Decentralization and Efficiency of Subsidy Targeting: Evidence from Chiefs in Rural Malawi*

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Abstract

A substantial share of the national budget in developing countries goes towards subsidies for the needy. The two most common methods to identify beneficiaries are a rule-based allocation relying on a proxy-means test (PMT) or a decentralized allocation in which a local leader selects beneficiaries. A decentralized allocation may offer informational or accountability advantages, but may be prone to elite capture. We study this tradeoff in the context of two large-scale subsidy programs (one for agricultural inputs and one for food) in Malawi, both of which were decentralized to traditional leaders or "chiefs". We find that chiefs are more likely to channel subsidies to relatives, but that chiefs target needy households (as proxied by consumption) nearly as well as (or, not much worse than) even a perfectly respected PMT. They mistarget the input subsidy somewhat more. Results from a model-based test are consistent with chiefs taking into consideration productive efficiency when identifying beneficiaries for input subsidies. This suggests that some of the poverty-mistargeting observed among chiefs could be welfare improving, since within-village redistribution is common.

JEL Codes: I38, O12, Q12, D73

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1 Introduction

Targeting programs such as subsidies or cash transfers to needy households is an important part of what governments do. To do this effectively, the first step is to correctly identify who should be eligible – who is truly needy. This is difficult in developing countries where government infrastructure and information technology is limited (particularly in rural areas). Governments typically have the choice to administer such selection of eligibles centrally, or to decentralize authority to local leaders.[1] As has been developed in a rich theoretical literature (Bardhan and Mookherjee 2000, 2005; Bardhan, 2002; Niehaus et al., 2013), decentralization has two main benefits. There may be an informational advantage: when most individuals do not file a tax return, local leaders may have more information on the relative neediness of individuals in their constituency than a centralized bureaucracy. Decentralization may also increase accountability, if local leaders face reelection or reputation incentives. However, decentralization also has the potentially substantial cost of opening the door for local capture, e.g. local leaders securing the benefits for their kin or supporters rather than based on need.

This paper uses rich panel data to explore this fundamental trade-off in the context of two subsidy programs in Malawi – the well-known farming input subsidy program and a one-time drought relief food aid program. Both programs were targeted at the poorest Malawians and both were decentralized to local traditional leaders, called chiefs. Unlike other settings where local leaders face re-election incentives (as in Bardhan and Mookherjee 2006 and Alatas et al. 2013) the position of chief in Malawi is hereditary and chiefs face fairly weak oversight. We ask two main questions in this paper. First, how well do chiefs target in terms of true underlying need, and could a centralized allocation do better? Second, do chiefs take into account productive efficiency when allocating farming inputs? Specifically, do they have an informational advantage regarding the distribution of returns to subsidized inputs and do they act on it? This is of interest because allocating based on productive efficiency could lead to pareto gains in the presence of *ex post* transfers within the village.

Assessing the relative effectiveness of chiefs in terms of need-based (poverty) targeting requires several important pieces of data. First, we must establish a benchmark with which to compare the observed allocation. To this end, we construct a counterfactual, centralized allocation based upon a proxy-means test (PMT). Second, we need to construct a measure of true "need." We follow Alatas et al. (2011, 2013) and use observed food expenditures in the immediate pre-subsidy period as our measure of consumption. To implement this empirically, we make use of unusually rich panel data collected from a sample of 1,387

[1] See Coady et al. (2004) for a detailed discussion of various forms of targeting.

households over four survey rounds in 2011-2013.[2] Critically, this data includes information on subsidy receipt, a host of background characteristics including assets at baseline (which form the basis for the hypothetical PMT allocation), and detailed expenditures modules in each survey round.

We find evidence of poverty-mistargeting for both types of subsidies considered: about 14% of people who should have qualified for an input subsidy based on consumption do not ultimately receive the subsidy, and 17% of those who should have qualified for the food subsidy do not get it. However, we find strong evidence that chiefs do target needy households: chiefs consistently perform better than a random allocation would have. Consistent with a prior literature, we find that chiefs target subsides to relatives – exclusion errors are substantially lower, and inclusion errors higher, among villagers related to the chief: even after controlling for observables, chief kins are 8 percentage points less likely to be wrongly excluded and 14 percentage points more likely to be wrongly included than non-kins when it comes to the food subsidy. In aggregate, a centralized PMT would perform only marginally better, however – this is because assets are poor predictors of consumption, in our data as in many rural settings in developing countries. The fact that our counterfactual PMT allocation would not reduce the error rate very substantially is striking since we consider somewhat of a "best-case" PMT: indeed, we assume perfect compliance with the allocation rule, ignoring potential implementation issues; what's more, our PMT formula is based on data that predates the consumption and subsidy allocation measures by only a year, while any actual PMT allocation rule would likely rely on older data in most years (since measuring household-held assets, a key component of the PMT formula, is costly, especially once households know their eligibility depends on their survey responses). Thus the fact that chiefs appear to target reasonably close to this ideal counterfactual PMT allocation is another data point in favor of relatively good targeting, along with Galasso and Ravallion (2005) for the food-for-education program in Bangladesh, Bardhan and Mookherjee (2006) for credit and farming input subsidies in West Bengal, and Alatas et al. (2013) for government benefits in Indonesia. It however contrasts with earlier papers on the Malawi input subsidy program, which, because of their reliance on assets as a proxy for need, heavily criticized the program for being poorly targeted (Dorward et al. 2008, 2013; Kilic et al. 2013).

The second contribution of our paper is to assess whether part of the poverty-mistargeting of farming subsidies by chiefs is driven by productive efficiency considerations. Because individual returns to fertilizer subsidies are unobserved, we cannot directly test for targeting based on these returns. Instead, we develop a model of subsidy allocation in which we allow the welfare weights to vary across households types (chief's kin vs. non-kin) and show that

[2]As discussed below, the panel data was collected as part of a separate study – Dupas et al. (2015).

we can back out the relative importance of productivity considerations in the chief's objective function by exploiting the wedge between how food and fertilizer subsidies were allocated within a village. Specifically, we can use the food subsidy allocation to back out relative welfare weights, and given those, any further differences in fertilizer subsidy allocations across types of households should reflect differences in productivity, if productivity is a consideration. We exploit across-village variation in the relative productivity of kins vs. non-kins to test the predictions of the model. Overall, the allocation patterns observed are consistent with chiefs taking productive efficiency into consideration when allocating farming input subsidies, and the more so the greater the degree of income pooling that can be achieved. We conclude from this evidence that chiefs deviate from the official poverty targeting rule in part to use the input subsidies as a growth instrument, bringing their village closer to the production possibility frontier.

Our paper makes several contributions to the literature. First, it is one of only a handful of papers to study targeting efficiency rigorously. Another notable example is Bardhan and Mookherjee (2006), who examine the targeting efficiency of several government programs in West Bengal. They find high overall targeting efficiency, and little evidence of elite capture. An important difference between that paper and ours is that their measure of efficiency is whether households with low assets (for example land) received the transfer; as discussed above, we find here that such assets are important but noisy predictors of consumption. Two closely related papers are Alatas et al. (2012) and Alatas et al. (2014). Alatas et al. (2012) conduct an RCT to compare PMT targeting to community targeting (where community members jointly decide on the allocation at a meeting), and find a small but significant effect in favor of the PMT in terms of targeting those poorest by consumption measures. Alatas et al. (2014) examine several government programs in Indonesia. The identification of beneficiaries in these programs differs somewhat from our context in that they involve some identification of people through asset surveys or other poverty identification, whereas the program we study in Malawi is entirely delegated to local leaders. They find that elite capture is present but minimal (in the sense that elites are more likely to receive the program but the overall welfare effect of this is small since elites are not much better off than non-elites and make up a small share of the population). However, they find that a PMT would do significantly better than the true allocation, and this gap is less pronounced in our data. This is likely due to the fact that assets and other characteristics are a much better predictor of consumption in their context (Indonesia) than ours: the R-squared from a regression of consumption on assets, household demographics and occupation is 0.48 in Alatas et al. (2012) vs. 0.2 in our data as well as in two other datasets we collected from rural areas of East Africa.

Second, we contribute to the literature on the role of traditional authorities in African development. While survey evidence from the Afrobarometer suggests that traditional leaders are perceived to regulate important aspects of the local economy in numerous African countries (Logan, 2011; Michalopoulos and Papaioannou, 2014), the question of whether their existence undermines or palliates weak governance is still unsettled. In a recent contribution, Acemoglu et al. (2014) find that areas of Sierra Leone where competition among potential chieftaincy heirs was low during and after British colonial rule have significantly worse development outcomes today, but higher levels of respect for traditional authorities. They hypothesize that this reflects the ability of uncontested traditional ruling families to simultaneously capture resources and civil society organizations. Our evidence from Malawi, where traditional leaders are uncontested but appear to target subsidies possibly more efficiently than a centralized allocation would, mitigates this view.

The layout of the paper is as follows. Section 2 presents some background on the Malawian local governance structure and decentralized subsidy programs. Section 3 discusses the sample and data. Section 4 presents motivating evidence on poverty-based (mis)targeting. Section 5 presents the model and tests for productive efficiency in targeting. Section 6 concludes.

2 Institutional Background

2.1 Local governance in Malawi and the role of chiefs

Malawi is a presidential democracy with a single federal legislative body (parliament) at the national level. At the sub-national level, Malawi is divided into 28 districts each administered by a District Assembly under the direction of a District Commissioner appointed by the President. This local government coexists with a traditional chieftaincy hierarchy. Within the chieftancy hierarchy there are four ranks: Paramount Chief, Traditional Authority (TA), Group Village Headman (GVH), and Village Headman (also known as village chief). In our data, TAs have authority over areas smaller than a district. They oversee from 10 to 45 GVHs, and GVHs oversee between 2 and 10 villages.[3]

[3]A brief history of the coexistence of these two systems of local governance is as follows (this note relies heavily on Lihoma (2012), Eggen (2011) and Cammack et al. (2007)). Prior to colonialism, local government structures in Malawi varied across ethnic groups. Most of the local governments included chiefs, but their role varied between centralized systems in which the chief's authority was recognized as paramount and more decentralized systems that were more participatory (Lihoma, 2012). Malawi was colonized by Britain under the Nyasaland Districts Protectorate in 1891. In the first few decades of British rule, Britain initially attempted a system of direct rule, removing or subjugating more powerful chiefs and enlisting more minor ones into colonial activities such as tax collection. In 1912, Britain moved towards a system of indirect rule which recognized chiefs as traditional authorities, reporting to the colonial district administrator. In

District Assemblies consist of a combination of democratically elected councilors and members of parliament (elected for 5-year terms), together with ex-officio, non-voting members including higher-ranked chiefs (TAs). District Assemblies are led by a chairperson elected among their members (Local Government Act 1998, Section 5). In general, District Assemblies do not have much authority. They have a limited ability to generate revenue from taxes and other fees[4] and therefore rely primarily on resources from the central government. However, transfers from the central government have been limited and councillors have de facto very few resources available.[5] Due in part to these problems, the functioning of local assemblies has been problematic. Most notably, local assembly elections were not held between 2000 and 2014 (such that local councils were not seated from 2005-2014).[6]

Modern chiefs in Malawi therefore hold little formal power: officially they serve only as non-voting advisory members of Assemblies, which themselves hold little authority. They do not have direct control over any public funds and are not allowed to raise local taxes. However, chiefs hold other customary responsibilities. The 1998 Decentralisation Policy and Local Government Act recognised the rights of chiefs to allocate communal land and adjudicate matters related to customary law (in particular customary land). Chiefs also play an advisory and coordination role regarding local development projects: local development funds are in principle spent through groups known as Area Development Committees (headed by TAs) and Village Development Committees (chaired by Group Village Headmen and composed of ward councilors, MPs, religious leaders, business leaders and youth and women representatives). Finally, and this is the focus of this paper, chiefs are typically relied on to identify beneficiaries for targeted government programs.

Traditional leadership positions are hereditary. Chiefs who pass away are replaced by

1933, traditional powers were extended such that chiefs could perform some rules of local government (such as administering communal land and arbitrating disputes in traditional courts), though chiefs were still financially dependent on colonial administrators. Beginning in 1953 and continuing until independence in 1964, the British transferred local authority from chiefs to district councils. While higher-ranked chiefs (TAs) served as ex-officio members of these councils, their powers to act unilaterally were limited (and were officially subordinate to the council itself). Under the one-party system that prevailed from independence through 1993, councilors were appointed by the cental government and benefited from little popular support. After the introduction of multi-party democracy in 1994, Malawi underwent a decentralization process. District Councils and District Administrations were merged into District Assemblies, which became the local governing body (Hussein 2005).

[4]Local revenue generation includes city and town fees, licensing of businesses and properties, market fees, and other fees and charges (Chirwa 2014)

[5]The Decentralisation Policy and Local Government Act of 1998 allowed the government to transfer 5% of the national revenue to District Assemblies, but in practice the sums transferred are smaller and not allocated equitably across districts (Patel et al. 2007).

[6]For the District Assemblies to continue working without the councilors, the Parliament imposed an amendment to Section 5 in the Local Government Act in 2010 that gave voting power to MPs in the assembly, while chiefs remained as non-voting members (Chasukwa et. al 2014).

someone from the chieftaincy clan. In patrilineal communities, such as in the northern part of the country, the chieftancy is inherited from father to son, while in matrilineal communities, like in the southern and central parts of the country, where our data comes from, the chieftancy is inherited from maternal uncle to nephews (so the first son of the first sister inherits the right to the position) (Chirwa 2014). There are some female chiefs, but they are often seen as "holding the place for a brother" (Peters 2010).

Chiefs are paid a salary by the government that is known as *mswahala*, but it is fairly small.[7] Chiefs do occasionally charge fees to villagers (in our sample, 44 percent of villagers report having ever made a payment to the village chief). Interestingly, chiefs are favorably viewed by the majority of the Malawian population. In 2008-2009, 74% of Afrobarometer respondents in Malawi perceived traditional leaders as having "some" or "a great deal" of influence, and 71% thought the amount of influence traditional leaders have in governing the local community should increase – for comparison, the average across 19 countries for these two questions were both 50% (Logan, 2011). Possibly as a result of this high popularity, chiefs appear able to influence local villagers on whom to support in general elections and local government elections (Patel et al., 2007), an influence that may limit their accountability to elected representatives.

2.2 Subsidy Programs

2.2.1 Fertilizer Subsidy Program

Malawi's Farming and Agricultural Input Subsidy Program (FISP) is one of the largest fertilizer and seed subsidy programs in the world.[8] Though the program has existed since 1998, it greatly expanded after a drought in 2004 and has steadily increased in size since then. In 2012-13, the program reached 4.4 million recipients and took up 10-15% of the government's budget (Dorward et. al 2013, Baltzer and Hansen 2011). In our data, the percentage of people receiving subsidies has increased steadily over time, from 63% in 2008 to 82% in 2012.

The subsidy program covers several inputs and comes in the form of vouchers, which are redeemable at a local agricultural shop in exchange for the item. The vouchers are indivisible. The four most popular subsidies in our study period were for planting fertilizer (a 50 kilogram

[7] As of 2014, a village chief in Malawi received 2,500 MWK per month as *mswahala*, around a week's worth of labor at the prevailing casual wage.

[8] Fertilizer subsidies are one of the more popular (and expensive) aid programs across the developing world, in some cases taking up significant fractions of government budgets. For example, Sri Lanka, Malawi and India spend 10-20% of their government's budget on fertilizer subsidies (Wiggins and Brooks 2010). The countries of Zambia and Tanzania also devote 1-2% of their budget to subsidies (Baltzer and Hansen 2011).

bag of NPK, worth about $40 at market prices in 2013), top-dressing fertilizer (a 50 kilogram bag of Urea, comparable in price to NPK), hybrid maize seeds (a 5 kg bag, worth about $6.80), and hybrid groundnut seeds (a 2-3 kg bag, worth about $1.30 per kilogram). In our data, in 2012 the average household got 27.8 kilograms of NPK fertilizer, 27.4 kilograms of urea fertilizer, 2.7 kilograms of hybrid maize seeds and, 1.4 kilograms of groundnuts seeds, for a total value of $49.4 but only had to pay $1.7 to redeem the vouchers, which implies a 96.5% subsidy during 2012. Because the subsidy is so large, redemption of the coupons in our data is close to 100%.

The subsidy is explicitly targeted towards the poorest Malawians. The official FISP guidelines reads that beneficiaries "will be full time resource poor smallholders Malawian farmers." In addition, the program is meant to target particular groups: "...the following vulnerable groups should also be considered: elderly, HIV positive, female headed households, child headed households, orphan headed households, physically challenged headed households and heads looking after the elderly and physically challenged" (MoAFS 2009).

The identification of beneficiaries has three main stages (Chirwa et al. 2010). First, the government conducts a national farmer registration census. Second, the central government allocates vouchers to districts as a function of the area's farming population and the acreage under cultivation. Within each district, the District Agriculture Development Office (DADO) allocates vouchers across villages based on farming population shares (Chirwa and Dorward 2013). Finally, within each village, once the number of subsidies available to the village is known, a list of eligible villagers is made. Formally, the selection of beneficiaries at this stage is supposed to be done by the Village Development Committee through open community meetings, and audited by the DADO. However, as we will show below, most authority appears to be *de facto* delegated to chiefs.[9] Once the list of beneficiaries have been received by the DADO, it establishes a date and venue for the distribution of the vouchers themselves. The distribution is done by a staff member from the DADO. Listed beneficiaries have to show their voter registration card in order to receive the vouchers and also to redeem the vouchers at the retail stores (MoAFS 2009).

The identification of beneficiaries and distribution of vouchers is timed to precede the main planting season (which begins in November and lasts until the harvest in March). Beneficiary lists are typically drawn in August, while the subsidy vouchers themselves are distributed in September/October, in advance of planting.

[9] For example, Dorward et. al (2013) show that around 70% of households in 2013 believed the decision on voucher recipients was made by the chiefs *before* the official meeting was held.

2.2.2 Food Subsidy Program

Malawi devalued its currency in 2012, causing inflation of 20-30% in 2012-13 (World Bank 2015) and making food imports prohibitively costly. What's more, there was a drought which caused the 2012 harvest to be poor. In response, a food subsidy program was put in late 2012, with subsidies given out from November 2012 to January 2013. In our area of study, the subsidies were distributed in kind. As with the input subsidy, the program was targeted at the poor. Eligible beneficiaires were entitled to receive a 50 kg bag of maize as well as 10 kg of pigeon peas or beans, 10 kg of corn/soy blend, and 2 liters of oil. As with FISP, chiefs were given primary responsibility for identifying which households should receive the food aid.

3 Data

3.1 Sample

The data we use for this paper was collected as part of a separate research project focused on estimating the impact of providing savings accounts to unbanked households (Dupas et al., 2015). The project took place around the catchment areas of NBS bank branches in two districts of Southern Malawi – Machinga and Balaka. The sampling frame for the savings project relied on a census of market businesses and a census of households – we use only the household sample for this analysis. The household census listed 9,297 households from 66 villages in three Traditional Authorities (TA) areas – Kalembo, Sitola, and Nsamala. Of these, 78.8% met the project's eligibility criteria (they did not have a bank account and had a female head). We randomly sampled a subset for the savings study and completed 1,922 baseline surveys. Of this baseline sample, 327 did not complete one of the three follow-up surveys used in this paper (16.9%). In addition, the module to measure food subsidy receipt was introduced only partially through the endline survey, and another 185 households were not asked these questions (9.7%). We are thus left with a sample of 1,410 households. For this paper, for reasons that will be come apparent later, we also need to drop villages with a small number of respondents. We therefore drop all villages with less than 5 individuals in our data, and are left ultimately with 1,387 households in 57 villages. The average number of respondents per village in our sample is 34.

This sampling frame creates two issues for the analysis in this paper. First, our data includes only a subset of people in each village (around 10%). Since our question of interest is to understand how chiefs allocated subsidies *within this sample*, and our basic thought experiment is to ask what the gains would be from re-allocating subsidies *within this sample*,

our results are still internally valid and of interest, however. Second, our sample is selected on not having a formal place to save. Since poorer people are less likely to have an account, it is likely that our sample is poorer than a fully representative sample. We may therefore underestimate inclusion errors (if any of the relatively better-off people with bank accounts ended up receiving subsidies).

3.2 Data Sources

Household Panel We have four waves of survey data for each household in the sample: (1) a baseline conducted from January to March 2011 (2) a first follow-up survey conducted from January to March 2012; (3) a second follow-up survey conducted from September to November 2012; and (4) an endline survey conducted from January to March 2013. The baseline survey includes a standard set of demographic variables, including a module on asset ownership which can be used to construct the hypothetical PMT allocation. Of great importance for this paper is that all survey rounds included detailed expenditure modules.

The follow-up and endline surveys include a module on the farming subsidy. This is used to construct a time series of subsidies received from 2008-2013, for each household. The module includes information on which input subsidy was received, whether the household received the voucher itself or shared another household's voucher, and what the household actually did with the subsidized products (used them, sold them, shared them, etc.). The endline survey also asked these questions for the food subsidy, which was introduced in 2012. Finally, the endline included a separate module with questions on how the input and food subsidies were allocated. These include questions on how (in the respondent's opinion) the vouchers were allocated (i.e. based on need), whether a public meeting was held, whether the respondent participated in the meeting, etc. We use this module to provide some descriptive evidence on how the programs were implemented.

In addition, between August and October 2014 we collected a fifth wave of data for a random subset of 563 households in the initital sample, approximately 10 per village. This survey asked additional questions on the process through which subsidies are allocated and on respondents' attitudes towards the allocation process as well as their perception of the traditional authorities' role, beliefs and objectives in this allocation. We also elicited households' beliefs on the returns to farming inputs on their own land.

Chiefs Survey Between August and October 2014 we collected surveys with 84 traditional leaders. These include surveys with all 57 village headmen (chiefs) for the villages in our sample, all 29 group village headmen (GVH) and each of the 3 traditional authorities (TA)

covering our study area.[10] The survey administered to these traditional leaders included questions on their tenure, their responsibilities, their accountability and specific details on how the FISP and Food subsidy programs are allocated across individuals within village as well as across villages within districts. We also asked village chiefs their beliefs about the distribution of returns to fertilizer within their village.

3.3 Characteristics of households, chiefs and villages in the sample

Table 1 presents basic summary statistics on the households in our sample. Panel A includes time-invariant characteristics collected at baseline while Panel B includes time varying expenditure and shock measures. Panel C shows summary statitstics on exposure to the input and food subsidy programs. Columns 1 and 2 present the mean and standard deviation, respectively.

The first variable we show in panel A is the household's self-reported relationship to the chief. We asked the following question to each respondent: "Are you related to the chief?". As many as 27% answered positively. In a follow-up question, we asked: "How are you related?". The modal answer was the chief is an uncle (25% of the related cases), followed by brother (13%), brother-in-law (12%) and grandfather (12%). In what follows, we refer to those who reported as being related to the chief as "kin".

Panel A shows that households in the sample are very poor: 90% have mud floors or worse quality, 77% have thatch roofs, 39% have mud brick walls or worse material, only 59% report being able to read or write in Chichewa and, on average the household head with highest education in the family completed 5 years of schooling.[11] The FISP program specifically targets single-headed households (the majority of which are widowed women), and they are a large number of these: 28% of households are headed by females alone.[12] Vritually all households in our sample cultivate some land, so they are all eligible for the fertilizer subsidy.

Panel B shows summary statistics from the follow-up surveys. Across the two rounds, households report spending a total of only $12.50 per month per adult equivalent, $7.10 on food, and about $2.40 on perishables. These figures place these households well below the global extreme poverty threshold of $1.25 per day. Shocks are also quite common: 24% lost at least 1 day of work in the past month due to illness, 61% had another household member sick over the past month, 9% experienced a flood, and 15% experienced crop loss or livestock

[10] A few villages were divided into multiple villages between our initial data collection in 2011-13 and the time of the survey in 2014. In these cases, we use the survey of the longest-tenured chief.

[11] The school system in Malawi is composed of 8 years of primary school and 4 years of high school.

[12] A breakdown of observable characteristics by kinship status does not reveal any differences in poverty level between kins and non-kins.

death. Across survey rounds, as many as 68% of households report being worried about having enough food to eat in the past 3 months.

As will be discussed in more detail in the next section, one of the limitations of a proxy-means-test allocation is that it is costly to survey households regularly to measure assets, so the allocation must be time-invariant (at least over some time period), making it impossible for PMT-based eligibility to respond to shocks. To shed some light on this issue, Column 3 of Table 1 presents the correlation between survey rounds for the variables in Panel B. In general, the correlation is fairly low: shocks are largely uncorrelated across rounds, and the correlation for perishable food expenditures is just 0.36.

Panel C of Table 1 shows that, as mentioned above, the percentage of households receiving input subsidies has increased steadily over time, from 63% in 2008 to 82% in 2012. Receipt of the input subsidy is quite correlated over time, with 54% of houseolds receiving some input subsidy in all five years covered in our data, and 9% never receiving any input subsidy. Conditional on receiving the subsidy, the quantity of fertilizer received (summing over the two types of fertilizer, for planting and top-dressing) was about 75.4 and 63.6 kg during 2011 and 2012 respectively. This is smaller than the official package that subsidy beneficiaries are entitled to get (100 kg), and is due to sharing of subsidy vouchers, an issue we come back to in detail in section 3.4. The food subsidy of 2012 was more limited in scope, reaching only 59% of households.[13]

Table 2 presents summary statistics on village chiefs in our sample and their villages, as well as group village headmen in the study area. The average village chief is 53 years old and has just over 5 years of education. Eighty four percent of chiefs (48 out 57) are male. They have been chief for 14 years on average, and all but two inherited their position. The vast majority faced no competition from within the family blood line for the position. In principle, traditional leaders can be removed from office or reprimanded, but our data suggests this almost never happens: only one of the chiefs we surveyed mentioned having ever been suspended. These basic statistics suggest that chiefs are *de facto* not accountable to anyone.

When asked what their responsibilites are, 90% of village chiefs we surveyed report they solve conflicts among villagers; 43% report encouraging and monitoring villagers participation in village development projects, 33% report serving as a bridge between the village and the local government, 14% report ensuring that traditions are being followed, and 6% report overseeing the use of customary land.

[13]In terms of the correlation between the two types of subsidies: In 2012, 53% of households received both the input and food subsidy, 13.6% received neither, 5% received the food subsidy only and 27.9% received the input subsidy only.

Group village heads, who are chosen from among village heads, are older and and have fewer years of education, 67 years and 4 years respectively. Eighty-six percent of group village headman inherited their position and 79% are male. On average, group village headmen in our sample have been in that position for about 12 years.

Panel B in Table 2 shows that in our sample, villages have 340 households on average, and over 7,000 acres of customary land.

3.4 Summary statistics on the allocation of subsidies in our sample

Table 3 presents summary statistics on the process through which input and food subsidies were allocated amoung households in our sample. Panels A and C rely on the latest round of survey data (2014) and presents evidence on how both chiefs and villagers experience and perceive the subsidy allocation mechanisms. Panel B presents data from the earlier household survey waves.

The data confirms that chiefs are the primary decision-makers when it comes to the allocation of subsidies. Turning first to panel A, the great majority of village chiefs report that they have control over the subsidy allocation: 63% declare deciding by themselves, and an additional 8% report deciding in collobaration with either the villagers in a meeting (4%) or the village development committee (4%). Of the remainder, 14% report that the village development committee (of which the chief is a member) decides the allocation.

Chiefs were asked what criteria are used to allocate subsidies. Chiefs report need as the primary criterion, and for the case of input subsidies temporary shocks are also taken into consideration, with 53% of chiefs reporting that households that recently experienced a negative shock are targeted. Consistent with program rules, other criteria commonly used for input subsidy beneficiary selection include female headed households, child headed households and households taking care of orphans.

Panel B suggests that community meetings regarding the selection appear to happen quite regularly, with approximately 95% of villagers reporting that a meeting was held to discuss input subsidies, and high attendance at the meeting (83% for inputs and 67% for food subsidies). Nevertheless, households report that the village chiefs has a considerable role in the allocation, with 49% of villagers reporting that the chief alone decides on who will benefit from the input subsidies and 74% reporting that the chief decides alone when it comes to food transfers. Households were also asked directly how subsidies were allocated. Like chiefs, households list neediness as the main criterion, but they also mention proxies for need, such as demographic characteristics of the household (elderly and female headed households). The great majority of households perceive the allocation of subsidies as "very

good." There seems to be two factors that households consider when deciding whether the allocation is good – one is whether the allocation benefits the poorest, and the other is whether the allocation reaches the largest possible share of households. The concern for reaching as many households as possible is somewhat echoed by chiefs: when asked how they would allocate additional vouchers if they were to receive them, all but one chief say they would give vouchers to more households so that the number of beneficiaries expand (Panel A).

This relates to an important fact about the allocation of subsidies that transpired from our data: while the FISP guidelines do not endorse sharing of subsidy packages, in practice sharing is quite common. We present evidence on sharing in Appendix Table A1. Chiefs appear reluctant to admit that much sharing is going on (Panel A), possibly because they are reluctant to admit to breaking the official FISP guidelines, but villagers readily admit to a lot of sharing, and report that this sharing is orchestrated by the chief. Seventy-eight percent (0.46/0.58) of households who received a voucher report sharing it, and of those 83% say they received instructions from the chief on whether to share it, and 79% received specific instructions from the chief on *whom* to share with.

Since our aim is to think about the efficiency of the chief's allocation, in what follows we consider the allocation observed in our data *after* sharing. That is, if a household answered "yes" to the question "Did you receive an input (food) subsidy in that year?", we consider this household as a beneficiary, irrespective of whether, in subsequent survey questions, the households reveals that it did not receive the actual voucher but a share from another household instructed to share their voucher. The results below are not hinging on this choice – if we only consider as beneficiary those who receive a voucher, we get fairly similar results, available upon request.

Other safety net programs

Beegle, Galasso and Goldberg (2015) document that chiefs are also somewhat involved in deciding which households are eligible for Malawi's public work program (PWP) – though the responsibility falls more on the Group Village Headmen and the villagers themselves. They report that Malawi's PWP "has been operational since the mid-1990s and aims to provide short-term labor-intensive activities to poor, able-bodied households for the purpose of enhancing their food security." While we unfortunately did not collect data on participation in the PWP directly from respondents in our surveys, a fuzzy name match between the original household sample and administrative data on PWP participants obtained from the two districts in our sample yields 167 matches for the 2012-2013 budget year, out of 1,922 households in the Dupas et al. (2015) study, suggesting that the PWP coverage in our

study area is about 9%. Verification surveys with a subset of those matched and unmatched conducted in March 2015 suggests that an additional 3% may have been participating in PWP, bringing our estimates to roughly 12%. [14] While name matching is always prone to significant error, this ballpark figure is not far from the 15% coverage targeted by the program. While studying how the PWP is targeted and the specific role of chiefs would have been interesting, omitting it due to data limitations does not affect our analysis of the other subsidy progams. Notably, Beegle, Galasso and Goldberg (2015) find no correlation between receipt of PWP and receipt of other benefits, suggesting no strategic allocation across programs, in particular, no compensation of non-PWP households with input or food subsidies.

4 Poverty targeting: Results

4.1 Constructing counterfactual allocations

Chiefs by and large decide which households benefits from input and food subsidies. Do they target the poorest? Would a centralized allocation using a proxy-means test (PMT) do better? A difficulty in these analyses is to construct a measure of which households "should" have gotten the subsidy under perfect poverty-targeting. As our most objective measure of need (poverty), we follow Alatas et al. (2012) and use whether households would have qualified based on their food expenditure distribution, which we consider a proxy for consumption.

Specifically, in our data we observe, for each village, the total number of households within our sample who benefited from a subsidy – call this number $\bar{s}$. To examine what the distribution of recipients would have been if vouchers were allocated based on actual consumption, we rank households (within each village) by their food consumption. While there are 15 total food categories measured in each survey wave, we focus on 5 categories of perishable foods only (since those must be closely linked to income since they cannot be stored). These are (1) vegetables; (2) fruits; (3) meat and fish; and (4) dairy products. In datasets from nearby Uganda, Ligon (2015) identifies those foods as among the most elastic goods, and thus most useful for drawing inferences regarding household's marginal utility of contemporaneous expenditures, or "neediness". We compute the per adult equivalent expenditure on perishable food and consider a household "PAEC eligible" if they are ranked at or below the $\bar{s}$th farmer in the per adult equivalent consumption (PAEC) distribution.[15]

[14] We are grateful to Santiago Saavedra for obtaining the administrative records and performing the matching analysis and verification surveys.

[15] We use a per adult equivalent formula of 1 child under 18 equal to 0.5 adults. While this is the most

As shown in Appendix Table A2, log PEA perishable food expenditure is highly correlated with reported food insecurity. Alternative proxies for neediness, namely log of total PAE food expenditure and food share, appear less well correlated or at least less systematically so, suggesting that they may suffer from greater measurement error, which is not surprising since total expenditure may suffer from greater recall problems.

To examine what the distribution of recipients would have been if vouchers were allocated via PMT, we repeat this procedure but this time we rank households (within each village) by a "PMT score". We consider households PMT eligible if they are ranked at or below the $\bar{s}$th household in the PMT score distribution. We compute the "PMT score" as follows: we regress the log of per-adult equivalent perishable food consumption on household characteristics, including demographic characteristics, dwelling characteristics, assets and occupation, and use the estimated coefficients to predict a score for each household. As in Alatas et al. (2012), we do this in two steps: we first run kitchen sink regressions with all available characteristics and then keep only those characteristics significant at the 10 percent level in the regression used to predict the score. We do this using our own survey data from the baseline survey. (In a future iteration of the paper, we will use the Integrated Household Survey from Malawi, a representative household survey, to be able to obtain weights for the PMT score that are estimated on a larger sample.) The PMT regressions are shown in Appendix Table A3. We show the results for a number of alternative "need" measures, besides our preferred perishable food consumption. As noted above, the R-squared in this regression remains stubbornly low, at around 0.18 for log PAE perishable food expenditure and 0.24 for total food expenditure per capita..

Once these counferfactual PAEC and PMT eligibility dummies are created, our empirical approach is to compare the characteristics of the eligible under the various types of allocations. *Timing.* The food expenditures we would ideally use to determine "true need" (PAEC eligibility) would be just before beneficiaries are identified (which is around August for the input subsidy and was around November for the food subsidy). Our expenditure modules covered 7-30 days (depending on the question) before the survey date. Thus, given the dates of the surveys mentioned in Section 3.2, we have consumption data for the following periods: December 2010 to February 2011; December 2011 to February 2012; August to October 2012; and January to March 2013. To study the targeting of the 2011 input subsidy, we thus have to rely on the December 2010 to February 2011 expenditure data, and this is not ideal because it is substantially before the period of interest. In particular, it is before the March

commonly use equivalence, it may be an underestimate of how much communities actually value children consumption (Olken 2005). We have done the entire analysis in the paper using per capita expenditure instead of per adult equivalent and the results are identical.

2011 harvest, which is likely an important determinant of actual neediness as of August - October 2011.[16] Our analysis mainly focuses on the 2012 allocation decisions, however, which is the year when both input and food subsidies were allocated. For that year, we determine PAEC eligibility with the August 2012 to October 2012 expenditure data, which is concurrent with the identification of beneficiaries and exactly preceeds any actual distribution of food.[17]

4.2 Poverty-targeting results

4.2.1 PMT vs. Chief Allocation

Our first main result is Figure 1, which plots the probability of receiving the subsidy by quintile of thePMT score distribution (left side), quintile of the PAEC distribution (middle) and the share of days during which the household had to cut meals or portion size. From the left hand side, it is clear that chiefs target very different people than the PMT: while the PMT, by definition, allocates subsidies to 100% of people at the bottom of the distribution, the chiefs' allocation has a much flatter gradient with respect to the PMT score. In isolation, this result looks similar to Dorward et al. (2008, 2013) and Kilic et al. (2013), who look at how well chiefs target based on assets and conclude that there is widespread mistargeting.

The middle and right hand side figures paint a somewhat different picture, however: chiefs' targeting in terms of PAEC or reported food insecurity appears to be quite similar to that of the PMT. Evidently, even though the chiefs clearly select different people (e.g. they include many "asset-rich"), they allocate subsidies to comparably needy households as measured by their PAEC – obviously, less so in 2011, for which the PMT performs relatively well mechanically since we used the 2011 data to determine the PMT formula, but only a year later the edge of the PMT is mostly gone. This result points out that assets (the most important factor in the PMT) are a relatively poor proxy for need in our study context, as in much of sub-Saharan Africa. We show this more explicitly in Table A4, in which we regress the log of PAE food expenditures (for total food as well as the measure we use in our

[16] We could possibly use the December 2011 to February 2012 data since no food subsidies were distributed that year and the proceeds of the maize planted with the subsidized inputs of 2011 were not reaped until March 2012. We have run the analysis for 2011 this way and the results are very similar.

[17] Since the subsidy program has been going on for many years, these consumption measures are potentially endogenous to subsidy receipt in previous years. We do not expect these to materially affect consumption in the August-October or December-February windows, however. If used on the entire farm, Duflo, Kremer and Robinson (2011) estimate that using fertilizer could increase agricultural output by 48 to 63%. Since the Malawian input subsidy for a 50 kg bag is enough for recommended use over 1 acre, while the average farm size is 1.7 acres, the estimated increase in harvest output would be around 24-32%. In an environment in which most households are subsistence farmers who do not sell any of their output, we expect the effect of the previous year's input subsidy on our survey estimate of perishable food expenditures (measured 5-11 months post-harvest to be negligible).

main analysis of perishable food) on asset measures, along with other observable household characteristics. We do so for our study sample, but also with datasets from Kenya and Uganda collected for separate projects. Overall, we find relatively low predictive power of baseline characteristics in all three countries, with an R-squared of 0.2 at best. Assets are positively correlated with expenditures, unsurprisingly, but the correlation is fairly weak, owing to the fact that there is significant time-variation in expenditures due to shocks. Given this, PAEC eligibility is far from a time-invariant characteristic. We show this in Appendix Table A5, which present cross-tabulations and correlations between being in the bottom 25%, 50%, and 75% of the food expenditure distribution between 2011 and 2012. The results suggest significant switching into and out of these percentiles. To take the 75th percentile as the most relevant example (since about this percentage of people received the input subsidy in the final year of the program), we find that 58% of people are in the bottom 75% in both years, but another 30% are in that part of the distribution in one year but not the other.

One important concern is that measurement error in food expenditures could explain this lack of stability, and as a result explain the fairly flat gradient in PAEC that we observe for both the chiefs and the PMT in 2012. Reassuringly, the results on the right-hand size, using reported need (share of days in the last month (2011) or last 3 months (2012) during which households had sufficient food) instead of expenditures, paint a comparable picture.

4.2.2 PMT and Chiefs: Equally good or equally bad?

Table 4 shows the poverty-targeting error rate under the two allocation schemes (chiefs and PMT). The table shows the average village error rate (averaging first over individuals within villages, and then across villages). Following Alatas et al. (2012), what we call the poverty-targeting error rate is the probability that a household is (1) categorized as eligible based on its position in the PAEC distribution and (2) does not make it onto the actual beneficiary list (chief allocation, column 1) or on the counterfactual PMT beneficiary list (PMT allocation, column 2). Note that since the number of beneficiaries within the village is kept fixed in this exercise, this error rate also provides the probability that a household is (1) categorized as ineligible based on its position in the PAEC distribution and (2) gets the subsidy. In other words, there are as many people who don't get the subsidy when they should (exclusion errors) as there are people who get the subsidy when they should not (inclusion errors). We also show what the expected error rate would be if subsidies were allocated randomly (random allocation, column 3). For these calculations, we include only those villages in which the probability of getting a subsidy is between 0 and 100% (so that targeting errors

are possible).[18]

We can see that both allocations make a significant number of errors compared to the PAEC, though they are comparable in their levels of mistargeting. Across years and subsidy types, the error rates varies from 12.9 to 16.6% for the chief allocation, and from 12.7 to 15.3% for the PMT. We cannot reject equality of the error rates between the two allocations (Column 4). However, both error rates are statistically significantly lower than what would be achievable through dumb luck. This can be seen first through a t-test in Column 5. We also show this in Appendix Figure A3, in which we simulate 10,000 draws of the subsidies under a random allocation. As can be seen, the probability of achieving such an error rate by chance is close to 0 for the input subsidies, though statistically insignificant for the food subsidy. In terms of magnitudes, a purely random allocation would increase errors by about 1-2 percentage points.

While the simple error rate already shows that the PMT and chief allocations do better than random, it is also evident from Figure 1 that subsidies are not allocated randomly as there is a gradient in PAEC. To capture the fact that not all errors are equal, and that wrongly excluding someone further away from the threshold is "costlier" in terms of poverty targeting, we compute a modified mean squared error rate, also shown in Table 4. For the chief and PMT allocation, this rate is the square of the difference between expenditure and the counterfactual PAEC threshold, multiplied by an indicator for whether the subsidy was allocated incorrectly. For the random allocation, this is the expectation of this sum. We find here that both the PMT and chief allocation do far better than random, but the chiefs perform worse than the PMT. The difference is not significant for the allocation of the food subsidy in 2012, but it is significant for the allocation of the input subsidy.

4.2.3 Who is favored and who is left out by chiefs?

Table 5 shows the results of a multivariate regression of actual subsidy receipt on background characteristics. We find a very significant level of nepotism: conditional on covariates, relatives of the chief are 7-10 percentage points more likely to receive the subsidies, a finding consistent with the observations made previously by Dorward et al. (2008, 2013) and Kilic et al. (2013). In addition, we find that chiefs target older households and households that own land (presumably because other households are not farming). Thus while the overall poverty targeting may not differ substantially across chiefs vs. PMT, the distributional impacts of the two schemes may be very different.

[18]The table reports the probability of all or none of the villagers getting the subsidy. The odds that all villagers got the subsidy was 12.3% for the 2011 input subsidy, 21.1% for the 2012 input subsidy, and 7.0% for the 2012 food subsidy. In addition, the food subsidy was not given out in 7.0% of villages.

We thus conclude the section on poverty targeting by studying the correlates of inclusion and exclusion errors under both schemes, to identify the winners and losers under each. For this, Table 6 shows the results of regressions of the following form

$$D_{it}^{j} = \alpha_1 + x_{it}'\beta_1 + \epsilon_{it} \, for \, D_{it}^{PCAE} = 0 \tag{1}$$

$$D_{it}^{j} = \alpha_2 + x_{it}'\beta_2 + \epsilon_{it} \, for \, D_{it}^{PCAE} = 1 \tag{2}$$

where $D_{it}^{j} = 1$ if the household would have qualified under scheme j (PMT or the true allocation) and 0 otherwise, and $D_{it}^{PCAE} = 1$ if the household qualified under PAEC and 0 otherwise. These are regressions of subsidy receipt under the two allocations, *conditional on qualifying (or not qualifying) under a hypothetical PAEC allocation*, so that any statistically significant regressors indicate a discrepancy between the PAEC allocation and the given allocation. More specifically, from equation 1, β_1 gives a measure of the correlates of *inclusion errors*: situations in which a household gets the subsidy under the given scheme but would not have under the PAEC allocation. This is shown in columns 1-4. From equation 2, β_2 gives a measure of *the correlates of exclusion errors*: situations in which a household does not get the subsidy even though they would have under the PAEC allocation. This is shown in columns 5-8.

The results for the counterfactual PMT allocation (shown in the even columns) is consistent with what was expected. The PMT makes more inclusion errors for larger households, and for characteristics correlated with assets (housing quality). This latter result is as expected since the regressions control for qualifying under the PAEC distribution – a household which does not qualify under PAEC despite having low assets must by definition have good unobservables, but that is what the PMT cannot take into consideration.

The odd numbered columns in Table 6 (which show the true chief allocation) show that chiefs are less likely to wrongly exclude and more likely to wrongly include older individuals (which could be for a number of reasons, including that older households were meant to benefit from the scheme). As suggested in Table 5, chiefs are much less likely to make exclusion errors and more likely to make inclusion errors with relatives (and therefore are more likely to exclude eligible non-relatives), suggesting nepotism.[19]

While the disproportionate allocation of food subsidies to relatives *must* reflect higher welfare weights assigned by chiefs to their relatives compared to non-relatives, it is possible that the disproportionate allocation of *input* subsidies to relatives is at least in part driven by relatives having higher returns to fertilizer. These higher returns could be due to relatives

[19]These results are not unique to Malawi. A review paper by Baltzer and Hansen (2011) of programs in four African countries (Ghana, Malawi, Tanzania and Zambia) finds significant evidence that subsidies disproportionately go to politically connected households.

having access to better land (since some of the land is itself distributed by chiefs), or to better information on how to use the inputs (if for example extension officers are coerced by chiefs to disproportionately target chief relatives too). We investigate these issues in the next section, which provides a test of whether chiefs do indeed take into consideration productive efficiency when allocating input subsidies.

5 Productive Efficiency Targeting: Model and Test

What we have shown so far is that chiefs do not target subsidies to the poorest, whether measured by PMT score or per adult equivalent food expenditure. They seem to perform somewhat worse than would a perfectly implemented centralized PMT allocation, especially when it comes to the targeting of input subsidies. In this section, we investigate whether this mistargeting of input subsidies may be due in part to the fact that chiefs may not want to target on poverty alone when it comes to inputs, but also on returns: if returns to input subsidies are heterogeneous across households, and chiefs have information on household-specific returns, they may be allocating the subsidies in a way that takes both poverty targeting and productive efficiency into account. In this section we present a model that allows for heterogeneity in returns as well as heterogeneity in the welfare weights that chiefs assign to households, and propose a method to test whether the mistargeting we observe for input subsidies is at least in part driven by productive efficiency considerations.

5.1 Motivating survey evidence

Two requirements for targeting based on productivity to be possible are that (1) there is heterogeneity in productivity and (2) chiefs can observe it. We present several pieces of descriptive evidence that both are the case in our study context. First, during the fifth survey round conducted in the summer 2014, we collected information on self-reported returns to fertilizer from a random subset of households in each village. Specifically, we asked them about the yield they would get on their land both with and without fertilizer. We average answers across household within subgroups (chief kins vs. non-kins) and compute gaps across subgroups. We show the distribution of the gap between kins and non-kins in Figure A2. We have significant variation across villages in this gap, variation which we will make use of in the test that we develop below.

Regarding chief's knowledge of productivity differences, in the survey of chiefs conducted in 2014, we asked chiefs a number of questions about what they could observe about households, which we present in Table 7. We find that 40% of chiefs report that returns to inputs

are heterogenous. Chiefs also report that they know who works harder, who has money for inputs, and whose returns are highest. While descriptive, these responses suggest significant local knowledge on the part of chiefs.

As a final piece of suggestive evidence, we examine whether, within the random subset of households interviewed in the fifth survey wave, the self-reported productivity measure correlates with subsidy receipt at the individual level, conditional on important covariates such as land size and assets. We calculate the percentage increase in yield for each farmer and categorize farmers as below or above median returns.[20] This can be seen in Columns 3-4 of Table 5. We find some evidence that those with higher returns are more likely to get input subsidies (Column 3, significant at 10%), and in particular significantly more likely to get input subsidies than food subsidies (comparing columns 3 and 7, or 4 and 8, of Table 5). The fact that sickness of the household head is negatively correlated with input subsidy receipt in column 1 could also be suggestive of chiefs considering productive efficiency when targeting, if they consider household health and inputs as complements.

5.2 Theoretical Framework: Set-up

In this section we present a simple model building on Bardhan and Mookerjee (2006), with the aim to generate predictions that we can take to the data.

We consider the problem of allocating subsidies across households within a village. The intra-village allocation is done by the village chief. There are two classes c of households, chief kins and non-kins, each with demographic weight β_c. Villages vary in the distribution of these demographic weights.

Suppose that allocation of subsidy s_c to a representative household of class c enables that household to generate additional income:

$$y_c = A_c s_c^{\mu}$$

where A_c denotes class-specific land productivity and suitability for subsidized inputs and $\mu \in (0, 1)$ denotes potentially diminishing returns in the subsidized resource. In the nested special case where the subsidized resource is food, rather than farming inputs, we set $\mu = 1$ and $A_c = 1$ for all classes of households (and thus start by abstracting away from a case in which there is a productive response to nutrition – we relax this assumption later).

Also assume that households share a common homothetic, CRRA utility function defined

[20] We do this because the specific numerical returns are noisy. The self-reported returns among households are very high, with a median at 150%. While very large, this is only about twice as high as the median of 63% reported in Duflo et al. (2009) for farmers in Western Kenya.

over household's total income:

$$u_c = \frac{(y_c + e_c)^{1-\rho}}{1-\rho}$$

with $\rho > 0, \neq 1$ and where e_c is the income that a representative class c household gets in addition to the subsidy-enabled income.

The aggregate supply of subsidies to the village is denoted by $\bar{s}$. Under a proxy-mean test, the subsidies would go the $\bar{s}$ households in the village with the lowest PMT score. In contrast, when allocating subsidies across households within the village, and assuming for now that there is no *ex post* redistribution orchestrated by the chief, the chief chooses the subsidy levels s_c so as to maximize the weighted sum of villagers' utility:

$$\sum \beta_c \omega_c \frac{(A_c s_c^{\mu} + e_c)^{1-\rho}}{1-\rho} \tag{3}$$

subject to

$$\sum_c \beta_c s_c = \bar{s}$$

In equation 3, ω_c is the relative welfare weight of class c households. Since chiefs do not face reelection incentives and have limited accountability (see section 2.1), the relative welfare weight of a class may not reflect its role in the political process as in earlier models (Bardhan and Mookherjee, 2000, 2003, 2006) but may instead depend on the preferences of the chief (e.g. if the chief favors his kins, the relative welfare weight of kins will be higher).

Note that $e_c$could be endogenous – as long as the chief knows how households' effort level as well as informal transfers respond to a particular subsidy allocation, this will not affect the problem, the chief can take the households' best response distribution of $e_c$as given when maximizing the objective function shown in 3.

5.3 Prediction and empirical test

Taking the ratio of the first order conditions for two classes of households c and d yields:

$$\left(\frac{\omega_c}{\omega_d}\right)^{-\frac{1}{\rho}} \left(\frac{A_c}{A_d}\right)^{-\frac{1}{\rho}} \left[\frac{A_c s_c^{(\mu - \frac{\mu-1}{\rho})} + e_c s_c^{-\frac{\mu-1}{\rho}}}{A_d s_d^{(\mu - \frac{\mu-1}{\rho})} + e_d s_d^{-\frac{\mu-1}{\rho}}}\right] = 1 \tag{4}$$

For food subsidies, where $A_c = 1$ and $\mu = 1$ for both classes, this simplifies to:

$$\left(\frac{\omega_c}{\omega_d}\right)^{-\frac{1}{\rho}} = \left[\frac{f_d + e_d}{f_c + e_c}\right] \tag{5}$$

where f_c and f_d denote the amounts of food subsidy received by each class. Equation

5 means that by observing the realized food distribution by class as well as the realized outside incomes, we can back out the relative welfare weight of kins. The intuition is simple: if kins get more food subsidy even though they are not consuming less at the time the food distribution occurs, it must mean that they have a higher pareto weight in the chief's objective function.

Having backed out the relative welfare weight $\frac{\omega_c}{\omega_d}$ from the food subsidy allocation, we can plug them into equation 4 and obtain:

$$\left[\frac{f_d + e_d}{f_c + e_c}\right]\left(\frac{A_c}{A_d}\right)^{-\frac{1}{\rho}}\left[\frac{A_c s_c^{(\mu-\frac{\mu-1}{\rho})} + e_c s_c^{-\frac{\mu-1}{\rho}}}{A_d s_d^{(\mu-\frac{\mu-1}{\rho})} + e_d s_d^{-\frac{\mu-1}{\rho}}}\right] = 1 \tag{6}$$

Thus by observing the realized subsidy distributions for inputs and food by class as well as the realized outside incomes, we can back out the extent to which relative productivity $\left(\frac{Ad}{A_c}\right)$ matters in the chief's allocation decision.

There is no simple analytical solution to non-linear equation 6 but we show the relationships between the parameters of interest graphically in Figure 2. For this exercise we set $\mu = 0.9$ and either $\rho = 0.5$ (top panel) or $\rho = 1.2$ (bottom panel). We plot the relationship between $\left(\frac{s_d}{s_c}\right)$ and $\left(\frac{f_d}{f_c}\right)$(and contrast it with the 45 degree line) for different ratios $\left(\frac{A_d}{A_c}\right)$. Because we allow concavity in the returns to fertilizer ($\mu \leq 1$), we should not expect $\frac{s_d}{s_c} = \frac{fd}{fc}$ even if $\frac{A_d}{A_c} = 1$. But as $\frac{A_d}{A_e}$ increases, the slope of the relationship between $\left(\frac{s_d}{s_c}\right)$ and $\left(\frac{f_d}{f_c}\right)$ unambigously steepens.[21] The intuition here is the following: if productivity considerations matter, then if kins have a higher return to the subsidy $\left(\frac{A_d}{A_c} > 1\right)$, then kins should be even more favored when it comes to the input subsidy than for the food subsidy. If kins have a lower return to the subsidy $\left(\frac{A_d}{A_c} < 1\right)$, then kins should be relatively less favored when it comes to the input subsidy than for the food subsidy. Unsurprisingly, when the utility function is very concave ($\rho = 1.2$, bottom panel), the impacts of productive efficiency considerations is considerably muted, since increases in the resources of the already better off have very low value.

This leads us to the first prediction we can test in the data:

Prediction 1 *If chiefs take into consideration productive efficiency when allocating farming subsidies, $d\left(\frac{s_d}{s_c}\right)/d\left(\frac{f_d}{f_c}\right)$ increases as $\frac{A_d}{A_e}$ increases. Namely, the wedge between the degree of nepotism observed in the allocation of input subsidies and that observed in the allocation of food subsidies increases with relative productivity.*

We test this prediction in Figure 3, which is the empirical analog of Figure 2. Group d

[21] Figure 2 plots the case where the two groups are equally rich, but note that this is true independently of whether group d is richer or poorer than group c.

are the chiefs kins and group c are the non-kins. The x-axis is the ratio of the share of kins that got the food subsidy over the share of non-kins that got the food subsidy. This is a measure of the level of nepotism in the allocation of the food subsidies, with a value of 1 corresponding to no nepotism. A ratio greater than 1 indicates some nepotism. The y-axis is the equivalent but for input subsidies. In cases where no non-kin received the subsidy, we top-code the measures at 4 (the results are robust to this top-coding choice).

The information on the returns by kinship category comes from the fifth survey round conducted in the summer 2014, as mentioned above. We separate villages into two types: villages where chief kins have on average higher returns to the subsidy than non-kins ($A_d > A_c$), and villages where kins have on average lower returns ($A_d < A_d$). We plot the linear fits separately for the two types of villages, and as predicted by the model, we find that in villages where kins have higher returns than non-kins, the slope of the relationship between the two nepotism measures is steeper than in villages where kins have lower returns. This is consistent with chiefs taking into consideration the returns to fertilizer when allocating input subsidies: when it comes to input subsidies, they favor kins relatively more, compared to the food subsidy, when kins can make a more productive use of the inputs, and relatively less when they cannot. (Note, and this is the insight of the model, that it cannot be explained by chiefs merely favoring kins in general, i.e. granting them higher productivity land and more subsidies, since this general favoritism would be reflected in the welfare weights and thus already accounted for by the allocation of food subsidies).

One caveat to the test we can perform with our data is that our measure of the returns to the fertilizer subsidy (and how it varies by class) is very coarse. This is not surprising since it is precisely because we do not have good data on the distribution of returns to the subsidy that we need to use an indirect, model-based test of productive efficiency. There are two main issues with the measure. First, we asked about returns from only a few households per village. This means that our estimated productivity gaps across classes at the village-level suffer from measurement error.[22] Second, we asked respondents about the *returns to fertilizer use* – but the predictions of the model are about the *returns to the fertilizer subsidy*, which may be lower than the returns to fertilizer if some of the subsidized fertilizer is inframarginal (i.e. crowds out purchase of unsubsidized fertilizer). This would be an issue if more of the subsidized fertilizer is more likely to be inframarginal for one class than another. In our context, however, kins and non-kins are equally poor, and what's more it appears that purchase of fertilizer absent any subsidy is minimal (which is the rationale for the government subsidy in the first place), and therefore approximating the returns to the

[22]This is also the reason why our analysis of the correlation between returns and subsidy receipt at the individual level in Table 5, column 3, is underpowered.

fertilizer subsidy with the returns to fertilizer is possibly acceptable. Nevertheless, we note that our test is somewhat weak, not only because it is one-sided, but also because of the potential measurement error in returns.

5.4 Allowing chiefs to orchestrate transfers

In the presence of a redistribution instrument, the chief's objective function would be modified as follows: the chief now chooses the sets of subsidies s_c and transfers t_c so as to maximize:

$$\sum_c \beta_c \omega_c \frac{(A_c s_c^{\mu} + t_c + e_c)^{1-\rho}}{1-\rho}$$

subject to

$$\sum_c \beta_c s_c = \bar{s}$$
$$\sum_c \beta_c t_c = 0$$

where t_c is the net ex-post income transfer received by class c households, which can be either negative or positive.

If there is perfect income pooling, for any class d, total income is $A_d s_d^{\mu} + t_d + e_d = \frac{1}{2}\sum_c \beta_c (A_c s_c^{\mu} + e_c)$, and the objective function of the chief can be rewritten as $\max \sum_c \beta_c (A_c s_c^{\mu})$. In such a case, we would expect the allocation of fertilizer subsidies to be entirely driven by productive efficiency since redistribution would happen ex post. The welfare impact of allocating more input subsidies to the most productive farmers clearly increases in the degree of income pooling: given the curvature in the utility function, increasing the size of the pie increases welfare more, the more the additional output can be used to increase the consumption of the neediest. This leads us to the second prediction we can test in the data:

Prediction 2 *If chiefs take into consideration productive efficiency when allocating farming subsidies,* $d\left(\frac{s_d}{s_c}\right)/d\left(\frac{f_d}{f_c}\right)$ *increases as* $\frac{A_d}{A_e}$ *increases, but the more so the more ex-post income pooling there is in the village (the more risk-sharing there is).*

We test this prediction in Figure 4, which replicates the analyses in Figure 3, but looking separately at villages where there appears to be more (less) income pooling than in the median village. Our measure of income pooling at the village level is based on the coefficient of variation of baseline assets within the village. Namely, a village is considered to be pooling income more than the median if its coefficient of variation in assets is less than the median (which is consistent with those generating more income transfering that income rather than

using it to accumulate disproportionately more assets). We find that the slope change is indeed greater in villages with a higher degree of income pooling, though the difference across the two types of villages is not very large. This is maybe not surprising, since the summary statistics we discussed above suggest that in almost all villages chiefs have the power to impose how vouchers are shared, which suggests that they have at least some authority over redistribution arrangements, and ensuring their kins redistribute to non-kins might be particularly easy for chiefs. Thus our entire sample may be composed of villages where chiefs have access to redistribution instruments.

Prediction 2 brings attention to the fact that the two subsidies we study could be complementary: the input subsidy as a growth instrument and the food subsidy as a redistribution instrument. This is an interesting insight which suggests that the introduction of the food subsidy may lead to an increase in the extent to which the input subsidy can be used by chiefs as a growth instrument going forward. Note that this does not invalidate our test: since the food allocation at any point in time should be based on the pareto weight and current consumption – irrespective of whether the current consumption level was secured through enhanced yields in the previous period thanks to inputs subsidies or not – relative pareto weights can still be backed out from jointly observing the food allocation and current consumption, as we do.

5.5 Robustness of predictions to model extensions

Productive response to better nutrition In the setup above, we did not allow for food subsidies to have a differential impact depending on the nutritional status of the beneficiaries. It is however possible that for really poor households, the nutritional intake absent subsidies is so low that their productive capacity is reduced (Strauss, 1986). In this section we show that allowing for food subsidies to boost productivity for poor households (that is, assuming that \$1 in food subsidies to a poor household is worth more than a \$1 increase in consumption) does not change the model predictions.

To see this, note that allowing for the efficiency of an hour worked to increase with food subsidies implies a negative correlation between the relative productivity of inputs for class c and the relative productivity of food for that class, given the complementarity between farm inputs and efficient labor units. This will increase the wedge between $\frac{f_d}{f_c}$and $\frac{s_d}{s_c}$ in the same direction as if class d was more productive. Indeed, if the least poor appear favored in terms of food subsidies *even though* the returns to food subsidies are lower for them, then it means they have a very high welfare weight. Given this, productive efficiency considerations will lead to the non-poor getting relatively *more* input subsidies when they have higher returns,

since those returns are heavily weighted (provided ρ is not too high). And hence the slope change from prediction 1 will be magnified. This can be seen by comparing the dotted green lines in Panel A1 of Figure 5 with Panel A1 of Figure 2.

Price effects If prices at the local level are a direct (decreasing) function of total production at the village level, then allocating subsidies to the most productive may reduce output prices. As many as 85% of the farming households in our sample do not sell any maize, so such price effects are unlikely. But say there were price effects. Since 90% of farmers in our sample are *net buyers* of grain (in other words, they consume more grain than they produce), such a price effect would translate into a positive income effect for most villagers and thereby increase welfare. To allow for this, we can rewrite the chief's objective function as:

$$\sum_c \beta_c \omega_c \frac{((A_c s_c^{\mu} + e_c)/p(T))^{1-\rho}}{1-\rho}$$

where $p(T)$ is the consumer price index and is a function of total production $T = \sum_c A_c s_c^{\mu}$ in the village, with $dp/dT < 0$. Let's assume linear price effects, such that $dp/ds_c = -\alpha dT/ds_c = -\alpha\mu A_c s_c^{\mu-1}$. The new first order condition for a given class c of household becomes:

$$\begin{aligned} \beta_c \omega_c \left(\frac{(A_c s_c^{\mu} + e_c)}{p}\right)^{-\rho} \left(\frac{\mu A_c s_c^{\mu-1}(p + \alpha(A_c s_c^{\mu} + e_c))}{p^2}\right) & \\ + \sum\nolimits_{d \neq c} \beta_d \omega_d \left(\frac{A_d s_d^{\mu} + e_d}{p}\right)^{-\rho} \left(\frac{\alpha\mu A_c s_c^{\mu-1}}{p^2}\right) &= \lambda \beta_c \end{aligned}$$

And taking the ratio of the first order conditions for two classes of households c and d now yields:

$$\frac{A s_c^{\mu-1}[\beta_c \omega_c (A_c s_c^{\mu} + e_c)^{-\rho}(p + \alpha(A_c s_c^{\mu} + e_c)) + \alpha\beta_d \omega_d (A_d s_d^{\mu} + e_d)^{-\rho}]}{A s_d^{\mu-1}[\beta_d \omega_d (A_d s_d^{\mu} + e_d)^{-\rho}(p + \alpha(A_d s_d^{\mu} + e_d)) + \alpha\beta_c \omega_c (A_c s_c^{\mu} + e_c)^{-\rho}]} = \frac{\beta_c}{\beta_d} \tag{7}$$

For $\alpha = 0$ (no price effects) we are back to 6.

We graphically show the relationship between the parameters of interest under equation 7 in Panel B of Figure 5. We set the baseline parameters as before and plot the case where group d is richer (specifically, $e_d = 1.2e_c$). Prediction 1 holds: as $\frac{A_d}{A_c}$ increases, the slope of the relationship between $\left(\frac{s_d}{s_c}\right)$ and $\left(\frac{f_d}{f_c}\right)$ unambigously steepens (from dashed red to dotted green to solid blue). When $\rho = 1.2$ (bottom panel B2), the impacts of productive efficiency considerations is again muted, but the results are directionally the same.

Thus the predictions tests we performed above are valid even when we allow for a nutrition response and for endogenous prices. Based on the results of these tests, chiefs appear to behave as if they take productive efficiency into consideration when allocating input subsidies. This is consistent with chiefs having substantial power to enforce redistribution, as evidenced by the fact that they control the allocation of vouchers and how they are shared among villages. This redistributive power allows chiefs to use the input subsidies as a growth instrument, bringing their village closer to the production possibility frontier. Interestingly, this is not what they are asked to do – the official guidelines of the inputs subsidy program is to target the poor, and thus when asked chiefs report targeting the poor, and few report taking into considerations potential returns, even though it seems they do to some extent.

6 Conclusion

Traditional leaders, often known as "chiefs", have maintained a significant amount of *de facto* if not *de jure* power in sub-Saharan Africa. Possibly owing to the weakness of local governance in most of the continent, chiefs are commonly involved in the decisions of how to allocate government resources. One prominent type of resource is subsidies. Developing country governments allocate an important portion of their national budget to subsidies targeted at the poor, and it is common for chiefs to be asked to identify who should be eligible for such subsidies. Do chiefs identify the right beneficiaries? Previous work on this question concluded that there was widespread elite capture (Dorward et al., 2008; Kilic et al., 2013). These conclusions are based on evidence that connected households are more likely to receive subsidies, and that household wealth measures do not strongly predict subsidy receipt.

We show that while these two pieces of evidence still hold in our context and data, they are not enough to conclude that the allocation realized by chiefs is worse than what could be achieved through a centalized or rule-based allocation system. Indeed, the fundamental relationship between assets accumulated over time and "need" at a point in time is not strong, and varies with shocks. This fact, which is not specific to our study context but applies to sub-Saharan Africa more broadly if not most of the developing world, means that assets are a poor proxy for need, and thus an allocation based on a proxy-means test will itself generate a substantial number of errors of exclusion (especially if the data on assets is collected infrequently). Thus even if chiefs do somewhat favor their kins, their overall success at targeting based on poverty appears not very far off from what an idealized PMT allocation would achieve. An allocation picked by a local leader also has the benefit of changing from year to year, in response to changes in household characteristics or exposure to shocks.

Chiefs' informational advantage may be particularly important for productive inputs such as fertilizer. We show that our data is consistent with chiefs targeting subsidies at farmers with larger returns to subsidized inputs. This result further underscores how a naive measure of mistargeting based solely on the neediness of households may overstate the true error rate. While this result is for one particular subsidy program in Malawi, the results have important policy implications because most of the inputs subsidized by governments are productive inputs (farming inputs, health inputs) that have heterogeneous returns. The extent to which input subsidies can be used as a pure growth instrument is a function of how much *ex post* redistribution is possible. In this sense, the recent introduction of a food subsidy in Malawi may further increase the ability of chiefs to targeting input subsidies based on productive efficiency. To our knowledge, this is the first paper to point out such potential completementarity across types of subsidies.

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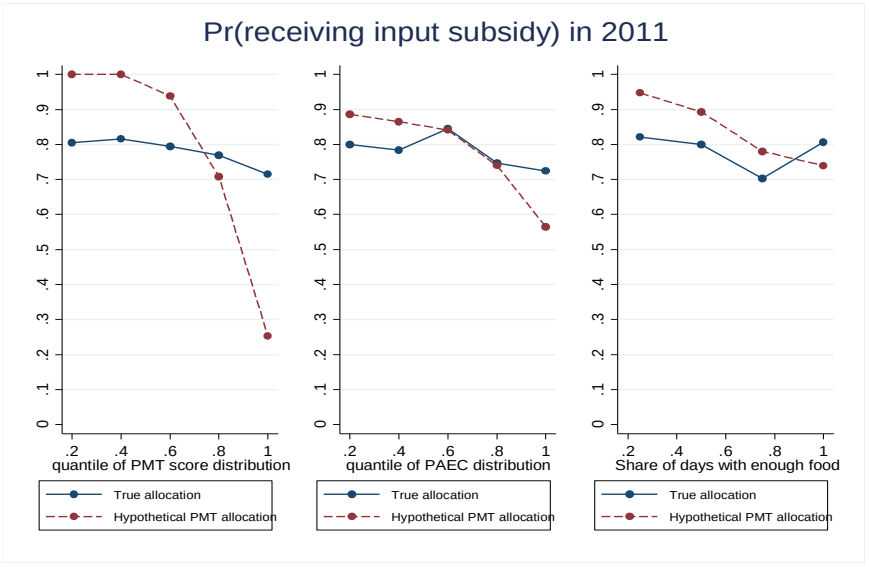
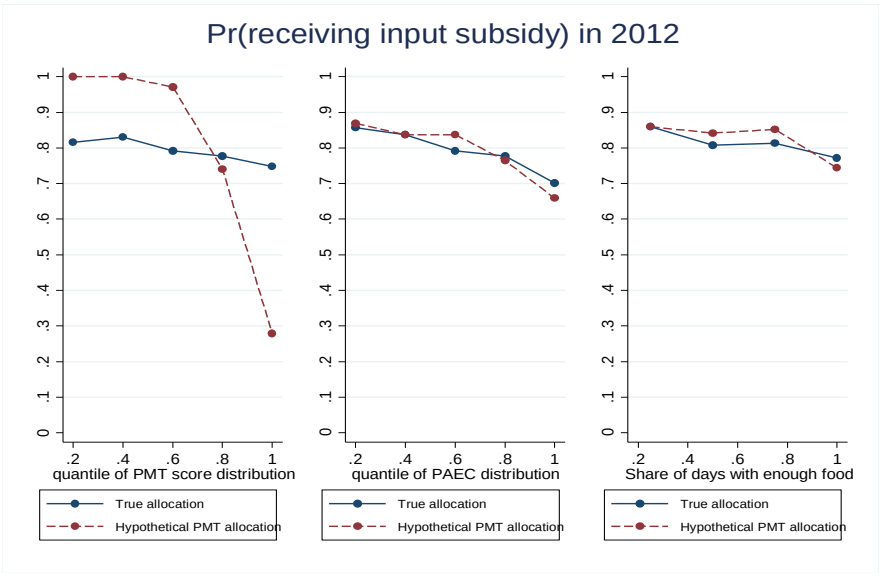
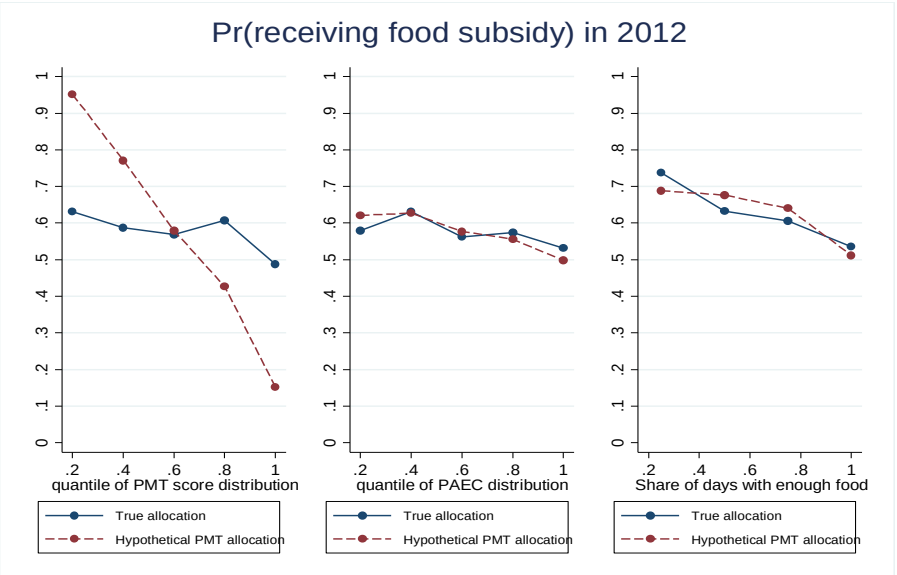
Figure 1. Relationship between PMT score, food expenditures and subsidy receipt



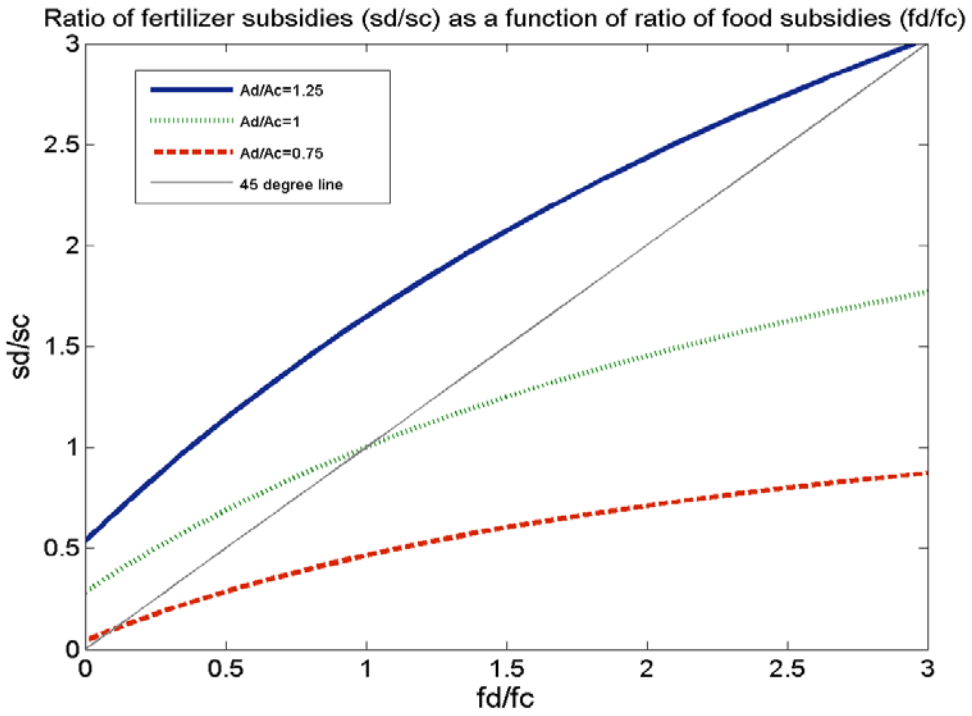




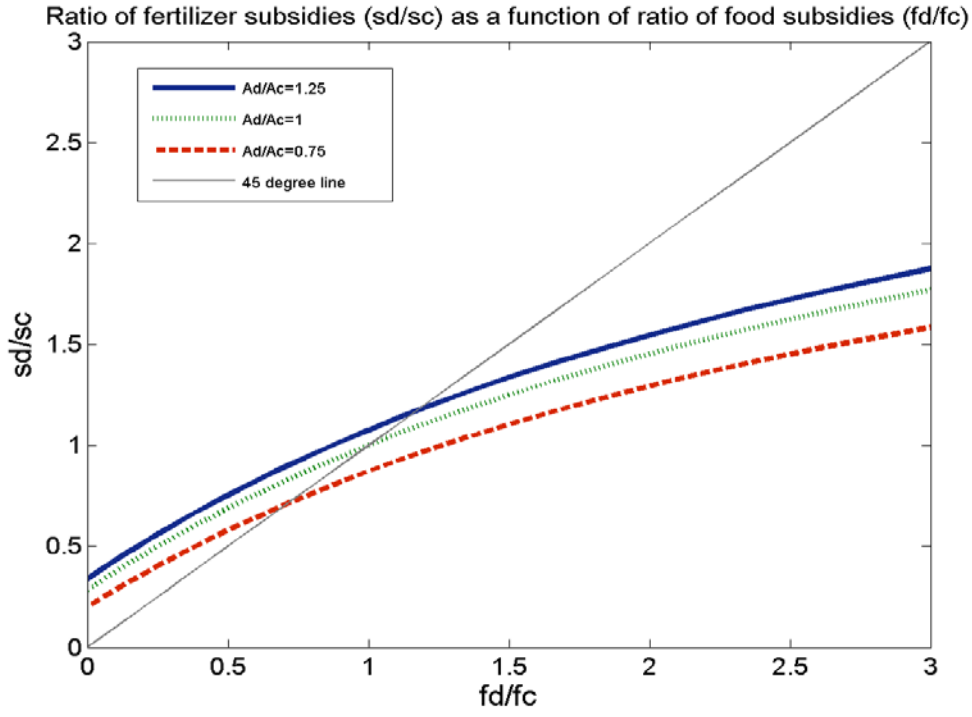
Notes: See main text section 4.2. The PMT formula is obtained using 2011 data. The "true" allocation is the allocation observed, made by chiefs. Because the share of households that receive subsidies vary across villages, the threshold PMT score for eligibility varies across villages, which explains why the allocation by PMT score quantile is not either 1 or 0.

Figure 2: Model Simulations

Panel A. ρ=0.5

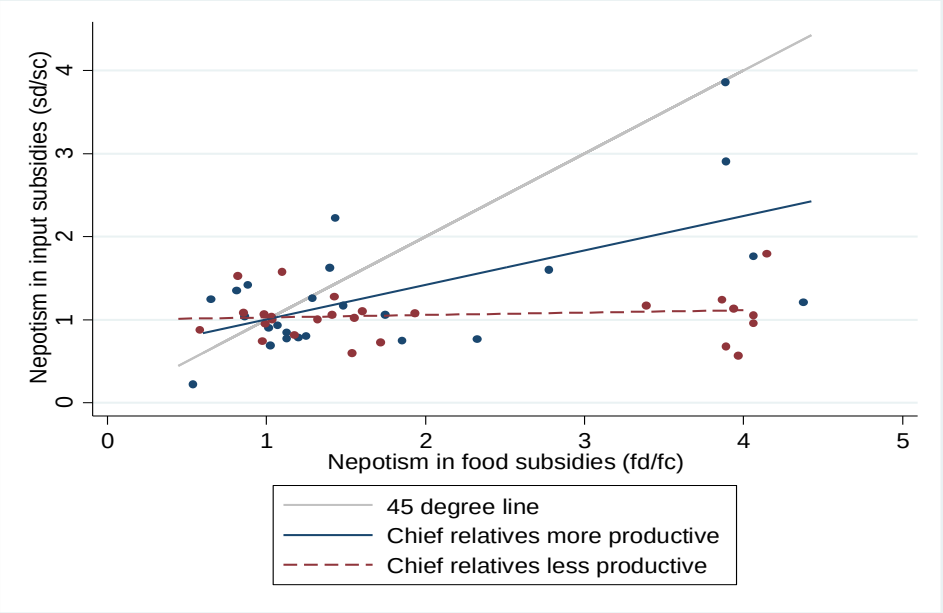


Panel B. ρ=1.2



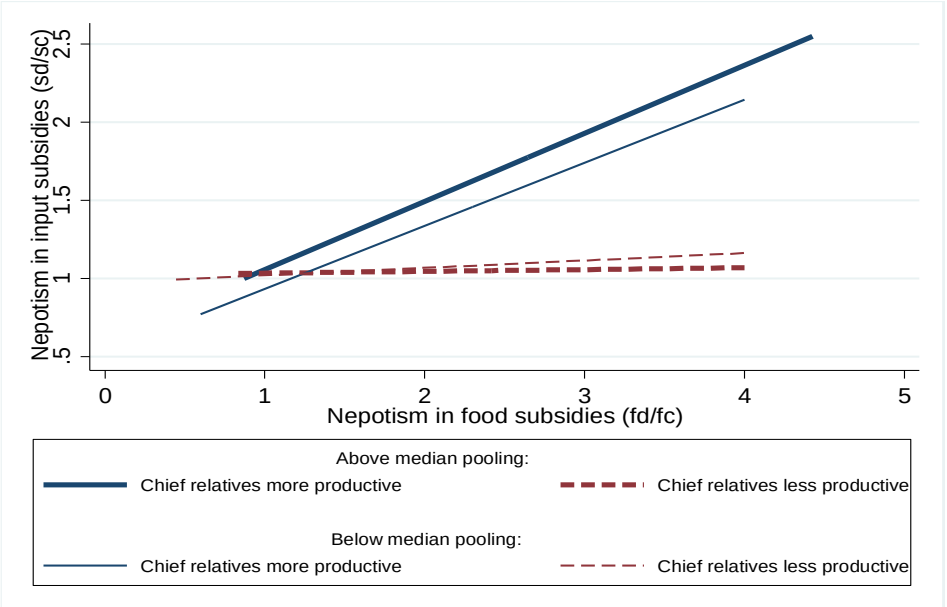
Notes: The baseline model parameters are set at μ=0.9, A_c=2, e_c=e_d=10, $f_c + f_d$=10, $s_c + s_d$=15.

Figure 3: Testing model prediction 1



Notes: Each dot corresponds to a village. N=50 (Villages with no chief kins are excluded). Productivity data comes from household survey wave 5. The x-axis is the ratio of the share of kins that got the food subsidy over the share of non-kins that got the food subsidy. Since kins are not poorer than non-kins on average, this is a measure of the level of nepotism in the allocation of the food subsidies, with a value of 1 corresponding to no nepotism. A ratio greater than 1 indicates some nepotism. The y-axis is the equivalent but for input subsidies. Nepotism top-coded at 4 (in cases where no non-kins received subsidy, e.g. f_c=0 or s_c=0). The results are robust to this top-coding choice.

Figure 4: Testing model prediction 2

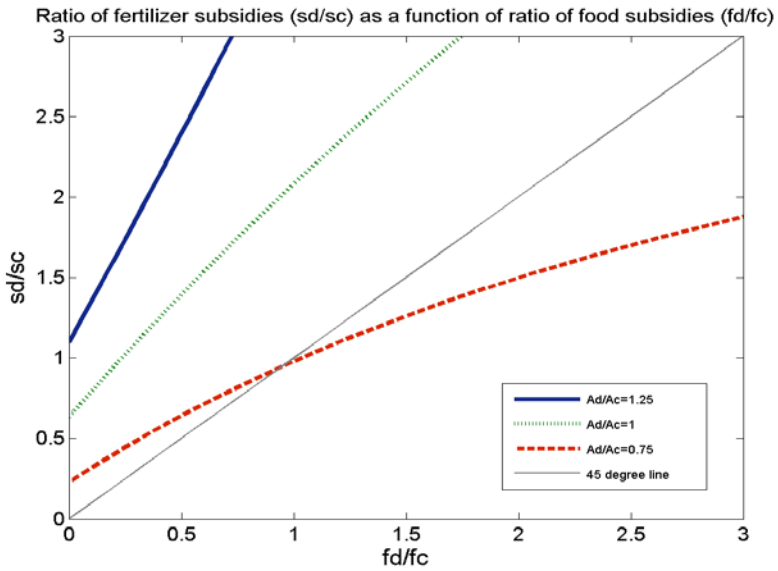


Notes: Each dot corresponds to a village. A village is considered to be pooling income more than the median if its coefficient of variation in assets is less than that of the median village. Productivity data comes from household survey wave 5. See Figure 3 notes for definitions and interpretations of nepotism measure. Nepotism top-coded at 4 (in cases where no non-relatives received subsidy, e.g. f_c=0 or s_c=0).

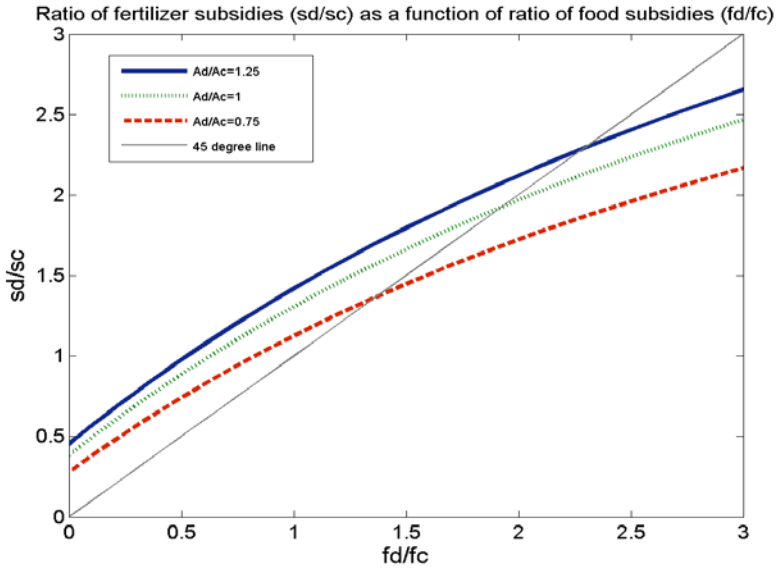
Figure 5: Simulations of Extended Model

Panel A.
Allowing productive response of food subsidies for the poor (class c)

A1. ρ=0.5

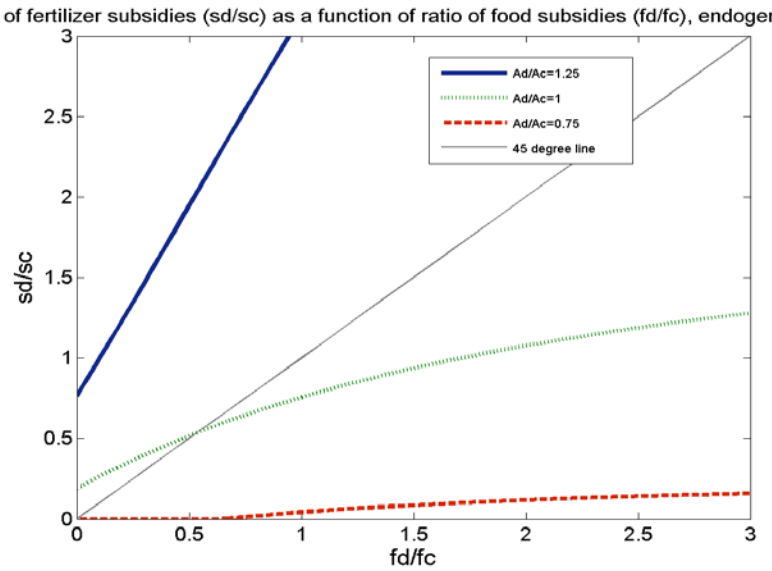


A2. ρ=1.2

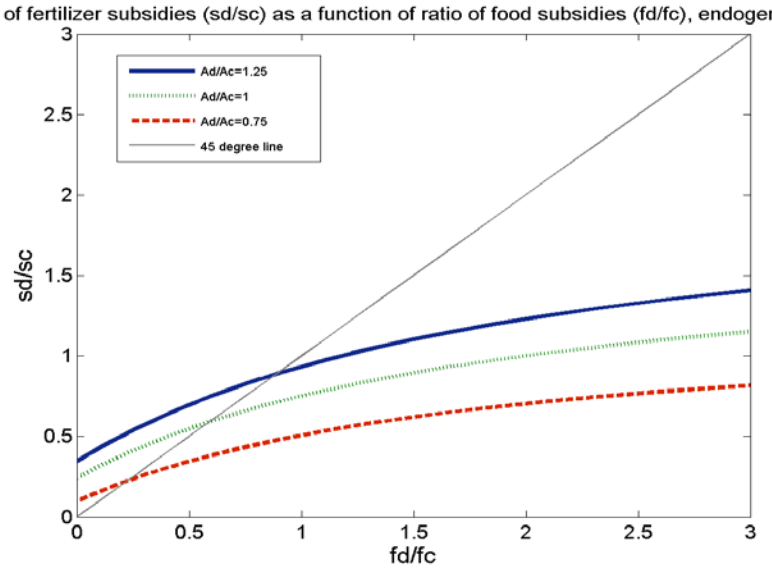


Panel B.
Allowing for endogenous grain prices

B1. ρ=0.5



B2. ρ=1.2



Notes: The baseline model parameters are set at μ=0.9, A_c=2, e_c=10, e_d=12, $f_c + f_d$=10, $s_c + s_d$=15. Panel B: We assume linear price effects and demographic weights for the two classes of β_d=0.25 and β_c=0.75.

Table 1. Summary Statistics on Households in the sample

Independent Variables	(1) Mean	(2) Std. Dev.	(3) Correlation between rounds
Panel A. Time-Invariant Baseline Variables			
Related to chief ("Kin")	0.27	0.45	-
Years of education (highest level of education completed)	4.94	3.48	-
Widowed or divorced female	0.28	0.45	-
Household size	4.64	2.09	-
Number of children	2.58	1.71	-
Respondent age	39.50	16.29	-
Reads or writes chichewa	0.59	0.49	-
Owns land	0.97	0.17	-
Farms land	0.99	0.10	-
Log acres of land owned	0.55	0.89	-
Log acres of land farmed	0.36	0.97	
Log value, all durable assets of household (in USD)	3.87	1.15	
Log value, all animal assets of household (in USD)	3.23	1.39	
Mud/dirt floor or worse	0.90	0.30	
Thatch roof	0.77	0.42	
Mud brick walls or worse	0.39	0.49	
Has electricity in dwelling	0.01	0.08	
No toilet	0.06	0.23	
Main source of drinking water: public tap	0.37	0.48	
Main source of drinking water: river or stream	0.01	0.07	
Number of households	1,387		
Panel B. Time-varying Variables			
Per adult equivalent total expenditures (monthly)	12.60	15.16	0.27
Per adult equivalent total food expenditures (monthly)	9.00	9.41	0.26
Per adult equivalent food expenditures on perishables (monthly)	2.56	3.35	0.36
Shocks			
Experienced drought or flood (past 3 months)	0.09	0.29	0.06
Experienced cattle death or crop disease (past 3 months)	0.15	0.36	-0.06
Lost employment or business (past 3 months)	0.03	0.17	-0.01
Respondent was sick (past month)	0.40	0.49	0.22
Respondent missed work due to illness (past month)	0.25	0.43	0.13
Other household member was sick (past month)	0.61	0.49	0.23
Report being worried about having enough food to eat (past month)	0.68	0.47	0.14
Number of observations	2,769		
Panel C. Exposure to subsidy programs			
Received input subsidy in 2008	0.63	0.48	-
Received input subsidy in 2009	0.68	0.47	-
Received input subsidy in 2010	0.75	0.43	-
Received input subsidy in 2011	0.78	0.41	-
Received input subsidy in 2012	0.82	0.39	-
Received input subsidy all 5 years	0.54	0.50	-
Never received input subsidy	0.09	0.29	-
Quantity of fertilizer received in 2011 if any (kgs)	75.44	28.85	
Quantity of fertilizer received in 2012 if any (kgs)	63.61	25.48	-
Quantity of seeds received in 2011 if any (kgs)	9.00	26.93	
Quantity of seeds received in 2012 if any (kgs)	6.79	19.35	-
Received food subsidy in 2012	0.59	0.49	-
Quantity of maize received in 2012 if any (kgs)	100.71	50.54	
Quantity of soy blend received in 2012 if any (kgs)	13.98	11.46	
Quantity of peas received in 2012 if any (kgs)	18.44	13.25	
Quantity of beans received in 2012 if any (kgs)	9.84	10.57	
Quantity of oil received in 2012 if any (liters)	3.01	2.31	
Received food and input subsidy in 2012	0.54	0.50	
Number of households	1,387		

Note: All monetary amounts are in US dollars. Exchange rate was roughly 150 MWK to $1 at the time of the baseline, and it was 300 MWK to $1 in late 2012.

Highest education reached, corresponds to either female or malke household head depeding on who had higher years of education.

Table 2: Summary statistics on chiefs and villages in the sample

	Village Chiefs (N=57)		Group Village Headmen (N=29)	
	Mean	SD	Mean	SD
Panel A. Chiefs				
Age	52.39	15.29	67.46	14.29
Male	0.84	-	0.79	0.41
Years of education	5.39	3.40	4.07	3.14
Religion				
Christian	0.37	-	n.a	n.a
Muslim	0.63	-	n.a	n.a
For how many years have you lived in this village?	43.47	17.30	n.a	n.a
For how many years have you farmed the land you currently farm?	22.46	12.64	n.a	n.a
For how many years have you been chief?	12.93	11.68	11.61	9.21
How were you selected to be chief?				
Hereditary	0.93	-	0.86	0.35
Appointed by Traditional Authority	0.02	-	0.34	0.48
Appointed by Group Village Head	0.07	-	0	0
Nominated by Dictrict Council			0.03	0.19
Elections were held	0.02	-	0.03	0.19
Self declared village head	0	-	0	0
Other	0	-	0.03	0.19
At the time you became chief, was there someone else considered for the position?	0.07	-	n.a	n.a
If yes: Did others refuse to take the position before the job came to you?	0.8	-	n.a	n.a
Receive a payment *(mswahala)* from the government for work as chief	0.91	-	0.76	-
Describe your responsibilities as village chief				
Demarcate and supervise good use of customary land	0.06	-		
Be a bridge between villagers and the government, disseminate information from district council to villagers	0.33	-		
Report to group village headman and traditional authority	0.61	-		
Encourage and monitor villagers participation in developments in the village	0.43	-		
Be in charge of subsidy programs working in the village	0.20	-		
Monitor public works program in the village	0.03	-		
Receive and reach out to NGOs working in the area	0.14	-		
Supervise that government laws are being followed	0.01	-		
Supervise that traditions are being followed, be a role model	0.14	-		
Solve conflicts among villagers	0.90	-		
Panel B. Villages (N=57)				
Number of households in village	340	367		
Village population	3727	4650		
Total acres of customary land in village	7491	6785		

Notes: Data from surveys conducted from August to October 2014 in the study districts.

Table 3. Allocation of subsidies

	Input subsidy	Food subsidy
Panel A. Surveys of Chiefs (N = 57)		
Who decides which households in the village will be beneficiaries of the subsidy program?		
Group Village head alone	0.02	
Village Development Committee alone	0.14	
Village head (chief) alone	0.63	
District Agriculture Development Office alone	0.07	
Villagers in open meeting	0.06	
Village head and villagers in open meeting, jointly	0.04	
Village head and Village Development Committee, jointly	0.04	
Does your village receive instructions from higher authorities on how beneficiaries should be selected?	0.19	
What selection criteria are used to allocate vouchers in your village?		
Neediness	0.98	0.97
Recent negative shocks	0.54	0.00
Farm size	0.11	0.00
Land quality	0	0.00
How hard-working the household is	0.12	0.00
Absence of male head	0.56	0.00
Child headed households and households taking care of orphans	0.25	0.00
Elderly or disabled	0.09	0.00
Other	0.05	0.03
If you received 15% more subsidy packages, how do you think they should be allocated across households?		
Give more to current beneficiaries	0.04	0.00
Give to households not currently receiving the subsidy, so that the number of beneficiaries expand	0.96	1.00
Panel B. Surveys of villagers in 2013 (N = 1,383)		
The chief organized a meeting to talk about the program	0.95	0.81
If yes, did you attend the meeting?	0.83	0.67
At the meeting, was there a discussion on:		
Who should get subsidies?	0.77	0.82
How subsidies should be shared?	0.75	0.71
How did you first hear about the program?		
Chief	-	0.68
Employee of program		0.01
Other villagers	-	0.30
Other person	-	0.01
Panel C. Survey of villagers in 2014 (N=542)		
Village head alone decides who will be a beneficiary of the subsidy program	0.48	0.74
What selection criteria are used to allocate vouchers in your village?		
Neediness	0.71	0.85
Number of children	0.06	0.08
Recent negative shocks	0.11	0.13
Farm size	0.01	0.01
Land quality	0.00	0.00
How hard-working the household is	0.13	-
Absence of male head	0.12	0.13
Elderly household	0.42	0.65
Other	0.51	0.57
Do you think the subsidy is allocated in a good way?		
Yes, very good	0.63	0.77
Somewhat good	0.29	0.20
Not so good	0.07	0.03
Very bad	0.01	0.01
What is your definition of a "good" allocation? An allocation that...		
... benefits the poorest	0.49	0.50
... increases total village production so that there is more food to share	0.08	-
... rewards those who work hard	0.04	0.00
... provides at least some inputs to most households	0.39	0.49
... benefits those not receiving subsidies from other programs	-	0.02
On a scale from 1 to 5, how much do you agree with the selection of input subsidy beneficiaries?	3.65	4.08

Notes: Panel A and C come from surveys administered in August-October 2014. Panel B comes from a survey administered February - May 2013.

Table 4: Targeting errors: Comparison of chief and PMT allocations with consumption-based allocation

	(1) True allocation (Chiefs)	(2) Hypothetical PMT Allocation	(3) Hypothetical Random Allocation	(4) P-val (1) = (2)	(5) P-val (1) = (3)	(6) P-val (2) = (3)
2011 Input Subsidy						
Percentage of population receiving subsidy	0.801					
Percentage of villages in which 100% received	0.123					
Percentage of villages in which 0% received	0.000					
If between 0 and 100%						
Simple error rate[1]	0.144	0.127	0.157	0.154	0.094*	0***
Mean squared error[2]	0.762	0.482	0.894	0.041**	0.136	0.001***
	(0.751)	(0.756)	(0.563)			
Number of villages	50					
2012 Input Subsidy						
Percentage of population receiving subsidy	0.837					
Percentage of villages in which 100% received	0.211					
Percentage of villages in which 0% received	0.000					
If between 0 and 100%						
Simple error rate	0.129	0.127	0.149	0.828	0.02**	0.014**
Mean squared error	0.354	0.290	0.458	0.043**	0.04**	0.003***
	(0.355)	(0.364)	(0.261)			
Number of villages	45					
2012 Food Subsidy						
Percentage of population receiving subsidy	0.567					
Percentage of villages in which 100% received	0.070					
Percentage of villages in which 0% received	0.070					
If between 0 and 100%						
Simple error rate	0.166	0.153	0.179	0.186	0.055*	0***
Mean squared error	0.452	0.335	0.558	0.161	0.131	0.001***
	(0.513)	(0.331)	(0.303)			
Number of villages	49					

Notes:

[1]Error rate is defined as the percentage of people who received the subsidy and shouldn't have. Since the total number of beneficiaries is fixed, this error rate is equal to the percentage of people who didn't receive the subsidy and should have.

[2]Mean squared error is calculated as deviations from the log PAEC threshold.

Table 5. Multivariate correlates of Subsidy Receipt

	(1)	(2)	(3)	(4)	(5)	(6)
	Received Input Subsidy (pooled 2011-12 seasons)			Received Food Subsidy (2012 only)		
Time Invariant Household Characteristics						
Related to chief	0.05	0.05	0.06	0.11	0.11	0.11
	(0.02)***	(0.02)***	(0.03)*	(0.03)***	(0.03)***	(0.05)**
Widowed or divorced female	0.03	0.03	-0.01	0.00	0.00	-0.02
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.06)
Household size	0.01	0.01	0.00	0.00	0.00	-0.01
	(0.00)**	(0.00)**	(0.01)	(0.01)	(0.01)	(0.01)
Respondent age	0.06	0.06	0.06	0.06	0.06	0.07
	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***
Respondent reads or writes chichewa	0.00	0.00	0.00	0.01	0.01	0.01
	(0.02)	(0.02)	(0.04)	(0.02)	(0.02)	(0.05)
Owns land	0.10	0.10	0.12	0.16	0.16	0.08
	(0.04)**	(0.04)**	(0.16)	(0.06)**	(0.06)**	(0.25)
Log acres farmed	0.02	0.02	0.01	0.01	0.01	-0.02
	(0.01)*	(0.01)*	(0.02)	(0.01)	(0.01)	(0.02)
Log durable assets	0.00	0.00	0.02	-0.01	-0.01	-0.04
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)*
Mud/dirt floor or worse	0.01	0.01	-0.03	0.06	0.06	0.14
	(0.03)	(0.03)	(0.06)	(0.04)	(0.04)	(0.08)*
Thatch roof	0.04	0.04	0.06	0.00	0.00	-0.10
	(0.02)*	(0.02)*	(0.05)	(0.03)	(0.03)	(0.06)*
Mud brick walls or worse	-0.08	-0.08	-0.08	-0.03	-0.03	-0.05
	(0.02)***	(0.02)***	(0.03)**	(0.03)	(0.03)	(0.05)
Expenditures						
Log perishable food PAE expenditures	-0.01	-0.01	-0.01	-0.02	-0.02	0.00
	(0.01)	(0.01)	(0.01)	(0.01)*	(0.01)*	(0.02)
Shocks						
Experienced cattle death or crop disease		0.02	0.02		-0.02	-0.05
(past 3 months)		(0.02)	(0.03)		(0.02)	(0.05)
Respondent missed work due to illness		-0.02	0.01		0.02	0.01
(past month)		(0.02)	(0.03)		(0.02)	(0.04)
Another household member sick		0.02	0.06		0.01	0.03
(past month)		(0.02)	(0.03)**		(0.03)	(0.05)
Returns						
Self-reported returns to fertilizer			0.05			-0.04
are higher than median			(0.03)*			(0.04)
Village FE?	Yes	Yes	Yes	Yes	Yes	Yes
Mean of dependent variable	0.73	0.73	0.71	0.59	0.59	0.55
Number of observations	6925	6925	2570	1385	1385	514
Number of households	1385	1385	514	1385	1385	514

Note: All monetary amounts are in US dollars. Exchange rate was roughly 300 MWK to $1 at the time of the baseline.

Standard errors clustered at the village level.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6. Correlates of inclusion and exclusion errors

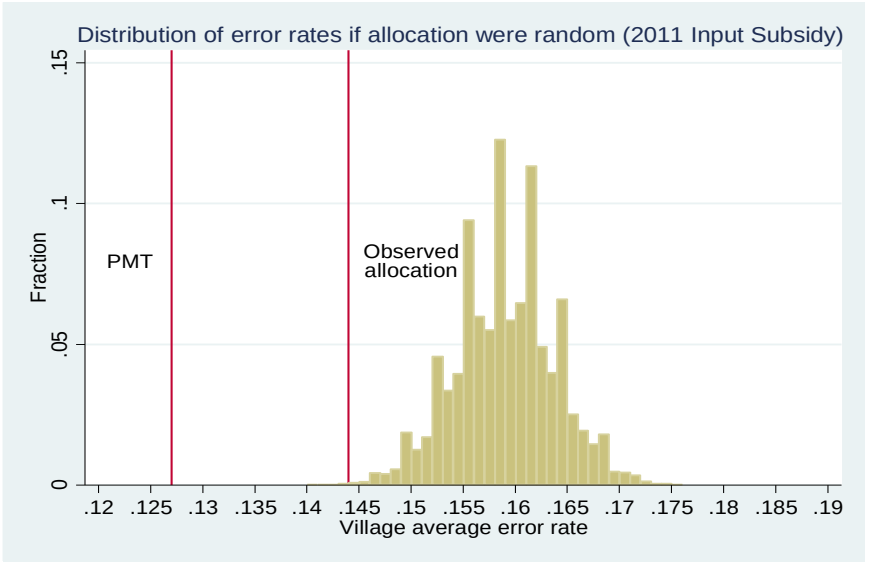
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Inclusion Errors				Exclusion Errors			
Subsample	Those *not* qualified under PAEC				Those qualified under PAEC			
Dep. Var	Received input subsidy		Received food subsidy		Did *not* receive input subsidy		Did *not* receive food subsidy	
Allocation	True (chief)	PMT	True (chief)	PMT	True (chief)	PMT	True (chief)	PMT
Baseline variables								
Related to chief	0.09	0.01	0.14	0.01	-0.05	-0.02	-0.08	0.01
	(0.07)	(0.06)	(0.05)***	(0.04)	(0.02)**	(0.02)	(0.03)***	(0.03)
Widowed or divorced female	0.07	0.20	0.16	0.15	0.01	-0.08	0.02	-0.14
	(0.08)	(0.08)**	(0.07)**	(0.05)***	(0.03)	(0.03)***	(0.03)	(0.04)***
Household size	0.00	0.08	-0.02	0.06	-0.01	-0.04	0.00	-0.05
	(0.02)	(0.01)***	(0.01)*	(0.01)***	(0.00)**	(0.01)***	(0.01)	(0.01)***
Respondent age (divided by 10)	0.05	0.04	0.06	0.03	-0.04	-0.03	-0.05	-0.04
	(0.02)***	(0.02)**	(0.02)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***
Reads or writes chichewa	0.00	-0.22	0.07	-0.16	-0.04	0.05	-0.05	0.04
	(0.06)	(0.07)***	(0.04)	(0.05)***	(0.03)	(0.02)**	(0.03)	(0.03)
Owns land	0.18	0.07	0.09	-0.03	-0.08	-0.20	-0.29	-0.20
	(0.10)*	(0.09)	(0.09)	(0.10)	(0.11)	(0.09)**	(0.11)***	(0.12)*
Log acres farmed	-0.02	-0.08	0.04	-0.01	-0.01	0.01	0.00	0.02
	(0.04)	(0.03)**	(0.02)**	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)
Mud/dirt floor or worse	0.06	0.04	0.02	-0.03	0.04	-0.05	-0.03	-0.08
	(0.12)	(0.12)	(0.07)	(0.07)	(0.03)	(0.04)	(0.05)	(0.06)
Thatch roof	0.04	0.17	-0.05	0.16	-0.06	-0.14	0.01	-0.07
	(0.08)	(0.11)	(0.06)	(0.05)***	(0.03)**	(0.03)***	(0.05)	(0.05)
Mud brick walls or worse	-0.12	0.08	-0.04	0.03	0.07	-0.01	0.05	-0.02
	(0.09)	(0.07)	(0.04)	(0.04)	(0.02)***	(0.02)	(0.05)	(0.03)
Variables from monitoring surveys								
Experienced drought or flood	0.17	0.02	0.08	0.06	-0.02	0.03	-0.04	-0.02
(past 3 months)	(0.08)**	(0.09)	(0.08)	(0.07)	(0.03)	(0.03)	(0.04)	(0.04)
Experienced cattle death or crop disease	0.09	0.07	0.04	0.08	-0.04	-0.03	-0.03	-0.05
(past 3 months)	(0.07)	(0.07)	(0.04)	(0.05)*	(0.02)*	(0.02)	(0.03)	(0.03)
Respondent missed work due to illness	0.01	0.11	-0.04	0.01	0.06	0.00	-0.01	0.01
(past month)	(0.06)	(0.06)*	(0.05)	(0.05)	(0.02)***	(0.02)	(0.03)	(0.04)
Another household member sick	0.01	0.03	0.03	-0.05	-0.01	0.00	0.03	0.02
(past month)	(0.06)	(0.06)	(0.05)	(0.04)	(0.03)	(0.02)	(0.03)	(0.03)
Variable from wave 5 only, estimated off of subsample only								
Self-reported returns to fertilizer	0.08	-0.13	-0.04	0.04	-0.07	-0.02	0.07	-0.05
are higher than median	(0.13)	(0.10)	(0.06)	(0.07)	(0.03)*	(0.03)	(0.04)	(0.05)
Observations	237	237	535	535	1090	1090	792	792
Number of households	237	237	535	535	1090	1090	792	792
Mean of dep. Var.	0.64	0.6	0.38	0.33	0.14	0.14	0.27	0.24
R-squared	0.1	0.27	0.11	0.16	0.06	0.14	0.07	0.12

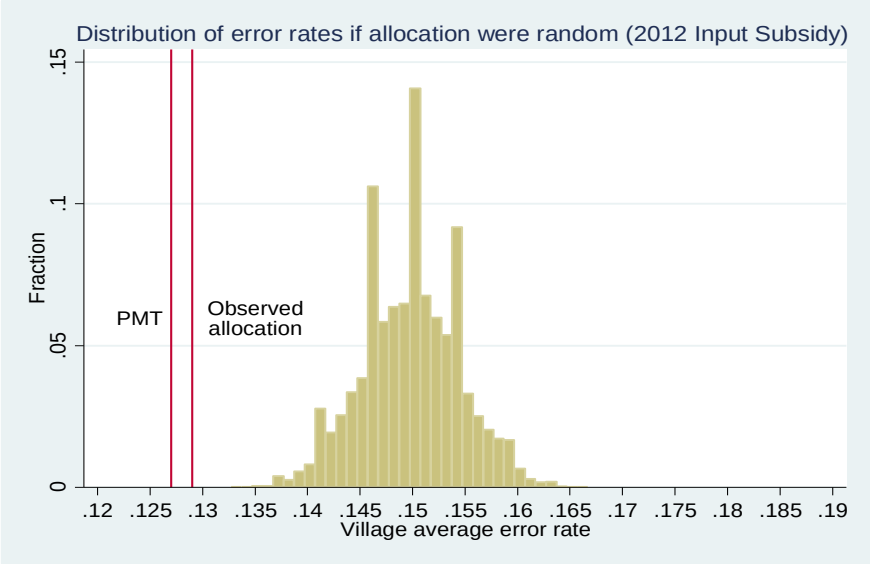
Notes: Standard errors, clustered by village, in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%. Analysis is for year 2012 only.

Table 7: Perceived Within-Village Heterogeneity among Village Chiefs

	Mean
At this time, do you have a good sense of who in the village is planning to farm the next farming season?	
Not at all	0.00
To some extent	0.04
Yes	0.26
N/A, everyone farms around here	0.70
Do you know which families in the village are having specific difficulty with money at a given time?	
Not at all	0.05
Only for some	0.19
For the most part	0.16
Yes, I know how everyone is doing	0.60
Do you know who is likely to have money to buy fertilizer for the coming planting season and who will not?	
Not at all	0.23
Only for some	0.12
For the most part	0.16
Yes, I know how everyone is doing	0.49
Can you easily categorize households in the village with land better suited for fertilizer and those with land not so well suited for fertilizer?	
Yes, easily	0.86
Not so easily	0.11
Not at all	0.02
Not sure / don't know	0.02
Can you easily categorize households in the village in two groyups, those who work hard in their land and those who don't?	
Yes, easily	0.86
Not so easily	0.12
Not at all	0.02
Can you easily categorize households in the village in two groups, those who are very poor and those who are less poor?	
Yes, easily	0.95
Not so easily	0.05
Number of observations	57

Figure A1. Permutation test, village average error rate





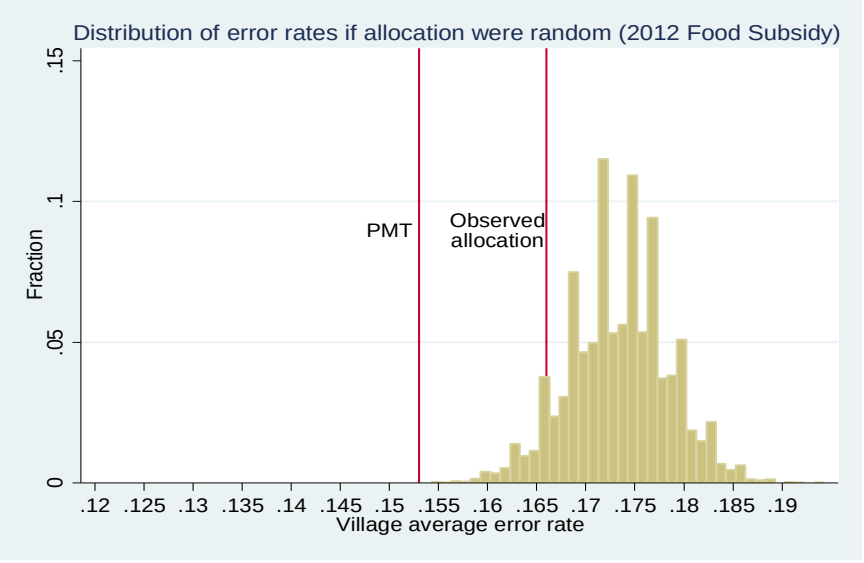
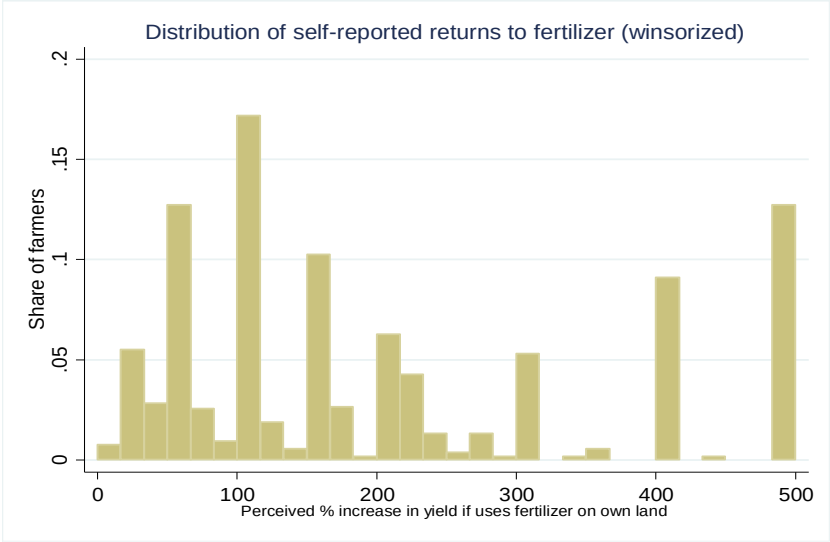


Figure A2: Heterogeneity in Perceived Returns to Fertilizer Use

Panel A. Distribution of Self-Reported Returns to Fertilizer



Notes: Farmers were asked the following questions: *How much maize would you get out of your land if you used no fertilizer at all?* And *How much maize would you get out of your land if you used fertilizer on all of your land at planting?* We use the answers to these two questions (y1 and y2) to compute the self-reported returns to fertilizer as (y2-y1)/y1 x 100.

Panel B. Variation in Within-Village Heterogeneity between Chief's Kins and non-Kins

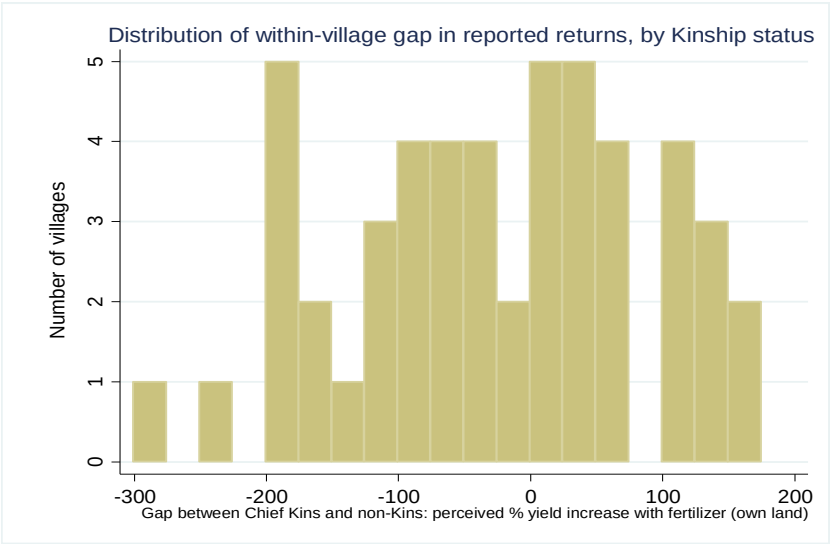
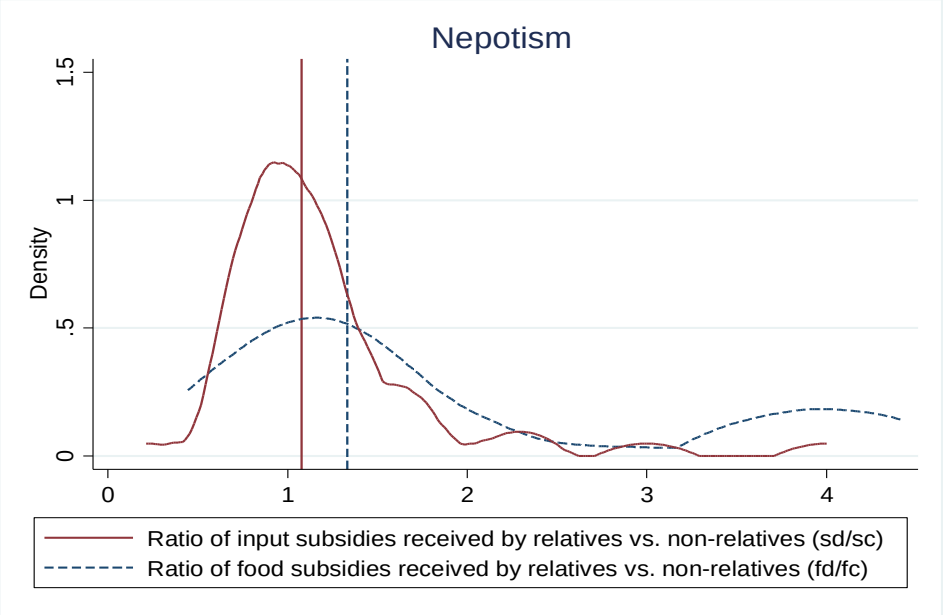


Figure A3: Distributions of Nepotism Measures Across Villages



Notes: The plots show the distribution of the nepotism measures across villages in the sample. The vertical lines indicate the medians. See Figure 3 notes for definitions and interpretations of the nepotism measure.

Table A1. Sharing of subsidies

	Input subsidy	Food subsidy
Panel A. Chiefs		
Do voucher recipients in your village usually share with someone else?		
Yes, all voucher recipients	0.16	0.33
Yes, some voucher recipients	0.23	0.49
No	0.58	0.18
Panel B. Villagers		
Received voucher and didn't share	0.12	n.a
Received voucher and shared	0.46	n.a
Received share of someone's voucher	0.34	
Didn't receive a voucher or share	0.09	
If received a voucher: Who decided the voucher would be shared?		
Respondent	0.11	n.a
Village members	0.03	n.a
Village Chief	0.83	n.a
Other	0.03	n.a
If shared or received share: Who decided with whom the voucher/food would be shared?		
Respondent	0.12	0.12
Person who received voucher	0.03	0.00
Village members	0.02	0.00
Village Chief	0.79	0.73
Group Village Head	0.00	0.03
Other	0.05	0.08
In your view, does the sharing improve the allocation? (Yes = 1)	0.77	0.86
Number of observations	541	455

Note: Data from survey wave 5 conducted in 2014. Panel B corresponds to subsidies received in 2012.

Table A2. Correlations between food expenditures and reported need in the last 30 days

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline			Follow-up 1		
	Dep. Var: Worried about not having enough food (0/1)					
Log Perishable food exp.	-0.05			-0.06		
	(0.01)***			(0.01)***		
Log Total food exp.		-0.03			-0.05	
		(0.01)***			(0.01)***	
Food share of exp.			0.12			0.15
			(0.07)*			(0.08)*
Observations	1384	1384	1384	1383	1383	1383
R-squared	0.03	0.01	0.00	0.04	0.02	0.00
Mean of Dep. Var.	0.60	0.60	0.60	0.66	0.66	0.66
	Dep. Var: Number days HH had to reduce number of meals					
Log Perishable food exp.	-0.76			-0.68		
	(0.11)***			(0.13)***		
Log Total food exp.		-0.84			-0.49	
		(0.14)***			(0.18)***	
Food share of exp.			-0.89			1.26
			(0.98)			(1.34)
Observations	1383	1383	1383	1385	1385	1385
R-squared	0.04	0.02	0.00	0.02	0.01	0.00
Mean of Dep. Var.	3.26	3.26	3.26	4.63	4.63	4.63
	Dep. Var: Number of days HH had to limit portion size					
Log Perishable food exp.	-0.92			-0.92		
	(0.13)***			(0.16)***		
Log Total food exp.		-0.82			-0.91	
		(0.17)***			(0.23)***	
Food share of exp.			-0.37			2.5
			(1.19)			(1.74)
Observations	1380	1380	1380	1385	1385	1385
R-squared	0.04	0.02	0.00	0.02	0.01	0.00
Mean of Dep. Var.	4.76	4.76	4.76	7.83	7.83	7.83

All dependent and independent variables are for the past 30 days. Standard errors in parentheses. Expenditure variables expressed in US dollars. We do not perform the exercise for follow-up 2 data as in that survey, the timeframe for the need questions was, unfortunately, the last 12 weeks, whereas the expenditures data is for the last 30 days.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A3. PMT formula

	(1) Log PAE perishable food expend.	(2) Log PC perishable food expend.	(3) Log PC total food expend.	(4) 10 * Food share of expend.	(5) Log PAE perishable food expend.	(6) Log PC perishable food expend.	(7) Log PC total food expend.	(8) Food share of expend.
Log durable assets	0.32	0.32	0.29	-0.08	0.34	0.35	0.30	-0.10
	(0.05)***	(0.04)***	(0.03)***	(0.05)	(0.04)***	(0.04)***	(0.03)***	(0.05)**
Log animal assets	0.02	0.02	0.01	0.00				
	(0.04)	(0.04)	(0.03)	(0.05)				
Owns land	-0.26	-0.23	-0.17	-0.03				
	(0.25)	(0.24)	(0.19)	(0.30)				
If yes: log acres owned	-0.01	-0.02	0.03	0.05				
	(0.06)	(0.05)	(0.04)	(0.07)				
If yes: log acres farmed	0.03	0.04	0.03	-0.03				
	(0.05)	(0.05)	(0.04)	(0.06)				
Dual-headed household	0.00	-0.07	-0.09	0.01				
	(0.12)	(0.11)	(0.08)	(0.14)				
Household size	-0.12	-0.15	-0.17	-0.11	-0.12	-0.13	-0.14	-0.10
	(0.05)**	(0.05)***	(0.04)***	(0.06)*	(0.05)**	(0.04)***	(0.03)***	(0.06)*
Number of children	-0.02	-0.06	-0.01	0.13	-0.03	-0.07	-0.04	0.12
	(0.06)	(0.05)	(0.04)	(0.07)*	(0.05)	(0.05)	(0.04)	(0.07)*
Age household head (in tens)	-0.01	-0.01	-0.01	0.00	-0.01	-0.01	-0.01	0.00
	(0.00)***	(0.00)**	(0.00)***	0.00	(0.00)***	(0.00)**	(0.00)***	0.00
Years education household head	0.06	0.05	0.05	0.02	0.06	0.06	0.04	0.00
	(0.02)***	(0.02)***	(0.01)***	(0.02)	(0.01)***	(0.01)***	(0.01)***	(0.02)
Household head is literate	0.02	0.03	-0.10	-0.21				
	(0.11)	(0.10)	(0.08)	(0.13)				
Has cement floor	0.04	0.08	0.07	-0.13				
	(0.16)	(0.15)	(0.12)	(0.20)				
Has mud floor	-0.04	-0.06	0.19	0.33	-0.05	-0.07	0.18	0.36
	(0.13)	(0.12)	(0.10)*	(0.16)**	(0.13)	(0.12)	(0.10)*	(0.16)**
Has thatch roof	-0.07	-0.04	0.18	0.33	-0.10	-0.08	0.16	0.38
	(0.13)	(0.12)	(0.09)*	(0.15)**	(0.11)	(0.10)	(0.08)**	(0.13)***
Has mud walls	0.02	0.00	0.04	0.04				
	(0.10)	(0.09)	(0.07)	(0.11)				
No toilet (private or shared)	-0.04	-0.07	-0.04	0.18				
	(0.18)	(0.17)	(0.13)	(0.22)				
Main source of drinking water: public tap	0.17	0.18	-0.01	0.09	0.16	0.17	-0.02	0.08
	(0.09)**	(0.08)**	(0.06)	(0.10)	(0.08)*	(0.08)**	(0.06)	(0.10)
Main source of drinking water: river/stream	-0.90	-0.82	0.03	0.70	-0.93	-0.85	0.00	0.67
	(0.58)	(0.54)	(0.43)	(0.69)	(0.58)	(0.54)	(0.43)	(0.69)
Main occupation: vendor	0.63	0.58	0.51	0.32	0.62	0.56	0.49	0.31
	(0.13)***	(0.13)***	(0.10)***	(0.16)**	(0.13)***	(0.12)***	(0.10)***	(0.16)*
Main occupation: other business	0.53	0.46	0.51	0.43	0.54	0.48	0.51	0.42
	(0.11)***	(0.10)***	(0.08)***	(0.13)***	(0.11)***	(0.10)***	(0.08)***	(0.13)***
Households	1385	1385	1385	1385	1385	1385	1385	1385
R-squared	0.18	0.21	0.24	0.05	0.17	0.20	0.23	0.04

Notes: Baseline data. Expenditure in USD. Standard errors in parentheses. *, **, and *** denote significance at 10%, 5%, and 1%.

Table A4. Predictive power of baseline characteristics for expenditures in 3 countries (Kenya, Malawi, and Uganda)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Malawi			Kenya			Uganda		
	Log total expend.	Log total food expend.	Log perishable food expend.	Log total expend.	Log total food expend.	Log perishable food expend.	Log total expend.	Log total food expend.	Log perishable food expend.
Log durable assets	0.33	0.23	0.34	0.24	0.21	0.23	0.20	0.16	0.18
	(0.02)***	(0.02)***	(0.02)***	(0.03)***	(0.04)***	(0.05)***	(0.03)***	(0.03)***	(0.03)***
Log animal assets	-0.010	-0.030	-0.010	0.03	0.02	0.04	0.060	0.010	0.020
	(0.02)	(0.02)*	(0.02)	(0.02)**	(0.02)	(0.03)	(0.02)***	(0.02)	(0.02)
Owns land	-0.27	-0.34	-0.32	0.13	0.17	0.20	-0.13	-0.27	-0.02
	(0.08)***	(0.09)***	(0.10)***	(0.09)	(0.11)	(0.13)	(0.07)*	(0.06)***	(0.06)
If yes: log acres owned	0.02	0.00	0.00	0.03	-0.01	-0.03	0.01	-0.05	0.04
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)	(0.05)	(0.03)	(0.03)**	(0.03)
Dual-headed household	0.00	-0.02	0.07	0.69	0.72	0.77	-0.16	0.09	0.03
	(0.05)	(0.05)	(0.06)	(0.06)***	(0.07)***	(0.09)***	(0.06)***	(0.06)	(0.06)
Age household head (in tens)	-0.34	-0.41	-0.48	0.04	0.05	0.08	1.06	0.34	0.21
	(0.06)***	(0.07)***	(0.07)***	(0.01)***	(0.01)***	(0.01)***	(0.14)***	(0.13)***	(0.13)
Age household head squared	0.02	0.03	0.04	0.00	0.00	0.00	-0.11	-0.04	-0.03
	(0.01)***	(0.01)***	(0.01)***	(0.00)***	(0.00)***	(0.00)***	(0.02)***	(0.02)**	(0.02)*
Years education household head	-0.01	-0.02	-0.02	0.04	0.03	0.03	1.73	1.46	1.67
	-0.040	-0.040	-0.050	(0.01)***	(0.01)***	(0.01)**	(0.46)***	(0.67)**	(0.13)***
Has thatch roof	0.00	0.03	-0.13	0.00	0.01	0.01	-0.22	-0.15	-0.26
	(0.05)	(0.06)	(0.07)*	(0.06)	(0.07)	(0.08)	(0.16)	(0.14)	(0.18)
Has mud walls	-0.01	-0.02	-0.02	-0.39	-0.27	0.02	-0.16	-0.04	-0.16
	(0.04)	(0.04)	(0.05)	(0.20)**	(0.20)	(0.24)	(0.08)**	(0.07)	(0.09)*
Has mud floors	-0.12	-0.06	-0.12	0.27	0.14	-0.06	-0.20	-0.13	-0.04
	(0.06)*	(0.07)	(0.08)	(0.19)	(0.19)	(0.21)	(0.06)***	(0.06)**	(0.06)
Observations	4032	3908	3712	5495	5495	5495	3966	3357	2844
Households	2167	2154	2123	981	981	981	2070	1894	1730
R-squared	0.23	0.11	0.16	0.13	0.13	0.13	0.11	0.05	0.05

Notes: Standard errors, clustered by household, in parentheses. *, **, and *** denote significance at 10%, 5%, and 1%. Data for Kenya comes from Dupas, Keats and Robinson (2014) and data for Uganda comes from Dupas, Karlan, Robinson and Ubfal (2014).

Appendix Table A5. Correlations between percentiles of distribution across survey rounds: Co

	(1)	(2)
	In bottom X percentile of PAEC distribution in 2011?	
	No	Yes
25th percentile		
In bottom X percentile of PAEC distribution in 2012?		
No	0.62	0.15
Yes	0.15	0.08
50th percentile		
In bottom X percentile of PAEC distribution in 2012?		
No	0.31	0.20
Yes	0.20	0.29
75th percentile		
In bottom X percentile of PAEC distribution in 2012?		
No	0.12	0.15
Yes	0.15	0.58

Notes: Number of observations = 1,387.