The impact of a mosquito net voucher subsidy programme on incremental ownership: the case of the Tanzania National Voucher Scheme

Keywords: malaria; subsidies; vouchers; targeting; Tanzania.

Abstract

The subsidisation of mosquito nets has been widely used to increase ownership in countries where malaria represents a public health problem. However, an important question that has not been addressed empirically is how far net subsidy programmes increase ownership above the level that would have prevailed in the absence of the subsidy (i.e. incremental ownership). This study addresses that gap by investigating the impact of a large-scale mosquito net voucher subsidy - the Tanzania National Voucher Scheme (TNVS) - on short-term demand for unsubsidised commercial nets, estimating a household demand model with nationally representative household survey data. The results suggest that, despite the TNVS using a categorical targeting approach that did not discriminate by wealth, it still led to a large increase in incremental ownership of mosquito nets, with limited evidence of displacement of unsubsidised sales. While no evidence is found of an additional TNVS voucher decreasing the *number* of unsubsidised sales in the same period, results indicate that an additional TNVS voucher reduced the *probability* of purchasing any unsubsidised net in the same period by 14 percent. The findings also highlight the critical role played by social learning or campaign messaging in increasing mosquito net ownership.

1. INTRODUCTION

The subsidisation of public health products (PHPs) has become a popular approach for tackling major public health concerns such as malaria. PHPs are 'commodities that are used for treatment of diseases of public health importance or for the promotion of health, which can be provided at the retail level without a "service" attached to them' (Conteh and Hanson, 2003: 1148). Examples include contraception, oral-rehydration therapy and mosquito nets.

The fundamental economic rationale for subsidising PHPs (and other products) emerges when a gap exists between actual and socially optimal levels of ownership and use of the products (e.g. Barker and Hayami, 1976). Reasons for this may include a low willingness to pay (WTP) due to lack of knowledge about the benefits of the product or credit and liquidity constraints. The rationale is further reinforced where positive externalities exists, as with PHPs that address communicable diseases (Hanson, 2004). By reducing the price consumers pay for a PHP, not only will a subsidy increase the overall quantity demanded (assuming a downward sloping demand curve), but it may help address information failures by providing recipients with an opportunity to experience the benefits of the PHP, thereby possibly increasing WTP and raising future demand (Nelson, 1970). Changes in WTP may also occur among non-recipients via social learning effects (Foster and Rosenzweig, 2010). On the other hand, however, questions remain over whether subsidising products may lead to reference dependence (anchoring) around the subsidised price (Köszegi and Rabin, 2006), causing recipients to lower their reserve price, lowering future aggregate demand.

The use of subsidies on mosquito nets has received strong support in recent years, with a large number of subsidy programmes being implemented, especially across sub-Saharan Africa (Kilian et al., 2010, Willey et al., 2012). Mosquito nets have been

around for some time though, from the 1980s, more effective insecticide-treated mosquito nets (ITNs) were developed and various entomological, efficacy and effectiveness trials have found them to be highly effective both at protecting those underneath them and in the same house and, when coverage levels are high enough, even those in the wider community (Hawley et al., 2003, Lines et al., 1987, Magesa et al., 1991, Schellenberg et al., 2001). It is now known that regular use of ITNs in Africa can reduce overall child mortality by around 20% (Lengeler, 2004) and the World Health Organisation recommends that countries at high risk use a combination of periodic campaigns of free ITN distribution and continuous distribution through multiple channels (including partially subsidised ITNs through antenatal clinics) to maintain universal coverage (WHO, 2014); an approach referred to as 'catch-up' and 'keep-up' (Roll Back Malaria, 2005).[1]

Despite the central importance of ITNs in helping to combat malaria, and widespread support for subsidising them, a number of important questions remain. One such issue concerns the extent to which mosquito net subsidy programmes lead to an increase in coverage beyond that which would have occurred in the subsidy's absence (i.e. an incremental increase), which will partly depend on how the subsidy is targeted. While a subsidy will tend to increase overall coverage by reducing the price faced by consumers, if a net purchased with a subsidy simply displaces a net that would have been purchased anyway without it, the subsidy may actually lead to fewer *new* purchases than coverage trends suggest. Such a scenario would imply a direct welfare gain to the consumer with no additional health benefit, which would also represent a

[1] Universal coverage is defined as use by more than 80% of individuals in populations at risk.

large opportunity cost in terms of the incremental increase that *could* have been achieved for the same cost, for example, through improved targeting.

Given the potentially high costs associated with displacement, this study estimates the impact of a large-scale voucher subsidy programme for mosquito nets in Tanzania on the incremental ownership of nets. In doing so, it contributes to the dearth of empirical evidence on this topic. As the following section shows, this is particularly interesting to study when subsidies are not narrowly targeted to the poorest (or those who are unlikely to purchase commercially-priced nets), as this raises the possibility of displacement effects and the question of whether alternative targeting mechanisms could have led to higher incremental coverage. This topic should be of interest to policy makers who are often challenged to show the value-added and efficiency of their policies and, as partial subsidies are likely to remain on the policy agenda, the study fills an important gap in the literature.

The following section sets out the conceptual framework. Section three then reviews the existing literature and section four sets out the methods. Section five presents the findings, which are discussed in section six along with policy implications.

2. CONCEPTUAL FRAMEWORK

As discussed in section 3.2, the focus of the analysis in this paper is on the impact of voucher subsidies provided to a certain group of individuals, which could be used as part payment for any conventional net packaged with insecticide treatment. As such, we may model the market for nets as comprising a single market with one source of supply, with demand made up of purchases with and without a voucher. Specifically, we can consider total household demand for nets in the current year (Y^T) being comprised of the quantity of unsubsidised purchases at the market rate (Qd^M) and the

quantity of subsidised purchases made with a voucher (Qd^V) (Equation 1). In Tanzania, as in other countries, there were also fully subsidised nets (i.e. free nets provided through mass campaigns or NGOs), which will affect total demand through any impacts on retail purchases with or without a voucher. While these are considered in the empirical model later, they are excluded here for the purpose of exposition.

Equation 1:

$$\boldsymbol{Y^T = Qd^M + Qd^V}$$

Unpacking the short-term impacts of the voucher subsidy, theory suggests that by lowering the price consumers pay, the receipt of a voucher subsidy might lead to three broad scenarios. First, if a voucher is given to someone for whom their marginal willingness to pay (MWTP) was already greater than the market price, p, then it may reduce demand for unsubsidised nets via a substitution or displacement effect, leading to a direct welfare transfer but no incremental increase in net ownership. Second, among those for whom their MWTP was $< p$ but $> (p - v)$, where v is the value of the voucher, they would purchase a net they otherwise would not have, meaning the subsidy leads to an incremental increase in ownership, determined by the overall price elasticity of demand. Third, there may be those for whom their MWTP was $< p$ and remains $< (p - v)$, meaning the subsidy rate was not high enough and that it does not lead to an incremental increase in net ownership.

Nets bought with a voucher may also potentially be re-sold, either on an individual basis or as part of a more systematic process. In so far as subsidised nets are re-sold at higher prices, this would effectively then reduce the likelihood of them leading to incremental increases in coverage, depending on how close to the market price they were sold for, and who they were sold to.

Empirically estimating which of the above effects dominates requires us to identify a counterfactual that can tell us about demand for unsubsidised nets among similar households that did not get a voucher. Given the focus on short-term impacts, the analysis in this paper assumes constant returns to scale and constant marginal costs. We also do not explore partial equilibrium effects which have been explored elsewhere (see below).

3. LITERATURE REVIEW

There is surprisingly limited empirical evidence on the effect mosquito net subsidies have on demand for fully priced unsubsidised nets over the short- or longer-term, though a number of studies have looked at the effect of free or partially subsidised nets on demand for *other subsidised nets*. For example, several authors investigate the interactions between mass free distribution campaigns and continuous subsidised sales in Tanzania. Gingrich et al. (2011a), Gingrich et al. (2011b) and Gingrich et al. (2014) find that free ITNs reduced the likelihood of households purchasing a commercial ITN with a subsidy voucher. For example, Gingrich et al. (2014) estimate a mass free ITN campaign reduced the number of partially subsidised nets being sold by around 34%, rising to 57% after six months. However, Renggli et al. (2011) and Eze et al. (2014) both find no evidence that mass free net campaigns in Tanzania reduced sales of subsidised commercial nets among voucher recipients. A similar finding was made by Dupas (2014) through an experiment in Kenya, which tested the effect of different levels of subsidy on the purchase of a long-lasting ITN (LLIN) one year later fixed at $2.30.[2] The study found no evidence that higher subsidies led to any greater reduction in the likelihood of purchasing a net in the future.[3]

[2] LLINs were not available in Kenya on the commercial market at the time of the study.
[3] Higher subsidies were actually associated with an increased willingness to purchase future LLINs though the effect was not statistically significant.

Among the very few studies that do look at the impact on fully priced nets, one looked at impacts of free nets on *reported* WTP and found that the ownership of a free net led to a statistically significant decrease in the demand for unsubsidised nets (Chase et al., 2009). However, reported WTP for ITNs has been shown to differ to observed WTP (Onwujekwe et al., 2005), plus the impact of free nets may well differ to the impacts of partially subsidised nets. A second study used a partial equilibrium model to simulate the effect of a partial voucher subsidy on nets in Tanzania on demand for unsubsidised nets, estimating that the increased demand for nets brought about by the subsidy crowded-out sales through increasing unsubsidised market prices (Gingrich et al., 2011a). However, while an increase in commercial prices did occur around 2008, the simulation methods used cannot prove a causal link with the subsidy programme, and other sources of potential price increases were present, such as the global oil price spike.

Overall, there is very little empirical evidence on the extent to which partially subsidising commercial nets through a large-scale on-going programme leads to changes in incremental coverage of nets. This represents an important gap given that raising incremental coverage (i.e. that beyond what would have occurred anyway) should be a key concern for policy makers as understanding a subsidy programme's effect on incremental coverage provides important information about its efficiency and appropriateness of its targeting approach.

4. METHODS

4.1 Study selection

This study uses the case of the Tanzanian National Voucher Scheme (TNVS) – which became one of the largest and most widely acclaimed mosquito net subsidy programmes in sub-Saharan Africa, pioneering the use of subsidy vouchers for scaling

up net coverage at a national scale. The TNVS is chosen as it represents an important case study for investigating the impacts of a large-scale voucher subsidy on incremental coverage, and also due to the unique availability of nationally representative household data. As details of the programme have been discussed in detail elsewhere (e.g. Gingrich et al., 2011a) only a brief overview of its key features is provided here.

The TNVS started in October 2004 and involved distributing discount vouchers to pregnant women attending antenatal care (ANC) and, from November 2006, parents of children under five attending their first measles vaccination.[4] Vouchers entitled the holder to a fixed discount on the retail price of a conventional mosquito net of their choice at participating retailers with a package of insecticide treatment, offering the holder a discount of 2750 Tanzanian Shillings (TZS) (around $US 2.50), raised to TZS 3250 (around $US 2.90) in January 2007, with any remaining cost paid by the voucher holder as a top-up.[5] This represented a subsidy of around 70-90% based on 2005-2006 net prices (Hanson et al., 2008), though increasing retail prices lowered the effective subsidy rate over time, leading programme designers to shift to a fixed price of TZS 500 for an ITN being set for voucher holders in 2009.

This study looks specifically at the period from 2004 until 2008. Analysis after 2008 is not possible due to the lack of appropriate nationally representative household survey data. While funding for the programme was suspended in 2015, data covering the period between 2004 and 2008 offer a unique opportunity to empirically investigate how far the categorical targeting of partially subsidised nets led to an incremental

[4] To improve targeting towards poorer households that could not even afford the top-up payment, an Equity Voucher was piloted in six districts in April 2007 entitling the holder to a free net, though very few vouchers were distributed and evaluations indicated it had limited effect, so was not brought to scale (Marchant et al., 2008).
[5] Figures based on an average exchange rate of TZS 1105 to US$ 1 from October 2004 to May 2006 (Oanda.com).

increase in coverage; an issue of continued relevance to this day given that the approach remains on the menu of options for policy makers and the fact that likely threats to funding for global health in the future mean targeted approaches are likely to be increasingly proposed again for LLINs. Furthermore, aside from the introduction of LLINs, overall net markets have not changed greatly since 2008 and so the results are of relevance to newer subsidy programmes.

Data from the TNVS household surveys show a clear increase in the proportion of households owning at least one net between 2005 and 2008 (Figure 1). At first glance the TNVS appears to have contributed significantly to this, along with a number of large free ITN campaigns (Figure 2). However, while overall ownership clearly appears to have increased, it is not yet clear what the effect of the TNVS was on *incremental* coverage. We see from Figure 2 that, since the TNVS began in 2004, the annual total number of nets purchased increased until 2007, driven by the increase in subsidised nets. However, at the same time, the number of *unsubsidised* net purchases declined. While a number of factors could explain this reduction in unsubsidised purchases, this study offers an insight into the extent to which partially subsidised nets may have played a role.

Figure 1

Figure 2

4.2 Data

The main data used come from the 2008 Tanzania National ITN Programme (NATNETS) household survey. The full sample of 6,918 households was selected using a two-stage cluster random sampling method. At the first stage, 24 districts were randomly sampled (stratified by zone) and at the second stage 10 wards (clusters) of 30 households in each of the districts were selected based on probability proportionate to size. Within each ward, one sub-village was selected using simple random sampling, within which households were randomly selected.

Other data sources used include retailer data from MEDA and 2002 Tanzania census data. Malaria prevalence was obtained from the Tanzania HIV/AIDS and Malaria Indicator Survey 2007-08.

In the absence of income data, we construct a wealth index using Multiple Correspondence Analysis (MCA), which is appropriate for discrete data (Howe et al., 2008).[6] The index was constructed using information on housing conditions and asset ownership including livestock, with households then split into five quintiles based on their score (Annex 1).

4.3 Empirical specification

In Equation 2, Y_{it} is the number of *unsubsidised* mosquito nets purchased by household i in the past 12 months. The key variable of interest, V_{it} is the number of TNVS vouchers received by the household in the same period. As shown in Table 1, a sizeable proportion of vouchers went unredeemed, with redemption rates declining over time. The main reason given for non-redemption in national household surveys was that the

[6] Experimentation using Principal Components Analysis suggests no substantive differences in the results.

voucher recipient had no money to pay the top-up (Hanson et al., 2006, Marchant et al., 2007, Marchant et al., 2008), though whether this reflects a lack of cash or low MWTP is unclear.

As voucher allocation was not random, those that received them may share certain characteristics that make their purchase decisions different to those of eligible non-recipients. Table 2 provides a comparison of voucher recipients and eligible non-recipients using a sub-sample of 1,626 households and shows that, in some respects, both are quite similar but that there are also small significant differences in others. For example, those that received any voucher were more likely to have heard of the subsidy programme and more likely to be headed by someone that was slightly older and that had more years of formal education. While all of these factors can be controlled for in the analysis, we cannot rule out the possibility that receipt of vouchers may also be related to unobserved differences.

In order to test whether the potential endogeneity of voucher receipt was a problem, it was tested using a control function (CF) approach (Wooldridge, 2007). First, a probit model was run estimating voucher receipt as a function of a range of exogenous variables used in the second-stage estimation, plus an instrument that satisfies the orthogonality condition of an instrumental variable. The reduced form residuals were then included in the second stage, which controls for potential endogeneity of voucher receipt and is tested through the significance of these residuals in the second stage.

As it was not possible to identify an appropriate instrument, a second broader eligible group was created to include both households with women that attended ANC, as well as those who were pregnant at interview, in the past 12 months, or had a child in the last 12 months. It was then possible to use whether the household had attended ANC as

the instrument, which is necessarily correlated with voucher receipt but is not expected to lead to an independent increase in Y^M_{it} except through individuals receiving a voucher (satisfying the exclusion restriction). Receiving a voucher in itself would unlikely lead to an unsubsidised purchase as the household could purchase one at a lower price with the voucher and mosquito nets were well established in Tanzania at the time. As expected, the instrument in an OLS regression explaining V_{it} is highly statistically significant (p=0.02) but is highly insignificant in explaining Y^M_{it} (p=0.56), suggesting it has no independent effect on Y^M_{it}.

Table 1

Other key factors likely to explain demand for unsubsidised nets include the number of free nets obtained by the household in the past 12 months (Y^F_{it}) and the existing stock of nets (13 months ago or longer) (Y^T_{it-1}), for which we would expect a negative relationship. The literature on demand for mosquito nets in sub-Saharan Africa also

suggests the importance of a number of other covariates at the household and local level (X_{it}), which are also included in the model (see Table 2) (Carneiro et al., 2012, Chase et al., 2009, Poulos et al., 2006).

Equation 2:

$$\boldsymbol{Y_{it}^{M} = \alpha + \beta V_{it} + \beta Y_{it}^{F} + \beta Y_{it-1}^{T} + \gamma X_{it} + e_{it}}$$

Table 2

It turns out that for around 84 percent of households Y_{it} equals zero while 12 percent Y_{it} equals one (Annex 2). As such, as well as estimating Equation 2 using OLS, a probit model is also estimated.

There is some evidence of diversion in the TNVS after the period of study through voucher fraud (MEDA, 2010, NMCP, 2014) and tracking studies prior to 2008 estimate that around 10% of distributed vouchers sampled were likely acquired by ineligible recipients who could not be tracked (Nathan et al., 2007, Nathan et al., 2008). One cannot rule out the possibility that some eligible recipients may have even resold their nets at commercial or near commercial prices. However, it is impossible to determine what proportion of subsidised nets were truly re-sold or whether any secondary buyers would have bought a full price net anyway and indicate any systematic bias.

5. RESULTS

The main results from the various models are presented in Table 3. As can be seen from the results for model one, the test for endogeneity of V_{it} (the coefficient against the residuals from the first stage reduced form equation) suggests that we cannot reject the null hypothesis of V_{it} being exogenous. It may simply be that accounting for the observed differences between voucher recipients and the comparison group was sufficient. We therefore prefer the results from the other models.

Looking at these, and heterogeneity analysis carried out on them by wealth quintile (Table 4), there are four main findings. Firstly, it can be seen that the receipt of TNVS vouchers appears to have had very little effect on the number of unsubsidised nets purchased, though, the probit results indicate that each additional TNVS voucher decreases the *probability* of purchasing any unsubsidised net by approximately seven

percentage points, which translates into a reduction of around 14 percent compared to the baseline mean number of unsubsidised mosquito nets owned.

Secondly, the displacement effect appears to be greater among wealthier voucher recipients based on the OLS estimates, though the results are only marginally significant ($p<0.10$) (Table 4). This may be due to the small sample size. As results from Table 4 show though, the magnitude of effect is in the region of four times greater among the wealthiest voucher recipients compared to the full sample effect in the OLS model.

Thirdly, despite the small displacement effect among voucher recipients, the highly significant positive signs against the variable for whether the household had heard of the pregnant woman voucher indicates that simply having heard of the subsidy appears to have led to households purchasing a higher number of unsubsidised nets (consistent with Dupas, 2014). This result is robust across all models, with the estimate from the probit model indicating a significant positive increase in the probability of purchasing an unsubsidised net of 10 percentage points; a 19 percent increase against the baseline average.

Fourthly, the receipt of *free* nets during the past 12 months is not associated negatively with unsubsidised purchases (consistent with Renggli et al., 2011 and Eze et al., 2014).

Most of the other variables are of the expected sign, with the exception of district average net prices being significantly but positively related to unsubsidised purchases. However, the effect size is less than 0.0001 and this may be due to imprecise measurement.

Table 3

Table 4

6. DISCUSSION

6.1 Limitations

Before discussing the results, the following main limitations should be noted. First, the allocation of subsidy vouchers was not random and opens up the possibility of selection bias. To address potential endogeneity of voucher receipt, the study controlled for a wide range of covariates and adopted a control function approach. Although the control function itself could only be run using a broader comparison group, the results did not indicate any clear endogeneity. Second, our dependence on a single cross-section of data may limit the efficiency of the estimates compared to if panel data were available, and restrict the ability to account for unobserved heterogeneity. Third, the results presented do not account for the effect any potential re-sale of subsidised nets may have had on incremental ownership of nets. However, as mentioned, the extent of secondary markets is expected to be relatively small and any resale at below market rates could have led to either incremental increases or displacement and so no systematic bias is anticipated. Lastly, the analysis does not differentiate between whether any unsubsidised nets purchased were conventional, bundled with insecticide, or ITNs meaning we cannot explore which type of net the observed impacts of vouchers or free nets relate to, though ITN ownership was still below 50 percent by 2008 in part due to higher prices.

6.2 Discussion and policy implications

Overall, the results from the regression analysis combined with the earlier data on overall net sales suggests that the TNVS has played a crucially important role in increasing incremental net ownership. This suggests that the reduction in unsubsidised purchases shown in Figure 2 may well have arisen due to other factors, not least the

rising price of nets, which was likely due in part to the global oil price spike at the time.[7] The low levels of displacement are perhaps not too surprising given the increasing retail price of ITNs (which would lead to lower unsubsidised sales in the comparison group). This highlights the crucial point that governments that introduce PHP subsidy programmes must not see it as a substitute for also trying to reduce or at least stabilise commercial prices. Otherwise, higher prices will end up costing the government in the form of higher subsidies and mean that those would have previously purchased an unsubsidised PHP may also then require a subsidy to maintain coverage.

The results of the heterogeneity analysis are consistent with neoclassical consumer theory when we see that displacement appears to mostly occur among the wealthiest households, who are also more likely and better able to purchase a full price net in the absence of the subsidy. However, the fact that the TNVS still led to an incremental increase in coverage among these wealthiest households (Table 4) suggests that a narrower poverty-targeted approach (e.g. using a proxy means-test) rather than the categorical approach would likely not have been more cost-effective in terms of raising incremental coverage. Reasons for this include the fact that the TNVS approach maximised coverage by targeting pregnant women who were expected to sleep under the net with their children, the higher costs associated with proxy mean-test targeting (e.g. Devereux et al., 2015), and the fact that the level of subsidy would have had to be further increased to raise incremental coverage among some of the poorest who did not even redeem their voucher (section 4.3).

Another main finding in the results was that the TNVS may have led to increasing unsubsidised purchases through a form of social learning effect in that those who had

[7] Interview with senior NATNETS official.

heard of pregnant women vouchers were more likely to purchase an unsubsidised net. This finding is consistent with Dupas (2014), who found that households were more likely to purchase an ITN when the density of households around them that received a subsidised net was greater. The finding is also consistent with the view of a senior NATNETS official, interviewed before the analysis, who highlighted that a key aspect of Tanzania's successful experience had been the on-going communications and marketing throughout society, including the role of politicians advertising the importance of nets in the media. While marketing and communications alone are unlikely to be able to rapidly and substantially increase the ownership of PHPs in contexts where the market price remains high, the finding does lend support to the idea that marketing and communications should form a key part of PHP subsidy interventions, as has been traditional in social marketing programmes for many years.

Lastly, the differential effects of receiving vouchers for partially subsidised nets versus free nets appears to suggest an important distinction which has so far not been drawn out in the literature on mosquito net subsidies. That is, while partially subsidised nets will affect the beneficiary's budget constraint, free nets generally will not, resulting in an increased ability and perhaps higher marginal willingness to pay compared to if the household has to pay even a subsidised price. The findings are in line with a number of other studies (Dupas, 2014, Eze et al., 2014, Renggli et al., 2011) and indicate that free nets should also be considered to play a role in malaria reduction strategies, at least as a complementary measure to partially subsidised mosquito nets.

6.3 Conclusion

This study set out to investigate the effect that a partial subsidy programme for mosquito nets had on incremental ownership of unsubsidised nets. Using the case of the TNVS, the study estimated the effect at the household level using national

household survey data and found no evidence of subsidy vouchers decreasing the *number* of unsubsidised nets purchased, but a small and significant reduction in the probability of purchasing *any* unsubsidised net. The displacement effect appears to be greater among wealthier households, though the high levels of incremental ownership even among these wealthiest households suggests that the additional benefits in terms of incremental coverage from a means-based targeting approach would not exceed the high additional costs of such a targeting approach. The results were also robust in suggesting that simply having heard of the TNVS may have led to higher unsubsidised purchases through a social learning or programme messaging effect. Further research is now needed to unpack the potential longer-term dynamic impacts that large programmes such as the TNVS may have on the private sector and market prices.

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FIGURES

Figure 1

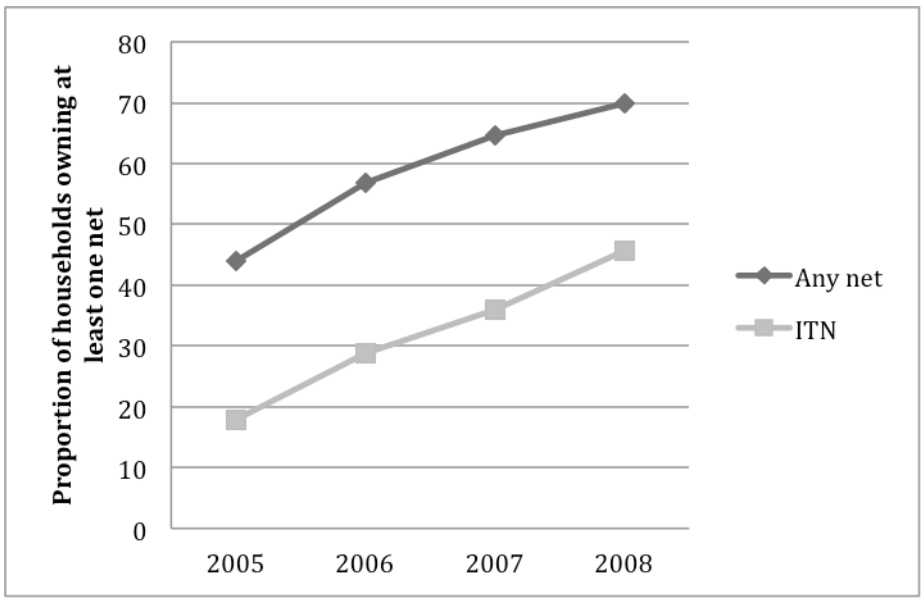
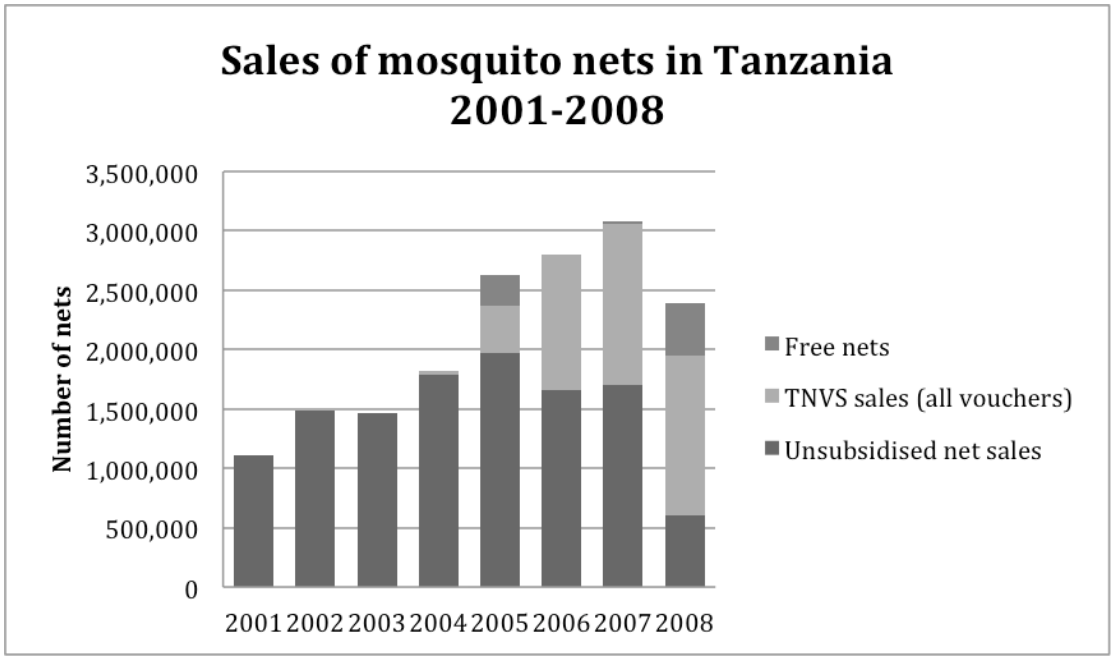


Figure 2



TABLES

Table 1: Distribution and redemption rate of TNVS vouchers (July 2005 to March 2009)

	Pregnant women vouchers			**Infant vouchers**		
Period	Distributed	Redeemed	Rate	Distributed	Redeemed	Rate
July 2005 to March 2006	339,750	275,473	81%			
April 2006 to March 2007	1,203,900	996,436	83%			
April 2007 to March 2008	1,358,075	972,921	72%	472,025	309,166	65%
April 2008 to March 2009	916,334	547,860	60%	525,525	295,807	56%

Source: National Insecticide-Treated Nets Programme (NATNETS) data sheets. Note: Infant vouchers were available from November 2006, though it takes some time for stubs and vouchers to be returned (by clinics and retailers respectively) and then counted.

Table 2: Comparison of voucher recipient and non-recipient households

Variable	(1) Non-receipt of voucher (n=774)	Standard error	(2) Receipt of at least one voucher (n=852)	Standard error	t-stat for difference between (1) and (2)
# of unsubsidised nets purchased in 12 months prior to interview	0.25	0.02	0.21	0.02	1.12
# of free nets received during 12 months prior to interview	0.04	0.01	0.02	0.01	1.37
# of nets purchased from other sources during 12 months prior to interview	0.01	0.01	0.01	0.00	0.86
Total # of nets owned 13 months prior to interview	0.67	0.03	0.83	0.03	-3.26***
Respondent heard of TNVS pregnant women vouchers	0.77	0.02	0.91	0.01	-8.02***
Respondent heard of TNVS infant vouchers	0.41	0.02	0.55	0.02	-5.84***
Weighted district median price of a 4x6x7 bundled net (TZS)	3110	12.03	3150	11.03	-2.48***
Participating retailer to population ratio (x 10,000)	1.41	0.02	1.47	0.02	-1.74*
Percentage of children (6-59 months) testing positive for malaria in the region	19.70	0.51	19.54	0.47	0.22
Rural household	0.67	0.02	0.65	0.02	0.87
Semi-urban household	0.26	0.02	0.27	0.02	-0.56
Urban household	0.07	0.01	0.08	0.01	-0.62
Quintile 1	0.22	0.02	0.21	0.01	0.89
Quintile 2	0.24	0.01	0.19	0.01	2.22**
Quintile 3	0.22	0.01	0.23	0.01	-0.09
Quintile 4	0.17	0.01	0.20	0.01	-1.70*
Quintile 5 (wealthiest)	0.14	0.01	0.17	0.01	-1.59
Household size	6.08	0.09	6.07	0.10	0.08
# of children in household 2 years old or younger	1.25	0.03	1.20	0.03	1.31
# of people in household 50 years old or over	0.31	0.02	0.35	0.02	-1.31
# of women in household aged 15 to 49	1.3	0.03	1.4	0.02	-0.47
Female headed household	0.16	0.01	0.16	0.01	0.22
Age of household head	37.4	0.57	39.0	0.53	-2.09**
Household head employed in professional role or business	0.10	0.01	0.13	0.01	-2.23**
Household head has no formal education	0.23	0.02	0.19	0.01	2.28**
Household head has 1-7 years education	0.15	0.01	0.13	0.01	1.36
Household head has 8 + years education	0.61	0.02	0.68	0.02	-2.93***

Notes: Comparison group represents eligible households that met the conditions to receive a voucher but did not receive one. ***, ** & * denote statistical significance at the 1%, 5% and 10% level.

Table 3: Estimates for number of unsubsidised nets purchased in past 12 months

	(1) CF	(2) OLS	(4) Probit
# of TNVS vouchers received during past 12 months	-0.315	-0.0541	-0.0722**
	(0.239)	(0.0399)	(0.0344)
Residuals from reduced form (CF) estimate	0.275		
	(0.251)		
Respondent heard of TNVS pregnant women vouchers	0.269***	0.207**	0.100**
	(0.101)	(0.0888)	(0.0463)
Respondent heard of TNVS infant vouchers	0.00103	-0.0370	-0.0310
	(0.0726)	(0.0780)	(0.0559)
# of free nets received during past 12m	0.495	0.599	0.0957
	(0.356)	(0.405)	(0.0647)
# of nets purchased during past 12m (other sources)	0.310	0.267	0.141**
	(0.204)	(0.202)	(0.0676)
Total # of nets owned 13 months prior to interview	-0.0988**	-0.110**	-0.0479*
	(0.0396)	(0.0506)	(0.0255)
Weighted district median price of a 4x6x7 bundled net (TZS)	0.000203	0.000295**	0.000245***
	(0.000135)	(0.000135)	(7.47e-05)
% children (6-59m) in region tested positive for malaria	-0.000885	-0.00107	0.000482
	(0.00232)	(0.00237)	(0.00144)
Rural household	0.258*	0.389***	0.256***
	(0.139)	(0.140)	(0.0864)
Semi-urban household	0.310**	0.435***	0.297***
	(0.154)	(0.140)	(0.109)
Quintile 2	0.0196	0.0740	0.0141
	(0.0730)	(0.0815)	(0.0589)
Quintile 3	-0.0281	0.0116	-0.0110
	(0.0677)	(0.0670)	(0.0616)
Quintile 4	0.0576	0.0678	0.0494
	(0.0961)	(0.0935)	(0.0706)
Quintile 5 (wealthiest)	0.351***	0.398**	0.266***
	(0.132)	(0.174)	(0.0822)
Household head has 1-7 years education	0.0506	0.230*	0.0698
	(0.102)	(0.137)	(0.0665)
Household head had 8 + years education	0.0607	0.126*	0.107**
	(0.0617)	(0.0682)	(0.0447)
Household size	0.0205	0.0111	-0.00532
	(0.0158)	(0.0183)	(0.0102)
Household head employed in professional role	0.0400	0.0571	0.0693
	(0.0651)	(0.105)	(0.0959)
Household head is 50 years or older	0.474**	0.605***	0.291**
	(0.225)	(0.226)	(0.122)
Household head is 30 to 49 years old	0.123	0.0815	0.142**
	(0.0808)	(0.0725)	(0.0633)
Household head is 22 to 29 years old	0.157*	0.0477	0.0713
	(0.0934)	(0.0597)	(0.0672)
Female headed household	0.0260	0.0152	-0.0117
	(0.0830)	(0.0943)	(0.0665)
# of women in household aged 15 to 49	0.0337	0.0206	-0.0305
	(0.0547)	(0.0700)	(0.0377)
# of people in household 50 years old or over	-0.0503	-0.112	0.0350
	(0.106)	(0.144)	(0.0736)
# of children in household 2 years old or younger	0.0488	0.0629	0.0811***
	(0.0425)	(0.0435)	(0.0297)
Participating retailer to population ratio (x 10,000)	-0.0299	-0.0758	-0.0626
	(0.0634)	(0.0674)	(0.0394)
Constant	-1.162**	-1.549***	
	(0.470)	(0.414)	
Mean outcome variable at 'baseline' (≥ 13months ago)	0.52	0.52	0.52
Observations	**1,987**	**1,626**	**1,626**
R-squared	**0.20**	**0.10**	

***, **, * denotes significance at 1%, 5% or 10%. Probit results are marginal effects. Baseline value of dependent variable is mean number of ITNs owned across sample 13 months ago.

Table 4: Sub-population analysis of voucher effect by wealth quintile

	Overall	Quintile 1 (least wealthy)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (wealthiest)
OLS estimate	-.05717**	0.0559	0.0582	-0.0299	0.112	-0.220*
Standard error	(0.025)	(0.060)	(0.045)	(0.057)	(0.071)	(0.130)
Mean outcome variable at 'baseline' (13 months ago or longer)	0.52	0.37	0.30	0.45	0.43	0.72

Subpopulation estimates calculated using full sample of 1,626 observations. ***, ** and * denote statistical significant at the 1%, 5% and 10% significance level. Note that baseline value of dependent variable is mean number of nets owned across sample 13 months ago.

ANNEXES

Annex 1: Summary of variables used for Multiple Correspondence Analysis

Category	Variable	Dimension 1 score	Mean	Standard deviation
Toilet	No toilet	-1.027	0.11	0.32
	Pit latrine	-0.206	0.83	0.37
	Flush toilet	5.128	0.06	0.23
	Rents the house	2.559	0.09	0.29
Water	Piped / external water	2.257	0.16	0.37
	Public tab	0.555	0.24	0.43
	Well / hole / spring	-0.903	0.42	0.49
	Surface water	-0.817	0.17	0.37
Fuel	Uses charcoal	3.647	0.15	0.36
	Uses firewood / dung	-0.710	0.84	0.37
Housing	Rudimentary or finished floor	2.486	0.17	0.37
	Iron sheet or tiled roof	0.817	0.58	0.49
	Has electricity	4.329	0.12	0.32
Assets	Owns a fridge	5.913	0.05	0.21
	Owns a TV	4.907	0.09	0.28
	Owns a radio	0.361	0.67	0.47
	Owns a bicycle	-0.111	0.45	0.50
	Owns a mobile	1.524	0.36	0.48
Livestock	Owns ducks or chickens	-0.431	0.62	0.49
	Owns other animals (e.g. goats, sheep or cattle)	-0.519	0.40	0.49

Means calculated on full sample. First dimension accounts for 75.68% of inertia.

Annex 2: Cross tabulation of number of unsubsidised net purchases and TNVS vouchers received during the past 12 months

	TNVS vouchers					
Unsubsidised nets	**0**	**1**	**2**	**3**	**4**	**Total**
0	641	654	61	4	1	1,361
1	94	89	11	0	0	194
2	28	23	2	0	0	53
3	5	3	0	0	0	8
4	5	1	0	0	0	6
5	1	1	0	0	0	2
6	0	2	0	0	0	2
Total	**774**	**773**	**74**	**4**	**1**	**1,626**