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Are agricultural markets more developed around cities? Testing for urban heterogeneity in separability in Tanzania

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ABSTRACT

A key question for policymakers concerned about feeding Sub-Saharan Africa's (SSA) rapidly growing cities is whether or not nearby farms benefit from improved agricultural markets. Evidence from case studies and agricultural location theory suggest so, but urban heterogeneity has not yet been found in a common economic test of functioning agricultural markets—the separability result. The test is based on a key insight of the agricultural household model, which finds that a farm's profit should be maximized independently from household utility given perfect factor markets (i.e., separability), but not so if the household faces at least two market failures (i.e., non-separability). In this paper, I test for geographic heterogeneity in separability between rural, peri-urban, and urban districts using 2014–15 data from the World Bank's Living Standards Measurement Study and Integrated Surveys on Agriculture (LSMS-ISA) from Tanzania. I find strong evidence that the correlation between pre-harvest labor demand and household size implying non-separability in rural areas is significantly weaker in three of Tanzania's five largest cities: Dar es Salaam, Arusha, and Mbeya. Given certain assumptions, this can be interpreted as evidence of increased agricultural market functionality around these cities relative to rural areas. Overall, these results contribute to the debate on how to achieve urban food security in SSA and give some validity to agricultural location theory and the separability test as tools to help policymakers characterize the nature of agricultural factor markets.

1. Introduction

Are agricultural markets more developed around cities, particularly in Sub-Saharan Africa (SSA)? This question is particularly relevant for policymakers concerned about feeding SSA's rapidly growing urban environments. A synthesis of evidence assembled for the Consultative Group on International Agricultural Research (CGIAR) by seven top researchers in this field would suggest so, arguing that “dynamic zones of increased commercialization arise around African towns and cities” and “along transport routes that carry a ‘quiet revolution’ in the commercialization of crops and livestock”; meanwhile, isolated households remain burdened by low productivity and high transaction costs (Masters et al., 2013, p160 & p163). Yet, a common assessment of agricultural market functionality—the separability test—has been used only once to check for geographic heterogeneity in this result, finding across five SSA countries that separability did not significantly vary by distance to a town (20,000+ residents) or the capital (Dillon and Barrett, 2017). In this paper, I build on agricultural location theory to reason when and why agricultural markets may be more developed around cities and then test for heterogeneous separability results between households in urban, peri-urban and rural areas.

Separability is one key prediction of the agricultural household model (Singh et al., 1986) and states that a household farm's profit function should be maximized independently of the household utility function. Intuitively, households should maximize profit without constraining themselves to family size or preferences, knowing that they can consume more—and thus attain a higher level of utility—with more profit than with less profit. Given separability, the model represents the dual nature of the agricultural household as both a firm and consumer. Conversely, non-separability occurs when a household's production decisions are affected by household demographics or preferences. Non-separability may also exist when market failures or high transaction costs for inputs or outputs limit the household's ability to maximize profit independent of arguments in the utility function.

Benjamin (1992) developed a simple reduced-form test for separability, and theorized how, in the absence of fully functioning labor markets, separability may not hold. In short, he runs a regression of farm labor demand on household demographics, land, market wages and other factors. He argues that a significant correlation between household demographics and farm labor demand is evidence that the household utility function affects the farm's production decisions—a rejection of separability. One way this can occur is if two or more factor

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markets are incomplete. Suppose one factor market (e.g., land) is already imperfect, then non-separability may occur if lack of off-farm employment obliges additional household members to work in the fields beyond when the farm's marginal productivity of labor is equal to the market wage. Here, the labor market imperfection and the inability to adjust land holdings lead to a positive association between household size and total farm labor, which implies non-separability. However, when farm labor demand seems to be independent of household demographics, then separability cannot be rejected. Separability was not rejected in Indonesia by Benjamin (1992) but has since been rejected using a similar reduced-form test in Burkina Faso and Kenya (Udry, 1996), Cote d'Ivoire (Grimard, 2000), Ethiopia (Muller, 2014), and elsewhere.

This paper applies Benjamin's (1992) reduced-form separability test to 2014–15 data from the World Bank's Living Standards Measurement Study and Integrated Surveys on Agriculture (LSMS-ISA) from Tanzania. Beyond reporting a global rejection of separability across an entire sample, which is problematic for interpretation, I interact household size with geographic variables in a regression on pre-harvest labor demand to look for heterogeneous estimates between rural, peri-urban and urban areas. In one specification, 16% of households are classified as either urban or peri-urban based on proximity to one of Tanzania's five largest cities: Dar es Salaam, Mwanza, Arusha, Dodoma and Mbeya. A final specification tests for heterogeneous results by city to see if separability results vary more for cities with a higher population. I find that the correlation implying non-separability in rural areas is significantly smaller in Dar es Salaam, Arusha, and Mbeya and discuss how this may be interpreted as evidence of increased agricultural market functionality relative to rural areas.

This paper makes three contributions to the literature. First, it contributes to the debate on the role of urban and peri-urban agriculture in addressing urban food security in SSA (e.g., Zezza and Tasciotti, 2010; Crush et al., 2011; Badami and Ramankutty, 2015) by looking in the data to see if households in these areas benefit from a better market environment. If not, then widespread market failure around cities with growing food demand should be of key concern; if so, then policymakers can consider how to utilize these markets to feed growing cities and spread these benefits to more remote areas. In Section 2, I review the literature's documentation of changes to SSA urban food demand which motivate the research question.

Second, this paper contributes to the literature on geography's role in determining markets and transaction costs. While the theory is clear that transaction costs impede market participation by agricultural households (Omamo, 1998; Barrett, 2008), transaction costs are often proxied as distance to road, market or urban center without articulating a theoretical motivation. In Section 3, I present a framework that builds on agricultural location theory to outline necessary assumptions for an urban center to bring about improved agricultural markets to a given area, providing a justification for testing for rural-urban heterogeneity in the separability result.

Third, this paper contributes to the literature on the separability test more broadly. Whereas other separability studies have primarily reported global results (Benjamin, 1992; Udry, 1996; Grimard, 2000; Muller, 2014) or looked for household-level heterogeneity (Sadoulet et al., 1998; Bowlus and Sicular, 1998; Carter and Yao, 2002; Vakis et al., 2004), only one other study has looked for geographic heterogeneity to the author's knowledge. Dillon and Barrett (2017) test for separability among agricultural households in five SSA countries—Ethiopia, Malawi, Niger, Tanzania, and Uganda—and look for heterogeneous results by sex of household head, linear distance to roads and cities, and agro-ecological zones; they strongly reject separability in all countries and only find a significantly weaker separability result among Tanzanian agricultural households located in warm sub-humid tropics. In Section 4, I discuss how the present study chooses to specify urban and peri-urban status by geographic polygons rather than linear distance and, in Section 5, present statistically significant

heterogeneous results for select cities in Tanzania. In Section 6, I discuss how the results might give validity to the separability test as a tool that helps economists and policymakers characterize the nature of agricultural factor markets.

2. Literature review

One reason to suspect that agricultural markets are more developed near cities in SSA is the large literature documenting trends in urban food demand and how, due to lower transaction costs, urban and peri-urban agriculture are responding first to these changes. For example, one survey of 77 vegetable producers from two districts in Kenya found that farmers from the peri-urban district sold more output and for a higher price than those in the rural district, while household composition, per capita land, non-farm income and output did not significantly differ (Otieno et al., 2009). Three potential explanations for this result are found in the literature: 1) urban areas have a high and increasing demand for food; 2) urban food systems spur investment by farmers able to participate; and 3) high transaction costs in SSA mean that these opportunities fall to nearby peri-urban farmers. These three motivating literatures are discussed here in brief.

Interest in urban and peri-urban agriculture in SSA is largely motivated by its cities' increasing demand for food as a result of urban population growth. According to UN estimates, SSA's urban population is expected to nearly triple between 2018 and 2050—from 424 million to 1.26 billion people. (United Nations, 2018). Such projections lead some to worry that, without urban and peri-urban agriculture, the challenge to feed large cities is overwhelming (Drechsel et al., 1999). Others argue that these figures are overestimated; still, there is consensus that African cities are growing in absolute terms even if not as a share of the overall population (Potts, 2012).

Urban food demand in SSA is also characterized by increasing incomes and a shift in preferences toward animal-based products and fresh produce (Romanik, 2007). This has motivated the rise of supermarkets around the world, and a literature relating to their impacts on local farmers (Reardon et al., 2003). As supermarket chains spread, they enforce safety and quality standards and invest in sophisticated procurement systems, both of which encourage investment in agriculture by farmers hoping to reach that market—what Hirschman would call a backward linkage (Hirschman, 1977). In Eastern Africa, supermarkets have expanded quickly from the largest cities to smaller cities and towns (Weatherspoon and Reardon, 2003), potentially spurring investment into agricultural markets close to these urban areas. Then, given that for most food products in SSA, urban food demand far exceeds export markets (Romanik, 2007), agricultural markets have enormous potential to develop a result of growing urban food markets.

Alongside this literature is research interested in characterizing and measuring transaction costs—an intuitive concept with implications well understood in the agricultural household model (Omamo, 1998; Barrett, 2008)—but one whose effects have been difficult to quantify. Generally speaking, transaction costs are the costs of market participation (e.g., transportation, bargaining, and networking) that create a wedge between the market price and the real price to the buyer or seller. For example, there is descriptive evidence in SSA of truck haulage companies forming cartels to charge excessively high prices (Wiggins, 2005), which take away from farm profits and affect farmers' decisions to participate in the market. Stifel and Minten (2008) identify an inverse relationship between agricultural productivity and isolation in Madagascar resulting from high transaction costs, concluding that farmers close to urban centers or transport infrastructure were most likely to succeed. Others have studied the effect of transaction costs using hedonic (Jacoby and Minten, 2009), structural modeling (Gollin and Rogerson, 2014) and spatial approaches (Storeygard, 2016), each finding that transaction costs play a significant role in economic development. This contributes to the idea that urban and peri-urban

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