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Impact of Improved Maize Adoption on Welfare of Farm Households in Malawi: A Panel Data Analysis

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Summary. — This paper assesses rural households' decision to use improved maize varieties in Malawi and examines its impact on household welfare using a three-year household panel data. The distributional effect of maize technology adoption is investigated by looking at impacts across wealth and gender groups. We applied control function approach and IV regression to control for possible endogeneity of input subsidy and area under improved maize. We found that area under improved maize varieties is positively correlated with own maize consumption, income and asset holdings. We found evidence that improved maize adoption has a stronger impact on welfare of poorer households.

Key words — improved maize, technology adoption, input subsidy, food security, Malawi, Africa

1. INTRODUCTION

Half the population in sub-Saharan-Africa (SSA) lives in poverty. This rate of poverty is twice that of the global average and the highest in the world (African Development Bank [AfDB], 2012). Three-quarters of Africa's poor live in rural areas where the primary economic activity is agriculture (International Fund for Agricultural Development [IFAD], 2011]). Evidently, the agriculture sector has not been able to ensure food security in most of the SSA countries both at the national and the household level. Although production has increased over the years, productivity has not increased as much as the area cultivated. For example, in the 50 years during 1961–2010, the maize area in SSA tripled. However, excluding South Africa, maize yields in SSA increased only by about 40% over this period (Shiferaw, Prasanna, Hellin, & Banziger, 2011).

Malawi's economy reflects this general agricultural dependence in SSA. Agriculture accounts for 80% of employment and 41% of gross domestic product (AfDB, 2011). Most farming households depend on rain-fed production that is not sufficient to meet their consumption needs. In 2009, for example, 64% of the households ran out of staple food before the end of the year (National Statistical Office [NSO], 2011). Own production of farmers covers on average between 6 and 7 months of household consumption in a normal year [Ministry of Agriculture and Food Security [MoAFS], 2011). Poverty is widespread in the country, particularly in rural areas where the poor account for 57% of the rural population according to the official estimate (NSO, 2012). [1]

Maize is the main staple food for Malawi. So much so that national food security is mainly defined in terms of access to maize (MoAFS, 2011). However, maize is produced mainly for subsistence consumption with only 15% of production going to the market (MoAFS, 2011). In fact, 60% of maize producers are net buyers of maize (SOAS, W., O.D., & U.o., 2008). The poor performance of the agricultural sector in Malawi, including maize production, is partly because of low yields and stagnating productivity growth. In the 35 years during 1970–2005, there have been only marginal increases in maize and rice productivity (MoAFS, 2011). Earlier studies, however, indicated high improved technology diffusion and hence high expectations of improved productivity (Heisey & Smale, 1995). The Government of Malawi believes that the major contributing factor to low productivity in the smallholder sector is low input use due to lack of resources (MoAFS, 2011). To ameliorate this, the government launched a Farm Input Subsidy Program (FISP) in 2005 explicitly

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targeting smallholder farmers who do not have the resources to purchase inputs. The official objectives of this large subsidy program (subsidized commodities were worth 210 Million USD in 2008/09 alone) were to increase food sufficiency and crop income (Dorward & Chirwa, 2011).

Minten and Barrett (2008) argue that agricultural technology adoption and productivity improvements have the potential to increase food security for all sections of the poor. Net food buyers benefit from the lower food prices while unskilled workers benefit from increased real wages. If output grows faster than the fall in grain price, net food sellers also benefit from farm profits. With 97% of farmers in Malawi planting maize, even smaller changes in maize productivity are likely to impact the life of many poor farm households in the country.

Using three rounds of household-level panel data (2004, 2007, and 2009), this study aims to assess the adoption of modern maize varieties in Malawi and its impacts on the welfare of rural households in the country. We investigate the distributional effects of maize technology adoption by looking at impacts across wealth and gender groups. The paper contributes to the growing body of knowledge on the subject through panel data analysis with due consideration for observed and unobserved heterogeneity within the sample. The study applies control function approach and IV regression to control for endogeneity of input subsidy and improved maize adoption. A disaggregated analysis of poor *versus* better-off households and male-headed *versus* female-headed households enables us to test whether or not improved maize seed adoption is pro-poor or neutral in its impact.

We found that while access to subsidized input did not affect the likelihood of modern maize planting, it has significant influence on the amount of improved maize planted. We found that maize variety adoption is positively correlated with the household's own maize consumption, income and asset holdings. A 1% increase in the area planted to modern varieties is associated with a 0.48% increase in income, a 0.34% increase in the maize available for consumption, and a 0.24% increase in asset wealth. Improved maize adoption has more impact on the poorest households.

The paper is organized as follows. Section 2 briefly describes maize technology development and diffusion in Malawi. It is followed by a description of data in Section 3 and the empirical approach in Section 4. In Section 5, we present the results and discussions, and conclude in Section 6 with highlights of the key findings and policy implications.

2. BACKGROUND: MAIZE PRODUCTION AND PRODUCTIVITY IN MALAWI

The Malawian economy depends primarily on rain-fed agriculture, which is characterized by low productivity, low technology, and high labor intensity. The low productivity has been attributed to the loss of soil fertility, low application of inorganic fertilizers, and traditional, low technology, rain-fed farming systems (Chibwana, Fisher, & Shively, 2012). Malawian agriculture is also characterized by the dominance of maize-producing farmers who own small plots of land.

Maize is the staple food crop of Malawians and its production and productivity plays a crucial role in ascertaining both household- and national-level food security. Maize is grown by 97% of farming households and accounts for 60% of the total calorie consumption (Famine Early Warning Systems Network [FEWSN], 2007). The majority of households are net buyers of maize; 56% of net buyers did not sell any maize in 2007 (SOAS *et al.*, 2008). On-farm storage losses are possibly high. There is evidence that maize produced in Malawi and many other countries in the region suffer from larger grain borer, which can cause up to 30% quantity loss after 6 months of storage (Boxall, 2002). Perhaps as a result, most households who buy maize, including net sellers, made their purchase during the lean season when prices are the highest.

Smallholder farmers in Malawi find it difficult to diversify their crop production, due mainly to their limited farm land size. The mono-cropping that characterized Malawian crop production for decades has led to land degradation. It has long been argued that adoption of improved (high yielding) maize varieties and improved soil fertility management—for example through the application of inorganic fertilizer—helps productivity per unit area, thereby freeing land for diversification and concomitantly improving food security (Denning *et al.*, 1995; Smale, 1995). Smallholder farmers continue to maintain preferences for local (as opposed to improved) maize, despite its lower yield potential (Denning *et al.*, 2009), due to the perceptions that local varieties produce better quality flour, require less external inputs, and exhibit better pest resistance in storage (Lunduka, Fisher, & Snapp, 2012; Smale, 1995; Smale & Rusike, 1998). Although improved maize varieties first became available in Malawi in the 1950s, these were mainly dent hybrids bred for high yield in foreign contexts where the commercial role of maize was far more important. In addition to good storage and processing, other qualities, such as yield stability and the capacity to either escape or withstand drought, are highly important for Malawian smallholders who operate in risky production conditions (Kassie *et al.*, 2011; Peters, 1995). In the early 1990s, the national breeding attempts led to the release of varieties with qualities better suited to the needs of smallholders in Malawi. But most of the hybrids in Malawi now are dent varieties that do not store as well and are harder to pound than the local flint varieties.

The slow (and low) adoption of improved maize varieties and soil fertility management has persisted despite concerted efforts by Malawi's governments over the last five decades to stimulate uptake through the provision of subsidies and free agricultural extension services. Malawi, like some other SSA countries (e.g., Kenya, Tanzania, Zambia, and Zimbabwe), implemented a universal subsidy program in the 1970s and early 1980s through several interventions, including direct subsidies that reduced fertilizer prices for farmers, government financed and managed input credit programs, centralized fertilizer procurement and distribution, and the control of output markets (Denning *et al.*, 1995; Druilhe & Barreiro-Hurlé, 2012).

Throughout the seventies and eighties the country was able to produce a maize surplus and agricultural productivity grew in general terms, under-girded by a pervasive reliance on input subsidies to support the adoption of hybrid maize and fertilizer (Katengeza *et al.*, 2012). But in the mid-nineties the credit and subsidy programs, upon which the country had been relying, were abandoned in response to conditions imposed by the structural adjustment programs (SAP) of the World Bank and IMF (Denning *et al.*, 1995; Harrigan, 2003). Liberalization had severe negative effects for smallholders in Malawi, as the purchase price of maize skyrocketed and key inputs like fertilizer became prohibitively expensive (Blackie & Mann, 2005). Severe productivity shortfalls were forecast and, despite donor reticence, government-led interventions were resumed, first, from 1998 to 2000 in the form of the Starter Pack Program, then up to 2005 as the Targeted Input Program, and finally, to date, as the Agricultural Input Subsidy Program (Chinsinga, 2011).

The large subsidy program that started in 2005 garnered some attention in the development literature. A series of