

The Structural Transformation of African Agriculture and Rural Spaces: Introduction to a Special Section[†]

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August 2017

Abstract: This paper briefly introduces a special section on the structural transformation of African agriculture and rural spaces. The five papers that comprise this special section all draw on household-level micro data to explore important aspects of the salient changes taking place in the world's most agrarian and poorest continent.

The Nobel Laureate W. Arthur Lewis famously observed that “industrial and agrarian revolutions always go together, and ... economies in which agriculture is stagnant do not show industrial development” (Lewis 1954, p. 433). Indeed, virtually every one of today’s high income economies enjoyed sustained agricultural productivity growth coupled with rapid expansion and modernization of the rural non-farm economy that jointly sparked rapid industrialization and inclusive economic growth. This ‘structural transformation’ is widely considered central to economic development. Structural transformation is the process by which low-income societies, in which agriculture absorbs most labor and generates most economic output, become high-income societies characterized by a relatively smaller but more productive agricultural sector. Economists have strived for decades to understand the dynamics of structural transformation as rural economies transition from a patchwork of semi-subsistence farmers relying on rudimentary technologies, to more commercially-oriented food systems using more advanced production, processing, and distribution methods integrated across the farm and non-farm sectors, connecting rural producers to increasingly urban consumers (Mellor 1966).

Three central themes emerge in this literature (Johnston and Mellor 1961, Timmer 1988, 2009, Dercon and Gollin 2014, Barrett et al. 2017). First, productivity growth on small farms hinges on intensification, which entails increased use of other factors of production per unit area cultivated, and increasingly market-oriented production, the joint product of which commonly results in expanded use of purchased, modern inputs such as improved seeds, agro-chemicals and machinery. Second, there exist important, two-way (i.e., so-called ‘backward’ and ‘forward’) linkages between the farm and non-farm sectors that foster rapid and inclusive structural transformation. Third, a close relationship emerges between transformation in agricultural production systems, demographic change – especially urbanization and falling birth rates – and shifting diets. Indeed, the central importance of linkages to the

[†] The special section that this paper introduces encompasses five substantive papers submitted in response to an open call for papers in conjunction with the initial, December 2015 conference of a collaborative project involving the Africa Economic Research Consortium, the African Development Bank, Cornell University, the Partnership for Economic Policy, and the World Bank. We thank Editor-in-Chief Awudu Abdulai for his support and guidance and the dozens of reviewers who graciously offered helpful comments on the 19 papers subjected to fully blind peer review out of over 250 originally submitted for the 2015 conference. Any errors are our responsibility alone. The views expressed are those of the authors and do not necessarily reflect the views of their employers.

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non-farm sector, to urban consumers, and to nutritional and demographic change is the fundamental reason why most scholars now use the broader term 'structural transformation' rather than the narrower, earlier construct of the 'agricultural transformation'.

Despite some heterogeneity, the economies of Africa are finally enjoying robust economic growth, and the region shows early signs of agricultural productivity growth consistent with the early stages of a structural transformation (Diao et al. 2017). Africa has been the world's most agrarian continent for several decades now, with a larger share of employment and output in agriculture than any other world region. But those shares are dropping quickly. After decades of relatively slow or stagnant growth in per capita agricultural output across the continent, since 2000 African agriculture has been enjoying a sustained period of steady real per capita growth (Block, 2013; Barrett et al. 2017; Diao et al. 2017). The resulting relative declines in agriculture's position in African economies have been closely associated with both absolute productivity growth within the sector and faster overall economic growth and poverty reduction.

Nevertheless, crop yields remain low and productivity growth in agriculture has not kept pace with growth in per capita consumption in many countries so that the region remains dependent on growing food imports, especially for staple grains like wheat and rice and processed foods like vegetable oils and sugar (Rakotoarisoa et al. 2011; Mason et al. 2015; Traub et al. 2015). This despite large, underutilized opportunities in irrigation, farm intensification as well as land expansion, which jointly indicate significant potential for productivity growth and increased food production. Structural transformation and productivity change have eluded African policy makers for a long time and will neither be easy nor inevitable. Sustained investments in agricultural research and extension, and in rural markets and infrastructure will particularly be needed to raise farm productivity, close yield gaps and create employment opportunities within and outside the food system to absorb the surplus rural labor force and youth that exit the farm sector as productivity increases. The process of structural transformation is not also without risks of unintended consequences or of bypassing distinct subpopulations. The original Green Revolution that swept Asia, and to a lesser degree Latin America, for example, had unintended environmental and dietary impacts that limited the sustainability of the very real gains it generated (Conway 1998, Pingali 2012).

Historically, the bulk of the literature on the structural transformation has been macroeconomic, beginning with dual economy models explaining the movement of factors of production from one, less productive, agricultural sector to a second, more productive, industrial sector (Lewis 1954, Ranis and Fei 1961; Jorgenson 1961, Mellor 1966, Timmer 1988). Newly available household- and individual-level data sources, such as the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) from across Africa, now permit more nuanced, microeconomic research to understand the phenomena underlying the macro-level trends. The micro data lend themselves especially well to identifying some of the potential unintended consequences of policies and processes occurring during the structural transformation.

This paper introduces a special section of *Agricultural Economics* containing five excellent papers that explore different, important dimensions of the structural transformation currently taking place across rural Africa and build on the three central themes flagged above. Descriptive trends suggest that food systems in Sub-Saharan Africa are rapidly transforming. An emerging non-farm sector and productivity growth are improving incomes and changing consumers' diets. While this context creates many opportunities, risks remain that must be addressed.

Productivity growth and the unexpected consequences of agricultural transformation

Structural transformation requires agricultural productivity growth, which itself depends on increased uptake of improved technologies and greater use of inputs that improve the productivity of land and labor. It also requires progress in remedying labor, land, and financial market failures that impede not only technology adoption, but also efficient resource allocation and investment.

Two interlinked challenges for the structural transformation of African agriculture are the shrinking size of farms as rural population growth has outpaced rural-to-urban migration, and concerns about soil health and natural resource degradation arising from unsustainable practices that reduce resilience and long term productivity in the face of climate change and in the absence of any remedial actions. These concerns have led to a growing interest in sustainable intensification of agriculture and food systems to produce more nutritious and healthy food and increase incomes while strengthening resilience and reducing environmental impact (Pretty et al. 2011; AGRA 2016). Valdivia et al. (this issue) emphasize the importance of complex, diversified production systems that integrate crop production with livestock husbandry in the biophysically heterogeneous agro-ecological landscapes across the continent. Using household data from the Machakos region of Kenya to calibrate and validate an integrated, econometric process simulation modeling approach, they show how policies that stimulate an increase in farm sizes and that reduce distortions and inefficiencies in input and output markets could lead to a sustainable development pathway for rural households dependent on crop-livestock systems. They also show, however, how a range of intensification strategies can aggravate soil nutrient mining, an unexpected consequence of increased input use on fragile soils in the absence of economic conditions that induce farmers to replenish nutrients lost to harvests and erosion. They demonstrate how the efficiency of the increased use of fertilizer depends largely on the soil conditions and the level of intensification. Therefore, facilitating growth in livestock holdings – which generate manure, a complement to nitrogen-rich inorganic fertilizers – and reducing input and output market distortions that drive fertilizer prices up and crop output prices down are essential steps to building and sustaining soil nutrients in order to achieve sustainable crop productivity growth and poverty reduction. Valdivia et al.'s analysis nicely demonstrates why the choice of policies and investments must consider the biophysical and economic heterogeneity of the underlying farming systems. One size-fits-all interventions rarely produce their intended results.

Increased use of agro-chemicals such as inorganic fertilizers and pesticides often serves as a marker of the agricultural intensification that commonly signifies the earlier stages of structural transformation. Africa has long lagged the rest of the world in the use of fertilizers as well as the broader class of agro-chemicals that includes fungicides, herbicides, insecticides and rodenticides.. Worldwide, the expiration of patents on a wide range of commonly used formulations and the rise of low-cost suppliers from Asia and Latin America has sparked a recent surge in agro-chemicals use across the developing world (Haggblade et al. 2017), including Africa (Sheahan and Barrett 2017).

Sheahan et al. (this issue) explore the relationship between pesticide use on two outcomes, the value of crop output and a range of human health indicators, using large-scale, nationally representative panel survey LSMS-ISA data from four Sub-Saharan African countries. They find that pesticide use correlates strongly with increased value of harvest, but also with higher costs associated with human illness, including increased health expenditures and time lost from work due to sickness in the recent past. This underscores a previously documented (Antle and Pingali 1994), but oft-overlooked unintended consequences of increased agro-chemicals use by low-income farmers. More broadly, the paper

suggests that when farmers are unaware or less informed about health effects and ways to limit health impacts from hazardous pesticides, important tradeoffs between food security or income and health outcomes can occur. Sheahan et al. are careful to note that their estimates are not causal, and could potentially reflect reverse causality wherein labor shortages caused by illness induce uptake of labor-saving pesticides. Nevertheless, given binding liquidity constraints on smallholder households that struggle to pay health care costs, this reverse causality seems rather unlikely. Their findings clearly signal that (i) pesticide use is becoming widespread in several countries, and (ii) there appear problematic productivity-health tradeoffs that should motivate more focused investigations as to why adverse human health effects are now widely associated with pesticides use in African agriculture. Additional research is needed to understand what types of interventions (such as education and protective clothing or application methods) could change behaviors and are both feasible to adopt and effective in limiting the potential health hazards of using agro-chemicals to improve yields or reduce loss of production from pests.

Valdivia et al. (this issue) emphasize the important effect of market imperfections on the price signals that guide farmers' investments in inputs and new technologies. While the limited available evidence generally suggests that Africa's crop output markets are reasonably competitive (Dillon and Dambro 2017), information asymmetries, high transactions costs and uninsured risk exposure often impede market access for smallholder farmers who generate limited marketable surpluses (Barrett 2008; Shiferaw et al. 2008). Governments, development organizations and private firms have therefore been making significant efforts to establish effective contracting mechanisms with smallholder producers, with some demonstrable successes through farmer organizations, outgrower schemes and other arrangements (Reardon et al. 2009, Barrett et al. 2012).

Significant challenges nonetheless remain to creating and sustaining effective mechanisms for buying crops in bulk from smallholder farmers. As Upton and Lentz (this issue), explain, contract farming can sometimes resolve farmers' challenges by providing a source of stable demand, addressing information asymmetries, and reducing risk associated with price volatility. Toward that end, since 2009 the World Food Programme (WFP) has undertaken a massive effort to buy commodities through its Purchase for Progress (P4P) program. One of the serious impediments to large-scale contracting is the prospect of default by either party; this appears a more commonplace problem than is often recognized (Barrett et al. 2012). Upton and Lentz use detailed transactions data from WFP's P4P procurements in Ethiopia, Kenya and Tanzania to explore the drivers of contract defaults by smallholder farmer organizations. They find, not surprisingly, that as spot market prices rise above the contract price, the likelihood of default by farmer organizations increases significantly and that such deviations are commonplace, leading to high rates of default. Larger contracted volumes attenuate these effects, indicating the value of bulking in reducing search costs and inducing partners to honor contractual agreements. While the short term gain from breaking a contract to grab a higher market price may seem to be increasing in the size of a contract, the reputational costs of renegeing on large commitments and the search costs of finding alternative buyers apparently more than offset the immediate gains from breach. As market linkages, storage, and financial intermediation simultaneously deepen, this linkage between aggregation and implicit contract enforcement may be one underappreciated mechanism through which structural transformation reduces risk.

The expanding rural non-farm economy

As smallholder farmers' productivity grows and their incomes increase, their demand for non-farm goods and services grows disproportionately quickly, following Engel's Law. Especially in more remote

rural areas, where transport costs render many inexpensive goods and services nontradable, the demand stimulus sparked by agricultural productivity growth ignites rapid growth in the non-farm rural economy. Since many households diversify their earnings between the farm and non-farm sectors, non-farm gains are often reinvested in further agricultural intensification (Johnston & Mellor 1961; Mellor 1966; Barrett et al. 2001). Indeed, given pervasive financial liquidity constraints, non-farm enterprises are often considered a primary vehicle for fostering on-farm investment, helping foster a virtuous cycle of inter-linked farm and non-farm productivity growth.

Non-farm entrepreneurship has expanded significantly in rural Africa, due to both push and pull factors, although most such activities are in easy-to-enter sub-sectors, such as petty trading, rather than in activities with significant start-up costs and higher expected returns (Barrett et al. 2001; Nagler and Naudé 2017). The low productivity of many of these enterprises may limit their ability to facilitate reinvestment in agriculture and to help stimulate structural transformation. Given that most African households continue to concentrate in on-farm activities, there remains much work to be done to identify how best to facilitate African smallholders embarking on a trajectory toward greater non-farm income, similar to those of other regions further along in the process of structural transformation (Davis et al. 2017).

Amare and Shiferaw (this issue) explore nonfarm-to-farm linkages using household LSMS-ISA panel data from Uganda. Previous research has identified multiple constraints to uptake of modern agricultural technologies and productivity growth in rural Uganda (Shiferaw et al. 2015), constraints that might be ameliorated by non-farm earnings. Amare and Shiferaw find that higher nonfarm incomes are strongly associated with households' greater human capital, higher non-land capital assets, and better access to markets, indicating that many smallholder households may face significant entry barriers in leveraging non-farm opportunities, because of limited human and physical capital. There is a positive association between non-farm income and the use of both purchased modern seeds and hired labor but a negative relationship with on-farm family labor use, indicating a degree of substitution between farm and nonfarm employment of family labor. In addition, Amare and Shiferaw can find no support for the hypothesis that nonfarm income induces on-farm intensification or productivity growth using a variety of indicators, including the joint use of modern inputs, inorganic fertilizer or sustainable agricultural practices, as well as crop-specific productivity measures. The expected nonfarm-farm linkages that would help stimulate smallholder agricultural productivity growth appear to break down. The important policy implication of their findings is that policy or project initiatives to stimulate the rural non-farm economy may not have the desired palliative effects on agriculture. Under such conditions, more research is needed to identify alternative policies that reduce negative tradeoffs and stimulate positive synergies between agriculture and nonfarm employment in the process of structural transformation.

Dietary change in the structural transformation

The early research on the structural transformation paid relatively little attention to the dietary changes that commonly accompany income growth and urbanization. Throughout the 20th century, the focus of nutritional policy fell squarely on reducing undernutrition associated with insufficient dietary energy (i.e., calorie) and protein intake. Agricultural productivity growth was seen as unambiguously contributing to nutritional advances by increasing both farmer and farm worker incomes as well as food availability, thereby lowering real food prices and thereby generating food security gains for all populations (Evenson and Gollin 2003; Minten and Barrett 2008). Beginning with at least Popkin (1993, 1994), however, scholars have recognized that one commonly observes a simultaneous nutritional

transition from undernutrition to obesity as energy intake exceeds and energy expenditure with increased dietary consumption and the transition away from arduous agricultural labor.

African evidence along these lines is just beginning to appear. National level stunting rates have improved sharply over time at all income levels in Africa, between the 1980s and the 2000s, but obesity rates do not appear to have increased, remaining significantly lower than among non-African countries at comparably low income levels, although they exhibit a strong, positive income gradient (Masters et al. 2016). This nutritional transition is now becoming apparent in the fastest growing African economies.

Hassen et al. (this issue) show that although households' food expenditures as a share of total consumption declined over four waves of nationally representative household survey data, 1996 to 2011, consistent with Engel's Law, food quantities and calorie intakes have grown considerably. These changes were mostly driven by improvements in household incomes, relatively little due to reduction in the real cost of calories over time. Income growth and relative price changes together also induced a shift in dietary intake patterns, with a gradual shift toward high-value foods such as animal products, fruits and vegetables, and processed foods. Even within staple food categories there are dietary transitions, for example, a shift away from lower-priced cereals (e.g., sorghum and maize) to more expensive ones (e.g., teff). Hassen et al. however caution that their estimates are based on observational data in repeated cross-sectional surveys where some of the changes observed over time could be due to exogenous factors and one should not attribute causality to these findings. In addition, there is no assurance that the observed changes in dietary patterns in Ethiopia will carry on to more recent periods beyond 2011. Further research using more recent data could investigate patterns in food consumption and diet transformation in Ethiopia as well as other African countries.

Despite rapid growth in urbanization in recent decades and an expected acceleration of this trend in coming years, Ethiopia remains relatively less urban than most of Sub-Saharan Africa (World Bank, 2015). In this context, Hassen et al. also document important rural-urban differences in diets. Income growth and urbanization are associated with increased consumption of oils and fats as well as animal products and processed foods. Combined with reduced dietary energy expenditure associated with occupational shifts out of agriculture, these patterns suggest a looming risk of nutritional problems associated with overweight and obesity, especially in urban areas. Such dietary changes taking place in Ethiopia and similar countries in Africa have important implications for structural transformation of agricultural and food economies and for producers to exploit the growing demand for more diverse and high value commodities as well as more healthy and nutritious foods.

Conclusions

Together, the papers in this special section document the transformation of African agriculture, of food consumption patterns, and of the relationship between the farm and non-farm sectors. A thread that runs through all of the papers is the vital importance of broad and careful data collection and analysis to identify trends, diagnose constraints, and assess policy options. The emergency of large-scale, high quality, longitudinal survey data in Africa opens up excellent opportunities to undertake more nuanced, micro-scale research to identify patterns and challenges in the structural transformation now taking place in much of Africa, and to inform appropriate policy choices.

The papers in this issue suggest several key frontiers for transformation policy including integrated approaches to land and other natural resource management that protect long run sustainability and system resilience over the temptation to seize short term gains. Beyond the farm, mature and accessible

markets are needed to ensure both that gains in farm productivity are linked to off-farm investment opportunities and that human health is protected during a transition to new farming practices and diets. Agricultural transformation should also take note of the emerging changes in dietary and consumption patterns and support production of more diversified and nutritious foods that will address the chronic problem of undernutrition as well as the growing risk of obesity. In addition to identifying trends from rigorous and nationally representative data, linking data collection efforts to policy interventions and understanding the salient changes in these areas will inform key course corrections that will shape the process of transformation.

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