# Equity and efficiency in the geographic allocation of public health resources in Mozambique

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## Declaration

I, Laura Anselmi, 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.

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## Abstract

Equitable and efficient health financing is crucial to improve health care provision, still inequitable in many low- and middle-income countries. The allocation of financial resources across geographic areas is important to increase the capacity to effectively provide services and their availability to the neediest population. However, how resources are transformed into service and finally reach the intended beneficiaries, depends on local health care management, on the supply-side, and on constraints to service use, on the demand-side. Equity and efficiency in the geographic allocation of public expenditure in Mozambique, and their determinants, are explored in this thesis.

First, inequities in the distribution of public health expenditure, assessed using a method based on Benefit Incidence Analysis, diminished over time due to improved resource allocation. However, inequities in health care use remain and limit the benefit from public health expenditure for the poor and neediest population. The difference between horizontal and vertical equity, assessed for each source of public health expenditure by raking individuals according to their economic wealth or to their need for health care, reveals initial discrepancies in government and donor expenditure targets and the potential trade-offs between equity objectives.

Second, inefficiencies in health care provision, assessed using Stochastic Frontier Analysis, exist at district level. Efficiency could be increased both in health administrations, where financial resources are managed to guarantee the availability of material resources, such as staff and equipment, and in health facilities, where those are used to deliver health care services. Heterogeneity in efficiency across districts depends on geographic, demographic, administrative and health system characteristics.

Third, results from an econometric model of demand for health care revealed that proximity to health facilities increases the probability of seeking care and that the availability of adequate staff and equipment can encourage service use by those who live near a health facility. Demand side constraints, mostly economic, prevent use even when services are available.

Results suggest that resource allocation policies are insufficient on their own to improve the distribution of public health expenditure. Extending health facility coverage and tackling demand-side barriers are needed to increase service use among and mitigate potential equity-efficiency and horizontal-vertical equity trade-offs. Increasing the efficiency of district health administrations and health facilities can contribute to increase service use among those who live close to a health facility.

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# Abbreviations

| | |
|---|---|
| BIA | Benefit Incidence Analysis |
| DH | District Hospital |
| HA | Health Administration |
| HBS | Household Budeget Survey |
| HC | Health Centre |
| HF | Health Facility |
| INE | Instituto Nacional de Estatistica |
| LMICs | Low and Middle-Income Countries |
| MF | Ministério das Finanças |
| MISAU | Ministério da Saúde |
| MoF | Ministry of Finance |
| MoH | Ministry of Health |
| MPD | Ministry of Planning and Development/ Ministério da Planificação e Desenvolvimento |
| NHIS | National Health Information System |
| NHS | National Health System |
| PCA | Principal component Analysis |
| RAF | Resource allocation Formula |
| U5M | Under-five Mortality |
| UHC | Universal Health Coverage |

# Chapter 1

# Introduction

## 1.1. Equity and efficiency in public health sector resource allocation

### *1.1.1. The relevance of equity and efficiency in public health financing*

The status of health as a fundamental human right and the principles of health equity and of governments' responsibility for the health of their people were clearly stated in the Alma Ata declaration in 1978 (WHO, 1978). More recently consensus has progressively been reached around the necessity to accelerate progress towards Universal Health Coverage (UHC), defined as 'good quality and effective interventions accessible to all individuals without incurring financial hardship' (Evans et al., 2013, WHO, 2010), and UHC is now promoted as the fundamental health component of the post-2015 development agenda (WHO, 2014).

Equitable and efficient health financing is a crucial element of a universally accessible health service, by contributing to extend service coverage and making resources available to provide services where they are most needed (Kutzin, 2013). In particular in low and middle-income countries (LMICs), where health services are mainly publicly funded and provided and scaling-up their provision is still a major challenge, an equitable and efficient allocation of public financial resources is a prerequisite to promote universal access to health care. Resource allocation provides the critical link between revenues generation and purchasing of services and is part of the mechanism through which service coverage, the range of services and their quality can all be increased. In LMICs contexts, where inequities in access to services are still a concern, an efficient allocation of resources across geographic areas is important to maximise the service made available to the population, while an equitable allocation is fundamental to ensure the extension of service to the neediest and most marginalised populations (Green, 2007, Kutzin, 2001, McIntyre and Kutzin, 2012).

### *1.1.2. Equity in health care*

Although multiple definitions of equity in health and health care have been used, a relative consensus has been achieved around the definition adopted by the WHO Commission on Social Determinants of Health: "*the absence of systematic differences in health, both between and* *within countries, that are judged to be avoidable by reasonable action*"(WHO Commission on Social Determinants of Health, 2008). Alllocating resources equitably, so that each individual can benefit from the health care they need, is important to prevent avoidable differences in health among individuals. Measuring equity in the allocation of health care and health resources therefore entails comparing their distribution with the distribution of need, to verify if individuals with the same needs receive the same resources (horizontal equity) and if individuals with different needs benefit from different resources (vertical equity) (Culyer and Wagstaff, 1993, Mooney, 2000).

Equity in the allocation of financial resources has been analysed either by comparing the actual allocation of financial resources across geographic areas with an ideally equitable benchmark set by resource allocation formulae (RAFs) (Rice and Smith, 2002, Smith, 2008, Diderichsen, 2004, McIntyre et al., 2007), or by assessing equity in the distribution of public health expenditure across beneficiaries according to their service use (Van de Walle and Nead, 1995, Demery, 2000). The first approach does not consider the consequences of resource allocation in terms of the final distribution of resources across beneficiaries, while the second approach fails to link the distribution of benefit directly to resource allocation practices. Therefore, the impact of resource allocation across geographic areas on the final distribution of public health expenditure across individuals has so far not been explored.

### *1.1.3. Efficiency in health care*

Efficiency in health care is concerned with the use of resources available to maximize the benefit, either in terms of health care delivery or health outcomes. Efficiency has been defined and analysed in three different ways (Palmer and D.J.Torgerson, 1999): technical, productive and allocative efficiency. Technical efficiency focuses on the use of given resources to maximize the otput. Economic or productive efficiency focuses on the choice of alternative combinations of resources to achieve the maximum health benefit for a given cost. Finally, allocative efficiency focuses on the mixture of healthcare programmes to maximise the health of society, accounting therefore for health service demand.

Benchmarking studies comparing the observed and optimal productivity of health care providers, and more recently of health systems at national and sub-national level, have been used to analyse technical and economic efficiency in the health sector (Hollingsworth, 2008, Jacobs et al., 2006). The analysis of efficiency in health care delivery has not linked the outcomes to resource allocation practices and the way in which the allocation of financial resources across geographic areas can influence efficiency has not been explored.

### *1.1.4. The equity-efficiency trade-off in health care resource allocation*

Equity and efficiency have long been debated in public finance as alternative criteria, and often presented as leading to a trade-off (Okun, 1975). A trade-off between efficiency and equity in resource allocation can arise because treating individuals with a higher level of need may imply higher costs (and require more resources) (Musgrove, 1999). In LMICs where inequalities in access to health care exists, the trade-off is likely to arise since providing the same service to individuals with the same need, but with higher constraints to service use, often implies higher costs (Mangham and Hanson, 2010). For example improving health care availability in remote and disadvantaged areas may be *per se* more expensive and less efficient than investing the same resources in better-off regions, as multiple costly interventions may be required to effectively reach the most disadvantaged populations (Victora et al., 2003, Tudor Hart, 1971, Gwatkin, 2005).

There is a growing consensus that both criteria of equity and efficiency should be taken into account in the analysis of resource allocation in the health care sector, and progress has been made towards the explicit incorporation of equity in the economic evaluation of public health interventions (Williams and Cookson, 2006, Cookson et al., 2009, Sassi et al., 2001a, Sassi et al., 2001b) or the explicit consideration of both criteria in public financing decision making (Glied, 2008, Culyer, 2006, Bevan, 2007). However, the equity-efficiency trade-off associated with geographical resource allocation has been mainly overlooked. In particular the mechanisms through which resource allocation across geographic areas affects the existing patterns of equity and efficiency in the distribution of public financial resources have not been jointly explored. Yet, anticipating the efficiency of the outcomes from alternative resource allocations, is critical to inform policy making towards a more effective use of resources.

### *1.1.5. Objectives of the thesis*

In this thesis I undertake an analysis of both equity and efficiency outcomes associated with the allocation of public resources for primary and secondary outpatient health care across local health administrations (geographic areas) in Mozambique. The thesis addresses the following specific questions:

1) To what extent is the current allocation of recurrent expenditure across local health authorities equitable?

2) How efficiently do local health authorities and health facilities perform their roles in managing financial resources and delivering health care?
3) How does the allocation of financial resources, reflected in health service availability, influence health care seeking behaviours of individuals?

## 1.2. Conceptual framework

The analysis developed in this thesis is based upon the conceptual framework presented in Figure 1.1, which follows a model of demand and supply for health care and aims to disentangle the mechanisms through which financial resources are transformed into benefit associated with utilisation.

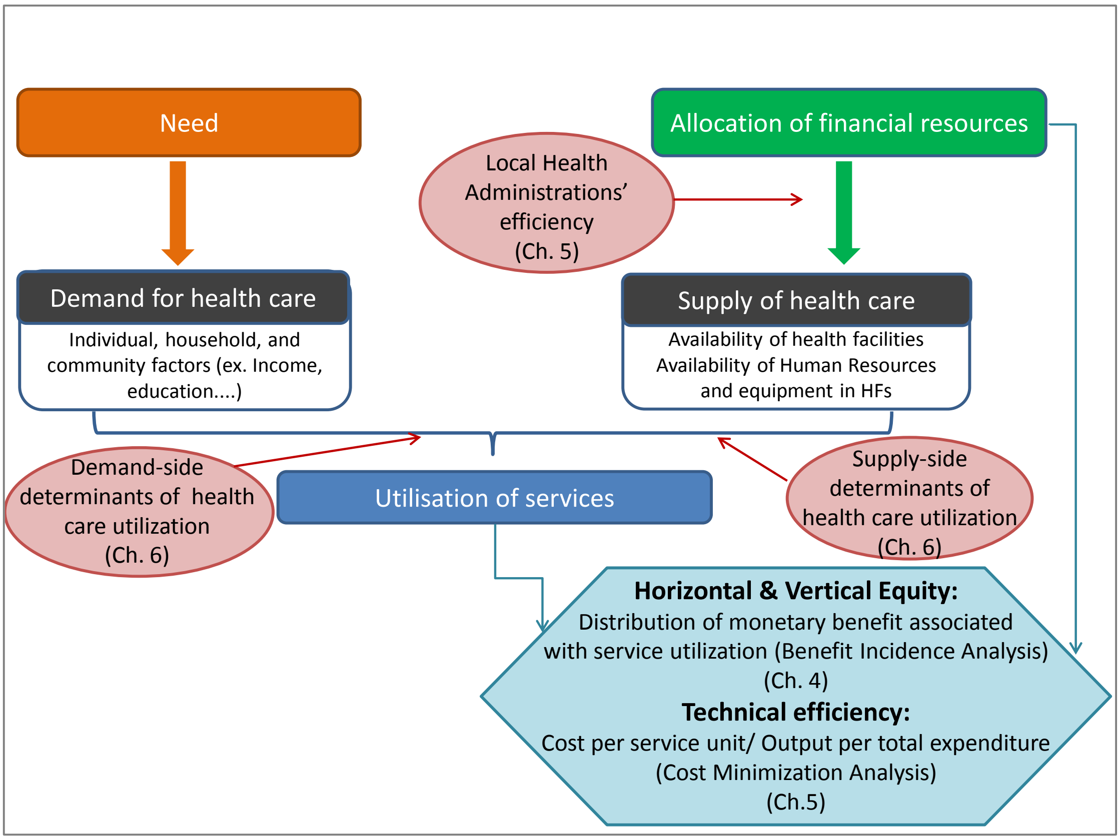
In this framework, 'need' is the leading determinant of demand for health care. The interactions between need and demographic and socio economic variables at the individual, household and community level, determines health seeking behaviour. Community level determinants of demand include, among others, access to health care, which depends on health facility (HF) coverage and their staffing and equipment (Black and Gruen, 2005).

The supply of health care depends greatly on resource allocation, since the latter determines the availability of infrastructure and other key health care inputs such as staff, equipment and drugs in a specific geographic area. Investment expenditure directly affects the number of HFs available, while the allocation of financial resources from central to local administrations determines the availability of other health care inputs, as well as of funding to support the running costs of HFs. The transformation of financial resources into inputs for health care provision depends, among other factors, on the efficiency of local health administration in using resources (Black and Gruen, 2005).

Following a benefit incidence analysis approach, equity in resource allocation, is defined as the correspondence between the distribution of need and the distribution of the individual benefit from health care expenditure, measured in monetary terms. The individual benefit from public expenditure depends on the frequency of utilisation and on the unit cost of the service used, estimated as the expenditure for each unit of service provided to the catchment population (Demery, 2000). Technical efficiency is defined as maximum output delivered (number of consultations realised) for given expenditure, or equivalently as the lowest unit cost per consultation realised.

In this framework, the allocation of financial resources across local health administrations affects benefit distribution and technical efficiency through two channels. Higher (lower) district expenditure is reflected first in a higher (lower) benefit provided to the catchment population, and second in a higher (lower) availability of staff and equipment in the existing HF, and therefore in a higher (lower) service use. The amount of service delivered, the unit cost and the final distribution of benefit can be influenced by resource allocation, but also by other demand and supply side policies incentivising service use.

**Figure 1.1 Analytical framework: Equity and Efficiency in resource allocation**




## 1.3. Outline of the thesis

This thesis follows a "by publication" format, in which each paper is presented in the format in which it has been published, submitted or written to be submitted to journals. Linking material between papers creates the necessary connections between thesis chapters and the overall conceptual framework that would be missing from academic papers, while appendices contain additional technical material used in the analysis and additional results produced. The thesis is structured in seven further chapters, four of which focus on a specific component of the conceptual framework, as illustrated in Figure 1.1 and described below.

Chapter 2 is a systematic literature review on equity in the allocation of financial resources in the public health sector, with a focus on low and middle-income countries. Two types of studies which populate the existing literature are identified and appraised. The first evaluates equity by comparing the share of resources allocated to different geographic areas to the ideally equitable share defined through resource allocation formulae, but does not investigate the consequences of such allocations on the distribution of benefit from health care across the population. The second type of studies uses benefit incidence analysis techniques to assess equity in the distribution of public health expenditure across the population, but does not relate results to resource allocation practices. Strengths and gaps of the existing literature are identified and discussed.

In Chapter 3, I present the context of this study, including the country setting and the data used. The organization of the public health sector and its financing in Mozambique, including resource allocation practices, are described. In this chapter also describes the five different sources of secondary data (all produced by national institutions) used for the analysisand the methods used to merge them.

In Chapter 4, I undertake an assessment of the evolution of equity in the allocation of financial resources for primary and secondary outpatient care across districts in Mozambique, in the period of study (2008 – 2011). The analysis is carried out using a benefit incidence analysis approach and differentiates the benefit according to the expenditure realised in district catchment areas. This allows to disentangle the service use and the resource allocation components of the observed inequity in benefit distribution. Both horizontal and vertical equity are assessed for both government and international donors' resources, alone and in conjunction.

In Chapter 5, I assess districts' efficiency in producing health care. First, in line with the existing literature, districts are considered as an integrated entity using financial, human and physical resources available to the existing HFs to deliver health care. Subsequently the efficiency of district administrations, which manage financial resources to make staff and equipment available into HFs, and the efficiency of HFs, which actually use those resources to deliver care, are analysed separately. Efficiency is evaluated using stochastic frontier analysis, an econometric technique comparing the realised output with what could have been produced for given inputs according to an estimated production frontier.

In Chapter 6, I investigate the determinants of outpatient health care utilisation among individuals reporting illness, and therefore considered in need of health care. A particular emphasis is placed on the effect of supply-side factors, defined by the type of HFs available and their level of staff and equipment with respect to the minimum set by norms, on the decision to seek care when ill. The causal relationship between the availability of staff and equipment and the decision to seek care is explored in more detail. The effect of demand-side determinants of health care seeking is also explored. The analysis is carried out on the full sample and on the sub-groups of individuals living close and far from HFs, to explore heterogeneity in the effects of the factors considered.

In Chapter 7, I discuss the results of my analysis and draw conclusions. First I summarize the findings of the thesis and then highlight the thesis' main contributions and limitations and identify areas for further research. I conclude presenting the policy implications of this research with respect to resource allocation practices (and their equity and efficiency implications) in the public health sector in Mozambique, and similar LMICs settings.

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# Chapter 2

# Equity in the allocation of public sector financial resources in low- and middle-income countries: a systematic literature review

### Preface

As a useful starting point for my thesis, I wanted to summarize in a systematic manner the existing literature on equity in the allocation of financial resources in public the health sector in low and middle income countries (LMICs).

While the focus of this thesis is the allocation of financial resources across geographic areas, given the relatively limited extent of the existing literature on that issue in LMICs, this review takes a broader perspective by not imposing restrictions on the units of resource allocation (e.g. geographic areas, levels of care, health programmes). There are two reasons for this choice. First, some studies with a broader focus on resource allocation may have included aspects related to the allocation across geographic areas, although not focusing directly on it. Second, a broader focus allows understanding how the analysis of the allocation of financial resources in the public health sector has been approached, what methods have been used and how they could be used to provide additional insights about my specific research question around allocation across geographic areas.

The chapter provides a starting point for the analysis of both equity and efficiency in the allocation of public health resources across geographic areas, by clearly identifying the approaches to the analysis of equity in the allocation of public health sector financial resources in LMICs, the methods used and the evidence produced.

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As the first author, I designed the study, including the methods used, searched, retrieved and assess the studies for review, extracted the data and undertook the meta-analysis, prepared and submitted the manuscript, and revised the manuscripts following comments from the journal's reviewers.

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REVIEW

# Equity in the allocation of public sector financial resources in low- and middle-income countries: a systematic literature review

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This review aims to identify, assess and analyse the evidence on equity in the distribution of public health sector expenditure in low- and middle-income countries.

Four bibliographic databases and five websites were searched to identify quantitative studies examining equity in the distribution of public health funding in individual countries or groups of countries. Two different types of studies were identified: benefit incidence analysis (BIA) and resource allocation comparison (RAC) studies. Quality appraisal and data synthesis were tailored to each study type to reflect differences in the methods used and in the information provided.

We identified 39 studies focusing on African, Asian and Latin American countries. Of these, 31 were BIA studies that described the distribution, typically across socio-economic status, of individual monetary benefit derived from service utilization. The remaining eight were RAC studies that compared the actual expenditure across geographic areas to an ideal need-based distribution. Overall, the quality of the evidence from both types of study was relatively weak. Looking across studies, the evidence confirms that resource allocation formulae can enhance equity in resource allocation across geographic areas and that the poor benefits proportionally more from primary health care than from hospital expenditure. The lack of information on the distribution of benefit from utilization in RAC studies and on the countries' approaches to resource allocation in BIA studies prevents further policy analysis.

Additional research that relates the type of resource allocation mechanism to service provision and to the benefit distribution is required for a better understanding of equity-enhancing resource allocation policies.

**Keywords** Equity, resource allocation, health financing, benefit incidence analysis, resource allocation formula

## KEY MESSAGES

- We find two types of studies assessing equity of public resource allocation: studies that consider the use of need-based allocation formulae and studies that look at the distribution of benefits from public health spending across socio-economic groups.
- Existing evidence suggests that need-based resource allocation formulae are likely to enhance equity across geographic areas. Existing evidence also suggests that public spending in primary health care is more equitable than spending in secondary care.
- Future research should include more information about resource allocation mechanisms and health system context.

# Introduction

The 2010 World Health Report identified three main barriers to universal health coverage (UHC): availability of resources, overreliance on direct payments and inefficient and inequitable use of resources. UHC may be defined as a set of final goals (utilization relative to need, quality services and universal financial protection) and intermediate objectives (equity in resource distribution, efficiency, transparency and accountability) (Kutzin 2013). Health financing arrangements are therefore central to achieving UHC, as it is through these mechanisms that resources are raised, financial risks and barriers to access are minimized, and services are purchased in ways that promote efficiency, eliminate waste and reduce inequalities in coverage (WHO 2010). In particular, reforms that promote equity in resource distribution may also improve utilization relative to need and financial protection (Kutzin 2013).

In low- and middle-income countries (LMICs) where physical and financial access remain important barriers to UHC, governments have the difficult task of trying to assure service access to all citizens. To achieve this objective, after they have collected and pooled financial resources from a mix of domestic and external sources, they have to make critical decisions on how to use these resources in an efficient and equitable manner through the purchase of health care services (WHO 2010). How to operationalize the objective depends on specific country settings and priorities, but the overall aim remains to match resources to relative need for health care across individuals (Kutzin 2013).

Resource allocation has been considered as part of the pooling function (Kutzinn 2001; McIntyre and Kutzin 2012), as part of the purchasing function (Rice and Smith 2002) or defined as meso-level purchasing (Robinson *et al*. 2005). In practice, resource allocation bridges the resource pooling and service purchasing functions, as governments typically have to make practical decisions about where to allocate their financial resources before they decide how to use them through various purchasing mechanisms. The allocation of resources across sub-national pools is crucial to redress inequities in the purchasing power of those institutions in charge of providing service to different population groups. Broadly speaking, governments decide how to allocate resources between different geographic entities and across the different levels of care (primary, secondary and tertiary). Systems for resource allocation differ in methods and criteria. Methods may be prospective and draw on resource allocation formulae (RAF) (particularly for geographic allocation) or other ad hoc criteria responding to specific needs, or retrospective and follow historical trends. Criteria are mostly efficiency or equity oriented. The allocation across geographic areas and services may happen simultaneously or sequentially, depending on the government administrative structure and degree of decentralization (Rice and Smith 2002; Green 2007).

Equity in resource distribution requires that individuals with the same need have access to the same resources (horizontal equity) and that individuals with greater need have access to more resources (vertical equity). Assessing equity therefore involves evaluating the match between supply- and demand-side features, namely, resource allocation and need. Equity across geographic entities may be assessed by judging whether differences in resources devoted to decentralized health authorities reflect differences in population needs or risks, as described by health or socio-economic indicators (McIntyre and Kutzin 2012). Equity across levels of care may be assessed only by considering population need for a specific type of service, which is unknown prior to consulting the health provider. Unlike equity across geographic areas, equity across levels of care may be assessed only after observing service utilization and evaluating the distribution of resources resulting from the match between allocation decisions and service utilization.

In spite of the critical importance of resource allocation decisions and a growing interest in equity, the empirical literature related to equity in resource allocation has yet to be synthesized in a comprehensive manner. To date, only two attempts have been made to summarize the evidence on equity in resource allocation, but these both focused on a specific geographic area and did not attempt to relate the use of resource allocation mechanisms to equity in the actual distribution of benefit across the population. The first focused on equity in geographic resource allocation in a number of eastern and southern African countries (McIntyre *et al*. 2007), while the second presented comparative evidence on the incidence of public health care spending in Asian countries (O'Donnell *et al*. 2007).

This review seeks to identify, assess and analyse systematically the evidence on equity in the distribution of public health sector expenditure in LMICs, in order to identify the implication in terms of equity of different mechanism for resource allocation across geographic areas and type of service.

# Methods

We followed the conventional three steps of a systematic literature review in searching the literature, extracting relevant information and assessing the quality of included papers. The approaches to extracting and synthesizing the information differed for the different types of study, due to the variation in methods and data used.

Four electronic databases were included in the search, and five websites were searched for additional grey literature. We used combinations of the words equity, allocation, expenditure, public health system and their synonyms in the searches. To maximize the pool of evidence, we did not apply any a priori restriction on specific resource allocation mechanisms, sources of expenditure or summary measure of equity used in the study. In doing so we guaranteed the inclusion of studies which, although not focusing explicitly on the consequences of resource allocation mechanisms, could indirectly provide insights through a quantitative assessment of equity in resource distribution. Other than restricting the evidence to LMICs, we did not put any geographical restriction in the search strategy. Finally, reference lists of all included studies were systematically screened and inclusion and exclusion criteria applied (Table 1).

The studies identified fell into two categories. The first type of studies took a normative approach and compared the actual expenditure (or budget allocation) across geographic areas to an 'ideal' equitable one where resources are distributed proportionally to need. We refer to these studies as 'resource allocation comparison' (RAC) studies. The second type of studies adopted a positive approach, describing the distribution of the financial benefit associated with health care use across individuals, typically ranked by socio-economic status (SES). We refer to these studies as 'benefit incidence analysis' (BIA) studies.

As a result of these fundamental differences in the research question and methods applied, data extraction (and synthesis) and quality appraisal were tailored to the two study types.

For RAC studies we compared results across countries and years in the form of the ratio of per capita resources of the best-off to the worst-off unit of analysis (province, district, etc.). For every allocation unit, per capita resources were calculated using the population weighted by health status or a deprivation index (as defined by the author) in order to account for differences in need across units. We called this measure the 'resource allocation inequality' (RAI) ratio. Since the measure of per capita expenditure is adjusted for need through population weighting, an RAI ratio of one reflects an allocation proportional to need across geographic areas and indicates equity, while greater values indicate larger inequity. When a study did not calculate the RAI ratio, we extracted data on actual budget/expenditure (in absolute or share value) and on the weighted population figures (per province or district) to calculate it ourselves. When data were presented in graphical form we extracted data through visual inspection of the

**Table 1** Search strategy

**Electronic databases searched:**

Pubmed, Econlit, Popline, Embase.

**Websites searched:**

World Bank (WB) Health Population and Nutrition (HPN), World Bank (WB) Policy Research Working Papers (PRWP).

**Combination of words and logic operators used to search in the electronic databases:**

(equity OR inequity OR equitable OR inequitable OR equal OR equalitarian OR unequal OR proportion OR proportional OR disproportional OR regressive OR progressive OR rich OR poor) AND (incidence OR distribution OR distributed OR allocation OR allocated) AND (expenditure OR expenditures OR spending OR resource OR resources OR benefit OR benefits OR subsidy OR subsidies OR subsidized OR subsidized OR funding OR fund OR funds OR financing) AND (public OR government OR state OR ''social health insurance'' OR ''national health insurance'') AND (''health system'' OR ''health systems'' OR ''health sector'' OR ''health care'' OR ''health service'').

**Search updated to:** 15 January 2013.

**Restriction on language:** none.

**Restriction on year of publication:** none.

**Inclusion criteria applied to title and abstract review:**
– quantitative studies;
– focus on resources distribution across individuals or groups;
– focus on one or multiple countries;
– focus on one or multiple regions in a country.

**Exclusion criteria applied to full text review**:
– results for public health sector (government funded institutions managing or providing health care services) could not be isolated from private sector;
– focus on a specific health programme;
– focus on a specific population group;
– determinants of equity in resource allocation were discussed but no assessment of the actual allocation was presented;
– an alternative and equitable resource allocation was discussed but no assessment of the actual allocation was presented;
– focus on non-financial resources (physicians, drugs, etc.);
– review of other studies (original study was searched and included);
– focus on high-income countries, identified according to the World Bank list of High-Income Economies (http://data.worldbank.org/about/country-classifications/country-and-lending-groups).

**Choice between similar studies found:**

the more detailed one and/or the one published in a peer-reviewed journal was chosen.

co-ordinates. We summarized the information through a scatter plot graph.

For BIA studies we compared results across levels (primary and hospital) and types (inpatient and outpatient) of health care service using the concentration index (CI) to summarize the distribution of benefits across wealth quintiles. For each country, year and level of service provision, the CI is calculated as the difference between the line of equality and the benefit concentration curve, which reports the cumulative shares for individuals ordered by wealth index. A positive (negative) CI indicates a pro-rich (pro-poor) benefit distribution. For those studies that did not report the CI, we calculated it. We extracted data on the distribution by wealth quintile reported by the authors, or we read it from the co-ordinates of the concentration curves. When information on the benefit was available for the poorest and richest quintiles only, we assumed the benefit to be proportionally distributed in the three intermediate quintiles. The following formula was applied for the calculation of the CI: $CI = (p_1L_2 - p_2L_1) + (p_2L_3 - p_3L_2) + (p_3L_4 - p_4L_3) + (p_4L_5 - p_5L_4)$, where $P_t$ is the cumulative percentage of the sample; $L_t$ is the concentration curve ordinate; and $t$ is the quintile of the sample ranked by socio-economic status (SES) (O'Donnell *et al*. 2008). We summarized the information through a scatter plot graph.

To assess the strength of the included studies we defined 10 criteria, five related to methods and five to data, allowing the detection of the main risks of bias in the data and methods used. Criteria were defined separately for BIA and RAC studies to account for differences in methods and data requirements, mostly related to the consideration of individual service utilization in BIA but not in RAC studies (see Table 2). Quality was assessed independently by two reviewers and disagreements were resolved through discussion. For every criterion a specific question was formulated. Each study received a score (0, 0.5 or 1 point) depending on whether the answer was 'no' or 'not reported,' 'not completely' or 'yes,' respectively. Each study could therefore score between 0 and 10. Studies that scored over 8.5 points were classified as providing strong evidence, between 6.5 and 8 as not very strong evidence, between 4.5 and 6 as weak evidence and 4 or below as very weak evidence.

# Results

Ten thousand four hundred four unique manuscripts were identified, and 94 were retained for full-text screening. We eventually included 39 papers (Figure 1).

## Description of included studies

Table 3 presents the main characteristics of the 39 included studies, of which 8 were RAC studies and 31 BIA studies.

Most studies focus on African and Asian countries and take a national-level perspective. Most RAC studies took a vertical equity approach and compare the actual allocation across geographic areas with an ideal one proportional to population weighted by need indicators. All BIA studies took a horizontal equity perspective and analysed the incidence across income quintiles of public health expenditure funded through government taxation, donor resources and/or National Health Insurance (NHI). Only four of these studies complemented the analysis with a vertical equity assessment of the incidence across quintiles of need defined according to individual self-assessed health status.

Overall the quality of the evidence presented was not very strong and the average quality assessment score was 6.2 out of 10 (6.4 and 6.1 for RAC and BIA studies, respectively). On average the quality of data (3.6 out of 5) was higher than the quality of methods used (2.5 out of 5). However, great variation was found for both types of studies (Table 4).

The studies retrieved fell into two broad categories according to the question asked and the method used: RAC and BIA studies.

RAC studies were used to assess equity in the geographic allocation of resources in settings characterized by a predominant public health sector and large inequalities in access to health care. In Latin America, decentralizing reforms of health systems were implemented during the 1990s (Bossert *et al*. 2003), drawing attention to monitoring equity in health and health policy (Arteaga *et al*. 2002) and the impact of decentralization (Bossert *et al*. 2003). All of the RAC studies reviewed from eastern and southern Africa were related to the development or evaluation of need-based resource allocation formulae, supported by Equinet Africa, the Regional Network on Equity in Health, which over the last decade has been promoting equity in health in the region (McIntyre *et al*. 2007). Resource allocation formulae serve to calculate the share of resources for each region based on a number of selected criteria, most commonly including population and health service workload, if the formula is efficiency oriented, or need indicators, if the formula is equity oriented.

RAC studies assessed equity by comparing the current allocation of resources to an ideal one proportional to the share of need for every unit of allocation. Only two studies implicitly referred to an ideal allocation based on population share alone (Arteaga *et al*. 2002; Bossert *et al*. 2003) while the remaining studies measured need through population weighted by demographic, socioeconomic or health status characteristics (McIntyre *et al*. 2007). Socio-economic status was measured through a mix of assets and housing characteristics, while health status was measured through disease incidence and mortality rates.

BIA studies were initially used by the World Bank in the 1990s to assess the redistributive effect of public expenditure across socioeconomic quintiles (Demery 2000) since social expenditure represented the main redistributive policy lever for many countries. From 2001 to 2005, the research conducted by the Equity in Asia and the Pacific (Equitap) project strengthened the use of BIA as a tool to assess equity in the health financing system as a whole (O'Donnell *et al*. 2007). The most recent wave of BIA studies (Akazili *et al*. 2012; Ataguba and McIntyre 2012; Chuma *et al*. 2012; Mtei *et al*. 2012) broadened the analysis to examine the distribution of benefit across individuals with different levels of need.

BIA studies assess the distribution of the monetary benefit from public expenditure received from individuals through health care utilization. Individuals are ranked by some dimension and the concentration of the distribution is measured to

**Table 2** Criteria for quality appraisal

**Resource allocation comparison studies**

**Methodology**

1) Are the variables used to calculate the ideal resource allocation explicitly reported and described?

YES: all the variables are listed and described;
NC: some of the variables are listed and described;
NO: none of the variables is listed and described.

2) Is the choice of the variables used to calculate the ideal resource allocation justified?

YES: The choice of every variable is justified;
NC: The choice of some variables is justified;
NO: The choice of none of the variables is justified.

3) Is the measure of need used for the ideal resource allocation based on one of the following: a health related index (e.g. morbidity); a SES index, if proved to be correlated with health status; an accepted policy?

YES: One of the listed measures is used;
NC: SES index is used but correlation with health status is not proved;
NO: None of the listed measures is used.

4) Is a visual or numeric measure of comparison between actual and ideal resource allocation reported?

YES: At least one of the measures is reported;
NC: At least one of the measures is partially reported or results to calculate the measure are reported;
NO: None of the measures is reported and results to calculate the measure are not reported.

5) Does the study define an interval within which an allocation can be deemed reasonably equitable (i.e. 'close enough' to the ideal resource allocation) and are results compared to this interval?

YES: The interval is defined and results are compared;
NC: The interval is defined but results are not explicitly compared;
NO: The interval is not defined.

**Data**

6) Are the data used described and the source reported?

YES: Brief description and source reported;
NC: Brief description or source reported;
NO: No description or sources reported.

7) Are there no reasons to think that data are affected by sampling bias?

YES: All data used are not affected by sampling bias;
NC: At less than half of the data sources are affected by sampling bias;
NO: More than half of the data sources are affected by sampling bias.
Note:
We consider not affected by sampling bias: Census, nationally and regionally representative survey data, NHI data if there are no specific selection criteria are applied.
We consider affected by sampling bias:
Income data from income taxation data, health information system data at local level, survey data from a non-random sample, expenditure data reported from local institutions.

8) Are there no reasons to think that data are affected by reporting bias?

YES: All data used are not affected by reporting bias;
NC: Less than half of the data sources are affected by reporting bias;
NO: More than half of the data sources are affected by reporting bias.
Note: We consider affected by reporting bias: self-assessed health status, income from personal income taxation data if the country was in the last 10 positions of the CPI (Corruption perception index) in 2001 (http://archive.transparency.org/policy_research/surveys_indices/cpi/2001). We use CPI 2011 since it is the most complete and close to the years of data from personal income taxation used in the studies.

9) Do data on public resources allocated report real expenditure (or budget allocation, if justified)?

YES: Data reflect real expenditure or budget allocation (if the research question focuses on allocation);
NC: Data on expenditure are used, but some disaggregation is estimated, or data on budget allocation are used while the research question focuses on expenditure;
NO: Data on budget allocation are used and disaggregated figures are estimated.

10) Are the variables used to calculate the ideal equitable allocation statistically representative with respect to the unit of allocation?

YES: All the variables are;
NC: Only some variables are;
NO: None of the variables are representative.

(continued)

**Table 2** Continued

**Benefit incidence analysis studies**

**Methodology**

1) Is the benefit distribution accounting for individual utilization of health care (number and type of visits)?

YES: Based on household survey data or database that reports the individual number and type of visits;
NC: Based on household survey data or database that reports only the individual type or number of visits;
NO: Not based on survey data or other survey.

2) Is the benefit distribution calculated accounting for seasonality in health care utilization?

YES: Seasonality correction is not needed or seasonality coefficients used are based on real reliable data, and not estimated;
NC: Seasonality coefficients are estimated and not based on real reliable data;
NO: Seasonality correction would be appropriate but it is not applied.

3) Is the unit cost diversified by level and type of care of health care and inpatient/outpatient service?

YES: The unit cost is differentiated by both dimensions;
NC: The unit cost is differentiated by only one dimension;
NO: The constant unit cost assumption is used.
Note: Even if disaggregated unit cost figures are not available, it is possible to estimate unit costs differentiated by level and type of health care.

4) Are the beneficiary units ranked according to a robust measure of the equity dimension addressed in the study?

For studies ranking individuals by SES:
YES: One of the following is used: consumption, expenditure or income (adjusted by adult equivalent); asset index (if variables included are justified);
NC: One of the following is used: consumption, expenditure or income (not adjusted by adult equivalent); asset index (if variables included are not justified);
NO: None of the above.
For studies ranking individuals by need for health care:
YES: An objective health measure is used;
NC: A self-assessed health measure is used;
NO: Other.

5) Are standard errors, level of statistical significance or dominance reported for the results obtained (if applicable)?

YES: They are reported for every result where it is applicable (based on sampled data);
NC: They are reported for some of the results where they are applicable;
NO: They are not reported for any of the results where they are applicable.

**Data**

6) Are the data used described and the source reported?

YES: A brief description and the source are reported;
NC: A brief description or the source are reported;
NO: Neither description or source are reported.

7) Are there no reasons to think that data are affected by sampling bias?

YES: Any of the data used is affected by sampling bias;
NC: Less than half of the data used are affected by sampling bias;
NO: More than half of the data used are affected by sampling bias.
Note:
We consider not affected by sampling bias: Census, nationally and regionally representative survey data, National Health Insurance data if there are no specific selection criteria.
We consider affected by sampling bias: Income data from income taxation database, Health Information System data at local level, survey data from a non random sample, expenditure data reported from local institution.

8) Are there no reasons to think that data are affected by reporting bias?

YES: Any of the data used is affected by reporting bias;
NC: Less than half of the data used are affected by reporting bias;
NO: More than half of the data used are affected by reporting bias.
Note:
We consider affected by reporting bias: self assessed health status, income from personal income taxation data if the country was in the last 10 positions of the CPI—Corruption perception index in 2001 (http://archive.transparency.org/policy_research/surveys_indices/cpi/2001). We use CPI 2001 since it is the most complete and temporally close to the years of data from personal income taxation used in the studies.

9) Do data on health care utilization distinguish by level of care and inpatient/outpatient service?

YES: Data distinguish by both dimensions;
NC: Data distinguish by only one dimension;
NO: Data do not distinguish for any of the dimensions.

10) Are data on the unit cost based on real expenditure and disaggregated by level or type of health care?

YES: Unit cost data are based on real expenditure and disaggregated by at least one of two dimensions: type and level of health care;
NC: Unit cost is not based on real expenditure but disaggregated by at least type or level of health care, or it is based on real expenditure but not disaggregated;
NO: Unit cost is not based on real expenditure and not disaggregated by any of the two dimensions.

NC = Not Completely.

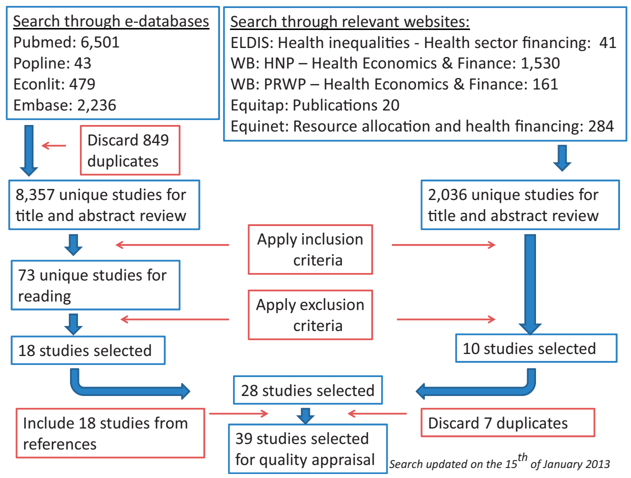


**Figure 1** Process for study selection

verify the extent of inequality. Data on the government subsidy (estimated as the unit cost of providing the service) by level and type of care obtained and data on individual service use are needed (Dayton 2001). The calculation of the individual benefit depends on the service unit cost and on the frequency of utilization. A variety of data and methods have been used for each of the steps included in the calculation (Demery 2000; Akazili et al. 2012), according to the research question and data availability. Most studies included in this review relied on estimates of government expenditure to calculate the unit cost, differentiated by level and type of health care (sixteen studies differentiating by both dimensions and the other nine by at least one of the two). The unit cost was differentiated only sometimes by region or province (six studies), so that benefit allocation across groups would reflect health care utilization patterns. Out-of-pocket payments were not considered. Health care utilization was measured using household survey data on the number of visits in the previous two weeks and annualizing them. Only six studies adjusted utilization figures for seasonality using reliable coefficients. Individuals were ranked by SES measured by household consumption or expenditure (not adjusted for household composition), or by asset index. All studies reported benefit incidence by quintile of population and seven also calculated the CI.

## What are the equity implications of different mechanisms for resource allocation across geographic areas and type of service?

The existing studies allow only two types of evidence to be synthesized: first, on the use of need-based resource allocation formula to distribute resources across geographic areas; and second, on the relative equity in the distribution of benefit from expenditure on primary vs specialized types of services.

Figure 2 presents the RAI extracted or calculated from RAC studies. We distinguished the administrative unit of allocation (province or district), the mechanism for resource allocation (use of resource allocation formulae) and the criteria used to set the benchmark equitable allocation (population, deprivation and/or health status).

The use of resource allocation formulae appears to have enhanced equitable allocation of resources across provinces or smaller administrative units, as shown in the case of Chile, Colombia, Zambia and Zimbabwe. No equity improvements were associated with the partial application of RAF, including the following situations: the formula was adopted for allocation across provinces but not across districts (Zambia district

**Table 3** Study characteristics

| Study characteristics | Number of RAC papers | Number of BIA papers | Total |
|---|---|---|---|
| **Publication** | **8** | **31** | **39** |
| Peer-reviewed journals | 4 | 13 | 17 |
| Other | 4 | 18 | 22 |
| **Geographic area** | **8** | **31** | **39** |
| Africa | 6 | 9 | 15 |
| South America | 2 | 7 | 9 |
| Asia | 0 | 12 | 12 |
| Middle East | 0 | 2 | 2 |
| More than one region (Africa, South America and Asia) | 0 | 1 | 1 |
| **Focus of analysis** | **8** | **31** | **39** |
| National | 6 | 28 | 34 |
| Sub-national | 2 | 1 | 3 |
| Partly sub-national due to data constraint | 0 | 2 | 2 |
| **Country/country comparison** | **8** | **31** | **39** |
| One country | 6 | 26 | 32 |
| Country comparison | 2 | 5 | 7 |
| **Research question** | **8** | **31** | **39** |
| Evaluate equity in health and health policy | 2 | 0 | 2 |
| Evaluate equity in resource allocation | 2 | 0 | 2 |
| Evaluate impact of decentralization | 1 | 0 | 1 |
| Evaluate implementation of RAF | 3 | 0 | 3 |
| General fiscal incidence | 0 | 7 | 7 |
| Targeting of public expenditure | 0 | 9 | 9 |
| Health and health policy | 0 | 3 | 3 |
| Incidence of health financing and/or spending | 0 | 12 | 12 |
| **Resources included in analysis** | **8** | **31** | **39** |
| Government (general taxation) | 5 | 24 | 29 |
| Government (NHI) | 0 | 0 | 0 |
| Donor | 2 | 1 | 3 |
| Government (general taxation and NHI) | 1 | 4 | 5 |
| Government and donor | 0 | 2 | 2 |
| **Unit of analysis (Resource beneficiary)** | **8** | **31** | **39** |
| Region/province | 3 | 0 | 3 |
| District/sub-district administration | 5 | 0 | 5 |
| Individuals | 0 | 31 | 31 |
| **Definition of equity (in resource allocation)** | **8** | **31** | **39** |
| Vertical | 5 | 0 | 5 |
| Horizontal | 2 | 27 | 29 |
| Both | 1 | 4 | 5 |

RAF = resource allocation formulae.

**Table 4** Study assessment

| Reference | Question | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Methodology | | | | | | Data | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | Subtotal | 6 | 7 | 8 | 9 | 10 | Subtotal | |
| **Resource allocation comparison studies** | | | | | | | | | | | | | |
| Arteaga *et al.* (2002) | 0.5 | 0 | 0 | 1 | 0 | 1.5 | 1 | 1 | 0.5 | 0 | 1 | 3.5 | **5** |
| Asante *et al.* (2006) | 1 | 1 | 1 | 1 | 0.5 | 4.5 | 1 | 1 | 1 | 1 | 1 | 5 | **9.5** |
| Bossert *et al.* (2003) | 0.5 | 0 | 0 | 1 | 0 | 1.5 | 0.5 | 1 | 0.5 | 1 | 1 | 4 | **5.5** |
| Chitah (2010) | 1 | 1 | 0.5 | 0.5 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 1 | **4** |
| McIntyre *et al.* (2007) | 1 | 0.5 | 1 | 1 | 0 | 3.5 | 0.5 | 0.5 | 0.5 | 1 | 1 | 3.5 | **7** |
| Philip (2004) | 1 | 1 | 1 | 1 | 0 | 4 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 3 | **7** |
| Semali and Minja (2005) | 0.5 | 0.5 | 0.5 | 1 | 0 | 2.5 | 0.5 | 1 | 1 | 0.5 | 1 | 4 | **6.5** |
| Zere *et al.* (2007) | 1 | 0.5 | 0 | 1 | 0 | 2.5 | 1 | 1 | 1 | 0.5 | 1 | 4.5 | **7** |
| **Average RAC** | **0.8** | **0.6** | **0.5** | **0.9** | **0.1** | **2.9** | **0.6** | **0.8** | **0.6** | **0.8** | **0.8** | **3.6** | **6.4** |
| **Benefit incidence analysis studies** | | | | | | | | | | | | | |
| Akazili *et al.* (2012) | 1 | 1 | 1 | 0.5 | 1 | 4.5 | 1 | 1 | 0.5 | 1 | 1 | 4.5 | **9** |
| ADB and World Bank (2002) | 1 | 0 | 0 | 0.5 | 0 | 1.5 | 0.5 | 1 | 1 | 0 | 0 | 2.5 | **4** |
| Ataguba and McIntyre (2012) | 1 | 1 | 1 | 0.5 | 1 | 4.5 | 1 | 1 | 0.5 | 1 | 1 | 4.5 | **9** |
| Baker (1997) | 0 | 0 | 0.5 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0.5 | 0 | 0.5 | **1** |
| Bitrán *et al.* (2000) | 1 | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 1 | 1 | 0.5 | 3.5 | **5.5** |
| Castro-Leal *et al.* (1999) | 1 | 0 | 0.5 | 0.5 | 0 | 2 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 2.5 | **4.5** |
| Chuma *et al.* (2012) | 1 | 1 | 1 | 0.5 | 1 | 4.5 | 1 | 1 | 0.5 | 1 | 1 | 4.5 | **9** |
| Dayton (2001) | 1 | 0 | 0.5 | 0.5 | 0 | 2 | 1 | 1 | 0.5 | 0.5 | 1 | 4 | **6** |
| Demery (2000) | 1 | 0.5 | 1 | 0.5 | 0 | 3 | 1 | 1 | 1 | 1 | 1 | 5 | **8** |
| Demery *et al.* (1995) | 1 | 0.5 | 1 | 0.5 | 0 | 3 | 1 | 1 | 1 | 1 | 1 | 5 | **8** |
| Devarajan and Hossain (1995) | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 1 | 1 | 0 | 0 | 2.5 | **2.5** |
| Ensor *et al.* (2002) | 0 | 0 | 0.5 | 0 | 0 | 0.5 | 0.5 | 0 | 0 | 0 | 0 | 0.5 | **1** |
| Granolati and Marini (2003) | 1 | 0 | 0.5 | 0.5 | 0 | 2 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 3 | **5** |
| Halasa *et al.* (2010) | 1 | 0 | 1 | 1 | 0 | 3 | 1 | 1 | 1 | 0.5 | 0.5 | 4 | **7** |
| Huang *et al.* (2007) | 1 | 1 | 1 | 1 | 0 | 4 | 1 | 1 | 0.5 | 1 | 0.5 | 4 | **8** |
| Johannes *et al.* (2006) | 1 | 0 | 0.5 | 0.5 | 0.5 | 2.5 | 0.5 | 1 | 0.5 | 0.5 | 0.5 | 3 | **5.5** |
| Lanjouw *et al.* (2001) | 1 | 0 | 1 | 0.5 | 0 | 2.5 | 1 | 1 | 1 | 1 | 0 | 4 | **6.5** |
| Leung *et al.* (2009) | 1 | 1 | 0 | 1 | 1 | 4 | 1 | 1 | 0.5 | 1 | 1 | 4.5 | **8.5** |
| Mahal *et al.* (2000) | 1 | 0 | 1 | 0.5 | 1 | 3.5 | 1 | 1 | 1 | 1 | 1 | 5 | **8.5** |
| Mangham (2006) | 1 | 0 | 0.5 | 0 | 0 | 1.5 | 0.5 | 1 | 1 | 0.5 | 0.5 | 3.5 | **5** |
| Mtei *et al.* (2012) | 1 | 1 | 1 | 1 | 1 | 5 | 1 | 0.5 | 0.5 | 1 | 0.5 | 3.5 | **8.5** |
| O'Donnell *et al.* (2007) | 1 | 0 | 1 | 1 | 1 | 4 | 1 | 1 | 1 | 0.5 | 1 | 4.5 | **8.5** |
| Prakongsai *et al.* (2009) | 1 | 0 | 1 | 1 | 0 | 3 | 1 | 1 | 1 | 0.5 | 1 | 4.5 | **7.5** |
| Rannan-Elya *et al.* (2000) | 1 | 0 | 1 | 1 | 0 | 3 | 1 | 1 | 1 | 1 | 1 | 5 | **8** |
| Sahn and Younger (1999) | 1 | 0 | 0.5 | 0.5 | 1 | 3 | 0.5 | 1 | 1 | 0.5 | 0 | 3 | **6** |
| Van de Walle (1992) | 1 | 0 | 1 | 0.5 | 0 | 2.5 | 1 | 1 | 1 | 1 | 1 | 5 | **7.5** |
| Wagstaff (2012) | 1 | 0 | 1 | 0.5 | 0 | 2.5 | 1 | 1 | 1 | 1 | 1 | 5 | **7.5** |
| World Bank (1997) | 0.5 | 0 | 0 | 0.5 | 0 | 1 | 0.5 | 1 | 1 | 0.5 | 0 | 3 | **4** |
| World Bank (1998) | 1 | 0 | 0.5 | 0.5 | 0 | 2 | 1 | 1 | 1 | 1 | 0.5 | 4.5 | **6.5** |
| World Bank (2003) | 0 | 0 | 0.5 | 1 | 0 | 1.5 | 0 | 0 | 0.5 | 0.5 | 0.5 | 1.5 | **3** |
| World Bank (2004) | 0 | 0 | 0 | 0.5 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **0.5** |
| **Average BIA** | **0.8** | **0.2** | **0.7** | **0.5** | **0.3** | **2.5** | **0.8** | **0.8** | **0.7** | **0.7** | **0.6** | **3.5** | **6.1** |
| **Average ALL** | **0.8** | **0.3** | **0.6** | **0.6** | **0.2** | **2.6** | **0.7** | **0.8** | **0.7** | **0.7** | **0.6** | **3.6** | **6.2** |

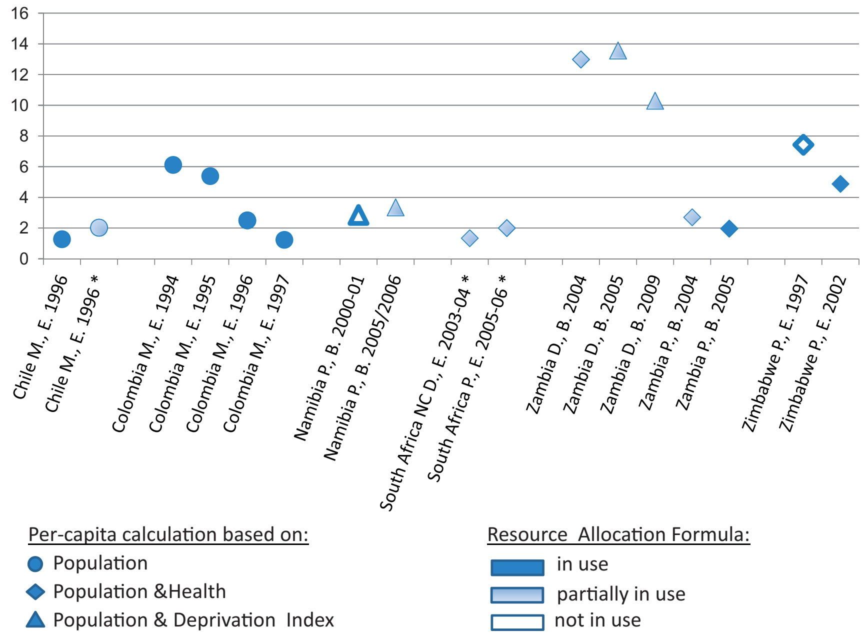


**Figure 2** Resource allocation inequality ratios
Note: ''*'' Refers to central and local government health expenditure; ''D.'' refers to districts, ''P.'' refers to provinces, ''NC D.'' refers to Northern Cape districts, ''M'' refers to municipalities; ''E.'' refers to expenditure, ''A.'' refers to budget allocation. Resource Allocation Formula: ''in use'' refers to situations where it is applied to determine allocation across Provinces; ''partially in use'' refers to situations where: it is applied at Provincial but not district level, it has been approved but it is not used yet, it has been in use for a short time.

allocation); the formula was defined but not applied (Namibia); the formula was defined and applied to government resources allocated from central to peripheral level but did not account for local revenues (South Africa and Chile).

Most studies had a minimal description of the data used and their sources, and the limited availability of good data on health care need and on detailed expenditure, constrained the quality of the evidence base. A weak measure of need for health care (based on deprivation indices) was often used in the calculation of the benchmark allocation. In assessing the quality of the studies, we considered it important to demonstrate the correlation between deprivation and health status, in order to demonstrate that those in the most deprived areas have a greater need for health care an need more health service resources. We therefore considered deprivation indices a weak measure of need for health care when the correlation with health status was not explicitly discussed. None of the studies presented a measure summarizing the gap between the actual and the equitable allocation across units of allocation or defined a threshold for assessing how equitable an allocation is.

Figure 3 shows the CIs of the benefit distribution from health care expenditure for the total public health service and/or disaggregated by level (primary and hospital) and type (inpatient and outpatient) of health care. Information on the source of funding (general taxation, national health insurance, donor) is also reported.

The distribution of total health care expenditure appeared to be slightly pro-rich, with CIs varying between around −0.3 and 0.4. When only inpatient or outpatient care is considered, the range is reduced to −0.15 to 0.15, with the exception of one case in which inpatient care benefits appeared to be slightly more pro-poor (−0.2). Unsurprisingly, the distribution of the benefit from primary health care utilization (with CIs ranging from −0.45 to 0.2) appears to be more equitable than that of hospital care, where CIs ranged from −0.15 to almost 0.5 with the exception of two specific cases of hospital inpatient and outpatient expenditure for which CIs are around −0.3. No important differences appear to exist between inpatient and

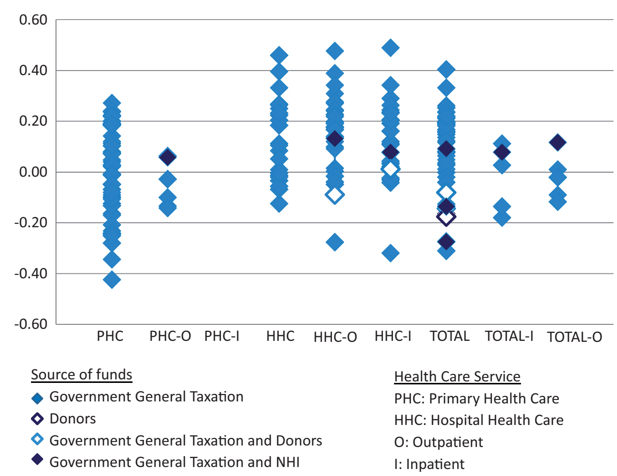


**Figure 3** Concentration indices per type of service
Note: Results from studies not reporting the CI or shares of public expenditure across SES were not included.

outpatient care. Expenditure funded through donor resources appears to be more pro-poor than government expenditure funded through general taxation or national health insurance, which in particular appears to be more pro-rich.

The quality of the evidence base is limited both by data quality and availability and by methodological problems. Reporting bias is likely to affect measures of self-assessed health status in household survey data since the poor may be less critical towards their health status (Demery *et al*. 1995; Mtei *et al*. 2012). Health facility or local administration data may be biased, for example if the less functional units underreport their workload, activities and expenditure (Demery *et al*. 1995; Demery 2000). The lack of expenditure data disaggregated by geographic area, type and level of care may lead to the use of assumptions, such as constant unit cost, that may substantially affect the final results (Demery 2000; Wagstaff 2012). In a number of studies differences are not tested statistically; health care utilization is not corrected for seasonality (Demery 2000); measures of socio-economic status do not account for household composition (Demery 2000); and finally, assumptions about unit cost by type and level of service do not necessarily reflect real differences in the value of the service (Demery 2000). The distribution of benefits across household quintiles may consequently overstate the extent to which it is pro-poor, since poorer households, having generally more populated, have a higher aggregate probability of service utilization (Lanjouw *et al*. 2001). Additionally, the quality and length of treatment may systematically differ across socio-economic groups, with the poor being the worst-off (Demery 2000).

## Discussion

This review has appraised and summarized the evidence on equity in resource allocation in LMICs. Two main approaches were used to analyse equity. The first is normative studies (RAC) that focus on the equity of resource allocation across geographic areas, while the second is positive studies (BIA) that examine equity in the distribution of the (publicly funded) benefit deriving from health care utilization. Of thirty-nine studies selected for appraisal, eight used RAC and thirty-one used BIA. We used a quality checklist to screen all the included studies and we found only a moderate quality, with a mean score of 6.2 out of 10 for both types of studies. The evidence analysed confirms that resource allocation formulae can help to increase equity in resource allocation across geographic areas (McIntyre *et al*. 2007) and that primary health care expenditure is more pro-poor than hospital expenditure (Castro-Leal *et al*. 1999). However, the variety in methods and data and the quality of studies prevent us from drawing strong policy recommendations.

This review is limited in the extent to which it can draw conclusions. First, it does not present evidence on the equity implication of all methods and criteria that may be followed in resource allocation in the public health sector. Merely the use of need-based formulae for geographic allocation and the distribution of benefit from primary vs specialized health care were considered in the studies retrieved. No evidence is available on the use of prospective efficiency-based or retrospective resource allocation mechanisms nor on the consequences of resource allocation decisions on primary vs specialized health care expenditure (and the associated benefit distribution). This first limitation derives from the scope of the existing studies (see Table A1), which do not address directly the equity consequences of resource allocation mechanisms, rather tend to provide an assessment of the country situation. Although a number of studies present assessments at different points in time revealing changes that could have been driven by financial reforms, the link is not explicitly investigated.

Second, the study results derive from a variety of health financing arrangements and health system architectures, in diverse countries and in different time periods, which limit their comparability. Furthermore, RAC studies differ in terms of the unit of allocation (provincial or lower administrative level), the use of allocation formulae and the definition of the equitable target allocation. BIA studies differ in terms of the source of funding considered, the service classification and the measures of health care utilization, unit cost and socio-economic status.

The evidence underlines the complexity of making resource allocation decisions that result in equitable distributions across population groups with different needs. The allocation across geographic entities based on resource allocation formulae incorporating equity considerations, when fully applied, can yield an equitable resource allocation *ex ante*. However, the existence of multiple barriers to service use on the demand side (particularly for secondary or tertiary care) makes equitable resource allocation *ex post* much harder to achieve. A number of other factors constrain the equity achievements of resource allocation formulae. Resource allocation formulae are helpful in identifying under-resourced areas, but they fail to account for cost differences in service provision at local level, which may not be incorporated into a formula. Moreover, resource allocation formulae generally apply to recurrent expenditure without accounting for the absorptive capacity of each geographic area or for the investment required to expand service provision. Finally, in most studies need is defined according to a measure of deprivation that includes health and other dimensions. However, addressing deprivation indirectly through health care expenditure is not necessarily the most effective way and a more careful analysis of the sources of deprivation might suggest investing resources in other sectors to prevent ill health.

Evidence from BIA studies suggests that resources spent on primary care are more equitably distributed than those spent on specialized inpatient care. This result stems from a combination of the most expensive services being provided by hospitals and the more intense utilization of hospital services by the richer population. Policy implications may therefore indicate need for both higher expenditure on primary care in the short run and for increased investment in inpatient and specialized care to make it more accessible for the poor. Complementary interventions may be required to incentivize utilization among the poor who would benefit from it. The evidence also indicates that donor expenditure is more pro-poor than national government spending. However, caution is required in interpreting this finding, due to the small number of studies and since complementarities in resource allocation may accommodate donor preferences to support pro-poor services, while national government resources fund the remaining services. Finally, BIA focuses on financial benefit, which may obscure heterogeneity in the type and quality of services provided. Indeed, differences in efficiency or other non-financial aspects (e.g. management practices) may yield provision of completely different health care services across populations.

Future RAC studies should consider using measures of health care need based on objectively assessed health status, such as mortality rates and disease prevalence, and which account for the absorptive capacity of administrative units. The geographic distribution of financial resources is often related to management capacity as well as to the presence of health facilities and human resources. Increasing resources alone does not ensure that they will be well spent and that the service provided to the population will be expanded and its quality improved. Future BIA studies should use better information on service utilization and unit cost differentiation by geographic area and service type. Decomposition of CIs into the components related to utilization and different sources of expenditure should be done more often in benefit incidence analysis. Studies from settings with an important incidence of out-of-pocket payments should separately assess the incidence of the gross benefit from public expenditure and of the out-of-pocket payments to understand their relative role in determining the net benefit distribution. A vertical equity perspective should also be incorporated and the distribution of benefit evaluated according to need. Finally, future BIA studies should also rely on better data. In particular, information about the length of inpatient stay and individuals' health status should be collected in household surveys, and public expenditure records should provide a higher level of disaggregation. This calls for a strengthening of national routine data collection and the use of a core set of standardized indicators and categorizations to enable international comparisons

Finally, since the two bodies of evidence presented here appear to be complementary but not connected, the analysis of how the process of health service production is affected by resource allocation and how in turn this affects equity in the distribution of benefits should be promoted. The inclusion in BIA studies of more information about resource allocation policies being applied, and in RAC studies about barriers to service provision and utilization may contribute to close the gap in the existing evidence.

# Conclusion

The literature reviewed confirms the conventional wisdom that both the application of resource allocation formulae and higher expenditure on primary health care may lead to greater equity in the use of public financial resources. However, this review reveals the inadequacy of the existing body of literature to support policy makers' decisions on resource allocation reforms. The lack of information on countries' approaches to resource allocation in BIA studies and the lack of assessment of the actual benefit distribution across individuals in RAC studies prevent the linking of resource allocation policy and practices with equity outcomes. The development of a body of literature devoted to the understanding of the implications of different resource allocation mechanisms for the attainment of the UHC goals should be encouraged. The application of standardized formats in health information systems should also be promoted to allow easier inter-temporal and international benchmarking.

# Supplementary Data

Supplementary data are available at *HEAPOL* online.

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# Appendix

**Table A1.** Study information including concentration indices and resource allocation inequality ratio

| Reference | Country | Research question | Unit of allocation | Equity definition used | Measure of need/SES | Type of funds | Methods quality | Data quality | Total quality | Resource allocation inequality ratio/ Concentration Index |
|---|---|---|---|---|---|---|---|---|---|---|
| **RAC studies** | | | | | | | | | | |
| Arteaga *et al.* (2002) | Chile | Evaluate equity in health and health policy including resource allocation | Municipalities (Comunas) | Horizontal | Population | Government (taxation) | 1.5 | 3.5 | 5 | |
| Asante *et al.* (2006) | Ghana (Ashanti and Northern Regions) | Evaluate equity in resource allocation | District | Horizontal and Vertical | Population weighted by deprivation index | Donor | 4.5 | 5 | 9.5 | |
| Bossert *et al.* (2003) | Colombia and Chile | Evaluate impact of decentralization | Municipalities | Horizontal | Population | Government (taxation and NHI) | 1.5 | 4 | 5.5 | Chile 1996, RAI: 1.27<br>Chile 1996, RAI: 2.02<br>Colombia 1994, RAI: 6.11<br>Colombia 1995, RAI: 5.39<br>Colombia 1996, RAI: 2.5<br>Colombia 1997, RAI: 1.23 |
| Chitah (2010) | Zambia | Evaluate implementation of RAF | Districts | Vertical | Population weighted by deprivation index | Government (taxation) | 3 | 1 | 4 | Zambia 2004, RAI: 12.99<br>Zambia 2005, RAI: 13.57<br>Zambia 2009, RAI: 10.30 |
| McIntyre *et al.* (2007) | South Africa, Namibia, Zambia, Zimbabwe | Evaluate implementation of RAF | Provinces | Vertical | Namibia: population weighted by deprivation index. South Africa: population weighted by deprivation index Zambia: population weighted by deprivation index Zimbabwe: population weighted by infant and maternal mortality rate, tuberculosis incidence rate, service coverage, immunization rates and availability of grain per capita. | Government (taxation) | 3.5 | 3.5 | 7 | Namibia 2000/2001, RAI: 2.85<br>Namibia 2005/2006, RAI: 3.35<br>Zambia 2004, RAI: 2.70<br>Zambia 2005, RAI: 1.97<br>Zimbabwe 1997, RAI: 7.43<br>Zimbabwe 2002, RAI: 4.88<br>South Africa 2005/2006, RAI: 2.00 |
| Philip (2004) | South Africa (Northern Cape) | Evaluate equity in resource allocation | Districts | Vertical | Public health sector dependent population weighted by proportional need of people on medical aid for public sector primary health care, socio economic and demographic indicators. | Government (taxation) | 4 | 3 | 7 | South Africa (Northern Cape) 2003/2004, RAI: 1.34 |
| Semali and Minja (2005) | Tanzania | Evaluate implementation of RAF | Districts | Vertical | Population weighted by deprivation index. | Donor | 2.5 | 4 | 6.5 | |
| Zere *et al.* (2007) | Namibia | Evaluate equity in health and health policy including resource allocation | Provinces | Vertical | Population weighted by deprivation index. | Government (taxation) | 2.5 | 4.5 | 7 | |
| **BIA studies** | | | | | | | | | | |
| Akazili *et al.* (2012) | Ghana | Incidence of health financing and/or spending | Individuals | Horizontal and vertical | Household asset index | Government (taxation and NHI) | 4.5 | 4.5 | 9 | Ghana 2008, TOTAL, GTGRNHI, CI: 0.09*<br>Ghana 2008, PHCOUT, GTGRNHI, CI: 0.06<br>Ghana 2008, GTGRNHI, CI: 0.11<br>Ghana 2008, GTGRNHI, CI: −0.01<br>Ghana 2008, GTGRNHI, CI: 0.21<br>Ghana 2008, GTGRNHI, CI: 0.16<br>Ghana 2008, HHCOUT, GTGRNHI, CI: 0.13<br>Ghana 2008, HHCIN, GTGRNHI, CI: 0.08<br>Ghana 2008, TOTALOUT, GTGRNHI, CI: 0.12<br>Ghana 2008, TOTALIN, GTGRNHI, CI: 0.08 |

(continued)

**Table A1.** Continued

| Reference | Country | Research question | Unit of allocation | Equity definition used | Measure of need/SES | Type of funds | Methods quality | Data quality | Total quality | Resource allocation inequality ratio/ Concentration Index |
|---|---|---|---|---|---|---|---|---|---|---|
| ADB (2002) | Bangladesh | Targeting of public expenditure | Individuals | Horizontal | Household per capita expenditure | Government (taxation and donor) | 1.5 | 2.5 | 4 | Bangladesh 2000, TOTAL, GTGRDR, CI: 0.08*<br>Bangladesh 2000, GTGRDR, CI: 0.05*<br>Bangladesh 2000, GTGRDR, CI: 0.12*<br>Bangladesh 2000, GTGRDR, CI: 0.09*<br>Bangladesh 2000, GTGRDR, CI: −0.05* |
| Ataguba and McIntyre (2012) | South Africa | Incidence of health financing and/or spending | Individuals | Horizontal and Vertical | Household asset Index | Government (taxation) | 4.5 | 4.5 | 9 | South Africa 2006, GGR, CI: 0.03*<br>South Africa 2006, PHCOUT, GGR, CI: −0.13<br>South Africa 2006, GGR, CI: −0.22<br>South Africa 2006, GGR, CI: −0.14<br>South Africa 2006, GGR, CI: 0.01<br>South Africa 2006, GGR, CI: 0.05<br>South Africa 2006, GGR, CI: 0.23<br>South Africa 2006, GGR, CI: 0.34<br>South Africa 2006, HHCOUT, GGR, CI: 0.02<br>South Africa 2006, HHCIN, GGR, CI: 0.11<br>South Africa 2006, TOTALOUT, GGR, CI: −0.02<br>South Africa 2006, TOTALIN, GGR, CI: 0.11<br>South Africa 2006, TOTAL, GGR, CI: 0.06 |
| Baker (1997) | Caribbean: Guyana, Jamaica, Trinidad and Tobago, S.Lucia | Targeting of public expenditure | Individuals | Horizontal | Not Available | Government (taxation) | 0.5 | 0.5 | 1 | Guyana 1993, HHC, GGR, CI: −0.03*<br>Guyana 1993, PHC, GGR, CI: −0.09*<br>Guyana 1993, PHC, GGR, CI: −0.42*<br>Guyana 1993, GGR, CI: 0.21*<br>Jamaica 1988, HHC, GGR, CI: 0.01*<br>Jamaica 1988, PHC, GGR, CI: −0.17*<br>Trinidad and Tobago 1992, HHC, GGR, CI: −0.01*<br>Trinidad and Tobago 1992, PHC, GGR, CI: 0.11*<br>S.Lucia 1995, HHC, GGR, CI: −0.12*<br>S.Lucia 1995, PHC, GGR, CI: −0.07* |
| Bitrán *et al.* (2000) | Chile | Health and health policy | Individuals | Horizontal | Income | Government (taxation) | 2 | 3.5 | 5.5 | |
| Castro-Leal *et al.* (1999) | Cote d'Ivoire, Ghana, Guinea, Kenya, Madagascar, Tanzania, South Africa | Targeting of public expenditure | Individuals | Horizontal | Household per capita expenditure | Government (taxation) | 2 | 2.5 | 4.5 | Cote d' Ivoire 1995, PHC, GGR, CI: 0.14*<br>Cote d' Ivoire 1995, HHCOUT, GGR, CI: 0.31*<br>Cote d' Ivoire 1995, TOTAL, GGR, CI: 0.24*<br>Ghana 1992, PHC, GGR, CI: 0.24*<br>Ghana 1992, HHCOUT, GGR, CI: 0.24*<br>Ghana 1992, HHCIN, GGR, CI: 0.24*<br>Ghana 1992, TOTAL, GGR, CI: 0.24*<br>Guinea 1994, PHC, GGR, CI: 0.27*<br>Guinea 1994, HHCOUT, GGR, CI: 0.48*<br>Guinea 1994, TOTAL, GGR, CI: 0.40*<br>Kenya 1992, PHC, GGR, CI: 0.02*<br>Kenya 1992, HHCOUT, GGR, CI: 0.18*<br>Kenya 1992, TOTAL, GGR, CI: 0.16*<br>Madagascar 1993, PHC, GGR, CI: 0.22*<br>Madagascar 1993, HHCOUT, GGR, CI: 0.20*<br>Madagascar 1993, TOTAL, GGR, CI: 0.21*<br>Tanzania 1993, PHC, GGR, CI: 0.10*<br>Tanzania 1993, HHCOUT, GGR, CI: 0.27*<br>Tanzania 1993, HHCIN, GGR, CI: 0.19*<br>Tanzania 1993, TOTAL, GGR, CI: 0.17*<br>South Africa 1994, PHC, GGR, CI: 0.03*<br>South Africa 1994, HHCOUT, GGR, CI: 0.10*<br>South Africa 1994, TOTAL, GGR, CI: 0.09* |
| Chuma *et al.* (2012) | Kenya | Incidence of health financing and/or spending | Individuals | Horizontal and vertical | Asset index | Government (taxation) | 4.5 | 4.5 | 9 | Kenya 2003, PHC, GGR, CI: −0.10<br>Kenya 2003, HHCOUT, GGR, CI: 0.09<br>Kenya 2003, HHCIN, GGR, CI: 0.12<br>Kenya 2003, TOTAL, GGR, CI: 0.08 |

(continued)

**Table A1.** Continued

| Reference | Country | Research question | Unit of allocation | Equity definition used | Measure of need/SES | Type of funds | Methods quality | Data quality | Total quality | Resource allocation inequality ratio/ Concentration Index |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Kenya 2007, PHC, GGR, CI: −0.17<br>Kenya 2007, HHCOUT, GGR, CI: 0.18<br>Kenya 2007, HHCIN, GGR, CI: −0.03<br>Kenya 2007, TOTAL, GGR, CI: −0.00 |
| Dayton (2001) | Nicaragua (Managua, Pacific, Central and Atlantic regions for health expenditure) | General fiscal incidence | Individuals | Horizontal | Household per capita expenditure | Government (taxation) | 2 | 4 | 6 | Nicaragua (Managua, Pacific, Central and Atlantic regions)<br>1993, PHC, GGR, CI: 0.04*<br>Nicaragua (Managua, Pacific, Central and Atlantic regions)<br>1993, HHC, GGR, CI: 0.22*<br>Nicaragua (Managua, Pacific, Central and Atlantic regions)<br>1993, TOTAL, GGR, CI: 0.15*<br>Nicaragua Managua Region 1998, PHC, GGR, CI: 0.18*<br>Nicaragua Managua Region 1998, HHC, GGR, CI: 0.40*<br>Nicaragua Managua Region 1998, TOTAL, GGR, CI: 0.33*<br>Nicaragua Pacific Region 1998, PHC, GGR, CI: −0.13*<br>Nicaragua Pacific Region 1998, HHC, GGR, CI: 0.08*<br>Nicaragua Pacific Region 1998, TOTAL, GGR, CI: −0.02*<br>Nicaragua Central Region 1998, PHC, GGR, CI: −0.23*<br>Nicaragua Central Region 1998, HHC, GGR, CI: −0.068*<br>Nicaragua Central Region 1998, TOTAL, GGR, CI: −0.17*<br>Nicaragua Atlantic Region 1998, PHC, GGR, CI: −0.21*<br>Nicaragua Atlantic Region 1998, HHC, GGR, CI: −0.02*<br>Nicaragua Atlantic Region 1998, TOTAL, GGR, CI: −0.14* |
| Demery (2000) | Bulgaria, Ghana, Vietnam | General fiscal incidence | Individuals | Horizontal | Per capita 'welfare' | Government (taxation) | 3 | 5 | 8 | Bulgaria 1995, PHC, GGR, CI: 0.07*<br>Bulgaria 1995, HHCOUT, GGR, CI: 0.17*<br>Bulgaria 1995, TOTAL, GGR, CI: 0.14*<br>Ghana 1992, PHC, GGR, CI: 0.19*<br>Ghana 1992, HHCOUT, GGR, CI: 0.19*<br>Ghana 1992, HHCIN, GGR, CI: 0.20*<br>Ghana 1992, TOTAL, GGR, CI: 0.19*<br>Vietnam 1993, PHC, GGR, CI: −0.12*<br>Vietnam 1993, HHCOUT, GGR, CI: 0.28*<br>Vietnam 1993, HHCIN, GGR, CI: 0.11*<br>Vietnam 1993, TOTAL, GGR, CI: 0.16* |
| Demery *et al.* (1995) | Ghana | General fiscal incidence | Individuals | Horizontal | Per capita 'welfare' | Government (taxation) | 3 | 5 | 8 | Ghana 1989, HHCOUT, GGR, CI: 0.23*<br>Ghana 1989, HHCIN, GGR, CI: 0.16*<br>Ghana 1989, PHC, GGR, CI: 0.21*<br>Ghana 1989, TOTAL, GGR, CI: 0.20*<br>Ghana 1992, HHCOUT, GGR, CI: 0.19* |

(continued)

**Table A1.** Continued

| Reference | Country | Research question | Unit of allocation | Equity definition used | Measure of need/SES | Type of funds | Methods quality | Data quality | Total quality | Resource allocation inequality ratio/ Concentration Index |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Ghana 1992, HHCIN, GGR, CI: 0.21*<br>Ghana 1992, PHC, GGR, CI: 0.19*<br>Ghana 1992, TOTAL, GGR, CI: 0.19* |
| Devarajan and Hossain (1995) | Philippines | General fiscal incidence | Individuals | Horizontal | NA | Government (taxation) | 0 | 2.5 | 2.5 | |
| Ensor *et al.* (2002) | Bangladesh | Targeting of public expenditure | Individuals | Horizontal | NA | Donor | 0.5 | 0.5 | 1 | Bangladesh 2000, TOTAL, DR, CI: −0.18* |
| Granolati and Marini (2003) | Guatemala | Health and health policy | Individuals | Horizontal | Consumption | Government (taxation) | 2 | 3 | 5 | Guatemala 2000, HHC,GGR, CI: 0.11*<br>Guatemala 2000, PHC,GGR, CI: −0.10*<br>Guatemala 2000, PHC,GGR, CI: −0.34*<br>Guatemala 2000, PHC,GGR, CI: −0.28*<br>Guatemala 2000, TOTAL, GGR, CI: 0.03* |
| Halasa *et al.* (2010) | Jordan | Incidence of health financing and/or spending | Individuals | Horizontal | Asset index | Government (taxation and NHI) | 3 | 4 | 7 | Jordan 2000, TOTAL, GTGRNHI, CI: −0.27* |
| Huang *et al.* (2007) | Taiwan | Incidence of health financing and/or spending | Individuals | Horizontal | Income per capita | Government (taxation and NHI) | 4 | 4 | 8 | |
| Johannes *et al.* (2006) | Cameroon | General fiscal incidence | Individuals | Horizontal | Household per capita expenditure | Government (taxation) | 2.5 | 3 | 5.5 | Cameroon 2001, GGR, CI: −0.28*<br>Cameroon 2001, GGR, CI: −0.19*<br>Cameroon 2001, GGR, CI: 0.06*<br>Cameroon 2001, GGR, CI: 0.18*<br>Cameroon 2001, GGR, CI: 0.38* |
| Lanjouw *et al.* (2001) | Indonesia | Targeting of public expenditure | Individuals | Horizontal | Consumption per capita, not adjusted | Government (taxation) | 2.5 | 4 | 6.5 | Indonesia 1998, PHC, GGR, CI: −0.03*<br>Indonesia 1998, HHC, GGR, CI: 0.27*<br>Indonesia 1998, TOTAL, GGR, CI: 0.19* |
| Leung *et al.* (2009) | Hong Kong | Incidence of health financing and/or spending | Individuals | Horizontal | Income equivalent | Government (taxation) | 4 | 4.5 | 8.5 | |
| Mahal *et al.* (2000) | India | Incidence of health financing and/or spending | Individuals | Horizontal | Per capita consumption | Government (taxation) | 3.5 | 5 | 8.5 | India 1998, GGR, CI: 0.22*<br>India 1998, GGR, CI: 0.31*<br>India 1998, GGR, CI: 0.04*<br>India 1998, GGR, CI: −0.07*<br>India 1998, TOTAL, GGR, CI: 0.26* |
| Mangham (2006) | Malawi | Incidence of health financing and/or spending | Individuals | Horizontal | NA | Government (taxation) | 1.5 | 3.5 | 5 | Malawi 2005, TOTAL, GGR, CI: 0.05*<br>Malawi 2005, HHC, GGR, CI: 0.11*<br>Malawi 2005, PHC, GGR, CI: −0.01* |
| Mtei *et al.* (2012) | Tanzania | Incidence of health financing and/or spending | Individuals | Horizontal and Vertical | Asset index | Government (taxation) | 5 | 3.5 | 8.5 | Tanzania 2008, PHCOUT, GGR, CI: −0.1<br>Tanzania 2008, GGR, CI: 0.15<br>Tanzania 2008, GGR, CI: −0.14<br>Tanzania 2008, GGR, CI: −0.13<br>Tanzania 2008, HHCOUT, GGR, CI: 0.14<br>Tanzania 2008, HHCIN, GGR, CI: 0.29<br>Tanzania 2008, HHC, GGR, CI: 0.25<br>Tanzania 2008, TOTALOUT, GGR, CI: 0.01<br>Tanzania 2008, TOTALIN, GGR, CI: 0.027<br>Tanzania 2008, TOTAL, GGR, CI: 0.03<br>Tanzania 2008, GGR, CI: 0.01* |
| O'Donnell *et al.* (2007) | Bangladesh, China (Gansu and Heilonjiang), Hong Kong SAR, India, | Incidence of health financing and/or spending | Individuals | Horizontal | Household adult equivalent consumption/ expenditure | Government (taxation) | 4 | 4.5 | 8.5 | Bangladesh 2000, HHCIN, GGR, CI: 0.23<br>Bangladesh 2000, HHCOUT, GGR, CI: 0.14<br>Bangladesh 2000, PHC, GGR, CI: 0.05<br>Bangladesh 2000, TOTAL, GGR, CI: 0.16<br>Gansu (China) 2003, HHCIN, GGR, CI: 0.24 |

(continued)

**Table A1.** Continued

| Reference | Country | Research question | Unit of allocation | Equity definition used | Measure of need/SES | Type of funds | Methods quality | Data quality | Total quality | Resource allocation inequality ratio/ Concentration Index |
|---|---|---|---|---|---|---|---|---|---|---|
| | Indonesia, Malaysia, Nepal, Sri Lanka, Thailand, Vietnam | | | | | | | | | Gansu (China) 2003, HHCOUT, GGR, CI: 0.12<br>Gansu (China) 2003, PHC, GGR, CI: 0.12<br>Gansu (China) 2003, TOTAL, GGR, CI: 0.20<br>Heilongjiang (China) 2003, HHCIN, GGR, CI: 0.03<br>Heilongjiang (China) 2003, HHCOUT, GGR, CI: 0.22<br>Heilongjiang (China) 2003, PHC, GGR, CI: 0.22<br>Heilongjiang (China) 2003, TOTAL, GGR, CI: 0.26<br>Hong Kong Special Administrative Region 2002, HHCIN, GGR, CI: −0.32<br>Hong Kong SAR 2002, HHCOUT, GGR, CI: −0.28<br>Hong Kong SAR 2002, PHC, GGR, CI: −0.24<br>Hong Kong SAR 2002, TOTAL, GGR, CI: −0.31<br>India 1996, HHCIN, GGR, CI: 0.26<br>India 1996, HHCOUT, GGR, CI: 0.00<br>India 1996, PHC, GGR, CI: −0.13<br>India 1996, TOTAL, GGR, CI: 0.21<br>Indonesia 2001, HHCIN, GGR, CI: 0.49<br>Indonesia 2001, HHCOUT, GGR, CI: 0.39<br>Indonesia 2001, PHC, GGR, CI: −0.01<br>Indonesia 2001, TOTAL, GGR, CI: 0.18<br>Malaysia 1996, HHCIN, GGR, CI: −0.04<br>Malaysia 1996, HHCOUT, GGR, CI: −0.02<br>Malaysia 1996, PHC, GGR, CI: −0.241<br>Malaysia 1996, TOTAL, GGR, CI: −0.08<br>Nepal 1996, HHCIN, GGR, CI: 0.34<br>Nepal 1996, HHCOUT, GGR, CI: 0.34<br>Nepal 1996, PHC, GGR, CI: 0.19<br>Nepal 1996, TOTAL, GGR, CI: 0.25<br>Sri Lanka 1997, HHCIN, GGR, CI: 0.02<br>Sri Lanka 1997, HHCOUT, GGR, CI: −0.05<br>Sri Lanka 1997, PHC, GGR, CI: −0.05<br>Sri Lanka 1997, TOTAL, GGR, CI: −0.00<br>Thailand 2002, HHCIN, GGR, CI: −0.02<br>Thailand 2002, HHCOUT, GGR, CI: −0.04<br>Thailand 2002, PHC, GGR, CI: −0.25<br>Thailand 2002, TOTAL, GGR, CI: −0.04<br>Vietnam 1998, HHCIN, GGR, CI: 0.04<br>Vietnam 1998, HHCOUT, GGR, CI: 0.17<br>Vietnam 1998, PHC, GGR, CI: −0.11<br>Vietnam 1998, TOTAL, GGR, CI: 0.01 |
| Prakongsai *et al.* (2009) | Thailand | Incidence of health financing and/or spending | Individuals | Horizontal | Asset index (Principal component analysis) | Government (taxation and NHI) | 3 | 4.5 | 7.5 | Thailand 2001, TOTAL, GTGRNHI, CI: −0.14<br>Thailand 2003, TOTAL, GTGRNHI, CI: −0.28 |
| Rannan-Elya *et al.* (2000) | Egypt | Incidence of health financing and/or spending | Individuals | Horizontal | Per capita consumption equivalent | Government (taxation) | 3 | 5 | 8 | Egypt 1995, GGR, CI: 0.01*<br>Egypt 1995, GGR, CI: 0.17*<br>Egypt 1995, GGR, CI: 0.05*<br>Egypt 1995, GGR, CI: 0.15*<br>Egypt 1995, TOTAL, GGR, CI: 0.08* |
| Sahn and Younger (1999) | Cote d' Ivoire, Ghana, Guinea, Madagascar, Mauritania, South Africa, Tanzania, Uganda | General fiscal incidence | Individuals | Horizontal | Per capita expenditure (no equivalent) | Government (taxation) | 3 | 3 | 6 | Cote d'Ivoire 1985, HHC, GGR, CI: 0.18*<br>Cote d'Ivoire 1985, PHC, GGR, CI: −0.01*<br>Ghana 1993, HHC, GGR, CI: 0.20*<br>Ghana 1993, PHC, GGR, CI: 0.08*<br>Guinea1994, HHC, GGR, CI: 0.46*<br>Guinea1994, PHC, GGR, CI: 0.08*<br>Madagascar 1993, HHC, GGR, CI: 0.33*<br>Madagascar 1993, PHC, GGR, CI: 0.19*<br>Mauritania 1996, HHC, GGR, CI: −0.06* |

(continued)

**Table A1.** Continued

| Reference | Country | Research question | Unit of allocation | Equity definition used | Measure of need/SES | Type of funds | Methods quality | Data quality | Total quality | Resource allocation inequality ratio/ Concentration Index |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Mauritania 1996, PHC, GGR, CI: −0.05*<br>South Africa 1993, HHC, GGR, CI: −0.00*<br>South Africa 1993, PHC, GGR, CI: −0.08*<br>Tanzania 1995, HHC, GGR, CI: 0.23*<br>Tanzania 1995, PHC, GGR, CI: 0.07*<br>Uganda 1992, HHC, GGR, CI: 0.05*<br>Uganda 1992, PHC, GGR, CI: 0.03* |
| Van de Walle (1992) | Indonesia | Targeting of public expenditure | Individuals | Horizontal | Per capita consumption/ expenditure | Government (taxation) | 2.5 | 5 | 7.5 | Indonesia 1978, TOTAL, GGR, CI: 0.24*<br>Indonesia 1987, TOTAL, GGR, CI: 0.12* |
| Wagstaff (2012) | Vietnam | Targeting of public expenditure | Individuals | Horizontal | Per capita consumption | Government (taxation) | 2.5 | 5 | 7.5 | Vietnam 2005, GGR, CI: −0.40<br>Vietnam 2005, GGR, CI: −1.06<br>Vietnam 2005, GGR, CI: 0.04<br>Vietnam 2005, GGR, CI: −0.04<br>Vietnam 2005, GGR, CI: −0.01<br>Vietnam 2005, PHCOUT, GGR, CI: −0.14<br>Vietnam 2005, PHCOUT, GGR, CI: 0.06<br>Vietnam 2005, HHCOUT, GGR, CI: 0.24<br>Vietnam 2005, HHCIN, GGR, CI: 0.01<br>Vietnam 2005, TOTAL, GGR, CI: 0.12<br>Vietnam 2005, GGR, CI: −0.12<br>Vietnam 2005, GGR, CI: 0.12<br>Vietnam 2005, GGR, CI: 0.31<br>Vietnam 2005, GGR, CI: 0.16<br>Vietnam 2005, GGR, CI: 0.22<br>Vietnam 2005, GGR, CI: −0.12<br>Vietnam 2005, GGR, CI: 0.12<br>Vietnam 2005, GGR, CI: 0.45<br>Vietnam 2005, GGR, CI: 0.35<br>Vietnam 2005, GGR, CI: 0.39<br>Vietnam 2005, GGR, CI: −0.03<br>Vietnam 2005, GGR, CI: 0.48<br>Vietnam 2005, GGR, CI: 0.52<br>Vietnam 2005, GGR, CI: 0.46<br>Vietnam 2005, GGR, CI: 0.48 |
| World Bank (1997) | Costa Rica | Targeting of public expenditure | Individuals | Horizontal | Income per capita | Government (taxation) | 1 | 3 | 4 | Costa Rica 1986, TOTALIN, GGR, CI: −0.18*<br>Costa Rica 1986, TOTALOUT, GGR, CI: −0.09*<br>Costa Rica 1986, GGR, CI: −0.15*<br>Costa Rica 1986, TOTAL, GGR, CI: −0.17*<br>Costa Rica 1992, TOTALIN, GGR, CI: −0.14*<br>Costa Rica 1992, TOTALOUT, GGR, CI: −0.12*<br>Costa Rica 1992, GGR, CI: −0.34*<br>Costa Rica 1992, TOTAL, GGR, CI: −0.13* |
| World Bank (1998) | Honduras | Health and health policy | Individuals | Horizontal | Income per capita | Government (taxation) and donors | 2 | 4.5 | 6.5 | Honduras 1995, TOTAL, GTGRDR, CI: −0.13*<br>Honduras 1995, GTGRDR, CI: −0.19*<br>Honduras 1995, HHCOUT, GTGRDR, CI: −0.09*<br>Honduras 1995, HHCIN, GTGRDR, CI: 0.08*<br>Honduras 1995, HHCIN, GTGRDR, CI: 0.04* |
| World Bank (2003) | Armenia | General fiscal incidence | Individuals | Horizontal | Consumption per capita | Government (taxation) | 1.5 | 1.5 | 3 | Armenia 1999, HHC, GGR, CI: 0.26*<br>Armenia 1999, PHC, GGR, CI: 0.10*<br>Armenia 1999, PHC, GGR, CI: 0.24*<br>Armenia 1999, TOTAL, GGR, CI: 0.22* |
| World Bank (2004) | Brazil | Targeting of public expenditure | Individuals | Horizontal | Consumption per capita | Government (taxation) | 0.5 | 0 | 0.5 | Brazil 1997, TOTAL, GGR, CI: 0.04* |

*Notes*: PHC: Primary Health Care; HHC: Hospital Health Care; IN: Inpatient; OUT: Outpatient; TOTAL: Inpatient and outpatient; TOTIN: Total Inpatient; TOTOUT: Total Outpatient; DR: Donor Resources; GGR: General Government Resources; GTGRDR: General Taxation Government Resources and Donors Resources; GTGRNHI: General Taxation Government Resources and National Health Insurance. CIs are repeated for Bangladesh 2000, Ghana 1992, Guinea 1994, Madagascar 1993 since they were extracted from different studies. CIs for Vietnam were calculated based on the assumption of fees proportional to use. The CI for Bangladesh 2000 is the population weighted average of the CIs calculated for males and females.

*Identifies CI calculated by the authors based on quintile distribution as reported in the study or as read from histogram or concentration curve co-ordinates.

# Chapter 3
# Study setting

### 3.1. Mozambique: background notes

Mozambique is a Sub-Saharan country with a population of 23 million. The country is divided in 11 provinces, including Maputo City, the capital, which alone has almost two million inhabitants (Figure 3.1). Provinces are subdivided in districts, administrative posts and localities. In 2009, excluding Maputo City, the country had 142 districts and 1,272 localities, whose number can vary between one and 22 per district. Districts' population ranges between 14,000 and 560,000 inhabitants, while localities' population ranges between 250 and 50,000 people, except for few urban localities which have up to 150,000 inhabitants (INE, 2008).

After independence from Portugal in 1975, the country was involved in a long civil war which lasted until the peace agreement was signed in 1992. Since then Mozambique has enjoyed peace and a sustained economic growth, consistently over 6% annually, and up to 11% in real terms in some years. This is reflected in the improvement of socio-economic indicators. For example, between 1997 and 2007, the GDP rose from 236 to 454 USD per-capita, the population living below the poverty line decreased from 69% to 55%, the primary school completion rate rose from 22% to 77%, with an enrolment rate up to 80% (MPD, 2010).

### 3.2. Inequalities in health and health care

Health indicators have also remarkably improved over the last 20 years. Infant mortality was reduced from 106 to 64 per thousand live-births and under-five mortality (U5M) from 158 to 97 per thousand live-births between 1996 and 2011 (MISAU et al., 2013). However, life expectancy is still low (49 years), and the burden of disease is still high and mostly constituted by preventable and curable diseases, most notably HIV/AIDS, malaria and respiratory diseases, which together represent over 60% of the current burden of disease (IHME, 2013). The same diseases, as well as maternal, neonatal, and nutritional causes of death constitute the major causes of U5M (MISAU et al., 2013).

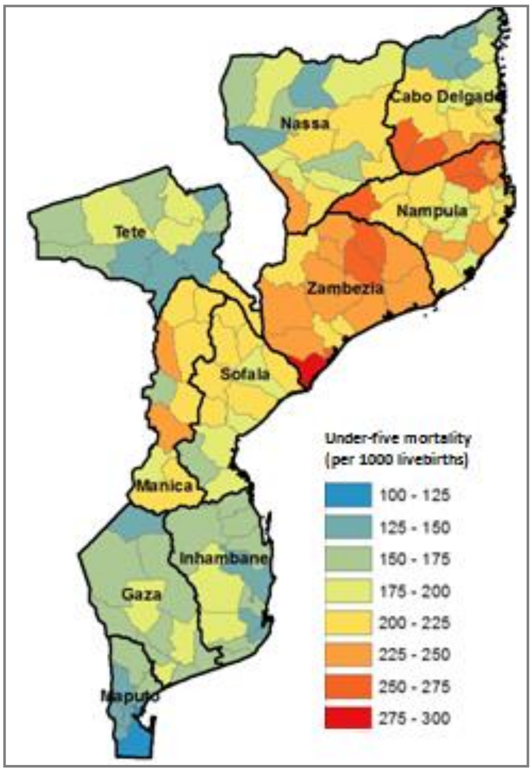
**Figure 3.1 Political map of Mozambique, including provinces and provincial capitals**


*Source: (Fernandes et al., 2014)*

However, these national figures hide important differences across geographic areas and socio-economic status (MISAU and TARSC/EQUINET, 2010). For example, HIV prevalence in 2009 varied between 3.7% in Niassa and 25.1% in Gaza (INS et al., 2010). U5M varies between 58 per 1,000 livebirths in Inhambane and 142 per 1,000 livebirths in Zambezia, and between 129 and 91 per 1,000 livebirths in the poorest and richest quintiles in the period 2000-2011 (MISAU et al., 2013). If differences in health indicators are high across provinces, they are even higher across districts. For example, U5M estimates vary between 103 and 291 per 1,000 livebirths across districts in the whole country, as illustrated in Figure 3.2, and up to over two-folds differences across districts in the same province (between 128 and 271 per 1,000 livebirths in Cabo Delgado) . Inequalities in health indicators appear to be related not only to socio-economic and environmental factors (Macassa et al., 2012, Macassa et al., 2003), but also to the availability of health care (Fernandes et al., 2014).

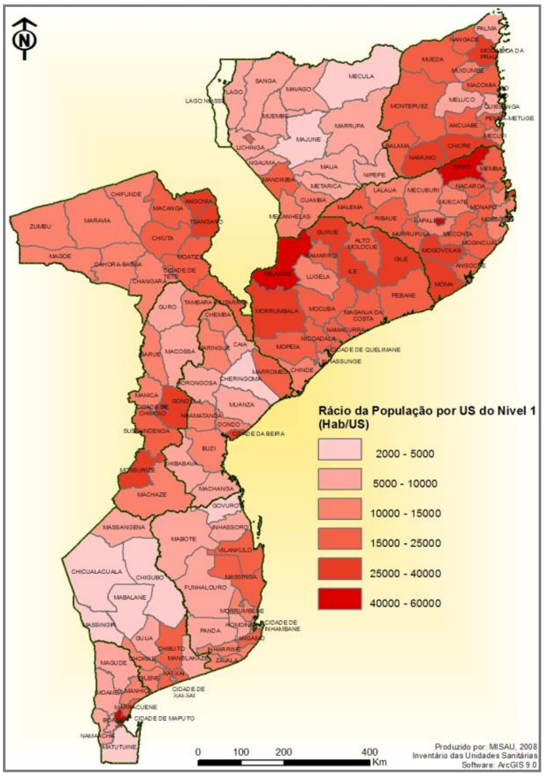
The national health sector coverage and the availability of material, human and financial resources, are quite heterogeneous across geographic areas (MISAU, 2013a), across provinces and even more across districts. As an example, Figure 3.3 shows the unequal distribution of HFs across districts (each colour indicates a different ratio of population per primary care HF). Looking at the two figures below allows the visual comparison of the distribution of HFs with the differences in U5M, showing that health care availability is not proportional to the potential need for health care. HF coverage, health workforce density and government financing have increased between 2000 and 2010. However, heterogeneity across provinces has remained quite high and is associated with differences in the reduction of U5M (Fernandes et al., 2014).

**Figure 3.2 Under-five mortality by district, Mozambique 2007**




*Source: Authors' elaboration from(INE, 2010a).*

**Figure 3.3 Population per primary health care facility by district, Mozambique 2007**




*Source: (MISAU, 2007)*

Providing an equitable access to quality health care, with an emphasis on child and maternal care, is the main priority of the Government (MISAU, 2013b). One of the key aims of the first health sector financing strategy, currently under development, is to redress inequities in the allocation of resources across geographic areas by promoting, among other actions, the equitable allocation of financial resources (MISAU and TARSC/EQUINET, 2010, MISAU, 2012b).

### 3.3. National Health System

Health care provision in Mozambique is predominantly publicly funded and provided (MISAU, 2012c). The health sector inherited from the colonial legacy, focused on curative care and centred in the provincial capitals (Walt and Melamed, 1983), was disrupted by civil war and has been undergoing a gradual reconstruction since the peace agreement in 1992, with a significant involvement of international donors (Pavignani and Durao, 1999). The sustained and progressive expansion of the health sector led to an increase in the number of facilities (from around 500 in 1975 to 1,210 in 2004 and to 1,392 in 2011) and in the number of doctors (from about 75 in 1975 to 424 in 2000 and 1,106 in 2010) (Walt and Melamed, 1983, MISAU, 2012c).

Central, provincial and district levels constitute the backbone of the top-down hierarchical National Health System (NHS) organization. Primary and secondary care is managed at district level. Primary care is provided through 1,314 type I and type II health centres (HC), which in the thesis will be referred to as HC and clinics. Secondary care is provided through 66 rural, general and district hospitals, which will be referred as district hospitals (DH). All district facilities provide basic primary outpatient care, while HCs provide primary and inpatient care and DHs also provide surgery. Specialised care is managed at provincial level and provided by seven provincial hospitals and three central hospitals, located in Beira, Nampula and Maputo, which also serve as regional referral facilities. The core functions and minimum requirements for each type of facilities are defined by law and are currently under revision (MISAU, 2002, MISAU, 2012c). Although increasing in number, there are only a few private clinics, which, at the time covered by this work, were concentrated mostly in the capital. Non-profit and community organizations generally support public health centres or hospitals (MISAU, 2012c).

A referral system is in place. Clinics represent the first point of contact and at least one DH or HC is available in each district as the reference facility, generally located in the main urban centre. The catchment areas of most primary health facilities (HFs), 8 Km for clinics, fall within the district and locality administrative boundaries and around 60% of the population has access to a HF within 1 hour walking distance. As long as the referral system is respected, user fees and drugs charges in public HFs are very low (MZM 2 and MZM 1 for outpatient consultation in urban and rural areas, MZM 5 for all drug prescriptions and MZM 10 per day for inpatient care, equivalent to USD 0.07, USD 0.04, USD 0.16, USD 0.32 respectively). Pre and post-natal care, institutional delivery, prevention of sexually transmitted diseases, care for children, pregnant women, malaria, TB and HIV/AIDS, chronic diseases, elderly and extremely poor people are exempted from charges for outpatient and inpatient care. Despite of official regulation, practices of unofficial payments are reported (MISAU, 2012c).

While the Ministry of Health (MoH) has the important role of defining policies, promoting health and supervising all national health sector activities, most of the activities are implemented at the provincial and district level. Since the decentralization reform, which began in 2007, provincial and districts administrations have been allocated progressively more responsibilities. In collaboration with provincial health administrations, district health administrations are increasingly involved in the definition of policies and activities at local level and in the management of financial and non-financial resources, as well as in hiring human resources to guarantee that HFs have the means to operate and deliver good quality services (MISAU, 2012c).

### 3.4. NHS financing and resource allocation

In 2011, total health expenditure in Mozambique was estimated to be over USD 850 million, representing around 6% GDP and corresponding to USD 27 per capita. According to the latest National Health Account (MISAU, 2010), in 2006 the majority of resources in the health sector came from public sources, including both government revenues, mostly collected through general taxation (about 35%), and donor funding (about 50%). Only about 15% of resources come from private sources, through out-of-pocket payments, which are mostly channelled through private providers. A small percentage of out-of-pocket payments is directed to public sector user fees and drugs charges collected by public HFs as a mean of cost recovery. An insurance scheme covering civil servants is in place and revenues are earmarked for medicine procurement (MISAU, 2012c).

The majority of resources is pooled and allocated by Mozambican public institutions, namely the Ministry of Finance (MoF) and the MoH, at various levels. The financial flow follows the hierarchical structure of the sector, as illustrated in Figure 3.4. The state budget is allocated by the MoF and the Ministry of Planning and Development (MPD) to the MoH and, since the implementation of the financial decentralization reform in 2007, to provincial directorates of health (managed at provincial level but spent on district health care) or directly to district administrations.

One-third of donor funding, which represents over 50% of health sector expenditure, is allocated through a pooled common fund (called PROSAUDE) earmarked to the health sector but not to specific health activities (MISAU, 2010, MISAU, 2012c, MISAU, 2012a). The rest of donor funding is made up of earmarked projects, some implemented in partnership with the MoH central administration and some with HFs or local health administrations (MISAU, 2011). PROSAUDE resources are managed by the MoH and allocated to national, provincial and district directorates of health to top-up the state. Earmarked funds are managed directly by donors, with a variable degree of involvement of local institutions. Other donor funds support activities implemented at provincial and district level, but these resources are often either difficult to track in a systematic way, or not managed by district administrations and remain off-budget and unquantified (MISAU, 2012c).

Government and donor agencies endorsed the objectives of the health sector strategic plan 2007-2012 of expanding access, improving the quality of health care and promoting equity. However, how, and according to which principles, health resources should be allocated to pursue these objectives, has never been discussed and agreed by the relevant stakeholders In a context where multiple funders and resource managers exist, it is not possible to identify a unique principle underpinning health resource allocation and therefore an agreed methodology consistent with it. To date, the MoF, MoH and donors allocate their resources across geographic areas and across health programs according to their priorities. In a setting where resources are scarce, the priority of the government is to maintain the existing health facilities working, enabling them to provide the best service they can, and whenever possible to expand the service by promoting outreach activities or building new facilities. Donor priorities and commitments to funding vary greatly from one year to another. The mechanisms influencing resource allocation across geographic areas are illustrated below with reference to the allocation of recurrent and investment expenditure, as well as drugs and medical equipment.

Recurrent expenditure is funded through government provincial and district expenditure and donor pooled common fund, each allocated according to different criteria. The budget for recurrent expenditure is elaborated on an institutional base and resources are allocated by the MoF, MPD of MoH across provincial directorates of health, following a historical and incremental approach. The MoF allocates government resources and defines the budgets for provincial governments. Additional resources are allocated discretionarily, according to the provincial activity plans, the priorities defined by the government for each year and the absorptive capacity of each province, as documented by the MoF budget expenditure reports. The MoH tops up the MoF allocations with funding from the donor's common fund, to attempt avoiding leaving planned activities unfunded. Until recently a resource allocation formula, first elaborated in the 90's, including service delivery units (0.35 weight), number of beds (0.25

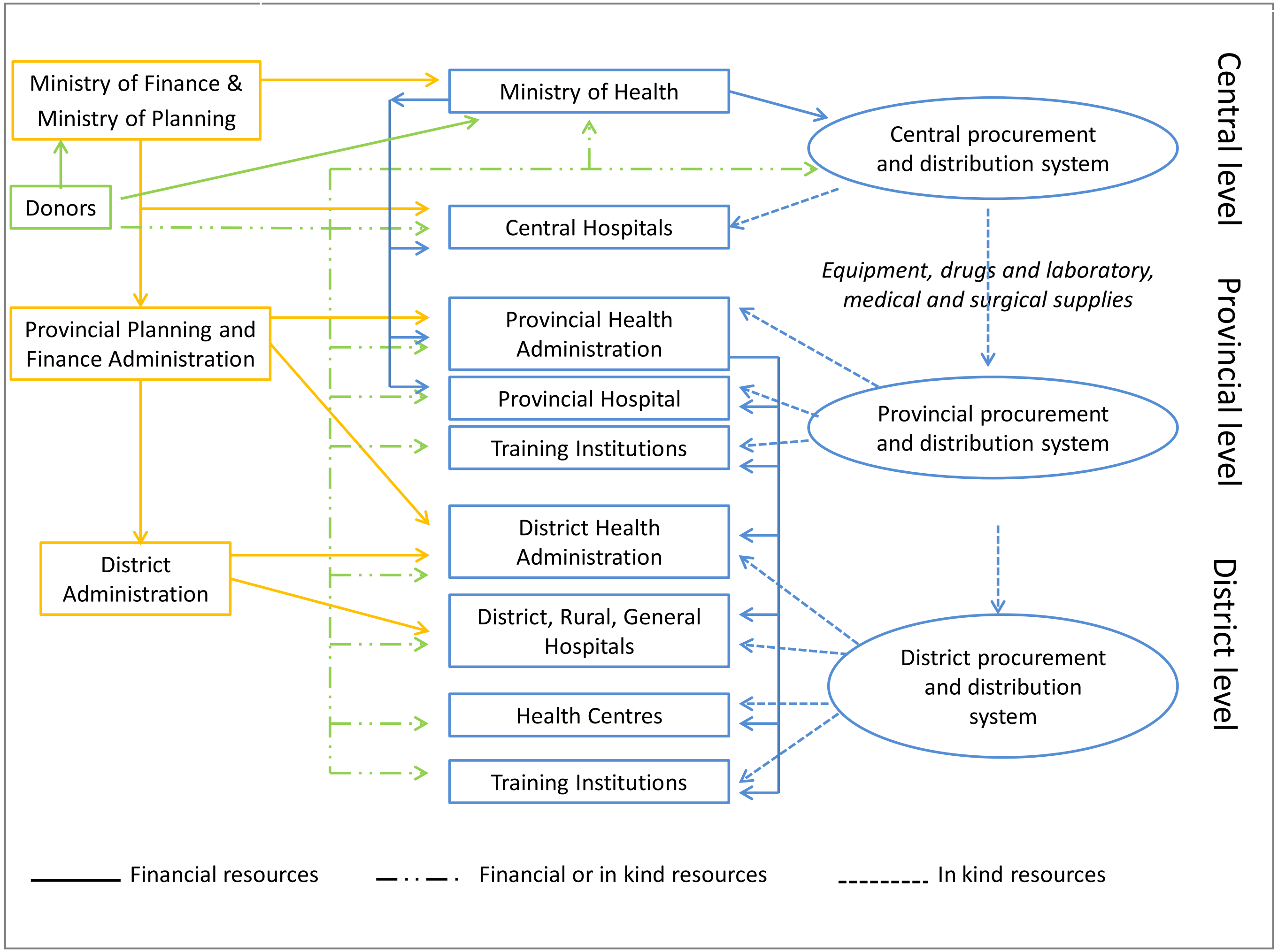
weight), population (0.25 weight), poverty (0.10 weight) and population density (0.05 weight) was used to redistribute additional donor common fund resources across provinces (MISAU, 2012b). However since resources from donor common fund remained stable in the years covered by this analysis, the formula could not be applied. After receiving them, the provincial directorates of health redistribute donor common fund resources across the district directorates of health following the same criteria.

Since 2008, following the decentralization process, resources for primary and secondary care recurrent expenditure have been increasingly allocated from the MoF to the Provincial Directorate of Planning and Finance and then directly to district administrations, based on a discretionary evaluation of the activity plans submitted by each institution. In 2011 district financial resources represented around 40% of the total recurrent expenditure at district level. Although the allocation is harmonised at all levels between the MoH and the MoF, the MoH has no direct influence on the decentralised resources allocated to districts.

The budget for investment is allocated according to specific approved projects and is mostly coordinated by the MoH. Only recently provincial and district health administrations have been attributed the autonomy to invest in primary care with resources allocated by the MoF or from local partnerships. Most investments in new primary care facilities are currently managed at provincial level and district administrations have started to manage small investments, mainly in housing for personnel.

Resources such as drugs and medical equipment are purchased by a central logistic unit and distributed to provincial health logistic units and then to HFs. Basic essential drugs are distributed to provinces, districts and facilities according to a push system, while other drugs are distributed monthly, based on a requisition system. The MoH is responsible for supervising the allocation of human resources, paying specific subsidies directly to the health personnel and contracting foreign medical doctors and specialists to work in provincial and district hospitals.

**Figure 3.4 Flow of resources in the National Health Sector in Mozambique**




*Source: Adapted from (MISAU. 2012b)*

### 3.5. Data used in the thesis

The analyses undertaken in this thesis rely entirely on the use of secondary data from five different sources:

- the Household Budget Survey (HBS) 2008/2009 (INE, 2010b);
- the Ministry of Finance annual electronic budget execution reports (E-Sistafe –MEX) (MF, 2012);
- the Ministry of Health external funding database (Inquérito aos Fundos Externos - IFE) (MISAU, 2012a);
- the National Health Information System (NHIS) (MISAU, 2012d, MISAU, 2013a);
- and the 2007 Census survey (INE, 2008, INE, 2010a, INE, 2010c).

Data on health care utilisation and on individual, household and community characteristics are derived from the 2008/2009 HBS. The sample consists of 10,831 households and 51,177 observations (9,632 households and 45,356 individuals excluding Maputo City) in 1,060 primary sampling units, and is representative at provincial level, and for urban and rural areas. The survey included also a community questionnaire administered in all the 599 rural communities surveyed. The measures of household consumption per capita, spatially and temporally adjusted, and the household adult equivalent scale were calculated (and made available) by the Ministry of Planning and Development (Direcção Nacional de Estudos e Analise de Politicas) for the third national poverty assessment, based on HBS 2008/2009 data (Arndt and Simler, 2010, Arndt et al., 2010). Details on the methods used are presented in the report of the first national poverty assessment (MPF et al., 1998).

Data on government managed expenditure per province and per district were derived from the MoF budget execution reports that contain information on the expenditure planned and effectively realised. Only data on district state budget expenditure are available disaggregated at district level, while data on provincial state budget are aggregated by province, even though these funds are effectively spent at district-level.

Data on the expenditure of donor earmarked projects were obtained from the MoH-IFE database, which includes information on both on- and off-budget projects and details the province and district of implementation, as well as the area of intervention. Data on the period from 2008 to 2011 were extracted from both databases (MISAU, 2012a, MF, 2012).

Data on HFs are derived from the National Health Information System as made available by the MoH in June 2012. The database contains a complete list of the existing HFs and information on their staffing, equipment and workload, collected monthly, first at district level and then aggregated at provincial and national level. Data for the period 2008 – 2011 were extracted. The existence of each HFs and its location were verified against the 2007 HF census (MISAU, 2007) and mismatches were resolved through consultation with the relevant provincial or district directorate of health.

Norms on minimum service coverage, staffing and equipment for each type of facility are defined by the Ministerial Act 127/2002 (MISAU, 2002) and summarized in (MISAU2012). I used the norms for a sample of six items, three referring to functioning equipment and three referring to staff per level of training. The following norms were used for the number of: autoclave (clinic: 1, HC: 1, DH: 1), motorbike (clinic: 2, HC: 2, DH: 2), car (clinic: 1, HCI: 1, DH: 1), basic level health cadres (clinic: 6, HC: 13, DH: 39), medium level health cadres (clinic: 1, HC: 9, DH: 29), high level health cadres (clinic: 0, HC: 1, DH: 9).

District demographic information was derived from census data. In particular, the population figures for 2008-2011 and the district U5M rates and socio-economic indicators estimates used in this analysis were elaborated by the National Institute of Statistics.

The various sources of data were merged by small geographic area, i.e. district or locality, and used for the different part of the analysis, as summarised in Table 3.1.

A period of fieldwork was undertaken to gain access to the secondary data and to verify the Ministry of Health budgets and expenditure at district level (including donor funds) in collaboration with the Directorate of Planning and Cooperation of the MoH. Although all data are publicly accessible, the authorization to use the various databases was obtained from the MoH, the National Institute of Statistics and the MPD. A copy of the authorization is included in appendix to the thesis.

The budget for investment is allocated according to specific approved projects and is mostly coordinated by the MoH. Only recently provincial and district health administrations have been attributed the autonomy to invest in primary care with resources allocated by the MoF or from local partnerships. Most investments in new primary care facilities are currently managed at provincial level and district administrations have started to manage small investments, mainly in housing for personnel.

Resources such as drugs and medical equipment are purchased by a central logistic unit and distributed to provincial health logistic units and then to HFs. Basic essential drugs are distributed to provinces, districts and facilities according to a push system, while other drugs are distributed monthly, based on a requisition system. The MoH is responsible for supervising the allocation of human resources, paying specific subsidies directly to the health personnel and contracting foreign medical doctors and specialists to work in provincial and district hospitals.

**Table 3.1 Summary of data used in the analysis**

| Data Source | Description | Disaggregation/ Representativeness | Chapter |
|---|---|---|---|
| **Household Budget Survey 2008/2009** | Data on: Individual characteristics including utilisation of health services; Household socio economic characteristics including sources of expenditure among which health care related expenditure; Community characteristics, including access to HFs. | Collected at individual, household and community level. Representative at urban/rural and provincial level. | 4,6,7 |
| **Ministry of Finance's electronic budget execution reports 2008-2011** | Data on state budget and donor common fund expenditure | Disaggregated at provincial or district level | 4,5,7 |
| **Ministry of Health's Inquérito aos Fundos Externos** | Data on donors' earmarked projects disbursement | Disaggregated at provincial or district level | 4 |
| **Census 2007** | Demographic and socio-economic indicators | Disaggregated at provincial, district and locality level | 4,5,7 |
| **Ministry of Health National Health Information System** | HFs type, availability of water, electricity, human resources and equipment, annual number of consultations realised | Disaggregated at HFs level | 5,6,7 |

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# Chapter 4

# Going beyond horizontal equity: an analysis of health expenditure allocation across geographic areas in Mozambique

## Preface

The conceptual framework adopted for the analysis undertaken in this thesis (see Chapter 1) highlighted how both equity (defined as the match between the allocation of resources and people's need) and efficiency (defined as the amount of service produced for a given set of resources) depend crucially not only on the allocation of existing resources, but also on who uses the services and how much they use them. Indeed, even if the most equitable and efficient allocations across local health authorities were implemented, there is no guarantee that they would translate into effective service delivery and that services would be used equitably so that individuals would receive an equitable share resources.

Additionally, the conclusion of Chapter 2 showed how the existing literature on LMICs has assessed equity in resource allocation without considering the consequences of different resource allocation practices in terms of how expenditure reach individuals and is distributed across them .

In the next chapter (Chapter 4) I address both issues by using a benefit incidence analysis approach. I explore to what extent in Mozambique changes in expenditure across geographic areas over time have translated into changes in the distribution of the monetary benefit across individuals according to their service use.

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## Abstract

In contexts where health services are mostly publicly provided and access is still limited, distributing financial resources across geographic areas according to population need, is particularly important to enable providers to deliver the services needed. Equity in public health expenditure has been evaluated either, by comparing allocations across spending units to equitable shares set using resources resource allocation formulae, or by using benefit incidence analysis and looking at the distribution of expenditure across individuals, but without linking it to allocation practices.

In this paper, we use data on district expenditure and apply benefit incidence analysis in an innovative way to assess horizontal and vertical equity in the geographic allocation of outpatient recurrent expenditure. We compare the actual distribution of expenditure with the horizontal and vertical equity benchmarks, set according to measures of economic status and need. We calculate equity measures and we quantify the relative contributions of service use and resource allocation to observed inequity. We analyse government and donor expenditure separately and combined, for the years 2008 – 2011 to compare changes over time and source of funding.  We use data from Mozambique from a number of national routine sources.

Results show improvements in both horizontal and vertical equity, along with the progressive alignment of government and donor resource allocation over time. While resource allocation was almost horizontally and vertically equitable in 2011, inequities in the distribution of expenditure were driven by inequities in service use. The discrepancy between economic or need indicators, evidences initial differences in government and donor expenditure targets, challenging the purpose of public health expenditure. Our results confirm the need to clearly define equity objectives to inform and evaluate resource allocation policies.

**Key words:** horizontal equity, vertical equity, public health expenditure, benefit incidence analysis, resource allocation formulae, donor expenditure, Mozambique.

## 4.1. Introduction

In contexts where health services are mostly publicly funded, the allocation of resources across levels of care and geographic areas is a key determinant of equitable provision and access to services (Kutzin, 2013, WHO, 2010). Governments are ultimately responsible for establishing appropriate mechanisms to guarantee access to health care services and financial protection to citizens. In particular, in low and middle-income countries (LMICs), where access to services is still limited and resources are scarce, distributing financial resources across geographic areas, according to population need, is necessary to enable providers to deliver the services needed (Green, 2007, Diderichsen, 2004).

Equity in the allocation of public financial resources has been discussed in different contexts using either resource allocation formulae (RAF) or benefit incidence analysis (BIA), two different but complementary approaches. However, the existing literature focusing on LMICs does not link resource allocation practices to the distribution of the monetary benefit from public expenditure and does not suggest to governments how to allocate their resources to meet the needs of their population (Anselmi et al., 2014).

RAFs are generally capitation based and identify the equitable share of resources for each geographic area according to their relative population share, adjusted by risk factors. The equitable share so identified provides a normative benchmark to evaluate budget or expenditure allocation (Rice and Smith, 2002, McIntyre et al., 2007). RAFs have been originally developed to provide a benchmark for horizontal equity (equal care and therefore expenditure across individuals with the same level of need) (Wagstaff et al., 1991, Rice and Smith, 2002). Service utilisation, adjusted for the supply and demand side influences, is used in high income settings as an indicator of relative need to get an unbiased estimate of the relative cost of people with different characteristics (Gravelle et al., 2003, Smith, 2008). Resources are allocated to guarantee equal treatment to individuals with equal need, irrespective of other socio-economic factors (Rice and Smith, 2002). In LMICs countries, where important differences in terms of access across geographic areas exist, RAFs have been developed using morbidity, mortality or deprivation (economic and non) as a proxy for need. RAF have been used to allocate more resources to deprived groups in order to accelerate their health improvements, on the grounds of vertical equity (expenditure commensurate to need) (Diderichsen, 2004, Mooney, 2000, Mooney and Jan, 1997). In both cases, RAFs have been developed to provide a benchmark for equitable allocation across local health authorities. However, the literature so far has not explored whether allocating resources on the grounds of benchmarks does indeed translate in a larger amount of resources reaching and being used by the intended beneficiaries. The lack of consideration for how resources ultimately reach different individuals represents the major limitation of the capitation funding approach to equity in health care resource allocation (Sheldon and Smith, 2000).

Unlike RAFs, that are helpful to allocate resources across spending units, BIA evaluates the distribution of public expenditure across beneficiaries. BIA combines the cost of providing services with their use to show how benefit from public spending is distributed across the population. A monetary benefit from public health expenditure is attributed to each individual according to their frequency and type of healthcare utilisation. The monetary value of the subsidy is approximated by the average cost of the service used by the individual. Individuals are ranked or aggregated in subgroups, typically by socio economic status, and the proportion of benefit received by each sub-group is compared (Demery, 2000, O'Donnell et al., 2008).

BIA was originally conceived in a broader public finance perspective to analyse the redistributive implications of public expenditure in social sectors (Demery, 2000, Van de Walle and Nead, 1995). Even when applied to the health sector, BIA has mostly been used to explore whether public subsidies reach the poor, without explicit reference to need for health care (Castro-Leal et al., 2000, Wagstaff, 2012, O'Donnell et al., 2008). From a health sector perspective, without further considerations about the distribution of need, inequalities in benefit from expenditure across socio-economic status could be deemed unjustified and therefore inequitable. However, the existing BIA studies have tended to assume implicitly a vertical equity perspective and consider desirable a pro-poor expenditure, for two reasons: either because from a public finance perspective it redistributes economic resources (Demery, 2000, Van de Walle, 1992, Lanjouw et al., 2001), or because inequalities in health tend to disadvantage the poor, who should therefore be entitled to more resources (Wagstaff, 2002, Mahal et al., 2000, O’Donnell et al., 2007).

Recently, a few studies have explicitly assessed vertical equity, comparing the share of monetary benefit with the share of need, measured by self-assessed health, across quintiles of the population ranked by socio-economic status (Akazili et al., 2012, Chuma et al., 2012, Ataguba and McIntyre, 2012, Mtei et al., 2012). However, none of these studies analysed vertical equity by comparing the distribution of benefit across the population ranked by need for health care, and none quantified inequity, allowing the comparison across settings and time.

BIA results are ultimately driven by the interplay of two separate factors: the amount of resources allocated to different services, and the extent to which individuals use those services

(Castro-Leal et al., 2000). Although it is beyond the scope of BIA, some studies have discussed the individual utilisation of different levels of care by economic groups to infer the redistributive implications of funding different levels of care (O'Donnell et al., 2007). However, so far, even in studies that accounted for differences in expenditure across regions or provinces (Mahal et al., 2000), BIA results have not been interpreted in light of the geographic resource allocation which generates them. Disentangling the relative contributions of service use and resource allocation is important to know how policies promoting access versus those allocating resources more equitably should be prioritized. In addition, in LMICs, public health sector financing often derives from multiple sources. International aid in particular constitutes on average 16% (with a maximum of over 80%) of all health expenditure in low income countries (WHO, 2012). Analysing and comparing the equity implications of expenditure driven by different allocation mechanisms is critical to further inform the health sector financial strategy.

In this paper the methods used in BIA served as a base to analyse equity in the incidence of public health expenditure and the extent to which the distribution depend on resource allocation. However, the methods used in BIA have been modified to account for differences in expenditure across geographic areas, so that the analysis could be extended to investigate to what extent benefit matches need and inequities depend on resource allocation and on health care utilization. An analysis of equity in utilization has been carried out and integrated with BIA to quantify inequities in resource allocation. We make several contributions to the existing literature. First, we apply the horizontal and vertical equity benchmark set by RAF to the distribution of resources across individuals, rather than geographic areas. We show how the scope covered by BIA can be enlarged and the methods adapted to analyse equity in the distribution of expenditure across geographic areas, accounting for how resources effectively reach individuals according to their service use. Second, we suggest accounting for need and integrating elements of health care utilization analysis into the methods used in BIA, to explicitly assess horizontal equity accounting for the distribution of need across economic status and vertical equity by ranking individuals by objective indicators of need. Third, we identify and quantify the relative contributions of geographic resource allocation and service use to the distribution of benefit from public health expenditure across individuals. Fourth, we analyse the equity of government and donor expenditure, separately and in combination, at the national level and for a four year period. To the best of our knowledge, this is the first study to attempt such an exercise.

The paper is structured as follows. Sections 2 and 3 set the context and describe the data. Section 4 details the methods used. Sections 5 and 6 present and discuss results and section 7 concludes.

## 4.2. Study setting

Mozambique is a low-income country where health care provision is predominantly publicly funded and provided, with few private clinics, mostly concentrated in the capital (MISAU, 2012c). Central, provincial and district levels constitute the backbone of the top-down hierarchical sector organization. Specialised care is managed at provincial level and provided through provincial or central hospitals. Primary and secondary care is managed at district level and provided through clinics, health centres (HC) and district hospitals (DH). There is generally one DH or HC per district and it is often located in the major urban centre. All district facilities provide basic primary outpatient care, while HCs provide primary and inpatient care and DHs provide also surgery (MISAU, 2012c). In 2009 there were 10 provinces and 142 district administrations, excluding Maputo City.

While the Ministry of Health (MoH) has the important role of defining policies, promoting health and supervising all national health sector (NHS) activities, most of the activities are implemented at the provincial and district level. Since the decentralization reform, which began in 2007, provincial and districts administrations have been attributed progressively more responsibilities. In collaboration with provincial health administrations, district health administrations are increasingly involved in the definition of policies and activities at local level. They are gradually attributed the responsibility for the management of financial and non-financial resources and for hiring human resources to guarantee that health facilities (HF) have the means to operate and deliver services (MISAU, 2012c).

The financial flow follows the hierarchical structure. The state budget is allocated from the Ministry of Finance (MoF) to the MoH and, since the implementation of the financial decentralization reform in 2007, to provincial directorates of health (managed at provincial level but spent on district health care) or directly to district administrations. Official outpatient fees in public HFs are negligible (MZM 2 equivalent to USD 0.07) and exemptions cover the large majority of the population (indigents, children under 5 years, pregnant women, chronically ill, patients suffering from malaria, TB and HIV/AIDS) (MISAU, 2012c, MISAU, 2012a).

The health sector was heavily disrupted by civil war and has been undergoing a gradual reconstruction since the peace agreement in 1992, with a significant involvement of international donors (Pavignani and Durao, 1999). Donors support both health care provision in public HFs and the health system in delivering its functions, including policy making. Donor funding represents over 50% of health sector expenditure (MISAU, 2010). One third of donor funding is allocated through a pooled common fund (called PROSAUDE), which is earmarked for the health sector but not for specific health activities. The rest of donor funding is made up of earmarked projects, some implemented in partnership with the MoH central administration and some with HFs or local administrations (MISAU, 2011). PROSAUDE resources are managed by the MoH and allocated to national, provincial and district directorates to top-up the state budget where most needed. Earmarked funds are managed directly by donors, with a variable degree of involvement of local institutions, according to prior agreement (MISAU, 2012c).

In the last two decades the economic improvements in Mozambique led to a decrease of the population living below the poverty line from 69% to 55% (Arndt et al., 2010) and to significant improvemnts in health. For example under-5 mortality (U5M) rate fell from 226 to 97 per 1000 livebirths (Fernandes et al., 2014). However, differences in health status persist across provinces and even more across districts. To keep the same example, U5M estimates vary between 58 and 142 per 1,000 livebirths across provinces and 103 and 291 per 1,000 live births across districts (MISAU et al., 2013). Differences are related to socio-economic factors, including area of residence, levels of economic wealth and education (Macassa et al., 2012, Macassa et al., 2003), but also to differences in the availability of material, human and financial resources for health care provision (Fernandes et al., 2014). Inequalities in health care provision across geographic areas still exist, and represent one of the major challenges that the government has committed to address (MISAU and TARSC/EQUINET, 2010, MISAU, 2013b). In spite of the commitment stated, to date harmonised principles and methods for resource allocation across geographic areas are discussed every year between MoH, MoF and donors at the time of the budget preparation. The lack of explicit country specific policy orientation motivates the evaluation of both horizontal and vertical equity in line with the principles underpinning resource allocation formulae in used in other countries. Additionally, although it has not been approved by policy makers, a proposal for a RAF based on need indicator has been elaborated.

### 4.3. Data

In the analysis, we use data from five different sources: the Household Budget Survey (HBS) 2008/2009 (INE, 2010b), the MoF annual electronic budget expenditure reports (E-Sistafe – MEX) for 2008-2011 (MF, 2012), the MoH external funding database (IFE) with data extracted for 2008-2011 (MF, 2012), the National Health Information System (NHIS) data for 2008-2011 (MISAU, 2012d), and the 2007 Census survey (INE, 2008, INE, 2010a). The information required for the analysis was extracted as explained below.

Data on individual and household characteristics, including health care utilisation, were obtained from the HBS 2008/2009. The dataset consists of a sample of 51,177 individuals (45,356 excluding Maputo City) stratified at provincial and urban/rural areas level. Data collection took place between August 2008 and September 2009. In the analysis, we use data on the household socioeconomic conditions and on the individual number of visits in a one-month recall period to a health practitioner in a public HFs. Spatially and temporally adjusted household per capita consumption was calculated and made available by the Ministry of Planning and Development for the third national poverty assessment (Arndt and Simler, 2010, Arndt et al., 2010). Adult equivalence scales were also provided by the Ministry of Planning and Development (MPF et al., 1998).

Data on the total number of outpatient visits per district were derived from the NHIS. The NHIS collects information on the existing HFs, their availability of staff and equipment, and the services delivered. Data are collected monthly at district level and then aggregated at provincial and national level. Strengthening the NHIS has been among the MoH priorities for almost ten years and has resulted into a growing confidence on the quality of data produced which has led the yearly publication of a statistical summary containing data disaggregated by provinces (MISAU, 2013a, MISAU, 2013b). To minimize the potential recording bias in the district NHIS data, we average the number of visits across the available years (2008 - 2011). Yearly figures on outpatient consultations at provincial level from the NHIS were compared with the totals obtained using HBS data. NHIS figures were systematically smaller across figures and discrepancies were found up to only 3%.

Data on government managed expenditure in each province and district were derived from the MoF budget expenditure reports, which include information on initial budget and on the final expenditure. Only data on district state budget expenditure are available disaggregated at district level, while data on provincial state budget are aggregated by province although these funds are spent in district HFs. Data on donor earmarked project expenditure were obtained from the MoH-IFE database. The IFE database includes information on both on- and off-budget projects and reports the province and district of implementation, as well as the area of intervention. We use the district U5M estimates calculated by the National Institute of Statistics from the Census data.

We merge data from the different sources by district. We exclude Maputo City, the capital, and Matola, the surrounding area, from the analysis due to the unusual presence of private facilities and numerous public facilities providing secondary and specialised care, which generate a specific pattern of expenditure and utilisation.

## 4.4. Methods

### *4.4.1. Measuring horizontal and vertical equity*

We extend the methods used in BIA to assess horizontal and vertical equity in recurrent expenditure for primary and secondary outpatient care in Mozambique. We distinguish between government managed (provincial and district state budget and PROSAUDE) and donor managed expenditure. For simplicity we will refer to them as 'government' and 'donor' expenditure. We follow the standard steps required by BIA (O'Donnell et al., 2008), adapting them to the objectives of the study and the data available, as described below.

***Calculating Individual benefit***

We define the individual monetary benefit received by individual *i*, in household *h*, in district *d,* as the benefit ($b_{ihd}$) associated with one outpatient visit to a clinic, HC or DH and calculated as:

$$b_{ihd}=v_{ihd}\, e_{dt} \qquad (1)$$

$v_{ihd}$ is the quantity of service used by individual *i*, measured as the number of visits reported by individual *i* in the month prior to the interview multiplied by a month specific scaling factor (inverse share of monthly to yearly visits), which standardizes the individual utilisation in the 30-day recall period to one year. Data on total monthly and yearly visits are derived from the HBS using the survey's household weights.

$e_{dt}$ is the outpatient visit unit cost in district *d,* in year *t*, calculated by dividing the outpatient recurrent expenditure by the number of visits, at district or provincial level according to the level of disaggregation of the available expenditure data:

$$e_{dt}=\frac{E^{G}_{pt}+E^{D}_{pt}}{V_p}+\frac{E^{G}_{dt}+E^{D}_{dt}}{V_d} \qquad (2)$$

where $V_p$ and $V_d$ are the yearly total number of outpatient consultations provided by primary and secondary care facilities in province *p* and district *d*. $E^{G}_{pt}$ is provincial government recurrent expenditure (provincial state budget and PROSAUDE) for primary and secondary care in province *p*, in year $t$. $E_{dt}^{G}$ is district state budget recurrent expenditure, in district *d* and in province *p*. Based on available records of district expenditure from yearly provincial reports (MISAU, 2012b), we assume that HFs providing inpatient services absorb half of the district budget, and spend one third of their budget on outpatient care. $E_{pt}^{D}$ and $E_{dt}^{D}$ include donor earmarked project expenditure in year *t,* in province *p* or more specifically in district *d*, according to the disaggregation of available data. We subtract 10% of total expenditure to account for management overheads, and consider one third of the remaining funds to be spent on outpatient services. It should be noted that $e_{dt}$ is the sum of two components: average provincial (government and donor) expenditure per unit of service delivered, common to all districts in a same province, and average district (government and donor) expenditure, which is district-specific.

We assume that individuals use outpatient health care services provided in their district of residence so that $v_{ihd}$ can be associated with a district specific unit cost, $e_{dt}$.

Unlike most BIA studies, we account for resource allocation through differences in expenditure across geographic areas, calculating the unit subsidy (outpatient visit unit cost) from disaggregated province and district expenditure. Since official outpatient fees are negligible, and exemptions cover the large majority of the population, we assume that outpatient care is free for users at the point of delivery. We adopt the constant unit subsidy assumption and exclude the possibility of negative subsidies (Wagstaff, 2012). Informal payments or private costs may in reality occur and generate a negative subsidy, but those would not affect public resources and their allocation, and are therefore beyond the scope of this study.

***Individual ranking variable***

To assess horizontal equity, we follow (O'Donnell et al., 2008) and rank individuals by economic status ($W_{hd}$) proxied by:

$$W_{hd} = C_{hd} a_{hd} \tag{3}$$

where $C_{hd}$ is the household consumption per capita, adjusted by spatial and temporal differences in price and $\alpha_{hd}$ the adult equivalent adjustment factor.

To assess vertical equity, we construct a composite index of relative need for health care ($K_{ihd}$), which is calculated as the average of three measures of need, standardised on a scale from 0 to 1 and capturing the dimensions typically included in need-adjusted RAF developed in LMICs

(McIntyre et al., 2007, Diderichsen, 2004). Individual demographic characteristics, household deprivation and health at the local level, are included in $K_{ihd}$ as follows:

$$K_{ihd} = \frac{1}{3}\left(I_{ihd}^{Dem} + I_{hd}^{Dep} + I_{d}^{Mor}\right) \quad (4)$$

$I_{ihd}^{Dem}$ is an individual indicator of need, based on the age-gender group to which individual *i* belongs (0-1 year, 1-4 year, 5-14 year, 15-49 year, over 50). For each age-gender group we calculate the average monthly number of visits at national level (U). We define $U_{ihd}$ as the specific value of U for the age-gender group to which *i* belongs to, and calculate:

$$I_{ihd}^{Dem} = \frac{U_{ihd} - U_{min}}{U_{max} - U_{min}} \quad (5)$$

where $U_{min}$ and $U_{max}$ are the minimum and maximum U across age-gender groups. Since $I_{ihd}^{Dem}$ is based on a weight attributed to each individual according to differences in the observed national average service utilization for specific age-gender groups, it does reflect the relative likelihood of needing health care related to specific demographic characteristics.

$I_{hd}^{Dep}$ is a household indicator of need for health care based on household non-economic deprivation $S_{hd}$, which we calculated using an 8 indicator Multidimensional Poverty Index (MPI), adapted from (Alkire et al., 2013):

$$I_{hd}^{Dep} = \frac{S_{hd} - S_{min}}{S_{max} - S_{min}} \quad (6)$$

where $S_{min}$ and $S_{max}$ are the minimum and maximum levels of deprivation across households. Out of the eight indicators, five are related to living standards (having electricity, improved sanitation, improved drinking water, flooring, cooking fuel), one to nutrition (a household is nutritionally deprived if 1 meal or less was enjoyed by the household during the day prior to the interview) and two to education (years of schooling and children's school attendance). We exclude two of the 10 Alkire's MPI indicators: household child mortality, which is captured at district level, and asset ownership, to avoid overlapping with the economic status indicator. The MPI dimensions selected recall very closely those included into the social determinants of health framework for action (Solar nd Irwin, 2010) and capture those factors who are likely to influence individual health status.

Finally $I_{d}^{Mor}$ is a district indicator of need, calculated from district U5M rates ($M_d$) derived from Census data:

$$I_{d}^{Mor} = \frac{M_{h} - M_{min}}{M_{max} - M_{min}} \quad (7)$$

where $M_{min}$ and $M_{max}$ are the minimum and maximum levels of U5M across districts.

It should be noted that since $K_{ihd}$ reflects the definition of need adopted in need-adjusted RAF proposed in Sub-Saharan Africa (McIntyre et al., 2007, Diderichsen, 2004), its use in the assessment of vertical equity allows to transpose the benchmark with policy legitimacy from the local health authority to the individuals.

Both economic wealth and household deprivation are commonly used as proxy for socio economic status. However, in the context of this study the two measures can not be considered interchangeable. There is no evidence (so far) of a direct effect of economic wealth on health status other than through access to higher education and improved living condition (O'Donnell et al., 2014). Although the living conditions captured by the household deprivation are likely to be correlated to economic wealth, the degree of correlation depends on household expenditure decisions. Consumption per capita measure the capacity to pay for health care and is used here to measure horizontal equity. Non-economic deprivation is a direct proxy for health (and need for health care) when more direct measures are not available and is used to measure vertical equity. Statistical correlation between the components of $K_{ihd}$ and $W_{ihd}$ are tested through Pearson's correlation test.

***Benefit distribution and equity assessment***

We calculate two benefit and two service use distributions, relative to the rankings based on consumption ($W_{hd}$) and need ($K_{ihd}$), and we derive the relative concentration curves and by plotting the cumulative proportions of benefit received and service used against the cumulative proportion of population (O'Donnell et al., 2008).

We measure **horizontal (in)equity** as the difference between the actual distributions of benefit and the distribution of need across individuals ranked by economic status ($W_{hd}$), represented by the relative concentration curves, $\mathcal{C}_{bW}$ and $\mathcal{C}_{KW}$. $\mathcal{C}_{KW}$ is the equity benchmark, since it represents a situation where individuals with the same need use the same amount of services and receive the same monetary benefit for each unit of service, irrespectively of their economic status. This method corresponds to the indirect standardization for need used in the analysis of health care utilisation, where horizontal inequity is calculated as the difference between the observed and the need-predicted allocation of health care (Wagstaff and van Doorslaer, 2000), or measured need for health care (Le Grand, 1978, Wagstaff et al., 1991). We apply the same method to BIA but set the need-predicted allocation of benefit equal to the distribution of need ($K_{ihd}$).

First, using the default multiple comparison approach decision rule we run the dominance test of $\mathcal{C}_{bW}$ against $\mathcal{C}_{KW}$. One curve dominates the other if its ordinates significantly lies above, which according to the multiple comparison approach rule is verified if there is at least one significant difference in one direction and no significant difference in the other. Dominance is tested at 19 equally spaced quantile points and with 5 percent significance level.

Second, we calculate the horizontal inequity measure (HI) as the need standardized concentration index (CI) of the benefit distribution corresponding to the difference between the CI of benefit ($CI_{bW}$) and the CI of need ($CI_{KW}$):

$$HI = CI_{bW} - CI_{KW} = \frac{2}{\mu_b}cov(b,r) - \frac{2}{\mu_K}cov(K,r) \quad (8)$$

where *b* is the benefit received by *i* and $\mu_b$ is its mean, *K* is the need for health care of i and $\mu_K$ is its mean, and $r = \frac{\mathrm{i}}{\mathrm{N}}$ is the fractional rank of individual *i* in the distribution, with *i*=1 for the lowest consumption and *i*=N for the highest consumption. HI corresponds to twice the area between the benefit and the need concentration curves.

**Vertical (in)equity** is assessed ranking individuals by need ($K_{ihd}$), from higher to low, for ease of comparison with the ranking by $W_{hd}$, We compare the concentration curve of benefit ($\mathcal{C}_{bK}$) to the need Lorenz curve ($\mathcal{C}_{KK}$), which represents the vertical equity benchmark, to assess progressivity in the distribution of benefit with respect to need. Only one study has assessed the progressivity of health care use with respect to need in UK (Sutton and Lock, 2000). We apply the same idea to the distribution of the monetary benefit. The need Lorenz curve is equivalent to a hypothetical need-based distribution, where individuals would receive a share of expenditure which is at least equal to their share of need, and where individuals are attributed different weights according to their health. The equitable benchmark reflects therefore a situation where the individuals use service proportionally to their need and resources are allocated so that the monetary benefit from a single consultation is at least equal across individuals (or relatively higher for individuals with higher need). There is not a unique vertically equitable distribution, as any distribution where the individual share of benefit is progressive to the share of need, would fit that criterion (Mooney, 2000, Mooney and Jan, 1997, McIntyre and Gilson, 2000).

After having tested for dominance between $\mathcal{C}_{bK}$ and $\mathcal{C}_{KK}$, we quantify the intensity of (in)equity (VI) using Kakwani index of progressivity, which measures the distance between the two. VI can be rewritten as the difference between the CI of need and the Gini coefficient of benefit:

$$\mathrm{VI} = CI_{bK} - G_K \quad (9)$$

where $G_K$ is the Gini coefficient of need (K) and $CI_{bK}$ is the CI of benefit. VI corresponds to twice the area between the $\mathcal{C}_{bK}$ and $\mathcal{C}_{KK}$.

### *4.4.2. Disentangling the sources of inequity*

Having obtained a measure of equity, we seek to quantify the contribution of the two factors potentially generating inequity in the distribution of benefit from public health expenditure: inequity in geographic resource allocation and inequity in service utilisation.

We rewrite HI and VI as the sum of two components. The first component represents inequity related to service use, measured as the distance between the concentration curves of service utilisation, $\mathcal{C}_{vW}$ and $\mathcal{C}_{vK}$, and the respective equity benchmarks, $\mathcal{C}_{KW}$ and $\mathcal{C}_{KK}$. $\mathcal{C}_{vW}$ and $\mathcal{C}_{vK}$ correspond to hypothetical benefit distributions, based on the actual number of visits ($v_{ihd}$) and a constant individual benefit. A constant individual benefit represents the realization of both a horizontally equitable resource allocation and the most conservative version of a vertically equitable resource allocation. The second component represents inequity related to resource allocation, and is measured as the distance between the observed benefit distribution and the service utilisation concentration curve. It measures the difference in benefit distribution attributable to differences in the unit cost of a single outpatient consultation, the unit benefit that individuals receive, across districts ($e_d$).

It should be noted that in this analysis health care use is considered fixed and the distinction between the health care use and the resource allocation component does not account for the different factors that influence health care use, among which resource allocation could play a role. Exploring the factors associated with health care inequality is beyond the scope of this paper. However, it should be recognised that if resource allocation was associated with health care use, then the magnitude of this component would be underestimated by the present analysis.

The same method, where target functions have been estimated rather than defined, has been previously used to disentangle the horizontal and vertical components of (in)equity in service use across socio-economic status (Sutton, 2002, Vallejo-Torres and Morris, 2013).

We rewrite HI as follows:

$$HI = (CI_{bW} - CI_{vW}) + (CI_{vW} - CI_{KW}) = HI_{RA} + HI_{USE} \qquad (10)$$

where $CI_{vW}$ is the CI of service utilisation. $HI_{USE}$ measures the use inequity component and corresponds to the need standardized CI of the number of visits ($v_{hd}$). $HI_{RA}$ measures the resource allocation inequity component and corresponds to the difference between the CIs of benefit ($CI_{bW}$) and use ($CI_{vW}$).

We rewrite VI as follows:

$$\mathrm{VI} = (CI_{bK} - CI_{vK}) + (CI_{vK} - G_K) = VI_{RA} + VI_{USE} \quad (11)$$

where $VI_{USE}$ is the use inequity component and corresponds to the Kakwani index of the number of visits ($v_{ihd}$). $VI_{RA}$ is the resource allocation inequity component and corresponds to the difference between the CIs of the benefit and use $CI_{bK}$ and $CI_{vK}$ .

### *4.4.3. Computing equity measures by type of expenditure and over time*

We calculate horizontal and vertical equity measures and disentangle their service utilisation and resource allocation components, separately for government ($\mathrm{E}_{\mathrm{pt}}^{\mathrm{D}}$=0 and $\mathrm{E}_{\mathrm{dt}}^{\mathrm{D}}$=0 in equation 2), donors ($\mathrm{E}_{\mathrm{pt}}^{\mathrm{G}}$=0 and $\mathrm{E}_{\mathrm{dt}}^{\mathrm{G}}$=0 in equation 2) and combined expenditures in 2008.

Assuming that economic status, need and utilisation are constant over a short time period, we calculate the distribution of benefit for 2009, 2010 and 2011. Since utilisation is held constant, changes in the distribution of benefit over time reflect changes in resource allocation through changes in district expenditure and derived unit benefit ($e_{dt}$).

### *4.4.4. Sensitivity analysis*

We test the robustness of the assumptions made on the shares of outpatient and inpatient expenditure and on the use of service in the district of residence. We run the same analysis excluding provincial capital districts, which have a higher concentration of public secondary care facilities and private health care providers, and potentially differentiated patterns of expenditure.

We test the robustness of results to the measure of need by running the same analysis using an alternative indicator of need calculated excluding the household non-economic deprivation component ( $K'_{ihd} = \frac{1}{2}(I_{ihd}^{Dem} + I_{d}^{Mor})$) to avoid potential correlation with the measure of economic status used in the assessment of horizontal equity.

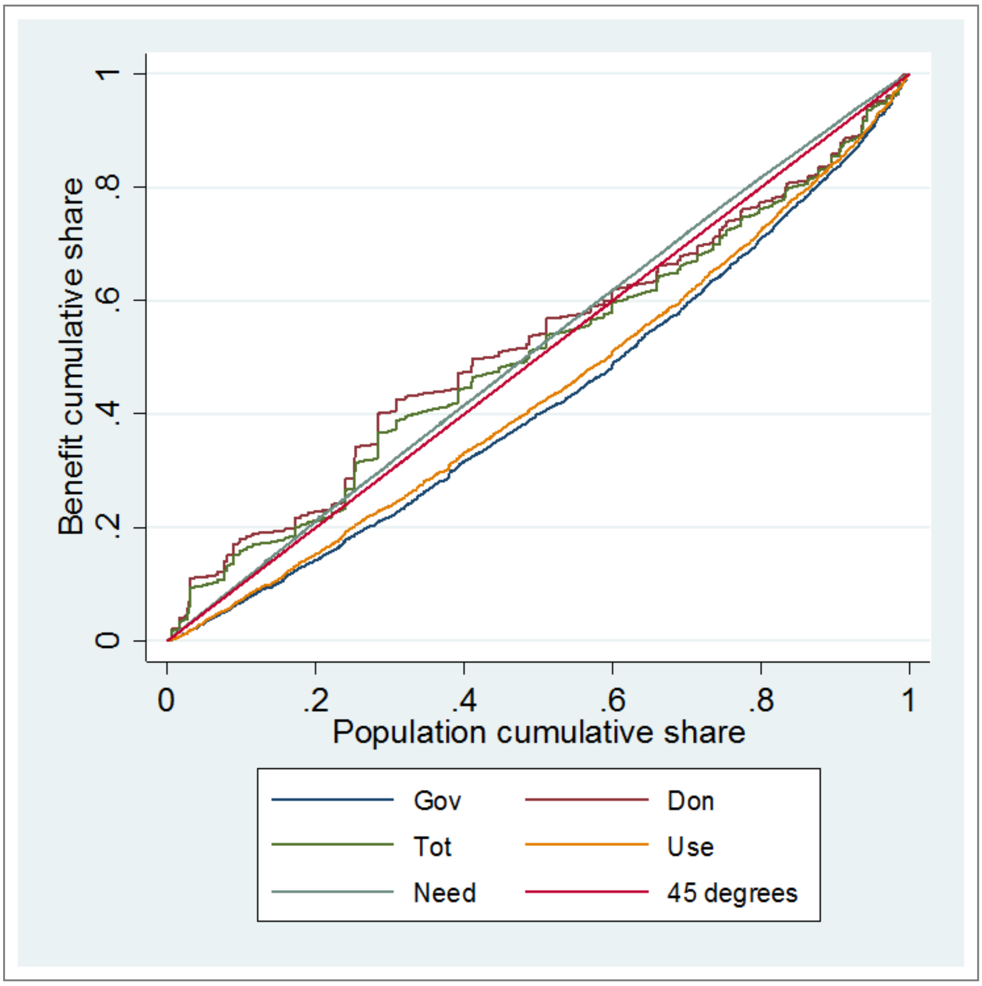
Since $K_{ihd}$ is a bounded variable and the magnitude of CI depends upon the mean of $K_{ihd}$ over the population, we test the sensitivity of HI and VI, by applying the Erreygers correction to the calculation of $CI_{kw}$ and $G_k$ (Erreygers, 2009, Erreygers and Van Ourti, 2011).

## 4.5. Results

### *4.5.1. Horizontal equity in Mozambique in 2008*

Figure 4.1 shows the concentration curves of monetary benefit from government, donor and combined recurrent expenditure in primary and secondary outpatient care. $\mathcal{C}_{KW}$ (benchmark for horizontal equity in monetary benefit and health care distribution) and $\mathcal{C}_{vW}$ (benchmark for equity in resource allocation) are included for comparison. The relative need standardised HIs are presented in Table 4.1 (the original unstandardized CIs are shown in Appendix 4.1). $\mathcal{C}_{bW}$ dominating $\mathcal{C}_{KW}$ and HI<0 indicate pro-poor inequalities (and vice versa). HI=0 indicates equity.

**Figure 4.1 Cumulative distribution of monetary benefit from government, donor and total expenditure in primary and secondary outpatient care across individuals ranked by economic status in Mozambique, 2008**




The results show that in 2008, the benefit from government expenditure was pro rich ($HI^{Gov}$ = 0.18). The need concentration curve dominates the 45 degrees and the health care use and government expenditure concentration curves, while the concentration curves of the donor and total expenditure cross the 45 degrees line of equality . By contrast, the distribution of benefit from donor expenditure appeared slightly pro-poor ($HI^{Don}$ = -0.02), although this result was not statistically significant due to the irregularity in the distribution of spending across economic status. Not surprisingly, the total public spending on health care was also found to be generally almost equitable ($HI^{Tot}$ = 0.01). However, the donor and total expenditure curves describe a situation where the benefit is concentrated on the poorest and richest quintiles. In the calculation of the CI associated with these curves, the pro-poor and pro-rich inequalities cancel out and a negative CI (and HI) measures the "excess" pro-poor inequality.

Disentangling the two components of inequity, we find that utilisation patterns are pro-rich and drive most of the horizontal inequity ($HI_{USE}$ = 0.15). Government resource allocation is very close to horizontal equity ($HI_{RA}^{Gov}$ = 0.03), while donor spending is clearly pro-poor ($HI_{RA}^{Don}$ = -0.17), and drives the progressivity of the combined public resource allocation ($HI_{RA}^{Tot}$ = -0.16).

#### *4.5.2. Evolution of horizontal equity in Mozambique from 2008 to 2011*

Figure 4.2 describes the evolution of the benefit distribution by population quintiles between 2008 and 2011 and compares it to the distribution of need for health care, the horizontal equity benchmark (shares are reported in Appendix 4.1). The CI of government, donors and combined expenditure for each year is presented in Table 4.1.

Three results emerge. First, against a distribution of need concentrated in the poorest quintile (Q1) government spending throughout the period seems to benefit the richest quintiles (Q5 and Q4) proportionally more than the other quintiles. However, the pro-rich nature of the government spending is slightly reduced over time, as confirmed by the decrease in $HI^{Gov}$ from 0.18 to 0.16 and the reduction of the share received by Q5. Second, in 2008 donor spending seemed to benefit Q1, Q2 and Q5, mostly, at the expense of Q3 and Q4. Over time we observe a redistribution of resources from Q1 to Q2 and Q3, reducing the pro-poor nature of the expenditure, as confirmed by the increase in $HI^{Don}$ from -0.02 to 0.12. Finally, the allocation patterns of donor and government expenditure seem to progressively converge and almost align by 2011.

The analysis of the sensitivity of the indices to different assumptions made about the shares of outpatient and inpatient expenditure and about the use of service in the district of residence produces negligibly different results. Results are robust to a definition of need based on demographic and mortality indicators only and to the application of the Erreygers correction in the calculation of HI, in spite of an increase of 0.03 for all HI measures.

**Figure 4.2 Monetary benefit from government and donor spending in primary and secondary outpatient care by economic quintiles in Mozambique, 2008-2011**

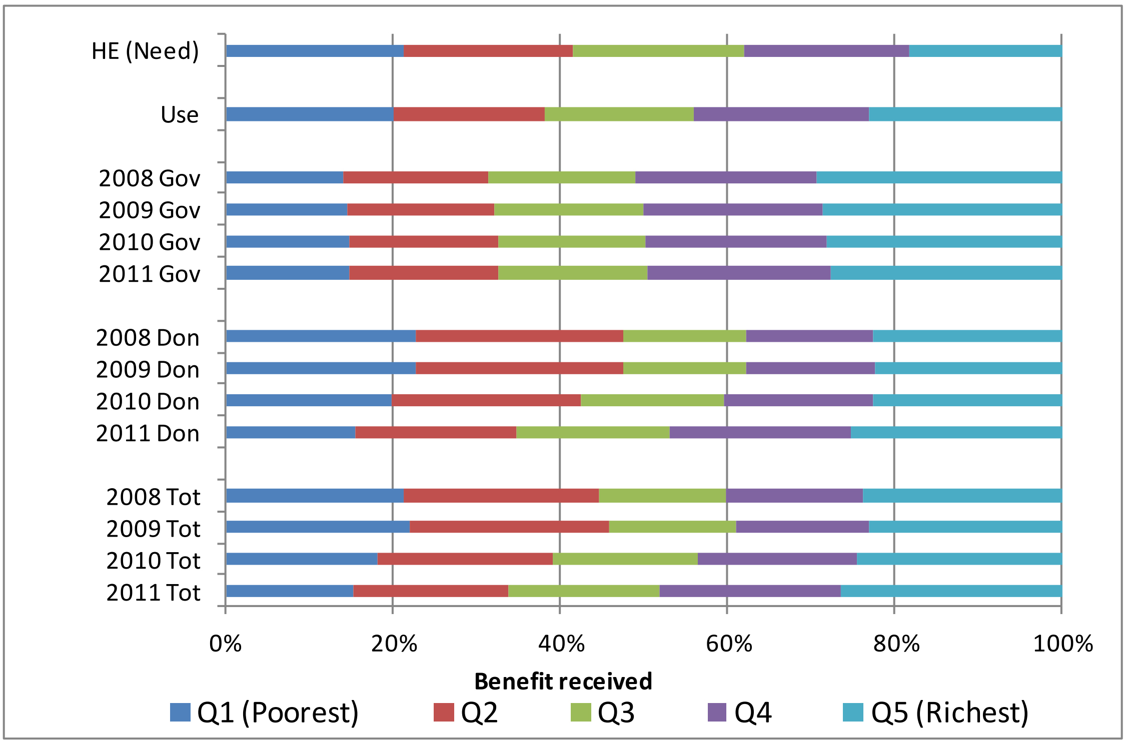



**Table 4.1 Horizontal Inequity in the distribution of monetary benefit from public health expenditure by source of spending, Mozambique, 2008-2011**

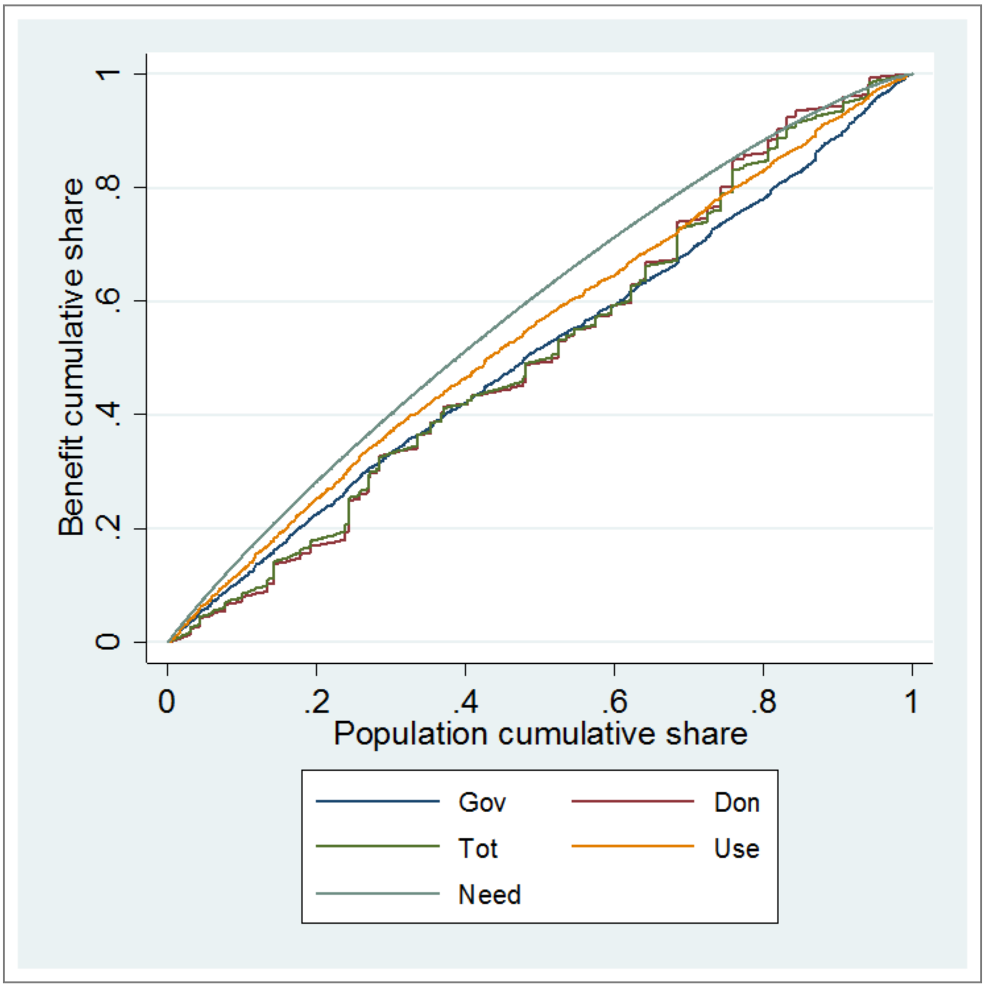
| | $HI_{USE}$ | 2008 | | | 2009 | | | 2010 | | | 2011 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $HI^{GOV}$ | $HI^{DON}$ | $HI^{TOT}$ | $HI^{GOV}$ | $HI^{DON}$ | $HI^{TOT}$ | $HI^{GOV}$ | $HI^{DON}$ | $HI^{TOT}$ | $HI^{GOV}$ | $HI^{DON}$ | $HI^{TOT}$ |
| HI* | 0.15 | 0.18 | -0.02 | 0.01 | 0.17 | -0.02 | 0.00 | 0.16 | 0.03 | 0.07 | 0.16 | 0.12 | 0.14 |

** HI corresponds to the concentration index standardised by need (CI of need: -0.03, SE: 0.03)*

#### *4.5.3. Vertical equity in 2008*

Figure 4.3 shows the concentration curves of monetary benefit on the population ordered from the most to the least needy from government, donor and combined recurrent expenditure in outpatient primary and secondary care. $\mathcal{C}_{KK}$ (benchmark for vertical equity in health care and benefit distribution ) and $\mathcal{C}_{VK}$ (benchmark for equity in resource allocation) are included for comparison. VIs are presented in Table 4.2. If the concentration curve of benefit dominates that of need and VI ≤0, the benefit distribution is proportional or progressive with respect to need and therefore vertically equitable (and vice versa). VI=0 reflects the most conservative definition of vertical equity.

**Figure 4.3 Cumulative distribution of benefit from government, donor and total expenditure in primary and secondary outpatient care across individuals ranked by need in Mozambique, 2008**




In spite of differences in the distributions, in 2008, the benefits from government, donor, and total expenditure were almost equally regressive and vertically inequitable ($VI^{Gov}$=0.15, $VI^{Don}$=0.14, $VI^{Tot}$=0.14). $\mathcal{C}_{KK}$ dominates the health care use and the government expenditure and crosses the government and total expenditure concentration curves indicating that $VI^{DON}$ and $VI^{TOT}$ underestimate inequity in the neediest quintiles. The service utilisation component of inequity was regressive to need ($VI_{USE}$= 0.08) and vertically inequitable. The allocation of resources from government and donors (and their combination) was regressive, contributing to increase the vertical inequity of the benefit distribution ($VI_{RA}^{Gov}$=0.07, $VI_{RA}^{Don}$=0.06, $VI_{RA}^{Tot}$=0.06).

### *4.5.4 Evolution of vertical equity in Mozambique from 2008 to 2011*

The evolution of the benefit distribution across need quintiles between 2008 and 2011 (Figure 4.4) reveals interesting differences in government and donor allocation patterns compared to the vertical equity benchmark.

**Figure 4.4 Benefit from government and donor spending in primary and secondary outpatient care by need quintiles in Mozambique, 2008-2011**

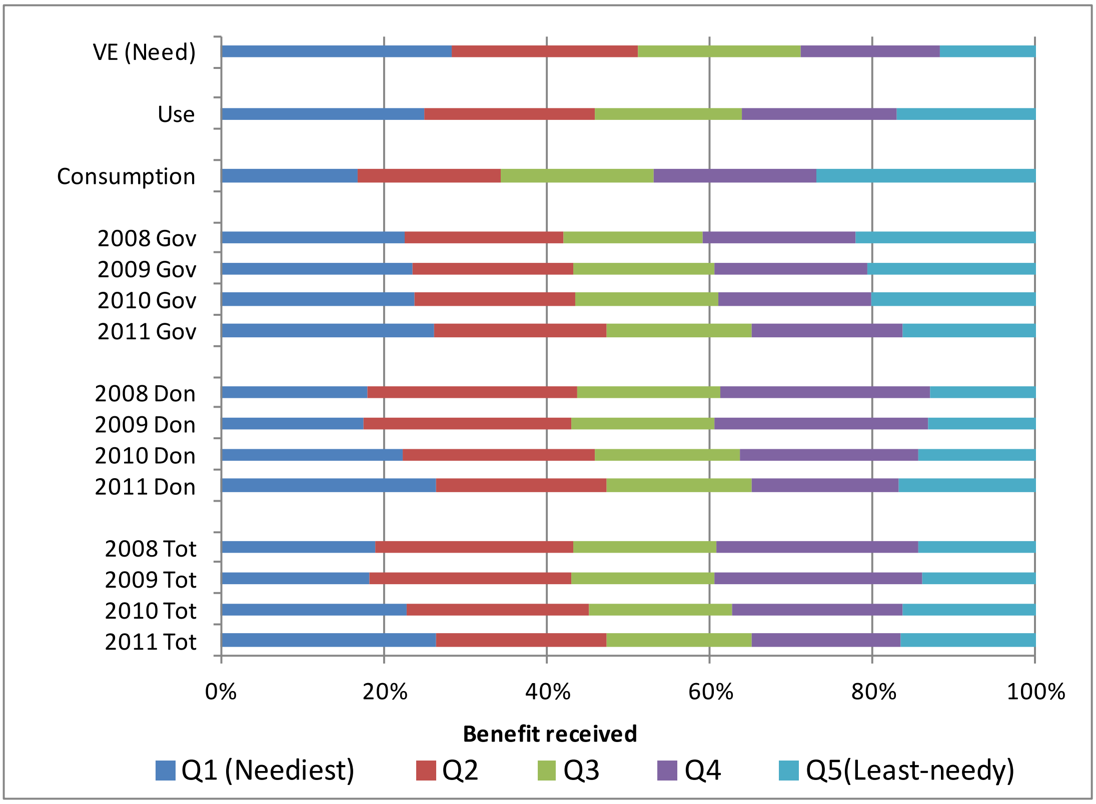



**Table 4.2 Vertical inequity in the distribution of benefit from public health expenditure by source of spending in Mozambique, 2008-2011**

| | $VI_{USE}$ | 2008 | | | 2009 | | | 2010 | | | 2011 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $VI^{GOV}$ | $VI^{DON}$ | $VI^{TOT}$ | $VI^{GOV}$ | $VI^{DON}$ | $VI^{TOT}$ | $VI^{GOV}$ | $VI^{DON}$ | $VI^{TOT}$ | $VI^{GOV}$ | $VI^{DON}$ | $VI^{TOT}$ |
| VI* | 0.08 | 0.15 | 0.14 | 0.14 | 0.13 | 0.15 | 0.15 | 0.12 | 0.10 | 0.11 | 0.07 | 0.07 | 0.07 |

** VI corresponds to Kakwani Index of need (Gini index of need: 0.17, SE:0.00)*

Four main results emerge. First, in 2008 government expenditure was benefiting Q5 over Q1 and Q2. Overall improvements in the allocation of government expenditure have been progressively attained between 2008 and 2011, as reflected in a reduction of VI from 0.15 to 0.07. Most importantly, improvements have been achieved through a redistribution of benefit from Q5 to Q1. Similarly, donor expenditure was mostly benefiting Q5 and marginally Q4 over Q1 and marginally Q3. In spite of $VI^{Don}$ (0.14) being closer to zero than $VI^{Gov}$, the share of benefit reaching Q5 but also Q1 was smaller than for government expenditure.

Second, overall improvements were attained between 2008 and 2011 through the redistribution of benefit from Q2 and Q4 towards Q1. Third, some discrepancies in government and donor allocation patterns existed in 2008. However, a progressive alignment towards an overall benefit distribution not too far from vertical equity ($VI^{Tot}$ =0.07) by 2011 can be observed. Fourth, in spite of a general improvement ($VI^{Tot}$ decreased from 0.14 to 0.07), further redistribution from Q5 to the other quintiles, particularly Q1, would be required to approach the equity benchmark.

The analysis of the sensitivity of the indices to different assumptions made on the shares of outpatient and inpatient expenditure and on the use of service in the district of residence produces negligibly different results. Results are robust to a definition of need based on demographic and mortality indicators only, in spite of marginally larger values of $VI^{DON}$, and to the application of the Erreygers correction in the calculation of VI, in spite of an increase of 0.17 fot all VI measures, suggesting that vertical inequity may be underestimated.

## 4.6. Discussion

In this paper, we sought to quantify the horizontal and vertical equity of government and donor recurrent spending on primary and secondary outpatient care in Mozambique, from 2008 to 2011. We defined the horizontal and vertical equity benchmark based on objective indicators of economic status and need for health care. Using health expenditure figures disaggregated at district level, we also set out to determine the extent to which inequity was driven by access to health care (service utilisation) or geographic resource allocation (variation of unit monetary benefit across districts).

In line with previous evidence that use of primary and outpatient care is generally more equitable than inpatient and specialised care, although often still inequitable (Anselmi et al., 2014), we found a pro-rich distribution of government spending, driven by pro-rich service utilisation while resource allocation was already very close to horizontal equity in 2008. The results for resource allocation are not surprising, since a capitation formula, adjusted for poverty and service workload, was applied since the 1990s until the period prior to the analysis to determine the provincial and district allocations of the donor pooled common fund (MISAU, 2012a). Additionally, we also found that donor-earmarked expenditure was pro-poor in 2008.

Similarly to previous studies based on subjective measures of need (Chuma et al., 2012, Ataguba and McIntyre, 2012, Mtei et al., 2012, Akazili et al., 2012), we found vertical inequity in the distribution of monetary benefit from health expenditure. Service utilisation was concentrated in the least needy quintile and resource allocation appeared to initially concentrate resources in less needy areas. Interestingly, while donor expenditure tended to favour the middle quintiles, government expenditure appeared to perform better in targeting the neediest quintile, although overall inequitable and favouring the least needy quintile most. We ranked individuals by need rather than socio-economic status and quantified inequity adapting the Kakwani index. Additionally we were able to disentangle the drivers of inequity.

Improvements towards horizontal and vertical equity, in both government and donor expenditure, were observed between 2008 and 2011. Changes in the geographic allocation of resources led to an alignment of government and donor allocation patterns, implying a reduction of the pro-poor nature of donor funding and a gradual re-distribution of resources toward the neediest quintile. This is not surprising. The shift of responsibility for provincial and district state budget allocation from the MoH to the MoF in 2007 led to an initial underfunding of some areas with lower managerial capacity but also with higher need, which was partially compensated in the following years (MISAU, 2012c). The end of a few NGO projects and the greater coordination between MoH and donors, resulting in the progressive inclusion of external resources in government planning, may have contributed to the observed improved alignment (MISAU, 2012c).

The allocation of government expenditure shows regular patterns over time, suggesting that it does not adjust to the more irregular donor allocations. Previous studies highlighted an adjustment of government resource allocation to the availability of donor fund, a phenomenon referred as fungibility (Chunling et al., 2010, van de Sijpe, 2013, Dieleman and Hanlon, 2013) However, we do not find evidence of donor-earmarked expenditure ‘crowding out’ government recurrent expenditure, suggesting that fungibility may affect resources for new investment, but not the core resources which guarantee the functioning of the health system. The disaggregation by type of expenditure, as well as by type of funding, provides additional insights on the nature fungibility.

Most BIA studies implicitly (or explicitly) assume that the poorest are also the neediest (Van de Walle and Nead, 1995, Wagstaff, 2002). However, our results show that poverty (measured by per capita consumption) and need for health care (proxied using an index including individual demographic characteristics, household non-economic deprivation and district U5M) do not always overlap. Indeed, we find that the correlation between measures of poverty and the indicators of need for health care chosen in this study is relatively weak (0.24). Need for health care appears to be more concentrated in the poorest quintile, particularly in the 2nd poorest decile, and almost equally distributed among the rest of the population. Household consumption per capita is not correlated, as one would expect, with the average number of consultations per age-gender group (-0.03), and mildly correlated with household (non-economic) deprivation (-0.34) and with district U5M rate (-0.12). All reported Pearson's correlation coefficients are significant at the one percent level. Previous studies in Mozambique highlighted the discrepancy between household consumption measures calculated using different methods to adjust for inflation (Alfani et al., 2012) and between household poverty based on consumption or asset based measures (Lindelow, 2006). These discrepancies suggest that the choice of the measure of economic status should be carefully evaluated, and that different measures of economic status may be more or less correlated with need for health care.

If the poorest are not necessarily those who need health services the most, trade-offs in resource allocation are likely to arise, as well as thorny questions about the objectives of public finance in the health sector: should public health expenditure target the poorest or should it target the neediest? Should it re-distribute economic resources from the richer to the poorer districts or should it aim at providing resources to the facilities operating in those areas with higher need for service? From a public health perspective, targeting those who need health services the most, would be desirable. However, in LMICs since poverty measures have been used as proxies for need since ill-health tend to be disproportionately concentrated amongst the poor (Wagstaff, 2002) and the use of public expenditure (including health expenditure) as a tool to redistribute economic resources, although arguable, has been promoted, with consequences for the development of the mainstream analytical tools (O'Donnell et al., 2008).

Results show that horizontal inequities in the distribution of the monetary benefit from public expenditure are driven by inequities in health care utilisation, which are likely to reflect inequalities in individual, household and community socio-economic and environmental characteristics (Wagstaff, 2002, WHO, 2008). Policies which go beyond the provision of health care, or rather policy combinations acting on different causes of ill-health, are required to tackle existing inequalities. Since the role of the MoH in most LMIC countries is currently confined to the provision of curative and preventive care, either a re-definition of this role or a collaborative approach involving a plurality of public services is required. The allocation of public resources across and within those sectors would then need to be reconsidered (Goddard and Smith, 2001). The clear definition of health policy objectives, in particular with respect to equity, is necessary to define the role of the health versus other public sectors in promoting equity in health, to evaluate public health expenditure against the appropriate benchmark and, if needed, to develop and promote appropriate analytical tools.

BIA analyses the distribution of the monetary benefit across the population, but does not provide any insights on how public health expenditure is effectively transformed into services, as well as on the quality and the outcomes of those services (Castro-Leal et al., 2000, Lanjouw et al., 2001). Complementary analysis of the absorptive capacity of local administrations and the constraints to service utilisation is required to inform policy and guarantee that the target population benefit from the service provided. Indeed, pursuing equity in public expenditure may lead to trade-offs with efficiency in public expenditure, especially where resources are limited and differences in the capacity of management and service delivery exist across geographic areas. Quantifying the dimensions of the trade-off and identifying the mechanisms which generate it is therefore important to inform policy.

The approach to the analysis of HI used in this study, was originally introduced by (Le Grand, 1978) and enhanced by (Wagstaff et al., 1991c). The approach is informative of horizontal equity only if vertical equity is defined, as it is in this study, as health care use (or expenditure) increasing proportionally to need (O'Donnell and Propper, 1991, Le Grand, 1991, Wagstaff et al., 1991b). Given the challenges in measuring need for health care, the definition of vertical equity adopted raises concerns on the practical validity, For example, it is inconsistent with individuals with no measured need being considered justly deserving of some health care resources, as it might be the case for preventive services. However, most of the preventive care provided at district level in Mozambique targets children and women and differences in the entitlement to preventive care across individuals are therefore accounted by the demographic component of the need index.

The restricted focus of this study on primary and secondary outpatient recurrent expenditure limits the extent to which results can be generalised. However, where a referral system is in place, the equitable provision of primary and secondary care across geographic areas is a necessary condition for equitable access to inpatient and specialised care, for which resources are often allocated based on service workload rather than with attention to geographic distribution. Due to lack of information on geographic distribution of drugs, equipment, and in some case specialized human resources, recurrent expenditure managed at central level to purchase them was assumed to reach equally the entire country and is not included in the analysis. However, it could be argued that the distribution of drugs and equipment is likely to be correlated with local administrative expenditure.

The assumption that resources managed by a provincial administration are equally distributed across districts, implied by the non-availability of expenditure figures disaggregated at district level for those sources of funding, may lead to under or overestimation of inequity, depending on the criteria in use. The use of an average district measure of health status has the advantage of being objective, unlike self-assessed health status which underestimate need among the poor (Mtei et al., 2012), but it masks intra-district inequalities. The assumption that individuals use outpatient services in their district of residence and would not change utilisation patterns in the short run, could systematically bias inequity estimates (in which direction it is unclear), if the choice of health provider was affected by health expenditure through service quality. However, the small variations in results in the sensitivity analysis are reassuring about the magnitude of the potential bias introduced. The exclusion from the analysis of Maputo City and Matola, which notoriously receive higher resources and the use of routine data in service utilisation from NHIS which may systematically underreport service use in the most deprived districts (and therefore inflate the level of individual monetary benefit received) may contribute to underestimate existing inequities. However the direction of the main results would remain.

## 4.7. Conclusion

We quantified horizontal and vertical equity in expenditure allocation across geographic areas and disentangled the contributions of resource allocation and service use to observed inequity to discuss the distributive implications of different resource allocation mechanisms and priorities. Results show that the allocation of recurrent expenditure in Mozambique is both horizontally and vertically nearly equitable, while inequities in the distribution of monetary benefit are determined by inequities in the use of services. Between 2008 and 2011, government and donor resource allocation patterns slowly converged, leading to the progressive reduction of targeting of poorest areas by donors to shift resources towards areas with higher need for health care but that are not necessarily the poorest.

The discrepancy between economic and need ranking raises questions about the ultimate objective of public expenditure in health care. The equity objectives to be pursued have to be clearly defined to identify the target population and the most effective policies to reallocate public expenditure in health services and other sectors.

Further research on the determinants of inequality in health care utilisation is required to advance the discussion of equity in resource allocation and in the final distribution of public health expenditure across the population. A better understanding of the absorptive capacity of local administrations is needed to inform effective and efficient allocative policies.

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## Appendices to Chapter 4

### APPENDIX 4.1: Additional results for Horizontal Equity analysis

**Table 4.3 Concentration index of benefit from public health expenditure by source of spending, Mozambique, 2008-2011**

| | Need | USE | 2008 | | | 2009 | | | 2010 | | | 2011 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | GOV | DON | TOT | GOV | DON | TOT | GOV | DON | TOT | GOV | DON | TOT |
| CI | **-0.03** | **0.12** | **0.15** | **-0.05** | **-0.01** | **0.14** | **-0.05** | **-0.03** | **0.13** | **0.00** | **0.05** | **0.13** | **0.09** | **0.11** |
| SE | 0.00 | 0.02 | 0.02 | 0.12 | 0.10 | 0.02 | 0.12 | 0.10 | 0.02 | 0.06 | 0.04 | 0.02 | 0.02 | 0.02 |

**Table 4.4 Shares of Benefit from government and donor spending in primary and secondary outpatient care by economic quintiles in Mozambique, 2008-2011**

| **Quintiles from poorest to richest** | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|
| 2011 Tot | 0.15 | 0.19 | 0.18 | 0.22 | 0.26 |
| 2010 Tot | 0.18 | 0.21 | 0.17 | 0.19 | 0.24 |
| 2009 Tot | 0.22 | 0.24 | 0.15 | 0.16 | 0.23 |
| 2008 Tot | 0.21 | 0.23 | 0.15 | 0.16 | 0.24 |
| 2011 Don | 0.16 | 0.19 | 0.18 | 0.22 | 0.25 |
| 2010 Don | 0.20 | 0.23 | 0.17 | 0.18 | 0.23 |
| 2009 Don | 0.23 | 0.25 | 0.15 | 0.15 | 0.22 |
| 2008 Don | 0.23 | 0.25 | 0.15 | 0.15 | 0.23 |
| 2011 Gov | 0.15 | 0.18 | 0.18 | 0.22 | 0.28 |
| 2010 Gov | 0.15 | 0.18 | 0.18 | 0.22 | 0.28 |
| 2009 Gov | 0.14 | 0.18 | 0.18 | 0.22 | 0.29 |
| 2008 Gov | 0.14 | 0.17 | 0.17 | 0.22 | 0.29 |
| Use | 0.16 | 0.18 | 0.18 | 0.22 | 0.26 |
| Consumption | 0.06 | 0.11 | 0.16 | 0.22 | 0.46 |
| Horizontal Equity (Need) | 0.21 | 0.20 | 0.20 | 0.20 | 0.18 |

**APPENDIX 4.2: Additional results for Vertical Equity analysis**

**Table 4.5 Kakwani index of benefit from public health expenditure by source of spending, Mozambique, 2008-2011**

| | USE | 2008 | | | 2009 | | | 2010 | | | 2011 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **GOV** | **DON** | **TOT** | **GOV** | **DON** | **TOT** | **GOV** | **DON** | **TOT** | **GOV** | **DON** | **TOT** |
| KI | 0.07 | **0.15** | **0.14** | **0.14** | **0.13** | **0.15** | **0.15** | **0.12** | **0.10** | **0.11** | **0.07** | **0.07** | **0.07** |
| SE | 0.02 | 0.02 | 0.09 | 0.07 | 0.02 | 0.09 | 0.08 | 0.02 | 0.05 | 0.03 | 0.02 | 0.02 | 0.02 |

*Gini index of need: 0.17 (SE:0.00)*

**Table 4.6 Shares of Benefit from government and donor spending in primary and secondary outpatient care by need quintiles in Mozambique, 2008-2011**

| **Quintiles from neediest to less needy** | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|
| 2011 Tot | 0.26 | 0.21 | 0.18 | 0.18 | 0.16 |
| 2010 Tot | 0.23 | 0.22 | 0.18 | 0.21 | 0.16 |
| 2009 Tot | 0.18 | 0.25 | 0.18 | 0.25 | 0.14 |
| 2008 Tot | 0.19 | 0.24 | 0.17 | 0.25 | 0.14 |
| 2011 Don | 0.26 | 0.21 | 0.18 | 0.18 | 0.17 |
| 2010 Don | 0.22 | 0.23 | 0.18 | 0.22 | 0.14 |
| 2009 Don | 0.18 | 0.26 | 0.18 | 0.26 | 0.13 |
| 2008 Don | 0.18 | 0.26 | 0.18 | 0.26 | 0.13 |
| 2011 Gov | 0.26 | 0.21 | 0.18 | 0.18 | 0.16 |
| 2010 Gov | 0.24 | 0.20 | 0.17 | 0.19 | 0.20 |
| 2009 Gov | 0.23 | 0.20 | 0.17 | 0.19 | 0.21 |
| 2008 Gov | 0.22 | 0.19 | 0.17 | 0.19 | 0.22 |
| Use | 0.25 | 0.21 | 0.18 | 0.19 | 0.17 |
| Vertical Equity (Need) | 0.28 | 0.23 | 0.20 | 0.17 | 0.12 |

**APPENDIX 4.3: Horizontal equity of government expenditure per source of funding**

**Figure 4.5 Cumulative distribution of benefit from provincial state budget, district state budget and provincial donor common fund in primary and secondary outpatient care across individuals ranked by economic status in Mozambique, 2008**

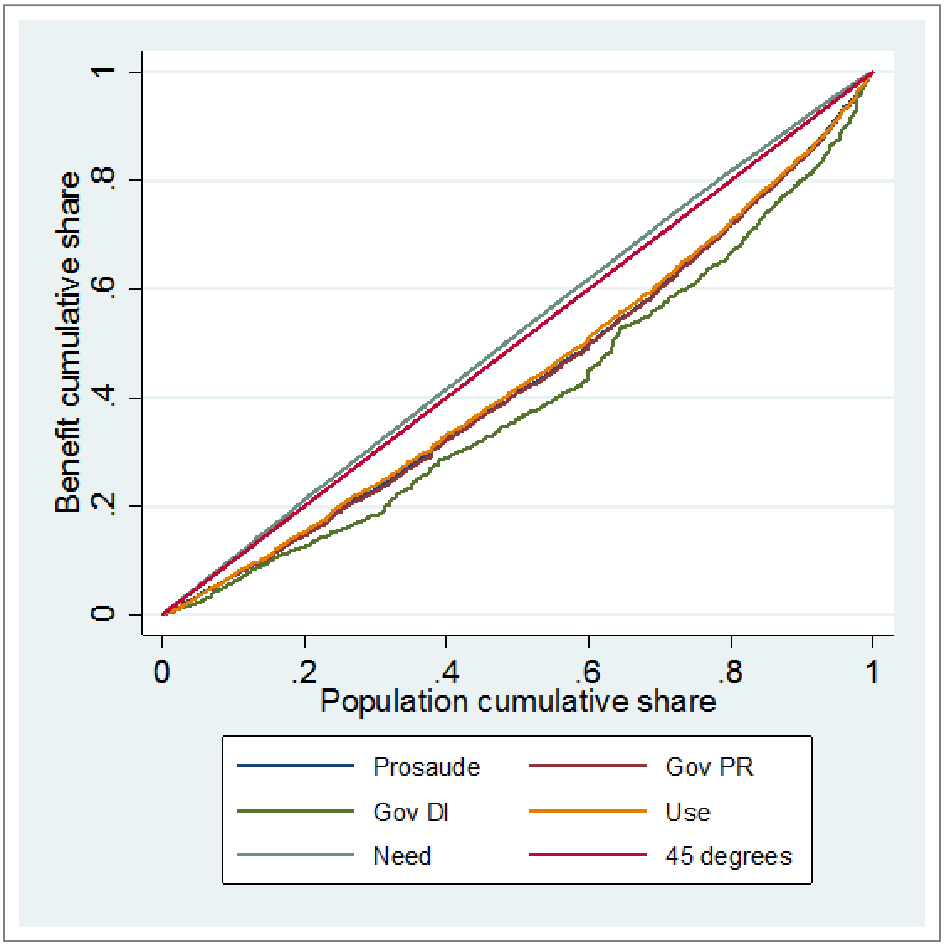
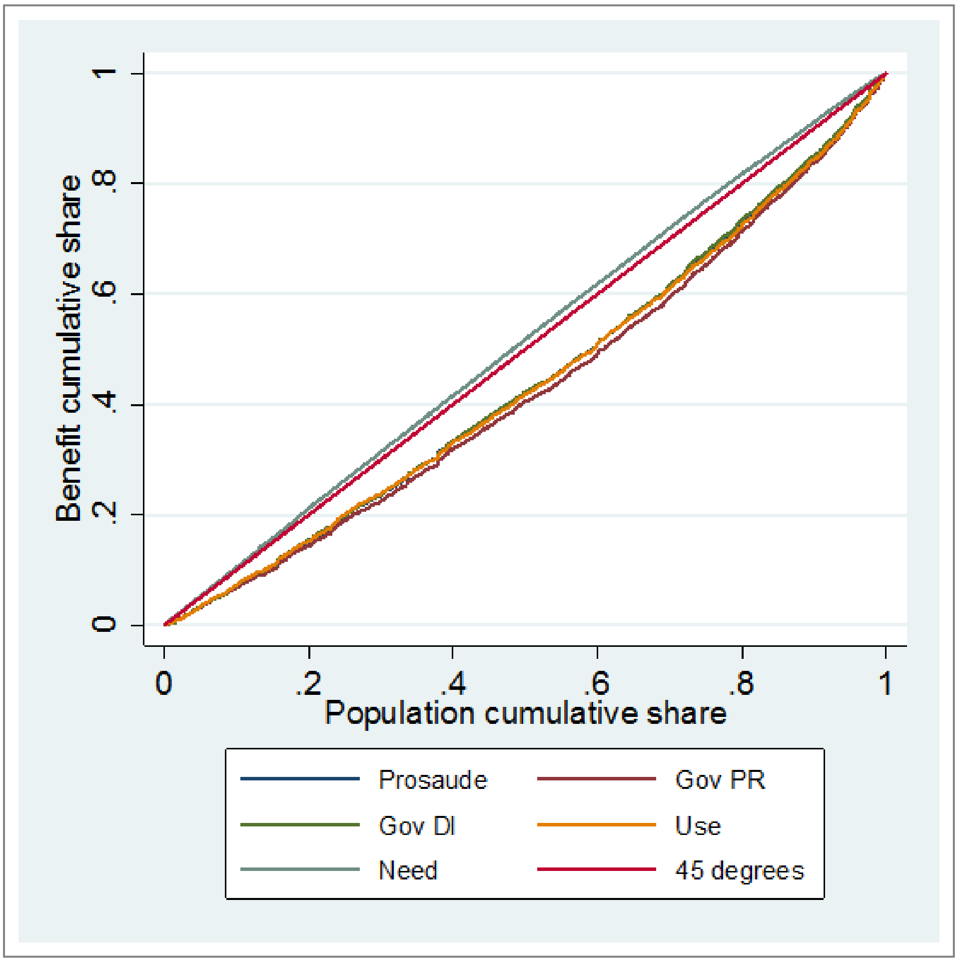


**Figure 4.6 Cumulative distribution of benefit from provincial state budget, district state budget and provincial donor common fund in primary and secondary outpatient care across individuals ranked by economic status in Mozambique, 2011**



**APPENDIX 4.4: Vertical equity of government expenditure per source of funding**

**Figure 4.7 Cumulative distribution of benefit from provincial state budget, district state budget and provincial donor common fund in primary and secondary outpatient care across individuals ranked by need (from higher to low) in Mozambique, 2008**

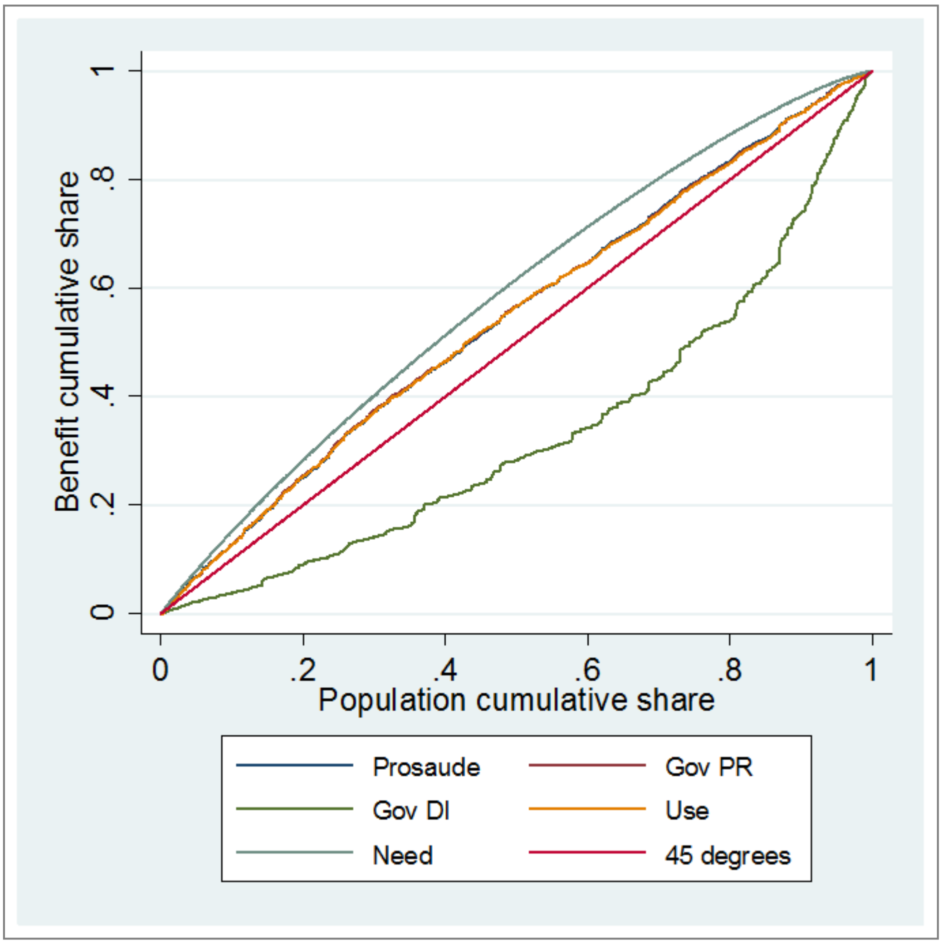
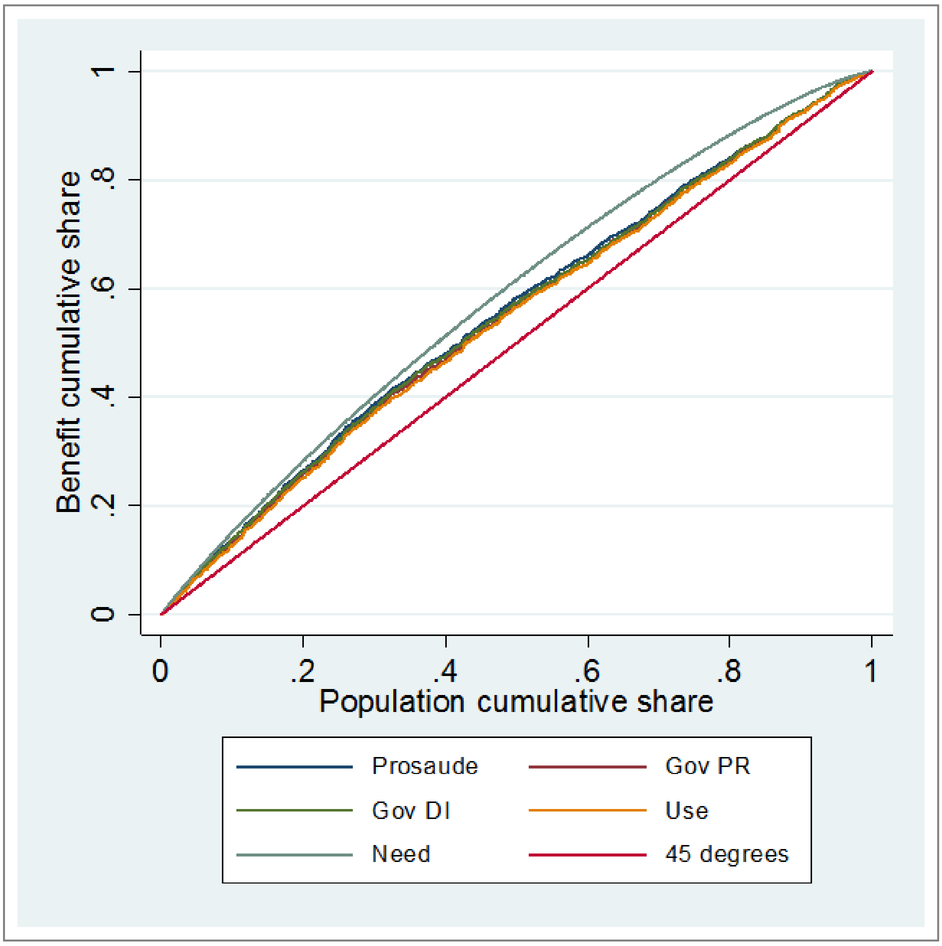


**Figure 4.8 Cumulative distribution of benefit from provincial state budget, district state budget and provincial donor common fund in primary and secondary outpatient care across individuals ranked by need (from higher to low) in Mozambique, 2011**



**APPENDIX 4.5: Sensitivity analysis on the measure of need based on demographic and mortality indicators only: Horizontal Equity**

**Figure 4.9 Cumulative distribution of monetary benefit from government, donor and total expenditure in primary and secondary outpatient care across individuals ranked by economic status in Mozambique, 2008**

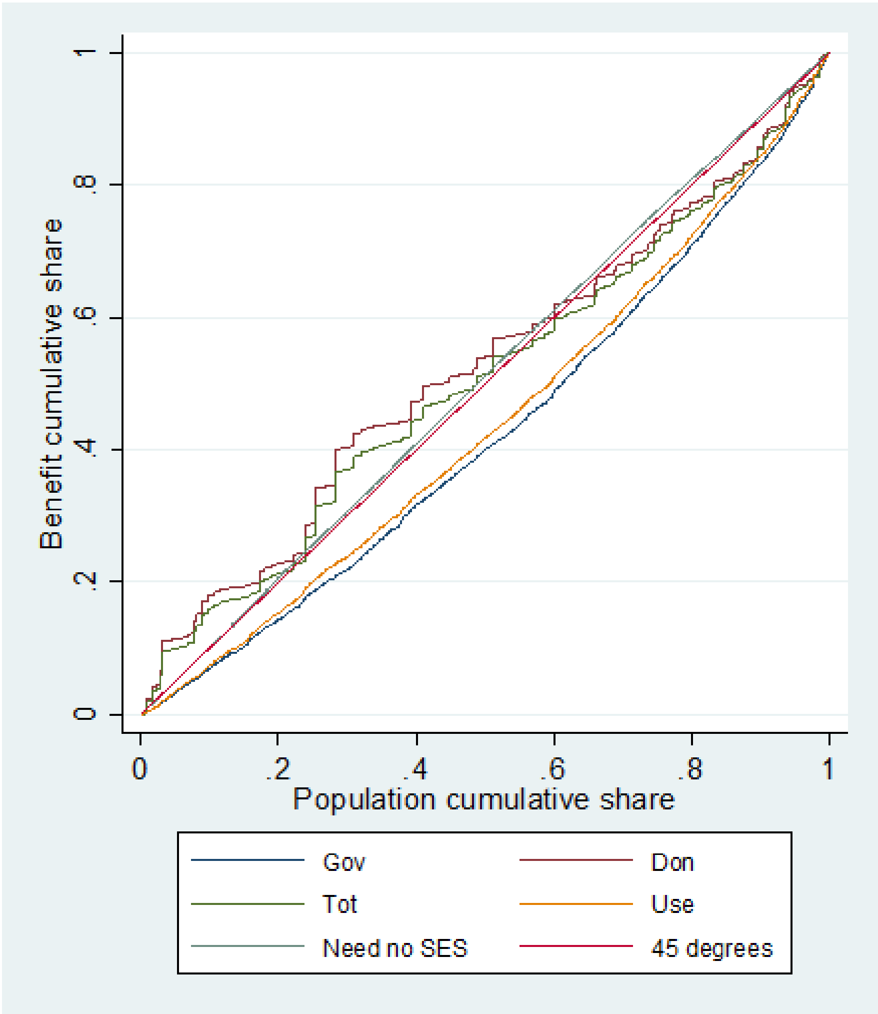


**Figure 4.10 Monetary benefit from government and donor spending in primary and secondary outpatient care by economic quintiles in Mozambique, 2008-2011**

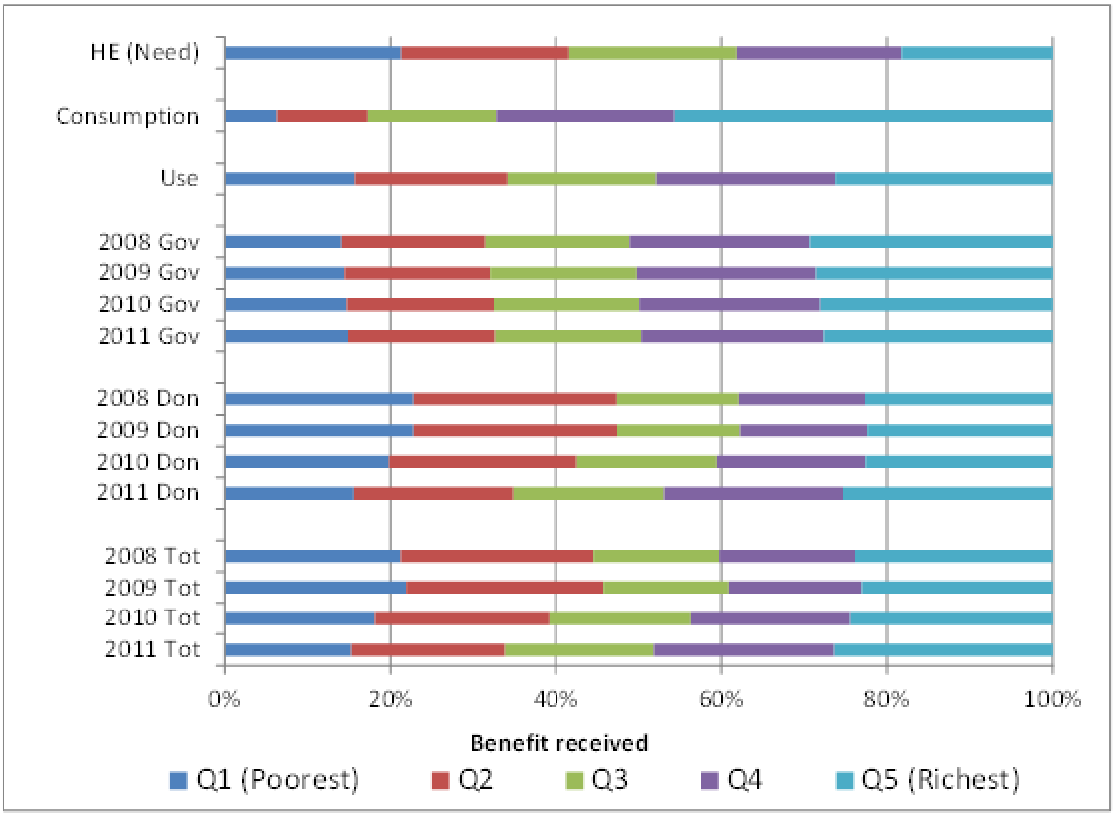


**Table 4.7 Concentration index of benefit from public health expenditure by source of spending, Mozambique, 2008-2011**

| | Need | USE | 2008 | | | 2009 | | | 2010 | | | 2011 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | GOV | DON | TOT | GOV | DON | TOT | GOV | DON | TOT | GOV | DON | TOT |
| CI | **-0.03** | **0.12** | **0.15** | **-0.05** | **-0.01** | **0.14** | **-0.05** | **-0.03** | **0.13** | **0.00** | **0.05** | **0.13** | **0.09** | **0.11** |
| SE | 0.00 | 0.02 | 0.02 | 0.12 | 0.10 | 0.02 | 0.12 | 0.10 | 0.02 | 0.06 | 0.04 | 0.02 | 0.02 | 0.02 |

**Table 4.8 Shares of Benefit from government and donor spending in primary and secondary outpatient care by economic quintiles in Mozambique, 2008-2011**

| Quintiles from poorest to richest | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|
| 2011 Tot | 0.15 | 0.19 | 0.18 | 0.22 | 0.26 |
| 2010 Tot | 0.18 | 0.21 | 0.17 | 0.19 | 0.24 |
| 2009 Tot | 0.22 | 0.24 | 0.15 | 0.16 | 0.23 |
| 2008 Tot | 0.21 | 0.23 | 0.15 | 0.16 | 0.24 |
| 2011 Don | 0.16 | 0.19 | 0.18 | 0.22 | 0.25 |
| 2010 Don | 0.20 | 0.23 | 0.17 | 0.18 | 0.23 |
| 2009 Don | 0.23 | 0.25 | 0.15 | 0.15 | 0.22 |
| 2008 Don | 0.23 | 0.25 | 0.15 | 0.15 | 0.23 |
| 2011 Gov | 0.15 | 0.18 | 0.18 | 0.22 | 0.28 |
| 2010 Gov | 0.15 | 0.18 | 0.18 | 0.22 | 0.28 |
| 2009 Gov | 0.14 | 0.18 | 0.18 | 0.22 | 0.29 |
| 2008 Gov | 0.14 | 0.17 | 0.17 | 0.22 | 0.29 |
| Use | 0.16 | 0.18 | 0.18 | 0.22 | 0.26 |
| Consumption | 0.06 | 0.11 | 0.16 | 0.22 | 0.46 |
| Horizontal Equity (Need) | 0.21 | 0.20 | 0.20 | 0.20 | 0.19 |

**APPENDIX 4.6: Sensitivity analysis on the measure of need based on demographic and mortality indicay: Vertical Equity**

**Figure 4.11 Cumulative distribution of monetary benefit from government, donor and total expenditure in primary and secondary outpatient care across individuals ranked by economic status in Mozambique, 2008**

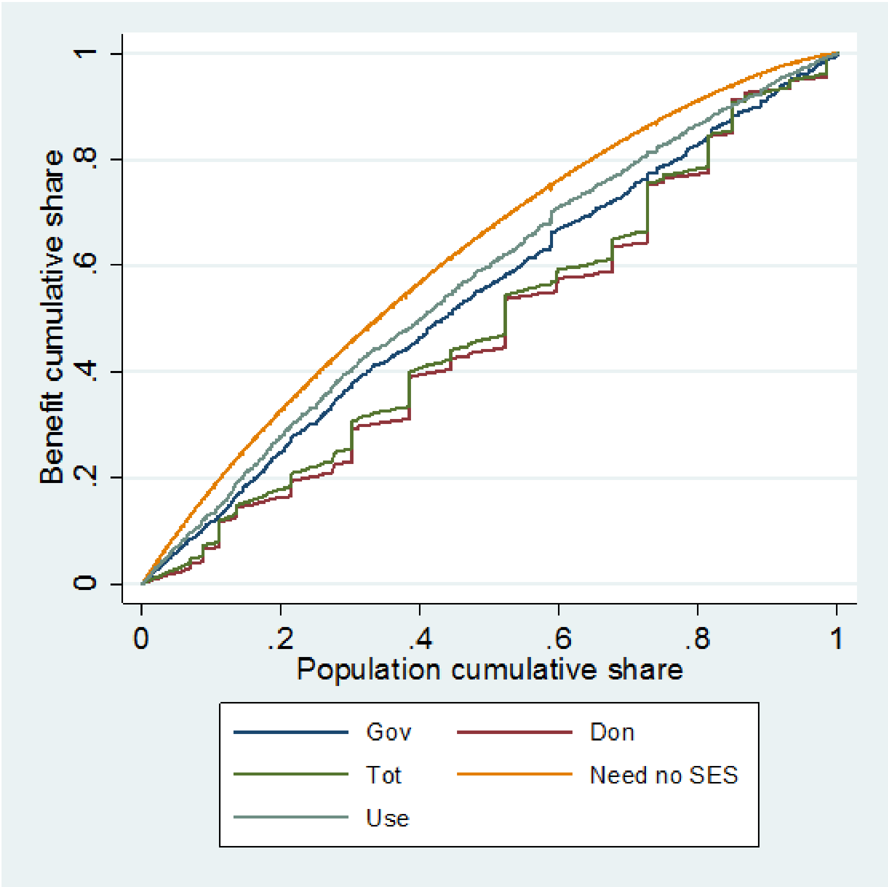


**Figure 4.12 Benefit from government and donor spending in primary and secondary outpatient care by need quintiles in Mozambique, 2008-2011**

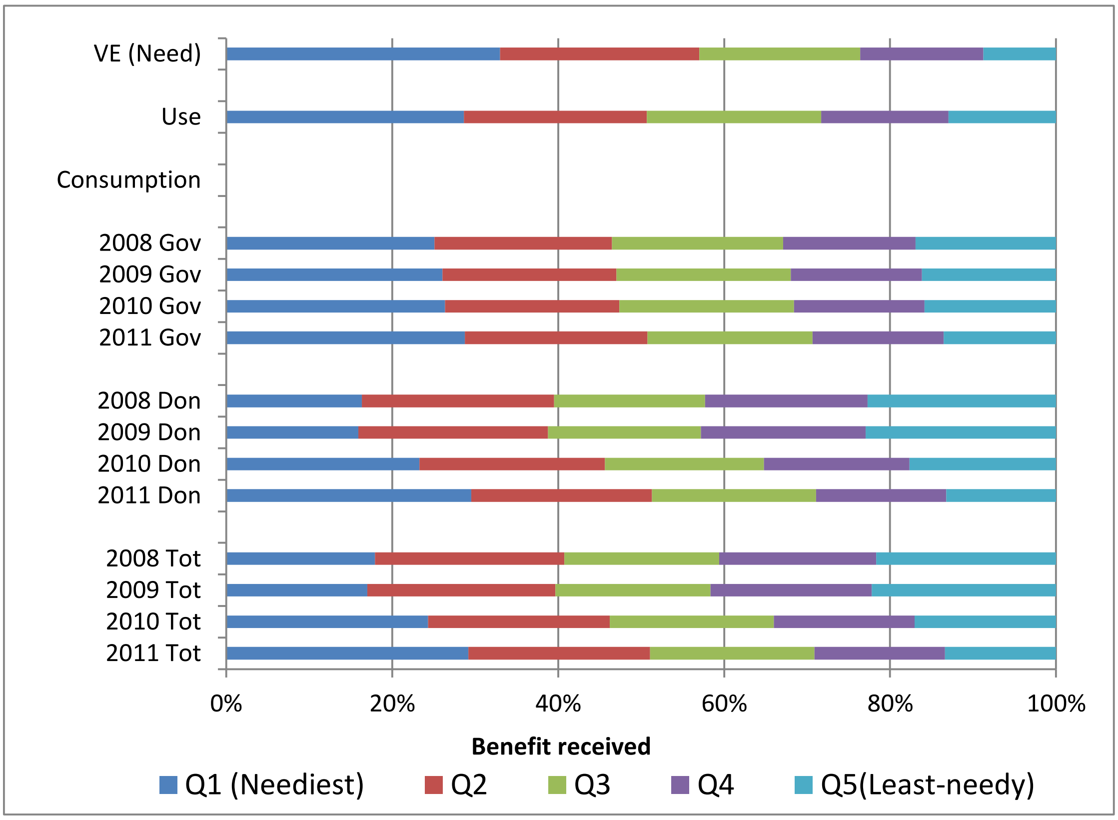


**Table 4.9 Kakwani index of benefit from public health expenditure by source of spending, Mozambique, 2008-2011**

| | USE | 2008 | | | 2009 | | | 2010 | | | 2011 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **GOV** | **DON** | **TOT** | **GOV** | **DON** | **TOT** | **GOV** | **DON** | **TOT** | **GOV** | **DON** | **TOT** |
| KI | 0.10 | 0.16 | 0.28 | 0.26 | 0.14 | 0.29 | 0.27 | 0.13 | 0.18 | 0.16 | 0.09 | 0.09 | 0.09 |
| SE | 0.02 | 0.02 | 0.09 | 0.07 | 0.02 | 0.09 | 0.08 | 0.02 | 0.05 | 0.03 | 0.02 | 0.02 | 0.02 |

*Gini Index of need: 0.23, (SE: 0.00)*

**Table 4.10 Shares of Benefit from government and donor spending in primary and secondary outpatient care by need quintiles in Mozambique, 2008-2011**

| **Quintiles from neediest to less needy** | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|
| 2011 Tot | 0.29 | 0.22 | 0.20 | 0.16 | 0.13 |
| 2010 Tot | 0.24 | 0.22 | 0.20 | 0.17 | 0.17 |
| 2009 Tot | 0.17 | 0.23 | 0.19 | 0.19 | 0.22 |
| 2008 Tot | 0.18 | 0.23 | 0.19 | 0.19 | 0.22 |
| 2011 Don | 0.29 | 0.22 | 0.20 | 0.16 | 0.13 |
| 2010 Don | 0.23 | 0.22 | 0.19 | 0.17 | 0.18 |
| 2009 Don | 0.16 | 0.23 | 0.18 | 0.20 | 0.23 |
| 2008 Don | 0.16 | 0.23 | 0.18 | 0.20 | 0.23 |
| 2011 Gov | 0.29 | 0.22 | 0.20 | 0.16 | 0.13 |
| 2010 Gov | 0.26 | 0.21 | 0.21 | 0.16 | 0.16 |
| 2009 Gov | 0.26 | 0.21 | 0.21 | 0.16 | 0.16 |
| 2008 Gov | 0.25 | 0.21 | 0.21 | 0.16 | 0.17 |
| Use | 0.28 | 0.22 | 0.21 | 0.15 | 0.13 |
| Vertical Equity (Need) | 0.33 | 0.24 | 0.19 | 0.15 | 0.09 |

**APPENDIX 4.7: Sensitivity analysis on the concentration of need across economic status and need quintiles measured using Erreyngers' corrected concentration index**

**Table 4.11 Horizontal inequity in the distribution of monetary benefit from public health expenditure by source of spending, Mozambique, 2008-2011**

| | $HI_{USE}$ | 2008 | | | 2009 | | | 2010 | | | 2011 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $HI^{GOV}$ | $HI^{DON}$ | $HI^{TOT}$ | $HI^{GOV}$ | $HI^{DON}$ | $HI^{TOT}$ | $HI^{GOV}$ | $HI^{DON}$ | $HI^{TOT}$ | $HI^{GOV}$ | $HI^{DON}$ | $HI^{TOT}$ |
| HI* | 0.18 | 0.21 | 0.01 | 0.05 | 0.20 | 0.01 | 0.03 | 0.19 | 0.06 | 0.11 | 0.19 | 0.15 | 0.17 |

** HI corresponds to the concentration index standardised by need (Erreygers CI of need: -0.06, SE: 0.03)*

**Table 4.12 Vertical inequity in the distribution of benefit from public health expenditure by source of spending in Mozambique, 2008-2011**

| | $VI_{USE}$ | 2008 | | | 2009 | | | 2010 | | | 2011 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $VI^{GOV}$ | $VI^{DON}$ | $VI^{TOT}$ | $VI^{GOV}$ | $VI^{DON}$ | $VI^{TOT}$ | $VI^{GOV}$ | $VI^{DON}$ | $VI^{TOT}$ | $VI^{GOV}$ | $VI^{DON}$ | $VI^{TOT}$ |
| VI* | 0.25 | 0.32 | 0.31 | 0.31 | 0.3 | 0.32 | 0.32 | 0.29 | 0.27 | 0.28 | 0.24 | 0.24 | 0.24 |

** VI corresponds to Kakwani Index of need (Erreygers corrected CI of need: 0.34, SE:0.00)*

# Chapter 5

# Investigating efficiency in health care production: the roles of health care administrations and providers

## Preface

The analysis of equity in the current allocation of public resources in Mozambique carried out in Chapter 4 revealed limited inequity, and showed improvements over time in the distribution of public health expenditure across the population. In particular, the allocation of financial resources across local health authorities seemed to compensate for some inequitable utilisation of services. However, it is important to go beyond this relatively descriptive analysis of the monetary benefits and understand how financial resources, once allocated to local health authorities, are effectively transformed into services. First, the distribution of benefit from health financial resources is driven by individual utilisation patterns. According to the framework presented in Chapter 1, individual utilisation depends, among others, on supply-side factors, including the availability of health care. The availability of staff and equipment in particular depends on the financial resources allocated to local health administrations, but also on their efficiency in managing those resources. Second, the capacity of service delivery at local level, which depends on the managerial efficiency of local health authorities but also on the efficiency with which HFs use health care inputs to address demand for health care, is what ultimately determines whether individuals get the services they need.

In sum, the capacity of local health authorities to produce health services represents a potential facilitating or hindering factor in the path from the allocation of resources to the individual benefits for the population. If resources are not effectively spent and there is heterogeneity in their use across geographic areas, more efficient outcomes (higher service delivery) could be attained through different resource allocations. Furthermore, even an equitable distribution of financial resources may not translate into equitable (non-monetary) benefit from service, for example because of the different capacity of local health administrations to manage financial resources in order to staff and equip the existing HFs. Understanding if and where inefficiencies exist is key to elaborate adequate policy changes.

Chapter 5 aims, therefore, to assess and understand the efficiency in the use of resources allocated to local health authorities.

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## Abstract

Efficiency in the use of resources is key for governments wishing to deliver cost-effective and equitable health care services. In most national health services, two separate entities are responsible for turning financial resources into health services at the local level: health care providers and health administrations. Health administrations manage financial resources to commission services from providers, or directly provide them with the inputs needed to deliver health care (e.g. human and material resources). Particularly in low- and middle-income countries where they play an extensive role in guaranteeing health care inputs to local providers, health administrations can have a fundamental impact on the efficiency of health systems. Despite this, the existing literature on health care efficiency has mainly focused on the role of health care providers in managing resources, or has conceived the production process at local level as an integrated one, where administrations and providers are amalgamated into a unique (fictitious) decision-making unit.

In this study, using Stochastic Frontier Analysis applied to panel data from Mozambique, we distinguish the relative contribution of local district health care administrations and facilities to efficiency in resource use. First, adopting the standard approach, we assume an integrated production process through which financial resources and health care inputs are simultaneously transformed into health care outputs at district level. We subsequently assume a two-step production process and analyse separately the efficiency of administrations in transforming financial resources into health care inputs and the efficiency of health facilities in transforming these into health care services.

We find that on average only 73% of the deliverable yearly outpatient consultations per capita were realized. However, individual districts may exhibit very different levels of efficiency in administrative or care delivery functions, both of which affect the final outcome. The two-step model for health care efficiency at district level provides a better fit for the data and reveals that administrative efficiency affects directly health facility and overall district performance through the availability of staff and equipment.

Results suggest that the separate analysis of different entities intervening in health care delivery allows a more precise identification of the sources of inefficiency, providing insights for effective policy interventions.


**Keywords:** efficiency analysis, stochastic frontier analysis, health system efficiency, health expenditure, local health administration, Mozambique.

## 5.1. Introduction

Understanding efficiency of resource use is critical to ensure the provision of health care services in accordance with population need (Hollingsworth, 2013). Exploring the productivity and the organizational efficiency of public health systems is of particular relevance for policy makers, since the existence of inefficiencies implies that public resources could be better used elsewhere in the health care sector, or in other sectors. Furthermore, variations in efficiency may lead to an uneven quality of services and a perception of unfairness (Smith and Street, 2005). This is even more critical in low and middle-income countries (LMICs) where the scarcity of financial resources is exacerbated (WHO, 2000).

There is a large literature looking at efficiency of resource use in the health care sector. Efficiency in health care has been analysed as the difference between the observed and optimal productivity of providers, mainly hospitals, but also individual practitioners, primary health care units, clinics, nursing homes, public health teams and primary health care facilities (Hollingsworth and Wildman, 2003, Hollingsworth, 2008, Au et al., 2014, Hussey et al., 2009, Kirigia et al., 2011, Hollingsworth and Peacock, 2008). More recently health systems efficiency has also been addressed, mostly at national level through cross-countries comparisons (Hollingsworth and Wildman, 2003, Greene, 2004, Retzlaff-Roberts et al., 2004, Gravelle et al., 2003), but also at state (Kathuria and Sankar, 2005, Prachitha and Shanmugam, 2012), district (Kinfu, 2013) and lower local health authority level (Puig-Junoy and Ortún, 2004, Varela et al., 2010, Giuffrida, 1999, Giuffrida and Gravelle, 2001, Giuffrida et al., 2000).

While important conceptual and methodological improvements in the performance assessment of health care organizations have been made, this research has had relatively little translation into policy (Hollingsworth, 2012). It has been suggested that this might be linked to scepticism about the data or the methods used (Hollingsworth, 2012), but also to the limited insights provided about where, in the production process, technical or allocative improvements could be made (Hollingsworth and Street, 2006).

Where multiple decision-making units co-exist and contribute to service delivery through separate production processes, studying their respective efficiency is likely to provide insights into where technical improvements should be made. In fact, when measured with respect to a unique output the efficiency in local health-care delivery is a combination of allocative and technical efficiency, attributable to health administrations (HAs) and health care providers respectively. Allocative efficiency implies that for given financial resources the correct input mix (e.g. human and material resources), which allows output to be maximized, was purchased, while technical efficiency implies that more health care could have been delivered for the given input mix.

The efficiency of individual decision-making units and their interaction influence the performance of the health system at sub-national level (Cacace and Nolte, 2011). Since many health systems are organized on a hierarchical basis, with local HAs responsible for purchasing or organizing health services at the lower level, understanding their role and measuring the performance of all actors involved in managing resources is potentially very important due to the distinctive roles they play. In such health systems, local health care providers are typically responsible for delivering care according to their capacity and to the needs of the catchment population. However, it is the local HAs that are responsible for managing the available financial resources, to commission services from health providers in their area or to directly generate capacity for their service provision (Robinson et al., 2005, WHO, 2000).

Some empirical insights into these issues have been provided by studies which have analysed cost-efficiency in contracting health services (Puig-Junoy and Ortún, 2004), while others have analysed the contribution of administrative costs to inefficiencies of local health authorities (Giuffrida et al., 2000), or have accounted for the hierarchical organization of health care delivery in assessing health care providers' efficiency through multilevel models (Jacobs et al., 2006). However, the efficiency of two separate production processes emerging from the respective roles of local HAs and health care providers has never been studied, nor has the way in which local HAs' efficiency influences health providers efficiency been explored.

In this study, we use stochastic frontier analysis (SFA) to assess the efficiency of health districts in delivering outpatient primary care in Mozambique. By separately analysing the efficiency of the entities which contribute to health care delivery, HAs and health facilities (HFs), our analysis can potentially offer more direct and practical recommendations as to which improvements to increase efficiency can be made. Following the standard approach, we first assume that health care provision at local level is the result of an integrated production process, through which financial resources and health care inputs are simultaneously transformed into service. We then analyse separately the efficiency of HAs in managing financial resources to equip and staff HFs and the efficiency of HFs in using these inputs to deliver health care. By including the measured managerial efficiency in the HFs or in the district integrated production functions, we explore its effect on health care delivery.

This study contributes to the literature on health care efficiency in several ways. First, it recognizes and seeks to conceptualize the composite nature of local health care production by accounting for the separate contributions of HAs and providers. Second, it is the first study to address separately Has' and HFs' inefficiencies and to suggest a method to analyse their interaction and their effect on health systems performance at sub-national level. Third, it identifies possible bias arising from the use of a standard integrated approach to the analysis of sub-national health systems and the consequences of this bias in terms of policy implications. Finally, it is the first study to apply a SFA model for panel data to analyse health system efficiency in a LMIC setting.

The rest of the paper is organised as follows. Section 2 describes the study setting, section 3 the methods and data, sections 4 and 5 present and discuss results. Section 6 concludes.

## 5.2. Study setting

The large majority of health care services in Mozambique are provided by the public sector. The National Health System (NHS) follows a centralised top-down hierarchical organization (MISAU, 2012c) where districts manage secondary and primary care, provided through district hospitals (DH), health centres (HC) and clinics. There is generally one DH or HC per district, often located in the major urban centre. There are 10 provinces and 142 districts in the country, excluding the capital, Maputo City.

Like in many sub-Saharan countries, the NHS in Mozambique relies heavily on districts, whose HAs organize service provision in line with the national targets and policies set by the Ministry of Health (MoH) (MISAU, 2012c). Specifically, district HAs manage financial and non-financial resources to guarantee that HFs have the means to operate and deliver services and are therefore responsible for the staff and equipment input mix in HFs (MISAU, 2002, MISAU, 2012c, HST, 1998). Minimum requirements with respect to staff and equipment are set for each type of HF according to the service they are set to provide and guide the distribution of health care inputs across districts and across HFs within the same district (MISAU, 2002, MISAU, 2012a).

Since the decentralization reform, which began in 2007, the responsibility for hiring human resources (HR), has gradually been devolved to district HAs. District health administrators are responsible for opening staff vacancies, selecting candidates and legalizing the recruitment according to the national administrative norms. Medical and clinical staff are still recruited by central or provincial administrations and allocated to districts. However, district administrations have first to communicate their needs to get the recruitment process started, and then follow-up with the hiring process, distributing staff across HFs, paying their salaries and managing their benefits and careers. Among other benefits, key health cadres, such as health technicians and maternal and child nurses, are entitled to staff housing in rural areas, which has emerged as the most important factor for HR retention (Vio et al., 2013). Although it is not always the case, a minimum number complement of staff housing should be built next to each HF by law (MISAU, 2007). The management of housing benefit, including building, renting, maintaining and allocating houses, and the daily HR management, also depends largely on district health administrators.

While the central or provincial level are responsible for infrastructure building and major maintenance, and purchase and distribution of drugs and major equipment, district health administrators are responsible for the direct procurement of small items of equipment and consumables. Therefore, the degree to which the HF's need for drugs, equipment and consumables is satisfied depends on the efficiency of health administrators first in identifying them, and second in channelling and pursuing them with the higher administrative levels, or most simply in directly purchasing what is needed.

District HFs provide health care to meet local populations' demand given their capacity, which is determined by the infrastructure conditions and the availability of staff and equipment. The actions of HF staff operating under the various constraints they face determine service availability and responsiveness to the population needs, for example through HF opening times, attitude towards patients and quality of care provided. In some cases a pro-active attitude of staff can lead to the involvement of community volunteers to support health personnel in performing basic health-care tasks or HFs maintenance (MISAU, 2012c). Finally, the capacity of HF staff to forecast needs and request in a timely manner drugs, equipment and consumables, affects the degree to which those needs are satisfied. Indeed, drugs stock-outs appeared to disproportionately affect HFs with fewer staff (Wagenaar et al., 2014).

District recurrent expenditure is mostly funded through provincial and district government grants, and non-earmarked donor resources. For simplicity we will refer to these sources respectively as district, provincial and donor financial resources. District financial resources have progressively increased since the implementation of the decentralization reform in 2008 and in 2011 represented around 40% of the total executed recurrent expenditure at district level. The budget is funded equally through provincial and donor financial resources which are allocated to districts according to the number and type of HFs. District own revenues represent a negligible share of their total financial resource. They come from small income generating activities, such as occasionally renting out a room for local events, and from user fees, which are very low and from which the large majority of the population is exempted. Other donor earmarked funds have supported district level activities, but those resources are often either difficult to track in a systematic way, or not managed by district administrations (MISAU, 2012c). All financial resources, at the time covered by this study, were managed by district HAs. No financial resources were managed directly by HFs.

## 5.3. Methods

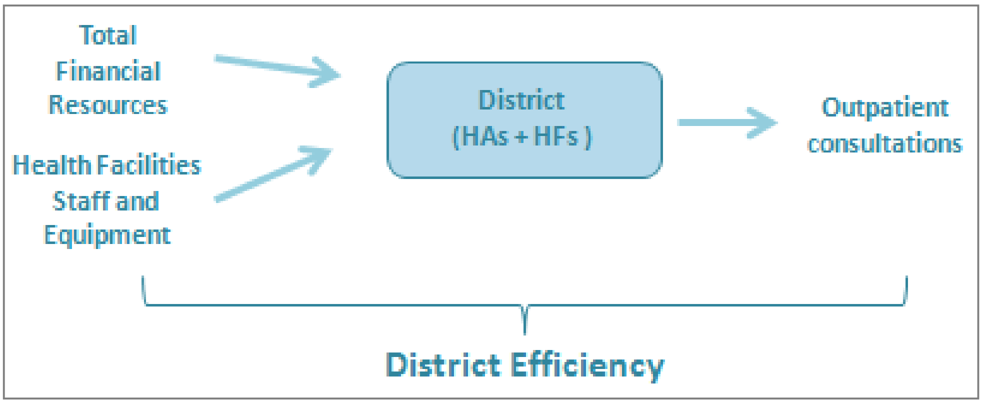
In econometric analysis, efficiency is defined as the difference between the observed and optimal productivity and it is measured by comparing observed and optimal ratios of output to input (Fried et al., 2006). The optimal productivity is unknown and estimated through production frontiers, usually using one of two techniques: stochastic frontier analysis (SFA) or data envelopment analysis (DEA) (Hollingsworth, 2008). SFA relies on the estimation of a production function, which requires assumptions about the production technology and the the efficiency distribution. DEA is based on linear programming and infers the efficient frontier identifying among similar organizations those that attain higher production levels (Jacobs et al., 2006, Greene, 2008). Here, we use SFA because it allows us to explicitly account for measurement error and to quantify the effect of factors outside the producers control (Kinfu, 2013). Additionally, 'when panel data are available, SFA models outperform DEA if the assumed functional form for the production function is close to the underlying production technology' (Giuffrida and Gravelle, 2001). We judge the assumption of a Cobb-Douglas production function a reasonable description of the health care delivery process, where complementary inputs are required, for each of the organizational levels considered.

We analyse district efficiency by considering health care delivery at district level first as an integrated process and then as a two-step process. In the two-step process, we explore the effect of HA efficiency on HFs' and district (integrated) performance. All models are estimated using Nlogit 5.

### *5.3.1. District efficiency assuming an integrated production process*

Following the existing studies of local health system efficiency (Giuffrida, 1999, Giuffrida and Gravelle, 2001, Giuffrida et al., 2000, Puig-Junoy and Ortún, 2004, Kathuria and Sankar, 2005, Varela et al., 2010, Prachitha and Shanmugam, 2012, Kinfu, 2013), we first consider health care delivery at district level as an integrated production process where the district, conceived as an individual decision making unit made of HAs and HFs, transforms the available inputs (financial resources, staff and equipment) into health care (Figure 5.1). Health care production is measured here through outpatient consultations, the only output directly comparable across districts, because of the referral system in place and the inequalities in inpatient and specialized care provision across the country

**Figure 5.1 District integrated health care production process**




The corresponding SFA model is formulated as:

$$Y_{it} = f(X_{it}^{D}, \beta)\, E^{D}(Y_{it}, X_{it}^{D}) \qquad (1)$$

where $Y_{it}$ is the health care output, outpatient consultations, delivered by district *i* at time *t*. $X_{it}^{D}$ includes health care inputs, here defined as total financial resources and HFs staff and equipment. The production frontier $f(\mathrm{X_{it}}, \beta)$ defines the maximum level of output ($Y_{it}$) attainable by district *i* at time *t*, for a given combination of inputs ($\mathrm{X_{it}^{D}}$). β is the vector of parameters of the production function *f (.)*.

$\mathrm{E^{D}}(\mathrm{Y_{it}}, \mathrm{X_{it}^{D}}) = \frac{\mathrm{Y_{it}}}{\mathrm{f(X_{it}^{D}, \beta)}}$ is the technical efficiency calculated as the ratio of observed production ($\mathrm{Y_{it}}$) to the maximum number of consultations deliverable with the inputs available and the technology in use, $\mathrm{f(X_{it}^{D}, \beta)}$.

To estimate the efficiency frontier, we assume a Cobb Douglas functional form for *f*(.) which accounts for complementarities in inputs. We log transform (1) to obtain a linear equation, apply a random effects model for panel data with time invariant inefficiency (Pitt and Lee, 1981) and derive the empirical specification of the SFA following (Greene, 2008):

$$y_{it} = \alpha + \beta x_{it}^{D} + \delta z_{it}^{D} + \varepsilon_{it}^{D} \qquad (2)$$

where $\varepsilon_{it}^{D} = v_{it}^{D} - u_{i}^{D}$ with $v_{it}^{D} \sim N(0, \sigma_{v^D}^{2})$, $u_{i}^{D} \sim N^{+}(0, \sigma_{u^D}^{2})$ and $cov(v_{it}^{D}, u_{i}^{D}) = 0$

$y_{it}$ is the natural log of the yearly number of outpatient consultations per-capita.

$x_{it}^{D}$ is a vector of inputs that includes:

- the (natural log of) annual recurrent expenditure per capita, a proxy for financial resources, which is the sum of the executed district, provincial and donor expenditure in district *i*;
- the (natural log of) average HF staff and equipment, measured using an index which averages across HFs the availability of six items: working car, autoclave, motorbike, number of basic, medium and high level trained health cadres. For each HF we calculate the average ratio of available resources to the minimum standard set by norms for each item (MISAU, 2002). The use of norms sets a minimum benchmark to normalize across different types of HFs, so that our index accounts not only for the total resources available, but also for their distribution across HFs (MISAU, 2012a).

$z_{it}^{D}$ is a vector of district characteristics that capture heterogeneity in the production technology and accommodate shifts of the production frontier. $z_{it}^{D}$ includes the (natural log of) number of HFs per type per 100,000 population, the percentages of HFs with access to electricity and to running water (time varying), the percentages of population that are economically active and illiterate (time invariant) and dummies for provinces to control for the influence of provincial management. The observed error term ($\varepsilon_{it}^{D}$) is a combination of the normally distributed stochastic error term ( $v_{it}^{D}$) and the half-normally distributed non-negative term ($u_{i}^{D}$). $u_{i}^{D}$ defines how far the *i*th district operates below the stochastic production frontier and measures the time invariant inefficiency in production (Kinfu, 2013).

We obtain estimates of the relative efficiency scores as follows (Greene, 2008):

$$\widehat{E_{i}^{D}} = e^{-\widehat{u_{i}^{D}}} \cong 1 - \widehat{u_{i}^{D}} \tag{3}$$

where $\widehat{u_{i}^{D}}$ are the input-oriented estimates of the inefficiency scores obtained with the JMLSE inefficiency estimator (Jondrow et al., 1982). $\widehat{E_{i}^{D}}$ quantifies the overall efficiency of the district in delivering health care.

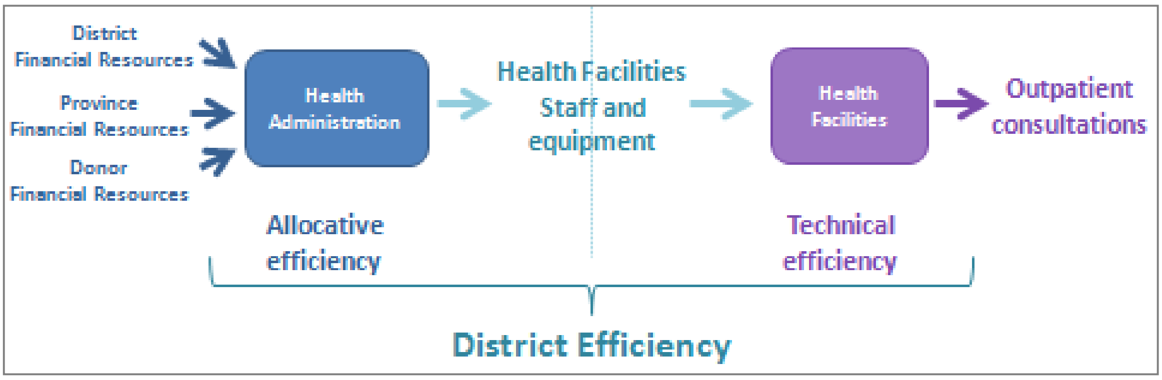
### *5.3.2. District efficiency assuming a two-step production process*

Since in Mozambique the financial management and health care delivery functions depend on different decision making units, we now model the health care production as a two-step process (Figure 5.2).

First, HAs use various financial resources to buy and maintain equipment, hire (or contribute to hire) staff, pay salaries and manage the health personnel in the existing HFs. Financial resources from three different sources (i.e. government provincial expenditure, government district expenditure, and donor common fund expenditure) are used by district HAs to fund recurrent expenditure of health facilities. HAs differs in their ability to provide to HFs the input they needs (for example medical equipment, staff, drugs, timely payment of energy bills, maintenance commodities for cleaning and hygiene, payment of providers for food in impatient wards, fuel for transport), plan the actions required to satisfy them, identify the options that could minimize costs (for example providing regular maintenance and exploit economies of scale in purchasing services for all HFs in the district), plan the use of funds from different sources and timely carry out the administrative work required. Differences in HAs abilities (and practically differences in management and supervision skills in the HA teams) influence the efficiency through which HAs use the available financial resources to fund HFs recurrent inputs needed to keep them functioning, quantified here through staffing and equipment levels. For example if staff are supported and supervised properly, they are more likely to stay in their post.

Second, HFs use HR and equipment to produce health care, measured here through outpatient consultations.

**Figure 5.2 Two-step district health care delivery production process in Mozambique**




***First step: health administration efficiency***

In the first step, the HAs of district *i*'s use the financial resources they are allocated by different sources ($X_{it}^{A}$) to make staff and equipment available into HFs, determining their production input-mix ($Y_{it}^{A}$):

$$Y_{it}^{A} = f(X_{it}^{A}, \beta)\, E^{A}(Y_{it}^{A}, X_{it}^{A}) \qquad (4)$$

where $E^A(Y_{it}^A, X_{it}^A) = \frac{Y_{it}^A}{f(X_{it}^A,\beta)}$ is the HA efficiency. As before, we assume a Cobb-Douglas functional form for *f*(.), log transform (3), apply a random effects model for panel data with time invariant inefficiency (Pitt and Lee, 1981) and derive the empirical specification of the district HA production process:

$$y_{it}^A = \alpha + \beta x_{it}^A + \delta z_{it}^A + \varepsilon_{it}^A \qquad (5)$$

where $\varepsilon_{it}^A = v_{it}^A - u_i^A$ with $v_{it}^A \sim N(0, \sigma_{v^A}^2)$, $u_i^A \sim N^+(0, \sigma_{u^A}^2)$ and $cov(v_{it}^A, u_i^A) = 0$

$y_{it}^A$ is the natural log of the average HFs staffing and equipment index described in 5.3.1. Since $Y_{it}^A$ is an average measure of HR and equipment with respect to a minimum benchmark differing across type of HF, the HA performance is affected not only by the total HR and equipment made available, but also by how well they are allocated across existing HFs.

$x_{it}^A$ includes the (natural log) of the realised recurrent expenditure, as a proxy for financial resources, per HF for each source of funding. To normalize the availability of financial resource per HF across districts accounting for differences in number and type of existing HFs, we weight each HF type based on the estimated cost of the minimum staff and equipment they should have according to norms (MISAU, 2012a).

$z_{it}^A$ is a vector of district characteristics, including the (natural log) total number of HFs, the percentages of HF with access to water and electricity, the average ratio of houses for personnel available and in good conditions compared to the minimum number established by norms (MISAU, 2012a) as a proxy for district capacity for HR retention, and dummies for provinces. The observed error term ($\varepsilon_{it}^A$) is a combination of the normally distributed stochastic term ($v_{it}^A$) and the half-normally distributed inefficiency term ($u_i^A$).

As before, we obtain estimates of the relative efficiency scores:

$$\widehat{E_i^A} = e^{-\widehat{u_i^A}} \cong 1 - \widehat{u_i^A} \qquad (6)$$

where $\widehat{u_i^A}$ are the input-oriented estimates of the inefficiency scores obtained with the JMLSE inefficiency estimator (Jondrow et al., 1982) and $\widehat{E_i^A}$ quantifies the efficiency of HA *i*, reflecting district *i*'s allocative efficiency.

***Second step: health facility efficiency***

In the second step the existing HFs (type and number) ($X_{it}^F$) use staff and equipment ($Y_{it}^A$) to deliver service ($Y_{it}$ ) in district *i*:

$$Y_{it} = f(X_{it}^{F}, Y_{it}^{A}, \beta)\ E^{F}\left(Y_{it}^{F}, X_{it}^{F}, Y_{it}^{A}\right) \quad (7)$$

where $\mathrm{E}^{\mathrm{F}}\left(Y_{it}^{F}, X_{it}^{F}, Y_{it}^{A}\right) = \frac{\mathrm{Y}_{\mathrm{it}}^{\mathrm{F}}}{f(X_{it}^{F}, Y_{it}^{A}, \beta)}$ is the HF technical efficiency.

Following the same method as before, we derive the empirical specification:

$$y_{it} = \alpha + \beta x_{it}^{F} + \delta z_{it}^{F} + \varepsilon_{it}^{F} \quad (8)$$

where $\varepsilon_{it}^{F} = v_{it}^{F} - u_{i}^{F}$ with $v_{it}^{F} \sim N(0, \sigma_{v^F}^{2}), u_{i}^{F} \sim N^{+}\left(0, \sigma_{u^F}^{2}\right)$ and $cov\left(v_{it}^{F}, u_{i}^{F}\right) = 0$

$y_{it}$, as in 5.3.1., is the natural log of the district total outpatient consultations per capita.

$x_{it}^{F}$ includes the average availability of staffing and equipment with respect to norms (see 5.3.1)

$z_{it}^{F}$ includes the (natural log of the) number of DH, HC and clinics per 100,000 population, the percentages of the district population that are economically active and illiterate (time invariant), the percentages of HFs in the district with electricity and with access to running water (time varying) and controls for provinces.

As before, we obtain estimates of the relative efficiency scores as:

$$\widehat{E_{i}^{F}} = e^{-\widehat{u_{i}^{F}}} \cong 1 - \widehat{u_{i}^{F}} \quad (9)$$

where $\widehat{u_{i}^{F}}$ are the input-oriented estimates of the inefficiency scores obtained with the JMLSE inefficiency estimator (Jondrow et al., 1982). $\widehat{E_{i}^{F}}$ quantifies the average efficiency of HFs in district *i* and measures district *i*'s technical efficiency.

Having estimated the district, HA and HFs efficiency scores ($\widehat{E_{i}^{D}}$, $\widehat{E_{i}^{A}}$ and $\widehat{E_{i}^{F}}$), we compare district performance under the assumption of an integrated or two-step production process calculating the correlation and rank correlation of the estimated efficiency scores and visualizing their difference through scatter plot graphs.

### *5.3.3. Testing for the effect of health administration efficiency on district and health facility efficiency*

Having estimated HA efficiency $\widehat{E_{i}^{A}}$, we test for its effect on district and HFs production (and efficiency) by including it as a control factor into the production functions defined in equations (2) and (8). A similar idea has been applied for example to the analysis of the impact of efficiency on profitability of life insurance companies in the U.S. (Greene and Segal, 2004). We are not aware of similar applications in health care literature.

For the integrated district production process, we therefore derive the following empirical specifications:

$$y_{it} = \alpha + \beta x_{it}^{D} + \delta z_{it}^{D} + \varphi \widehat{E_i^A} + \varepsilon_{it}^{D} \quad (10)$$

which is identical to the one defined by equation (2), except for the addition of $\widehat{E_i^A}$. The coefficient $\varphi$, associated with the HA efficiency scores ($\widehat{E_i^A}$), captures the effect of administrative (or allocative) efficiency on the service deliverable by a district. We compare the goodness of fit of (10) with (2) using a Likelihood ratio (LR) test. The rejection of the null hypothesis ($H_0: \varphi = 0$) indicates better fit to the data of the production frontier model including administrative efficiency.

Using the LR test, we further compare (10) to a restricted specification where we exclude the HF staff and equipment to test the hypothesis that its inclusion in the model jointly with financial resources and administrative efficiency does not improve the fit for the data. We also compare the log likelihood and Akaike information criterion of the three specifications to evaluate which model of district performance best fits the data.

For the HFs, we obtain an empirical specification of the production process identical to equation (8) except for the inclusion of the efficiency scores $\widehat{E_i^A}$:

$$y_{it} = \alpha + \beta x_{it}^{F} + \delta z_{it}^{F} + \varphi \widehat{E_i^A} + \varepsilon_{it}^{F} \quad (11)$$

The coefficient $\varphi$ associated with the HA efficiency scores can be interpreted as the effect of administrative efficiency on the service delivered by HFs. We test for the goodness of fit of (11) compared to (8) using the LR test. The rejection of the null hypothesis would indicate that the model including administrative efficiencies fits the data better suggesting that administrative efficiency has not only an indirect effect on the service deliverable by HFs, through the staff and equipment provided, but also a direct one. The more efficient a HA is in providing staff and equipment, the more responsive we can expect it to be to other HF requirements not measured in the analysis.

We compare $\widehat{E_i^D}$ and $\widehat{E_i^F}$, as estimated in (10) and (11) accounting for administrative efficiency, with those originally estimated in (3) and (9) by calculating their correlation and rank correlation, to test if accounting for heterogeneity in administrative efficiency affects the evaluation of district and HFs performance.

### *5.3.4. Data*

We use data from a number of routine sources over a four-year period (2008-2011). Data on HF staff and equipment were derived from the National Health Information System (NHIS), as provided by the MoH in June 2012 (MISAU, 2012d). Provincial and district recurrent expenditure for 2008-2011 were obtained from the Ministry of Finance (MF, 2012) and MoH budget execution reports (MISAU, 2012b). Population figures are based on annual projections from the 2007 Census (INE, 2010b). District socio-economic indicators were estimated by the National Institute of Statistics from 2007 Census data, and are therefore time invariant over the period considered in the analysis (INE, 2008, INE, 2010a).

Since disaggregated district figures are available only for district expenditure, we assume, in line with current practice, that donor and provincial expenditure are allocated by the provincial directorate of health to each district according to the number and type of HFs. Although part of donor expenditure goes to provincial hospitals providing specialised care, because allocations are ad-hoc, vary over time and data are not always available, we make the simplifying assumption that donor expenditure benefits exclusively primary and secondary care.

To minimize reporting bias and improve the consistency of HF data over time, we substituted the yearly data on HF equipment and staff with the average for 2008-2011, when the discrepancy between the two was higher than fifty percent. All HFs were re-classified based on the most recent information provided.

We merged data at the district level to obtain a single four-year database (2008-2011). We exclude Maputo City from the analysis, due to the unusual presence of specialised health care providers, and eight districts, due to incomplete information.

## 5.4. Results

### *5.4.1. Descriptive statistics*

The descriptive statistics presented in Table 5.1 reveal considerable heterogeneity across districts in terms of service delivered, access to health care, public health expenditure and HF and population characteristics.

Population density and geographic dispersion are underlying determinants of the observed heterogeneity in the number of HFs per 100,000 inhabitants. More HFs may be required to ensure the geographical coverage of the NHS where the population is small but spread out.

Similarly, heterogeneity in the number and characteristics of HFs is related to population density and level of urbanization. Heterogeneity in expenditure is driven by the number and type of HFs and variability in financial resources by source reflects institutional changes associated with the undergoing decentralization process. In particular the gradual devolution of the financial resources to districts, which started in 2009, explains the low district expenditure per-capita.

**Table 5.1 District descriptive statistics, Mozambique (2008-2011)**

| | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| ***Output*** | | | | |
| Outpatient consultations per capita per year | 1.08 | 0.46 | 0.19 | 2.50 |
| ***Inputs*** | | | | |
| HF staff and equipment index | 45.80 | 14.67 | 17.35 | 92.49 |
| Total expenditure per capita (MZM) | 138.26 | 101.67 | 6.84 | 646.12 |
| Government district expenditure per capita (MZM) | 41.74 | 54.90 | 0.00 | 339.98 |
| Government provincial expenditure per capita (MZM) | 20.55 | 15.67 | 2.44 | 127.83 |
| Donor provincial expenditure per capita (MZM) | 12.63 | 8.24 | 2.08 | 77.93 |
| Government district expenditure per HF (1,000 MZM) | 5.28 | 8.44 | 0.00 | 72.15 |
| Government provincial expenditure per HF (1,000 MZM) | 134.29 | 47.77 | 45.06 | 276.03 |
| Donor provincial expenditure per HF (1,000 MZM) | 85.31 | 24.54 | 44.02 | 146.32 |
| ***District characteristics*** | | | | |
| District/Rural hospitals (per 100,000 inhabitants) | 0.16 | 0.30 | 0.00 | 1.68 |
| Health centres (per 100,000 inhabitants) | 1.43 | 1.68 | 0.00 | 12.39 |
| Clinics (per 100,000 inhabitants) | 7.39 | 5.40 | 1.09 | 41.12 |
| Total number of HF per district | 8.70 | 3.72 | 3.00 | 20.00 |
| HF with water (percentage) | 42.27 | 28.78 | 0.00 | 100.00 |
| HF with electricity (percentage) | 29.09 | 27.24 | 0.00 | 100.00 |
| HF housing availability (ratio actual to norms) | 0.98 | 0.66 | 0.00 | 3.63 |
| Economically active population (percentage) | 72.77 | 8.59 | 38.50 | 87.80 |
| Illiterate population (percentage) | 55.85 | 15.26 | 14.40 | 79.80 |

N=532 (133 districts over 4 years)

### *5.4.2. Estimates of district efficiency assuming an integrated or two-step production process*

Table 5.2 presents the coefficients associated with the estimated stochastic frontier and the derived efficiency scores for district, HA and HFs, under the alternative assumptions of an integrated or two-step production process (presented respectively in equation 2, 5 and 8 in the methods section).

The average efficiency differs if evaluated at the HA, HF or integrated district level. On average districts produce only 73% of the deliverable outpatient consultations. The presence of inefficiency may be attributed to technical inefficiencies, since for given health care inputs HFs deliver only 74% of the attainable outpatients consultations, but also to allocative efficiency. Indeed on average HAs appear to reach only 66% of the HFs staff and equipment which they could potentially achieve for the given financial resources. In fact since HF staff and equipment is measured against norms per type of HFs and averaged at district level, the index used to measure HAs efficiency reflects both the capacity to purchase HR and staff and allocate it to HFs, and the capacity to guarantee its distribution across HFs, so that each of them is guaranteed the minimum required to function.

The coefficients of the stochastic production frontier show that HFs staff and equipment, financial resources per capita, the presence of a district hospital and the proportion of HF with access to water and electricity are positively correlated with the maximum number of yearly outpatient consultations per capita deliverable at the district level. On the contrary, the proportions of illiterate and economically active population are negatively correlated with the attainable output.

Under the assumption of a two-step production process the donor and district recurrent expenditures, the proportions of HFs with access to water and electricity, and the availability of housing for health personnel, are positively correlated with the attainable average HF staff and equipment attainable by HA, while the total number of HF in the district is negatively correlated with it. Interestingly, the provincial expenditure has no significant correlation with the production frontier, probably due to its reduction as a consequence of increasing district expenditure arising from decentralization policies.

The HF staff and equipment, the number of DH, HC and clinics and the proportions of HF with access to water and electricity, are positively correlated with the number of yearly outpatients consultations per capita deliverable by HFs. Conversely, the proportions of illiterate and economically active population are negatively correlated with it.

**Table 5.2 District, health administration and health facility stochastic frontiers and efficiency scores, Mozambique (2008-2011)**

| Production Process (Decision Making Unit) | Integrated (District) | Two-step (Health Administration) | Two-step (Health Facilities) |
|---|---|---|---|
| **Stochastic Frontier** | | | |
| ***Inputs*** | | | |
| HF staff and equipment index | 0.132** | | 0.201*** |
| | (0.054) | | (0.056) |
| Total expenditure per capita (MZM) | 0.271*** | | |
| | (0.025) | | |
| Government district expenditure per HF (MZM) | | 0.037*** | |
| | | (0.005) | |
| Government provincial expenditure per HF (MZM) | | 0.069 | |
| | | (0.043) | |
| Donor provincial expenditure per capita (MZM) | | 0.160*** | |
| | | (0.037) | |
| ***District characteristics*** | | | |
| District/Rural hospitals (per 100,000 inhabitants) | 0.237*** | | 0.114* |
| | (0.054) | | (0.061) |
| Health centres (per 100,000 inhabitants) | 0.009 | | 0.116*** |
| | (0.038) | | (0.032) |
| Clinics (per 100,000 inhabitants) | 0.082 | | 0.159*** |
| | (0.054) | | (0.051) |
| Total number of HF | | -0.203*** | |
| | | (0.072) | |
| HF with electricity (percentage) | 0.002* | 0.004*** | 0.002* |
| | (0.001) | (0.001) | (0.001) |
| HF with water (percentage) | 0.002*** | 0.001*** | 0.002*** |
| | (0.001) | (0.000) | (0.001) |
| HF housing availability (ratio actua/minimum standard) | | 0.060*** | |
| | | (0.014) | |
| Illiterate population (percentage) | -0.015*** | | -0.011*** |
| | (0.003) | | (0.003) |
| Economically active population (percentage) | -0.009** | | -0.007* |
| | (0.004) | | (0.004) |
| Constant | -0.529* | 1.093 | 0.221 |
| | (0.293) | (0.798) | (0.279) |
| Provincial dummies | Yes | Yes | Yes |
| **Variance Parameters** | | | |
| Lambda | 1.790*** | 2.633*** | 1.558*** |
| | (0.261) | (0.419) | (0.201) |
| Sigma(u) | 0.334*** | 0.406*** | 0.319*** |
| | (0.036) | (0.038) | (0.033) |
| **Log likelihood** | 30.779 | 91.323 | -5.850 |
| **AIC** | -19.600 | -144.600 | 51.700 |
| **Efficiency scores** | | | |
| Mean | 0.730 | 0.662 | 0.742 |
| Std. Dev. | 0.178 | 0.214 | 0.167 |
| Minimum | 0.175 | 0.001 | 0.098 |
| Max | 0.968 | 0.976 | 0.957 |

***, **, * indicates significance at 1%, 5%, 10% level.

N=532 (133 districts over 4 years)

Standard Errors in parenthesis

All Stochastic Frontier Inputs in natural log

The coefficients of the HF production frontier are very close to those estimated under the assumption of a district integrated production process, as expected, since inputs are very similar and the production output is the same. However, in the HF production frontier, where recurrent expenditure does not enter directly as an input, the coefficient associated with average HF staff and equipment, which depends on financial resources and HA efficiency, is larger. The numbers of HCs and clinics in a district are positively correlated with the output attainable by HFs. On the contrary, the number and type of HF are not significantly correlated with the district output under the assumption of an integrated production process, probably as a reflection of the negative effect that the total number of district HFs has on HA performance.

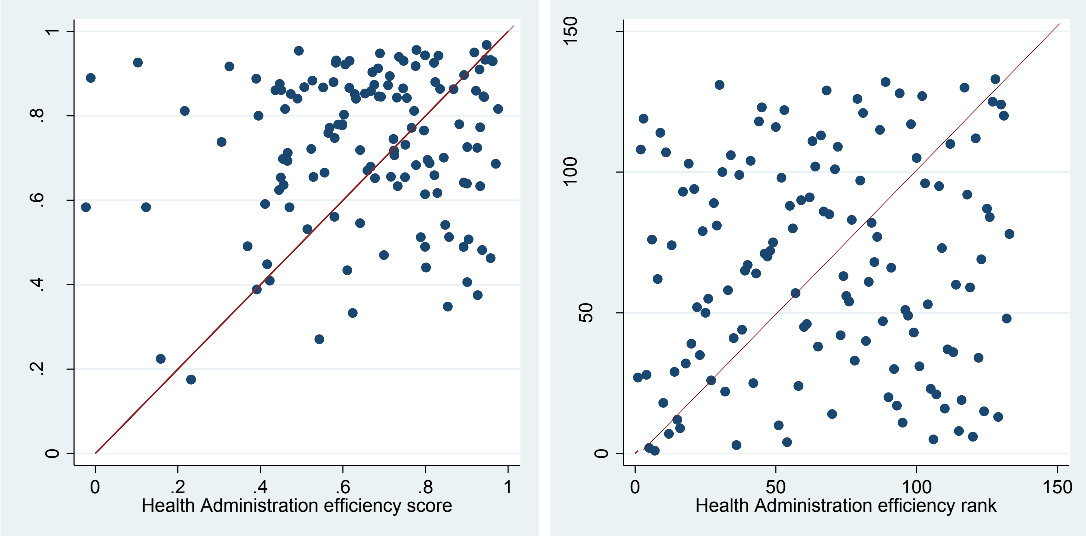
The significance of the variance parameters confirms the presence of inefficiency in each of the production processes considered. The efficiency scores obtained in the two-step production process suggest that on average 66% of the attainable levels of staff and equipment, for given financial resources, were available in HFs and 74% of the deliverable outpatient consultations were realised in the period of study. Interestingly, the average district efficiency score under the assumption of an integrated production process (0.73; SD: 0.18) is very similar to the HF efficiency scores under the assumption of a two-step process (0.74; SD: 0.17).

With simple scatter plots (Figure 5.3) and correlation coefficients, we compare the efficiency scores of district, HA and HFs, as well as the ranking of districts obtained from each analysis.

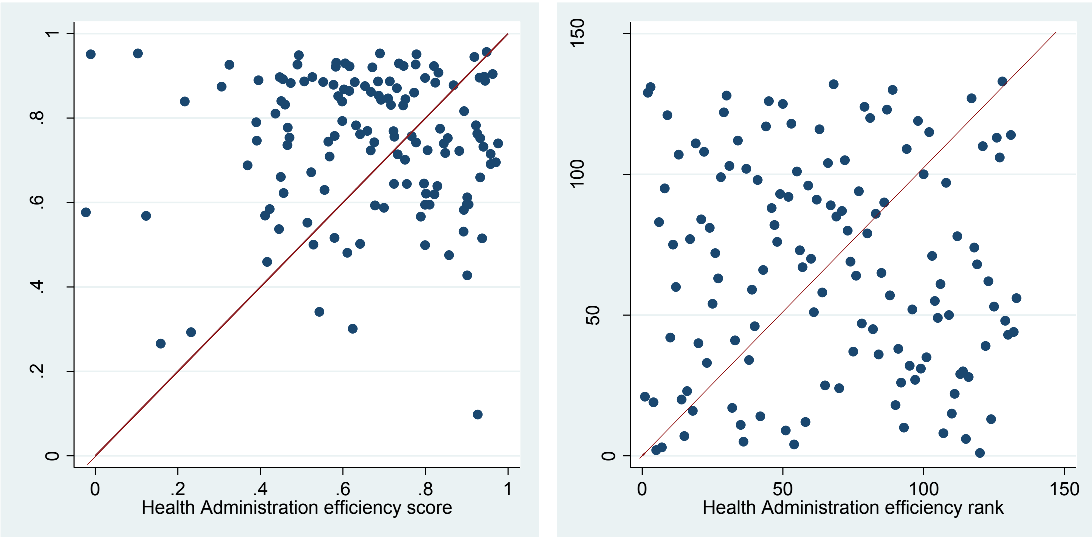
District efficiency and their ranking under the assumption of an integrated production process are only mildly correlated with HA efficiency (Perason's correlation: 0.11, p-value: 0.00 and Kendall's rank correlation: 0.07, p-value: 0.09). The difference is illustrated by the dispersion of the plots of district against HA efficiency scores and their ranks, in Figure 5.3.a. HA and HF efficiency scores and their ranks are different (Figure 5.3.b) and not significantly correlated (Perason's correlation: 0.01, p-value: 0.87 and Kendall's rank correlation: -0.05, p-value: 0.26), while integrated district and HF efficiency scores and their ranks are well correlated (Perason's correlation: 0.86, p-value: 0.00 and Kendall's rank correlation: 0.88, p-value: 0.00) and very similar, as illustrated by their plots relatively close to the 45 degrees line of equality (Figure 5.3.c).

**Figure 5.3 Comparison of district, health administration and health facilities efficiency scores and rankings, Mozambique (2008-2011)**

**a) Health Administration and District**




**b) Health Administration and Health Facilities**




**c) Health Facilities and District**

Overall, results suggest that although the role of the HA is crucial to enable HFs functioning, their performance may be quite different from that of HFs at district level. Indeed HAs and HFs production processes are quite dissimilar in nature. The integrated district performance, mostly reflects HFs performance, but as suggested from the small but significant correlation with HAs efficiency, incorporates not only technical but also allocative efficiency.

#### *5.4.3. The effect of health administration efficiency on district and health facility efficiency*

Table 5.3 shows the stochastic frontiers estimated when administrative efficiency is included in district and HF production process (Equations 10 and 11), under the assumption of an integrated or two-step process. Results are reported in the first and third column, while the second column reports results for the district production process including administrative efficiency but excluding HF staff and equipment.

When introduced into the district integrated production function, the HA efficiency score has a positive and significant effect on the district integrated production frontier (Table 5.3, first column). Compared to the estimates presented in Table 5.2 (first column), the coefficient associated with the HF staff and equipment is no longer significant and the magnitude of the coefficient associated with district expenditure increases. The higher log likelihood and lower AIC criterion of this specification (Table 5.3, first column), compared to the one presented in Table 5.2 (first column) suggests that accounting for administrative efficiency in the estimation of district efficiency improves the model fit. This is formally confirmed by the result of a LR test (LR=6.61>3.84) which rejects the null hypothesis of the coefficient associated with the administrative efficiency being equal to zero. When administrative efficiency is introduced in the district production function, the inclusion of HF staff and equipment does not significantly improve the model fit, as confirmed by the LR test (LR=0.414<3.84) comparing the model specification presented in the first and second columns of Table 5.3.

When introduced into the HF production function, the HA efficiency score does not have any significant effect on the HF production frontier and related efficiency scores (Table 5.3, third column). The smaller log likelihood, the higher AIC criterion and the LR test (LR=2.11<3.84) confirm that the model specification including administrative efficiency (Table 5.3, third column), does not improve the fit to the data compared to the original specification (Table 5.2, third column).

**Table 5.3 District and health facility stochastic frontiers and efficiency scores, accounting for health administration efficiency, Mozambique (2008-2011)**

| **Production Process (Decision Making Unit)** | **Integrated (District)** | | **Two-step (Health Facilities)** |
|---|---|---|---|
| | Model 1 | Model 2 | |
| **Stochastic Frontier** | | | |
| ***Inputs*** | | | |
| HF staff and equipment index | 0.037 | | 0.251*** |
| | (0.072) | | (0.078) |
| Total expenditure per capita (MZM) | 0.308*** | 0.317*** | |
| | (0.027) | (0.025) | |
| ***District characteristics*** | | | |
| District/Rural hospitals (per 100,000 inhabitants) | 0.247*** | 0.253*** | 0.118** |
| | (0.060) | (0.058) | (0.059) |
| Health centres (per 100,000 inhabitants) | 0.013 | 0.012 | 0.107*** |
| | (0.038) | (0.038) | (0.033) |
| Clinics (per 100,000 inhabitants) | 0.050 | 0.043 | 0.171*** |
| | (0.059) | (0.056) | (0.054) |
| HF with electricity (percentage) | 0.002** | 0.003** | 0.001 |
| | (0.001) | (0.001) | (0.001) |
| HF with water (percentage) | 0.001** | 0.002*** | 0.002*** |
| | (0.001) | (0.001) | (0.001) |
| Illiterate population (percentage) | -0.016*** | -0.016*** | -0.012*** |
| | (0.004) | (0.004) | (0.003) |
| Economically active population (percentage) | -0.010** | -0.010** | -0.007* |
| | (0.004) | (0.004) | (0.003) |
| Health Administration efficiency score | 0.290** | 0.336*** | -0.156 |
| | (0.130) | (0.095) | (0.120) |
| Constant | -0.506 | -0.441* | 0.134 |
| | (0.309) | (0.265) | (0.294) |
| Provincial dummies | Yes | Yes | Yes |
| **Variance Parameters** | | | |
| Lambda | 1.799*** | 1.801*** | 1.556*** |
| | (0.265) | (0.267) | (0.197 |
| Sigma(u) | 0.333*** | 0.333*** | 0.318*** |
| | (0.036) | (0.036) | (0.032) |
| **Log likelihood** | 34.068 | 33.861 | -4.795 |
| **AIC** | -24.100 | -25.700 | 51.600 |
| **Efficiency scores** | | | |
| Mean | 0.731 | 0.730 | 0.744 |
| Std. Dev. | 0.179 | 0.179 | 0.167 |
| Minimum | 0.234 | 0.238 | 0.137 |
| Max | 0.967 | 0.967 | 0.959 |

***, **, * indicates significance at 1%, 5%, 10% level.
N=532 (133 districts over 4 years)
Standard Errors in parenthesis
All Stochastic Frontier Inputs in natural log

The district efficiency scores resulting from the SFA model which includes HAs' efficiency are very highly correlated with the efficiency scores resulting from the original model where HA is not included (Pearson's correlation: 0.99, Kendall's rank correlation: 0.99). The same applies to HF efficiency scores. Although having a significant effect on district performance (Table 5.3, first column), the inclusion in the analysis of administrative efficiency along with the available

HF staff and equipment, does not seem to affect the measured performance of the district or the HF.

Overall, the results suggest that district performance under the assumption of a integrated production process is affected by both HA and HF performance. However HAs affect health care delivery only indirectly through the extent to which they can guarantee staff and equipment to HFs.

#### *5.4.4. Robustness checks*

Efficiency estimates are sensitive to assumptions about the production functional form, the distribution of the inefficiency term and the definition of the model used (Street, 2003, Kumbhakar et al., 2014). Although the institutional and production context of this application led us to use Pitt and Lee's SFA model, with the assumption of a half-normally distributed inefficiency term, we test for the robustness of our results to two alternative assumptions.

First, we assume an exponential, rather than half-normal distribution for the inefficiency terms $u_i^D$, $u_i^A$, and $u_i^F$, in (2), (4) and (6). Second, we measure health care output in service units, a composite measure used in Mozambique's NHS planning, which includes inpatient days, institutional deliveries, vaccinations doses, outpatient consultations and maternal and child health consultations, each weighted by the relative time required to deliver the service(MISAU, 2012a). The average yearly service units per capita in the period of analysis was 3.47 (SD=1.06).

The coefficients associated with input factors in the estimated district, HA and HF production frontiers, and relative efficiency scores, under the assumption of exponential distribution for the inefficiency term, were very similar to those in the original model. Differences in magnitude, and for some district characteristics in significance, were found when output was measured in service units, reflecting the different nature of the production process. The significant and positive effect of administrative efficiency on the district production frontier under the integrated production process assumption, but not on the HFs, was confirmed by both robustness checks. Full results are available in Appendix.

The correlation and rank correlation between the efficiency scores obtained from the original model and from the two robustness checks, presented in Table 5.4, vary between 0.98 and 0.99 when we assume an exponential distribution for the inefficiency term and between 0.52 and 0.60, when we measure the output in service units.

**Table 5.4 Correlation of efficiency scores from original and alternative SFA model, Mozambique 2008-2011**

| **Production Process (Decision Making Unit)**<br>Robustness check performed | **Pearson** | **Kendall's rank order** |
|---|---|---|
| **Integrated (District)** | | |
| Inefficiency term exponential distribution | 0.98*** | 0.98*** |
| Service units measure of output | 0.52*** | 0.55*** |
| **Two-steps (Health Administration)** | | |
| Inefficiency term exponential distribution | 0.99*** | 1.00*** |
| Service units measure of output | 1.00*** | 1.00*** |
| **Two-step (Health Facilities)** | | |
| Inefficiency term exponential distribution | 0.99*** | 0.99*** |
| Service units measure of output | 0.59*** | 0.60*** |

***, **, * indicates significance at 1%, 5%, 10% level.
N=532 (133 districts over 4 years)

Estimates of district, HA and HFs efficiency scores were produced applying DEA as a further robustness check. As expected, the estimated average efficiency was higher and the efficiency scores and district ranks not correlated with those produced from SFA, because of the difference in the benchmark used by each method (Giuffrida and Gravelle, 2001). However, DEA estimates confirm the high correlation between district and HFs efficiency scores and ranking and no correlation between HA and HFs efficiency scores and ranking.

## 5.5. Discussion

In this study we set out to assess the efficiency of health districts in delivering outpatient primary care in Mozambique. We investigated the alternative assumptions of an integrated versus a two-step health care delivery process where HAs and HFs hold the separate responsibilities of managing financial resources to purchase health care inputs and using them to deliver health care. We found evidence of inefficiency at the HA, HF and integrated district levels. On average only 73% of the deliverable yearly outpatient consultations per capita are produced. Existing inefficiency can be attributed to both HAs, which attain only 66% of the HF staffing and equipment (allocative inefficiency), and to HFs, which achieve only 74% of the deliverable consultations (technical inefficiency). Individual districts exhibit very different levels of efficiency at the HA and HF or integrated district level, whereas performance at the HFs and integrated district level are similar, as expected, since they are both evaluated with respect to the same output and similar inputs. Administrative efficiency, affects district health care delivery through the availability of staff and equipment in HFs. Robustness checks corroborate the results, but also show that, as expected, individual districts performance differs according to the measure of output used.

The results obtained are in line with those of the literature on sub-national health systems in LMICs settings (Kinfu, 2013, Kathuria and Sankar, 2005, Varela et al., 2010). As in these studies, we found a great variability across districts in input availability and in the environmental factors, which significantly affects their performance, emphasizing the importance of accounting for heterogeneity in this type of analysis (Greene, 2004). Similarly we also found that district performance varies according to the definition of output. However, the comparison of the integrated versus the two-step district health care production revealed that in Mozambique, a model accounting for administrative inefficiencies appears to better fit available data. Results are likely to apply to other contexts, where financial resources are managed by the district administration to purchase inputs for health care delivery at the HF level.

The similarity of district efficiency evaluated at HF and integrated district level, and the difference when evaluated at HA and HFs level, suggest that the existing studies, which assume an integrated process, tend to capture HFs rather than HA performance. However, district performance is really a reflection of both allocative and technical efficiency. The choice of an integrated or two-step model for district health care efficiency ultimately depends on the organization of the NHS. However, in settings where specific responsibilities in the production process are attributed to separate organizations, analyzing their performance separately may help in identify and quantify allocative and technical inefficiencies. Conversely, assuming an integrated production process and ignoring the effect of administrative efficiency in the analysis of health system performance at sub-national level, may generate misleading conclusions. For example,where an input such as the number of facilities has opposing effects on the HA and HF level, these may cancel each other out leading to an insignificant coefficient on district heatlh care delivery. In such cases, the estimated effect of specific input or environmental factors may be biased and lead to the formulation of ineffective policy recommendations.

In spite of the well known drawbacks deriving from the sensitivity of results to assumptions about the production function and the distribution of the error term, the use of parametric techniques, may have some advantages over non-parametric technique. Not only is the case that SFA may perform better than non parametric techniques when panel data are available and the assumed functional form is a good representation of the true (unknown) production technology (Giuffrida and Gravelle, 2001), but it can also provide additional insights on how the efficiency can be increased. For example, among financial inputs to the HA production process, a higher coefficient is associated with donor non-earmarked resources, which compared to state budget resources are known to be more flexible in management. A smaller coefficient is associated with government district expenditure, which requires coordination among all sectors at district level before proceeding to disbursement. Interestingly, the presence of staff housing in the HF is significantly correlated with the achievement of better equipment and staffing levels, signalling an important effect of housing on HR retention. The negative coefficient associated with the number of HFs suggests the presence of managerial difficulties increasing with the size of the district health network.

The study presents a few limitations, some common to SFA models and some related to data availability.

The Pitt and Lee's model that we used assumes time invariant inefficiency and non-correlation between inputs and inefficiency and district heterogeneity. Yet we do not have evidence supporting this assumption, which if it does not hold would lead us to overestimate efficiency. However, among the SFA models for panel data used in the literature the Pitt and Lee model generates the lowest estimates of efficiency (Greene, 2008). We are therefore confident that our estimates are close to the lower bound. Furthermore, the bias would affect HA and HF efficiency estimates equally, and the broad conclusions related to their comparison and interaction would remain unaffected. Confidence intervals around point efficiency estimates were also produced

The definition of input and outputs is limited by data availability and may not be adequate to evaluate the performance of sophisticated production processes, with multiple objectives, such as health care. Additionally, the use of outpatient consultations as a measure of output may be controversial. In fact, a higher number of consultations may be driven not only by HFs efficiency, but also by worse population health or low efficacy of the treatment provided, both indicating inefficient health care. However, the presence of unmet demand for health care in LMICs, supports the interpretation that a higher number of outpatient consultations delivered reflects a better capacity to satisfy demand. The measures of input included in the analysis also suffer limitations. For example the measure of staff and equipment considered in the study has limited explanatory power with respect to the production of service units, including inpatient care and institutional delivery. However, the dimensions used in the staff and equipment index, HR availability in particular, are essentials and are likely to be correlated with the presence of other inputs required to deliver health care, such as drugs (Wagenaar et al., 2014). Although the inclusion of staff and equipment availability as separate inputs to the HFs production process could be informative, we kept the two as part of a unique indicator for coherence with the analysis of the HAs production process and the choice of a two-step model where HAs output represent HFs inputs. Finally, as in most efficiency literature, none of these measures accounts for quality of the service delivered.

The data used also present a few limitations which led to some of the assumption made in the study. The number of HF has been stable over time and HF classification was based on the 2012 classification. Possible substantial changes in infrastructure availability overtime may have been hidden and consequently affected expenditure and led to inflated efficiency estimates for those districts where infrastructure improved. We assumed that the distribution of provincial government and donor financial resources across districts is proportional to the number and type of HF, based on the available provincial reports. However, if the allocation of financial resources was proportional to HA efficiency, efficiency may have been overestimated for the most efficient districts and vice versa. Finally, we focused on the average performance of HFs at district level, which may hide great variability. However, the measure of HF staff and equipment incorporates distributional concerns, accounting for resource distribution across HFs according to the minimum requirement set by norms. Although we recognize the existence of potential limitations related to the data available, we are confident that the use of routine data made in this study represents an advance in comparison with previous studies focusing on similar settings.

The average HA efficiency coefficient indicates that in the period of study only 66% of the attainable levels of staff and equipment were available in HFs, leaving room for improvement in financial management capacity. The latter may translate into higher availability of inputs for health care provision, and therefore increased capacity for service delivery. The non-significant coefficients associated with the administrative efficiency in the HFs production frontier, corroborates the idea that the provision of inputs is the main channel through which HAs affect health care delivery at district level. These findings indicates that policies increasing financial resources without addressing HA inefficiencies may not produce the expected outcome, even when HFs are efficient. On the contrary policies tackling administrative efficiencies may result in increased health care delivery. Furthermore the efficiency assessment and the choice of policies need to be district specific, since different districts wil have different mixes of inefficiency generated at the HA and HF level.

Further research which explicitly accounts for the organizational architecture of the NHS can improve the understanding of health systems performance in LMICs. In particular, a better knowledge of the drivers of administrative inefficiency may help to identify simple interventions that may enhance cost-effectiveness of a wide range of health interventions. Efficiency analysis in particular may benefit from the use of SFA as long as a better knowledge of the health care production process is pursued and that this understanding serves as a base to motivate the assumptions required by parametric methods. The development of specific and appropriate metrics for each of the production processes and a further investigation of the specific role of different inputs, such as staff and equipment, is recommended and needs to be supported by routine data collection, to produce timely and sound research output feeding into policy resolution. Finally, the inclusion of distributional and quality concerns into efficiency analysis is crucial to evaluate whether the output produced responds to health care need, particularly where substantial inequalities in service provision exist.

## 5.6. Conclusion

Differences in the performance at the HA, HFs or integrated district level and the significant effect of administrative efficiency on health care delivery through the availability of staff and equipment in HFs, suggest that improvement of local capacity for resource administration may significantly increase the efficiency of health care delivery at sub-national level.

Studying the effect of administrative efficiency on district and HFs performance has shown that the analysis of each production process separately may be more informative than one which assumes an integrated production process. The use of contextual knowledge about health care production processes to inform efficiency analysis together with the development of a routine data collection system which supports it, are recommended to advance the understanding of where improvements can be made.

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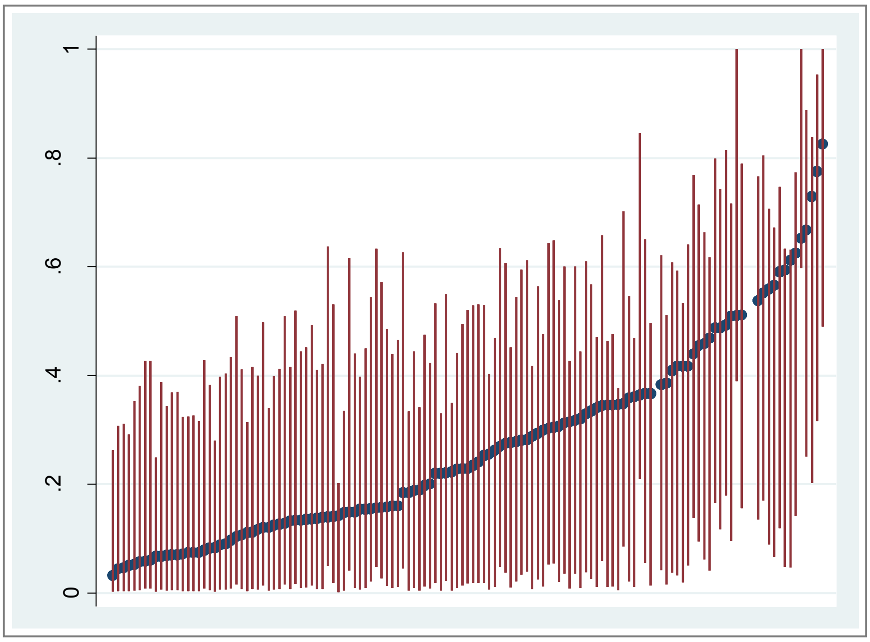
## Appendices to Chapter 5

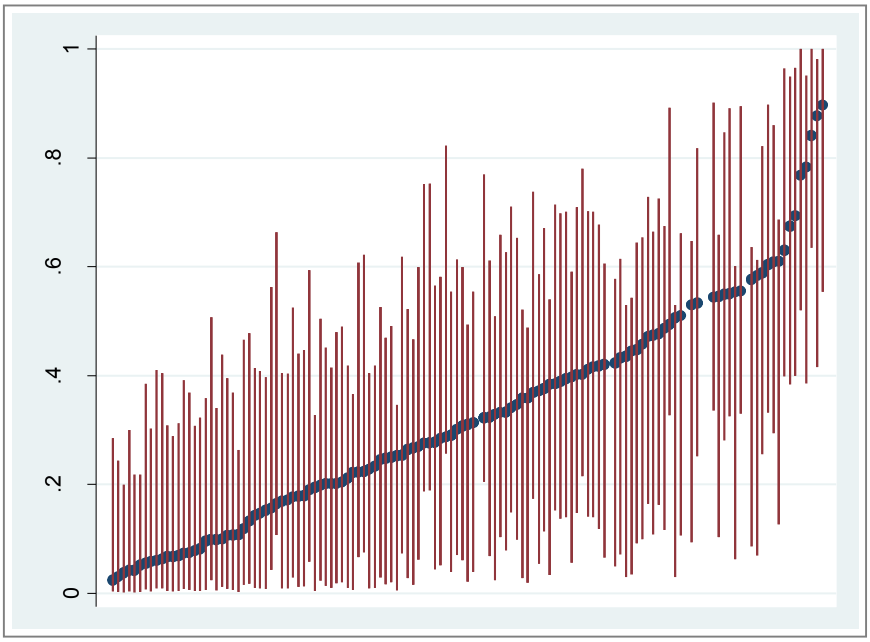
### APPENDIX 5.1: Additional results

**Figure 5.4 District, health administration and health facilities confidence intervals around inefficiency scores, Mozambique 2008-2011**

**a) Integrated process: District inefficiency scores**




**b) Two-step process: Health administration inefficiency scores**



c) **Two-step process: Health Facilities inefficiency scores**

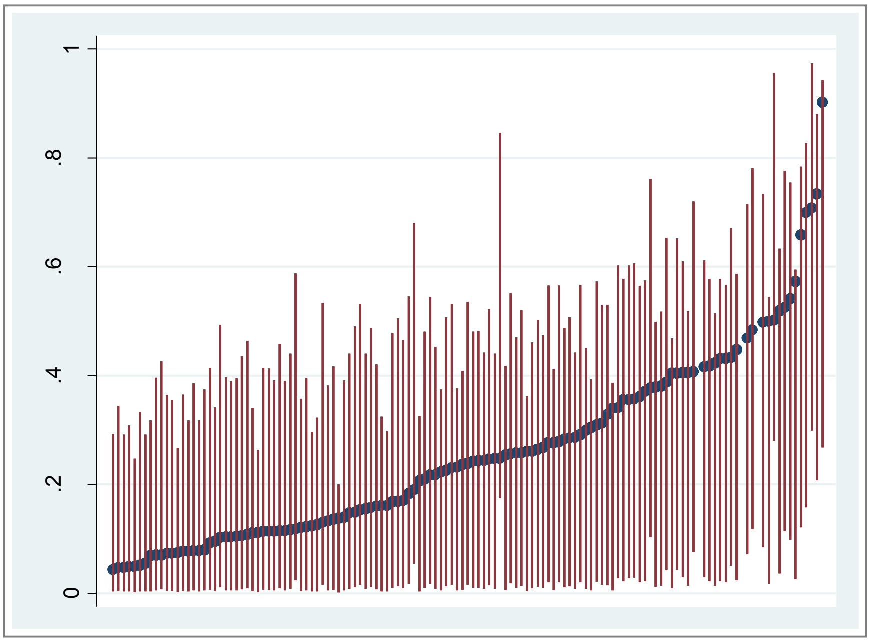



**Figure 5.5 District, health administration and health facilities efficiency scores kernel densities, Mozambique 2008-2011**

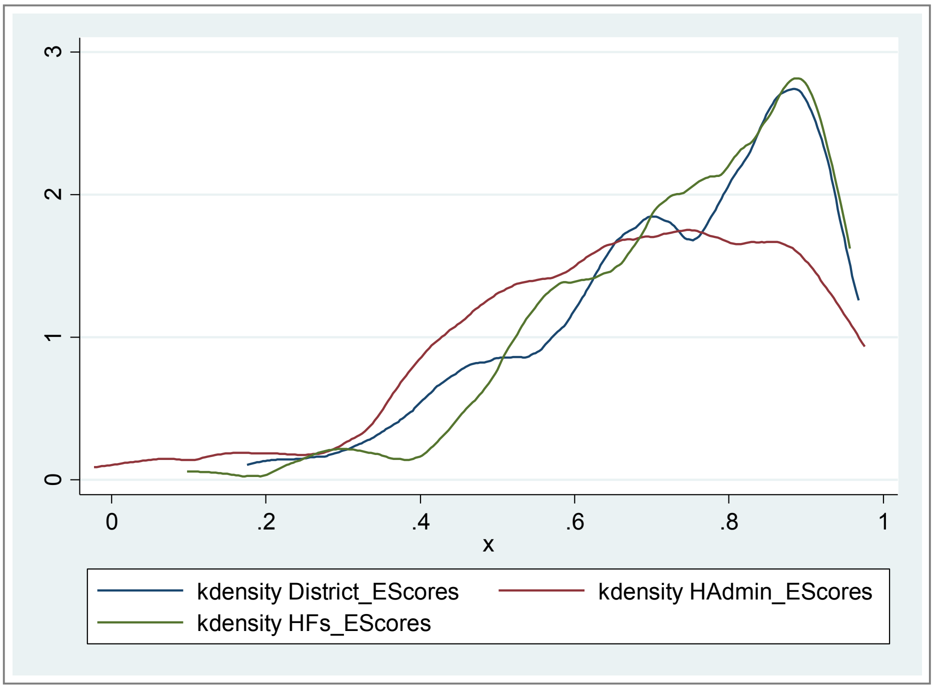


**Figure 5.6 District efficiency scores , Mozambique 2008-2011**

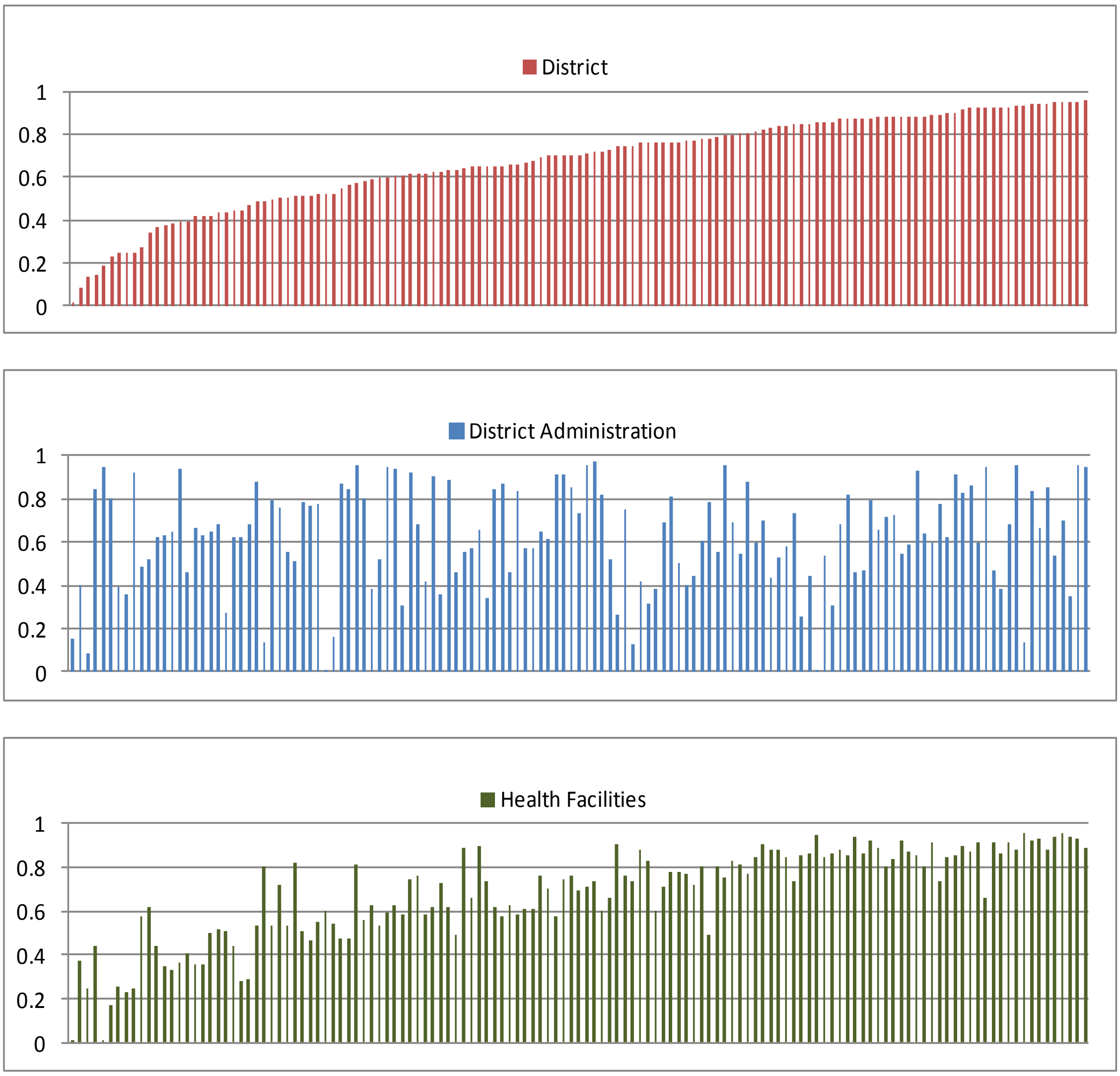


**Table 5.5 District efficiency scores correlation , Mozambique 2008-2011**

**a) District, health administration and health facilities efficiency scores correlation, Mozambique (2008-2011)**

| Efficiency scores correlation | Pearson | Kendall's rank order |
|---|---|---|
| District and Health Administration | 0.11 ** | 0.07 * |
| District and Health Facility | 0.86 *** | 0.88 *** |
| Health Administration and Health Facility | 0.01 | -0.05 |

***, **, * indicate significance at 1%, 5%, 10% level.

**b) District and health facilities efficiency scores with and without administrative efficiency correlation, Mozambique (2008-2011)**

| Efficiency scores correlation | Pearson | Kendall's rank order |
|---|---|---|
| District and district accounting for administrative efficiency | 0.99*** | 0.99*** |
| Health Facility and Health Facility accounting for administrative efficiency | 0.99*** | 0.98*** |

***, **, * indicate significance at 1%, 5%, 10% level.

N=532 (133 districts over 4 years)

**Appendix 5.2: Sensitivity analysis: Output measured in service units**

**Table 5.6 District and health facilities stochastic frontiers and efficiency scores, Mozambique 2008-2011**

Note: Health Administration is the same as in the main model

| **Production Process (Decision Making Unit)** | **Unitary (District)** | **Two-step (Health Facilities)** |
|---|---|---|
| **Stochastic Frontier** | | |
| Constant | 0.993*** | 1.494*** |
| | (0.232) | (0.244) |
| HF staff and equipment index | 0.068* | 0.131*** |
| | (0.037) | (0.040) |
| Total expenditure per capita (MZM) | 0.154*** | |
| | (0.023) | |
| District/Rural hospitals (per 100,000 inhabitants) | -0.024 | -0.098* |
| | (0.043) | (0.052) |
| Health centres (per 100,000 inhabitants) | 0.051* | 0.099*** |
| | (0.028) | (0.030) |
| Clinics (per 100,000 inhabitants) | 0.082** | 0.147*** |
| | (0.039) | (0.046) |
| HF with electricity (percentage) | 0.001 | 0.000 |
| | (0.001) | (0.001) |
| HF with water (percentage) | 0.001** | 0.001** |
| | (0.000) | (0.000) |
| Illiterate population (percentage) | -0.009*** | -0.006* |
| | (0.002) | (0.003) |
| Economically active population (percentage) | -0.008** | -0.010*** |
| | (0.003) | (0.003) |
| Health Administration efficiency score | | |
| Povincial dummies | Yes | Yes |
| **Variance Parameters** | | |
| Lambda | 2.098*** | 2.274*** |
| | (0.367) | (0.346) |
| Sigma(u) | 0.276*** | 0.310*** |
| | (0.033) | (0.030) |
| **Log likelihood** | 199.769 | 174.689 |
| **AIC** | -357.500 | -309.400 |
| **Efficiency scores** | | |
| Mean | 0.772 | 0.742 |
| Std. Dev. | 0.145 | 0.160 |
| Minimum | 0.978 | 0.977 |
| Max | 0.338 | 0.117 |

***, **, * indicate significance at 1%, 5%, 10% level.

N=532 (133 districts over 4 years)

Standard Errors in parenthesis

All Stochastic Frontier Inputs in natural log

**Table 5.7 District and health facility stochastic frontiers and efficiency scores, accounting for health administration efficiency, Mozambique (2008-2011)**

| **Production Process (Decision Making Unit)** | **Unitary (District)** | **Unitary (District)** | **Two-step (Health Facilities)** |
|---|---|---|---|
| **Stochastic Frontier** | | | |
| Constant | 1.002*** | 1.042*** | 1.471*** |
| | (0.224) | (0.207) | (0.250) |
| HF staff and equipment index | 0.024 | | 0.145*** |
| | (0.043) | | (0.049) |
| Total expenditure per capita (MZM) | 0.168*** | 0.174*** | |
| | (0.025) | (0.024) | |
| District/Rural hospitals (per 100,000 inhabitants) | -0.021 | -0.018 | -0.095* |
| | (0.043) | (0.043) | (0.052) |
| Health centres (per 100,000 inhabitants) | 0.055** | 0.055** | 0.096*** |
| | (0.027) | (0.027) | (0.031) |
| Clinics (per 100,000 inhabitants) | 0.061 | 0.056 | 0.156*** |
| | (0.040) | (0.038) | (0.048) |
| HF with electricity (percentage) | 0.001 | 0.001 | 0.000 |
| | (0.001) | (0.001) | (0.001) |
| HF with water (percentage) | 0.001** | 0.001** | 0.001** |
| | (0.000) | (0.000) | (0.000) |
| Illiterate population (percentage) | -0.008*** | -0.008*** | -0.006** |
| | (0.002) | (0.002) | (0.003) |
| Economically active population (percentage) | -0.008*** | -0.008*** | -0.009*** |
| | (0.003) | (0.003) | (0.003) |
| Health Administration efficiency score | 0.150* | 0.179** | -0.066 |
| | (0.090) | (0.073) | (0.095) |
| Povincial dummies | Yes | Yes | Yes |
| **Variance Parameters** | | | |
| Lambda | 2.055*** | 2.046*** | 2.270*** |
| | (0.346) | (0.343) | (0.369) |
| Sigma(u) | 0.271*** | 0.270*** | 0.309*** |
| | (0.031) | (0.031) | (0.032) |
| **Log likelihood** | 201.365 | 201.189 | 174.973 |
| **AIC** | -358.700 | -360.400 | -307.900 |
| **Efficiency scores** | | | |
| Mean | 0.777 | 0.778 | 0.742 |
| Std. Dev. | 0.143 | 0.143 | 0.159 |
| Minimum | 0.979 | 0.979 | 0.976 |
| Max | 0.307 | 0.312 | 0.145 |

***, **, * indicate significance at 1%, 5%, 10% level.
N=532 (133 districts over 4 years)
Standard Errors in parenthesis
All Stochastic Frontier Inputs in natural log

## Appendix 5.3: Sensitivity analysis: Inefficiency term exponential distribution

### Table 5.8 District, Health administration and health facilities stochastic frontiers and efficiency scores, Mozambique 2008-2011

| **Production Process (Decision Making Unit)** | **Unitary (District)** | **Two-step (Health Administration)** | **Two-step (Health Facilities)** |
|---|---|---|---|
| **Stochastic Frontier** | | | |
| Constant | -0.613** | 1.062 | 0.129 |
| | (0.256) | (0.812) | (0.246) |
| HF staff and equipment index | 0.139*** | | 0.191*** |
| | (0.050) | | (0.051) |
| Total expenditure per capita (MZM) | 0.267*** | | |
| | (0.025) | | |
| Government district expenditure per HF (MZM) | | 0.036*** | |
| | | (0.005) | |
| Government provincial expenditure per HF (MZM) | | 0.068 | |
| | | (0.044) | |
| Donor provincial expenditure per capita (MZM) | | 0.164*** | |
| | | (0.037) | |
| District/Rural hospitals (per 100,000 inhabitants) | 0.229*** | | 0.082 |
| | (0.048) | | (0.061) |
| Health centres (per 100,000 inhabitants) | 0.031 | | 0.136*** |
| | (0.033) | | (0.027) |
| Clinics (per 100,000 inhabitants) | 0.093** | | 0.170*** |
| | (0.047) | | (0.044) |
| Total number of HF | | -0.218*** | |
| | | (0.060) | |
| HF with electricity (percentage) | 0.002** | 0.004*** | 0.002* |
| | (0.001) | (0.000) | (0.001) |
| HF with water (percentage) | 0.002*** | 0.001*** | 0.002*** |
| | (0.001) | (0.000) | (0.001) |
| Illiterate population (percentage) | -0.016*** | | -0.012*** |
| | (0.003) | | (0.003) |
| Economically active population (percentage) | -0.009** | | -0.006* |
| | (0.003) | | (0.003) |
| HF housing availability (ratio actual/norms) | | 0.061*** | |
| | | (0.014) | |
| Health Administration efficiency score | | | |
| Povincial dummies | Yes | Yes | Yes |
| **Variance Parameters** | | | |
| Theta | 4.293*** | 3.345*** | 4.693*** |
| | (0.679) | (0.508) | (0.714) |
| Sigma(v) | 0.188*** | 0.157*** | 0.208*** |
| | (0.003) | (0.004) | (0.004) |
| **Log likelihood** | 26.107 | 82.176 | |
| **AIC** | -10.200 | -126.400 | |
| **Efficiency scores** | | | |
| Mean | 0.674 | 0.642 | 0.675 |
| Std. Dev. | 0.171 | 0.206 | 0.162 |
| Minimum | 0.902 | 0.931 | 0.900 |
| Max | 0.100 | 0.000 | 0.177 |

***, **, * indicate significance at 1%, 5%, 10% level.
N=532 (133 districts over 4 years)
Standard Errors in parenthesis
All Stochastic Frontier Inputs in natural log

**Table 5.9 District and health facility stochastic frontiers and efficiency scores, accounting for health administration efficiency, Mozambique (2008-2011)**

| **Production Process (Decision Making Unit)** | **Unitary (District)** | **Unitary (District)** | **Two-step (Health Facilities)** |
|---|---|---|---|
| **Stochastic Frontier** | | | |
| Constant | 0.591** | -0.513** | 0.022 |
| | (0.272) | (0.231) | (0.266) |
| HF staff and equipment index | 0.044 | | 0.252*** |
| | (0.070) | | (0.077) |
| Total expenditure per capita (MZM) | 0.309*** | 0.320*** | |
| | (0.028) | (0.026) | |
| Government district expenditure per HF (MZM) | | | |
| Government provincial expenditure per HF (MZM) | | | |
| Donor provincial expenditure per capita (MZM) | | | |
| District/Rural hospitals (per 100,000 inhabitants) | 0.239*** | 0.247*** | 0.091 |
| | (0.053) | (0.051) | (0.057) |
| Health centres (per 100,000 inhabitants) | 0.031 | 0.030 | 0.125*** |
| | (0.032) | (0.033) | (0.029) |
| Clinics (per 100,000 inhabitants) | 0.062 | 0.054 | 0.183*** |
| | (0.051) | (0.049) | (0.046) |
| Total number of HF | | | |
| HF with electricity (percentage) | 0.002** | 0.003*** | 0.001 |
| | (0.001) | (0.001) | (0.001) |
| HF with water (percentage) | 0.001** | 0.001** | 0.002*** |
| | (0.001) | (0.001) | (0.001) |
| Illiterate population (percentage) | -0.017*** | -0.017*** | -0.012*** |
| | (0.003) | (0.003) | (0.003) |
| Economically active population (percentage) | -0.009*** | -0.009*** | -0.005* |
| | (0.003) | (0.003) | (0.003) |
| HF housing availability (ratio actual/norms) | | | |
| Health Administration efficiency score | 0.308** | 0.368*** | -0.201* |
| | (0.124) | (0.084) | (0.121) |
| Povincial dummies | Yes | Yes | Yes |
| **Variance Parameters** | | | |
| Theta | 4.286*** | 4.275*** | 4.696*** |
| | (0.670) | (0.669) | (0.704) |
| Sigma(v) | 0.187*** | 0.187*** | 0.207*** |
| | (0.003) | (0.003) | (0.004) |
| **Log likelihood** | 29.032 | -9.513 | -7.977 |
| **AIC** | -16.100 | 59.000 | 58.000 |
| **Efficiency scores** | | | |
| Mean | 0.675 | 0.674 | 0.675 |
| Std. Dev. | 0.171 | 0.171 | 0.164 |
| Minimum | 0.900 | 0.885 | 0.889 |
| Max | 0.177 | 0.000 | 0.009 |

***, **, * indicate significance at 1%, 5%, 10% level.
N=532 (133 districts over 4 years)
Standard Errors in parenthesis
All Stochastic Frontier Inputs in natural log

## Appendix 5.4: Summary of sensitivity analysis performed

**Table 5.10 District, Health administration and health facilities sensitivity analysis efficiency scores and correlation with the original model, Mozambique 2008-2011**

| Organization/ Robustness check | Efficiency scores | | | | Correlation with corresponding main model estimates | |
|---|---|---|---|---|---|---|
| | **Mean** | **Std. Dev.** | **Min** | **Max** | **Pearson** | **Kendall's rank order** |
| **District** | | | | | | |
| Inefficiency term exponential distribution | 0.63 | 0.20 | 0.01 | 0.89 | 0.99*** | 0.99*** |
| Service units measure of output | 0.61 | 0.23 | 0.01 | 0.98 | 0.67*** | 0.66*** |
| DEA scores | 0.92 | 0.09 | 0.67 | 1.00 | -0.04 | 0.03 |
| **Health Administration** | | | | | | |
| Inefficiency term exponential distribution | 0.61 | 0.22 | -0.02 | 0.93 | 1.00*** | 1.00*** |
| Service units measure of output | 0.63 | 0.23 | 0.00 | 0.97 | | |
| DEA scores | 0.85 | 0.13 | 0.51 | 1.00 | 0.01 | 0.03 |
| **Health Facility** | | | | | | |
| Inefficiency term exponential distribution | 0.63 | 0.20 | 0.01 | 0.89 | 1.00*** | 1.00*** |
| Service units measure of output | 0.62 | 0.22 | 0.01 | 0.98 | 0.62*** | 0.59*** |
| DEA scores | 0.91 | 0.09 | 0.67 | 1.00 | -0.02 | 0.05 |

***, **, * indicate significance at 1%, 5%, 10% level.
N=532 (133 districts over 4 years)

**Table 5.11 Correlation between district, health administration and health facilities efficiency scores estimated from sensitivity analysis models, Mozambique 2008-2011**

| Efficiency scores correlation | Pearson | Kendall's rank order |
|---|---|---|
| **Inefficiency term exponential distribution** | | |
| District and Health Administration | -0.01 | -0.03 |
| District and Health Facility | 0.84*** | 0.87*** |
| Health Administration and Health Facility | 0.05 | -0.02 |
| **Service units measure of output** | | |
| District and Health Administration | 0.09 | 0.07* |
| District and Health Facility | 0.94*** | 0.95*** |
| Health Administration and Health Facility | -0.13 | 0.06 |
| **DEA** | | |
| District and Health Administration | 0.11 | 0.15* |
| District and Health Facility | 0.98*** | 0.86*** |
| Health Administration and Health Facility | -0.05 | 0.18** |

# Chapter 6

# What is the impact of health services availability on health-seeking behaviour? Evidence from Mozambique

## Preface

Results from the BIA carried out in Chapter 4 indicate the presence of small inequities in the distribution of the monetary benefit from health care expenditure. However, a closer look at utilisation patterns across consumption and need quintiles indicated the presence of inequities in service use. The analytical framework presented in Chapter 1 clearly outlines how the distribution of monetary benefit across the population results from how much individuals with different need make use of services and from the amount of resources allocated for the provision of these services. Furthermore, the framework illustrates how resource allocation can influence the distribution of benefit. Resource allocation determines directly the magnitude of the monetary benefit associated to a single outpatient consultation, but also indirectly through the effect that health service availability has on individual health care utilisation.

Understanding which factors influence health seeking behaviour is essential to understand where the causes of health care inequities lie. In particular, supply-side factors, such as the availability of staff and equipment, can influence demand and service utilisation, and therefore the distribution of benefit from resource allocation across the population. Therefore, identifying the causal relationship between the availability of staff and equipment in HFs and health care seeking is important to quantify the indirect effect of resource allocation on equity and efficiency. Because the presence of staff and equipment in HFs directly depends on resource allocation and on the efficiency of local health administration (see Chapter 5), quantifying the magnitude of its effect on demand for health care allows understanding the possible impact of supply-side policies on health care utilisation. In addition to supply-side factors, demand-side constraints to health care seeking, such as distance from a HF and household socio-economic characteristics, may prevent service use even when services are available. Demand-side policies designed to address these bottlenecks may help to improve resource allocation outcomes.

Therefore, the present chapter (Chapter 6) investigates the determinants of health care seeking among individuals reporting illness, with special attention to the effects of health care availability on demand.

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## Abstract

Low-income countries are plagued by a very high burden of preventable and curable diseases as well as unmet need for health care due to supply- and demand-side obstacles to service use. While the effect of demand-side factors on health care use has been extensively explored, evidence on the role of supply-side characteristics is still limited. In particular the causal relationships between supply-side factors and utilisation of services are difficult to assess because of the potential reverse causality between service provision and use, which arises because in settings with limited resources, more and better services could be expected to be provided where demand is higher. In this study, using a rich dataset from Mozambique, we investigate the causal relationship between the availability of health care services and the decision of individuals to seek care.

We measure health services availability as the type of health facilities existing in the proximity of households and their level of staffing and equipment. We first analyse the impact of health services availability on the decision to seek care for the whole population, and then explore heterogeneous effects based on the distance of households to the closest health facility. We apply an instrumental variable approach to identify the causal effect of staff and equipment availability on the decision to seek care.

We find no evidence that people's decision to seek care is affected by the type of facilities available in the proximity of their houses, but they tend to seek care less when services available in the district are limited to basic primary care. We find no effect of the presence of staff and equipment at the population level. However, we find that for those individuals who live less than one hour from a health facility, higher availability of staff and equipment has a positive and causal impact, although small, on their health care use. These results suggest that improved services and resource availability, on the supply side, are not providing high enough benefits to overcome the multiple barriers (information) and costs (opportunity and indirect) faced by those individuals who live far away from health facilities .



**Key words:** health seeking behaviour, demand for health care, health care availability, reverse causality, instrumental variables, Mozambique

## 6.1. Introduction

The analysis of health-care seeking behaviour is particularly relevant in Low and Middle-Income Countries (LMICs) because against the backdrop of high burden of disease, which is largely preventable and curable (Lozano et al., 2012), the unmet need for health care is still high (Dupas, 2011). Service availability is still limited and numerous barriers exist to access (Ensor and Cooper, 2004), preventing service use especially in the poorer socio-economic groups (Bonfrer et al., 2013, Van de Poel et al., 2012). Given these premises, exploring the determinants of service utilisation is central to identifying the causes of inequalities in health and health care. Especially where service provision is constrained and unequal across geographic areas, quantifying the causal effect of health care supply on use is required to understand the drivers of inequities in all dimensions of health care financing and provision. In particular, identifying the separate effects of supply and demand-side determinants of health care use may provide indications to policy makers about the most effective levers to increase access and encourage service use when needed.

The empirical literature on the determinants of health care use in LMICs has mostly relied on household survey data to analyse the decision to seek care or not when ill, as well as the choice of provider (Salvucci, 2014, Lindelow, 2004b, Akin et al., 1986, Akin et al., 1995, Lepine and Nestour, 2013, Mwabu et al., 1993). These studies analysed the influence of demand-side factors, including individual and household demographic and socio-economic characteristics, as well as the indirect cost of using services, most commonly proxied by the travel time to the nearest health facility (HF). This body of literature highlights the existence of demand-side barriers to service use, mostly represented by household geographic remoteness (and therefore difficulties in reaching the providers), low-education levels, cultural aspects and poor economic conditions.

Different aspects of health care supply have also been included in empirical studies (Akin et al., 1986, Akin et al., 1995, Lepine and Nestour, 2013, Mwabu et al., 1993), which can broadly be divided into those looking at the effects of access and those looking at the impact of quality on service use. Access, as defined by (McIntyre et al., 2009), refers to availability, affordability and acceptability of health services. Empirical studies of the demand for health care services have so far captured the effects of availability and affordability. Affordability has been proxied by user fees (Heller, 1982, Akin et al., 1986), while availability has been measured through structural indicators, such as the number, type and conditions of health infrastructures (Akin et al., 1995) and the presence in HFs of staff (Lepine and Nestour, 2013), equipment (Lindelow, 2004a) and drugs (Akin et al., 1995, Mwabu et al., 1993). Fewer studies have analysed the impact of quality on service use, using measures of technical quality, such as staff adherence to the treatment protocol (Leonard et al., 2002, Lepine and Nestour, 2013), or patients' perceptions of quality (Hanson et al., 2004). Although HF characteristics have been interpreted in many of these studies as proxies for structural quality, it could be argued that they capture HFs' capacity to provide services and therefore health care availability. The evidence points to the existence of a positive correlation between the availability and quality of health services and its use (Lepine and Nestour, 2013, Akin et al., 1995, Lindelow, 2004a). However, uncertainty around the causality and the intensity of the effects remain.

Assessing the causal impact of availability of health care services on health care utilisation can be challenging because, especially in settings with limited resources, more and better resources should be located in areas where service use is higher. Therefore, there is a potential reverse causality between the availability and use of health services. Although acknowledged in the literature (Collier et al., 2002, Gravelle et al., 2003), the endogeneity of health care services availability has rarely been addressed in studies looking at the determinants of health care seeking in LMICs. We found only one study (Kumar et al., 2014) that used an instrumental variable approach to estimate the causal impact of the household distance to the HF (used there as a measure of access) on institutional delivery.

In this study, we seek to investigate the effect of health services availability on the decision to use health care when ill. We use household survey and routine HF data from Mozambique and measure health service availability along two dimensions: the type of HF available in the locality where a household lives (i.e. lower-level HFs providing only basic primary care vs. higher-level HFs providing extended primary and secondary care) and their resources in terms of staff and equipment, as a proxy for their capacity for effective provision of care. Considering the number and type of HFs fixed in the short run, we focus on the availability of staff and equipment in existing HFs and apply an instrumental variable approach to address the potential endogeneity of health service availability. We use the availability of housing for personnel as an instrument for HFs staffing and equipment, to assess the presence of a causal effect and its magnitude. This study contributes to the existing literature by addressing the potential reverse causality between health service availability and use. This paper is constructed as follows. Sections 2 describes the study setting and the data, while sections 3 and 4 present the methods and the results. Sections 5 and 6 discuss and conclude.

## 6.2. Setting and data

### *6.2.1 Setting*

Mozambique is a low-income country with a population of 23 million people and a life expectancy of 49 years. Despite improvements in health and health care provision, socio-economic indicators are still low and inequalities in health and health care use still exist, for example across socio-economic status and geographic areas (Fernandes et al., 2014, MISAU, 2012b, MISAU, 2012a, MISAU and TARSC/EQUINET, 2010). Similarly to other low-income countries the causes of morbidity and mortality are mostly preventable and curable communicable diseases as well as maternal, neonatal, and nutritional causes of death (IHME, 2013), which are also amongst the major causes of under 5 mortality (MISAU et al., 2013).

Health care is mostly publicly funded and provided. Although private care is growing, at the time of this analysis it was limited to a few private clinics mainly concentrated in the capital (MISAU, 2012b). Central, provincial and district levels constitute the backbone of the top-down hierarchical sector organization. Specialised care is managed at provincial level and provided by central or provincial hospitals, while primary and secondary care are managed at district level and provided through district hospitals (DH), health centres (HC) and clinics. Clinics only provide basic primary care, HCs provide inpatient and general medicine consultation, while DH provide also small surgery. At least one HC is available in most districts when a DH is not. Figure 6.1 provides an example of the health care system organization at the provincial and district level and illustrates the variability in health services availability across districts and localities as well as the overlap, in most cases, between HF catchment areas and the administrative boundaries. The figure shows that catchment areas of most HFs, defined as an 8 Km circle around a clinic, are virtually all included within the district and locality administrative boundaries (MISAU, 2012b). This implies that for most households living in a given locality the closest HF is a clinic located in their locality (and a fortiori district) of residence.

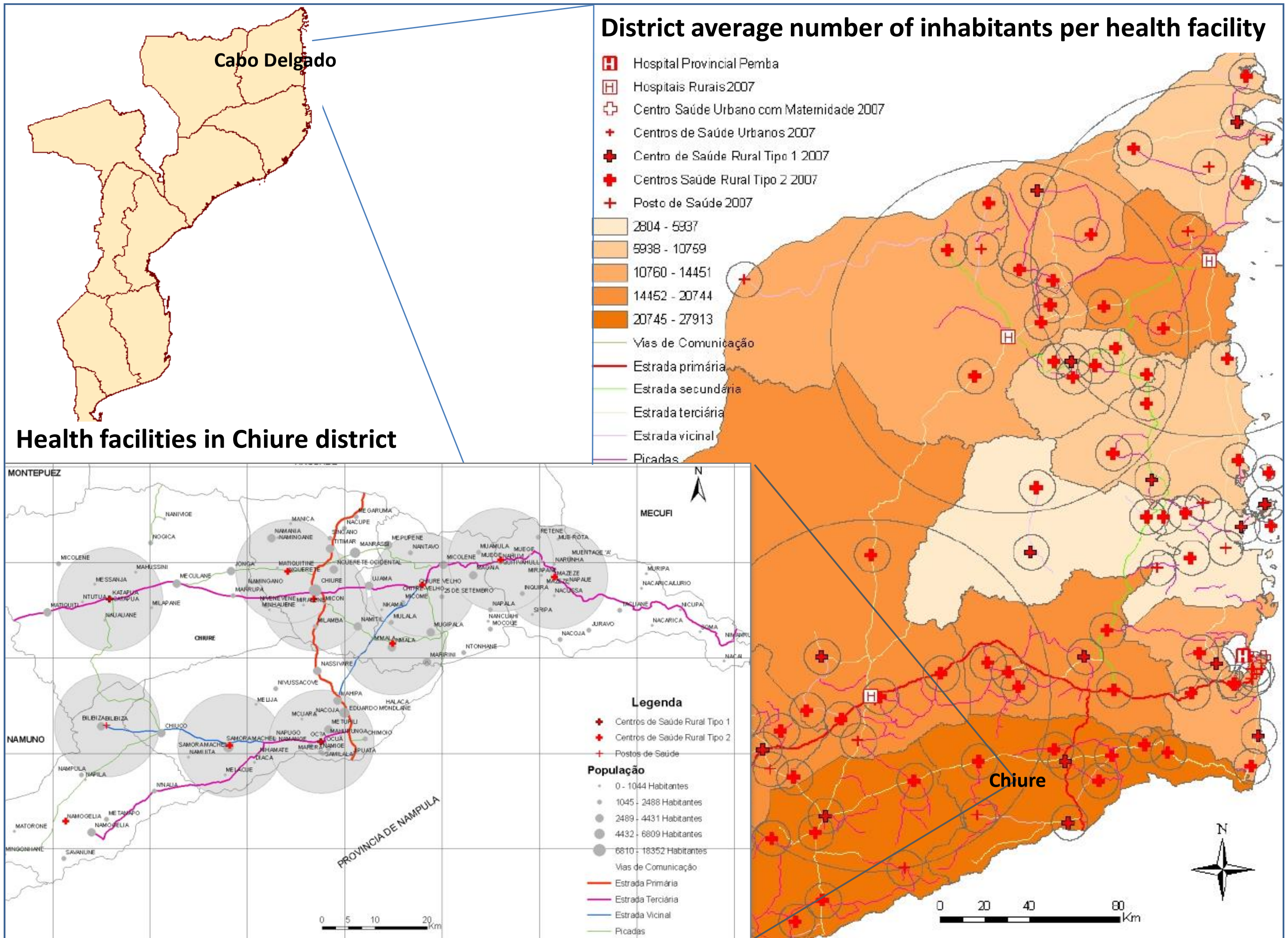
Inequalities in the offer of health services in Mozambique are a reflection of disparities in the number and type of HF across provinces, districts and localities (see an illustration with Figure 6.1), as well as inequalities in the distribution of human and physical resources across geographic areas (MISAU, 2013, Fernandes et al., 2014, MISAU and TARSC/EQUINET, 2010). For each type of HF, minimum staff and equipment requirements are set by norms and correspond to the necessary inputs typically required to deliver the type of health care that a HF ought to provide (MISAU, 2002). Additionally, to improve recruitment and retention of professional health care workers outside the capital city Maputo, housing facilities for mid- and high-level cadres should exist next to HFs, in relation to the number of staff who should work in the HF (MISAU, 2007a). Despite these existing norms, lack of adequate equipment, staff and housing options are widespread across HFs in the country, and much more prevalent in some provinces and districts than others (MISAU, 2013, MISAU and TARSC/EQUINET, 2010).

If the referral system is respected, user fees in public HFs are low: MZM 2 and MZM 1 for outpatient consultation in urban and rural areas, MZM 5 for all drug prescriptions and MZM 10 for inpatient care (equivalent to USD 0.07, USD0.04, USD0.16 and USD0.32 respectively). Furthermore exemptions cover the large majority of the population (MISAU, 2012b). Higher fees are applied to prevent unreferred access to DHs and provincial hospitals. However anecdotal evidence of unreferred cased in DHs and provincial hospitals exist (MISAU, 2012b). Despite these limited direct costs, many other obstacles limit the use of health care services by households in Mozambique, especially the distance that separate them from HFs, as well as socio-economic factors such as low education and income (Salvucci, 2014, Lindelow, 2004b). There is limited evidence suggesting that the presence of trained health personnel in HF influences institutional delivery, but not the demand for outpatient care (Lindelow, 2004a).

### *6.2.2. Data*

In this study, data on health care utilisation and on individual, household and community characteristics are derived from the 2008/2009 household budget survey (HBS) (INE, 2010). The sample consists of 10,831 households and 51,188 individual observations (9,632 households and 45,356 individuals in 847 communities excluding Maputo City) and is representative at provincial level, and at urban and rural areas level. Data were collected through a household questionnaire and a community questionnaire administered in the 599 rural communities. Measures of household (real) consumption per capita, spatially and temporally adjusted, were calculated by the Ministry of Planning and Development (MPD) for the 3rd national poverty assessment, based on HBS 2008/2009 data (Arndt and Simler, 2010, Arndt et al., 2010). Adult equivalence scales were also provided by the MPD (MPF et al., 1998).

**Figure 6.1 Example of health facilities distribution in Cabo Delgado Province, Mozambique 2008**




*Source: Adapted from (DPS-CaboDelgado, 2009)*

As in similar surveys, information on health care seeking (decision to seek care and choice of provider) is available only for individuals who reported illness in the past two weeks. Following the approach adopted in most of the existing literature, we restrict the sample of the analysis to those individuals who reported illness in the recall period for whom information on health care use is available. The sample restriction generate a selection bias since individuals who report illness may also be more likely to use health care. For example individuals who previously used health care are more likely to self-report illness.

Data on HFs are derived from the National Health Information System (MISAU, 2012c) as provided by the Ministry of Health (MoH) in June 2012. A complete list of existing HFs is available for 2009, with information on staffing, equipment and housing for personnel. We verified the existence of each HF and its location based on a census of HFs undertaken in 2007 (MISAU, 2007b) and resolved mismatches through consultation with the relevant provincial or district directorates of health. Since routine data collected at local level may be biased and resource availability may be understated in less resourced HFs, to minimize inconsistency and bias, we cross-checked information on availability of staff and equipment across all available years (2008, 2009, 2010 and 2011). When a large discrepancy was found, the 2009 value was substituted with the average across the four years, to avoid using data that reflect availability in an exceptional period rather than the usual one. If the discrepancy was found for one year only, the exceptional year was excluded from the calculation if the average. A total number of 1,261 HFs providing primary and secondary care constituted the database in 2009. We excluded four districts (Mecula, Ibo, Tambara, Massingira) because of implausible HF characteristics.

Information about official norms on minimum service coverage, staffing and equipment for each type of HF were extracted from official documents (MISAU, 2002, MISAU, 2012a). This information was then used to create variables corresponding to the gap between required and actual availability of staff, equipment, housing in each HF. For example, according to official norms, each type of HF should dispose of a minimum number of houses for the key health personnel: at the very least one for clinics, two for HCs and four for DHs (MISAU, 2007a) .

Since the HBS does not provide information on the specific HF visited by individuals, we merged household survey and HF data at the locality level. In 2009, excluding Maputo City, the country was organised in 10 provinces, 142 district administrations and 1,272 localities. Districts comprise between 1 and 22 localities, which cover a population between 250 and 50,000 people, except for some urban localities which cover up to 150,000 people. The organization of the public sector referral system and the limited presence of alternative care providers led us to focus on the decision to visit a public HF providing outpatient health care when ill. Not having information on the specific HF visited, we assume that individuals visit the closest HF. Since most HF catchment areas fall within the administrative boundaries of the locality of residence (see Figure 6.1) we assume that the closest HF is within the locality of residence of the household.

Because of their unusual pattern of health service provision and peculiar demographic and socio-economic characteristics compared with the rest of the country, we excluded Maputo City and Matola from the analysis.

## 6.3. Methods

### *6.3.1. Theoretical framework*

The economic analysis of health care use is rooted in a random utility model framework (Grossman, 2000, Becker, 1965), where individuals maximize their utility according to preferences over health and the consumption of other goods, conditional to their budget constraint, which incorporates individual income and the prices of consumables. The individual utility function can therefore be written as:

$$U_i = (H_i , Z_i ) \quad (1)$$

where $H_i$ is health status, which depends on the decision to seek care, and $Z_i$ is the bundle of other goods consumed by individual *i*.

Since individuals derive indirect utility from health care through the improvement of their health status, they choose from the affordable combinations of health care and other consumables the one that maximizes their utility:

$$U_i^* = max \ (U_i^{S1}, U_i^{S0}) \quad (2)$$

where $U_i^{S1}$ and $U_i^{S0}$ are the utility levels associated with using health care or not respectively.

### *6.3.2. Estimating the probability of seeking care*

Since both $H_j$ and $Z_j$ depend on a set of individual, household and community characteristics, including health care use, the observed decision to seek care can be written as a function of the observed determinants of health care demand and supply, through a latent variable approach:

$$y^*_{icl} = U^{S1}_i - U^{S0}_i = \alpha_1 + \beta_1 X_{icl} + \beta_2 D_{cl} + \beta_3 HLF_l + \beta_4 HRE_l + \varepsilon_{icl} \quad (3)$$

$$S_{icl} = \begin{cases} 1 \; if \quad y^*_{icl} \geq 0 \\ 0 \; if \quad y^*_{icl} < 0 \end{cases}$$

where $y^*_{icl}$ is the unobserved difference between the utility from seeking ($U^{S1}_i$) and not seeking care ($U^{S0}_i$), and $S_{icl}$ is a dummy taking value 1 if the individual *i*, in community *c* and locality *l*, is better off when seeking care from a public provider, and 0 vice versa.

$HLF_l$ and $HRE_l$, capture the supply-side characteristics in locality *l*, where we assume the closest HF to be. $HLF_l$ is the proportion of higher level HFs (HC and DH) out of all HF, to account for the type of service which is accessible. $HRE_l$ is an index of HF staffing and equipment, to account for technical quality of the service provided. $HRE_l$ is measured as the ratio of available to minimum required by norms averaged across the following six dimensions: basic, medium and high level trained health cadres hired by the government, functional motorbike, car and sterilizer. In the absence of specific information, all dimensions are attributed the same weight to capture the complementarities of human resources and equipment in service provision. When more than one HF is situated in a locality, $HRE_l$ is obtained by averaging across HFs. When no HF is situated in a locality, we assumed that the individual would visit the closest HF in the same district of residence, and we imputed $HLF_l$ and $HRE_l$ using the equivalent average figures at district level. Although in many settings user fees would be an important supply-side determinant of service use, they are not included in the specification here, since publicly provided outpatient care is almost free at the point of delivery and we do not expect variability in price across HFs. Indirect costs of service use are captured by demand-side characteristics, such as distance, transport availability and employment conditions (defined below).

$D_{cl}$ includes a set of dummies for the walking time between the community and the closest HF, defined according to the following thresholds: 0-59 minutes, 60-119 minutes and 120 minutes or more, which we used as the reference category. Distance from the closest HF was set to 0-59 minutes for households in urban areas to which the community questionnaire did not apply.

$X_{icl}$ is a vector of individual, household and community characteristics including the household distance from the closest HF (which is a supply-side variable since it is a reflection of the number of HF) and the following demand-side determinants of health care seeking behaviour:

- Gender and age to account for specific health care needs;
- Two non-mutually exclusive dummies for self-defined employment: as permanently employed (versus seasonally or occasionally) and as non-remunerated housekeeping worker to capture the commitment required and the opportunity cost;

- The highest level of education attained among household members, measured by years of schooling, as a proxy of social status. We prefer this measure to the commonly used level of education of the head of household since schooling opportunities for the current head of household generation, were limited by civil war disruptions until 1992;
- The household adult equivalent consumption per capita, logged to allow for non linear effects, to capture the economic condition;
- The average number of household members per room, since discrepancies between the measure of consumption and assets were found, suggesting that they may capture different aspects of economic status (Lindelow, 2006);
- The availability of a latrine in the house, to account for household access to and attitudes toward sanitation;
- The availability of public transport reaching the community, to account for geographic remoteness and ease of travelling to a HF;
- The month of the interview, corresponding to the month of the reported illness, to account for disease seasonality.

From the empirical specification shown in (3) we estimate the probability of seeking care, using a probit model:

$$\Pr(S_{icl} = 1 | X_{icl}, D_{cl},\ HLF_l, HRE_l) = \Phi(\alpha_1 + \beta_1\, X_{icl} + \beta_2 D_{cl} + \beta_3\, HLF_l + \beta_4 HRE_l) \qquad (4)$$

We correct for clustering at the locality level, the lower administrative level which incorporates villages with similar characteristics in terms of health care and other public service provision. We run the analysis using Stata 13.

### *6.3.3. Using an instrumental variable to assess the causal effect of health services availability*

***Identifying a good instrument***

Since facilities, staff and equipment could be placed in relation to the demand for care, availability may be greater in localities in which observed health care utilization is higher. In this analysis the number and type of health facilities is considered exogenous since the marginal changes observed in the short run would not allow for adjustment to health care utilization patterns. However, there might be a reverse causality relationship between availability of staff and equipment in HFs and use of health services. We use an instrumental variable (IV) approach to estimate the causal relationship between health care availability and the decision to seek care. A good IV should meet the following two criteria:

- Be correlated with the endogenous predictor of interest (non-weak or relevant)
- Be uncorrelated with the error term and having no effect on the main outcome except through the endogenous predictor (exogenous or valid).

While the relevance of an instrument can be easily tested, its external validity is not directly testable and judgements rely ultimately on persuasive arguments based on theory, knowledge of the institutional context and previous empirical studies (Angrist and Pischke, 2009).

The availability of staff housing in good physical condition at the HF, is a good candidate as an instrument for the availability of staff and equipment since it is likely to satisfy both the relevance and external validity conditions.

First, staff housing is an important non-financial benefit for the retention of human resources in rural areas (Dolea et al., 2010). In Mozambique, according to a recent study, after salary, the availability of housing is the most important incentive for health workers to accept a posting outside of the capital (Vio et al., 2013). Housing for personnel is therefore highly likely correlated with the availability of health care personnel in HF. Since the availability of equipment and other resources, such as drugs (Wagenaar et al., 2014), are likely to depend on the presence of HF staff, availability of staff housing is probably also correlated with availability of equipment.

Second, this instrument is likely to be valid, because there are no obvious channels through which housing availability could influence the decision to seek care, other than the availability of HR and equipment in HF. Additionally the availability of staff housing is not influenced by policy concerning the availability of staff and equipment in localities with relatively higher observed health care utilization. Since 2007, districts were attributed the autonomy to build clinics and staff housing, and started receiving decentralised financial resources from the Ministry of Finance to support small local initiatives. The criteria for the allocation of those funds across districts were not fixed. Decisions on allocations would ultimately depend on the quality of the investment proposal. New HFs were rarely built following local initiatives, but houses for personnel were more frequently, given the smaller investment required (MISAU, 2012b). The decentralization of responsibilities and financial resources gave districts the full capacity to build new houses or refurbish old ones and regularized an ongoing situation where housing improvements were mostly driven by district administration and local communities' initiatives, as well as private or NGOs initiatives. Furthermore, in practice, the construction of new staff housing in HFs and the maintenance of the existing ones in HFs does not depend exclusively on district, provincial or national health administrations (MISAU, 2012c) that in the period of analysis were ultimately responsible for staff recruitment and placement. The distribution of staff housing is therefore unlikely to be correlated with the patterns of service use, as HF staff and equipment could be.

### *Estimating an IV probit model*

We use an IV probit model which includes a set of two simultaneous equations: a structural equation which estimates the probability of seeking care as previously described in equation (3) and a reduced-form equation which predicts HF staff and equipment (the endogenous variable) as a function of housing for personnel (our instrument) as well as of the other independent variables:

$$y^*_{icl} = \alpha_1 + \beta_1 X_{icl} + \beta_2 D_{cl} + \beta_3 HLF_l + \beta_4 HRE_l + \varepsilon_{icl}$$

$$HRE_l = \gamma_0 + \gamma_1 X_{icl} + \gamma_2 D_{cl} + \gamma_3 HLF_l + \gamma_4 HS_l + v_{icl} \quad (5)$$

$$S_{icl} = \begin{cases} 1\ if & y^*_{icl}\iota \geq 0 \\ 0\ if & y^*_{icl} < 0 \end{cases}$$

As in (3), $S_{icl}$ is a dummy taking value 1 if the individual *i*, seeks care from any public provider and 0 vice versa, $HLF_l$ and $HRE_l$ capture supply-side characteristics, $D_{cl}$ is the distance from the closest HF and $X_{icl}$ is a vector including other demand-side characteristics and controls, as described in 6.3.2. $HS_l$ is the ratio of available housing for personnel to the minimum set by norms for each type of HF. Where more than one HF is present in the same locality, we average housing availability across HFs and when none is available, we input the average across all district HFs.

After estimating the model, we check for the endogeneity of $HRE_l$, since if $HRE_l$ is exogenous the IV probit estimator may generate larger standard errors and be less efficient than the probit estimator. First, we look at the correlation (rho) between the error terms of the reduced form equation ($\varepsilon_{icl}$) and of the structural equation ($v_{icl}$). We also perform a Wald test of exogeneity, which in the case of a single endogenous variable boils down to testing the null hypothesis of rho=0. We expect rho to be significant, and the Wald test to reject the null hypothesis of exogeneity if HF staff and equipment was endogenous (Cameron and Trivedi, 2009). To evaluate whether $HS_l$ is a strong instrument, we look at the significance of the coefficient associated with $HS_l$ ($\gamma_4$) and at the F statistics of the first-stage OLS regression. We expect $\gamma_4$ to be significant and F> 10 if $HS_l$ is a non-weak instrument (Cameron and Trivedi, 2009).

### *6.3.4. Exploring heterogeneity in the effect of health care availability*

We explore the heterogeneity in the effect of health care availability, and in particular the extent to which it depends on the household opportunity cost of care seeking, by estimating the effect of staff and equipment availability on the decision to seek care separately in two sub-samples of the population. We allocate households to the two-subsamples according to their proximity to a HF (more or less than one hour walking distance).

## 6.4. Results

### *6.4.1 Descriptive statistics*

Individuals reporting an illness during the two weeks preceding the interview represent 13% of the whole survey sample. Of these, 61% sought care from a public HF, while only 3% sought care from other providers (see Table 6.1 for descriptive statistics).

Ninty-two percent of individuals and 97% of those residing within one hour distance to the closest HF live in a locality with at least one HF. Around 80% of the HFs are clinics and their availability of staff and equipment and staff housing are 77% and 60% of the minimum set by norms, respectively. Greater variability is observed across localities rather than across districts.

Fifty-eight percent of individuals surveyed are women, and the average age is 24 years. The highest level of schooling attained in the household is on average 5 years, equivalent to the completion of primary school. 40% of the sample define themselves to be permanently employed, while 20% declare unpaid housekeeping to be their main occupation. Households report average daily consumption per capita of 33 MZM (around USD 1) and have two household members per each room. Only 58% of the households live in a house with latrine. 37% percent of the sample resides in urban area, 63% in a community reached by a public transport and 60% within one hour walking distance from a HF. The subsample of individuals residing within one hour distance from the closest HF exhibits better socio-economic and health care availability indicators compared to the rest of the sample (see Table 6.5 in the Appendix).

**Table 6.1 Descriptive statistics for individuals ill in the two weeks prior to the interview, Mozambique 2009**

| Variable | Mean | SD | Min | Max |
|---|---|---|---|---|
| ***Service utilisation*** | | | | |
| Number of visits to HF (previous month) | 0.75 | 0.83 | 0.00 | 15.00 |
| Seeking care from a public HF | 0.61 | 0.49 | 0.00 | 1.00 |
| Seeking care from other providers | 0.03 | 0.18 | 0.00 | 1.00 |
| ***Demand-Side Characteristics*** | | | | |
| Woman | 0.58 | 0.49 | 0.00 | 1.00 |
| Age | 24 | 22 | 0 | 99 |
| Highest level education in household (years schooling | 5.44 | 3.23 | 0.00 | 18.00 |
| Employed in permanent work | 0.44 | 0.50 | 0.00 | 1.00 |
| Employed in non remunerated housekeeping work | 0.20 | 0.40 | 0.00 | 1.00 |
| Household adult equivalent consumption per-capita (MZM per day) | 33 | 33 | 1 | 921 |
| Number of household members per room | 1.98 | 1.23 | 0.03 | 10.00 |
| Latrine in the house | 0.58 | 0.49 | 0.00 | 1.00 |
| Transport reaching the community | 0.63 | 0.48 | 0.00 | 1.00 |
| Urban | 0.37 | 0.48 | 0.00 | 1.00 |
| ***Supply-Side Characteristics*** | | | | |
| 1 hour time distance from closest HF | 0.60 | 0.49 | 0.00 | 1.00 |
| 2 hours time distance from closest HF | 0.08 | 0.28 | 0.00 | 1.00 |
| More than 2 hours time distance from closest HF | 0.31 | 0.46 | 0.00 | 1.00 |
| HF in locality of residence | 0.92 | 0.28 | 0.00 | 1.00 |
| Percentage of HCs and DHs among HFs in locality | 0.23 | 0.24 | 0.00 | 1.00 |
| Percentage of HC s and DHs among HFs in district | 0.18 | 0.11 | 0.33 | 1.00 |
| HF Staff and Equipment index (locality average) | 0.50 | 0.26 | 0.00 | 2.13 |
| HF Staff and Equipment index (district average) | 0.47 | 0.18 | 0.19 | 1.25 |
| HF housing availability index (locality average) | 0.60 | 0.89 | 0.00 | 10.00 |
| HF housing availability index (district average) | 0.60 | 0.62 | 0.00 | 3.38 |

Observations: 6,034

[a] Adult equivalent, spatially and temporally adjusted

### *6.4.2. Effect of health care availability on the decision to seek care*

Table 6.2 presents the results from the probit (column 1) and IVprobit (columns 2 and 3) models estimated on the whole sample. The probit model (column 1) shows that living in proximity of a HF increase the probability of seeking care when ill, while the availability of services provided in the vicinity of households does not affect the decision to seek care. Indeed, neither the type of HF available in the locality and their resources in terms of staff and equipment have a significant effect on the decision to seek public care. Among the demand side characteristics, as expected, having better education, income and assets availability, being permanently employed, living in a house with latrine and in a community reached by public transport, increase the probability of seeking care when ill. Interestingly, being employed in unpaid housekeeping work and residing in urban area reduce the probability of seeking car, which may be explained respectively by time constraints and by the availability of alternative providers.

## Table 6.2 Determinants of the decision to seek care when ill in Mozambique (2009)

| | Probit | IV-Probit | |
|---|---|---|---|
| | | 2nd Stage | 1st Stage |
| ***Supply-Side Characteristics*** | | | |
| Percentage of HCs and DHs among HFs in locality | 0.042 | 0.033 | -0.118 |
| | (0.038) | (0.040) | (0.077) |
| HF Staff and Equipment index (locality average) | 0.043 | 0.122 | |
| | (0.029) | (0.083) | |
| HF availability of housing (locality average) | | | 0.098*** |
| | | | (0.023) |
| ***Demand-Side Characteristics*** | | | |
| Woman | 0.011 | 0.011 | 0.000 |
| | (0.014) | (0.014) | (0.005) |
| Age | -0.005*** | -0.005*** | 0.000 |
| | (0.001) | (0.001) | (0.001) |
| Age Squared | 0.000*** | 0.000*** | 0.000 |
| | (0.000) | (0.000) | (0.000) |
| Higher level education attained in household | 0.012*** | 0.012*** | 0.005* |
| | (0.003) | (0.003) | (0.003) |
| Employed in permanent work | 0.061*** | 0.063*** | -0.015 |
| | (0.020) | (0.020) | (0.013) |
| Employed in housekeeping work | -0.046** | -0.046*** | 0.002 |
| | (0.020) | (0.019) | (0.009) |
| Log household consumption per-capita | 0.032*** | 0.031*** | 0.014* |
| | (0.010) | (0.010) | (0.008) |
| Number of household members per room | -0.014** | -0.014** | -0.001 |
| | (0.006) | (0.006) | (0.004) |
| Latrine in the house | 0.029* | 0.030* | -0.007 |
| | (0.017) | (0.017) | (0.014) |
| Transport reaching the community | 0.069*** | 0.068*** | 0.016 |
| | (0.025) | (0.025) | (0.018) |
| HF time distance: < 1 hour | 0.184*** | 0.182*** | 0.016 |
| | (0.026) | (0.026) | (0.019) |
| HF time distance: 1-2 hour | 0.053 | 0.050 | 0.034 |
| | (0.033) | (0.034) | (0.028) |
| Urban | -0.052** | -0.060** | 0.138*** |
| | (0.025) | (0.025) | (0.039 |
| Constant | Yes | Yes | Yes |
| Province dummies | Yes | Yes | Yes |
| Month dummies | Yes | Yes | Yes |
| Observations | 6,026 | 6,026 | |
| Pseudo R-Squared | 0.090 | | |
| Log pseudolikelihood | -3676.406 | -2916.161 | |
| Rho | | | -0.054 |
| Standard error | | | (0.056) |
| Wald test of exogeneity [(a)] | | | 0.333 |
| p-value | | | 0.397 |
| F-test 2SLS first stage [(a)] | | | 18.697*** |

*** p<0.01, ** p<0.05, * p<0.1
Average marginal effects reported
1st and 2nd Stage refer respectively to the reduced-form and structural equations
Standard errors corrected for intra-cluster correlation at locality level in parentheses
[(a)] Adjusted for clusters (N=452)

The IV probit model (columns 2 and 3) rules out the hypothesis of reverse causality bias in the probit estimates. While the significance of the housing gap in the first stage of the IV probit and the F-test (F=18.7) confirm that the housing availability is a non-weak instrument for staff and equipment availability at the HF level, the results of Wald test (p=0.397) and the DWH test (p=0.940) suggest that the explanatory variable of interest (HF staff and equipment) is not endogenous in the first place, and therefore the probit estimates are more efficient and should be preferred to the IV estimates (Cameron and Trivedi, 2009). In particular the negative and non significant estimate of rho does not support the hypothesis that more health care resources would be made available where observed health care use is higher. However, it should be noted that in spite of the Wald test indicating exogeneity, some still interpret the difference between the probit and IVprobit coefficient as a sign of endogeneity (Cameron and Trivedi, 2009).

Overall, the results of the analysis carried out suggest that, on average in the entire population, distance from HF is an important determinant of health care seeking. However, neither the type of health services (mostly essential primary care versus higher primary and secondary level care) available in the locality, nor resources in terms of staff and equipment have a significant effect on the decision to seek care.

Moving on to heterogeneous effects, Table 6.3 shows the results of the probit models estimated on two sub-samples of individuals, living within one or more than one hour from the closest HF. Three findings emerge from the probit estimates on the subsample of individuals living close to a HF (column 1). First, as before, the type of services provided in the locality has no significant effect on the decision to seek care. However, the availability of resources in local HFs (staff and equipment) has a positive and significant effect on the decision to seek care, with a marginal effect of 0.075 (corresponding to an increase in the probability to seek care by 0.00075 for each extra percentage point in the ratio of available to minimum staff and equipment).

The probit results of the analysis performed on the population living further away from HFs (column 4) show that neither the type of services available in the locality nor the availability of staff and equipment have a significant effect on the decision to seek care. The effect of some demand-side socio-economic factors is different from that estimated on the whole sample, since employment in housekeeping work, the availability of a latrine in the house and of public transport reaching the community have no significant effect for those living faraway from a HF.

**Table 6.3 Average marginal effect of supply-side characteristics on healthcare seeking according to distance from the closest health facility, Mozambique 2009**

| | Hhold lives within 1 hour from HF | | Hhold lives more than 1 hour from HF | |
|---|---|---|---|---|
| | Probit | | Probit | |
| ***Supply-Side Characteristics*** | | | | |
| Percentage of clinics among HFs in locality | -0.025 | | -0.077 | |
| | (0.050) | | (0.063) | |
| HF Staff and Equipment index (locality average) | 0.075 | *** | -0.060 | |
| | (0.029) | | (0.061) | |
| HF time distance: 1-2 hour | | | 0.054 | |
| | | | (0.036) | |
| ***Demand-Side Characteristics*** | | | | |
| Woman | 0.026 | | -0.014 | |
| | (0.017) | | (0.020) | |
| Age | -0.004 | *** | -0.007 | *** |
| | (0.001) | | (0.002) | |
| Age Squared | 0.000 | ** | 0.000 | |
| | (0.000) | | (0.000) | |
| Highest level education in hhold (years schooling) | 0.009 | *** | 0.018 | *** |
| | (0.003) | | (0.005) | |
| Employed in permanent work | 0.045 | ** | 0.085 | ** |
| | (0.021) | | (0.037) | |
| Employed in housekeeping work | -0.046 | * | -0.038 | |
| | (0.028) | | (0.027) | |
| Log hhold consumption per-capita | 0.028 | ** | 0.047 | ** |
| | (0.011) | | (0.020) | |
| Number of hhold members per room | 0.006 | | -0.039 | *** |
| | (0.010) | | (0.008) | |
| Latrine in the house | 0.034 | | 0.017 | |
| | (0.024) | | (0.026) | |
| Transport reaching the community | 0.106 | *** | 0.052 | |
| | (0.037) | | (0.032) | |
| Urban | -0.060 | ** | | |
| | (0.025) | | | |
| Constant | Yes | | Yes | |
| Province dummies | Yes | | Yes | |
| Month dummies | Yes | | Yes | |
| Observations | 3,597 | | 2,429 | |
| Pseudo R-Squared | 0.040 | | 0.070 | |
| Log pseudolikelihood | -2,079.49 | | -1,557.05 | |

*** p<0.01, ** p<0.05, * p<0.1
Average marginal effects reported
Standard errors corrected for intra-cluster correlation at locality level in parentheses
Number of clusters: 1 hour walking distance: 234, more than 1 hour walking distance: 281.

Overall results suggest that the availability of HF staff and equipment has a positive and causal effect on the probability of seeking care only for those individuals living near a HF. The probability to seek care increase of 0.00075 for each extra percentage point of the ratio of available to minimum HF staff and equipment. Since on average HF currently have only 50% of the staff and equipment set by norms, reaching that standard would increase the probability of seeking care for those who live in the proximity of a HF by approximately 0.04. Interestingly, most demand-side factors seem to have similar effects on health care seeking for individuals living close by or further away from HFs. Employment in unpaid housekeeping work and transport availability have a negative and positive effect only for individuals living close to a HF, while the number of household members per room has a negative effect only for those living further away from a HF.

#### *6.4.3. Robustness checks*

We carried out four additional analyses to test the robustness of our results to the assumptions made and the methods chosen. The marginal effects associated with the two measures of availability of health services used throughout this paper, obtained from the different robustness checks, are summarized in Table 6.4.

First, since in settings with varying quality of providers individuals may not automatically seek care from the closer provider, but rather seek higher quality of care (Leonard, 2014), we assume that individuals would consider seeking care from a HF in their district rather than locality of residence. We re-estimate all models substituting district to locality measures of health care availability. The results, reported in Table 6.6 in the appendix, broadly confirm the previous findings, providing even further support to the relationship between supply-side factors and health-seeking behaviours. To start with, we find that availability of staff and equipment at district level has a significant and positive effect on the decision to seek care for the whole sample. Moreover, we find that this effect is twice as big for the subsample of individuals living in proximity of a HF. Finally, we find that the higher the level of services available in a district, the more people tend to seek care. However, it should be noted that since the Wald test indicates endogeneity of HF staff and equipment at district level for the whole sample, and since housing for personnel is a weak instrument at district level, caution should be taken in inferring a causal relationship.

Second, since in provincial capitals health care provision is notoriously more heterogeneous and housing allowances may be given instead of providing accommodation, we re-estimate all models excluding the provincial capital districts from the sample. The results presented in Table 6.7 in the appendix broadly confirm previous findings. We find that the marginal effect of district average HF staff and equipment on the decision to seek care for individuals living in proximity of a HF is also positive, although larger. We also find that the proportion of HFs offering a higher level of services has a positive and significant effect for the whole sample, as well as for those living in proximity of a HF. In this specification the Wald test confirms exogeneity of the availability of staff and equipment, allowing a causal interpretation of the marginal effect obtained from the probit model.

Third, the six dimensions chosen for our index of HF staff and equipment were arbitrarily attributed the same weight. To test for the sensitivity of the results to this choice, we construct an alternative HF staff and equipment measure where we weight each dimension using factor scores obtained from a principal component analysis (PCA). PCA is a multivariate statistical technique often used to reduce multiple dimensions into a unique indicator by weighting each of them proportionally to how much of the observed variation they explain (Vyas and Kumaranayake, 2006). From the first principal component we take the following weights for the dimensions included: motorbike 0.4601, sterilizer 0.1888, car 0.4052, high level trained cadres 0.0173, medium level trained cadres 0.5054, basic level trained cadres 0.5769.We re-estimate all models using the PCA-generated index of HF staff and equipment at locality and district level. Results, reported in Table 6.8 in the appendix, confirm previous findings, although the average marginal effects of HF staff and equipment appears smaller when the index is calculated using PCA weights, suggesting that different dimensions of health care availability and their combination may influence the calculated impact on health care use. However, having shown that the aggregation of health care availability dimensions may affect results, and lacking precise information on their relative weight, we tend to prefer equal weighting, since there is no reason to assume that each dimension's relevance in explaining sample variability in HF staff and equipment would reflect its relevance for health care delivery.

Fourth, since a trade-off between clustering at higher level and reducing the number of clusters may arise, we follow the common practice and control for clustering from the lowest to progressively higher levels and stop when the changes in standard errors are minimal (Cameron and Miller, 2014). We re-estimate all models correcting standard error for intra-cluster correlation at village or district level, to account for the HBS survey design or for the hierarchal organization of service provision. Results, reported in Table 6.9 and 6.10 in the appendix, confirm the sign, significance and magnitude of the coefficients associated with HF staff and equipment under the various specifications. The small difference in standard errors when controlling for clustering at locality or district level corroborates the choice of controlling for clustering at the locality level. Interestingly, although housing is still a weak instrument, result of the Wald test indicates exogeneity of district average HF staff and equipment when correction for clustering at district level is applied.

Fifth, to test for the consistency of the effect of health service availability across economic status, we re-run the probit model on the full sample and on the two-subsamples of individuals living close and far by adding to the model specification the interaction term between the measures of health service availability and two indicators for the poorest or richest income quintile. In none of the models the interaction terms were significant, suggesting that the effect of health care availability is the same on individuals with different economic status.

**Table 6.4 Summary of robustness checks results for health care availability, Mozambique 2009**

**a. Average marginal effects associated with percentage of clinics among HF in locality and district, Mozambique 2009**

| | Whole sample | Hhold lives within 1 hour from HF | Hhold lives more than 1 hour from HF |
|---|---|---|---|
| | Probit | Probit | Probit |
| ***Main model*** | | | |
| Percentage of HC and DH among HFs | 0.042 | 0.025 | 0.077 |
| (in locality) | (0.038) | (0.050) | (0.063) |
| Percentage of HC and DH among HFs | 0.57* | 0.137 | 0.272 |
| (in district) | (0.085) | (0.092) | (0.222) |
| ***Excluding provincial capitals*** | | | |
| Percentage of HC and DH among HFs | 0.037 | 0.011 | 0.077 |
| (in locality) | (0.042) | (0.060) | (0.063) |
| Percentage of HC and DH among HFs | 0.236* | 0.243* | 0.272 |
| (in district) | (0.121) | (0.142) | (0.221) |
| ***Village cluster SE*** | | | |
| Percentage of HC and DH among HFs | 0.042 | 0.025 | 0.077 |
| (in locality) | (0.038) | (0.050) | (0.056) |
| Percentage of HC and DH among HFs | 0.157* | 0.137 | 0.272 |
| (in district) | (0.092) | (0.098) | (0.209) |
| ***District cluster SE*** | | | |
| Percentage of HC and DH among HFs | 0.042 | 0.025 | 0.077 |
| (in locality) | (0.038) | (0.055) | (0.061) |
| Percentage of HC and DH among HFs | 0.157** | 0.137 | 0.272* |
| (in district) | (0.081) | (0.100) | (0.150) |

*** p<0.01, ** p<0.05, * p<0.1
Average marginal effects reported
Standard errors corrected for intra-cluster correlation at locality level in parentheses
Constant, HFs Staff and Equipment, Demand-side characteristics, Province and month controls included

### b. Probit and IV probit average marginal effects associated with HF staff and equipment in locality and district, Mozambique 2009

| | Whole sample | | Hhold lives within 1 hour from HF | Hhold lives more than 1 hour from HF | HF Staff and Equipment index Endogeneity | Instrument strenght |
|---|---|---|---|---|---|---|
| | Probit | IVProbit | Probit | Probit | | |
| ***Main model*** | | | | | | |
| HF Staff and Equipment index | 0.043 | 0.122 | 0.075*** | -0.060 | Exogenous | Strong |
| (locality average) | 0.029 | 0.083 | 0.029 | 0.061 | | |
| HF Staff and Equipment index | 0.074* | 0.464** | 0.132*** | -0.062 | Exogenous except for all sample | Weak |
| (district average) | 0.042 | 0.230 | 0.044 | 0.087 | | |
| ***Excluding provincial capitals*** | | | | | | |
| HF Staff and Equipment index | 0.041 | 0.099 | 0.072** | -0.060 | Exogenous | Strong |
| (locality average) | 0.031 | 0.082 | 0.034 | 0.061 | | |
| HF Staff and Equipment index | 0.076 | 0.218* | 0.155*** | -0.062 | Exogenous | Strong |
| (district average) | 0.049 | 0.117 | 0.059 | 0.087 | | |
| ***PCA weighting*** | | | | | | |
| HF Staff and Equipment index | 0.009 | 0.041 | 0.024** | -0.027 | Exogenous | Strong |
| (locality average) | 0.010 | 0.028 | 0.010 | 0.020 | | |
| HF Staff and Equipment index | 0.020 | 0.191* | 0.041*** | -0.022 | Exogenous except for whole sample | Weak |
| (district average) | 0.013 | 0.109 | 0.014 | 0.024 | | |
| ***Village cluster SE*** | | | | | | |
| HF Staff and Equipment index | 0.043 | 0.122 | 0.075** | -0.060 | Exogenous | Strong |
| (locality average) | 0.033 | 0.087 | 0.037 | 0.059 | | |
| HF Staff and Equipment index | 0.074 | 0.464** | 0.132** | -0.062 | Exogenous except for whole sample | Weak |
| (district average) | 0.053 | 0.219 | 0.059 | 0.091 | | |
| ***District cluster SE*** | | | | | | |
| HF Staff and Equipment index | 0.043 | 0.122 | 0.075** | -0.060 | Exogenous | Strong |
| (locality average) | 0.029 | 0.083 | 0.030 | 0.057 | | |
| HF Staff and Equipment index | 0.074* | 0.464* | 0.132*** | -0.062 | Exogenous except for whole sample | Weak |
| (district average) | 0.043 | 0.245 | 0.047 | 0.081 | | |

*** p<0.01, ** p<0.05, * p<0.1
1st and 2nd Stage refer to reduced-form and structural equation
Average marginal effects reported
Standard errors corrected for intra-cluster correlationat locality level in parentheses
Constant, Percentage of clinics among HFs, Demand-side charactericties, Province and month controls included
Exogeneity if Wald test for exogeneity does not reject the null hypothesis of exogeneity at 5% level

## 6.5. Discussion

In this study, we set out to analyse the effect of health services availability on health-seeking behaviour. We used two measures of health services availability: the proportion of HFs in the vicinity of the household offering inpatient and secondary care and the availability of staff and equipment in all HFs existing in the locality where the household resides. We found that a greater availability of referral health services in the locality has no significant effect on decision to seek care while it seems to have a positive effect when considered at district level. Moreover, we find that the availability of staff and equipment in all HFs, although very small has a positive and causal effect on the decision to seek care, but only among those individuals who can reach a HF within one hour. An increase of 13 percentage points in the ratio of the available to minimum staff and equipment may lead to an increase of at least one percentage point in the probability of seeking care when ill.

The lack of significance of breadth of services at the locality level may partly be due to a lack of variation in services provided at such a small level. However, the positive effect of a broader range of health services in a district suggests that individuals may be willing to travel further distances to access more specialised care. These results are in line with anecdotal evidence and reasons for bypassing the referral system (MISAU, 2012b).

For those living near a HF, the measure of health services availability that matters relates to the actual availability of inputs to provide the services, first because once distance is not a major barrier to use service, other factors may play a bigger role, and second because they probably have more and better information than those living further away. These findings are generally in line with previous studies from Mozambique (Lindelow, 2004b, Lindelow, 2004a, Salvucci, 2014). Differences concern the non significance effect of income in Lindelow (2004b) and of HF characteristics in Lindelow (2004a), which may be explained respectively by the evolution of health seeking behavior over time and real increases in consumption per capita, and by the use of data from a sub-sample of provinces and by the analysis of health behavior unconditional on illness reporting.

From a policy perspective, the results suggest that increased utilisation of health services can be achieved if service provision is scaled-up, which can be done through three different channels. First, health care services can be made more accessible to a larger population by increasing the number of HFs in a given area. Second, the type of services provided in a given locality could be expanded, with existing HFs offering a wider range of health care services, or through a change in the 'HF mix' of a given area, with a greater proportion of HFs providing primary and secondary care. Third, governments would increase the availability of inputs necessary to make health services available in a given HF (i.e. staff, equipment and drugs) , at least to meet the minimum level set by official existing norms. Previous studies suggested that making more resources available in existing HFs is more cost-effective than increasing the number of HFs in order to improve health care utilisation (Collier et al., 2002). Our results suggest that choosing one policy or the other might have different equity implications since the subsample of individuals living closer to HFs, who would benefit from the second approach, may also tend to be from more advantaged groups of the population. Our results also suggests that here are demand-side barriers that have to be addressed to improve health care utilization among individuals needing care.

The study suffers from several limitations, mostly related to data availability, and common to the majority of the existing literature on health care seeking behaviours in LMICs. Firstly, results are not representative for the whole population, but only for individuals who reported illness in the two weeks prior to the interview. Since illness reporting may be a reflection of self-perceived rather that objective measures of health there is a possible systematic bias in health status self-assessment. For example individuals are more likely to report illness and make use of health care if the illness is more serious or if they have previously used health care, leading to an over-estimation of the effect of the variables of interest (Appleton, 1998). Additionally individuals who have used health care following an illness spell are more likely to remember and report it in the interview. Secondly, the lack of a suitable measure of illness severity/ need for health care limit the insights which can be derived from the analysis, since this is likely to be a major demand-side factor affecting health care use. More in detail, the lack of information on health status and illness type and seriousness prevents a deeper understanding of the magnitude and heterogeneity of the effect associated with both demand and supply-side determinants of health care use. However, unfortunately, this limitation is common to studies using data from surveys on living standards or similar. Third, in the interpretation of results, we implicitly assume that individuals have a perfect knowledge of where HF are, what type of services they offer and how well staffed and equipped they are. If individuals were not perfectly informed and information was, for example, inversely correlated to distance from a HF, the lack of effect of supply-side determinants on the probability of seeking care could then be the reflection of lack of information. However, considering the very basic nature of the services provided at clinics level and the basic equipment considered here, it is likely to believe that individuals get information about HF before deciding whether to seek care or not. Fourth, the number and type of HF, and therefore distance from a HF, have been treated as exogenous in this analysis. However similarly to HF resources those more HFs and providing higher level of care may also be concentrated where individuals are more likely to use health care when in need. While the assumption is plausible in the short run, the possible endogeneity of the number and type of HF in the longer run needs to be explored and the complementarity/ substitution of decisions concerning the number, type and resourcing of HFs should be explicitly discussed. Fifth, the lack of information on the specific HF visited by individuals forced us to assume that individuals visit the closest HF, or one in their locality. However, if the most easily accessible HFs were not those in the locality of residence, the coefficient associated with

HFs staff and equipment may have been biased, although it is difficult to say *a priori* in which direction. If individuals were linked to a HF better staffed and equipped than the one where they sought care, the effect of staff and equipment may have been underestimated, and vice-versa. However, since there is no reason to have systematically linked individuals to better or worst HFs, there is no reason to expect the estimated coefficient to be systematically biasedSixth the proxies of health care availability used here refer to very basic characteristics and may have underestimated differences in capacity of service provision across HFs. However, the physical attributes of HFs considered in this analysis allow us to discriminate across HFs and represent a necessary, although not always sufficient, condition for health care provision. Finally, since we focused on outpatient care, our results cannot be generalised to other types of care. However, if individuals account for HF characteristics in their decisions to seek outpatient care, they will do so even more for more specialised or inpatient care, as long as those services are accessible.

## 6.6. Conclusion

In contexts where resources are limited, investing in service availability, not only in terms of number and type of HF but also in terms of resources available in HFs will contribute to better quality of care and encourage populations to use health services. However, we found that this effect would be small but significant only for those living closer to existing HFs, suggesting that such policy could benefit primarily more advantaged populations, while those in greater need would remain under-served without extending the services currently provided. Even when services are available, demand-side constraints still limit access to health care.

Further research should aim to generate a deeper understanding of the relative importance and interplay between demand and supply-side determinants of service use and between the various dimensions of health care need, access and quality. The role of demand and supply-side factors should be explored not only in determining the decision to seek care, but also the choice of provider, the frequency of use and the effective use of more specialised services.

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# Appendices to Chapter 6

**Table 6.5 Descriptive statistics for individuals ill in the two weeks prior to the interview by sample, Mozambique 2009**

| Variable | Whole sample | | | | Household lives within 1 hour from HF | | | | Household lives more than 1 hour from HF | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Min | Max | Mean | SD | Min | Max | Mean | SD | Min | Max |
| ***Service utilization*** | | | | | | | | | | | | |
| Number of visits to HF (previous month) | 0.75 | 0.83 | 0.00 | 15.00 | 0.89 | 0.88 | 0.00 | 15.00 | 0.54 | 0.71 | 0.00 | 7.00 |
| Number of visits to HF, if using HF (previous month) * | 1.24 | 0.74 | 1.00 | 15.00 | 1.26 | 0.79 | 1.00 | 15.00 | 1.19 | 0.59 | 1.00 | 7.00 |
| Seeking care from a public HF* | 0.61 | 0.49 | 0.00 | 1.00 | 0.71 | 0.45 | 0.00 | 1.00 | 0.46 | 0.50 | 0.00 | 1.00 |
| Seeking care from Other providers* | 0.03 | 0.18 | 0.00 | 1.00 | 0.03 | 0.16 | 0.00 | 1.00 | 0.04 | 0.20 | 0.00 | 1.00 |
| ***Demand-Side Characteristics*** | | | | | | | | | | | | |
| Woman | 0.58 | 0.49 | 0.00 | 1.00 | 0.57 | 0.49 | 0.00 | 1.00 | 0.59 | 0.49 | 0.00 | 1.00 |
| Age | 24 | 22 | 0 | 99 | 24 | 21 | 0 | 96 | 25 | 23 | 0 | 99 |
| Highest level education in household (years schooling) | 5.44 | 3.23 | 0.00 | 18.00 | 6.35 | 3.28 | 0.00 | 18.00 | 4.10 | 2.62 | 0.00 | 13.00 |
| Employed in permanent work | 0.44 | 0.50 | 0.00 | 1.00 | 0.41 | 0.49 | 0.00 | 1.00 | 0.49 | 0.50 | 0.00 | 1.00 |
| Employed in non remunerated housekeeping work | 0.20 | 0.40 | 0.00 | 1.00 | 0.16 | 0.37 | 0.00 | 1.00 | 0.25 | 0.43 | 0.00 | 1.00 |
| Household adult equivalent consumption per-capita (MZM per day) | 33 | 33 | 1 | 921 | 35 | 37 | 2 | 921 | 30 | 25 | 1 | 519 |
| Number of household members per room | 1.98 | 1.23 | 0.03 | 10.00 | 1.89 | 1.12 | 0.03 | 10.00 | 2.11 | 1.37 | 0.25 | 10.00 |
| Latrine in the house | 0.58 | 0.49 | 0.00 | 1.00 | 0.69 | 0.46 | 0.00 | 1.00 | 0.43 | 0.49 | 0.00 | 1.00 |
| Transport reaching the community | 0.63 | 0.48 | 0.00 | 1.00 | 0.84 | 0.37 | 0.00 | 1.00 | 0.32 | 0.47 | 0.00 | 1.00 |
| 1 hour time distance from closest HF | 0.60 | 0.49 | 0.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 hours time distance from closest HF | 0.08 | 0.28 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.41 | 0.00 | 1.00 |
| More than 2 hours time distance from closest HF | 0.31 | 0.46 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.78 | 0.41 | 0.00 | 1.00 |
| Urban | 0.37 | 0.48 | 0.00 | 1.00 | 0.62 | 0.48 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Supply-Side Characteristics*** | | | | | | | | | | | | |
| HF in locality of residence | 0.92 | 0.28 | 0.00 | 1.00 | 0.97 | 0.17 | 0.00 | 1.00 | 0.83 | 0.37 | 0.00 | 1.00 |
| Percentage of HCs and DH among HFs in locality | 0.77 | 0.24 | 0.00 | 1.00 | 0.75 | 0.23 | 0.00 | 1.00 | 0.81 | 0.25 | 0.00 | 1.00 |
| Percentage of HCs and DH among HFs in district | 0.82 | 0.11 | 0.33 | 1.00 | 0.82 | 0.12 | 0.33 | 1.00 | 0.83 | 0.09 | 0.57 | 1.00 |
| HF Staff and Equipment index (locality average) | 0.50 | 0.26 | 0.00 | 2.13 | 0.54 | 0.28 | 0.00 | 2.13 | 0.45 | 0.21 | 0.08 | 1.59 |
| HF Staff and Equipment index (district average) | 0.47 | 0.18 | 0.19 | 1.25 | 0.48 | 0.19 | 0.19 | 1.25 | 0.45 | 0.16 | 0.19 | 1.24 |
| HF housing availability index (locality average) | 0.60 | 0.89 | 0.00 | 10.00 | 0.57 | 0.96 | 0.00 | 10.00 | 0.64 | 0.77 | 0.00 | 5.00 |
| HF housing availability index (district average) | 0.60 | 0.62 | 0.00 | 3.38 | 0.57 | 0.63 | 0.00 | 3.38 | 0.63 | 0.61 | 0.00 | 2.88 |

Sample: Whole sample: 6,034; 1 hour distance: 3,603; more than 1 hour distance: 2,431.
* Observations: Whole sample: 3,663; 1 hour distance 2,549; more than 1 hour distance: 1,114.

**Table 6.6 Effect of district supply-side characteristics on healthcare seeking according to distance from the closest health facility, Mozambique 2009**

| | Whole sample | | | Household lives within 1 hour from HF | | | Household lives more than 1 hour from HF | | |
|---|---|---|---|---|---|---|---|---|---|
| | Probit | IVProbit | | Probit | IVProbit | | Probit | IVProbit | |
| | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage |
| ***Supply-Side Characteristics*** | | | | | | | | | |
| Percentage of HCs and DH among HFs | 0.157* | 0.236** | -0.169 | 0.137 | 0.190 | -0.170 | 0.272 | -0.446 | -0.116*** |
| (in district) | (0.085) | (0.114) | (0.185) | (0.094) | (0.120) | (0.206) | (0.222) | (0.343) | (0.019) |
| HF Staff and Equipment index | 0.074* | 0.464** | | 0.132*** | 0.396* | | -0.062 | -0.344 | |
| (district average) | (0.042) | (0.230) | | (0.044) | (0.239) | | (0.087) | (0.219) | |
| HF availability of housing | | | 0.072** | | | 0.072* | | | 0.091*** |
| (district average) | | | (0.030) | | | (0.039) | | | (0.019) |
| Demand-side characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month dummies | | | | | | | | | |
| Observations | 6,026 | 6,026 | | 3,597 | 3,597 | | 2,429 | 2,429 | |
| Pseudo R-Squared | 0.090 | | | 0.044 | | | 0.071 | | |
| Log pseudolikelihood | -3674.7 | -858.324 | | -2077.565 | -2077.565 | | -1556.43 | -138.391 | |
| Rho | | | -0.182 | | | -0.132 | | | -0.205 |
| Standard error | | | (0.104) | | | (0.118) | | | (0.132) |
| Wald test of exogeneity [(a)] | | | 2.930 | | | 1.220 | | | 2.270 |
| p-value | | | 0.087 | | | 0.269 | | | 0.132 |
| F-test of instrument in first stage [(a)] | | | 5.734 | | | 3.375 | | | 23.394 |

*** p<0.01, ** p<0.05, * p<0.1

Average marginal effects reported

Standard errors corrected for intra-cluster correlation at locality level in parentheses (Number of clusters: 1 hour walking distance: N=234 , more than 1 hour walking distance: N=281, whole sample: N= 452).

[(a)] Adjusted for clusters

## Table 6.7 Effect of supply-side characteristics on healthcare seeking excluding provincial capitals, Mozambique 2009

### a. Locality characteristics

| | Whole sample | | | Household lives within 1 hour from HF | | | Household lives more than 1 hour from HF | | |
|---|---|---|---|---|---|---|---|---|---|
| | Probit | IVProbit | | Probit | IVProbit | | Probit | IVProbit | |
| | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage |
| ***Supply-Side Characteristics*** | | | | | | | | | |
| Percentage of HCs and DH among HFs | 0.037 | 0.027 | 0.172** | 0.011 | 0.003 | 0.242** | 0.077 | 0.063 | 0.119* |
| (in locality) | (0.042) | (0.043) | (0.068) | (0.060) | (0.061) | (0.096) | (0.063) | (0.077) | (0.064) |
| HF Staff and Equipment index | 0.041 | 0.099 | | 0.072** | 0.108** | | -0.060 | 0.053 | |
| (locality average) | (0.031) | (0.082) | | (0.034) | (0.056) | | (0.061) | (0.393) | |
| HF availability of housing | | | 0.107*** | | | 0.128*** | | | 0.062*** |
| (locality average) | | | (0.022) | | | (0.030) | | | (0.018) |
| Demand-side characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,117 | 5,117 | | 2,688 | 2,688 | | 2,429 | 2,429 | |
| Pseudo R-Squared | 0.092 | | | 0.051 | | | 0.070 | | |
| Log pseudolikelihood | -3152.812 | -2648.086 | | -1560.524 | -1457.230 | | -1557.05 | -894.714 | |
| Rho | | | -0.041 | | | -0.031 | | | -0.059 |
| Standard error | | | (0.057) | | | (0.051) | | | (0.199) |
| Wald test of exogeneity [(a)] | | | 0.520 | | | 0.380 | | | 0.090 |
| p-value | | | 0.471 | | | 0.537 | | | 0.767 |
| F-test of instrument in first stage [(a)] | | | 22.495 | | | 18.397 | | | 11.526 |

*** p<0.01, ** p<0.05, * p<0.1
Average marginal effects reported
Standard errors corrected for intra-cluster correlation at locality level in parentheses (Number of clusters: 1 hour walking distance: N=225 , more than 1 hour walking distance: N=281 , whole sample: N=443).
[(a)] Adjusted for clusters

## b. District characteristics

| | Whole sample | | | Household lives within 1 hour from HF | | | Household lives more than 1 hour from HF | | |
|---|---|---|---|---|---|---|---|---|---|
| | Probit | IVProbit | | Probit | IVProbit | | Probit | IVProbit | |
| | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage |
| ***Supply-Side Characteristics*** | | | | | | | | | |
| Percentage of HCs and DH among HFs | 0.236* | 0.251** | -0.120 | 0.243* | 0.243* | -0.123 | 0.272 | 0.344 | -0.116 |
| (In district) | (0.121) | (0.119) | (0.096) | (0.142) | (0.142) | (0.135) | (0.222) | (0.219) | (0.090) |
| HF Staff and Equipment index | 0.076 | 0.218* | | 0.155*** | 0.111 | | -0.062 | 0.446 | |
| (district average) | (0.049) | (0.117 | | (0.059) | (0.089) | | (0.087) | (0.343) | |
| HF availability of housing | | | 0.138*** | | | 0.172*** | | | 0.091*** |
| (district average) | | | (0.022) | | | (0.026) | | | (0.019)( |
| Demand-side characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,117 | 5,117 | | 2,688 | 2,688 | | 2,494 | | |
| Pseudo R-Squared | 0.093 | | | 0.053 | | | 0.071 | | |
| Log pseudolikelihood | -3149.878 | -289.332 | | -1556.878 | 66.573 | | -1,556 | -138.391 | |
| Rho | | | -0.068 | | | 0.025 | | | -0.205 |
| Standard error | | | (0.053) | | | (0.044) | | | (0.132) |
| Wald test of exogeneity [(a)] | | | 1.680 | | | 0.310 | | | 2.270 |
| p-value | | | 0.195 | | | 0.580 | | | 0.132 |
| F-test of instrument in first stage [(a)] | | | 38.040 | | | 42.190 | | | 23.394 |

*** p<0.01, ** p<0.05, * p<0.1
Average marginal effects reported
Standard errors corrected for intra-cluster correlation at locality level in parentheses (Number of clusters: 1 hour walking distance: N=225, more than 1 hour walking distance: N=281 , whole sample: N=443).
[(a)] Adjusted for clusters

## Table 6.8 Effect of supply-side characteristics on healthcare seeking using PCA index of HF staff and equipment, Mozambique 2009

### a. Locality characteristics

| | Whole sample | | | Household lives within 1 hour from HF | | | Household lives more than 1 hour from HF | | |
|---|---|---|---|---|---|---|---|---|---|
| | Probit | IVProbit | | Probit | IVProbit | | Probit | IVProbit | |
| | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage |
| ***Supply-Side Characteristics*** | | | | | | | | | |
| Percentage of HCs and DH among HFs | 0.040 | 0.014 | 0.801 | 0.016 | 0.003 | 0.796** | 0.093 | 0.055 | 0.851*** |
| (in locality) | (0.038) | (0.045) | (0.246) | (0.050) | (0.056) | (0.340) | (0.064) | (0.116) | (0.220) |
| HF Staff and Equipment index | 0.009 | 0.041 | | 0.024** | 0.048** | | -0.027 | 0.016 | |
| (locality average) | (0.010) | (0.028) | | (0.010) | (0.020) | | (0.020) | (0.119) | |
| HF availability of housing | | | -0.007*** | | | 0.338*** | | | 0.205*** |
| (locality average) | | | (0.070) | | | (0.086) | | | (0.064) |
| Demand-side characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,026 | | | 3,597 | 3,597 | | 2,429 | 2,429 | |
| Pseudo R-Squared | 0.089 | | | 0.043 | | | 0.071 | | |
| Log pseudolikelihood | -3677.148 | -9885.584 | | -2079.688 | -5810.532 | | -1556.19 | -3813.371 | |
| Rho | | | -0.069 | | | -0.058 | | | -0.075 |
| Standard error | | | (0.060) | | | (0.051) | | | (0.199) |
| Wald test of exogeneity [(a)] | | | 1.320 | | | 1.310 | | | 0.140 |
| p-value | | | 0.250 | | | 0.253 | | | 0.706 |
| F-test of instrument in first stage [(a)] | | | 17.044 | | | 15.213 | | | 10.055 |

*** p<0.01, ** p<0.05, * p<0.1

Average marginal effects reported

Standard errors corrected for intra-cluster correlation at locality level in parentheses (Number of clusters: 1 hour walking distance: 234, more than 1 hour walking distance: N=281, whole sample: N=452).

[(a)] Adjusted for clusters

## b. District characteristics

| | Whole sample | | | Household lives within 1 hour from HF | | | Household lives more than 1 hour from HF | | |
|---|---|---|---|---|---|---|---|---|---|
| | Probit | IVProbit | | Probit | IVProbit | | Probit | IVProbit | |
| | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage |
| ***Supply-Side Characteristics*** | | | | | | | | | |
| Percentage of HCs and DH among HFs | 0.146* | 0.173 | -0.100 | 0.115 | 0.125 | -0.028 | 0.277 | 0.305 | -0.101 |
| (In district) | (0.083) | (0.124) | (0.581) | (0.092) | (0.131) | (0.643) | (0.221) | (0.216) | (0.317) |
| HF Staff and Equipment index | 0.020 | 0.191* | | 0.041*** | 0.175 | | -0.022 | 0.165 | |
| (district average) | (0.013) | (0.109) | | (0.014) | (0.132) | | (0.024) | (0.126) | |
| HF availability of housing | | | 0.171* | | | 0.162 | | | 0.243*** |
| (district average) | | | (0.097) | | | (0.126) | | | (0.062) |
| Demand-side characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,026 | | | 3,597 | 3,597 | | 2,429 | 2,429 | |
| Pseudo R-Squared | 0.090 | | | 0.043 | | | 0.071 | | |
| Log pseudolikelihood | -3675.164 | -8046.404 | | -2077.784 | -4657.854 | | -1556.268 | -3120.095 | |
| Rho | | | -0.259 | | | -0.212 | | | -0.251 |
| Standard error | | | (0.166) | | | (0.210) | | | (0.166) |
| Wald test of exogeneity [(a)] | | | 2.220 | | | 0.960 | | | 2.080 |
| p-value | | | 0.136 | | | 0.327 | | | 0.149 |
| F-test of instrument in first stage [(a)] | | | 3.125 | | | 1.635 | | | 14.924 |

*** p<0.01, ** p<0.05, * p<0.1
Average marginal effects reported
Standard errors corrected for intra-cluster correlation at locality level in parentheses (Number of clusters: 1 hour walking distance: 234, more than 1 hour walking distance: 281, whole sample: 452).
[(a)] Adjusted for clusters

## Table 6.9 Effect of supply-side characteristics on healthcare seeking with village cluster control, Mozambique 2009

### a. Locality characteristics

| | Whole sample | | | Household lives within 1 hour from HF | | | Household lives more than 1 hour from HF | | |
|---|---|---|---|---|---|---|---|---|---|
| | Probit | IVProbit | | Probit | IVProbit | | Probit | IVProbit | |
| | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage |
| ***Supply-Side Characteristics*** | | | | | | | | | |
| Percentage of HCs and DH among HFs | 0.042 | 0.033 | 0.118** | 0.025 | 0.017 | 0.130* | 0.077 | 0.063 | 0.119* |
| (in locality) | (0.038) | (0.039) | (0.053) | (0.050) | (0.051) | (0.073) | (0.056) | (0.073) | (0.061) |
| HF Staff and Equipment index | 0.043 | 0.122 | | 0.075** | 0.136** | | -0.060 | 0.053 | |
| (locality average) | (0.033) | (0.087) | | (0.037) | (0.067) | | (0.059) | (0.375) | |
| HF availability of housing | | | 0.098*** | | | 0.026*** | | | 0.062*** |
| (locality average) | | | (0.020) | | | (0.117) | | | (0.016) |
| Demand-side characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,026 | 6,026 | | 3,597 | 3,597 | | 2,429 | 2,429 | |
| Pseudo R-Squared | 0.089 | | | 0.043 | | | 0.070 | | |
| Log pseudolikelihood | -3676.41 | -2916.16 | | -2079.49 | -1714.33 | | -1557.05 | -894.71 | |
| Rho | | | -0.05 | | | -0.049 | | | -0.059 |
| Standard error | | | (0.059) | | | (0.053) | | | (0.191) |
| Wald test of exogeneity [(a)] | | | 0.840 | | | 0.850 | | | 0.090 |
| p-value | | | 0.360 | | | 0.357 | | | 0.758 |
| F-test of instrument in first stage [(a)] | | | 24.759 | | | 20.317 | | | 15.519 |

*** p<0.01, ** p<0.05, * p<0.1
Average marginal effects reported
Standard errors corrected for intra-cluster correlation at village level in parentheses (Number of clusters: 1 hour walking distance: N=472, more than 1 hour walking distance: N=374 , whole sample: N=846).
[(a)] Adjusted for clusters

## b. District characteristics

| | Whole sample | | | Household lives within 1 hour from HF | | | Household lives more than 1 hour from HF | | |
|---|---|---|---|---|---|---|---|---|---|
| | Probit | IVProbit | | Probit | IVProbit | | Probit | IVProbit | |
| | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage |
| ***Supply-Side Characteristics*** | | | | | | | | | |
| Percentage of HCs and DH among HFs | 0.157* | 0.236** | -0.169** | 0.137 | 0.190* | -0.170* | 0.272 | 0.344 | -0.116 |
| (In district) | (0.092) | (0.104) | (0.085) | (0.098) | (0.110) | (0.098) | (0.209) | (0.209) | (0.079) |
| HF Staff and Equipment index | 0.074 | 0.464** | | 0.132** | 0.396* | | -0.062 | 0.446 | |
| (district average) | (0.053) | (0.219) | | (0.059) | (0.238) | | (0.091) | (0.328) | |
| HF availability of housing | | | 0.072*** | | | 0.072** | | | -0.019*** |
| (district average) | | | (0.021) | | | (0.029) | | | (0.042) |
| Demand-side characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,026 | 6,026 | | 3,597 | 3,597 | | 2,429 | | |
| Pseudo R-Squared | 0.090 | | | 0.044 | | | 0.071 | | |
| Log pseudolikelihood | -3674.663 | -858.324 | | -2077.565 | -441.142 | | -1556.43 | -138.391 | |
| Rho | | | -0.182 | | | -0.132 | | | -0.205 |
| Standard error | | | (0.101) | | | (0.120) | | | (0.126) |
| Wald test of exogeneity [(a)] | | | 3.140 | | | 1.200 | | | 2.520 |
| p-value | | | 0.076 | | | 0.273 | | | 0.113 |
| F-test of instrument in first stage [(a)] | | | 11.517 | | | 6.138 | | | 33.491 |

*** p<0.01, ** p<0.05, * p<0.1
Average marginal effects reported
Standard errors corrected for intra-cluster correlation at village level in parentheses (Number of clusters: 1 hour walking distance: N=472 , more than 1 hour walking distance: N=374 , whole sample: N=846).
[(a)] Adjusted for clusters

### Table 6.10 Effect of supply-side characteristics on healthcare seeking with district cluster control, Mozambique 2009

#### a. Locality characteristics

| | Whole sample | | | Household lives within 1 hour from HF | | | Household lives more than 1 hour from HF | | |
|---|---|---|---|---|---|---|---|---|---|
| | Probit | IVProbit | | Probit | IVProbit | | Probit | IVProbit | |
| | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage |
| ***Supply-Side Characteristics*** | | | | | | | | | |
| Percentage of HCs and DH among HFs | 0.042 | -0.033 | 0.118 | 0.025 | 0.017 | 0.130 | 0.077 | 0.063 | 0.119* |
| (in locality) | (0.038) | (0.041) | (0.073) | (0.055) | (0.059) | (0.106) | (0.061) | (0.077) | (0.065) |
| HF Staff and Equipment index | 0.043 | 0.122 | | 0.075** | 0.136** | | -0.060 | 0.053 | |
| (locality average) | (0.029) | (0.083) | | (0.030) | (0.057) | | (0.057) | (0.384) | |
| HF availability of housing | | | 0.098*** | | | 0.117*** | | | 0.062*** |
| (locality average) | | | (0.026) | | | (0.032) | | | (0.016) |
| Demand-side characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,026 | 6,026 | | 3,597 | 3,597 | | 2,429 | 2,429 | |
| Pseudo R-Squared | 0.089 | | | 0.043 | | | 0.070 | | |
| Log pseudolikelihood | -3676.406 | -2916.161 | | -2079.493 | -1714.328 | | -1557.051 | -894.714 | |
| Rho | | | -0.054 | | | -0.049 | | | -0.059 |
| Standard error | | | (0.059) | | | (0.049) | | | (0.195) |
| Wald test of exogeneity [(a)] | | | 0.830 | | | 0.990 | | | 0.090 |
| p-value | | | 0.362 | | | 0.319 | | | 0.763 |
| F-test of instrument in first stage [(a)] | | | 14.503 | | | 13.284 | | | 14.143 |

*** p<0.01, ** p<0.05, * p<0.1

Average marginal effects reported

Standard errors corrected for intra-cluster correlation at district level in parentheses (Number of clusters: 1 hour walking distance: N=123, more than 1 hour walking distance: N=110 , whole sample: N=136).

[(a)] Adjusted for clusters

## b. District characteristics

| | Whole sample | | | Household lives within 1 hour from HF | | | Household lives more than 1 hour from HF | | |
|---|---|---|---|---|---|---|---|---|---|
| | Probit | IVProbit | | Probit | IVProbit | | Probit | IVProbit | |
| | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage | | 2nd Stage | 1nd Stage |
| ***Supply-Side Characteristics*** | | | | | | | | | |
| Percentage of HCs and DH among HFs | 0.157** | 0.236** | -0.169 | 0.137 | 0.190 | -0.170 | 0.272* | 0.344 | -0.116 |
| (In district) | (0.081) | (0.113) | (0.198) | (0.100) | (0.127) | (0.212) | (0.150) | (0.159) | (0.147) |
| HF Staff and Equipment index | 0.074* | 0.464* | | 0.132*** | 0.396 | | -0.062 | 0.446 | |
| (district average) | (0.043) | (0.245) | | (0.047) | (0.247) | | (0.081) | (0.303) | |
| HF availability of housing | | | 0.072** | | | 0.072 | | | 0.091*** |
| (district average) | | | (0.037) | | | (0.047) | | | (0.028) |
| Demand-side characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,026 | | | 3,597 | 3,597 | | 2,429 | 2,429 | |
| Pseudo R-Squared | 0.090 | | | 0.044 | | | 0.071 | | |
| Log pseudolikelihood | -3674.663 | -858.324 | | -2077.565 | -441.142 | | -1556.43 | -138.391 | |
| Rho | | | -0.182 | | | 1.13 | | | -0.205 |
| Standard error | | | (0.111) | | | (0.287) | | | (0.115) |
| Wald test of exogeneity (a) | | | 2.580 | | | 1.130 | | | 3.010 |
| p-value | | | 0.108 | | | 0.287 | | | 0.083 |
| F-test of instrument in first stage (a) | | | 3.794 | | | 2.327 | | | 10.858 |

*** p<0.01, ** p<0.05, * p<0.1
Average marginal effects reported
Standard errors corrected for intra-cluster correlation at district level in parentheses (Number of clusters: 1 hour walking distance: N=123, more than 1 hour walking distance: N=110 , whole sample: N=136)
(a) Adjusted for clusters

# Chapter 7

# Discussion and conclusion

## 7.1. Introduction

In the existing literature focusing on low- and middle-income countries (LMICs) settings, equity in the allocation of public health financial resources has been approached in two complementary ways. The first approach has evaluated equity by comparing the current distribution of resources across geographic areas to an ideal equitable target, mostly set by resource allocation formulae (RAFs). The second approach has evaluated the extent to which public health expenditure is equitably distributed across the population, but it has failed to link results to resource allocation practices. RAFs have been used as mechanisms to promote equity in the allocation of financial resources across geographic areas. However, the extent to which an equitable allocation of resources across geographic areas translates into an equitable distribution of resources across individuals has not been examined in the existing literature. Furthermore, there has been no analysis of the efficiency implications of alternative resource allocations criteria or the mechanisms that can mitigate or exacerbate potential equity-efficiency trade-offs.

In this thesis, I set out to address these existing gaps by carrying out an analysis of equity and efficiency in the allocation of public financial resources for primary and secondary outpatient health care across local health authorities in Mozambique. Specifically, this thesis aimed to investigate the following research questions:

1) To what extent is the current allocation of recurrent expenditure across local health authorities equitable?
2) How efficiently do local health authorities and health facilities perform their roles in managing financial resources and delivering health care?
3) How does the allocation of financial resources, reflected in health service availability, influence health care seeking behaviours of individuals?

## 7.2. Summary of research findings

Reviewing the existing literature on resource allocation in LMICs (Chapter 2), I illustrated how two approaches, complementary in some ways, have been used so far. In one strand of the literature, studies focus on resource allocation across geographic areas and compare the shares of resources allocated to each area to an ideal target defined through RAFs. In a second body of literature, studies use benefit incidence analysis (BIA) to examine the distribution of the benefit (measured in monetary terms) received from public health expenditure and associated with individual health care utilisation. The evidence reviewed suggests that RAFs may be helpful in promoting equity in resource allocation across geographic areas and that primary health care expenditure benefit the poor relatively more than hospital expenditure. Two major gaps emerged from the literature analysed. First, existing literature does not link resource allocation practices and the distribution of benefit from public health expenditure. Second, there is a lack of consideration of the mechanisms through which financial resources are effectively transformed into health care and reach the population. Finally, the review underlined the poor quality of the methods and data used in the included studies, which prevented us from drawing strong policy recommendations.

Turning to the analysis of equity in the allocation of recurrent expenditure across local health authorities in Mozambique (Chapter 4), I extended the traditional BIA framework in several ways. These extensions allowed to assess horizontal and vertical inequities in the distribution of the monetary benefit from public health expenditure, disentangle their service use and resource allocation components and compare changes over time. The results show inequities in the current distribution of resources, driven by inequity in service utilisation rather than resource allocation. A discrepancy in the ranking of the population by household per-capita consumption and by need for health care emerged and evidenced initial differences in donors' and government public health expenditure priorities. While donor expenditure in 2008 was heavily pro-poor, government expenditure appeared to reach better the neediest quintile of the population. Overall improvements towards horizontal and vertical equity were observed between 2008 and 2011. During this period, changes in the geographic allocation of resources led to an alignment of the allocation pattern of donors to that of government, reducing the pro-poor concentration of donor funding and progressively re-distributing resources toward the neediest quintile. While resource allocation was almost equitable in 2011, the benefit from public expenditure was still concentrated amongst the richest and least needy quintiles of the population, essentially because of inequitable utilisation patterns.

Proceeding to an analysis of the processes by which resources are transformed into services, in Chapter 5 I examined the efficiency of health districts in delivering outpatient primary care in Mozambique, using a stochastic frontier analysis (SFA) approach. The results show that on average only 73% of the deliverable yearly outpatient consultations per capita were effectively produced between 2008 and 2011. The analysis of service delivery at district level as the output of a two-step production process, where HAs and health facilities (HFs) have separate but complementary roles, provided additional insight into the sources of inefficiency. HAs succeeded in providing only 66% of the HF staff and equipment that they could potentially purchase and allocate, for their given financial resources (allocative inefficiency). HFs delivered only 74% of the outpatient consultations that they could have realised given their human and material resources (technical inefficiency). The use of a SFA approach allowed me to investigate the factors that contributed to HAs' and HFs' productivity, as well as how administration efficiency can influence health care delivery. Increases in financial resources, in particular those from sources involving lower administrative bureaucracy, translate into greater availability of staff and equipment in HFs. I also found that local development, broadly measured by the availability of running water and electricity in HFs and by district socio-economic indicators, is associated with higher levels of both HA and HF productivity.

Having analysed how financial resources are transformed into health services, I then analysed how the availability of health services influences individual health seeking behaviour (Chapter 6), by estimating an econometric model of demand for health care. I found that availability of HFs providing inpatient and secondary care at district level, but not at locality level, had a positive effect on the decision to seek care. The availability of staff and equipment in existing facilities also had a positive and causal effect on the probability of seeking care, but only for those individuals who live close enough to a HF. The results suggest that staffing and equipping all HFs to meet the minimum standards required by current official norms would increase the probability of using services by around four percent points. The effect is almost double when the availability of staff and equipment in HFs is considered at district, rather than locality level. Distance from the health facility remain an important barrier to health care use. The level of education attained in the household, employment in a permanent job, household consumption per capita and asset ownership were all found to have a positive effect on the decision to seek care, suggesting that demand-side barriers limit access to health care even when services are available.

In the conceptual framework used in this thesis, equity and efficiency are conceived as the final results of the interaction between need for health care and resource allocation, mediated by the efficiency in the use of resources, and observed through the individual utilisation of health care. Interpreted in light of this framework, the results described above offer some insights with respect to resource allocation. In Mozambique, where resources appears equitably distributed despite inequities in service use, resource allocation policies on their own are insufficient to achieve a meaningful improvement in the distribution of the monetary benefit from public expenditure. Indeed resources would not have any effect on health care use for those living far from a HF and currently not using service. Changes in health care use patterns would be achieved only through an expansion of health service geographic coverage to reach the currently underserved (and potentially neediest populations), and policies to tackle demand side barriers to improve the use of health care services amongst the poorest (who do not use services even when those are available). Policies increasing efficiency of local HAs may contribute to increase the availability of staff and equipment in HFs incentivising service use for those who live close to a HF, but not for those who are currently unserved.

The trade off-between equity and efficiency outcomes associated with resource allocation *per se* is potentially minimal since it does not produce meaningful changes in health care utilization patterns. Alternative (or complementary policies) incentivising service use are likely to have more important implications.

## 7.3. Contribution of the thesis

### *7.3.1. Methodological contributions*

***Extension of the methods used in Benefit Incidence Analysis (BIA)***

In this thesis I adopted an innovative approach to the evaluation of equity in resource allocation which combined the normative perspective of RAFs (McIntyre et al., 2007, Diderichsen, 2004), with the positive perspective of BIA studies that evaluate the distribution of resources across individuals (Demery, 2000, O'Donnell et al., 2008). I linked resource allocation practices with the distribution of the monetary benefit from public health expenditure received by individuals. I separately assessed horizontal and vertical equity with respect to the normative equitable benchmarks implied by RAF principles and I disentangled the relative contributions of service utilisation and resource allocation to the observed inequities.

The second extension of the methods used in BIA consisted in explicitly assessing vertical equity by ranking individuals according to their need for health care and comparing the progressivity of the cumulative distribution of benefit with respect to the cumulative distribution of need. The cumulative distribution of need corresponds to the most conservative definitions of vertical equity according to which each individual receive a proportion of benefit from public health expenditure, which is at least commensurate to their proportion of need. In vertical equity had been analysed so far only by comparing the distribution of benefit to the distribution of need across individuals ranked by socio-economic status (Mtei et al., 2012, Ataguba and McIntyre, 2012, Chuma et al., 2012), but never directly ranking individuals by need for health care. Only one study so far has assessed vertical equity in health care ranking individuals according to their need (Sutton and Lock, 2000). However, this approach had never been applied to investigate the incidence of public health expenditure. Ranking individuals by need for health care to assess vertical equity in the distribution of expenditure has allowed to assess separately horizontal and vertical equity.

The third extension of the methods used in BIA consisted in the differentiation of expenditure across districts and the association of a district specific unit cost (unit benefit) to each beneficiary. Accounting for differences in expenditure across districts allowed the separate contributions of inequities in service use and in resource allocation to inequities in the distribution of benefit to be disentangled, turning the methods used in BIA into a tool to assess equity in resource allocation. I compared the distribution of health care and the distribution of need to quantify inequity in service use, and the distribution of benefit with the distribution of health care use to quantify inequity in resource allocation. The distribution of health care use reflects the situation where resources are allocated equitably, so that each individual receive the same benefit for each single outpatient consultation, independently on their economic status. The distribution of health care across individuals ranked by economic status reflects the target set by RAFs promoting horizontal equity in health care. The distribution of health care across individuals ranked by need reflects the target set by the most conservative RAFs promoting vertical equity in RA. The idea of disentangling different components of inequity by comparing the actual distributions to a target distribution had been previously applied in the analysis of inequities in health care (Wagstaff and van Doorslaer, 2000, Sutton, 2002, Vallejo-Torres and Morris, 2013), but never to BIA.

***Assessing efficiency and understanding the role of local health authorities in the use of financial resources***

This thesis also makes the two contributions to the still limited literature on efficiency in the use of health care resources at sub-national level in LMICs.

First, in this analysis a model for panel data was applied for the first time to analyse efficiency at sub-national level in a low-income setting. Very few applications of SFA to LMICs exist, and all of these use cross sectional data (Varela et al., 2010, Kathuria and Sankar, 2005, Prachitha and Shanmugam, 2012, Kinfu, 2013). The use of panel data allows unobservable district characteristics to be controlled for, so that the bias in the estimates of the efficiency term and of the parameters associated with the explanatory variables is expected to be lower. Controlling for unobservable characteristics is particularly important in settings such as LMICs where there is lot of heterogeneity and a limited number of reliable control variable that can be used.

Second, I applied SFA in an innovative way, exploring the different and complementary roles of local HAs and health facilities in health care delivery at district level. The specific roles of those two entities were recognised and separately analysed for the first time. Previous studies had analysed administrative efficiencies in local health authorities (Giuffrida et al., 2000, Puig-Junoy and Ortún, 2004). However, their specific role in the overall process of health care delivery at the local authority level had never been considered. The results of the analysis carried out indicate indeed that HAs and HFs have specific roles in determining the efficiency of local health authorities, and that those should be recognised to avoid reaching misleading conclusions. Looking at the efficiency of the local health authorities as aggregate entities, may be misleading. First, it gives information on the average efficiency of the two processes and it does not allow to identify exactly where the inefficiency is, and second, results may not allow the effect of different inputs and environmental factors on the service delivered to be disentangled.

### *7.3.2. Contributions to knowledge and policy*

The specific contributions to the existing literature on the analysis of equity in resource allocation, on efficiency in health care delivery at local health authority level and on the effect of supply-side factors on health care utilisation were highlighted in Chapters 4, 5 and 6, respectively. In this section, I highlight what I see as three contributions to the analysis of equity in resource allocation made through the approach used in this thesis.

First, while so far equity in resource allocation had been evaluated from with respect to the distribution of public health expenditure across local health administrations, in this thesis I looked at the distribution across individuals, the ultimate beneficiaries. The major body of literature on equity in resource allocation across geographic areas has been developed following the approach of RAF. The two main limitations of the RAF approach, the lack of consideration for unmet need and for how resources are used by local purchasers and providers (Sheldon and Smith, 2000), were addressed separately in the literature and the results used to refine RAF (Bevan, 2009). On the contrary, the framework proposed in this thesis suggest a novel approach to account for demand and supply factors and the efficiency in the use of resources and at the same time offers a tool for monitoring the effects of resource allocation.

The second contribution lies in providing insights in considering the equity- efficiency trade-offs that may be associated with resource allocation, and/or with the implementation of demand and supply- side policies incentivising service utilisation. The adoption of aperspective focusing on resource allocation in the literature has precluded analysts from considering the consequences in terms of equity and efficiency based on individual health care utilization and the possible trade-off. Instead, the approach and the framework adopted here have allowed draw insights on the expected equity and efficiency outcomes associated with alternative resource allocation policies. Results have highlighted that minimal trade-offs may arise from resource allocation practices, and may be amplified or mitigated by policies incentivising service use. The equity-efficiency trade-offs in resource allocation across geographic areas had never been explicitly considered so far.

## 7.4. Limitations

The analysis carried out in this thesis presents a few limitations, most of which are related to data, as described and discussed in detail in each of the chapters. Since the limitations of each piece of analysis have been discussed in detail in the respective chapters, I present here a few broad limitations of the overall analysis, and I discuss their implications for the conclusions that can be drawn.

### *7.4.1. Narrow focus of analysis*

The analysis done in the thesis is limited to primary and secondary outpatient care, which has a number of implications for the interpretation of results. First of all, as the evidence has shown for other countries (see Chapter 2), primary and secondary outpatient care are generally more equitably distributed than inpatient and specialised care, as are resources allocated to the provision of these services. Although actual evidence is not available, the presence and concentration of hospitals in urban areas suggests that in Mozambique inpatient and specialised care are also likely to be more inequitable than primary and secondary outpatient care. Since the level of resources required, the complexity of the organization of service provision and the demand-side barriers to service use are much higher for specialised and inpatient care, the results cannot be extended to other levels of care. Still, understanding inequities and efficiency in lower level outpatient care represents an essential first step in the investigation of equity and efficiency in those health systems where a gate-keeping referral system is in place.

### *7.4.2. Limited definition of benefit*

The analysis carried out in this thesis was concerned with the allocation of financial resources and the quantity of service provided. Since the analysis is closely linked to the approach and definitions used in BIA methods, only the monetary benefit associated with health care utilisationn has been quantified, meaning that the results capture the distribution of public expenditure rather than of the broader "benefit" in terms of improved health outcomes that the population can derive from health care. Similarly the analysis of efficiency was carried out with respect to the quantity of service provided not with respect to health outcomes.

Aspects related to the quality of services provided and to the benefit in terms of health outcome which people derive from care was not taken into account. This represent a major limitation in understanding whether the resources allocated are enough to provide services of a sufficient quality to improve health outcomes.

Ignoring aspects related to the quality and effectiveness of the services provided may imply underestimating heterogeneity in health care provided and in the expected health outcome derived from its consumption. The estimates of local health authorities' efficiency and of the distribution of the service provided and of the benefit received by patients, could be underestimating heterogeneity. The responsiveness of individual demand to health care availability is likely to have been underestimated, since we can expect utilisation of care to be responsive to quality. Nevertheless, by trying to understand how financial resources translate into material resource availability this analysis made some advances and some first attempt to include considerations beyond purely monetary benefits. Indeed, the availability of staff and equipment in HFs could be considered as a very rough proxy of the quality of services delivered.

### *7.4.3. Challenges associated with the definition of need*

Two definitions of need were used, one based on proxy indicators from administrative data (gender, age and average district population health) in the equity and efficiency analysis, and one based on self-reported illness in the analysis of health care seeking. Both definitions present limitations in the extent to which they can be used to measure equity and efficiency, since they do not account for whether there is a match between the service needed and actually received by a patient; nor do they capture the quality of the services received. In fact, it is impossible to discuss if financial resources are transformed into effective service and of sufficient quality in response to populations' need, without knowing how the services provided match need. The decision to seek care ultimately depends on the expected cost and expected benefit related to it and those cannot be quantified without knowing the specificities of the illness requiring care. We may therefore expect the effect of supply-side factors on health care seeking behaviours to differ across types of illness, implying that the estimated effect of supply side factors represent an average across the population. Although the measures of need available limits the policy insights that this thesis may provide, they still serve to illustrate possible extensions of existing methods, which may be refined with better data availability.

#### ***7.4.4. Interaction between resource allocation and supply- and demand- side policies***

The framework used in this thesis to analyse resource allocation allows considering the influence of alternative policies on equity and efficiency outcomes related to different resource allocation. However the framework used in the analysis inevitably presents a simplified picture of reality. For example, it does not explicitly show the effect of health workers discretion in delivering services, which affects both the demand and supply sides, and it does not show behavioural feedback loops.

Moreover, since the policies are never defined, it is impossible to cost them and to define whether their cost should be covered by additional resources or through the same resources considered in the allocation policy. These limitations imply that no conclusion can be drawn about the relative cost-effectiveness of different policies. Nevertheless, fitting the analysis into the framework has served to clearly illustrate that resource allocation alone is not sufficient to re-dress inequities and that different type of policies may lead to diverging equity and efficiency outcomes.

#### ***7.4.5. Generalizability***

The issues analysed and discussed in this thesis are common to the public health systems of most low- and middle-income countries, and to some extent even high-income countries. However, there are specific characteristics of the Mozambique's National Health System (NHS) that should be taken into account in applying methods or conclusions to other countries.

First, the NHS is based on a structured organization with relatively well-defined processes and responsibilities covering the whole territory. This is not the case for example in "fragile states".. Second, at the time covered by this analysis, the whole public sector, including the NHS, was in the initial phase of undergoing a decentralization process. This implied that all resources were still pooled at central level and distributed across local health authorities, while almost no revenue ware locally generated and managed. Third, unlike many LMICs, user fees are very low with exemptions covering in practice the large majority of the population. In contexts where user fees represent an important source of local revenue and household out-of pocket expenditure is relatively more important, they should be explicitly accounted in the analysis of resource allocation. Fourth, at the time of the analysis the private sector was almost non-existent with the exception of a few private facilities mostly concentrated in Maputo and in the provincial capitals. In settings where there is a greater presence of the private sector, it should be included in the analysis. Fifth, international donors are prominent in the country and over 50% of health expenditure is funded through international aid. In particular, the presence of a consolidated mechanism of coordination between donors and the Ministry of Health (MoH)has contributed to the harmonization of resource allocation and contributed to channel resources towards a sustained expansion of the NHS.

## 7.5. Implications for policy

Four policy implications emerge from the overall analysis of resource allocation presented in this thesis.

### *7.5.1. Setting the equity target*

In LMICs, since worse health status and lower access to services tend to be concentrated amongst the poor, improving equity in health care is often associated with improving health care for the poor (Wagstaff et al., 2014). However, results from Chapter 4 have shown that in the case of Mozambique although need appears to be concentrated amongst the poor, there is a discrepancy between household consumption per capita and the indicator of need for health care used in the analysis. Additionally, results from Chapter 6 on the determinants of health care use and results indicate that there are two types of barriers preventing individuals from benefiting from health care expenditure. Demand and supply-side barriers to service use are different in nature, their intensity is heterogeneous across individuals and different policies may be required to address them. The discrepancy between economic and need indicators highlights how possible trade-offs between pursuing horizontal and vertical equity may arise and therefore how it is important to define the equity objectives to identify the most effective policies. Pursuing horizontal equity requires allocating resources towards areas where the poor are concentrated and using resources to address demand side barriers to service use. Pursuing vertical equity requires instead allocating resources and increasing health care availability in areas where need for health care is concentrated. Depending on the joint distribution of poverty, need and health care availability in a specific setting, a trade-off between the two policies may arise and clarifying the equity objectives may avoid unintended consequences.

Reallocating resources may influence the distribution of public health expenditure by increasing the individual benefit associated with an outpatient consultation for those individuals who currently use services. However, in settings where inequities are driven by inequities in service use, meaningful improvements towards equity can be achieved only by altering the existing patterns of health care utilisation. Re-allocating resource across geographic areas alone is not enough to re-dress inequities. What matters is how resources are spent. Either complementary policies that facilitate service utilisation among those who currently underuse service should be implemented together, or the additional resources received by the targeted areas should be invested in similar actions.

### *7.5.2. Achieving equitable improvements in service use*

Results from Chapter 6 indicate that not surprisingly both demand and supply- side barriers to service utilisation exist, in particular distance from the HF and economic constraints. The availability of health services may incentivise service use among those who live close to a HF. A combination of different supply and demand-side policies is required to increase service uptake by tackling the existing constraints to service use. Extending HF coverage emerged as a priority intervention required to increase equity in service use, since it is essential to increase access amongst the poor and needy population who are currently underserved. Not only should the number of primary HF (or they outreach activities) be increased, so that services become accessible to households within a reasonable distance, but also the number of HF providing secondary and inpatient care, so that cases can be referred. Extending HF coverage emerged as the only policy, among those considered, which may lead to an increase in both horizontal and vertical equity.

Additional policies should be set to increase health care seeking among those who are currently not using services, even when those are close and available. Two types of policies can be implemented. First, supply-side policies increasing the availability of human and physical resources in HFs, beside the obvious consequences in terms of capacity to provide effective service, may contribute to incentivise service use among those who live close to HF and can observe the quality. Second, specific policies may be required to address demand side barriers, such as lack of transport and economic barriers and increase access, particularly for the poor. Results from chapter 6 on the determinants of health care seeking behaviour, indicate the variety of existing barriers to health care use that may require interventions that go beyond the administrative responsibility of the public health sector.

### *7.5.3. Equity- efficiency trade off*

The equity and efficiency trade-off in the allocation of resources across geographic areas may arise if in those areas with higher need for health care, resources are not used efficiently to deliver health care, or if demand side barriers to service use exist.

Results from the simulation in Chapter 6 suggest that reallocating resources across geographic areas to fund the recurrent costs of existing HF does not produce changes in health care utilisation and therefore in health care delivery, unless implemented in conjunction with other policies. What could produce higher changes in service use is the concurrent extension of HF geographic coverage and the implementation of demand and supply-side policies increasing service use. If resources are re-allocated and at the same time measures to increase service utilisation and reduce unmet need for health care are implemented, equity can be pursued while increasing efficiency. In particular a combination of resource allocation towards the neediest areas, extension of HF coverage and policies addressing demand side barriers could increase horizontal and vertical equity as well as efficiency.

Results from chapters 5 and 6 also indicate that policies contributing to the socio-economic development of districts, such as increasing the availability of running water and electricity and the level of education and employment in the population, are also likely increase district administrations' and HFs' productivity as well as facilitate service use among those who need service. Social policies promoting local development are important to mitigate the potential trade-off that may arise between equity or efficiency-oriented resource allocation.

## 7.6. Areas for further research

The analysis carried out in this thesis has contributed to raise new questions related to the understanding of equity and efficiency in the allocation of resources for health care, particularly in LMICs.

First, while the analysis has shown that BIA can be used as a tool to evaluate equity in resource allocation, this approach is limited to the consideration of the monetary benefit associated with utilisation of health care services funded by different sources. Further research to measure how resource allocation influences the distribution of benefit from health care resources across the population could be implemented using new extensions of BIA. Weights could be introduced on the unit benefit to account for the efficiency of district administrations and the quality of the service provided. At the same time, more precise need indicators could be developed and the extent to which the service provided matches the need could be evaluated. Some studies have started to explore the heterogeneous response of use to need (Van de Poel et al., 2012). A similar approach could be used to account for variations in the quality of services received.

Second, the results highlighted the importance of administrative efficiency at the local health authority level. However, little is known about it. Further research could be carried out to understand the production process and its efficiency at district level by extending the variety of output, inputs and environmental factors considered and by exploring the district production function. In particular, it would be interesting to know the nature of the relationship between financial resources and efficiency. Is it sensible to allocate fewer resources to less efficient districts, or is inefficiency a sign that more resources are required for districts to function well? And if so, which type of resources? What other environmental factors and policies may catalyze district productivity? What is the effect of these factors in changes of efficiency overtime? These questions could be investigated through SFA, but also using non-parametric techniques or productivity analysis (Kumbhakar et al., 2014, Ferrier and Trivitt, 2013, Chilingerian and Sherman, 2011).

Third, further research should focus on the relative cost- effectiveness of supply and demand-side policies in influencing health care behaviour. This would require data that allow the causal impact of different policies on health care use to be estimated. For example, this can be done by simultaneously including demand and supply-side variables in the estimation of demand functions, as in Chapter 6, to understand to what extent supply and demand-side policies are complementary or substitute interventions. Exploring this relationship in an inter-temporal framework would also be relevant to get insights on the sustainability of different policies. Since such analysis may be limited by the existence of adequate data, discrete choice experiments could be used to establish the expected results of demand and/or supply-side policies (Ryan and Farrar, 2000, Ryan et al., 2008, Hanson et al., 2005, Kruk et al., 2009).

Finally, while the framework used in this thesis could be a valid tool for monitoring resource allocation and the effective use of these resources, it could be further developed as a model in which the interactions between demand and supply and the mechanisms to reach equilibrium would be clearly specified. The model would allow estimating the equity and efficiency consequences of alternative resource allocation policies, implemented alone or in conjunction with demand and supply-side policies incentivising service utilization. Computable general equilibrium models could be used to extend the framework in that direction, and allow for the introduction of policies, interactions with other markets and complex dynamics over time (Rutten and Reed, 2009, Rutten, 2004).

### 7.7. Conclusions

An equitable and efficient allocation of public health financial resources is fundamental to progress towards universal health coverage, particularly in LMIC settings where resources are limited and access to services still represents a major challenge. In this thesis I assessed the equity in the allocation and efficiency in the use of public financial resources for primary and secondary outpatient care across geographic areas in Mozambique, using data from five different routine data sources.

The analysis carried out contributes to the existing literature by contextualizing the analysis of equity in resource allocation in a broader framework that explicitly considers elements of public finance management and accounts for individual health care utilisation. This framework allows deriving insights on the equity and efficiency consequences of alternative resource allocation policies and other demand and supply-side policies incentivising service use. The perspective adopted in this thesis led to adapt in an innovative manner well-consolidated methods for equity and efficiency analysis.

While resource allocation is almost horizontally and vertically equitable in Mozambique, inequities in the distribution of public health expenditure across the population are driven by inequities in health care utilisation. Existing inequities in health care use depend on the still limited geographic coverage of HFs and on demand-side bottlenecks that constrain access for the neediest and for the poorest population. The reallocation of resources for recurrent expenditure may contribute to increase (or decrease) the availability of staff and equipment in the existing HFs and therefore the probability of seeking care among those who live close to a HF. Inefficiencies in use of financial resources and inputs for health care delivery exist at the level of local HAs and local HFs, are heterogeneous across districts and contribute to differences in the availability of staff and equipment in HFs.

RAFs can therefore influence equity through differences in the monetary benefit associated with an outpatient visits. However, inequities in the distribution of resources can be addressed only by extending the geographic coverage of the service provided and tackling demand-side bottlenecks to increase access for the neediest and for the poorest. Tackling existing administrative inefficiencies is also important to guarantee that the same financial resources translate into the same health service availability at local level. The trade-off between equity and efficiency oriented resource allocations is potentially minimal, due to the little effect on service utilization, and the implementation of complementary policies influencing service use may contribute to mitigate it. Resource allocation is a tool, whose use has to be planned within the broader health sector activities.

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# Appendices

## Authorizations to carry out the research and to use the data from Ministry of Health, National Institute of Statistics and Ministry of Planning and Development of Mozambique

Senhor Ministro da Saúde

Autorizo
16/03/12

Local

Excelência,

**Laura Anselmi**, Economista em serviço no MISAU – Direcção de Planificação e Cooperação (em regime de Assistência Técnica no Departamento de Planificação e Economia Sanitária), de nacionalidade Italiana, estando a prosseguir os seus estudos superiores - Doutoramento em Economia Sanitária, na Universidade de Londres (London School of Hygiene and Tropical Medicine), e pretendendo colher e utilizar os dados existentes no Ministério da Saúde e noutras instituições tais como o Instituto Nacional de Estatística e Ministério das Finanças, vem mui respeitosamente requerer a V.Excia., que se digne autorizar a realização da pesquisa subordinada ao tema "Equidade e Eficiência no Financiamento Público ao Sector Saúde: análise de alocação de recursos em Moçambique". Em anexo a Credencial da Unidade e o Protocolo da pesquisa, pelo que

Pede deferimento

Maputo, 13 de Março de 2012

Laura Anselmi

**London School of Hygiene & Tropical Medicine**
(University of London)

Faculty of Public Health & Policy
Department of Global Health and Policy
15-17 Tavistock Place, London, WC1H 9SH

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London, 12th of March 2012

To whom it may concern in the Ministry of Health of Mozambique

I hereby confirm that Laura Anselmi is a PhD student in the Department of Global Health and Development of the Faculty of Public Health and Policy of the London School of Hygiene and Tropical Medicine (University of London). She started her PhD in January 2011 under the joint supervision of Dr Kara Hanson and myself.

Her research is focusing on studying the equity and efficiency aspects of in public financing of the health sector. As part of her thesis, she is carrying out an in-depth analysis of secondary data already collected by Mozambican public institutions to understand how equitable and efficient is the current distribution of financial resources across geographic areas and how it would change if different criteria were applied. More details about her research plans are provided in the document attached.

During the first year of her PhD, Laura has been working on the review of the literature existing in the field and on the development of an original methodology to answer her research questions. The proposal has been evaluated by a committee that found it met the quality standards required by the LSHTM.

I believe that Laura's research will provide significant academic contributions and policy insights, since it is combining strong quantitative methodology and a knowledge of the Mozambican health system developed through her previous experience.

I know that you are familiar with Laura's hard-work and dedication in any work she does, and I trust that you believe the outputs of her work will be very useful for the Ministry. I understand that the Ministry has already shown a strong support for Laura's research ideas, for which I am very grateful. I would like to kindly ask you to provide her again with your official support, so that she can get access to the various datasets that she needs to complete her PhD.

I thank you in advance for your support and I am grateful for the renewed support you have given to Laura.

Best regards,

Dr Mylene Lagarde

À:
Senhora Directora Nacional de Planificação e Cooperação

Autorizo
31/7/12

Local

**Laura Anselmi**, estando a realizar uma pesquisa subordinada ao tema "Equidade e Eficiência no Financiamento Público ao Sector Saúde: análise de alocação de recursos em Moçambique", vem mui respeitosamente requerer a V.Excia., que se digne autorizar o uso dos seguintes dados: base de dados de financiamento público no sector da saúde por fonte de recurso e por área geográfica para o período 2007-2012 e lista das unidades sanitárias do Pais em 2007 e 2011, detalhando os recursos disponíveis, pelo que

Pede deferimento

Maputo, 25 de Julho de 2012

1656/024.9
31 07 2012

Autorizo
1. Trabalhar com Sr. Cassiano e Sr. Matavel
2.8.12

Ao

Presidente do Instituto Nacional de Estatística
Av. 24 de Julho nº 1989
Maputo

Excelência,

**Laura Anselmi**, de nacionalidade Italiana, estudante de Doutoramento em Economia Sanitária, na Universidade de Londres (London School of Hygiene and Tropical Medicine), estando a realizar uma pesquisa subordinada ao tema "Equidade e Eficiência no Financiamento Público ao Sector de Saúde: análise de alocação de recursos em Moçambique", vem mui respeitosamente requerer a V.Excia., que se digne autorizar o uso da base de dados do Inquérito sobre Orçamento Familiar 2008/2009 (questionário comunitário e questionário de agregado familiar excluindo agricultura e pecuária) e de Censo 2007 (incluindo indicadores de esperança de vida e mortalidade infantil ao nível distrital).

A pesquisa tem fins académicos e pretende apoiar a Direcção de Planificação e Cooperação do MISAU na revisão de critérios de alocação de recursos.

Em anexo a autorização do MISAU, a Credencial da Unidade e o Protocolo da pesquisa, pelo que

Tomei conhecimento
02.08.2012

Pede deferimento

Maputo, 30 de Julho de 2012

Laura Anselmi

INSTITUTO NACIONAL DE ESTATÍSTICA
GABINETE DO PRESIDENTE
Entrada nº 649 em 01/08/12
Saída nº ___ em ___/___/___
Ass. Leta Rubens

INSTITUTO NACIONAL DE ESTATÍSTICA
GABINETE DO VICE-PRESIDENTE/D
Entrada nº 61 em 01/08/12
Saída nº ___ em ___/___/___
Ass.: Célia Alage

Entrada nº 202 em 02.08.12
Saída nº ___ em ___
Ass.

V.

1. Autorizo.
2. Condições:
(a) Citar a fonte da base de dados;
(b) Não passar a base de dados a terceiros;
(c) Respeitar dados individuais, onde se aplica.
Maputo, 31 Jul. 2012

Ao

Ministério de Planificação e Desenvolvimento
Direcção Nacional de Estudos e Análise de Politicas
Av. Ahmed Sekou Touré n° 21
Maputo

**Laura Anselmi**, de nacionalidade Italiana, estudante de Doutoramento em Economia Sanitária, na Universidade de Londres (London School of Hygiene and Tropical Medicine), estando a realizar uma pesquisa subordinada ao tema "Equidade e Eficiência no Financiamento Público ao Sector Saúde: análise de alocação de recursos em Moçambique", vem mui respeitosamente requerer a V.Excia., que se digne autorizar o uso da base de dados do Inquérito sobre Orçamento Familiar 2008/2009 incluindo o indicador de consumo. Em anexo a autorização do MISAU, a Credencial da Unidade e o Protocolo da pesquisa, pelo que

Pede deferimento

Maputo, 25 de Julho de 2012

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