Regulation and the Transformation of Agriculture

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(September 2016)

Abstract:

The economic thinking around the role of agriculture for development has evolved since the 1950's. Over the past decades, in particular, the agricultural sector has been rediscovered as a sector with great potential of triggering growth, reducing poverty and inequality, providing food security, and delivering environmental services. The economic literature has acknowledged an enabling business environment as an important prerequisite to mobilize these functions. Among others, government policies and regulations play a key role in shaping the business environment through their impact on costs, risks and barriers to competition for various players in the value chain. In this paper, we argue that the peculiar nature of business in agriculture warrants a fresh and comprehensive examination of what constitutes an enabling regulatory framework agricultural transformation. Looking at both the *quality* and the *efficiency* of business regulations, and using new cross-sectional data, we investigate the relationship between the heterogeneity in countries' agricultural productivity and differences in how they regulate agricultural markets. Our results show that agricultural productivity is on average higher where transaction costs are lower and countries adhere to a higher number of regulatory good practices. This paper is intended as an initial step and it aims to contribute to the generation of an evidence-based discussion around the role of laws and regulations in supporting agricultural performance and, more importantly, the agricultural transformation processes.

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I. Introduction

The economic thinking around the role of agriculture for development has evolved since the 1950's. Classical economists viewed economic development as the relocation of factors of production from a traditional agricultural sector to a more productive, modern industrial sector (Lewis, 1954). A new view emerged in the 1960s, largely thanks to the success of the Green Revolution in Asian economies, which highlighted agriculture's central role as a driver of growth, especially in the early stages of industrialization (Johnston and Mellor, 1961). Scholars emphasized agriculture's modernization potential (Schultz, 1964; Hayami and Ruttan, 1985), growth linkages and multiplier effects (Adelman, 1984; Mellor, 1998; Hsieh and Sadoulet, 2007). More recently, Byerlee, de Janvry and Sadoulet (2009) highlighted agriculture's new role as the result of globalization, technological and institutional innovations, and environmental constraints. They stress agriculture's multiple utilities for development: triggering growth, reducing poverty and inequality, providing food security, and delivering environmental services.

Creating an enabling business environment to spur agricultural sector performance is now as an important prerequisite to mobilize these functions. Among others, government policies and regulations play a key role in shaping the business environment through their impacts on costs, risks and barriers to competition for various players in the value chains (Cullinan, 1999; World Bank, 2008; Dethier and Effenberg, 2012; Diaz-Bonilla et al., 2014; Hafeez, 2003; Christy et al. 2009; FAO, 2007; Alternburg and von Drachenfels, 2007). An inappropriate policy and regulatory framework can lead to the distortion of market efficiency, increasing costs for participants and stunting the development of the agricultural sector.

In this paper, we argue that the peculiar nature of business in agriculture warrants a fresh and comprehensive examination of what constitutes an enabling regulatory framework agricultural transformation. Indeed, agriculture's nature suggests that there are unique and evolving dimensions through which it interacts with relevant laws and regulations. These include, for example, regulations of agricultural input markets such as seed and fertilizer as well as regulations that enable small-scale and remote farmers to access finance. Moreover, they include product quality, sanitary and phytosanitary standards as well as trucking licenses. Regulations in these areas play a particularly critical role in connecting farmers to domestic and international markets (World Bank, 2016a).

Looking at both the *quality* and the *efficiency* of business regulations, and using new cross-sectional data, we investigate the relationship between the heterogeneity in countries' agricultural productivity and differences in how they regulate agricultural markets. Our research follows the argument of Hayami and Ruttan (1985), which emphasizes poor institutions as the major constraint to agricultural performance over resource endowments and technological availability. Unlike capital and technology, policies and regulations are characterized by high spatial stickiness: they cannot flow easily across countries. This puts high responsibility in the hands of policymakers across developing countries to enact an enabling policy and regulatory environment for agriculture.

This analysis focuses mostly on business regulations and it uses a new cross-sectional data set. Although earlier studies have looked at the impact of business regulations on economic performance (Djankov, McLiesh and Ramalho, 2006; Jalilian, Kirkpatrick and Parker, 2007; Loayza and Servén, 2010), this paper identifies and focuses on regulations that are relevant for the performance of the agricultural sector and introduces new measures of quality and efficiency of business regulations. The results show that agricultural productivity is on average higher when transaction costs are lower and countries adhere to a higher number of regulatory good practices.

With this analysis, this paper aims to contribute to the generation of an evidence-based discussion around the role of laws and regulations in supporting agricultural performance and, more importantly, the agricultural transformation processes. This paper is intended as an initial step due to the limited country-coverage of data on agricultural regulations. While it lays the foundation for a broader analysis, it will be updated once the dataset on agricultural regulations for more countries is finalized.[1]

The remainder of this paper is organized as follows. Section II presents the evidence and literature around the relationship between regulation and economic performance. Section III outlines the main components and the driving forces of agricultural transformation. Section IV provides a theoretical analysis of the relationship between business regulations and agricultural transformation. Section V proposes some measures of regulatory quality and presents an empirical analysis of the relationship between business regulations and productivity in agriculture. Section V contains some concluding remarks.

II. Regulation and Economic Performance

Institutional quality is a major determinant of countries' long-term economic performance (Hall and Jones, 1999; Acemoglu, Johnson and Robinson, 2001). The theory of economic regulation – a particular kind of institution – emerged in the nineteenth century, and is now supported by a vast collection of literature (for recent reviews, see Laffont and Tirole, 1993; Levy and Spiller, 1994). Regulations are sets of rules that constrain the actions of economic agents with the objective of achieving social goals such as safety, job security or health. The rationale for the existence of regulations is based on structural market failures arising from informational asymmetries, economies of scale in production, fragmented markets and externalities. In the presence of these factors, economic agents don't internalize the social costs and benefits of their actions, and therefore adequate regulation can raise social welfare. However, the political economy that characterizes regulations is complex and social goals typically compete with interest groups that distort regulations to capture economic rents.

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[1] The Enabling the Business of Agriculture (EBA) 2017 report – featuring an increased sample of 62 countries – is expected to be completed by December 2016.

Over the past decade a branch of economic literature has highlighted the significant impact of business regulations on economic performance (Djankov, McLiesh and Ramalho, 2006; Jalilian, Kirkpatrick and Parker, 2007; Loayza and Servén, 2010). The impact of business regulations on a country's economic performance depends on the balance between the market failures they are able to correct and the costs they impose on economic agents. Among many effects, regulations impose economic costs on businesses, creating incentives for firms to work outside the legal framework. These include monetary costs of complying with regulations, which divert resources from productive activities. Moreover, there are efficiency costs as regulations influence the allocation of resources across firms and sectors. In this context, understanding the transmission channels through which regulations impact economic performance becomes particularly important. The literature provides some evidence.

Excessive regulation – often in the form of high business registration costs – makes it too costly for firms to engage in the formal economy, causing them to not invest or to move to the informal economy (Bruhn, 2011; Branstetter et al., 2014). Overregulated labor markets, like overregulated business entry, can also lead to a large informal economy and high unemployment because they increase barriers to formal employment and make markets too rigid to adjust to changing conditions (Amin, 2009).

Another channel through which regulations affect firms is by reducing risk. Effective judicial courts, credit markets, bankruptcy laws and investor protection mechanisms ensure easier contract enforcement and higher debt recovery rates, shorten debt recovery suits and strengthen the rights of lenders to recover assets of defaulting borrowers (Visaria, 2009). Higher predictability puts companies in a better position to optimize their productive decisions.
Regulations also impact transaction costs for firms. Several studies show that regulations that make import and export processes more burdensome significantly decrease trade volumes (Djankov, Freund and Pham, 2010; Hoekman and Nicita, 2011). Others highlight the negative effects of high entry-costs on economic output and productivity across firms (Barseghyan, 2008). Similarly, overly strict financial regulations limit access to financial services and disproportionally penalize smaller firms (Love, Martinez-Peria and Singh, 2016).

III. Agricultural transformation

Several economists have studied structural transformation, which is described as the process of change in the production structure of an economy (Clark, 1951, Kuznets, 1957, Chenery and Syrquin, 1975). This marks the change from an agrarian society to an industrial one, and from artisanal manufacturing to mass production. As economies grow and urbanize, services from commerce, finance, and the state become increasingly important. A less obvious, though no less important, transformation occurs within the agricultural sector itself (Timmer 1988). No country has undergone a successful structural change towards higher levels of income per capita without transforming its agricultural sector. Indeed, agriculture plays a central role in the broader

structural change by supporting non-agricultural sectors through strong growth linkages and multiplier effects.[2]

Agricultural transformation has been shaped by three interrelated processes (Divanbeigi, Paustian and Loayza, 2016). First, higher yields and lower costs from existing and new farming lands have increased agricultural productivity. From 1960 to the present, agricultural output per hectare has expanded by over 250 percent (Alston, Babcock and Pardey, 2010). In some cases, this expansion has been led by developing countries. Cereal yields in East Asia have risen by an impressive 2.8 percent per year, much more than the 1.8 percent growth in industrial countries. Likewise, the shares of arable and cultivated land in low- and middle-income countries have risen by 29 percent and 36 percent, respectively, since 1960, while in high-income countries they have not increased, on average.[3]

Second, the types of agricultural products have changed, from subsistence to cash crops, from food staples to intermediate inputs, and from low-value/low-risk to high-value/high-risk varieties. This change is reflected in the evolution of agricultural commodities in global markets. Whereas traditional exports have grown at an average of 2.5 percent per year in the last 50 years, cereals and fruits have grown by over 5 percent per year, and livestock has grown by more that 7 percent per year. Naturally, this evolution has differed across regions and countries, given their heterogeneous geographic and climatic endowments.

Third, agricultural market transactions have become more integrated with the rest of the economy, more dependent on finance, and more oriented to international trade. Fueled by food industries and services, agribusiness – which includes the value added for agro-related industries and for agricultural trade and distribution services – has expanded in most developing countries, despite the decline in the share of agriculture in GDP. The percentage of adults in rural areas who have an account at a financial institution increased sharply from 2011 to 2014, in both low-income countries (by over 15 percent) and in middle-income countries (over 44 percent) (FINDEX, 2016). In the last 50 years, exports of agricultural commodities from developing countries have increased eight-fold. The expansion of manufactured exports based on agricultural inputs has been at least as remarkable.

These general trends provide a picture of how the agricultural sector is transforming in developing countries. However, progress towards agricultural transformation is far from homogeneous. Some specific factors have emerged in the literature as important driving forces. Much of this transformational success has been generated by the combination of high rates of investment in crop research, infrastructure, and market development, and appropriate policy support that took place during the Green Revolution (1966 to 1985) and the two decades that followed (Pingali, 2012). The fundamental strategy for the growth in productivity of food crops was that spillovers from existing advanced technologies could be captured across political and

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[2] See Byerlee, de Janvry and Saudolet (2009) for an extensive review.
[3] See Alston and Pardey (2014) for a more detailed discussion on agricultural productivity.

agro-climatic boundaries. As neither private firms nor national governments had sufficient incentive to invest in all of the research and development of such international public goods, great focus was put on promoting appropriate institutional mechanisms (Hazell, 2010).

The provision of public goods – including physical and institutional infrastructure – is another driver of agricultural transformation. Among other things, irrigation and transportation infrastructure can be critical (Dercon and others, 2009; Lipton, Litchfield and Faurès, 2005). Similarly, by setting the right institutional and regulatory framework, governments can help increase the competitiveness of farmers, enabling them to integrate in regional and global markets. Land rights (Besley, 1995; de Soto, 2000; Goldstein and Udry, 2008) and water property rights (Das, 2012; Mobarak and Rosenzweig, 2013) are good examples of governments supporting agricultural competitiveness.

Sustained trade liberalization over the past five decades also supported agricultural transformation by expanding opportunities for exporters of agricultural products. In the past 50 years, exports of agricultural products from developing countries have multiplied eight-fold while those of agriculture-based manufactured products increased ten-fold (United Nations, 2016). Such trends have continued recently: largely thanks to an increase in prices, exports of agricultural products nearly tripled between 2000 and 2012, while also increasing in volume by around 60 per cent (WTO, 2013).[4]

IV. Business Regulations and Agricultural Transformation

As discussed in section II, the impact of regulations on economic performance has been consistently covered by economic literature. A far less often considered aspect is which policies and regulations matter for agricultural markets and the relationship between these regulations and agricultural transformation. Do regulations play a role in promoting (or hampering) agricultural transformation processes? What type of regulation impacts which of the components of agricultural transformation – i.e. productivity, composition and market integration?

Answering these questions is challenging due to the lack of comparable data on business regulation and on agricultural activities. Agriculture's nature warrants a fresh and comprehensive examination of what constitutes an enabling regulatory environment, which we propose in section V. Nonetheless, the channels through which business regulations affect overall economic performance are also relevant for agriculture. Several factors point in this direction.

A first consideration stems from the predominance of externalities in agriculture. As stressed by the World Development Report 2008, regulation in agriculture is critical in a number of areas including biosafety, food safety, grades and standards, intellectual property protection, agricultural input quality, groundwater extraction, and environmental protection. Due to agriculture's importance for human health and food security, political stability and environmental sustainability, it is not unusual for governments to implement more stringent

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[4] For a deeper review of the literature see Divanbeigi, Paustian and Loayza (2016)

agricultural regulations (Diaz-Bonilla, 2014; USAID, 2015). More pervasive regulations demand continuous evaluation to ensure effectiveness in correcting market failures and monitor their implications for firms.

As discussed, regulations often impact economic performance through informality. When the cost of compliance is higher than the benefits of legality, firms may move to the informal sector. In comparison to the more complex processes that characterize industrial production, agricultural activities favor informality by making legal protection and contract enforcement less relevant and valuable. Firms in agriculture may therefore be more sensitive to regulations with high costs of compliance, and consequently more prone to avoiding them by remaining (or becoming) informal (Loayza, Servén and Sugawara, 2009).

Another factor that highlights the relevance of business regulations for agriculture pertains to risk and predictability. Farmers face considerable risk due to their susceptibility to exogenous elements such as weather, plague of insects, and diseases, all of which play a fundamental role in agricultural production. Moreover, biological processes often make intermediate production phases unobservable, limiting the scope for corrective actions before harvest. Similarly, farmers must make production decisions before they know the market price of their crops. What's more, uncertainty is exacerbated by the inherent volatility of agricultural markets (Aimin, 2010). As highlighted above, regulations can enable businesses to operate in a context where the outcomes of their decisions are more predictable by setting clear and easily enforceable rules. Predictability is critical in the farming business where risk is typically inherent.

Transaction costs represent another dimension where regulatory efficiency is key to agriculture. Transport costs can make up one-third of the farm gate price in some Sub-Saharan African countries (World Bank, 2007) and prevent farmers from specializing in the goods where they have a competitive advantage (Gollin and Rogerson, 2010). What's more, high marketing costs due to isolation from markets and roads, lack of means of transport or inefficient transport services often discourage farmers from commercializing their production (Gebremedhin and Jaleta, 2012). Finally, credit is often rationed in rural areas and financial services are often low quality and do not respond adequately to the demand of producers (Hoellinger, 2011). Well-designed regulations can support farmers by limiting their transaction costs in accessing transportation, marketing and financial services.

Finally, while the studies cited above focus on the impact of regulations on manufacturing activities, many elements of an enabling regulatory environment for agriculture are not sector-specific. Therefore their conclusions extend to the agricultural sector as well. Lio and Liu (2008), show that a more market-friendly regulatory environment contributes to higher agricultural productivity. What's more, a friendly investment climate can support the development of agribusiness. This comprises private agroenterprises that provide inputs and other services such as handling, processing, transportation, marketing, and distribution of food and other agricultural products (FAO, 2007). Like traditional manufacturing firms, these businesses would benefit from secure property rights, efficient taxation, increased access to finance and the balanced entry and

operational standards that a supportive investment climate offers. In light of widespread concerns for quickly growing concentration in the agribusiness sector, minimizing regulatory barriers to competition is particularly important (World Bank, 2007).

V. Measuring Regulations in Agriculture

The prevalence of externalities, uncertainty, informality and high transaction costs suggest that business regulations' impact on economic performance in agriculture can be significant. The peculiar nature of the farming business suggests that there are unique dimensions through which it interacts with the regulatory climate. These include regulations of agricultural input markets such as seed and fertilizer as well as regulations that enable small-scale and remote farmers to access finance. Moreover, they include product quality, sanitary and phytosanitary standards as well as trucking licenses. Among others, regulations in these areas play an important role in connecting farmers to domestic and international markets (World Bank, 2016a).

In light of the outlined complexity, designing regulations that can pursue social objectives without imposing excessive costs on firms or other undesired economic effects is no easy task. There is a recognized need to craft balanced regulations that foster well-functioning markets while ensuring transparent and strong protections for consumers (Swinnen et al., 2015). Economic research is key in guiding evidence-based policymaking towards more effective regulations. This relies critically on the availability of firm-level data as well as on data on the quality and efficiency of regulatory practices.

Data description

To build our measure of business regulations for agriculture, we use a new data set produced by the World Bank Group (WBG), Enabling the Business of Agriculture (EBA), which provides benchmarks on regulations that impact firms along the agriculture value chain. The EBA data covers 40 economies in its 2016 edition, and will expand to 60 by the end of 2016.[5] An important feature of EBA data is that it is standardized through case-study assumptions, allowing researchers and policy makers to compare a country's regulations with those of others. EBA data collection is primarily survey-based and the data is validated through a direct analysis of the relevant legislation. Questionnaires are completed by private and public sector experts as well as civil society organizations in each target country.

EBA collects primary data focusing on legal barriers for businesses operating in agriculture attempting to quantify the transaction costs of dealing with government regulations. The EBA indicators cover a wide range of regulatory domains that are relevant to firms operating in agriculture. They benchmark regulations of inputs and of other markets enablers (Table 1). The

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[5] See Annex I for the list of countries included in the EBA sample. The 40 countries were chosen to represent all country groups based on income level, geographical position and role of the agricultural sector as defined by World Bank (2007). For full information on EBA data and underlying methodology see: eba.worldbank.org.

EBA dataset features two types of indicators. *Quality* indicators reflect the text of laws and regulations. They assess their conformity with a number of global regulatory good practices aimed at correcting market failures. For example, requirements on registration, labeling and monitoring of new fertilizers are important. They ensure that farmers have full information on the fertilizer they plan to use on their crops and protect them from purchasing low-quality products. Inadequate nutrients, heavy metals or other residues found in fertilizer products can contaminate crops, animals and humans (Sartain et al., 2004). Farmers should be given assurance that the products they use will not contaminate their crops and the environment.

Further, e*fficiency* indicators measure the transaction costs that firms have to bear to comply with national regulations on the ground. Transaction costs are expressed in time or monetary units, like the time and cost needed to comply with requirements on agricultural exports. Regulatory bottlenecks exporting agricultural products – such as special licenses, registration and export documentation – can raise transaction costs associated specifically with exports and discourage private investment in marketing and storage capacity (World Bank, 2012; Pannhausen and Untied, 2010). Delays in obtaining mandatory export documents can reduce overall export volumes due to damage or deterioration, especially for time-sensitive agricultural products (Djankov, Freund and Pham, 2010).

Table 1. List of topics covered by EBA indicators

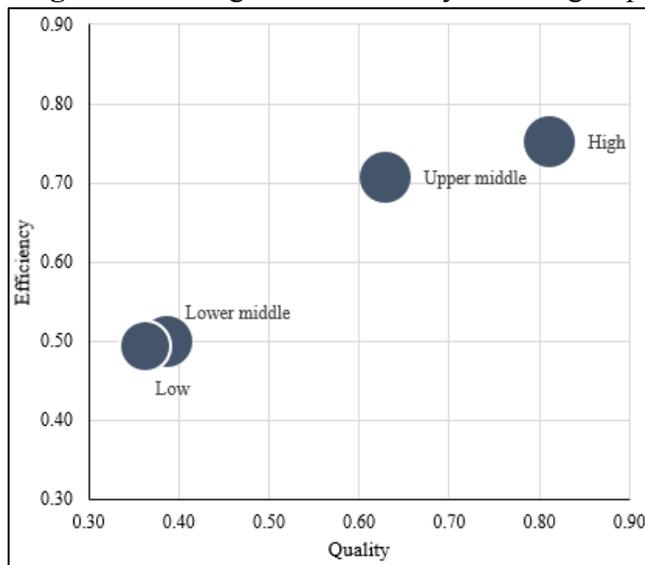| Topic	Indicator
Seeds	Time to comply with procedures to commercialize a locally developed seed variety
	Cost to comply with procedures to commercialize a locally developed seed variety
Fertilizer	Required procedures to register a new fertilizer product
	Labeling requirements, legislation on the sale of mislabeled and open fertilizer containers, and practices in monitoring fertilizer quality
	Statutory requirements for fertilizer import
	Time to comply with processes required to register a new fertilizer product
	Cost to comply with processes required to register a new fertilizer product
Machinery	Testing of tractors, licensing requirements, warranties and post-sale services
	Operational safety and performance standards of tractors
	Required procedures to import agricultural tractors and harvesters
Finance	Regulations for deposit-taking microfinance institutions and credit unions
	Entry and operational requirements for agent banking and electronic money issuers
	Regulations on the use of agricultural commodities as collateral
Markets	Legal obligations applicable to domestic pest management
	Regulation of farmers' cooperatives, contract farming arrangements and related disputes resolution
	Time to comply with processes required to export agricultural products
	Cost to comply with processes required to export agricultural products
Transport	Licensing and inspection regulations
	Statutory restrictions to cross-border transport and regulations on carrier's liabilities

Data aggregation: Quality and Efficiency

As highlighted in section IV, the debate on the impact of regulation evolves around both quality and efficiency arguments. It depends on the balance between the market failures it is able to correct and the costs it imposes on businesses. In this context, EBA indicators are of particular interest as they provide information on both dimensions. Based on the nature of each EBA indicator *i* we compute our quality or efficiency scores for economy j as follows:

$$x_{i,j}^{QUAL} = \frac{GP_{i,j}-GPmin_i}{GPmax_i-GPmin_i} \quad (1) \qquad\qquad x_{i,j}^{EFF} = 1 - \frac{TC_{i,j}-TCmin_i}{TCmax_i-TCmin_i} \quad (2)$$

where *GP*, *GPmin* and *GPmax* are the observed, minimum and maximum number of regulatory good practices; *TC*, *TCmin* and *TCmax_i* are the observed, minimum and maximum transaction cost amounts in the sample. The scores that we obtain are normalized between 0 and 1, with 1 representing the best practice and 0 the worst. To avoid outliers transaction costs that exceed the 99th percentile are assigned a value of 1. Aggregate efficiency and quality scores are obtained for each economy by averaging the respective indicators. Finally an overall regulatory quality is obtained by averaging the efficiency and quality indicators for each economy.
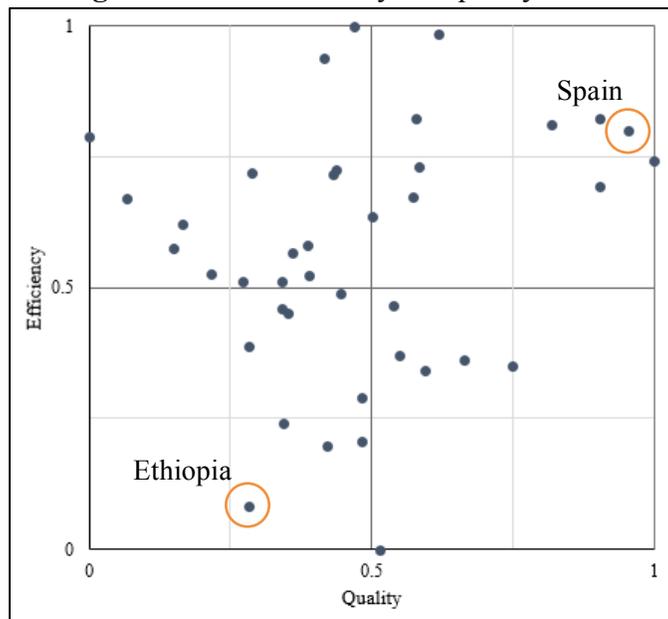
Figure 1. Average EBA scores by income group

Source: Authors' calculations based on World Bank (2016a)
Notes: Average scores for each income group are reported in annex II.

Both regulatory good practices and transaction costs display substantial variation across the sample. Averaging them over income groups we observe a positive association between income levels and the supportiveness of countries' regulatory environment. Countries with higher income per capita have in fact more efficient and higher quality agricultural regulations (Figure 1).

To explore further the relationship between regulatory quality and efficiency we look at country-level scores ("overall scores"). Once we move away from income-groups, the positive association weakens (Figure 2). This suggests that the interaction between regulatory good practices and transaction costs varies across our sample.

Figure 2. EBA efficiency VS quality scores

Source: Authors' calculations based on World Bank (2016a).

A number of countries combine low transaction costs with a high number of regulatory good practices. This points against the argument that improvements in regulatory quality involve high efficiency costs. Spain displays good practices across several regulatory areas. It imposes sound requirements on registration, labelling and monitoring of new fertilizers. Further, it ensures reliable pest management and control at the border through surveillance and pest reporting obligations, quarantine pest lists and risk-based border inspections, domestic containment and border quarantine procedures. At the same time, transaction costs that businesses in Spain bear to register new fertilizer, commercialize new seed varieties and export agricultural goods are rather low. Conversely, other economies perform poorly in either dimension. Ethiopia, for example, lacks most mentioned good practices while imposing high transaction costs on agribusinesses. Finally, several countries display high scores in only one of the two dimensions while not performing as good on the other, showing potential for targeted regulatory improvement.

Correlations with related measures of institutional quality

The EBA overall score provides a synthetic measure of the quality of countries' regulatory environment for agriculture. To be effective, however, regulations need to be enforced. One potential critique to EBA scores could be that, being largely based on the books, the good
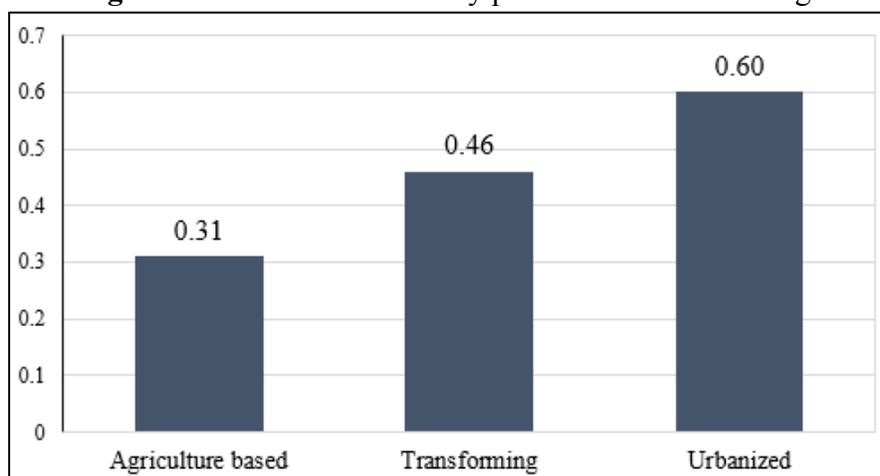
practices that they reward are not observed in practice. In this case one would expect a negative association between our scores and measures of law enforcement. Conversely, EBA scores could be perfectly correlated with other measures of business regulation making them redundant.

To address these points we look at the correlations between EBA scores and the following indexes: Rule of Law (RoL) from the Worldwide Governance Indicators database and the Ease of Doing Business (DB) from the World Bank's Doing Business dataset. As expected, both correlations are positive and significant.[6] The RoL index proxies the level of enforcement of laws and other societal rules. Its positive correlation (r=0.52) with the EBA score implies that where good regulatory practices are in place, laws also tend to be better enforced. On the other hand, the DB index measures the quality of a country's business regulations for the manufacturing sector. EBA scores do not correlate perfectly with the DB index (r=0.63). This implies that our measure captures different and more agriculture-specific dimensions of regulatory quality.

Relationship with agricultural transformation

The literature referenced earlier contains some evidence of the supportive role that an enabling regulatory climate can play for agricultural transformation. By providing an aggregate measure of the quality or the regulatory environment in agriculture, EBA data can add to this debate.

Figure 3. EBA overall score by phase of structural change

Source: Authors' calculations based on World Bank (2016a, 2016b).
Notes: The three groups follow the classification proposed by World Bank (2007) and are computed for average values over the 2000-14 period. The correlation between EBA scores and structural change phase is significant at the 95% level after controlling for GDP per capita.

Following World Bank (2007) we group economies based on their dependence on agriculture for growth and poverty reduction (Figure 3). As shown, on average the regulatory environment for

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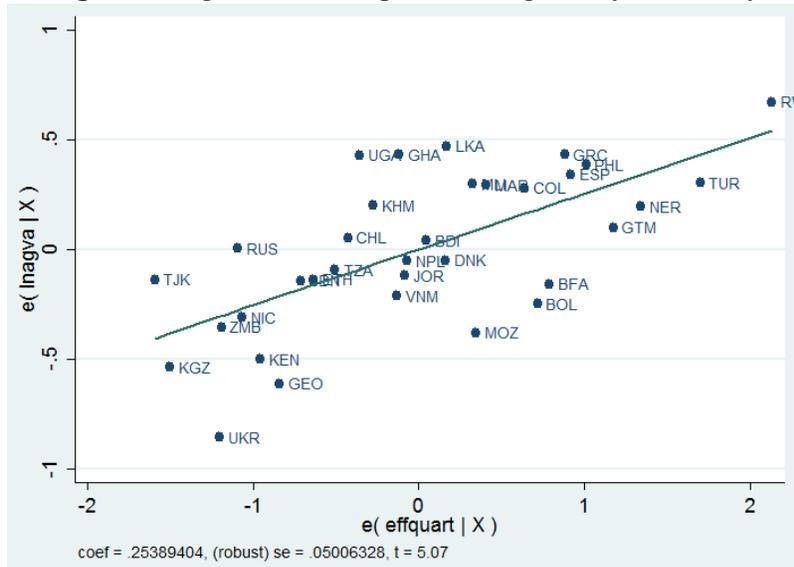[6] See Annex III for details on the correlations.

agriculture is more supportive in countries that have successfully shifted their economic activities to services and manufacturing.

As highlighted earlier, regulations can ensure efficient land administration, secure land and water rights and accessible storage facilities and irrigation systems, comprehensive financial infrastructure and sound sanitary and phytosanitary standards. Through such channels regulations contribute to raising productivity, improving crop composition and increasing farmers' market-orientation (Divanbeigi, Paustian and Loayza, 2016). Following the approach of Lio and Liu (2008) we investigate the relationship between regulation and productivity in agriculture.

The first dataset used draws from the World Bank's World Development Indicators (2016) and covers agricultural total output and countries' stock of human capital. The agricultural total output is measured by agricultural value added in constant 2000 US dollars.[7] The stock of human capital is measured by combining primary, secondary and tertiary gross enrollment ratios. Moreover, figures on four agricultural inputs (fertilizer, labor, land and livestock) are drawn from FAO (2016). Fertilizer use is measured as the sum of nitrogen, potash, and phosphate content of various fertilizers consumed, in metric tons. Labor is in thousands of economically active population in agriculture. Land is measured as thousands of hectares of arable land and permanent cropland. Livestock is measured in thousands of cow-equivalent livestock units, as calculated by Hayami and Ruttan (1970). We use data from CIA (2016) to build a dummy variable for landlocked countries. Previous studies have found this geographical property to have negative impacts on a country's development (Faye et al., 2004). Finally, in order to concentrate on significant regulatory differences we group economies into quartiles based on their EBA scores.

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[7] Converting production value in domestic currency to US dollars may result in a downward bias for products relevant to developing countries. An alternative is using international dollars, but following Antle (1983) we prefer to use US dollars as purchasing power parity-adjusted values might overstate the agricultural production in developing countries.
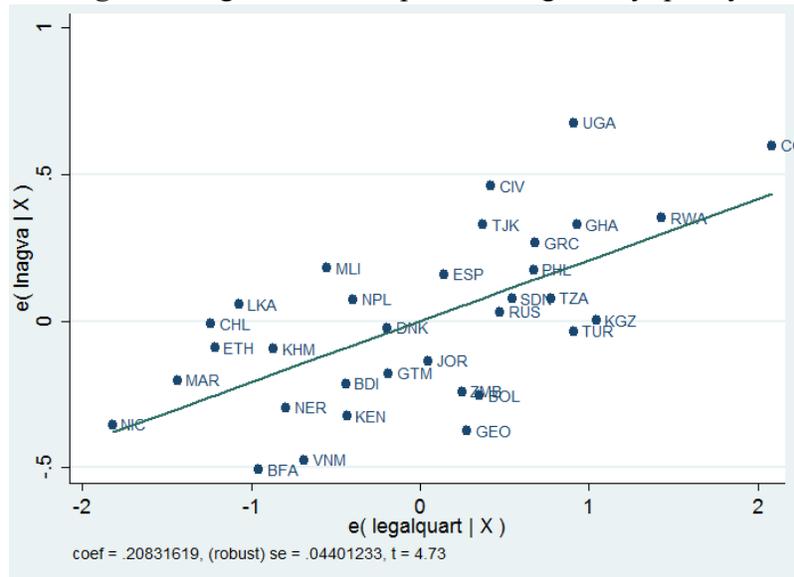
Figure 4. Agricultural output VS. Regulatory efficiency

Source: Authors' calculations based on World Bank (2016a, 2016b).
Notes: The coefficient associated to regulatory efficiency is 0.25 and is significant at the 99% level. Coefficients for all controls have the expected signs based on the existing literature.

Figure 5. Agricultural output VS. Regulatory quality

Source: Authors' calculations based on World Bank (2016a, 2016b).
Notes: The coefficient associated to regulatory quality is 0.21 and is significant at the 99% level. Coefficients for all controls have the expected signs based on the existing literature.

Figures 4 and 5 display the association between regulations and agricultural output after controlling for four main agricultural inputs (labor, land, livestock and fertilizer), countries'

stock of human capital and landlocked-ness.[8] The coefficient associated to both quality and efficiency are positive and significant. This result suggests that both dimensions matter. Where regulatory transaction costs are higher agricultural productivity is on average lower. Similarly, given same amounts of agricultural inputs, economies that adhere to a higher number of regulatory good practices display higher average agricultural output.

VI. Conclusions

The development of the agricultural sector has been considered a key priority for all developing countries. Economists and policymakers have devoted their attention to improving agricultural technologies, physical infrastructure and education. More recently, the interest on the role of institutions such as governance and regulations on economic development has increased. Looking at both quality and efficiency related aspects, and using new cross-sectional data, this paper explores the relationship between the heterogeneity in countries' agricultural productivity and their policy and regulatory environment. Our results indicate that agricultural productivity is on average higher where transaction costs are lower and countries adhere to a higher number of regulatory good practices. Our study aims to contribute to the generation of an evidence-based discussion around the role and characteristics of business regulations and their potential to support agricultural transformation in developing countries. This research is intended as an initial step due to the limited country-coverage of data on agricultural regulations and it will be updated once the dataset on agricultural regulations for more countries is finalized.

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[8] The complete model for country i's aggregate agricultural production function is then specified as: $lnAGVA_i = \alpha_0 + +\alpha_1 lnLABOR_i + \alpha_2 lnLAND_i + \alpha_3 lnLIVEST_i + \alpha_4 EDU_i + \alpha_5 lnFERT_i + \alpha_6 LANDLOCK_i + \alpha_7 EBAqtile_i^{QUAL} + +\alpha_7 EBAqtile_i^{EFF} + \varepsilon_i$

References

Acemoglu, D., S. Johnson and J.A. Robinson, 2001. The Colonial Origins of Comparative Development: an Empirical Investigation. American Economic Review 91(5), 1369-1401.

Adelman, Irma. 1984. Beyond Export-led Growth. World Development 12(9):937-49.

Aimin, H. 2010. Uncertainty, risk aversion and risk management in agriculture. Agriculture and agricultural science procedia, 1, pp.152-156.

Alston, J.M. and Pardey, P.G., 2014. Agriculture in the global economy. The Journal of Economic Perspectives, 28(1), pp.121-146.

Alston, J.M., Babcock, B.A. and Pardey, P.G., 2010. The shifting patterns of agricultural production and productivity worldwide. Midwest Agribusiness Trade Research and Information Center.

Alternburg, T. and C. von Drachenfels. 2007. Creating an enabling environment for private sector development in Sub-Saharan Africa. GTZ, UNIDO.

Amin, M., 2009. Labor regulation and employment in India's retail stores. Journal of Comparative Economics, 37(1), pp.47-61.

Antle, J. 1983. Infrastructure and aggregate agricultural productivity: international evidence. Economic Development and Cultural Change 31, 609–619.

Barseghyan, L., 2008. Entry costs and cross-country differences in productivity and output. Journal of Economic Growth, 13(2), pp.145-167.

Besley, T. 1995. Property Rights and Investment Incentives: Theory and Evidence from Ghana. Journal of Political Economy 103 (5): 903–37.

Branstetter, Lee G., Francisco Lima, Lowell J. Taylor and Ana Venâncio. 2013. Do Entry Regulations Deter Entrepreneurship and Job Creation? Evidence from Recent Reforms in Portugal. The Economic Journal (July 16).

Bruhn, M. 2011. License to Sell: The Effect of Business Registration Reform on Entrepreneurial Activity in Mexico. Review of Economics and Statistics 93, (1):382–86.

Byerlee, D., De Janvry, A. and Sadoulet, E. 2009. Agriculture for development: Toward a new paradigm. Annu. Rev. Resour. Econ., 1(1), pp.15-31.

Chenery, H.B. and Syrquin, M. 1975. Patterns of development, 1950-1970. London: Oxford University Press.

Christy, R., Mabaya, E., Wilson, N., Mutambatsere, E. and N. Mhlanga. 2009. Enabling environments for competitive agro-industries. In: C. Da Silva, D. Baker, A.W. Shepherd, C.

Jenane and S. Miranda da Cruz. Agro-industries for development, pp. 136-185. Wallingford, UK, CABI.

CIA, 2016, The World Factbook, Central Inteligence Agency.

Clark, C. 1951. The conditions of economic progress. Macmillan.

Cullinan, C. 1999. Law and Markets: Improving the legal framework for agricultural marketing. FAO Agricultural Services Bulletin 139, Rome.

Das, S. 2012. State Rights over Water and Agricultural Productivity: Evidence from the Krishna Basin. Working Paper 12-03, Department of Economics, University of Wisconsin–Whitewater.

De Soto, H. 2000. The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else. Basic Books.

Demirgüç-Kunt, A., Klapper, L.F., Singer, D. and Van Oudheusden, P., 2015. The Global Findex Database 2014: measuring financial inclusion around the world. World Bank Policy Research Working Paper, The World Bank, Washington, DC.

Dercon, S., D. O. Gilligan, J. Hoddinott, and T. Woldehanna. 2009. The Impact of Agricultural Extension and Roads on Poverty and Consumption Growth in Fifteen Ethiopian Villages. American Journal of Agricultural Economics 91 (4): 1007-1021.

Dethier, J.-J. and A. Effenberger. 2012. Agriculture and Development: A brief overview of literature. Economic Systems 36, pp. 175-205

Diaz-Bonilla, E., Orden, D., and A. Kwiecinski. 2014. Enabling environment for agricultural growth and competitiveness: Evaluation, indicators and indices. OECD Food, Agriculture and Fisheries Papers, No. 67, OECD publishing.

Divanbeigi, R., Paustian, N. and Loayza, N. 2016. Structural Transformation of the Agricultural Sector: A Primer. World Bank Policy Research Paper No.2, The World Bank, Washington, DC.

Djankov, S., Freund, C. and Pham, C.S., 2010. Trading on time. The Review of Economics and Statistics, 92(1), pp.166-173.

Djankov, S., McLiesh, C. and Ramalho, R.M., 2006. Regulation and growth. Economics Letters, 92(3), pp.395-401.

FAO. 2007. Challenges of Agribusiness and Agro-Industries Development. Committee on Agriculture, 20th session. Rome, Italy.

FAO. 2016. FAOSTAT database collections. Food and Agriculture Organization of the United Nations.

Faye, M.L., McArthur, J.W., Sachs, J.D., Snow, T., 2004. The challenges facing landlocked developing countries. Journal of Human Development 5, 31–68.

Gebremedhin, B., and M. Jaleta. 2012. Market Orientation and Market Participation of Smallholders in Ethiopia: Implications for Commercial Transformation. Paper presented at the International Association of Agricultural Economists (IAAE), August 18–24.

Goldstein, M., and C. Udry. 2008. The Profits of Power: Land Rights and Agricultural Investment in Ghana. Journal of Political Economy 116 (6): 981–1022.

Gollin, D., and R. Rogerson. 2010. Agriculture, Roads, and Economic Development in Uganda. In African Successes: Sustainable Growth. National Bureau of Economic Research.

Hafeez, S. 2003. The Efficacy of Regulations in Developing Countries. United Nations, New York.

Hall, R.E. and Jones, C.I., 1999. Why do some countries produce so much more output per worker than others? The Quarterly Journal of Economics 114 (1): 83-116.

Hayami, Y., Ruttan, V., 1970. Agricultural productivity differences among countries. American Economic Review 60, 895–911.

Hayami, Y., Ruttan, V., 1985. Agricultural Development: An International Perspective. John Hopkins University Press, Baltimore.

Hazell, P. 2010. An Assessment of the Impact of Agricultural Research in South Asia since the Green Revolution. In Handbook of Agricultural Economics, vol. 4, 3469–3530. Elsevier BV.

Hoekman, B. and Nicita, A., 2011. Trade policy, trade costs, and developing country trade. World Development, 39(12), pp.2069-2079.

Hollinger, Frank. 2011. Rural and Agricultural Finance - Trends, Issues and Challenges. Germany Agency for International Cooperation (GIZ).

Hsieh, C., and E. Sadoulet. 2007. Agriculture and Development. Background note for the World Development Report 2008, The World Bank, Washington, D.C.

Huber, P. J. 1967. The behavior of maximum likelihood estimates under nonstandard conditions. In Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. Berkeley, CA: University of California Press, vol. 1, 221–233.

Jalilian, H., Kirkpatrick, C. and Parker, D., 2007. The impact of regulation on economic growth in developing countries: A cross-country analysis. World development, 35(1), pp.87-103.

Johnston, B. G., and J. W. Mellor. 1961. The Role of Agriculture in Economic Development. American Economic Review 87(2):566-593.

Kuznets, Simon (1957). Quantitative Aspects of the Economic Growth of Nations: II. Industrial Distribution of National Product and Labor Force. Economic Development and Cultural Change: 1-111.

Laffont, J.J. and Tirole, J., 1993. A theory of incentives in procurement and regulation. MIT press.

Levy, B. and Spiller, P.T., 1994. Institutional Foundations of Regulatory Commitment: A Comparative Analysis of Telecommunications Regulation, The. JL Econ. & Org., 10, p.201.

Lewis, W. A. 1954. Economic Development with Unlimited Supplies of Labor. The Manchester School of Economics and Social Studies (22):139-191.

Lio, M. and Liu, M.C., 2008. Governance and agricultural productivity: A cross-national analysis. Food Policy, 33(6), pp.504-512.

Lipton, M., J. Litchfield and J-M Faurès. 2005. The Effects of Irrigation on Poverty: A Framework for Analysis. Journal of Water Policy 5: 413–27.

Loayza, N. and Servén, L. eds., 2010. Business regulation and economic performance. World Bank Publications.

Loayza, N., Servén, L. and Sugawara, N. 2009. Informality in Latin America and the Caribbean. World Bank Policy Research Working Paper Series.

Martinez Peria, M.S. and Singh, S. 2014. The impact of credit information sharing reforms on firm financing?. World Bank Policy Research Working Paper, The World Bank, Washington, DC.

Mellor, John. 1998. Agriculture on the Road to Industrialization. In Carl Eicher and John Staatz, eds., International Agricultural Development. Baltimore: Johns Hopkins University Press.

Mobarak, A. M., and M. Rosenzweig. 2013. Informal Risk Sharing, Index Insurance and Risk-Taking in Developing Countries. American Economic Review 103 (3): 375-80.

Pannhausen, C, and B. Untied. 2010. Regional Agricultural Trade for Economic Development and Food Security in Sub-Saharan Africa. Eschborn, Germany: Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) mbH.

Pingali, P. 2012. Green Revolution: Impacts, Limits, and the Path Ahead. Proceedings of the National Academy of Sciences (PNAS) 109 (31): 12302–08.

Sartain, J.B., Hall, W.L., Littell, R.C. and Hopwood, E.W., 2004. Environmental impact of fertilizer on soil and water. In ACS Symposium Series 872: 180–195.

Schultz, T.W. 1964. Transforming Traditional Agriculture. New Haven: Yale University Press.

Swinnen, J., Deconinck, K., Vandemoortele, T. and Vandeplas, A., 2015. Quality Standards, Value Chains, and International Development: Economic and Political Theory. Cambridge University Press.

Timmer, C. 1988. The agricultural transformation. Handbook of development economics 1. Part II: 276-331.

United Nations (UN). 2016. UN comtrade database. New York, United Nations. http://comtrade.un.org/.

US Agency for International Development (USAID). 2015. Agribusiness Regulation and Institutions (AGRI) Index, USAID, Washington D.C.

Visaria, S. 2009. Legal reform and loan repayment: The microeconomic impact of debt recovery tribunals in India. American Economic Journal: Applied Economics, 1(3), pp.59-81.

White, H. 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica 48: 817–830.

World Bank. 2007. World Development Report 2008: Agriculture for Development.

World Bank. 2012. Africa Can Help Feed Africa: Removing Barriers to Regional Trade in Food Staples. The World Bank, Washington, DC.

World Bank. 2016a. Enabling the Business of Agriculture 2016. The World Bank, Washington, DC.

World Bank. 2016b. World Development Indicators 2016. The World Bank, Washington, DC.

World Bank. 2016c. Doing Business Report 2016. The World Bank, Washington, DC.

World Bank. 2016d. Worldwide Governance Indicators. The World Bank, Washington, DC.

Annex I. List of countries covered by EBA 2016 indicators

High income	Upper middle income	Lower middle income	Low income
Chile	Bosnia and Herzegovina	Bangladesh	Burkina Faso
Denmark	Colombia	Bolivia	Burundi
Greece	Georgia	Cambodia	Ethiopia
Poland	Jordan	Côte d'Ivoire	Mali
Spain	Russian Federation	Ghana	Mozambique
	Turkey	Guatemala	Nepal
		Kenya	Niger
		Kyrgyz Republic	Rwanda
		Lao PDR	Tanzania
		Morocco	Uganda
		Myanmar	
		Nicaragua	
		Philippines	
		Sri Lanka	
		Sudan	
		Tajikistan	
		Ukraine	
		Vietnam	
		Zambia	

Annex II. Average EBA scores by income group

	Overall	Efficiency	Quality
High income	0.85	0.75	0.81
	(0.26)	(0.10)	(0.25)
Upper middle income	0.67	0.71	0.63
	(0.18)	(0.26)	(0.15)
Lower middle income	0.34	0.50	0.39
	(0.16)	(0.20)	(0.17)
Low income	0.32	0.49	0.36
	(0.20)	(0.27)	(0.16)
All	**0.45**	**0.56**	**0.47**
	(0.26)	(0.24)	(0.23)

Source: Authors' calculations based on World Bank (2016a)
Notes: Standard errors in parenthesis. T-tests confirm that High and Upper middle income have higher mean than the Low and Lower middle income group with 95% confidence level.

Annex III. Correlation of EBA with other indexes

	r
Rule of Law	0.52*
Ease of Doing Business	0.63*

Notes: * = significant at the 99% level

Annex IV. Description of non-EBA variables

Variable	Definition	Source
AGVA	Agricultural value-added in constant 2000 US dollars	World Bank (2016b)
DB	Ease of doing business index (distance to the frontier)	World Bank (2016c)
EDU	Education index: combined primary, secondary and tertiary gross enrollment ratios	World Bank (2016a)
FERT	Sum of nitrogen, potash, and phosphate content of various fertilizers consumed, measured in metric tons	FAO (2016)
LABOR	Thousands of economically active population in agriculture	FAO (2016)
LAND	Arable land and permanent cropland, in thousands of hectares	FAO (2016)
LANDLOCK	Dummy variable for landlocked countries	CIA (2016)
LIVEST	Thousands of cow-equivalent livestock units as calculated by Hayami and Ruttan (1970)	FAO (2016)
RoL	Rule of Law index	World Bank (2016d)

Notes: All variables refer to year 2014 where data is available. FERT and LAND data refer to 2013. Values for some countries are interpolated using most recent available observations.