

Agricultural Productivity and Rural Household Incomes: Micro-level Evidence from Zambia

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Introduction

It is widely agreed that for countries in their early stages of development, agricultural growth is almost always at the heart of initial structural transformation processes. It has become a stylized fact of the development economics literature that agricultural productivity growth generates important general equilibrium effects on the rest of the economy through linkages with other production sectors, factors markets, downstream agricultural marketing systems, and consumption (Johnston and Mellor, 1961; Johnston and Kilby, 1975; Mellor, 1976). A major conclusion from this literature is that in developing countries, policies that discriminate against agriculture can hamper structural transformation and economic growth.

However, the micro-level evidence underpinning this *agricultural growth multipliers hypothesis* for contemporary Africa is surprisingly weak considering that it continues to be the foundational framework for most agricultural economists' view of the development process in this region. In fact, we are unaware of any African micro-level studies that estimate the impact of agricultural productivity growth - which may have complex lagged effects - on household incomes or consumption. This is largely because of the unavailability of annual household or regional data on agricultural productivity over a reasonably long time period.

This study is perhaps the first to estimate the effects of changes in agricultural productivity on the farm and off-farm incomes per adult equivalent of rural households in an African setting. To do this, we use household panel data from the nationally representative Rural Agricultural Livelihoods Survey (RALS) in Zambia, merged with annual data on crop productivity at the district-level computed from Zambia's annual Crop Forecast Surveys (CFSs). The CFSs cover the whole Zambia and are statistically representative at the district level.

This approach allows us to estimate the strength of the relationship between district-level lagged values of crop land productivity and rural farm household incomes from own-farm and off-farm work.

Key Findings

- Changes in district level crop productivity among smallholder farmers have strong and positive lagged multi-year effects on the own-farm incomes of rural households in that district
- This impact is especially true for productivity changes among (a) the highest productivity farms in each district, and (b) smallholder farms cultivating >2 hectares.
- There is also some evidence of a similar effect on total income, however this effect is not as robust.
- Overall, the least robust set of results are between district-level crop productivity and off-farm household incomes, suggesting that some of the recent critiques of the small farm-led multiplier effect hypothesis mentioned earlier for the African context may be valid.
- However, we do find tentative evidence (interpreted with caution due to their lack of significance in the robustness checks) that smaller farm productivity (<2 hectares) indirectly raises off-farm incomes.

Data and Methods

The data used for this analysis come from three main sources. The dependent variables - household incomes from own farm and off-farm work, and the sum of these (total household income) - and most of the control variables come from the Rural Agricultural Livelihoods Survey (RALS), a two-wave panel survey covering the 2010/11 and 2013/14 agricultural years (October-September) and the subsequent marketing years (May-April of 2011/12 and 2014/15, respectively). The RALS data were collected in June-July 2012 and 2015 by the Indaba Agricultural Policy Research Institute (IAPRI) in collaboration with the Zambia Central Statistical Office (CSO) and the Ministry of Agriculture (MoA).

The district summaries of lagged household values of crop



productivity come from the annual Zambia CFS conducted by the CSO and MoA. A maximum of six lags is included following econometric criteria. These data are collected in late March/early April shortly before the main harvest period begins in May, are based on farmers' expected quantity harvested of each crop after the crop reaches physiological maturity.

The rainfall measures are calculated from data collected by Tropical Applications of Meteorology using Satellite data and ground-based observations (TAMSAT). We use dekadal (10-day) data for moisture stress periods and monthly data for the other rainfall measures. The TAMSAT data were matched to the GPS locations of the RALS households and the rainfall indicators were derived using the Raster Calculator tool in ArcGIS Model Builder. The TAMSAT data has a spatial resolution of roughly 4 x 4 kilometers, or 16 square kilometers, and so for all practical purposes, they can be thought of as village-level measures.

The general hypothesis is that there is a relationship between long-term district-level agricultural land productivity and the total, own-farm, and off-farm incomes/AE of rural households in that district. We are therefore mainly interested in deriving unbiased estimates of the β_1^{t-j} 's. We also want to determine whether changes in agricultural productivity have a greater impact on own-farm or off-farm incomes. To estimate equation (1) and test this hypothesis, we employ a correlated random effects (CRE) Mundlak-Chamberlain device distributed lag approach. See the full report for more information on the empirical model and estimation strategy.

Results

Changes in district-level median and mean crop productivity have strong and positive lagged multi-year effects on the own-farm incomes of rural households in that district. This is consistent with the structural transformation model and the growth multiplier hypothesis of the development economics literature in that localized farm productivity growth provides farmers with increased incomes, which they tend to spend on other goods and services, including food and agriculturally-related off-farm activities that raise the demand for food. We also find consistently strong impacts of productivity

changes at the 90th percentile of households in the district, suggesting that it is the productivity changes among the most productive strata of farm households in the district that have the greatest indirect effects on the total and own-farm incomes of rural households in that district.

Furthermore, it is the productivity of the relatively larger farms specifically that drives higher own farm income overall. This last result suggests that the relatively larger farms in our study may be reinvesting their productivity gains back on the farm and in improved marketing, and this may also be creating positive indirect multiplier effects on smaller farmers via improved input and output market access, and more favorable farmgate prices. These findings are consistent with Sitko et al. (2018), who show that smallholders in Kenya and Zambia, especially in areas with a high concentration of relatively commercialized medium-scale farms, have greatly increased their sale of maize to large-scale traders in the last 10 years. This has resulted in these farmers receiving higher prices, along with improved access to private extension and input credit services.

Overall, the least robust set of results are between district-level crop productivity and off-farm household incomes, suggesting that some of the critiques of the multiplier effect hypothesis. When not separating by land size, none of the results on off-farm impacts are significant. However, we do find tentative evidence (interpreted with caution due to their lack of significance in the robustness checks) that smaller farm productivity (<2 hectares) indirectly raises off-farm incomes. In other words, our overall results do not confirm the original hypothesis that an increase in agricultural productivity has multiplier effects on the rural off-farm economy - at least based on our sample of agricultural households - but productivity change among small farms in particular (<2 hectares planted) tentatively does. Smaller farmers may have a higher income elasticity of demand for locally-produced off-farm goods and services. Higher productivity creates surplus earnings and a market for rural off-farm economic activity, leading to more opportunities for local off-farm income generation, something that has shown to be of great importance to rural African household livelihood strategies in the last several decades (Barrett, Reardon, and Webb 2001; Haggblade, Hazell, and Reardon 2007).

Conclusions

This study is perhaps the first to provide micro-level evidence from contemporary sub-Saharan Africa on the extent to which agricultural productivity continues to be a key driver of broader economic development. Focusing on the case of Zambia, the study estimates the extent to which lagged multi-year farm productivity in a given district influences the incomes of households in that district through own farm vs. off-farm activities. In so doing, this work is a novel test of the structural transformation model of agricultural-led development in a contemporary African setting using detailed household panel survey data.

The findings of this study may help policymakers in Zambia prioritize rural economic investments. Overall, this study upholds the Johnston-Mellor structural transformation consensus that investments that raise agricultural productivity in a given district may indirectly raise the incomes of all rural farm households over the period of a few years. There have been growing concerns that changes in demographics and employment patterns may be weakening the contribution of farm productivity growth to broader economic development. These findings for the most part do not support these views – even in contemporary Africa, which is generally witnessing major shifts in the labor force from farm to off-farm employment, localized crop productivity growth generally contributes indirectly to the incomes of households in the area. However, the effect of district-level agricultural productivity on the off-farm incomes of households in the district was less robust than we expected, although there is tentative evidence that increases in the agricultural productivity of local farms cultivating less than two hectares does increase

the off-farm incomes of all households in the area. This may point to the rising importance of identifying policy levers for directly raising the productivity of workers in the increasingly important off-farm segments of the economy, highlighting the need for rural policy and technology strategies that go far beyond agriculture.

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