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# Disrupting Demand for Commercial Seed: Input Subsidies in Malawi and Zambia

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**Summary.** — This study uses nationally representative household-level panel data from Malawi and Zambia to identify the determinants of subsidized maize seed and fertilizer receipt, and to estimate how input subsidies affect households' commercial purchases of improved maize seed varieties. In both countries we find that households in areas where the ruling party won the last presidential election acquire significantly more subsidized inputs than other households. Results also indicate that each additional kilogram of subsidized maize seed acquired by a household reduces its commercial improved maize seed purchases by 0.58 kg in Malawi and by 0.49 kg in Zambia on average.
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*Key words* — Sub-Saharan Africa, Malawi, Zambia, input subsidies, improved maize seed, crowding out

## 1. INTRODUCTION

Input subsidy programs that provide inorganic fertilizer and improved maize seed to small farmers below market rates are currently receiving a great deal of support as a sustainable strategy to foster an African Green Revolution (Denning *et al.*, 2009). In recent years numerous countries in Sub-Saharan Africa (SSA) including Ethiopia, Ghana, Kenya, Malawi, Nigeria, Tanzania, and Zambia have implemented such programs at substantial cost to government and donor budgets. For example, Malawi spent an annual average of 9.8% of its national budget subsidizing fertilizer and seed between 2005–06 and 2008–09. The annual expenses ranged from 5.6% in 2005–06 to 16.2% in 2008–09 (Dorward & Chirwa, 2011). In Zambia between 2004 and 2011, an average of 40.2% of the government's agricultural sector budget was devoted to fertilizer and maize seed subsidies each year. The annual budget shares for the subsidies ranged from a low of 31.2% in 2007 to a high of 45.6% in 2011 (Government of the Republic of Zambia, various years). The high direct and opportunity costs of input subsidy programs justify thorough evaluation of their benefits relative to their costs.

Unlike universal input subsidies that were common prior to the agricultural market reforms of the 1980s and 1990s, many of the current input subsidy programs in SSA target the inputs toward households that meet certain criteria. A general criterion for targeted input subsidies is that they be allocated to people who would not be able to purchase fertilizer and seed at commercial prices. By selecting people who would not otherwise participate in input markets, in principle these subsidies should not disrupt purchases of commercial inputs in the way that universal input subsidies did in the past. This is important because the fiscal and economic returns to input subsidies are undermined if they do not stimulate additional input use.

The main objective of this article is to determine the extent to which receipt of improved varieties of maize seed at subsidized prices affects Malawian and Zambian smallholder households' demand for such seed on the commercial market. [1] If receipt of subsidized improved maize seed has a positive effect on farmers' demand for commercial seed, *ceteris paribus*, then the seed subsidy can be said to *crowd in* commercial seed purchases. Conversely, if farmers who acquire subsidized seed use it in place of what would have been commercial seed purchases, then it can be said that the seed subsidy program *crowds out* or *displaces* commercial seed purchases. Determining the extent of seed crowding in/out from the subsidy is essential for understanding how much additional improved maize seed ends up on farmers' fields as a result of the subsidy program. This ultimately determines how effective subsidy programs are at boosting maize production and improving smallholder food security.

A second objective of the article is to determine the extent to which receipt of subsidized *fertilizer* crowds in or crowds out commercial improved maize seed purchases. To achieve the article's objectives, we use nationally representative household panel survey data from Malawi and Zambia to estimate household-level models of demand for commercial improved maize seed, where the two key explanatory variables of interest are the quantity of subsidized improved maize seed and the quantity of subsidized fertilizer received by the household. A positive and statistically significant coefficient on a given sub-

sidy variable indicates that the subsidy crowds in commercial improved maize seed purchases, whereas a negative and statistically significant coefficient indicates crowding out.

There is a small but growing literature that quantifies the impacts of input subsidy programs in SSA (see, for example, Banful, 2011; Chibwana, Fisher, Masters, & Shively, 2011; Chibwana, Fisher, & Shively, 2012; Holden & Lunduka, 2010; Mason, 2011; Ricker-Gilbert, Jayne, & Chirwa, 2011; Xu, Burke, Jayne, & Govereh, 2009). However the vast majority of past efforts have focused on the effectiveness of the *fertilizer* component of input subsidy programs, while relatively little attention has been paid to evaluating aspects of the *seed* subsidy. To our knowledge, the only study to consider the seed component finds that nearly half of the yield gains from Malawi's input subsidy program come from increases in improved maize seed use (Chibwana *et al.*, 2011). By focusing on the seed component of input subsidy programs, the present article broadens the knowledge base on the impacts of input subsidies.

Furthermore, this article is the first to empirically estimate the extent to which subsidies for improved maize seed and fertilizer crowd in or crowd out commercial *improved maize seed* purchases. It builds on previous studies that estimate the crowding out effects of fertilizer subsidies on commercial *fertilizer* purchases in Zambia (Mason, 2011; Xu *et al.*, 2009) and in Malawi (Ricker-Gilbert *et al.*, 2011). The general finding of these previous studies is that subsidized fertilizer crowds out commercial fertilizer, and that the crowding out rate is higher among wealthier households who are more likely to purchase fertilizer at commercial prices.

Beyond these contributions, this article makes two additional contributions to the existing literature. First, this is the only study to date that takes a cross-country approach when measuring the impacts of an input subsidy program in SSA. We estimate how an additional kilogram of subsidized maize seed affects demand for improved varieties of maize seed purchased on the commercial market in both Malawi and Zambia. We conduct very similar analyses for Malawi and Zambia using nationally representative farm household panel data from each country. These data were collected during years when the seed and fertilizer subsidy programs were in place in both countries. However the surveys in Malawi and Zambia reference different growing seasons, and the scale of the subsidy programs differs between the two countries and across survey years. We analyze data from each country separately, but compare and contrast the results in order to draw useful conclusions on factors that affect demand for commercial seed in these two African countries.

Second, this article provides a useful application for dealing with multiple potentially endogenous explanatory variables in non-linear panel data models. Non-linearities arise in this application because the dependent variable, kilograms of improved maize seed purchased on the commercial market, takes on properties of a corner solution variable. Corner solution variables, sometimes called censored variables, have a relatively continuous distribution over a range of values, but take on one or two focal points with positive probability (Wooldridge, 2010). In our study household commercial seed purchases have a pile up at zero, because many households do not buy seed commercially, but for those who do the quantity purchased is relatively continuous.

The two key explanatory variables of interest in the models, quantity of subsidized maize seed acquired by the household and quantity of subsidized fertilizer acquired by the household, also take on properties of corner solution variables. Many households acquire no subsidized seed or fertilizer, and although in theory subsidy program participants are supposed to obtain a standard packet of inputs, in practice participants often obtain different quantities of inputs.

Furthermore, since subsidized seed and fertilizer are not distributed randomly in either Malawi or Zambia, it is likely that unobservable factors that affect commercial seed demand also affect how much subsidized seed and fertilizer households acquire. In other words, the quantity of subsidized improved maize seed acquired by the household and the quantity of subsidized fertilizer acquired by the household are likely to be endogenous to the household's demand for commercial improved maize seed.

To deal with these complexities, the household-level models of commercial improved maize seed demand are estimated via correlated random effects (CRE) Tobit combined with the control function (CF) method. Use of the Tobit estimator deals with the corner solution nature of the dependent variable, while the CRE framework provides a way to control for time-constant unobservable factors that may affect commercial seed demand. The CRE approach (Chamberlain, 1984; Mundlak, 1978) entails including household time averages of all explanatory variables as additional covariates in the commercial seed demand Tobits. The CF method with instrumental variables is used to deal with correlation between subsidized seed, subsidized fertilizer, and time-varying unobservable factors that affect commercial seed demand (Rivers & Vuong, 1988; Vella, 1993). Dealing with the potential endogeneity caused by the way subsidized seed and fertilizer is distributed in Malawi and Zambia is an important part of this paper's modeling effort.

Estimation results indicate that an additional kilogram of subsidized improved maize seed crowds out 0.58 kg of commercial improved maize seed in Malawi and 0.49 kg of commercial improved maize seed in Zambia. Another way to interpret these results is that 100 tons of subsidized improved maize seed distributed to farmers only adds an additional 42 new tons of improved maize seed to farmers' fields in Malawi, and 51 new tons of improved maize seed to farmers' fields in Zambia. We also find that acquiring subsidized fertilizer has an economically insignificant effect on commercial seed purchases in both countries.

The remainder of this article is organized as follows. Section 2 describes the extent of adoption of improved maize varieties in Malawi and Zambia as well as the level of maize seed market development in the two countries. Next, the details of the seed and fertilizer subsidy programs are briefly discussed in Section 3. Section 4 outlines the methods used in the study, and Section 5 describes the data. Descriptive and econometric results are presented in Section 6, and the paper concludes with a discussion of the policy implications of the results.

## 2. ADOPTION OF IMPROVED MAIZE VARIETIES & MAIZE SEED MARKET DEVELOPMENT IN MALAWI AND ZAMBIA

### (a) *Malawi*

Hybrid maize seed development dates back to 1946 in Malawi. However even though it has the highest per capita maize consumption in the world, Malawi has yet to develop varieties of hybrid maize that meet the needs of the smallholder population (Smale & Jayne, 2003). A key reason for this is the estate sector's dominance in Malawi and its interest in export crops such as tobacco. In addition, the millions of smallholders in Malawi that grow maize for subsistence have