Agricultural Growth and Poverty in Rural Malawi

Final Report

By

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Abstract

Since the implementation of the agricultural subsidy programme in 2005/06 season, the agricultural sector in Malawi has grown at 10.7 percent per annum and gross domestic product has been increasing at more than 6 percent per annum. Poverty has also declined from 52 percent in 2004/05 to 39 percent in 2009. This study explores the relationship between initial poverty conditions and agricultural growth and the role of the agricultural input subsidy programme in Malawi using panel data between 2005 and 2008. The study uses matched panel data from 1227 households and controls for possible endogeniety between access to subsidy and agricultural growth. The results show that households in lower income quintiles tend to have lower agricultural growth rates compared to the richest 20 percent of households; hence poverty is constraining agricultural growth. However, the results are sensitive to the indicator of poverty used in the analysis. Using initial poverty status in terms of classification of households into poor and non-poor groups based on the national survey, we do not find evidence that poverty is a binding constraint on agricultural growth. Importantly, the study shows that access to subsidy by the poorest 20 percent does not lead to higher agricultural growth rates amongst the poorest households, suggesting that such productivity enhancing interventions are inappropriate in addressing the fertilizer affordability problem among poor smallholder farmers. We also find a positive relationship between agricultural growth and purchase of commercial fertilizers, land size and access to extension advice. The policy implications of the study are two-fold. First, agricultural subsidies may not be the best instrument for unlocking the growth potential of the poorest; hence this group may require other social protection instruments such as direct cash transfers. Secondly, revitalisation of extension services in the agricultural sector is important for agricultural growth.

1.   Context and Background

The agricultural sector is the most important sector in sub-Saharan Africa and is a dominant form of livelihood for a majority of the population that resides in the rural areas. About 60 percent of the economically active population is engaged in agriculture, and agriculture accounts for more than 15 percent of gross domestic product (GDP) in most countries in Africa (Gollin, 2009). Africa is also the poorest continent, and faces persistent problems of food insecurity, high malnutrition and high mortality rates. Duclos and O'Connell (2009) reckon that 'Africa will soon have the largest absolute number of poor people on earth, larger than in East Asia or in South Asia, where absolute population sizes are larger'. There are several arguments that have been advanced as to why countries in which most of their labour in agriculture remains largely food insecure and its population remaining in poverty. One argument is that agricultural productivity in sub-Saharan Africa is low and farmers face low-productivity trap. Dorward et al. (2008) note that unstable food prices lead to low producer investment and consumers lock in to low productivity food crops, and these consequently lead to low agricultural productivity. Low productivity leads to low and vulnerable real incomes which in turn lead to low demand for non-agricultural goods and services. Agriculture has failed to get Africa out of poverty, and most countries are experiencing low agricultural growth, rapid population growth, weak foreign exchange earnings and high transaction costs (World Bank, 2008).

In Malawi, agriculture remains the dominant sector and its role in contributing to gross domestic product and employment has not significantly changed since Independence in 1964. Agriculture accounts for 35 percent of GDP and generates more than 80 percent of foreign exchange. It is estimated that crop production accounts for 74 percent of all rural incomes and agriculture is the most important occupation for 71 percent of the rural population (Chirwa and Zakeyo, 2006). The agricultural sector development in Malawi is characterised by a two pronged approach based on smallholder and estate agriculture. While the estate sector has been the main source of the expanding crop exports; the smallholder farmers account for the bulk of food supplies as well as providing some export surplus. The main crop grown by the smallholder farmers is maize, the main staple crop in Malawi. Maize is cultivated by smallholder farmers mainly to meet their subsistence needs, with less than 20 percent produced as marketed surplus. However, a large proportion of smallholder farmers do not produce adequate food to last them from one season to another and therefore rely on the market to provide food supplies. Tobacco is the main cash crop grown by the smallholder farmers. Other cash crops grown by smallholder farmers include cotton, groundnuts, tea and coffee, although the proportion of farmers that grow these cash crops are far much lower than the proportion cultivating maize. The structure of the economy has not changed substantially from the 1970s with agriculture contributing 40 percent of gross domestic product and the manufacturing sector contributing only 12 percent of gross domestic product. Recent statistics show that while the agricultural sector continue to be the dominant sector in Malawi, the contribution of the manufacturing sector has declined to 8 percent while the

agriculture sector continue to contribute 35 percent. The experience of the performance of the economy in the past two decades in Malawi has been erratic and poverty has remained high. Chirwa et al (2008) note that the annual growth rates in per capita gross domestic product averaged -2.1 percent in the 1980-84 period, -2.7 percent in 1990-94 period, 3.8 percent in 1995-99 and -0.2 percent in the 2000-05 period. The performance of the agricultural sector and other sectors has been similar to the trends in gross domestic products with periods of high growth rates in the 1970s and experiencing negative growth rates in the 1980s. More recently, particularly since 2006, the agricultural sector has been growing at an average rate of 10.7 percent per annum, largely attributed to the input subsidy program that has been implemented since the 2005/06 season and the good weather conditions that the country has experienced.

The poverty incidence remains high in Malawi. Using the first integrated household survey, it was estimated that in 1998 about 54.1 percent of the population was living below the poverty line, with rural poverty at 58.1 percent (NSO, 2005). The second integrated household survey conducted in 2004/5 revealed that 52.4 percent of the population was poor, with rural poverty only falling to 55.9 percent (GOM and World Bank, 2007). Recent poverty estimates indicate that the proportion of the poor dropped to 45 percent in 2006 from 52 percent in 2004 (NSO, 2007). According to NSO (2010) poverty decreased to 40 percent in 2008 and to 39 percent in 2009. Similarly, the proportion of ultra-poor has decreased from 22 percent in 2004 to 15 percent in 2009. Rural poverty has also declined from 53 percent in 2005 to 43 percent in 2009. Despite the decrease in poverty estimates, inequalities in living standards among households persist. GOM and World Bank (2007) find that inequality measured by the Gini coefficient has remained at 0.39.

Development strategies in Malawi have emphasized the importance of the growth of the agricultural sector in the fight against poverty, since most of the poor are currently engaged in the agricultural sector and mostly involved in subsistent agriculture. For instance, GOM (2002) recognises increasing agricultural incomes as one strategy of ensuring pro-poor growth. The role of agriculture in pro-poor growth is also emphasized in the recent development strategy (GOM, 2006) in which it is stated that improving agricultural productivity is critical in improving the welfare of the poor in Malawi. The growth rates in agricultural output have been volatile between 1990 and 2005, and during this period there has been marginal reduction in national poverty rates. For instance, between 1998 and 2005, the growth rate in GDP and agricultural GDP rose respectively by 6.8 percent and 6 percent per annum but poverty fell by 0.2 percent point per year. Although Malawi has experienced strong economic and agricultural growth, the question remains whether such consistent positive growth rates in the past five years have lead to poverty reduction.

2.   Gaps in Literature on Nexus

The links between growth and poverty are complex and are well documented and debated in the literature (see Thorbecke, 2009). There is consensus among economists that while growth may be necessary for poverty reduction, it is not a sufficient condition. The existing empirical evidence on the link between growth and poverty just demonstrate the complexity of the relationship (Ravallion and Datt, 2002). There are dynamic relationships that exist between growth and income distribution and their interactions with poverty (Thorbecke, 2009). There are generally two strands of arguments about the relationship between growth and poverty. On one hand, there are theoretical frameworks that show the impact of growth on poverty reduction; generally associated with the pro-poor growth concept. On the other hand, the literature on poverty traps suggests that growth can be constrained by poverty while the traditional neoclassical growth model suggests that poverty may be associated with higher growth rates.

The growth-poverty link is associated with the pro-poor growth concept, which focuses on the impact of growth on poverty reduction. However, the extent to which a given rate of growth translate into poverty reduction will depend on how distribution of income changes with growth and on initial inequalities in incomes, assets and access to opportunities that allow poor people to participate in generating growth (World Bank, 2001). Others, such as Hoekman et al. (2001), argue that for growth to have some meaningful impact on poverty, that growth must occur in sectors in which a large proportion of the poor derive their livelihood. Timmer (2005) concludes that in many circumstances, growth in the agricultural sector has been an important ingredient in the formula that connects economic growth to the poor.

Poverty may also affect the rates at which economies grow. On one hand, based on the Solow's neoclassical growth theory that implies β-convergence, which predicts that countries that are far from the steady state are likely to grow at a faster rate than those that are close to the steady state. This implies that there is a negative relationship between initial incomes and growth rate of economies. The underlying assumption is that the poor have higher marginal returns to productive assets than the rich, which enables the poor to catch up with the rich. On the other hand, high inequality may be harmful to growth particularly in situations where credit markets fail and are biased against the poor. Summarizing the arguments from some studies, Ravallion and Datt (2002) note that the higher the proportion of the credit-constrained poor in an economy the lower the growth rate. This is consistent with the poverty traps theoretical framework which contends that developing countries do not grow fast because of high levels of poverty. There is a growing literature about the impact of poverty traps on the growth of economies (see for example Carter and Barrett, 2006; Carter and May, 2006; Adato et al, 2006; Barrett et al, 2006; Orr et al, 2009). Ravallion and Datt (2002) also note that high

inequality may also explain why the same level of growth may have different implications on poverty in different environments. In the poverty traps theoretical framework, there may exist self-reinforcing multiple equilibriums of the persistently poor and persistently rich people.

The literature on growth and poverty suggests that growth is necessary but not sufficient for poverty reduction (Ravallion and Datt, 2002; Hoekman et al., 2001). Others argue that growth in incomes of the poor is strongly correlated with overall growth of the economy, and this fact has been demonstrated in cross-country and individual country studies (Hoekman et al., 2001). It can therefore be argued that policies that promote growth are likely to lead into poverty reduction. However, as the World Bank (2001) notes, the patterns of growth, the changes in the distribution of income and resulting opportunities and the rates of poverty distribution are a result of a complex interaction among the policies, institutions, history and geography of countries. Thus, countries that achieve the same growth rate are unlikely to reduce poverty in the same manner.

Bigsten and Shimeles (2003) assert that the direction of causality of growth-income distribution-poverty relationship is still very unclear in theory as well as in empirical studies. According to Perry et al (2006), poverty and growth interact in a vicious circle where high poverty leads to low growth and low growth in turn leads to high poverty. While most of the empirical studies that test the link between initial poverty and growth have mainly utilized cross-country data (such as O'Neill and Van Kerm, 2004), our understanding of the link between poverty and growth at household level empirically remains limited. There are a few studies that have focused on the relationship between growth and poverty at household level exploiting panel data (Ravallion and Datt, 2002; Bigsten et al., 2003; Deininger and Okidi, 2003; Chirwa, 2004; Azzoni et al, 2000).

3.   Objectives of the Study

The main objective of the study is to investigate the relationship between agricultural growth and poverty in Malawi. Specifically, the study intends to

- Analyse the impact of poverty, human capital and other resource constraints on agricultural growth at household level.

- Investigate the role of the agricultural input subsidy program in promoting agricultural growth among households with different income levels.

4.   Agricultural Policies and Agricultural Development in Malawi[1]

Agricultural development in Malawi since Independence has been based on a dual strategy: promotion of estate and smallholder agriculture. First, the government promoted estate agriculture that has expanded rapidly on leasehold land from unused customary land. Lele (1989) argues that the rapid expansion of estate agriculture,

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[1] This section draws on Chirwa et al (2008).

particularly for the production of tobacco, has resulted in a more unequal distribution of land in rural Malawi. Most estates grow high value cash crops, and it is not surprising that estate-led agricultural development was the main economic strategy in Malawi. Second, the government has also been promoting smallholder agriculture on customary land, on which rights to cultivate and transfer land are conferred by traditional chiefs. In 1997/1998 it was estimated that one third of smallholder households were cultivating between 0.5 and 1 hectare of land (GOM, 2001). Several policies and policy changes have been introduced to support the dual agricultural strategy. Agricultural policies in Malawi can be divided into three main policy regimes: pre-reform, reform and the post-reform periods. The policies pursued during these periods have largely shaped the performance of the agricultural sector.

Table 1 presents the main policy actions in different regimes introduced to promote economic growth in different sectors of the economy and the agricultural sector in particular. Most of the domestic policies in the pre-reform period, 1964 – 1979, were geared towards provision of public support services and direct interventions in the agricultural sector through a coordination of various policies. For example, the coordination of the state marketing agency, the Agricultural Development and Marketing Corporation (ADMARC) in the marketing of agricultural produce and guaranteed prices were highly liked to access to inputs and finance by smallholder farmers. This period was also associated with macroeconomic stability in terms of low and stable inflation and interest rates. There was also high investment in public services including agricultural research and extension services. Some of these policies contributed to the growth in agricultural output, which in per capita terms grew by 1.9 percent per annum.

Table 1 Main agricultural policy actions and agricultural growth,1964 - 2010

Period		Main Agricultural Policy Actions	Average Annual Agricultural Growth per Capita
Pre-Reform Period	1964–1980	• Active government involvement in economic activities (Malawi Development Corporation (MDC) and ADMARC investments). • Overvalued exchange rate system - fixed peg. • Provision of extension services and active research in agricultural technologies, maize seeds and other crops. • Macroeconomic stability - low and stable inflation, low and stable interest rates. • Preferential lending to agricultural sector.	1970-79: 1.9 %
Reform Period	1981–1986	• Periodic increases in interest rates and agricultural prices. • Restructuring of state owned enterprises. • Liberalization of industrial output prices. • Periodic devaluation of the Malawi Kwacha.	1980-84: -2.7%
	1987–1994	• Liberalization of the financial sector and interest rates between 1987 and 1989. • Removal of preferential lending to agricultural sector in 1990. • Liberalization of agricultural marketing services (output in 1987 and inputs in 1990). • Liberalization of some agricultural produce prices in 1988. • Removal of fertiliser subsidies by 1991. • Privatization of state-owned enterprises. • Liberalization of entry into manufacturing in 1991. • Periodic devaluation of the Malawi Kwacha and eventual floatation in February 1994.	1985-89: -1.87% 1990-94: -1.19%
Post-Reform Period	1995–2010	• Removal of restrictions that prevented smallholder farmers from producing and marketing high value crops in 1995. • Export levy on tobacco and sugar in 1995 and eventual removal in 1999. • Reduction in base surtax to 20% in 1996. • Liberalization of prices for all crops except maize and introduction of a maize price band in 1996. • Privatization of state owned enterprises since 1996. • Devaluation of the Malawi Kwacha in 1998.Elimination of the maize price band in 2000. • Agricultural input support programs for smallholder farmers such as Starter Pack and Targeted Input Programme. • Introduction of a national agricultural input subsidy programme since 2005/06 season. • Government setting of minimum producer prices.	1995-99: 11.5% 2000-05: 0.36% 2006-10: 8.14%

Source: Updated based on Chirwa et al (2008)

The reform period, from 1981 to 1994, is the period of structural adjustment programmes, with most policies aimed at reducing direct intervention by government in

economic activities. Most of the reforms occurred between 1984 and 1994 with the liberalisation of agricultural marketing activities which allowed the participation of the private sector in the marketing of agricultural produce. There was also removal of subsidies on fertilizers and a series of devaluation of the Malawi Kwacha. However, throughout this period, the average annual growth rates in per capita agricultural output were negative, -2.7 percent in 1981-84 and -1.8 percent in 1985-89 and -1.2 percent in 1990-94.

The post-reform period is characterized by a return to more direct government intervention in economic activities, particularly in the agricultural sector. The major policy intervention in the agricultural sector has been the implementation of the agricultural input subsidy programme. More recently, the government has re-introduced minimum producer prices for agricultural crops grown by smallholder farmers, a return to policies that were popular in 1970s. However, due to the presence of the private sector in agricultural marketing activities and due to weak institutional capacity, it has been difficult for government to enforce these minimum prices. The agricultural sector has performed well with agricultural output per capita increasing at 11.5 percent in the 1996-99 period, 0.3 percent in the 2000-05 period and 8.4 percent in the 2006-10 period.

The agricultural input subsidy has been the main policy in the agricultural sector since the 2005/06 season. The Malawi government has been implementing an agricultural input subsidy programme that provides targeted fertilizers and improved seeds to smallholder farmers as one way of improving agricultural productivity, increasing growth and fighting poverty (Dorward et al., 2008). The provision of agricultural inputs to resource-poor farmers attempts to address the asset trap or cash constraints that most smallholder farmers experience in the face of high input prices and poor crop prices. The agricultural input subsidy programme has been a major policy intervention in the agricultural sector in the past five years covering about 50 percent of farming households in rural Malawi. The programme has been targeting resource-poor households who own a piece of land, resident in the village with special consideration to guardians looking after physically challenged persons and vulnerable groups[2] (GOM, 2008). In the 2008/09 season, an open system of identification of beneficiaries (community-based targeting) using farming households register was introduced (though not universally followed) in the allocation of coupons. However, as Chirwa et al (2011) and Dorward and Chirwa (2011) note, there are variations in the application of the targeting criteria and it has been usually found that the better-off farmers are more likely to receive subsidized fertilizers compared to poor households. The subsidy program coincides with a period in which economic growth has been positive and increasing while agricultural growth has been positive but decreasing. These positive growth rates have also occurred within an environment of macroeconomic stability, characterized by single digit inflation. There

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[2] These include child headed, female-headed or orphan headed households and those households with infected or affected with HIV and AIDS.

have been concerns on the economic efficiency of the subsidy programme in Malawi. SOAS et al. (2008) show that benefit/cost ratios for the 2006/07 programme could, with reasonable variation in assumptions, range from 0.76 to 1.36, with a mid-estimate of 1.06. In the 2008/09 subsidy programme, Dorward et al (2010) find the benefit cost ratio in the range 0.8 to 1.10 depending on assumptions about fertilizer responses. This is a year in which international fertilizer prices increased substantially.

The experience of the performance of the economy and the agricultural sector in the past two decades in Malawi has been erratic and poverty has remained high. Figure 1 shows the annual growth rate of gross domestic product (GDP) and GDP originating from the agricultural sector between 1990 and 2009. It is evident that both real GDP and agricultural GDP growth rates have been erratic and tend to be positively correlated. However, major swings in growth rates were experienced more in the early 1990s. Since 1996, the growth swings have been moderate. In terms of growth in GDP, there are three episodes in the past two decades. First, is the period between 1990 and 1994 in which negative growth rates of nearly 10 percent were witnessed, and the average growth rate in GDP during this period was 0.62 percent while agricultural GDP grew at 2.22 percent per annum. Generally, growth rates in both GDP and agricultural output in this period was most volatile with standard deviations of 10 percent and 33 percent, respectively. This period also coincided with the period in which Malawi was in its transition from a one party state to a multiparty state and towards the end of the implementation of structural adjustment programmes.

Figure 1 Annual Growth Rate in real GDP and Agricultural GDP, 1990 - 2010
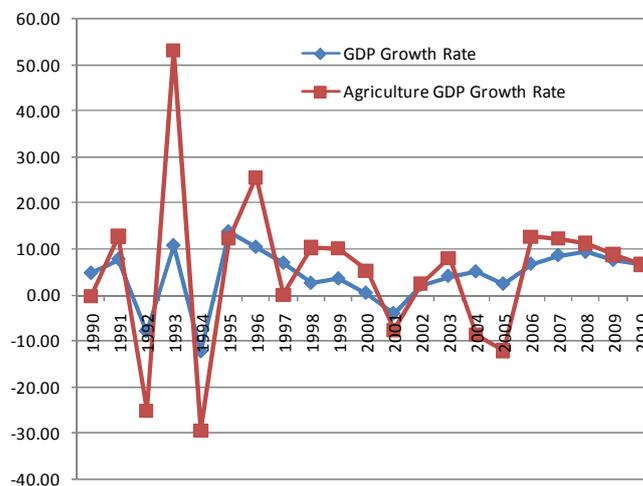
Secondly, the period between 1995 and 2001 is the period of positive but declining growth rates in the economy. Average annual growth rates in GDP averaged 4.81 percent, despite the strong growth of 8 percent per annum in the agricultural sector. There was a drop in both GDP and agricultural GDP in 2001. Thirdly, since 2002 the economy has experienced positive and rising growth rates of the economy although the performance of the agricultural sector has been erratic except since 2006 when

government started implementing the agricultural input subsidy programme. Since the implementation of the subsidy programme in 2005/06 season, agricultural output has been growing at 10.7 percent per annum. During this period, the macroeconomic management of the economy also improved with low inflation and manageable fiscal deficits.

Agricultural productivity in Malawi remains low and stagnant and there is overdependence on rain-fed farming which increases vulnerability to weather related shocks (MoAFS, 2007). There is low uptake of improved farm inputs and smallholder agriculture remains unprofitable. This is exacerbated by weak links to markets, high transport costs, few farmer organizations, poor quality control and lack of information on markets and prices. Due to high risks in agricultural production and poor access to credit, investments and re-investments in the sector have been poor. More recently, with the realisation of low productivity in agriculture, government policies have focussed on addressing some of the constraints that smallholder farmers experience in their farming activities such as development of infrastructure and agricultural input support.

5.   Methodology and Data

5.1   Model Specification

This study tests the hypothesis that poverty is a binding constraint on agricultural growth in rural Malawi using panel data obtained in 2004/05 prior to the implementation of the subsidy programme and in 2008/09 during the implementation of the agricultural subsidy program. We hypothesise that agricultural growth is dependent on level of initial conditions and time-varying policy variables including receipt of subsidized farm inputs. However, access to subsidized farm inputs involves targeting based on specific criteria that vary in application across communities. SOAS et al (2008) provides evidence that suggest that the coupon allocation guidelines were not adhered to in the communities and there is likelihood that the most productive farmers that are usually not poor might have influenced the allocation of coupons in some areas. Over time there have been changes at community level with respect to transparency in allocation of coupons. One such innovation has been the use of open meetings to decide on who is going to obtain coupons (Chirwa et al, 2011) in order to minimize the influence of elites in the allocation of coupons. However, due to non-randomisation of subsidy allocation there may be biases in estimates of the impact of the subsidy on agricultural growth. For example, the farmers who accessed subsidized fertilizers may have had greater exposure to the program for administrative or other reasons, and/or may have decided to participate because they anticipated high returns. In order to reduce this bias, our econometric approach uses a two-stage instrumental variable procedure. In the first stage, we estimate a probit model of coupon receipt, from which we obtain the predicted probability of receiving subsidy in 2008/09 which is used as one of the explanatory variables in the

agricultural growth models in the second stage[3]. The eligibility criteria for access to subsidies emphasize on the poor, female-headed households and transparent systems of coupon allocation but exclude those that are employed. We use some of these, headship of household, access to safety nets (proxy for the poor), participation in the labour market and open system of coupon allocation as our instrumental variables for access to subsidized fertilizers. The validity of the instruments was checked using the over-identification test by estimating the agricultural growth equation using the two-stage least squares method with the number of coupons as a measure of access to subsidized fertilizers.

In the first stage, selection into the subsidy program or coupon receipt is treated as endogenous and conditional on a range of household socio-economic characteristics. We estimate the following empirical model following SOAS et al (2008) and Chirwa et al (2011);

$$ASF_i = \alpha + \beta HC + \gamma FC + \kappa POV + \tau X + \varepsilon_i \qquad (1)$$

where for household i, *ASF* is access to subsidized farm inputs, *HC* is a vector of household characteristics including household composition and assets, *FC* is a vector of farming characteristics such as land sizes and commercial farming, *POV* is a vector of poverty and vulnerability variables, *X* is a vector of other control variables and ε is the error term. Access to subsidized farm input coupons is specified as a dichotomous variable representing receipt of farm input coupons, equation (1) is estimated using the probit model. We use headship of household, access to safety nets, participation in labour market and the method of coupon allocation as the instrumental variables and enter as dummy variables in the model. Other control variables in the model include age of household head, dummy for elderly headed households, dummy for crop marketing as a proxy for commercialisation, quantity of commercial fertilizer in the previous season (2007/08), receipt of remittances and receipt of subsidy coupons in the previous season (2007/08).

We adapted the model specification by Deininger and Okidi (2003) and Balisacan and Fuwa (2004) in the second stage, to estimate the relationship between agricultural growth and initial income poverty levels. The specification is consistent with the existing literature where it may be argued that poverty may be a binding constraint on growth (Duclos and O'Connell, 2009). We estimate variants of the following agricultural growth and initial poverty model:

$$GRAGR_i = \alpha_0 + \alpha_1 AGRI05_i + \sum_j \beta_j POVI05_{ij} + \lambda SUBSIDY_i + \sum_k \gamma_k X_{ij} + \varepsilon_i \qquad (2)$$

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[3] Chibwana et al (2010b) use a similar two-stage instrumental variable procedure in farm input subsidy program impact assessment.

where $GRAGR_i$ is the change in agricultural output for household i, $AGRI05_i$ is the initial agricultural output in 2005 of household i, $POVI05_{ij}$ is the indicator of initial poverty in 2005 of household i in initial income group j, $SUBSIDY_i$ is the instrumented variable representing receipt of subsidized farm inputs by household i, X_{ij} is a vector of initial household level conditions and time-varying policy variables including value of durable assets, education of household head, land size, extent of commercialization and purchase of commercial fertilizers, and community level variables such as access to extension service, phones, markets and distance to the tarmac road. The error term is represented by ε_i. Ravallion and Datt (2002) and Deininger and Okidi (2003) note that initial conditions matter for both growth and poverty reduction. Equation (2), by using different levels of initial poverty status enables us to test whether there are differences in their impact on agriculture growth, in which we expected the coefficients of the lower income groups to have lower growth rates compared to the upper income group if poverty is constraining agricultural growth. We also extend equation (2) by including the interaction terms between initial income groups or poverty status and access to subsidized inputs in order to assess the impact of the subsidy programme in resolving some of the binding constraints faced by households in the agricultural sector.

Our dependent variable is the annualized real agricultural growth measured by the annual change in the real value of agricultural output at household level between 2004/05 and 2008/09. We selected the main agricultural crops grown by smallholder farmers in Malawi including maize, rice, tobacco, pulses, and groundnuts. Maize is mainly produced by rural households mainly to meet subsistent needs. We valued the outputs in both periods using average district level prices for each crop from the survey data with the 2008/09 output valued at 2004/05 agricultural season prices.

The independent variables include initial agricultural output, indicators of initial incomes or poverty, access to subsidized fertilizers, purchase of commercial fertilizers, value of durable assets, land size, commercialization index, education of household head, community level variables including access to extension services, distance of the community to the tarmac road, existence of a permanent ADMARC market and access to phone facilities. We use alternative measures of initial income and poverty. First, we divide households into quintiles based on per capita consumption expenditure and include quintile dummies of per capita expenditure. This enables us to test whether growth is constrained by poverty by comparing the magnitudes of the coefficients of the quintile expenditures. Secondly, we use the poverty classification which groups households into better-off, poor, marginally poor and the ultra poor. We use the NSO (2005) categorization of households into poverty groups. The poor group includes households that are also ultra-poor. Using the definition of the poor and ultra-poor, we create an intermediate group of marginally poor represents those that are poor but not ultra-poor. Hence, the poor are divided into marginally poor and ultra-poor, with the poor being those below the poverty line but above the ultra-poverty line. If poverty

constrains agricultural growth, we expect to find significantly lower growth rates among households in the lower quintiles of per capita expenditure or among households that were classified as poor in 2005.

The agricultural input subsidy has been the main policy instrument that has been used to stimulate growth in the agricultural sector and consequently leading to increase in food security and reduction in poverty. The effect of the subsidy is analysed by including instrumented version of the variable defined as dummy equal to 1 if the probability of receiving subsidized farm input is greater than or equal to 0.5, and zero otherwise. As Dorward and Chirwa (2011) notes, the agricultural subsidy in Malawi addresses the problems of affordability of inorganic fertilizers, improved seeds and chemicals which is necessary to stimulate agricultural productivity. Under the subsidy programme, each targeted household is provided with two coupons for purchase of 2 bags of 50 kilograms of basal fertilizer and urea at a redemption price equivalent to less than a third of the market price of fertilizers. Other subsidized inputs include maize, tobacco, tea and coffee fertilisers, maize seed (hybrid and open pollinated varieties), legume seed, cotton seed and chemicals, and maize storage chemicals. Farmers that receive subsidized fertilizers for maize production also receive subsidized seeds. Since the major component of the subsidy is fertilizer, we use access to subsidized fertilizer as a proxy indicator of participation in the subsidized farm input programme. We, therefore, expect a positive relationship between agricultural growth and access to subsidized farm inputs.

Apart from the targeted subsidized fertilizers, farmers purchase additional fertilizers at market prices from commercial providers. This represents an additional investment by smallholder farmers in their agricultural activities. We capture this in the models by including a dummy variable equal to 1 if the household purchased unsubsidized fertilizers from the market in 2008/09 agricultural season. Since fertilizers are expected to enhance productivity, the relationship between agricultural growth and investments in commercial fertilizers is therefore expected to be positive. To account for initial use of fertilizer, we include a dummy variable equal to 1 if the household applied fertiliser in 2004/05 farming season. We expect a negative relationship between application of fertilizer in the initial period and agricultural growth on the basis of the convergence argument. Thus, on average farmers that already adopted technology (use of fertilizers) on their farms are expected to have lower average growth than farmers that did not apply fertilizers in 2005.

We also include access to extension advice by smallholder farmers in rural areas. Extension services are important in promoting best practices or technologies that can enhance agricultural productivity. Chirwa et al (2008) notes that following liberalisation, government extension services have been declining through a process of non-replacement of extension staff and reduced funding to extension staff state training institutions. National surveys indicate that only 13 percent of farming households have access to extension services (GOM and World Bank, 2007). SOAS et al (2008) note that

the share of the extension services expenditures in agriculture expenditure has been declining and there is very scattered presence of extension workers in communities. We, however, expect that farmers with access to extension services benefit from productivity-enhancing advice; hence a positive relationship between agricultural growth and access to extension services.

We also include the natural logarithm of the value of durable assets held by the household in 2005 to control for the wealth of the household. Household wealth can affect growth in either positive or negative way. On one hand, wealthier households are likely to afford the complementary investments in agriculture such as hired labour and other inputs which can lead to higher agricultural productivity. Indivisibility in investments and market imperfections imply that only those with the minimum level of assets can invest in activities that enhance their returns to labour (Deininger and Okidi, 2003). On the other hand, wealthier households may be those that have diversified away from agriculture, and their agricultural activities may not experience as much growth compared to households whose main livelihood is derived from the agricultural sector.

Land is a vital asset for agrarian economies and it can be a binding constraint for agricultural growth. In Malawi, land is unequally distributed, with most smallholder farmers owning less than one hectare of land. To capture the effect of land size on agricultural growth, we include the natural logarithm of the initial size of land owned by the household in 2005. We expect land size to be negatively associated with agricultural growth based on the convergence of assets. We further include an interaction term of land and receipt of farm input subsidy in order to assess their effects on agricultural growth for different-sized farms.

Access to markets and the extent of commercialisation can provide incentives for increased productivity and lead to increases in agricultural growth. Commercially-oriented smallholder farmers, with increasing prices, are likely to invest in productivity-enhancing measure which can lead to higher output levels. If commercialization is reflective of size, such farmers may be close to the steady state, and we expect growth to be negatively associated with commercialisation. In order to capture smallholder farmers' market orientation, we include a commercialisation index which is measured as a ratio of the value of crop sales to the value of crops harvested by the farmer. We also included a dummy variable for existence of a permanent ADMARC market in the community in 2005 since market access is crucial to commercialisation.

We also include the education of the household head to capture the human capital effects on agricultural growth. We capture the human capital by including the number of years of schooling for the household head and we expect a positive relation between agricultural productivity and investments in human capital.

In order to assess the effect of the agricultural input subsidy in unlocking the growth potential of different types of households by poverty or expenditure group status, we include interaction variables between receipt of subsidized fertilizers and indicators of poverty and welfare. If the subsidy unlocks the potential for the poor to contribute to agricultural growth, we should expect a positive relationship between agricultural growth and the receipt of subsidized fertilizers in the lower quintiles of per capita consumption expenditure or the ultra-poor and the marginal poor who receive fertilizers should contribute positively to agricultural growth.

We have also included community variables such as distance to the nearest tarmac road in 2005 and existence of a public place for making phones in the community in 2005 representing infrastructure that provides a conducive environment for agricultural development. We expect closeness to the tarmac road and access to phones to be positively associated with agricultural growth. As Deininger and Okidi (2003) note infrastructure variables in cross-country growth models have been found to be significant determinants of growth and find household's initial access to electricity to be positively associated with growth in Uganda.

We also control for district variations in agricultural growth to capture differences in agricultural activities in Malawi and control for potential sources of regional/spatial bias. The data is drawn from a total of 14 districts out of 28 districts. These districts are Chitipa, Karonga, Mzimba, Kasungu, Nkhotakota, Lilongwe, Dedza, Ntcheu, Mangochi, Zomba, Blantyre, Thyolo, Phalombe and Chikwawa. We use Chitipa district as the base category.

5.2   Data

The study used panel data for two agricultural seasons, 2004/05 and 2008/09 from which a matched panel of 1,365 households is obtained. The sampling units in the data sets were enumeration areas which on average have a population of 250 households. In each of the selected enumeration areas 20 households were randomly selected from a household listing exercise and each household in the enumeration areas had equal probability of being selected for the survey in the first panel. The second panel randomly selected the districts and followed up households in enumeration areas sampled in the first panel with about 1,400 households being followed in both surveys. In 2004/05 the survey interviewed 11,280 households while in 2008/09 the survey interviewed 1,982 households including replacements of 2004/05 households that were not found in the 2009 survey. After eliminating outliers from a matched panel of 1,365 households, we obtain a usable sample of 1,227 households which we use to estimate equation 1 and 2. We also used the matched panel sample for our test for the validity of instrumental variables.

6. Results and Discussion

6.1 Descriptive Statistics

Table 1 presents descriptive statistics of the variables used in the estimated models. There is a lot of variability of agricultural growth among households averaging about 1.6 percent per annum but with a very high standard deviation. The average per capita consumption expenditure in 2004/05 was US$85 per annum while the average value of crops harvested was MK8,823. About 66 percent of rural households were predicted to have received subsidized fertilizers while 40 percent purchased unsubsidized commercial fertilizers in 2008/09, with about 27 percent of households receiving subsidized fertilizers and also purchasing commercial fertilizers. Access to subsidized fertilizers seem to be evenly distributed across different per capita consumption expenditure quintiles, about 14 percent in each expenditure quintile received subsidized fertilizers. We present descriptive statistics for recipients and non-recipients of subsidized farm inputs for the matched sample in the appendix (Table I).

With respect to asset endowment, household durable assets were valued at an average of US$8 in the 2004/05 agricultural season, but there is also high variability in asset holding among households. The average land holding size per household in 2004/05 was 0.6 hectare, but with high variability in land sizes. The extent of commercialisation of agriculture in Malawi is low with only 17 percent of household output being sold, which indicates that the agricultural sector in rural Malawi remains subsistent. About 40 percent of the households have a commercialisation index of zero, implying that their agricultural activities in 2004/05 were for subsistence needs. Our sample is dominated by male-headed households, with only 29 percent of households being female-headed. On average, the household heads attended 4.6 years of education indicating that they do not have even the primary school certificate of education. Only 20 percent of the households in the panel received extension advice in 2008/09 growing season of which 10 percent were in the poor category.

Table 2 Descriptive Statistics

Variables[*]	Mean	SD	Min	Max
Annualized real agricultural growth	0.0160	0.251	-0.240	1.069
Log of agricultural output in 2005 (MK)	9.0851	1.687	3.334	13.12
Log per capita expenditure in 2005 ($)	4.4368	0.608	2.719	6.331
Received subsidy in 2008 & expenditure quintile 1 (0/1)	0.1271	0.333	0.000	1.000
Received subsidy in 2008 & expenditure quintile 2 (0/1)	0.1288	0.335	0.000	1.000
Received subsidy in 2008 & expenditure quintile 3 (0/1)	0.1288	0.335	0.000	1.000
Received subsidy in 2008 & expenditure quintile 4 (0/1)	0.1320	0.339	0.000	1.000
Received subsidy in 2008 & expenditure quintile 5 (0/1)	0.1467	0.354	0.000	1.000
Poor in 2005 (0/1)	0.4817	0.500	0.000	1.000
Ultra poor in 2005 (0/1)	0.1760	0.381	0.000	1.000
Marginal poor in 2005 (0/1)	0.3056	0.461	0.000	1.000
Received subsidy in 2008 & ultra-poor in 2005 (0/1)	0.1108	0.314	0.000	1.000
Received subsidy in 2008 & marginal poor in 2005 (0/1)	0.1940	0.396	0.000	1.000
Received subsidy in 2008 & poor in 2005 (0/1)	0.3048	0.461	0.000	1.000
Received subsidy (predicted) in 2008 (0/1)	0.6634	0.473	0.000	1.000
Purchased commercial fertilizer in 2008 (0/1)	0.4042	0.491	0.000	1.000
Applied fertilizer in 2005 (0/1)	0.6593	0.464	0.000	1.000
Log of value of durable assets in 2005 ($)	2.0565	2.788	-4.774	8.033
Log of land size in hectares in 2005 (hectares)	-0.4100	2.087	-8.517	6.933
Commercialisation index in 2005	0.1713	0.254	0.000	1.000
Household head years of schooling in 2005	4.6015	4.010	0.000	23.000
Received extension advice in 2008 (0/1)	0.2037	0.403	0.000	1.000
Distance to the nearest tarmac road in 2005	24.369	23.22	0.050	137
Existence of permanent ADMARC market in 2005 (0/1)	0.1402	0.347	0.000	1.000
Existence of a public phone in community in 2005 (0/1)	0.1239	0.330	0.000	1.000
Chitipa (0/1)	0.0668	0.250	0.000	1.000
Karonga (0/1)	0.0652	0.247	0.000	1.000
Mzimba (0/1)	0.0742	0.262	0.000	1.000
Kasungu (0/1)	0.0766	0.266	0.000	1.000
Nkhotakota (0/1)	0.0497	0.217	0.000	1.000
Lilongwe (0/1)	0.0652	0.247	0.000	1.000
Dedza (0/1)	0.0921	0.289	0.000	1.000
Ntcheu (0/1)	0.0864	0.281	0.000	1.000
Mangochi (0/1)	0.0791	0.270	0.000	1.000
Zomba (0/1)	0.0733	0.261	0.000	1.000
Blantyre (0/1)	0.0742	0.262	0.000	1.000
Thyolo (0/1)	0.0750	0.263	0.000	1.000
Phalombe (0/1)	0.0562	0.230	0.000	1.000
Chikwawa (0/1)	0.0660	0.248	0.000	1.000
Number of observations	1227			

Notes: [*] (0/1) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category.

Figure 2 presents proportions of households experiencing different growth rates in agricultural output between 2005 and 2009. The growth in agricultural output is classified into three groups: households experiencing decrease, no change and increase. We examine the movements in terms of the quintiles of initial per capita expenditure and initial poverty status. With respect to per capita expenditure quintiles (PCQ1 – PCQ5) in the left panel, a majority of households in different income groups experienced a decrease in agricultural output, with smaller proportions in the fourth and fifth quintiles. The data also shows that the richest and poorest groups had higher proportions of households experiencing negative growth. The highest proportion of households that did not experience any growth is in the fourth and fifth quintiles while the lowest proportion is in the first quintile. In terms of initial poverty status in the right panel, about 61 percent of the poor compared to 58 percent of the non-poor experienced a decrease in

agricultural output. The non-poor who experienced no growth were 5.8 percent compared to 3.7 percent among the poor. The proportions of household that witnessed increases in agricultural growth are, however, not significantly different among the non-poor and poor households. Overall, there is no particular group that has outperformed in terms of agricultural growth.

Figure 2 Changes in Agricultural Output by Income Groups, 2005 - 2009
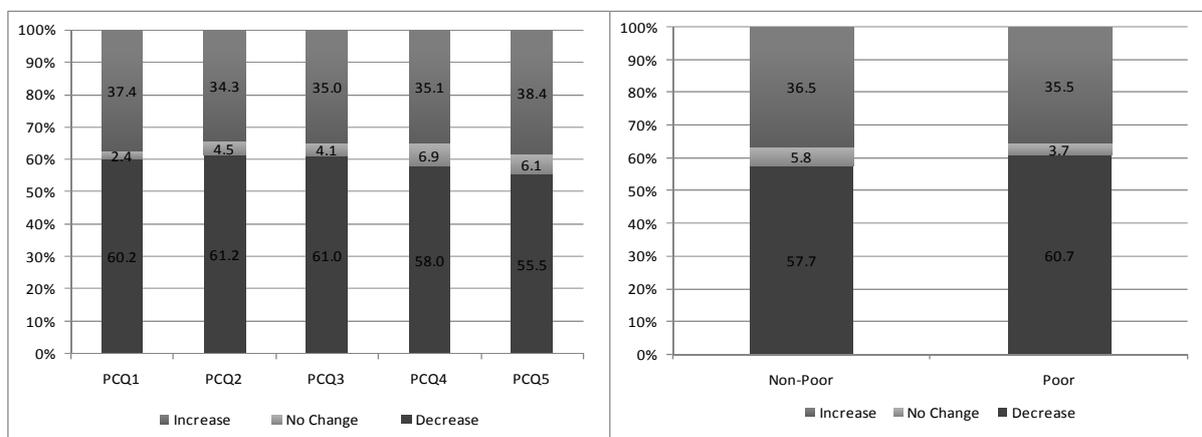
6.2   Econometric Results

6.2.1   Determinants of Access to Subsidized Fertilizers

We first estimated a probit model of factors that determined access to subsidized fertilizer coupons in the 2008/09 agriculture season.[4] The results of the regression are reported in Table 3. We find that our instrumental variables, participation in labour market, access to safety nets and open forums for allocating coupons statistically significant at least at the 5 percent level while headship of household is not statistically significant. Households with employed members in the labour market are unlikely to receive subsidized coupons and the probability falls by 6 percent. Access to other safety nets, which is a proxy for poverty, increases the household probability of accessing subsidized fertilizers by 11 percent. Similarly, use of open system of allocating subsidy coupons increases the chance of receiving coupons by about 7 percent suggesting that community based targeting maybe superior to allocations that involve traditional leaders and committees as was previously the case in the 2005/06 up to the 2007/08 season.

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[4] We also estimated a model excluding access to subsidized fertilizers in the previous season, but the Pseudo R-squared drop significantly.

Table 3 Probit estimates for access to farm input subsidy coupons in 2008/09

Variable	dF/dx	z
Age of household head (years)	0.0023	1.81[c]
Male headed household*	0.0407	1.34
Elderly headed household*	-0.0833	-1.46
Crop marketing in 2008/9*	0.0230	0.07
Quantity of commercial fertilizers bought in 2007/8 (kg)	0.0000	-0.45
Labour market participation in 2007/8*	-0.0579	-2.06[b]
Remittance receipts in 2007/8*	0.0583	2.02[b]
Access to social safety nets in 2007/8*	0.1127	3.05[a]
Access to subsidy fertilizer in 2007/08*	0.4552	16.31[a]
Open forum allocations of coupons 2008/9*	0.0731	2.15[a]
Number of observations	1227	
Wald chi-squared (18)	296.75	
Prob > chi-squared	0.000	
Pseudo R-squared	0.2249	

Note: The dependent variable is a dummy variable for access to subsidized fertilizer coupons received in the 2008/09 agricultural season. (*) dF/dx (marginal effect) is for discrete change of dummy variable from 0 to 1. Robust t-statistics with superscripts a, b and c denotes significance at the 1, 5 and 10 percent levels, respectively.

The results also show that the probability of receiving farm input coupons in the 2008/9 season significantly increases with the age of the household head, remittances and household access to subsidized in the previous season. The positive effect of age of household head is consistent with one of the targeting criteria of the number of years of residence in the village; older households are likely to have lived in the village for a long time. There is a statistically significant positive relationship at the 5 percent level between remittances and probability of receiving subsidized fertilizer coupons. Receipt of remittances in the previous season increases the probability of receiving coupons by 5.8 percent. Remittances are one of the sources of cash for redemption of coupons and purchase of farm inputs in the rural areas (Dorward et al, 2010).

6.2.2 Agricultural Growth and Initial Consumption Expenditure Quintiles

In order to assess how poverty traps affect agricultural growth, we estimated a model on dummies representing quintiles of per capita consumption expenditure. This allows us to investigate how low incomes may constrain growth. If poverty constrains agricultural growth we expect some negative relationship between agricultural growth and lower levels of income. We use the upper quintile as our base category. The predicted probability of access to subsidized farm inputs is then used the second stage regression analysis of agricultural growth models.[5] Controlling for the possibility of endogeneity of coupon receipt lowers the point estimates in the agricultural growth models but does not

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[5] In the agricultural growth model, access to subsidy is instrumented and defined as a dummy variable equal to 1 if the predicted probabilities from the first model were 0.5 and more, otherwise equal to zero.

change the significance or sign of most estimated coefficients.[6] Using the Sargan and Basamann chi-squared tests of over-identification of instruments, we obtained 1.157 (p=0.8825) and 1.129 (p=0.8896) implying that we cannot reject the null hypothesis that additional instruments are valid, respectively.

Table 4 presents the estimates based on quintiles of per capita expenditure. Model 1 regresses annualized agricultural growth on quintiles dummies of per capita consumption expenditures while controlling for other initial endowments. In model 2 we investigate whether the subsidy programme addresses the affordability constraints among households in different income groups by interacting dummies of income quintiles and receipt of subsidized fertilizers. Overall the models explain about 17 percent of the variation in annualized real agricultural growth and the F-statistic suggests rejection of the null hypothesis that all parameter estimates are zero.

We find a statistically significant negative relationship between agricultural growth and initial agricultural output. The coefficient is statistically significant at the 1 percent level in both models. The negative relationship between the agricultural growth and initial agricultural output is consistent with the neoclassical β-convergence which postulates that households with low initial output are expected to grow much faster than those with higher agricultural output. These results are consistent with the findings in other studies such as Deininger and Okidi (2003) who also find strong income convergence in the case of Uganda. Balisacan and Fuwa (2004) find similar results in the case of the Philippines and Azzoni et al (2000) find strong support for income convergence in Brazil.

With respect to quintiles of per capita consumption expenditure, we find that agricultural growth was lower among households in lower quintiles compared to households in the fifth quintile (richest households). However, the coefficients are statistically significant at the 5 percent level only among households in the second and third quintiles of expenditure in model 1 and second to fourth quintiles in model 2, suggesting that low incomes constrain agricultural growth. In model 2, the results suggest that households in the second, third and fourth quintiles experienced 7.5 percent, 6.2 percent and 6.1 percent lower growth than the richest households, respectively. The households in the lowest quintile of expenditure compared to those in the third quintile tend to have smaller land parcels (0.8 hectare less), lower assets and low human capital, and have higher number of adult equivalent numbers.

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[6] Original results for a model without controlling for endogeneity of coupon access are available from authors.

Table 4 OLS Estimates of agriculture growth and initial expenditure quintiles

Dependent variable: annualized real agricultural growth	Model 1		Model 2	
	coeff.	*t-ratio*	*coeff.*	*t-ratio*
Log of agricultural output in 2005	-0.0764	-8.10[a]	-0.0750	-7.95[a]
Per capita expenditure quintile 1 in 2005[*]	-0.0286	-1.28	-0.0342	-1.07
Per capita expenditure quintile 2 in 2005[*]	-0.0318	-1.51[b]	-0.0758	-2.70[a]
Per capita expenditure quintile 3 in 2005[*]	-0.0456	-2.24[b]	-0.0615	-2.06[b]
Per capita expenditure quintile 4 in 2005[*]	-0.0129	-0.61	-0.0605	-2.26[b]
Received subsidy in 2008 & expenditure quintile 1[*]	-	-	0.0038	0.11
Received subsidy in 2008 & expenditure quintile 2[*]	-	-	0.0633	2.15[b]
Received subsidy in 2008 & expenditure quintile 3[*]	-	-	0.0196	0.63
Received subsidy in 2008 & expenditure quintile 4[*]	-	-	0.0679	2.25[b]
Received subsidy in 2008[*†]	0.0364	2.32[b]	-	-
Purchased commercial fertilizer in 2008[*]	0.0653	4.38[a]	0.0649	4.35[a]
Applied fertilizer in 2005[*]	-0.0124	-0.68	-0.0139	-0.76
Log of value of durable assets in 2005	-0.0008	-0.29	-0.0007	-0.26
Log of land size in hectares in 2005	0.0348	4.52[a]	0.0338	4.45[a]
Received subsidy in 2008 & log land size	0.0134	2.19[b]	0.0135	2.23[b]
Commercialisation index in 2005	-0.0116	-0.40	-0.0114	-0.39
Household head years of schooling 2005	0.0010	0.52	0.0008	0.46
Received extension advice in 2008[*]	0.0429	2.33[b]	0.0432	2.34[b]
Distance to tarmac road in 2005	-0.0002	-0.64	-0.0002	-0.67
Permanent ADMARC market in 2005[*]	0.0217	1.03	0.0215	1.02
Community phone in 2005[*]	0.0315	1.35	0.0299	1.28
Karonga[*]	-0.0130	-0.26	-0.0197	-0.40
Mzimba[*]	-0.0571	-1.40	-0.0589	-1.44
Kasungu[*]	-0.0177	-0.37	-0.0202	-0.42
Nkhotakota[*]	-0.0119	-0.25	-0.0148	-0.31
Lilongwe[*]	-0.1146	-2.60[a]	-0.1170	-2.62[a]
Dedza[*]	-0.1124	-2.73[a]	-0.1134	-2.75[a]
Ntcheu[*]	-0.1026	-2.39[b]	-0.1041	-2.40[b]
Mangochi[*]	0.0457	0.97	0.0445	0.95
Zomba[*]	0.0309	0.66	0.0312	0.66
Blantyre[*]	0.0006	0.01	0.0015	0.03
Thyolo[*]	0.0356	0.72	0.0376	0.77
Phalombe[*]	-0.0268	-0.58	-0.0244	-0.53
Chikwawa[*]	-0.0368	-0.75	-0.0408	-0.84
Constant	0.7265	7.46[a]	0.7428	7.63[a]
Number of observations	1227		1227	
F- Statistics	8.38		7.57	
Prob>F	0.0000		0.0000	
R-squared	0.1697		0.1717	

Note: The estimates use heteroscedasticity-consistent standard errors. Superscripts a, b and c denote statistically significant at 1%, 5% and 10% level, respectively. [*] indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category. [†] Received subsidy in 2008 is used as an instrument.

The results show that the agricultural input subsidy programme plays an important role in agricultural growth in Malawi. In model 1, the coefficient of access to subsidized farm inputs is positive and statistically significant at the 1 percent level. This shows that beneficiary households to the fertilizer subsidy programme experienced about 5.6 percent more growth compared to non-beneficiary households. Similar positive impact of the agricultural input subsidy on real income (Dorward and Chirwa, 2011), on allocation of

land to cash crops (Chibwana et al, 2010b) and fertilizer use intensity (Chibwana et al, 2010a). Dorward and Chirwa (2011) in a livelihood model of rural households find that real incomes for poor beneficiary households increase by 10 - 100 percent while incomes of poor non-beneficiary households increase by 0 - 20 percent.[7]

In model 2, there is also compelling evidence from the analysis that the subsidy programme addresses affordability of inputs and enhances agricultural growth particularly for households in higher income quintiles. The coefficients of the interaction of income quintiles and receipt of the subsidy programme are only statistically significant at the 5 percent level for households in the second and fourth quintiles. The growth potential of the poorest of the poor is not affected by access to subsidized fertilizers. Nonetheless, it is interesting to note that the subsidy effectiveness, based on the magnitude of coefficients, tend to be high in the second and fourth quintiles. This suggests that for the poorest households productivity-enhancing subsidies may not be the best instruments to encourage their participation in productive activities. This suggests that the subsidy programme is more effective if it is targeted at households in the middle income groups.

The purchase of commercial fertilizer which represents private investment into agriculture is positively associated with agricultural growth. The coefficient of commercial fertilizers is statistically significant at the 1 percent level in both models. The value of the coefficient suggests that smallholder farmers that invest in productivity enhancing technologies experienced about 6.5 percent higher growth rates than smallholder farmers who did not invest in fertilizers. This also implies that farmers that received subsidized fertilizers and also invested in commercial fertilizers in 2008/09 farming season experienced about 10 percent higher agricultural growth than those that did not.

The natural logarithm of the value of durable assets which is an indicator of wealth is negatively associated with agricultural growth but the coefficient is statistically insignificant in both models. We find that households with larger land parcels in 2005, experience an increase in agricultural growth. The coefficient of land size is statistically significant at the 1 percent level in both models. The interaction of receipt of subsidy and land size in both models is also positive and statistically significant at the 5 percent level. This suggests that the farm input subsidy has differential effect on the growth of agricultural output for different-sized farms, with production increasing more for farmers with relatively larger parcels. This also reflects the fact that one of the criteria for targeting the farm input subsidy is that the 'household must have land'.

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[7] The difference with our results arises partly due to different methodologies used in the analysis. Dorward and Chirwa (2011) use a household model to simulate the livelihoods and labour market effects of a subsidy on total real incomes using two livelihood zones. Our analysis is based on an econometric model that controls for many other factors using data from all the 17 livelihood zones and only focusing on real agricultural output.

Providing farmers with extension services complements initiatives to increase agricultural growth in Malawi. Farmers that received agricultural extension advice experienced about 4.3 percent higher agricultural growth relative to non-recipients. The coefficient of extension advice is statistically significant at the 5 percent level in both models. This underscores the importance of reviving extension services in the agricultural sector in Malawi. As SOAS et al (2008) argue, the effectiveness of the farm input subsidy can be greatly enhanced with availability of extension services, especially in advising farmers of fertilizer use and farm management such as timely weeding.

All the community level variables, although with expected signs, are statistically insignificant. The district effects are also important in explaining the variations in agricultural growth but we only find statistically significant coefficients for Lilongwe, Dedza and Ntcheu. The rest of the districts have their coefficients statistically insignificant although most have positive coefficients.

6.2.3 *Agricultural Growth and Initial Poverty Status*

Table 5 presents estimates of the relationship between agricultural growth and initial poverty status in 2005 using the NSO (2005) categorisation. The models explain about 17 percent of the variation in agricultural growth. There is consistency in the performance of initial agricultural output and control variables such as dummy for purchase of commercial fertilizers, land size and access to extension services. Model 1 categorizes the poor into the marginal poor and ultra-poor. Although the coefficients are negatively associated with agricultural growth, there is no statistical evidence that poverty constrains growth in rural Malawi using the national categorisation of poverty.

Model 2 includes interaction variables of access to subsidized fertilizers and the initial poverty status in 2005. The coefficients of the interaction variables are statistically insignificant in both cases. Model 3 uses the initial poverty status (combining marginal and ultra-poor) and its interaction with access to subsidized fertilizers, we neither find evidence that poverty constrains growth nor evidence that the fertilizer subsidy programme targeted at the poor unlock the growth potential of poor farmers. Compared with the results obtained using quintiles of per capita consumption expenditure model, the results based on NSO (2005) categorisation of the poor suggest that the latter categorisation is too broad for analysis of the growth-poverty relationship.

Table 5 OLS Estimates of agricultural growth and initial poverty status

Dependent variable: annualized real agricultural growth	Model 1		Model 2		Model 3	
	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio
Log of agricultural output in 2005	-0.0763	-8.03[a]	-0.0761	-7.99[a]	-0.0765	-8.04[a]
Poor in 2005*	-	-	-	-	-0.0122	-0.54
Ultra poor in 2005*	-0.0099	-0.50	-0.0012	-0.04	-	-
Marginal poor in 2005*	-0.0178	-1.16	-0.0183	-0.71	-	-
Received subsidy in 2008*[†]	0.0373	2.39[b]	0.0393	1.96[b]	0.0394	1.97[b]
Purchased commercial fertilizer in 2008*	0.0641	4.31[a]	0.0640	4.30[a]	0.0643	4.31[a]
Received subsidy in 2008 & poor in 2005*	-	-	-	-	-0.0042	-0.15
Received subsidy in 2008 & ultra-poor in 2005*	-	-	-0.0135	-0.33	-	-
Received subsidy in 2008 & marginal poor in 2005*	-	-	0.0011	0.03	-	-
Applied fertilizer in 2005*	-0.0132	-0.72	-0.0133	-0.73	-0.0132	-0.72
Log of value of durable assets in 2005	-0.0008	-0.28	-0.0008	-0.28	-0.0008	-0.29
Log of land size in hectares in 2005	0.0348	4.48[a]	0.0345	4.46[a]	0.0349	4.49[a]
Received subsidy in 2008 & log land size	0.0132	2.15[b]	0.0133	2.18[b]	0.0132	2.16[b]
Commercialisation index in 2005	-0.0115	-0.39	-0.0112	-0.38	-0.0117	-0.40
Household head years of schooling	0.0012	0.68	0.0013	0.69	0.0013	0.69
Received extension advice*	0.0405	2.20[b]	0.0405	2.20[b]	0.0407	2.21[b]
Distance to tarmac road in 2005	-0.0002	-0.57	-0.0002	-0.60	-0.0002	-0.58
Permanent ADMARC market in 2005*	0.0239	1.13	0.0241	1.14	0.0242	1.14
Community phone in 2005*	0.0303	1.29	0.0304	1.30	0.0305	1.30
District dummies	Yes	-	Yes	-	Yes	-
Constant	0.7073	7.27[a]	0.7046	7.26[a]	0.7079	7.27[a]
Number of observations	1227		1227		1227	
F- Statistics	8.86		8.28		8.83	
Prob>F	0.0000		0.0000		0.0000	
R-squared	0.1669		0.1670		0.1668	

Note: The estimates use heteroscedasticity-consistent standard errors. Superscripts a, b and c denote statistically significant at 1%, 5% and 10% level, respectively. * indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category. [†] Received subsidy in 2008 is used as an instrument.

7. Conclusions

Economic growth in Malawi for a long time has been erratic and poverty has remained high. However, since 2005 the economy has consistently grown at more than 5 percent per annum. Recent estimates of poverty also show that the poverty headcount has declined from 52 percent in 2004 to about 39 percent in 2009. With such high levels of poverty and low growth rates the country has witnessed over time, this paper set out to test the hypothesis that initial poverty or per capita consumption expenditure is constraining agricultural growth in Malawi using household level panel data between 2004/05 and 2008/09 agricultural season. Since the 2005/06 agricultural season, the government has also been implementing an agricultural input subsidy programme targeted at resource poor farmers. The programme addresses affordability of inorganic fertilizers, improved seeds and chemicals that are critical in raising productivity in Malawi. Since this is a major policy change in the agricultural sector, the study also test the hypothesis that subsidized farm inputs unlock the potential of resource poor farmers to contribute positively to agricultural growth.

The study provides evidence of convergence of initial agricultural output found in most growth models. However, we find that households with larger parcels of land tend to grow at faster rates compared to those with smaller land parcels. There is also strong evidence that access to subsidized farm inputs under the agricultural input subsidy programme has been the main driving factor of agricultural growth since 2005/06. Similarly, investment in fertilizers through commercial purchase provided further impetus for agricultural growth. The lack of access to extension services by smallholder farmers is also one of the constraints to agricultural growth in Malawi. The demand-driven extension service system that government introduced seems to reach very few farmers. There is therefore need to revitalize the extension system so as to reach as many farmers as possible. This is particularly important in the context of the subsidy programme in which access to extension services and other complementary services can enhance the efficiency of input use (SOAS et al, 2008; Dorward and Chirwa, 2010).

The evidence on the test of whether growth is constrained by poverty is sensitive to the indicator of initial poverty. Using the NSO (2005) poverty categorisation as initial poverty in 2005, there is no evidence that growth is constrained by poverty. However, using the dummies of quintiles of consumption expenditure, we find evidence that growth may be constrained by poverty, with lower growth rates in low income groups compared to the group of richest households in the sample. The role of the farm input subsidy in unlocking the growth potential of poorest households (poorest 20 percent) is not evident, but rather the results suggests that the subsidy enhances agricultural output among households in the middle income groups. This has implications on the targeting of the agricultural input subsidy programme. Targeting the subsidy at the poorest of the poor, may not be effective in expanding the productive capacity of poorest farmers. It implies that the poorest of the poor need alternative policies to input subsidies in order to break the vicious circle of poverty. This is a group that may require social cash transfers rather than productivity-enhancing interventions.

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Appendix

Table I Descriptive statistics according to receipt of subsidized farm inputs

Variables	Recipient		Non-Recipient	
	Mean	**SD**	**Mean**	**SD**
Annualized real agricultural growth	0.0379	0.263	-0.0342	0.214
Log per capita expenditure in 2005 ($)	4.4432	0.603	4.4223	0.621
Probability of receiving subsidized fertilizer in 2008	0.8374	0.369	0.3387	0.474
Poor in 2005 (0/1)	0.4690	0.500	0.5108	0.501
Ultra poor in 2005 (0/1)	0.1708	0.377	0.1882	0.391
Marginal poor in 2005 (0/1)	0.2982	0.458	0.3226	0.468
Purchased commercial fertilizer in 2008 (0/1)	0.3825	0.486	0.4543	0.499
Log of value of durable assets in 2005 ($)	2.2294	2.625	1.6592	3.100
Log of land size in hectares in 2005 (hectares)	-0.3336	1.937	-0.5855	2.390
Commercialisation index in 2005	0.1752	0.258	0.1623	0.243
Household head years of schooling 2005	4.7918	3.887	4.1640	4.251
Applied fertilizer in 2005 (0/1)	0.7240	0.447	0.5108	0.501
Received extension advice in 2008 (0/1)	0.2304	0.421	0.1425	0.350
Distance to tarmac road in 2005	24.820	23.34	23.332	22.94
Community weekly market in 2005 (0/1)	0.3205	0.467	0.3333	0.472
Permanent ADMARC market in 2005 (0/1)	0.1404	0.348	0.1398	0.347
Community phone in 2005 (0/1)	0.1287	0.335	0.1129	0.317
Number of observations	855		372	

Notes: [*] (0/1) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category.