdot \left[YF_f - trnsfr_{row\,f} \cdot EXR \right]$	(29)
$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i' \in INSDNG'} TRII_{ii'} + trnsfr_{i\,gov} \cdot \overline{CPI} + trnsfr_{i\,row} \cdot EXR$	(30)
$TRII_{ii'} = shii_{ii'} \cdot (1 - MPS_{i'}) \cdot (1 - \overline{tins}_{i'}) \cdot YI_{i'}$	(31)
$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{ih} \right) \cdot (1 - MPS_h) \cdot (1 - \overline{tins}_h) \cdot YI_h$	(32)
$PQ_c \cdot QH_{ch} = PQ_c \cdot \gamma_{ch}^m + \beta_{ch}^m \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma_{c'h}^m \right)$	(33)
$QINV_c = IADJ \cdot \overline{qinv}_c$	(34)
$QG_c = \overline{GADJ} \cdot \overline{qg}_c$	(35)

Source: Thurlow (2008b)

Appendix 4.2: CGE Model Equations (continued)

$$EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in INSDNG} trnsfr_{i\,gov} \cdot \overline{CPI} \qquad (36)$$

System Constraints and Macroeconomic Closures

$$YG = \sum_{i \in INSDNG} \overline{tins}_i \cdot YI_i + \sum_{c \in CMNR} tm_c \cdot pwm_c \cdot QM_c \cdot EXR + \sum_{c \in C} tq_c \cdot PQ_c \cdot QQ_c + \sum_{f \in F} YF_{gov\,f} + trnsfr_{gov\,row} \cdot EXR \qquad (37)$$

$$QQ_c = \sum_{a \in A} QINT_{c\,a} + \sum_{h \in H} QH_{c\,h} + QG_c + QINV_c + qdst_c + QT_c \qquad (38)$$

$$\sum_{a \in A} QF_{f\,a} = QFS_f \qquad (39)$$

$$YG = EG + GSAV \qquad (40)$$

$$\sum_{r\ c \in CMNR} pwm_{cr} \cdot QM_{cr} + \sum_{f \in F} trnsfr_{row\,f} = \sum_{r\ c \in CENR} pwe_{cr} \cdot QE_{cr} + \sum_{i \in INSD} trnsfr_{i\,row} + FSAV \qquad (41)$$

$$\sum_{i \in INSDNG} MPS_i \cdot \left(1 - \overline{tins}_i\right) \cdot YI_i + GSAV + EXR \cdot FSAV = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \qquad (42)$$

$$MPS_i = \overline{mps}_i \cdot \left(1 + MPSADJ\right) \qquad (43)$$

Capital Accumulation and Allocation Equations

$$AWF^a_{f\,t} = \sum_a \left[\left(\frac{QF_{f\,a\,t}}{\sum_{a'} QF_{f\,a'\,t}} \right) \cdot WF_{f\,t} \cdot WFDIST_{f\,a\,t} \right] \qquad (44)$$

$$\eta^a_{f\,a\,t} = \left(\frac{QF_{f\,a\,t}}{\sum_{a'} QF_{f\,a'\,t}} \right) \cdot \left(\beta^a \cdot \left(\frac{WF_{f,t} \cdot WFDIST_{f\,a\,t}}{AWF^a_{f\,t}} - 1 \right) + 1 \right) \qquad (45)$$

$$\Delta K^a_{f\,a\,t} = \eta^a_{f\,a\,t} \cdot \left(\frac{\sum_c PQ_{c\,t} \cdot QINV_{c\,t}}{PK_{f\,t}} \right) \qquad (46)$$

$$PK_{f\,t} = \sum_c PQ_{c\,t} \cdot \frac{QINV_{c\,t}}{\sum_{c'} QINV_{c'\,t}} \qquad (47)$$

$$QF_{f\,a\,t+1} = QF_{f\,a\,t} \cdot \left(1 + \frac{\Delta K^a_{f\,a\,t}}{QF_{f\,a\,t}} - \upsilon_f \right) \qquad (48)$$

$$QFS_{f\,t+1} = QFS_{f\,t} \cdot \left(1 + \frac{\sum_a \Delta K_{f\,a\,t}}{QFS_{f\,t}} - \upsilon_f \right) \qquad (49)$$

Source: Thurlow (2008b)

Appendix 5

Table A5. 1: Classification of intermediate inputs for government healthcare production

SAM entry	Item description	Uganda Classification and Chart of accounts Codes	International standard industrial classification (ISIC)-rev.4
cfuel	Petrol & diesel	227004	192
cchem	Other chemicals	224001	21
cmach	Machinery & equipment	228003, 228004	
cutil	Energy & water	223005, 223006, 223007	
ccons	Construction	228001	
ctrad	Trade	228002, 224002	
ctran	Transport	227001, 227002, 227003, 222002	
ccom m	Communications	221001, 221007, 222001, 222003, 221008	
creal	Real estate	223001, 223002, 223003, 223901, 223004, 281401	
cosrv	Other services	213001, 213002, 263101-263104, 263106, 263108, 225001, 225002, 282101, 282104, 282151, 221005-22006, 221009-221017, 273101-273103	94, 96
ceduc	Education	221002, 221003, 282103	8522

Source: Uganda Government Finance Statistics manual 2011, Uganda Classification and Chart of Accounts 2011, and International Standard Industrial Classification revision 4.

Table A5.1 shows the SAM account entries and the codes in the chart of accounts which were used to arrive at the expenditure share for the specific item descriptions.

Table A5. 2: Balanced SAM accounts/description

ACTIVITIES		COMMODITIES		FACTORS		INSTITUTIONS/OTHER ACCOUNTS	
AAG01	agriculture	CAG01	agriculture	lab-self	self-employed labour	entAG	**enterprises**
AAG02	mining	CAG02	mining	lab-unsk	unskilled labour	hhd-r-f	rural farming households
AAG03	food processing	CAG03	food processing	lab-skll	skilled labour	hhd-r-nf	rural non-farming households
AAG04	fuel	CAG04	fuel	cap	capitals	hhd-k-nf	Kampala non-farming households
AAG05	chemicals	CAG05	chemicals	lnd	land	hhd-u-f	urban farming households
AAG06	machinery	CAG06	machinery			hhd-u-nf	urban non-farming households
AAG07	utilities	CAG07	utilities			gov	Government
AAG08	construction	CAG08	construction			dtax	Direct taxes
AAG09	other manufacturing	CAG09	other manufacturing			stax	Sales taxes
AAG10	trade	CAG10	trade			mtax	Import tariffs
AAG11	transport	CAG11	transport			s-i	Savings-investment
Ahltng	non-government health	chltng	non-government health			dstk	Inventories
AAG13	other private services	CAG13	other private services			row	Rest of world
AAG14	administration	CAG14	administration			trcAG	Transaction costs
AAG15	education	CAG15	education				
ahltgPc	government health-primary care	chltgPc	government health-primary care				
ahltgOc	government health-other care	chltgOc	government health-other care				
AAG18	other government services	CAG18	other government services				

Table A5. 3: Balanced health-focussed Uganda SAM (Billions of Uganda Shillings)

	AAG01	AAG02	AAG03	AAG04	AAG05	AAG06	AAG07	AAG08	AAG09	AAG10	AAG11	ahltng	AAG13	AAG14
AAG01														
AAG02														
AAG03														
AAG04														
AAG05														
AAG06														
AAG07														
AAG08														
AAG09														
AAG10														
AAG11														
ahltng														
AAG13														
AAG14														
AAG15														
ahltgPc														
ahltgOc														
AAG18														
CAG01	360,050		1,292,686			3,688			52,802					
CAG02			370	21,380		21,387		83,581	4,986					
CAG03	101,400		778,606		107	2,020			54,469	72,729			118,092	

Table A5.3 continued

	AAG15	ahltgPc	ahltgOc	AAG18	CAG01	CAG02	CAG03	CAG04	CAG05	CAG06	CAG07	CAG08	CAG09	CAG10
AAG01					6,048,861									
AAG02						80,073								
AAG03							3,658,802							
AAG04								24,498						
AAG05									2,947					
AAG06										560,902				
AAG07											1,111,753			
AAG08												4,843,871		
AAG09													1,513,855	
AAG10														4,123,197
AAG11														
ahltng														
AAG13														
AAG14														
AAG15														
ahltgPc														
ahltgOc														
AAG18														
CAG01														
CAG02														
CAG03														

Table A5.3 continued

	CAG11	chltng	CAG13	CAG14	CAG15	chltgPc	chltgOc	CAG18	trcAG	lab-self	lab-unsk	lab-skll	cap	lnd
AAG01														
AAG02														
AAG03														
AAG04														
AAG05														
AAG06														
AAG07														
AAG08														
AAG09														
AAG10														
AAG11	1,250,791													
ahltng		405,842												
AAG13			5,327,425											
AAG14				1,475,883										
AAG15					2,389,754									
ahltgPc						94,754								
ahltgOc							236,324							
AAG18								448,939						
CAG01														
CAG02														
CAG03														

Table A5.3 continued

	entAG	hhd-r-f	hhd-r-nf	hhd-k-nf	hhd-u-f	hhd-u-nf	gov	dtax	stax	mtax	s-i	dstk	row	total
AAG01														6,048,861
AAG02														80,073
AAG03														3,658,802
AAG04														24,498
AAG05														2,947
AAG06														560,902
AAG07														1,111,753
AAG08														4,843,871
AAG09														1,513,855
AAG10														4,123,197
AAG11														1,250,791
ahltng														405,842
AAG13														5,327,425
AAG14														1,475,883
AAG15														2,389,754
ahltgPc														94,754
ahltgOc														236,324
AAG18														448,939
CAG01		2,941,394	688,526	445,005	275,236	273,747							1,188,441	7,521,574
CAG02		38,862	11,110	3,558	2,702	3,114						25	25,466	216,542
CAG03		1,984,142	728,462	766,112	308,575	446,926						22,427	600,961	5,985,027

Table A5.3 continued

	AAG01	AAG02	AAG03	AAG04	AAG05	AAG06	AAG07	AAG08	AAG09	AAG10	AAG11	ahltng	AAG13	AAG14
CAG04	86,573		17,068	98	87		9,220			163,604	142,546		95,747	62,944
CAG05	125,260				157		11,869		93,443					
CAG06	3,033	1,064	126,373			143,606	6,248	659,356	15,197				11,904	
CAG07	2,893	1,299	14,834			7,455	19,247		16,648	72,922	13,079	5,996		19,554
CAG08			14,049		37	1,561		106,885	7,734	14,315			447,914	33,961
CAG09	245,597	7,628	261,515	163	183	82,155	39,984	679,919	557,782	193,663	67,276	58,718	123,579	12,038
CAG10			34,888		16	4,212	5,561		10,807	52,041	44,759		26,691	16,757
CAG11	230,246	1,021	51,935	856	32	6,426		119,226	27,823	311,175	26,168	9,845	44,794	96,502
chltng	49,889													
CAG13	29,617	5,539	241,998	429	347	36,701	24,515	88,053	118,387	646,361	93,623	38,023	437,377	170,769
CAG14														24,744
CAG15												40,105		147,562
chltgPc														
chltgOc														
CAG18														2,469
trcAG														
lab-self	569,401													
lab-unsk	826,367	9,160	129,607	150	165	24,873	10,704	266,194	86,253	465,773	130,394	18,944	273,477	85,664
lab-skll		2,082	90,773	213	235	11,508	148,667	18,280	24,771	93,999	3,326	150,801	318,735	711,010
cap	948,235	52,281	604,101	1,210	1,581	215,309	835,739	2,822,378	442,753	2,036,615	729,620	83,410	3,429,116	91,910

Table A5.3 continued

	AAG15	ahltgPc	ahltgOc	AAG18	CAG01	CAG02	CAG03	CAG04	CAG05	CAG06	CAG07	CAG08	CAG09	CAG10
CAG04	99,385	3,514	21,206	13,061										
CAG05														
CAG06	52,432													
CAG07	31,062	341	11,118	22,260										
CAG08	16,554	2,426	13,311	5,212										
CAG09	135,535	17,436	90,067	57,883										
CAG10	28,085	7,569	11,299	8,875										
CAG11	38,662	2,204	3,267	12,558										
chltng														
CAG13	188,139	5,543	10,567	36,637										
CAG14														
CAG15	166,449	6,034	4,272											
chltgPc														
chltgOc														
CAG18														
trcAG					1,111,670	55,272	1,535,034	58,218	60,175	150,376			1,226,556	
lab-self														
lab-unsk	144,166	1,207	721	86,212										
lab-skll	1,196,579	27,760	16,584	60,356										
cap	292,707	20,721	53,911	145,885										

Table A5.3 continued

	CAG11	chltng	CAG13	CAG14	CAG15	chltgPc	chltgOc	CAG18	trcAG	lab-self	lab-unsk	lab-skll	cap	lnd
CAG04														
CAG05														
CAG06														
CAG07														
CAG08														
CAG09														
CAG10									3,816,283					
CAG11									381,016					
chltng														
CAG13														
CAG14														
CAG15														
chltgPc														
chltgOc														
CAG18														
trcAG														
lab-self														
lab-unsk														
lab-skll														
cap														

Table A5.3 continued

	entAG	hhd-r-f	hhd-r-nf	hhd-k-nf	hhd-u-f	hhd-u-nf	gov	dtax	stax	mtax	s-i	dstk	row	total
CAG04		203,561	128,568	47,564	64,486	37,527						-239		1,196,522
CAG05												29	2,283	233,039
CAG06		138,168	27,183	46,720	29,376	24,672					8,002	5,583	50,100	1,349,016
CAG07		428,676	118,388	165,952	64,351	72,835							54,969	1,143,879
CAG08		146,394	72,376	23,020	39,308	26,662					3,890,482	2,453		4,864,657
CAG09		1,231,689	326,731	446,440	175,633	280,663					1,105,655	11,559	284,150	6,493,641
CAG10		32,005	3,490	4,464	8,928	10,302						843		4,127,875
CAG11		396,147	129,985	244,157	82,594	138,616						126	428,470	2,783,851
chltng		245,181	39,063	31,777	17,121	22,744						68		405,842
CAG13		784,033	321,362	713,166	272,618	364,910						14,820	1,129,856	5,773,390
CAG14							1,451,138							1,475,883
CAG15		468,725	97,224	240,290	157,109	121,442	940,543							2,389,754
chltgPc		98	29	74	29	39	94,484							94,754
chltgOc		20,986	5,194	3,146	1,821	2,390	202,786							236,324
CAG18		220,381	55,410	102,730	42,743	45,379						4,195		473,307
trcAG														4,197,300
lab-self														569,401
lab-unsk														2,560,030
lab-skll														2,875,679
cap														12,807,480

Table A5.3 continued

	AAG01	AAG02	AAG03	AAG04	AAG05	AAG06	AAG07	AAG08	AAG09	AAG10	AAG11	ahltng	AAG13	AAG14
lnd	2,470,301													
entAG														
hhd-r-f														
hhd-r-nf														
hhd-k-nf														
hhd-u-f														
hhd-u-nf														
gov														
dtax														
stax														
mtax														
s-i														
dstk														
row														
total	6,048,861	80,073	3,658,802	24,498	2,947	560,902	1,111,753	4,843,871	1,513,855	4,123,197	1,250,791	405,842	5,327,425	1,475,883

Table A5.3 continued

	AAG15	ahltgPc	ahltgOc	AAG18	CAG01	CAG02	CAG03	CAG04	CAG05	CAG06	CAG07	CAG08	CAG09	CAG10
lnd														
entAG														
hhd-r-f														
hhd-r-nf														
hhd-k-nf														
hhd-u-f														
hhd-u-nf														
gov														
dtax														
stax					99,755	4,340	178,050	27,820	8,518	9,299	32,126	20,785	145,068	4,678
mtax					1,837	9,070	54,454	484,305	18,142	95,949			381,980	
s-i														
dstk														
row					259,450	67,787	558,687	601,681	143,257	532,491			3,226,181	
total	2,389,754	94,754	236,324	448,939	7,521,574	216,542	5,985,027	1,196,522	233,039	1,349,016	1,143,879	4,864,657	6,493,641	4,127,875

Table A5.3: continued

	CAG11	chltng	CAG13	CAG14	CAG15	chltgPc	chltgOc	CAG18	trcAG	lab-self	lab-unsk	lab-skll	cap	lnd
lnd														
entAG													12,807,480	
hhd-r-f										543,673	1,111,355	666,264		2,367,047
hhd-r-nf											421,715	530,337		
hhd-k-nf											559,513	686,730		
hhd-u-f										25,729	177,977	572,585		103,254
hhd-u-nf											289,471	419,763		
gov														
dtax														
stax	63,852		40,819					24,368						
mtax			71											
s-i														
dstk														
row	1,469,208		405,075											
total	2,783,851	405,842	5,773,390	1,475,883	2,389,754	94,754	236,324	473,307	4,197,300	569,401	2,560,030	2,875,679	12,807,480	2,470,301

Table A5.3 continued

	entAG	hhd-r-f	hhd-r-nf	hhd-k-nf	hhd-u-f	hhd-u-nf	gov	dtax	stax	mtax	s-i	dstk	row	total
lnd														2,470,301
entAG														12,807,480
hhd-r-f	5,445,488													10,133,826
hhd-r-nf	2,079,352													3,031,403
hhd-k-nf	2,628,984													3,875,228
hhd-u-f	844,525													1,724,069
hhd-u-nf	1,386,402													2,095,636
gov	124,682							692,649	659,479	1,045,809			1,385,034	3,907,653
dtax	298,047	49,918	33,618	233,712	35,708	41,646								692,649
stax														659,479
mtax														1,045,809
s-i		803,465	244,684	357,339	145,729	182,022	1,218,701						2,114,087	5,066,027
dstk											61,888			61,888
row														7,263,817
total	12,807,480	10,133,826	3,031,403	3,875,228	1,724,069	2,095,636	3,907,653	692,649	659,479	1,045,809	5,066,027	61,888	7,263,817	

Source: Author computations