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Welfare impacts of improved chickpea adoption: A pathway for rural development in Ethiopia?

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ABSTRACT

We analyse the impact of improved chickpea adoption on welfare in Ethiopia using three rounds of panel data. First, we estimate the determinants of improved chickpea adoption using a double hurdle model. We apply a control function approach with correlated random effects to control for possible endogeneity resulting from access to improved seed and technology transfer activities. To instrument for these variables we develop novel distance weighted measures of a household's neighbours' access to improved seed and technology transfer activities. Second, we estimate the impact of area under improved chickpea cultivation on household income and poverty. We apply a fixed effects instrumental variables approach where we use the predicted area under cultivation from the double hurdle model as an instrument for observed area under cultivation. We find that improved chickpea adoption significantly increases household income while also reducing household poverty. Finally, we disaggregate results by landholding to explore whether the impact of adoption has heterogeneous effects. Adoption favoured all but the largest landholders, for who the new technology did not have a significant impact on income. Overall, increasing access to improved chickpea appears a promising pathway for rural development in Ethiopia's chickpea growing regions.

1. Introduction

Ethiopia is among the poorest countries in the world, is highly drought-prone and has an agricultural sector that accounts for 85 percent of employment (Dercon et al., 2012; Spielman et al., 2010). Exacerbating the situation, Ethiopia's population of 92 million is expected to grow to 160 million by 2050 (Josephson et al., 2014). As a result, farm sizes have been rapidly declining, increasing the need for agricultural intensification (Headey et al., 2014). Accordingly, increasing the productivity of smallholders through improved technology has become a policy priority for development agencies as well as the Ethiopian government (Abebaw and Haile, 2013). It has been suggested that tropical legumes can contribute to poverty reduction by improving food security and incomes of smallholder farmers in Africa (Gwata, 2010). One particularly promising technology is high yielding, drought tolerant chickpea varieties which can be used for on-farm consumption as well as export.

In this paper, we analyse the impact of adopting improved chickpea varieties on household welfare in rural Ethiopia. To do so we employ three rounds of panel data (2006/07, 2009/10, 2013/14) with a control function approach and instrumental variable estimation to control for endogeneity of access to improved seed, technology transfer activities and adoption.[1] We seek to answer the following research questions: What has been the impact of improved chickpea adoption on household income? To what extent did adoption contribute to poverty reduction? And, did adoption affect households differently depending on initial wealth status?

To motivate our empirical analysis, we first develop a simple conceptual framework using a non-separable model of a farm

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[1] Access to improved seed includes households that bought (from the market), borrowed (from a revolving seed fund) or were given (by friend/family/neighbour) improved seed. Technology transfer activities include farm trials or demonstrations, farmer field days, farmer field schools and seminars.

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household that is simultaneously involved in both production and consumption decisions. We then estimate the area under improved chickpea using a double hurdle model. We apply a control function approach with correlated random effects to control for possible endogeneity of access to improved seed and participation in chickpea technology transfer activities. We develop a novel distance weighted measure to instrument for these endogenous regressors. Finally, we estimate the impact of area under improved chickpea on household income and poverty. We apply a fixed effects instrumental variables model where we use the predicted values from the double hurdle model as an instrument for observed area under improved chickpea cultivation.

Our primary contribution is to provide rigorous evidence on the impact of agricultural technology adoption on household income and poverty reduction. This comes at a particularly relevant time, as the 68th United Nations General Assembly declared 2016 the International Year of Pulses. Improved chickpea adoption increased dramatically from 30 to almost 80 percent of the sampled households between the 2006/07 and 2013/14 seasons. We find that adoption has a positive and significant impact on household income. Furthermore, households that adopt improved chickpea are less likely to be poor than households that choose not to adopt. We also isolate the impact of improved chickpea adoption on income based on a household's initial land ownership. Improved chickpea adoption has a positive and significant impact on income for households with landholding in the three lower quartiles, but no significant effect on the income of the largest landholding households. The beneficial biotic and nutritional characteristics of legumes combined with our positive findings, implies that there is considerable potential for upscaling improved chickpea distribution networks for rural development in Ethiopia.

Our research contributes to a growing literature on the impact of technology adoption on poverty and income in Sub-Saharan Africa, which has been thin and mixed (Cunguara and Darnhofer, 2011; Kassie et al., 2011). Much of the previous work has focused on hybrid maize, either in Kenya (Mathenge et al., 2014), Malawi (Bezu et al., 2014) or Zambia (Mason and Smale, 2013; Smale and Mason, 2014). Previous research on the impact of improved varieties of legumes does exist but, to date, has been hampered by data limitations. Research on chickpea in Ethiopia (Asfaw et al., 2012, 2010), groundnut in Malawi (Simtowe et al., 2012) and groundnut in Uganda (Kassie et al., 2011) all relied on cross-sectional data, which limited the ability of these studies to identify causal impacts. To our knowledge, no research exists that identifies the impact of improved legume adoption on farmer welfare in Sub-Saharan Africa.

2. Background: chickpea production in Ethiopia

Chickpea is an important crop in Ethiopia. The country is the seventh largest producer in the world and accounts for over 90 percent of Sub-Saharan Africa's chickpea production (Kassie et al., 2009; Pachico, 2014). In Ethiopia chickpea is grown in rotation with cereals (primarily teff and wheat) and does not directly compete for land and labour with these cereals. Kassie et al. (2009) suggested that improved chickpea varieties are a key pro-poor and environmentally friendly technology for agricultural development and economic growth in Ethiopia. First, the growing demand in both the domestic and export markets provides a source of cash for smallholder producers (Abera, 2010; Shiferaw and Teklewold, 2007). Second, chickpea are considered environmentally friendly due to their capacity to fix atmospheric nitrogen and reduce chemical fertilizer use and costs in subsequent cereal crops (Giller, 2001). Finally, chickpea and its residues are a source of protein and can reduce malnutrition (Malunga et al., 2014; Sarker et al., 2014) and/or increase livestock productivity (Macharia et al., 2012).

The ability of Ethiopia's chickpea sector to foster economic growth and development depends on the country's ability to improve productivity, enhance grain quality and consistently supply the required volumes of market-preferred products at competitive prices (Abera, 2010; Keneni et al., 2011). More than ten improved chickpea varieties have been released (Asfaw et al., 2012). But until 2004, insufficient seed production limited the availability of quality seeds and the adoption of improved varieties was low (Shiferaw et al., 2007). Various initiatives were started to accelerate the adoption of improved chickpea varieties in Ethiopia. The Ethiopian Institute of Agricultural Research (EIAR) cultivated partnerships with major actors along the value chain to support the adoption of improved varieties (Abate et al., 2011). Primary co-operatives received breeder seed and multiplied them using contract farmers to enable the dissemination of improved chickpea varieties (Shiferaw et al., 2007). Moreover, the Tropical Legumes II (TLII) development program has conducted various chickpea research and development activities, including the establishment of seed grower associations (Monyo and Varshney, 2016).[2] TLII focused on major chickpea producing areas in the Shewa region for the upscaling of suitable chickpea varieties and marketing strategies. Other developments that boosted the chickpea sector included the decision to include chickpea in the Ethiopian commodity exchange and formation of the multi-stakeholder EthioPEA alliance.

Access to improved seeds and chickpea technology transfer are important pre-conditions for adoption. Krishnan and Patnam (2013) suggested that technology transfer activities provided by extension agents in Ethiopia transmit information vital to farmers in the early stages of adoption. They also found, however, that learning from neighbours who have adopted is more important than extension for the further diffusion of technologies. On chickpea, Asfaw et al. (2012) found that relatively affluent farmers had better access to improved seed in our study area which suggests that richer farmers might have been targeted through the extension system. They further note that Lume-Ejere district (one of our study areas) is strategically located on a main interstate road and closest to the national research centre that developed improved chickpea varieties, which might have disproportionately benefited farmers in the district in the form of pre-extension demonstrations and improved seed distribution trials. This suggests that access to improved variety seed and chickpea technology transfer activities in the area was neither universal nor random. We adopt an instrumental variables approach to address the non-random access to improved varieties.

3. Conceptual framework

It is too simplistic to assume that promoting agricultural technologies will automatically boost productivity, improve livelihoods and alleviate poverty (Tittonell, 2007). The potential effect of technology transfer depends on whether farmers adopt and, if they do, whether they adopt the technologies in an ideal combination and for the prescribed length of time needed to produce results (Parvan, 2011). For innovations that are 'divisible' and can be adopted in a stepwise manner the adoption decision involves a choice regarding the intensity of adoption (Marra et al., 2003). Adoption decisions are generally assumed to be the outcome of

[2] Tropical Legumes II was a Bill and Melinda Gates Foundation project to enhance grain legume productivity and production to increase poor farmers' income in drought-prone areas of Sub-Saharan Africa and South Asia. It was led by ICRISAT in partnership with CIAT, IITA and NARS partners and has just been renewed for a third phase (Tropical Legumes III). For more information see http://www.icrisat.org/TropicalLegumesII/