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To Specialize or Diversify: Agricultural Diversity and Poverty Dynamics in Ethiopia

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Summary. — Recent agricultural development policies have begun to shift focus from the promotion of a few staple crops toward encouraging crop diversity. The belief is that crop diversification is an effective strategy for dealing with a variety of issues, including poverty alleviation. However, there is a lack of empirical evidence to justify these positions. We contribute to filling this research gap by providing quantitative evidence on the impact of diversity in crop cultivation on household poverty. Using household panel data from Ethiopia we develop a diversity index to measure the effect of crop diversity on poverty status. To control for endogeneity and selection bias resulting from unobserved heterogeneity we utilize a recently developed parametric method for estimating dynamic binary response models with endogenous contemporaneous regressors. Our results provide evidence that households which grow a diverse set of crops are less likely to be poor than households that specialize in their crop production. Additionally, crop diversity reduces the probability that a non-poor household will fall into poverty and the probability that a poor household will remain in poverty. We conclude that crop diversification is a viable way to deal with the exigencies of being poor.

Key words — crop diversity, poverty, control function approach, dynamic binary response models, rural Ethiopia

1. INTRODUCTION

Ex post, specialization in production will always be profit maximizing. However, the *ex ante* choice to specialize or diversify crop production is non-trivial. This is because there are numerous constraints and uncertainties in the agricultural production process that may result in households choosing to cultivate a diverse crop portfolio (Hardaker, Huirne, & Anderson, 1997). In recognition of this, an increasingly common policy prescription for smallholders has been agricultural diversification. Food and Agriculture Organization (FAO) policy supports crop diversification with the understanding that it may be an effective strategy for dealing with issues as varied as food and nutrition security, employment generation, sustainable agricultural development, environmental and ecological management, and poverty alleviation (FAO, 2012). A series of country-level case studies undertaken by the FAO recommend methods to increase crop diversity but provide no quantitative evidence to support the efficacy of these policies (Hazra, 2001; Kaguongo *et al.*, 2013; Mengxiao, 2001). Similarly, recent International Food Policy Research Institute (IFPRI) publications have argued that growth in agricultural incomes will require diversification by farming households (Taffesse, Dorosh, & Asrat, 2011). Despite this shift of focus by development agencies from the promotion of a few staple grain crops to policies designed to encourage diversification, there is a lack of rigorous empirical evidence to support these positions. We fill this research gap by providing some of the first clear, rigorous quantitative evidence on these policies. [1]

In the spirit of recent literature designed to assess the impact of specific development programs (Bezu, Kassie, Shiferaw, & Ricker-Gilbert, 2014; Jodlowski, Winter-Nelson, Baylis, & Goldsmith, 2016; Larsen & Lilleør, 2014; Loschmann, Parsons, & Siegal, 2015; Mendola & Simtowe, 2015), we formulate our research question as a test of the impact of diversity in crop cultivation on household poverty in Ethiopia. While there is no defined policy or program in Ethiopia to encourage diversification, there is a secular trend in our data of increased crop diversity among households. We develop a diversity index that measures the variety of crops under cultivation by a household in a given year. [2] We use this index to measure the effect of crop diversity on poverty status, controlling for endogenous regressors and selection bias resulting from unobserved heterogeneity. We use poverty as our outcome of interest because it provides insight regarding the distributional effects of crop diversity, that is, whether diversification can pull poor households out of poverty. Furthermore, the Millennium Development Goals make poverty reduction the central objective of development. Consistent with this, we follow Christiaensen, Demery, & Kuhl (2011) in focusing our analysis on poverty reduction and not household income or consumption growth. In addition to our primary research question, we formulate a second research question: what is the impact of crop diversity on the probability that a poor household will rise out of poverty or that a non-poor household will fall into poverty?

Assessing the impact of crop diversity on poverty is not straightforward, especially in the case where no specific program or no distinct treatment exists. Estimation is complicated by state dependence in the binary outcome in addition to two potential sources of endogeneity. First, it is likely that there are unobserved household characteristics (e.g., skill,

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entrepreneurship) that create selection bias in the choice to diversify. Second, the decision to diversify or specialize may be driven by negative shocks that also increase the probability of a household being poor. Instead of adopting the standard methods to assess causal impact, we utilize a recently developed approach to estimating dynamic binary response models with endogenous regressors (Giles & Murtazashvili, 2013). This new method allows us to account for the endogeneity in cropping decisions by employing a control function approach similar to Papke and Wooldridge (2008) while also accounting for the initial conditions problem and the existence of unobserved heterogeneity via a correlated random effects model developed by Wooldridge (2005).

We find that crop diversity has a positive and significant impact on reducing the probability of a household being in poverty. Specifically, a 10% increase in crop diversity reduces the probability of being poor by 18%. Furthermore, a 10% increase in crop diversity reduces the probability that a poor household will remain in poverty by 18%. Finally, a 10% increase in crop diversity reduces the probability that a non-poor household will fall below the poverty line by 17%. We conclude that agricultural diversification, not specialization, is associated with poverty reduction. Households which cultivate a variety of crops are less likely to be poor. Our results provide much needed evidence regarding the increasingly common policy prescription of agricultural diversification.

2. LITERATURE REVIEW

Much of the literature on smallholder cropping decisions is framed as a debate over whether it is better to specialize or diversify. Cash crops are often promoted to alleviate poverty through welfare gains as part of a strategy based on comparative advantage (Govereh & Jayne, 2003) while a diverse crop portfolio is promoted as part of a strategy to manage production risk (Rosenzweig, 1988). Specializing in cash crops, which are assumed to have a higher value than food crops, may directly increase a household's income. The production and sale of cash crops allows the household to earn, and thus consume, more than could be done by allocating the same resources to own-food production.[3]

However, the benefits of specializing in cash crops may be limited by agro-climatic conditions (Orr, 2000).[4] While predicted declines in poverty due to cash cropping are based on the Ricardian theory of comparative advantage, portfolio theory predicts that risk averse households will reduce production risk through crop diversification (Rosenzweig, 1988). Optimal crop mix will depend on the relative magnitudes of the variance and covariance of the crops in question. In Appendix A we develop a theoretical model of multi-crop production by risk averse agents to more formally demonstrate the mechanism by which crop diversity impacts poverty.

Within the literature on crop diversity, production risk, and income, the focus is generally on estimating the determinants of diversity.[5] Several studies find a positive relationship between household income and agricultural diversity (Barrett *et al.*, 2001; Caviglia-Harris & Sills, 2005; Ellis, 1998, 2000). Contrary evidence exists, however, indicating that greater diversity may be associated with poverty. Feder, Just, and Zilberman (1985) argue that income drives diversification, generating income gains for the already wealthy and resulting in a poverty trap for those at the bottom.

Instead of estimating the determinants of diversity we analyze the role diversity plays as a determinant of poverty. Fewer studies have taken this approach. Among studies that do, most treat diversity as an exogenous variable (Baird & Gray, 2014; Bezu, Barrett, & Holden, 2012; Bigsten & Tengstam, 2011). By failing to control for endogeneity in the choice to diversify, or control for the initial condition of households, these studies provide only suggestive results about the relationship between diversity and poverty. Our econometric methodology, which includes instrumenting for crop diversity, resolves these issues and provides clear evidence that diversity reduces poverty.

In addition to our contribution to the literature on the relationship between crop diversity and income, our work also contributes to recent research on household coping strategies to increase food security and adapt to climate change. Despite evidence that farms are becoming less diversified (Bradshaw, Dolan, & Smith, 2004), diversification has come to be viewed as an important way to increase food security. This is particularly true when faced with increasing variability in production due to climate change. Several studies conducted in Ethiopia find that combinations of different farming techniques, including greater crop diversity, may mitigate food insecurity and help farmers cope with climate change (Bezabih & Sarr, 2012; Di Falco, Veronesi, & Yesuf, 2011; Di Falco & Veronesi, 2013). Our results provide further evidence that crop diversification is a viable way to deal with the exigencies of being poor.

3. DATA

Our empirical analysis uses panel survey data collected in the Ethiopian Rural Household Survey (ERHS) by the Economics Department at Addis Ababa University, the Centre for the Study of African Economics at Oxford University, and IFPRI. The data cover approximately 1,500 households in 15 villages from 1989 to 2009. The villages were selected to provide coverage of the variety of farming systems in the country and thus are considered nationally representative of rural, non-pastoral households. We use a balanced panel of 1,015 households from six rounds of the survey covering 1994 to 2009.[6] For more details on the ERHS, see Dercon and Hoddinott (2011).

(a) *Poverty status and household characteristics*

Our dependent variable is a binary indicator that measures if the household was below the poverty threshold. Our decision to use a binary indicator is motivated by three factors. First, the primary concern of many development agencies is raising households out of poverty. By focusing on poverty status, our results are easily interpreted and speak directly to the mandate of many development stakeholders. Second, income and expenditure data in the ERHS are incomplete.[7] Due to heterogeneity in age and quality of durable and non-durable goods (as well as an inability to establish market prices for these goods), consumption data in the ERHS are limited to only food items and non-investment non-food items (Dercon *et al.*, 2009). By using a binary indicator for poverty we are able to minimize measurement error in calculating our dependent variable. Third, while use of a continuous dependent variable might provide more *precision* in coefficient estimates, our use of a binary dependent variable does not require any sacrifice in the *accuracy* of coefficient estimates. Thus, our use of a binary poverty indicator instead of a continuous consumption variable allows us to reduce measurement error in our dependent variable, makes our results easily interpretable, and does so at no cost to the accuracy of our estimates.

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