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Speed of adoption of improved maize varieties in Tanzania: An application of duration analysis

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ABSTRACT

Maize is a strategic commodity for improving food security and alleviating poverty in Tanzania, but its productivity remains low. The importance of improved maize varieties (IMVs) in increasing productivity is documented in existing literature. Previous adoption studies in Tanzania did not examine the factors that influence the speed/timing of adoption. This study examines the determinants of the speed of adoption of IMVs using a duration model and recently collected plot- and household-level data in rural Tanzania. The results highlight the importance of social capital and networks in speeding up the adoption of IMVs. Similarly, government extension workers as a main source of information have a positive effect on the speed of adoption. The regression results also suggest that rainfall and farmers' confidence in government support during crop failure speed up the adoption of IMVs. The findings imply that interventions that strengthen the role of extension services, rural institutions and networks can accelerate the adoption of IMVs by smallholder farmers in Tanzania.

1. Introduction

Maize is a staple food in sub-Saharan Africa where 95% of the maize produced constitutes a significant part of the daily diet (Høgh-Jensen et al., 2007). It is the primary food and cash crop grown in Tanzania, accounting for over 45% and 75% of the total cultivated land and cereal production, respectively (Shao, 2007). Over the last five decades the trend has been to increase the area of cultivated maize (Fig. 1). The annual per capita consumption of maize is around 115 kg; and because of its greater caloric density compared to other crops, maize is an important source of calories, contributing 33% of total household consumption (Minot, 2010; Otunge et al., 2010).

Despite the economic importance of maize in the national economy of the country, the sector is characterized by decades of stagnation and volatility in production and productivity (Fig. 1). Although there is an increase in total maize production over the years, most of the increase is due to area expansion. Between 1980 and 2010, there was only a marginal increase in maize productivity (Fig. 1). The low yield level is associated with a low level of adoption of technologies such as improved seeds and complementary inputs. In our sample, about 38% and 34% of farmers adopted hybrid fresh seeds and open pollinated varieties (OPV) seeds fresh and recycled up to three seasons, respectively. Only five percent of households used chemical fertilizer.

With areas of available arable land shrinking due to population growth, increasing productivity through expansion of agricultural technology is a key, and perhaps the only, strategy option for increasing agricultural production. Minton and Barrett (Minten and Barrett, 2008) argue that the adoption of agricultural technologies, with subsequent improvements in productivity, has the potential to increase food security for all sections of the poor. Net food buyers benefit from lower food prices while unskilled workers benefit from increased real wages. If output

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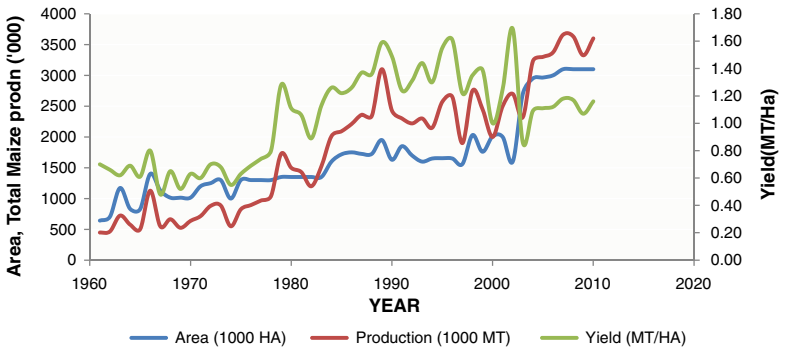

Fig. 1. Area cultivated, production and productivity of maize over time.

grows faster than price, net food sellers also benefit from farm profits. With almost all farmers in Tanzania growing maize, even small changes in the productivity of maize are likely to impact the lives of many poor farm households.

In Tanzania, improved agricultural technologies, including improved maize cultivars, have been stressed in key strategic documents as important tools for achieving reductions in hunger and poverty. However, despite several programmes and considerable efforts by organizations over the past decades, the adoption of improved technologies is low. A number of factors such as socioeconomic, institutional, cultural and policy conditions affect the ability of farmers to adopt technologies. A better understanding of the constraints that condition farmers' adoption behavior is important for designing and implementing policies that could stimulate the adoption of improved maize technology.

With few exceptions (e.g., (Dadi et al., 2004; Abdulai and Huffman, 2005; Matuschke and Qaim, 2008)), previous adoption studies (e.g., (Munasib and Jordan, 2011; Dimara and Skuras, 2003; Isham, 2002; Teklewold et al., 2013; Marenya and Barrett, 2007; Langyintuo and Mekuria, 2008; Bandiera and Rasul, 2006; Kaliba et al., 2000)) in developing countries fail to consider the timing of the adoption event and do not explicitly address the effect of explanatory variables on the time-path of adoption. Including the timing of an adoption can provide important information, particularly if adoption is related to specific events that occurred in the past or if time is considered to be linked to phenomenon-like learning by doing and learning from others (Matuschke, 2007). To bridge this gap duration, models are applied in this study. These models allow us to determine not only why farmers adopted a technology, but also on the timing of the adoption decision and what factors influenced the observed time patterns (Matuschke and Qaim, 2008).

Speed of adoption is desirable, since timely adoption of new technology can improve overall agricultural productivity and determine the survival of farms (Fuglie and Kascak, 2001; Batz et al., 2003). Production increases in the early years of adoption have a much greater impact on the rate of return on capital investment than increases in later years; thus with such rapid results policy makers are in a position to justify investments (Hazell and Anderson, 1986). Overtime, widespread adoption of new technology is likely to put downward pressure on product prices and upward pressure on the prices of purchased inputs that embody the new technology. This can adversely affect marginal farmers that have not yet adopted new technology or have done so less successfully (Fuglie and Kascak, 2001).

Using duration analysis to explore the factors that affect the length of time required for Tanzanian farmers to adopt IMVs, this paper contributes to existing literature in the following ways: firstly, it contributes to the limited literature on the application of duration analysis to agricultural technology adoption — to our knowledge, this is the first study to apply a hazard function to maize technology adoption; secondly, although there is well-developed literature on the impact of a host of explanatory variables on technology adoption, this analysis provides new evidence on the impact of policy-relevant variables such as social capital (e.g., the number of traders a farmer knows), and a farmer's expectations as regards social safety nets (social insurance) during crop failure. We also include technology information sources which are not available in most other similar studies. Thirdly, one of the major contributions of this study is the inclusion of how lag rainfall, which is a time-varying variable, can affect the decision to adopt IMVs. In Tanzania, rain-fed agricultural production dominates, which makes the country susceptible to extreme climate events. The knowledge and information obtained from this study may be useful in designing strategies that could speed up the adoption of private and public improved maize technologies by farmers.

The paper is structured as follows: the next section presents data and description of variables including the study area used in the empirical analysis; section three presents a detailed discussion about the econometric duration or hazard-rate model of adoption employed in the analysis; section four presents the results of the empirical analysis; and the last section concludes and draws policy implications.

2. Data and description of variables

Our data comprises information on 681 farm households collected across 60 villages in 4 districts of Tanzania. The data were collected by the International Maize and Wheat Improvement Center (CIMMYT) in collaboration with the Selian and Ilonga Agricultural Research Institutes between November and December 2010. Well-trained and experienced enumerators who had knowledge of the local language administered a structured survey