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Looking like an Industry: Supporting Commercial Agriculture in Africa

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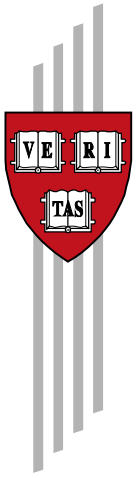
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Looking like an Industry: Supporting Commercial Agriculture in Africa

Ishac Diwan, Olivier Gaddah & Rosie Osire

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Center for International Development
at Harvard University

COMMERCIAL AGRICULTURE IN AFRICA

Making agriculture more like an industry and less like a "country"

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Introduction

Convergence is the process by which poor countries absorb knowledge and ideas from the technological frontier thereby catching up with richer countries (Rodrik, 2011). It has long been known that countries only converge conditionally i.e. poor countries catch up with richer ones only if they adopt policies and institutions that are conducive for economic growth and development. However, manufacturing industries are different. Rodrik determined that manufacturing industries, unlike countries, converge *unconditionally* (Rodrik, 2011). That is to say that once factories within a country starts producing say agricultural machinery or lawn mowers, productivity in these industries converges to the technological frontier irrespective of the country's overall economic state. We conducted a convergence analysis on the agricultural sector and found that unlike industry, agricultural productivity actually shows divergence! Like GDP, agriculture converges conditional on good policies, but for poor countries, these policies can be quite challenging. We find, however, that many crops converge unconditionally and behave like particular industries. The question we ask then is: how can we help more sectors in agriculture become more like an "industry" and less like a "country"? How can we increase agricultural productivity irrespective of the state of the country as a whole? As this paper will illustrate, the answer lies in finding business models that provide capital and access to other missing markets in an aggregated fashion thus forming high-productivity enclaves or islands of quality.

The tea industry in Kenya is an extreme example to illustrate the idea of high-productivity enclaves. Kenya exports 16% of the world's tea, making it the third largest producer of tea after China (15%) and Sri Lanka (18%). Tea accounts for 21% of Kenya's exports and earns $1.2 billion in foreign exchange (UN Comtrade, 2010). The industry employs thousands of people. Most of the tea in Kenya is grown in plantations or estates which manage all aspects of tea production, processing, marketing and distribution. The estates typically have their own schools, hospitals and amenities for employees. Also, plantation owners often provide and maintain their own infrastructure e.g. feeder roads, electricity and water. In a sense, the tea industry looks very much like an "enclave" – seemingly insulated from power outages, dilapidated infrastructure and several other country-wide economic challenges. The success of the tea industry in Kenya is illustrative of the potential of high-productivity enclaves to increase the competitiveness of the agricultural sector thus contributing to foreign exchange, employment and economic growth.

The idea of agricultural enclaves goes against the grain of prevailing development thinking which strives to lift everyone - not just some. Policymakers are more amenable to policies such as national subsidies, producer price regulation, state marketing boards and such other all-encompassing strategies rather than strategies that seem to focus on a few. However, in the name of equity, efficiency has been too often sacrificed in African agriculture, and the sector has continued to perform dismally. As shown in the Fig 1, Africa lags behind in agricultural productivity

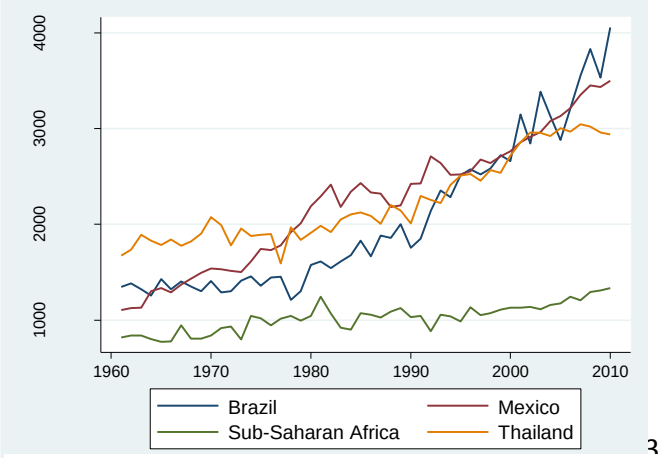


Fig 1: Cereal Yields relative to other countries

and yields. This poor performance in the agricultural sector has dire ramifications, not only on food security, but also on overall economic welfare. On average, 60% of Africans rely on agriculture for their livelihood and when agricultural incomes stagnate, expenditures on education, healthcare and nutrition also diminish. A major concern is therefore how to harness Africa's agricultural potential in order to make Africa's farmers more productive, efficient, entrepreneurial and well-off generally. The answer we argue lies in the commercialization of agriculture along business models that can work in attracting more capital to particular crops and opening up access to the core missing markets. Even if progress happens initially only in particular enclaves of poor countries, it will spread over time through technological progress and other synergies to the rest of the economy.

Unfortunately, the literature on commercial agriculture is fraught with ideological debates with little empirical analysis of what works and what doesn't. Some argue that smallholders left to their own devices simply lack the capacity, finance and technical know-how to commercialize agriculture in any significant way. Therefore, the best way to commercialize is to attract large-scale, capital-endowed farmers/investors who can then commercialize the sector. Others argue that "small is beautiful" and that the best way to commercialize agriculture is to provide small atomistic farmers with the right institutional and material support so they can connect directly to markets without "predatory" intermediaries. Proponents of this view contend that colonial hegemonic models such as plantations result in exploitation, land grabs and marginalization of peasant farmers. Farmers are reduced to the status of "hired hands on their own land" (Little & Watts, 1994). Smallholder-centered business models are especially popular in Africa because smallholders represent 70 to 80% of the producers in the sector (Monitor, 2011). Even though Africa has more than half of the world's uncultivated land, most of this land would require huge investments to make it economically viable. In the face of land scarcity, land sale and ownership tend to be highly emotive subjects and large-scale farming is perceived as a threat to farmers' livelihood and property rights.

This paper does not engage in the ideological debates of small versus large-scale farming. We believe that even smallholder farmers, when properly positioned in the right business ecologies, can be equally – if not more – effective at commercializing agriculture. However, their participation is constrained by inadequate access capital. The key challenge is therefore to find business models that relax this constraint in order to allow farmers to "intensify their use of productivity-enhancing technologies, expand their participation in markets, improve their export competitiveness and ultimately raise their output, incomes and living standards" (MSU, 2010).

The dominant strategy thus far has been to provide farmers with various goods and services in a disaggregated manner. So for instance, a non-profit organization might focus exclusively on technical assistance and training of farmers, a fertilizer and seed company would provide inputs, a parastatal would market the crops…etc. This model requires high levels of coordination and capacity among various institutions, and high capacity for dealing with many different providers and farmers, both of which are typically lacking in poorer developing countries. As a result, the commercial agriculture landscape tends to be very fragmented with multiple ongoing initiatives which attest to good intentions – but misguided and uncoordinated interventions - of well-meaning NGOs, entrepreneurs and governments.

This paper explores the strengths and weaknesses of various business models that can make agriculture behave more like industries – enjoying high levels of productivity irrespective of systemic challenges. The main idea in all cases is to move away from the uncoordinated and untargeted provision by the state of all the inputs needed to modernize agriculture, to the provision of bundles of services that resolve many market inefficiencies in ways that are adapted to particular environments. The ultimate goal is to create islands of quality even as markets remain incomplete and policies imperfect in the country as a whole.

Why is agriculture important?

Many economists and policymakers argue that agriculture, whether commercial or subsistence, is simply not a viable means of growing an economy. Bailey and Klinger found that countries diversify by moving into "nearby" products or products that make use of their current capabilities(Hausmann & Klinger, 2007). Intuitively speaking, it is (arguably) easier to move from shirts to blouses than it is to move from textiles to machinery because the capabilities required to produce textiles are very different from those needed to produce machinery. Based on this logic, they constructed a product space mapping all 772 products according to their proximity to other products. The result of this mapping was the product space shown below (Fig 3). The product space has a core-peripheral structure whereby products in the core such as construction (red) and machinery (cerulean blue) are highly connected to other products and those at the periphery such as cereals or tropical tree crops have fewer connections. Countries diversify based on their initial position in the product space. If a country is producing goods in a connected part of the product space, then the process of export diversification is much easier because there are many nearby products. However, if a country is specialized in peripheral products such as agriculture, then diversification is more challenging because there are few nearby products requiring similar capabilities.

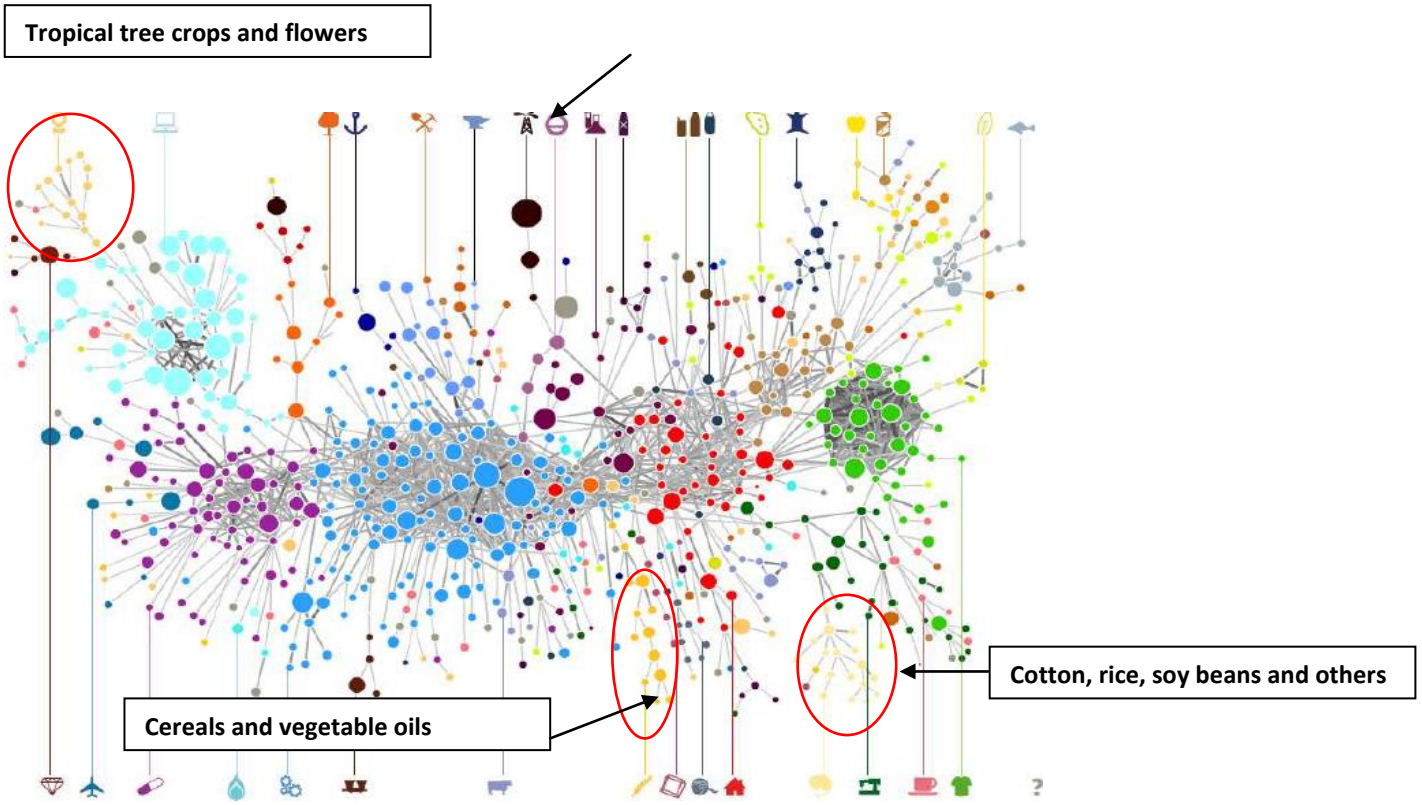


Fig 2. Depiction of the Product Space (Hausman et al)

Dani Rodrik refers to growth-reducing structural change as the movement of labor from high-productivity activities such as manufacturing and tradable services to "low-productivity services, informality and agriculture". He finds that Latin America and Africa experienced a lot of growth-reducing structural change during 1990-2005 (Rodrik, 2011). Renowned Ghanaian economist, Ernest Aryeetey, says, "It is in everyone's interest really to have more and more of our output coming from the manufacturing sector instead of low-productivity agriculture. That is how we will create jobs. That is how incomes will rise for large numbers of people. That is how we will deal with the poverty issues that confront our economy" (Agyeman-Duah, 2008).

Even though economic development is often accompanied by structural transformation and a declining share of agriculture in employment and GDP, agricultural output often increases in absolute terms (Timmer, 2012). Our contention is that agriculture also produces tradable goods. While agriculture often serves as a residual sector, like services, that absorb residual excess labor, large segments of agriculture can be rescued to become engines of dynamic change that contributes to raising labor productivity.

Indeed, agriculture creates employment in areas where the only real alternative is unemployment or informal employment. In these circumstances, agricultural employment is a much better way of absorbing labor in productive activities while making the transition to other more sophisticated industries. Countries that rush to industrialize and abandon their agricultural sector risk moving workers into unemployment and the informal sector and reducing the overall productivity of the economy. The fact remains that in most African countries, agriculture forms the backbone of the economy with some countries having as much as 80% of the population employed in agriculture. In 2009, Ethiopia's GDP was about $28 billion, of which $13.4 billion came from the agricultural sector (Rashid & Jayne, 2010). Agriculture's share of GDP is also still quite high in Sub-Saharan Africa compared to other regions of the world (UNCTAD, 2007). With this in mind, sound development policies and strategies need to make the most use of the resources that these countries have rather than those they wish they had.

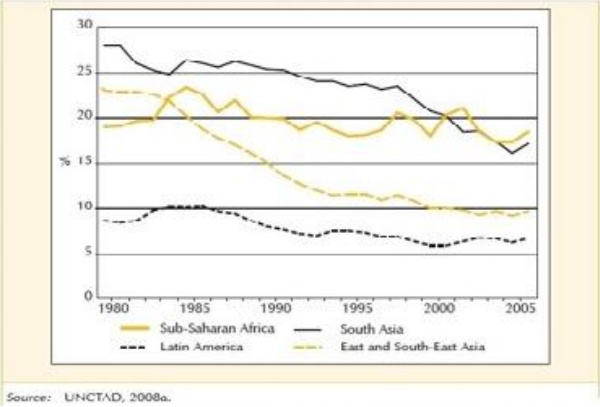


Fig 3. Agriculture as a Percentage of GDP

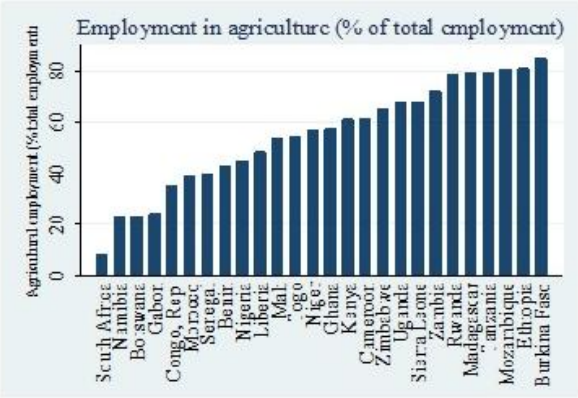


Fig 4. Agricultural employment in some African countries

Improving agricultural productivity does not preclude diversification; both goals can be pursued in tandem. Countries such as South Korea and Taiwan had relative success diversifying their

economies by leveraging the agricultural sector. The Japanese colonial government in Taiwan and Korea invested heavily in irrigation and mechanization of agriculture in order to increase agricultural productivity, raise revenue and to secure economic growth. "Korea and Taiwan's experience implies that investment in agriculture, leading to growth in agricultural productivity and diversification of the economy, can provide the foundation upon which tax reform could be built and a shift to export-oriented development could be achieved" (Grabowski, 2010). Other countries such as Brazil, Thailand and Malaysia are some of the top exporters of processed foods and these countries are also more diversified and more prosperous than their African counterparts.

Convergence in Agriculture

It has long been known that countries converge conditionally i.e. they only grow faster than richer economies when they manage to have the same policies as rich countries. Recently, Rodrik (2011) found to his surprise that industries converge unconditionally. As it turns out, industries are not like countries; irrespective of where it is located, a particular industry will move to its global efficiency frontier. The result seems largely due to the inflexibility of production functions in industry – there tends to be "best practices" that are hard to beat with different mixes of factors of production. We can think of such production functions as being close to Leontief functions, with fixed coefficients, especially with respect to the capital to output ratio. To take a simple example, you either produce aluminum efficiently or you don't, given that aluminum production requires specific amounts of alumina and electricity. Management inefficiencies could allow for varying amounts of labor inputs, but this has a marginal impact on labor productivity, because the other inputs are given. In effect, industry, when it exists, operates in enclaves rather than in countries. Transport, energy, and other inputs have to be available, but they can be developed for the industry (for example in Export Processing Zones), rather than in the country as a whole for the industry to thrive.

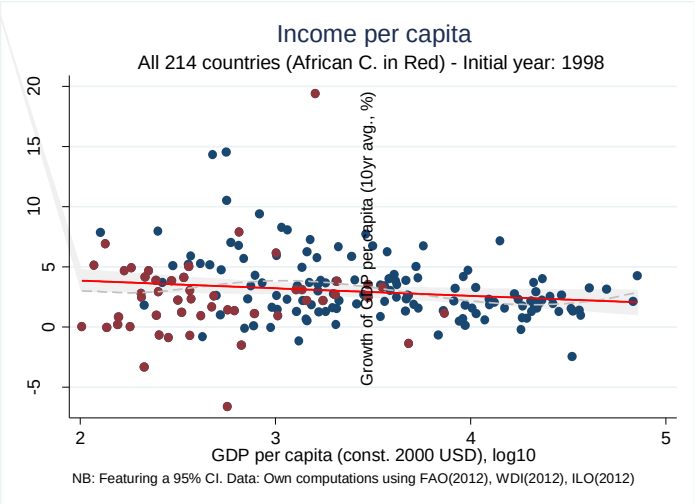


Fig 5. Conditional convergence in income per capita

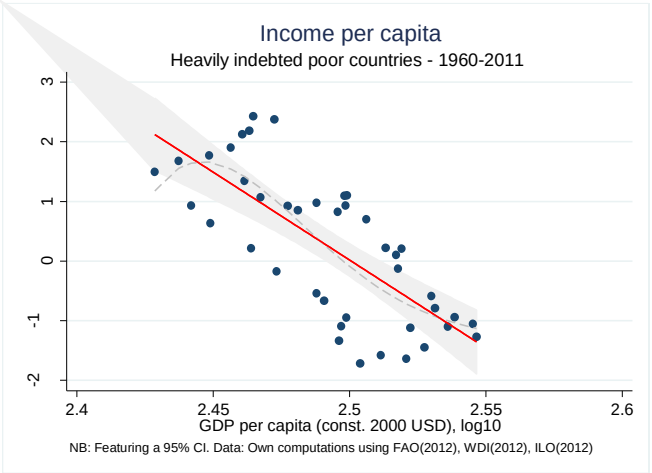


Fig 6. Conditional convergence in income per capita for HIPCs

With data sourced mainly from the UN Food and Agricultural Organization, the International Labor Organization, and the World Development Indicators of the World Bank, we analyzed 214 countries and 184 crops to try to determine the convergence pattern for agriculture as a whole and for individual crops.

First we replicated existing results. As found in other studies, we also found that income per capita only converges conditionally (Figures 5 and 6). Extending Rodrik (2011), we found that there is unconditional convergence in the industry sector as a whole (Rodrik's study had focused on individual manufacturing sectors). (See Table 1 in Annex for regressions).

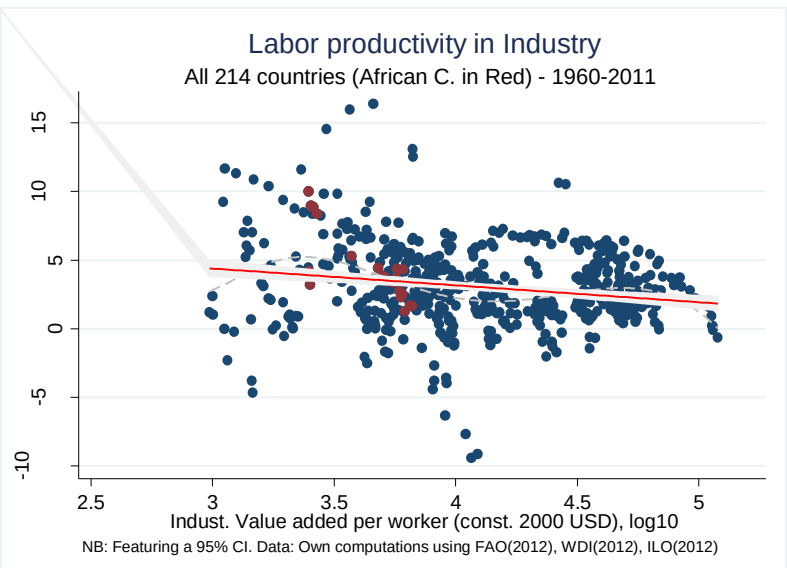


Fig 7. Unconditional convergence in manufacturing industries

In agriculture, the results are quite different (for more details, see Diwan and Gaddah, 2013). Following a similar approach as for industry, the agricultural sector does not show the same patterns in terms of convergence, at least regarding the labor productivity in agriculture, as measured by the value added per worker in agriculture (data, in constant 2000 US dollars). Rather, there seems to be a form of "unconditional" **divergence** in the agriculture sector. This is indicated by the positive and highly significant coefficient of 1.473*** on initial year labor productivity. (See Table 1 in Annex for regressions). In other words, when we don't control for country characteristics and time-invariant factors, the higher the initial productivity, the faster the productivity in agriculture and the gap between countries' productivity tends to widen. This result is robust across time periods and grouping of countries.

It is only when we control for countries' specificities that we get convergence – conditional on countries specificities (expressed simply by country dummies), we find a highly significant convergence à la Solow for labor productivity in agriculture. This is indicated by the negative and highly significant coefficient of -16.57*** on initial year labor productivity. (See Table 1 in Annex for regressions).

How do we interpret these results? In effect, while factories tend to become increasingly similar in an interconnected world, irrespective of the country they are in, farmers on the other hand tend

to become increasingly different (all unconditionally). They would explain why overall, we see neither convergence nor divergence for GDP per capita, as there are divergent forces at play. The deeper question is why it is that we see divergence in agriculture. One possibility is that like services, and as in Rodrik's quote above, agriculture becomes the "residual" sector. When the forces of convergence operating through industry are not strong enough, workers have no choice but to take refuge in agriculture and services. If there is not sufficient dynamism in these sectors then, divergence will of per capita productivity set in.

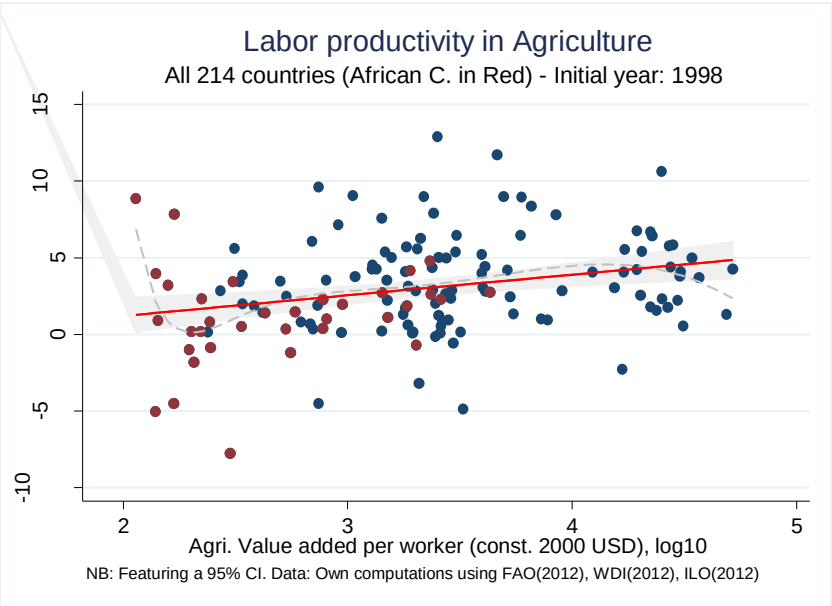


Fig 8. Unconditional divergence in agriculture

The main implication is that it will be very hard to rescue the sector as a whole. A whole set of policies will have to be successfully mobilized. We can get a better sense of the factors that affect productivity in agriculture by replacing the country dummies by a set of explanatory country variables, in ways to recover the conditional convergence result. We can see in Table 2 that many factors that are intuitively good for agriculture turn out to be significant and of the expected sign. This means that the overall divergence in the sector can be explained by divergence in the progress done in using more inputs – in particular, poor countries are not accumulating machinery or building roads fast enough to catch up with the richer countries. [1]The debt variable is significant with a negative sign, suggesting that countries with less access to capital do less well in agriculture. Inflation is bad for agriculture, and urban growth helps by creating more demand. The effect of the real exchange rate is highly significant and negative.[2]

[1] The sign of the fertilizers coefficient is negative, which seems to indicate that countries with lower land productivity use more fertilizers. The precipitation variable produces a negative relation, probably because it indicates tropical countries.

[2] Note that a main characteristic of models x and y is that we now control for productivity growth rate of the previous year ("lagged variable"). This suggests that the growth rate of productivity is dependent of the growth rate of the previous year in a second order sense, i.e that beyond the rate of change (i.e. the growth rate), the "speed" of change of productivity is driven by the initial productivity.

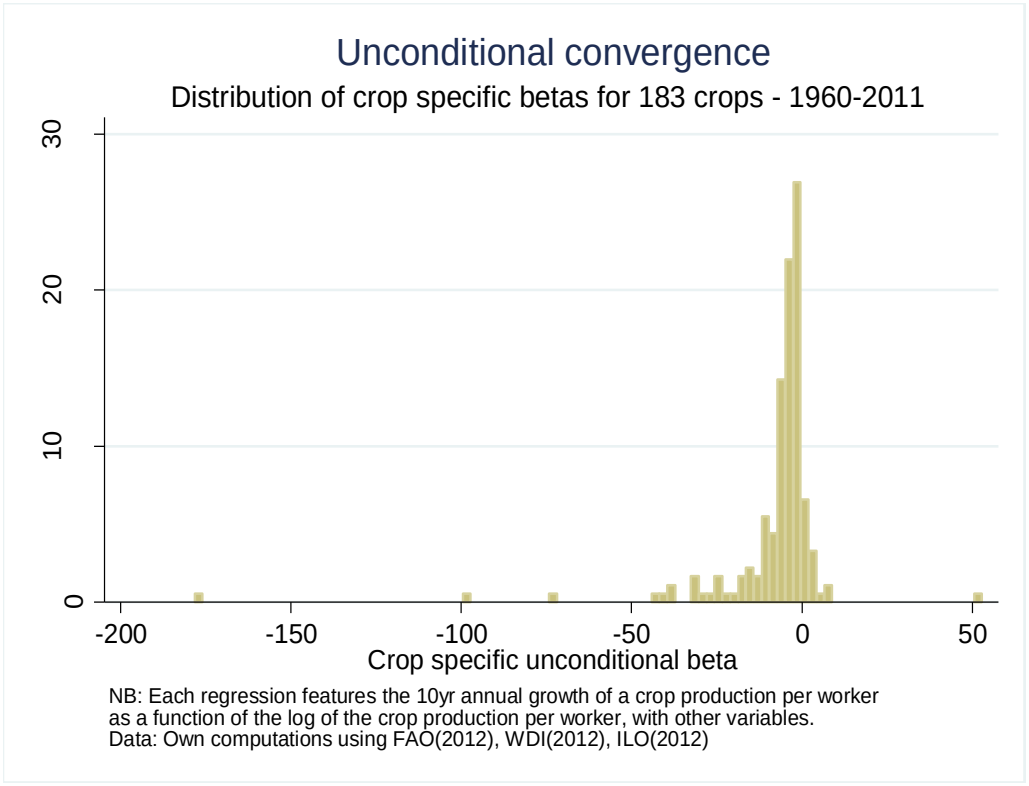
In addition to poor policy, divergence in agriculture can be due to two forces: either there is divergence in most crops, or there have been movements in poorer countries towards crops that exhibit divergence. Clearly, we would expect some crops at least to exhibit convergence, since agriculture is after all a traded goods, and some crops are produced in competitive conditions for the global markets, for example cut-roses and horticulture. However, other crops in poorer countries, and maybe the majority of crops, tend to be produced in informal and non-connected markets, where labor gets the residual product when the crop is marketed, or uses the crop for own subsistence.

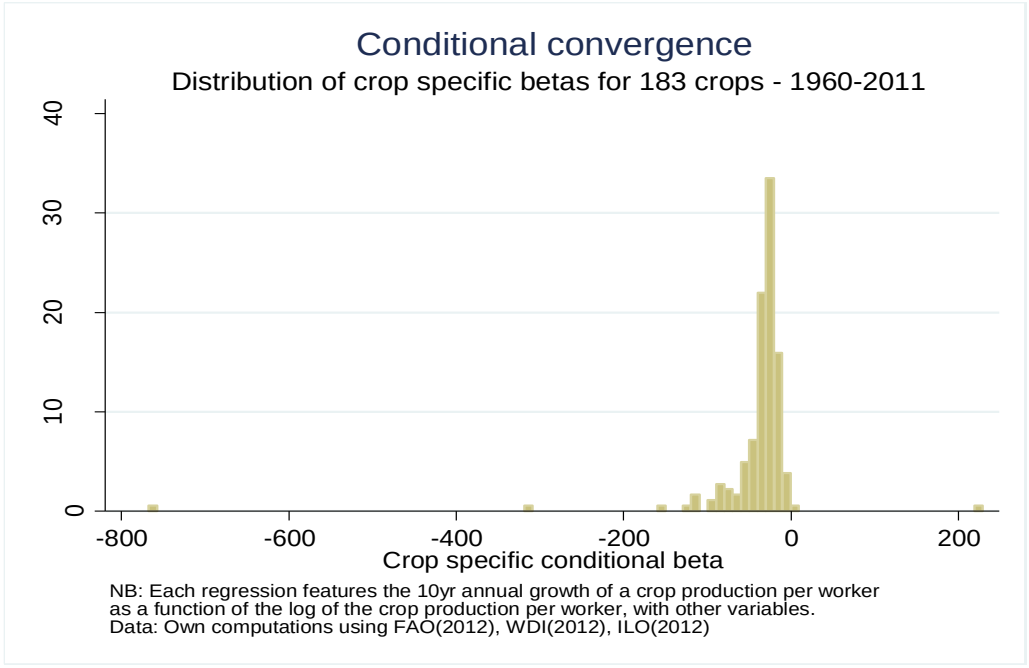
To look at convergence at the crop level, we need to make heroic assumptions given data limitations (see Diwan and Gaddah 2013 for more detail). We have some information on 183 crops (principally, quantity produced per country and year), which allow us to run two regressions per crop, one unconditional, and one with countries and time dummies. We find, to our surprise, that 61 crops out of 183 exhibit unconditional convergence at the 95% level of significance[3]. Also in this group, but significant only at the 90% level, there are 18 additional crops for a total of 79 crops that exhibit unconditional convergence. The rest of the crops exhibit mostly non-significant unconditional convergence and significant conditional convergence. See Table 3 in the Annex for the crop by crop details.

It is difficult to see from these lists what are the characteristics of crops within each of the sub-group. But several observations can be made. First, there is a surprising large number of crops that converge. Second, most of the crops in the converging group 1 are of the "cash crops" category -- crops that are not planted for subsistence but for the market (cotton, coffee, cocoa, various nuts and seeds, maize, rice). However, many of the non-converging crops are also cash crops (eg palm oil and natural rubber), although the list includes many subsistence crops (such as cereals and wheat, pulses, and local fresh fruits and vegetables). Third, a few crops have extremely high convergence coefficients and they tend to be crops that are grown for exports (fruits and vegetables such as cherries, bananas, kiwis, or artichokes); or inputs for industry (eg seeds for oils such as jojoba). Finally, and as expected, the coefficient of the conditional regressions tends to be much larger and much more often significant.

The list should be taken with a grain of salt, given the data limitations discussed earlier, but also, because several crops may have a potential for convergence but do not show convergence yet – i.e, the list shows what is possible, but it should not be taken to limit what is feasible. For example, the fact that rubber and palm oil have not converged yet can indicate a failure so far to commercialize these relatively capital intensive products (who require in particular local processing factories to be built) in West Africa to date, relative to their huge success in East Asia. It remains that these are crops with high potential for commercialization and thus future convergence. Even crops like tomatoes that typically remain restricted to their local market because of their perishable nature can become commercialized with proper investment in processing plants such as canning.

[3] Among these 61 crops, 30 crops exhibit unconditional convergence at the 99% level.


Unconditional convergence
Distribution of crop specific betas for 183 crops - 1960-2011
Percent (%)
0
10
20
30
-200
-150
-100
-50
0
50
Crop specific unconditional beta
NB: Each regression features the 10yr annual growth of a crop production per worker
as a function of the log of the crop production per worker, with other variables.
Data: Own computations using FAO(2012), WDI(2012), ILO(2012)


Conditional convergence
Distribution of crop specific betas for 183 crops - 1960-2011
Percent (%)
0
10
20
30
40
-800
-600
-400
-200
0
200
Crop specific conditional beta
NB: Each regression features the 10yr annual growth of a crop production per worker
as a function of the log of the crop production per worker, with other variables.
Data: Own computations using FAO(2012), WDI(2012), ILO(2012)

Capital-related constraints to agriculture

Our results so far indicate that agriculture tends to behave more like "countries" than industries. Industries, when they take a foothold, tend to attract global capital and skills. Here we argue that is it the inability of agriculture to attract capital that produces divergence and that constrains productivity improvement,

To get a sense of the importance of the capital constraint, we go back to our data and look at the effect of capital on convergence, for particular crops. The FAO data set gives us not only the production volume (in tons) for each crop/country/year, but also the volumes of seed and fertilizer used (in tons), and the machinery employed (in value), which we use to construct a broad measure of capital applied to each crop/country/year.

Figures 11 and 12 show the relation between the total Capital Stock per worker in agriculture and production per worker, controlling for countries GDP per capita, for the cases of Maize, and Cereals. The countries with the highest levels of productions (with circles around them showing the size of this production) stand on the top of the cloud of points, delineating a sort of efficiency frontier - -the highest labor productivities at each level of capital. Note that most other countries, including most African countries (in red) tend to cluster not too far from this production frontier, showing that countries try to do the best of their factor allocation. This means that to improve productivity, the main effort needs to be, besides moving toward the frontier at the current level of capital, to invest more capital in the sector. The challenge is especially clear for Africa - -in both graphs, African countries stand squarely on the bottom-left, with little capital stocks and low labor efficiency.

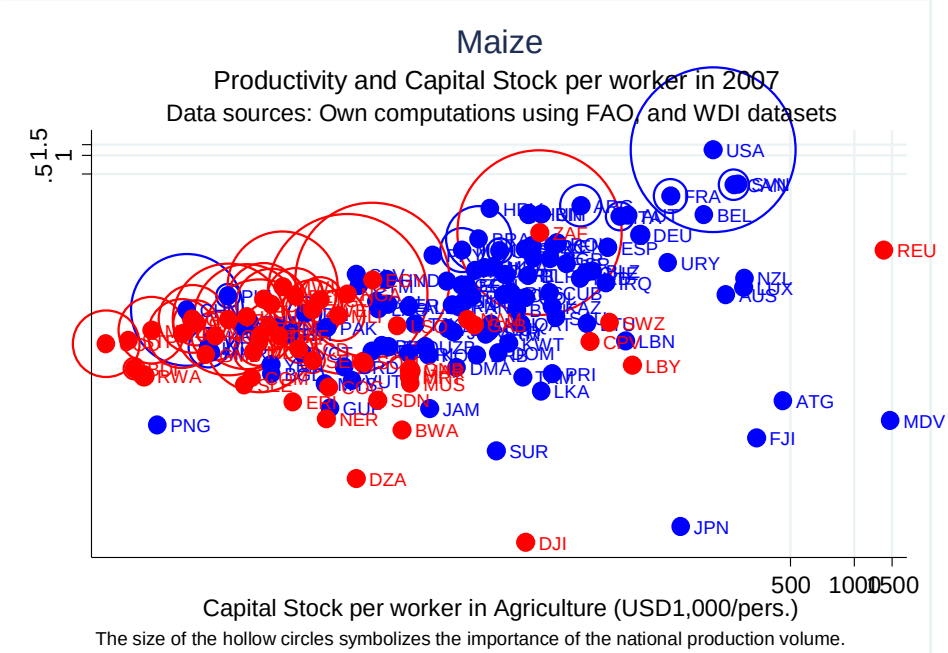


Fig 11. Relationship between productivity and capital stock for maize

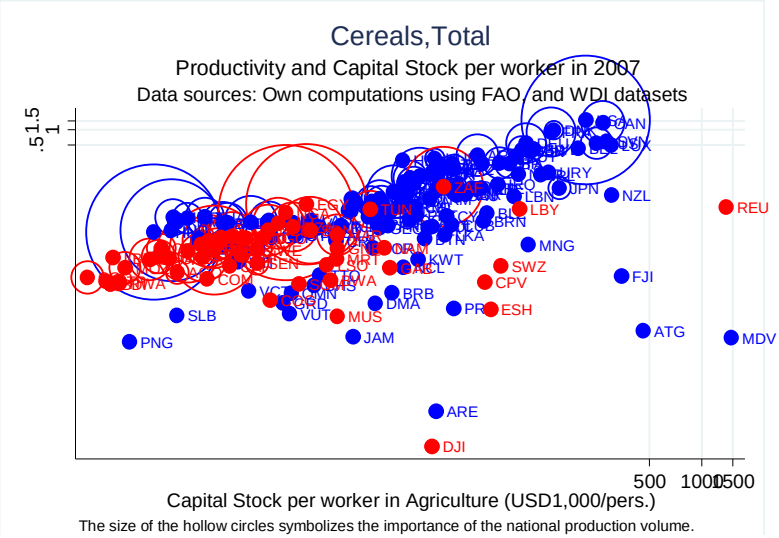


Fig 12. Relationship between productivity and capital stock for cereals

Table 1 shows that the percentage of loans offered by commercial banks to farmers is very low. Admittedly, commercial banks are not the only means of financing agriculture and the table below therefore understates the amount of funding going to the sector. Nonetheless, the data is illustrative of the fact that banks and other lenders are wary of the inherent risks of agricultural lending and therefore underfund the sector (Mhlanga, 2010).

One of the main reasons why capital does not flow to agriculture is that agriculture is an inherently risky activity. Financial markets needs to develop products that can spread this risk and take it away from small farmers to more diversified operators. Agricultural risks could be categorized into production risks (relating to threat of drought, floods, infestations, etc.), marketing risks (relating to inadequate physical infrastructure, inadequate access to credit/insurance markets, lack of information, etc.) and price risks (relating to global and local price volatility). Capital allows the use of modern risk-management tools such as warehouse receipt systems, commodity exchanges and weather-index insurance systems to mitigate some of these risks.

Table 1. Share of commercial bank lending to the agricultural sector, 1995–2008 (percentage of total portfolio)

Country	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Botswana	1.40	0.61	0.93	0.67	0.76	1.42	1.42	1.13	1.06	0.68
Gambia	–	–	–	–	–	–	–	–	7.20	5.53
Ghana	–	9.65	9.56	9.38	9.45	7.65	6.71	5.37	4.41	4.28
Kenya	–	6.57	6.01	6.07	6.20	6.00	6.25	5.38	4.08	3.60
Lesotho	–	–	–	–	–	–	–	0.31	1.90	8.17
Malawi	28.62	7.55	8.63	3.23	10.40	12.11	9.90	15.25	16.27	14.60
Mozambique	–	–	17.87	15.97	12.37	10.69	8.66	6.39	9.42	8.05
Nigeria	–	–	–	–	5.16	4.46	2.44	1.96	3.11	1.37
Sierra Leone	–	4.84	8.29	1.12	1.75	1.93	1.97	0.88	2.49	2.95
Uganda	22.54	10.71	8.57	11.14	9.69	11.07	10.05	9.13	6.67	5.88
United Republic of Tanzania	8.10	6.30	9.60	17.1	12.0	13.90	12.40	13.94	11.01	12.35

Fig 13. Data from Central Banks (Source: Mhlanga 2010)

Role of government in agricultural commercialization

Governments and non-governmental actors have tried to intervene directly and replace inexistent capital markets, but usually, unsuccessfully. They are countless government and non-bank NGO programs that have ended up in failure, often riddle with rent-seeking by powerful interest groups. Recently, more promising efforts have started to try to complement private operators, rather than try to substitute for them. These programs try to mitigate the financing constraint by offering loan guarantees to banks in order to overcome their aversion. For instance, the Alliance for Green Revolution in Africa (AGRA) and other partners provided a loan guarantee of $10 million thereby allowing Standard Bank to avail $100 million for loans to farmers in Ghana, Mozambique, Tanzania and Uganda (GIIN, 2009). Various partnerships and business models such as out-grower schemes could also offer credit as one of their contract services in order to allow farmers to use high quality seeds, fertilizer and other technologies that enhance productivity. The next section provides an angle to evaluate the strengths and weaknesses of such programs in terms of whether of not they "fit" particular business models that can address particular crop constraints in a more comprehensive way, and start making parts of agriculture more like an industry and less like a country.

Besides working with the privates sector to reduce the credit constraint, there are crucial roles that only Governments can play in pushing for the modernization of agriculture. Indeed, agricultural underperformance is largely a public policy issue. Governments that care about the growth of their agricultural sectors institute a policy mix policies that encourage growth and productivity. To the contrary, governments that neglect their agricultural sector – perhaps owing to the fact that they generate revenue from oil or other natural resources – institute policies that are not conducive to the growth of the agricultural sector. But Governments are not good at

every aspect of this challenge, especially when they have limited capacity, and they need to work at enhancing the role of the private sector to be successful.

A few examples illustrate this very well:

- During the oil boom of the 1970s, currencies experienced the natural tendency to appreciate (Dutch Disease). Countries such as **Indonesia** mitigated against these pressures by investing oil revenues in rural infrastructure. However, countries such as **Nigeria** kept their currency appreciated because they were supporting import substitution policies and wanted to encourage the imports of intermediate goods for their manufactured goods. Indonesian agriculture continued to be successful while Nigeria's did not.

- **Brazil** was able to commercialize its agricultural sector on the backs of large-scale farmers. As of 2004, there were only 3,000 commercial farmers cultivating 4.5 million ha of land – this translates to an average landholding of 1,500 per farm (Matthey, Fabiosa, & Fuller, 2004). Historically, agricultural production was concentrated in the Southeastern part of the country by small farmers owning at most 30ha. However, in a bid to encourage wheat production and self-sufficiency, the government offered cheap land, credit and price supports to encourage agricultural expansion in the hitherto unexploited Cerrado region. Large-scale commercial farming developed in Cerrado and farmers planted wheat, soybeans, cotton and other profitable crops. The large-scale farmers also developed research, infrastructure, quality management systems etc. In less than four decades, Brazil went from producing no soybeans to being the second largest exporter of soybeans after the United States. "Brazil also switched from being a net importer of corn and cotton to being a net exporter, providing 7.7 and 5.8 percent, respectively, of corn and cotton traded in 2003" (Matthey et al., 2004). Several factors contributed to this phenomenal success but government policy especially played a catalytic role. The government taxed raw materials that were transported to another state for processing thus encouraging the proliferation of crushing facilities in Cerrado. The tax rate on land also decreased with increased land utilization thus avoiding speculative land purchases that leave large swathes of land unutilized. The government also set up Embrapa as the research arm of the Ministry of Agriculture and Food Supply. Embrapa has one research center in each state and these centers work with private companies to develop varieties and technologies that can improve the productivity of agriculture.

- Commercial agriculture in **Malaysia** was driven primarily by small farmers. In 1960, the government through FELDA (Federal Land Development Authority) established resettlement schemes for the poor and landless. The government resettled landless peasants and gave them plots of 3 or 4 ha to produce oil palm or rubber. Largely owing to FELDA's role, Malaysia is the number one producer of palm oil in the world.

- In the **United States**, the government started land grant colleges which invested in university-level education and training in modern agricultural science and technologies. The result was a new cadre of experts who could add to the food and agricultural value chain through their acquaintance with modern farming, business and entrepreneurial practices.

Evidently, the government plays a crucial role in providing an enabling environment in which commercial agriculture can thrive. Unfortunately, African governments have often stifled the

growth of commercial agriculture through macroeconomic policies that have taxed the agricultural sector. When they have intervened, it is often through a myriad of disconnected efforts, trying at the same time to fund and manage research and development, plan extension services, subsidize and often import directly seeds and fertilizers, support mechanization and marketing, create funds to reduce price volatility, engage in land reforms and land certification programs, support the provision of farm credit, or encourage the development of cooperatives. The list goes on. Ministries of agriculture tend to be the locus of a multitude of donors program, many of whom are in addition limited to particular crops and to particular parts of the country. It is not surprising that such fragmented efforts have rarely succeeded. Not only do they demand enormous public sector management capacity, and a positive political economy that discourages rent-seeking, but they also place enormous risk on farmers, as failure to get any one part of the package will often lead to failure.

Instead, more successful countries have focused their efforts in two separate bundles, walking in effects "on two legs". The first leg focuses on poverty alleviation and on "spreading the wealth" as fairly and broadly as possible. The goal here is to help farmers escape poverty traps, to provide them with insurance and mitigation mechanisms, and to offer health and educations services that can break inter-generational traps. The second leg then can focus much more squarely on doing what it takes to increase labor productivity in promising areas, working closely at leveraging private sector efforts. The types of government efforts that can play a crucial role in commercializing African agriculture are those that the private sector won't play, such as promoting research, developing infrastructure, promoting international trade and instituting land policies that make it easier for investors to engage in commercial agriculture.

Business models in practice[4]

Our investigation so far has revealed that performance in agriculture tends to diverge between poor and rich countries. This points to the difficulty of the challenge of making agriculture more productive, as the forces of divergence will have to be beaten. We have found that access to capital is a key constraint. And we have also discovered that many crops do converge and behave like industries, managing to attract technology, capital, and skills to compete in the world market. In this section, we will argue that since it is difficult to attract capital to countries, the question should be, how can it be attracted to particular crops that are more promising. The answer we believe lies in the "commercialization" of parts of agriculture, in the sense of creating enclaves or islands of quality will be characterized by labor being more productive than in the rest of the economy.

One problem that is at the heart of the under-performance of agriculture is that it is populated by a multitude of small and atomistic agents, often dispersed over low density geographies. As a result, it is difficult for markets to function properly, as a lack of demand and supply aggregation increases transaction costs. For example, smallholder atomistic farmers have great difficulties marketing their products because they are unable to benefit from economies of scale. Farmers often fail to coordinate planting and harvesting schedules and as a result, they end up producing similar products at the same time thus saturating spot markets and depressing prices. Vertical

[4] References for the case studies can be found in the Reference section

and/or horizontal integration could mitigate some of these difficulties and help farmers to connect to markets more effectively. A related marketing difficulty is stringent quality requirements. Several African countries are experiencing a burgeoning middle class, increased urbanization and a proliferation of supermarkets. As a result, there is a large and growing demand for high quality fresh fruit and vegetables from retailers and importing countries. Vegetables are highly labor intensive and can be harvested throughout the year; they are therefore a good source of income for smallholder farmers. However, "the dominant market players tend to favor suppliers who can ensure high volumes, consistent quality and can do so in the long run. These criteria have tended to favor the more capitalized commercial sector over the emerging sector" (Louw, Vermeulen, & Madevu, 2006). Small farmers who are unable to meet these requirements are sometimes left out of commercial agriculture. In Kenya for instance, smallholder participation in green beans dropped from 60% in the 1980s to 30% in 2003 (World Bank, 2009). The export value chain is now dependent on large contract growers and a limited number of small and medium growers.

The idea of developing business models that work for particular crops is to find ways to deliver to small farmers the bundle of input/outputs they need to be more productive in ways that are commercially viable, using as much as possible private sector operators, both domestic and foreign, that will play the role of aggregators as a way to make profits, while at the same time benefitting the small farmers themselves.

There are numerous successful business models that have increased productivity quite phenomenally. The two most widely cited examples are the Cerrado region in Brazil that used mostly large-scale farmers and the FELDA scheme in Malaysia that used mostly small-scale farmers.

A. Growth Corridors

Growth corridors promote efficient use of resources by concentrating capital on the area of greatest agricultural potential. In such cases, eliciting a quick supply response that can generate virtuous loops is central for the success of the initiative. Sometimes, there are heavy investments in poor farmers so as to push them to move out of poverty traps. But more often, priority is given to farmers and investors who have the capital and expertise to invest in agriculture. The large-scale, integrated approach attracts the participation of many investors because risks are pooled. Concentration of agribusinesses also allows for economies of scale and lowers costs per unit of production. Technology diffusion takes place more easily, and various supportive markets (labor, fertilizers, rental of machinery, seeds) form to service the area. As more companies enter into the market, greater competition ultimately leads to lower input prices for farmers.

Growth corridors can be financed by the public sector and donors – as in Ethiopia for example where the emergence of several corridors around infrastructure dense regions has allowed agriculture to grow in double digits for over a decade, and for export to grow at about 25% per year. But partnership with patient capital can be a more useful method, both because it economizes public resources, and brings professionalism into the endeavor. Patient capital is long-term investment that is socially conscious and thus willing to suffer short-term losses for the sake of long-term development.

Case Study: Beira Agricultural Growth Corridor

In 2008, Yara (a Norwegian fertilizer company) served as the main convener and author of a plan that would employ patient capital to revamp the agricultural sector in the Beira region. This initiative is called the Beira Agricultural Growth Corridor (BAGC). The Beira corridor is strategically located along a network of road and rail thus connecting Mozambique to neighboring Malawi and Zambia. It is also one of the most fertile areas in Mozambique. BAGC seeks to take advantage of the networks of road and rail to develop agricultural infrastructure such as irrigation, fertilizer manufacturing, seed development, warehouses, distribution systems etc. The goal was be to encourage commercial farming in the region by attracting local and foreign infrastructure service companies to provide various services, and it was largely successful.

Problems associated with Growth Corridors

1. **Disenfranchising smallholder farmers from the best land** – Since growth corridors favor large capital-endowed farmers, it is possible for small farmers to be marginalized. Issues of inclusiveness can be mitigated by using the following models:

   a) **Out-grower models:** Small-scale farmers could procure seeds, fertilizer, irrigation and other services from the large Infrastructure Service Companies (ISC) that invest in the corridor. These small farmers could then use these inputs to cultivate their own land and sell produce to aggregators that are connected to internal and external markets.

   b) **Serviced farm blocks:** The ISCs typically own serviced farms (i.e. farms with the necessary agricultural infrastructure) and lease out blocks of land to small and medium farmers. In this model, farmers do not cultivate their own land but rather cultivate land owned by the ISC monopolies in exchange for a wage.

2. **Food security could be compromised:** even though growth corridors are mainly for the economic advancement of a region, they typically attract farmers and investors who are likely to focus on the production of high-value commercial crops for export. Biofuel production, for instance, is now a highly profitable venture that many large investors are pursuing in Mozambique and Tanzania. In order to assure local food security, the government can subsidize farmers that focus on cereals and other food products in order to incentivize their participation in the corridor.

3. **The problem of coordination:** Since growth corridors are highly integrated, overall success is contingent upon each actor fulfilling his role in a timely manner otherwise the entire project will be compromised. Yet, the numerous actors involved in the partnership often makes it extremely difficult to coordinate efforts. For instance, if Yara develops a state-of-the-art fertilizer processing plant but the Mozambican government fails to develop the rail and road networks, consumers will not be able to access the fertilizer and the plant will become yet another "white elephant". Two recent initiatives – the Bagre project in Burkina Faso, and the Accra Plains project in Ghana, will be highly dependent on coordination in irrigation management between

the public sector's investment in primary canals, and the private sector investment in and management of secondary canals.

B. Plantations

Large-scale land acquisitions are becoming increasingly common in Africa as land and water-constrained countries look abroad for opportunities to generate biofuels and to grow food for their populations. Most of these land transfers are in the form of leases or concessions. These purchases could be beneficial as land is transferred from less efficient to more efficient producers. Unilever Tea Kenya Limited (henceforth UTKL) is the largest producer of tea in Kenya and the single largest private sector employer in Kenya, employing 20,000 people. Its foreign exchange contribution is estimated at Ksh. 5.5 billion, and the company owns twenty tea estates and eight factories (UTKL). Other successful large-scale farming projects include Del Monte Kenya Ltd for the production of pineapples, Triangle and Hippo Valley Sugarcane plantations in Zimbabwe and others.

Problems Associated with Plantations

1. **Threat to small farmers and food security:** Like growth corridors, plantations often result in land grabs and marginalization of small farmers. Further, they could potentially threaten food security when investors use the scarce land available to produce biofuels or food for exports, and especially when this produced little value added at home.

2. **Risk of expropriation:** Plantation owners also face the risk of expropriation and lost investments when there is political instability or reforms. The fast-track land reform in Zimbabwe, for instance, took land away from the white settlers to redistribute to black farmers. Several African countries are also undergoing land reforms in a bid to redistribute land to the landless so the risk to plantations remains a constant concern. Plantations also require large amounts of labor and there is always the risk of strikes and other labor-related issues. Nonetheless, people should not rush to dismiss large-scale farming; countries such as Brazil, the United States and others are proof of the potential of these models to engender high agricultural productivity. Moreover, they can lead to the spread of new technologies, and when successful, be imitated by the local private sector. A good example is Ethiopia's horticulture "miracle", when the first foreign investors where imitated in time by a multitude of local investors, leading in a few years to a large and successful new industry replete with its own labor market, input markets, and transport and credit services.

C. Contract farming/Outgrower schemes

Contract farming is a form of vertical integration whereby a company or other entity procures outputs from farmers. The parties involved sign a contract specifying the quantity and quality of crops that need to be delivered, specific times of delivery and the price that will be offered. Farmers often receive a fraction of payments upfront and the rest of the payment later once the contractor has sold the product.

Contracts vary in intensity and services offered. Sometimes the contractor gives farmers inputs on credit and deducts loan payments from the final price. Some contractors also provide extension services, grower management, post-harvest logistics such as transport and packaging etc. Outgrower schemes involving nucleus estates often have contracts of the highest intensity because of the large investments involved in an estate and processing facilities whose profitability depends on throughput. Other models where aggregators contract with farmers informally have low intensity contracts and are characterized by inconsistent supplies.

Contractors could vary from non-profit organizations to private companies to parastatals and retailers. Contract farming has been the choice model for retail companies/supermarkets which procure fresh produce from farmers and offer credit facilities, basic processing facilities and extension services. The advantage of such a model is that the members of the community are already familiar with the supermarket and would therefore be more willing to enter into a contract arrangement with supermarket owners. Further, since the supermarket already has a market for its own goods, contract farming helps to increase market size and to stretch initial investments even further. Examples of successful contract arrangements with retailers include SPAR (South Africa), Shoprite (South Africa) and Nakumatt (Kenya), which are often engaged in contract farming for their fresh produce.

1. **Risk of side-selling**

Side-selling is a major problem that contractors have to contend with. When farmers enter into a contract, they agree to provide a certain quantity of products for a specified price, and to pay back loans and other services advanced by the out-grower. However, farmers will have an incentive to renege ex-post. This is exacerbated when spot market prices are higher than the contract price and farmers divert some of their produce. Most contractors pay farmers once they are able to export the products or sell them in the domestic market and the delays in payment sometimes forces farmers to side-sell so as to get quick cash. These incentive problems are to some extent resolved by the repeated nature of the game, and the attempt by farmers to build a reputation in order to benefit from contracting with out-growers.

Confidence develops through repeated games mainly when the out-grower is a monopoly, as this increases the farmer's incentives to build a trusting relation. Other ways to mitigate the side-selling problem in more competitive environments is for the producers to cooperate in drawing a black list of offenders, or to create group accountability by giving loans to small groups as opposed to individuals. Side-selling by an individual would then result in the group failing to receive inputs on credit in the next crop cycle.

2. **Risk of exploitation:**

We have argued above that for out-grower schemes to work, they must be *de facto* monopolies. But in such circumstances, farmers become highly dependent on contractors, and this can lead to the exploitation of farmers. A main way to guard against exploitation is for farmers to form cooperatives in order to collectively demand the enforcement of their rights.

But more important, out-grower schemes are a good way to initiate commercial farming in a region, that must be followed up by other initiatives to sustain this dynamism. The main innovation that needs to happen is the introduction of private sector credit. This allows farmers to

reduce their dependence on the out-growers, and for the latter to specialize in offering services rather than credit. In turn, as credit expands, farmers are able to buy services from competitive out-growers, and later more specialized servicing businesses, and as a result, the exclusive relation loses its raison d'etre, and competition can become more prevalent in the sector.

Case Study: Thohoyandou SPAR & the local emerging vegetable sector

SPAR supermarket was started in 2002 and has played an important role in integrating farmers with the market. Their mission is to promote community development. As such, they procure fresh produce from small farmers and pay them every Friday. They also offer other services e.g. interest-free production loans of R 2,500 contingent upon approval of a viable business plan that addresses production, marketing, income and cash flow. The loans are to be repaid in three months at the latest. Farmers also receive extension services, training and farm visits by SPAR personnel. Since farmers deliver small supplies regularly, SPAR is able to have fresh produce every day. SPAR's innovate approach fostered rapport and patronage. In only two years, SPAR had 66% of market share and an impressive 22,550 customers daily. The store procures mainly cabbages, spinach, carrots and beetroot from emerging farmers. They refrain from procuring mangoes and tomatoes because they do not want to crowd out hawkers who concentrate on these products. The model has been replicated in five other stores across the country

Case Study: Ghana Rubber Estates Limited

Ghana Rubber Estates Limited (GREL) was started in 1957 as a small private plantation but was later nationalized in 1960. This is the largest industrial rubber plantation in Ghana accounting for 98% of rubber production. The company has a 36-year concession on 15,000 ha of land. The Rubber Outgrowers' Plantation Project (ROPP) was started in 1995 with support from the government and international donors. The scheme has 5540 outgrowers who receive training, technical assistance and inputs from GREL. GREL has also invested in social facilities such as schools and clinics thus increasing goodwill and legitimacy in the community. Outgrowers must have land use rights to at least 4 ha of land in order to qualify to be a GREL outgrower. Farmers also have to have an alternative source of income because rubber is a perennial crop that takes eight years to fully mature. GREL encourages farmers to intercrop and provides technical assistance on farm management practices.

3. Risk of inadequate supplies

Companies that engage in outgrower schemes often make large capital investments in a processing plant whose profitability depends on the plant operating at/near full capacity. Inadequate supplies – resulting from side-selling or low productivity – could therefore result in significant losses for the investor. One way to mitigate against this problem is for the contractor to maintain a nucleus estate while also maintaining links with outgrowers who possess their own land but direct supplies to the contractor for processing/marketing/exporting. The nucleus estate would help supplement throughput when supplies from outgrowers are low. In some cases, the nucleus estate could also be used as an experimentation plot to try out new technologies or as a demonstration plot to show the viability of a new crop as in the case of Mumias Sugar Company in Kenya. The downside is that the nucleus estate requires large initial investments and the contractor has to bear the cost of labor management and face the risk of expropriation.

Case Study: Mumias Sugar Company in Kenya

Mumias Sugar Company (MSC) was formed in 1971 following a legal agreement between a private company, Booker Agriculture International (BAI), and the Kenyan government. MSC has a nucleus estate (3,400 ha) which supplies about one tenth of the factory's cane requirements. The remaining portion is supplied by the Mumias Outgrowers' Company (MOC) representing 23,000 outgrowers who account for roughly 85% of Mumias' sugar supply. MSC's outgrowers are concentrated in the over-populated and impoverished Nzoia region. Eligible outgrowers have to own at least 1.2ha of land within 21km radius of the factory. They should also be located close to other suitable lands so farmers can operate in 6 ha units to facilitate mechanical cultivation and consistent harvesting routines. MSC contracts are of a high intensity; the company provides inputs and uses its own labor and equipment for planting and harvesting. The farmer is responsible for the initial clearing of land and weeding before the cane is ready to be harvested 18 months later.

Case Study: Integrated Tamale Fruit Company (ITFC) in Ghana

ITFC was started in 1999 as a private company in Savelugu-Nanton District, which has a high incidence of poverty. 70% of the company's shareholders are Ghanaian. ITFC has a nucleus farm covering an area of about 160 hectares (with over 38,000 trees) and an outgrower scheme that currently includes 1,300 outgrowers. Each farmer has a plot of around 1ha and 100 mango trees. ITFC provides inputs and technical assistance on credit and farmers start paying back loans after five years. This nucleus-estate model is very expensive; ITFC invests an average of US$7,000 per outgrower. ITFC also started a school in the area. The Organic Mango Outgrowers Association (OMOA) advocates for the interests of farmers and mediates between the farmers and the company. The model is currently expanding to pineapple production.

4. Issues of inclusiveness:

Women are sometimes left out of contracting and outgrower schemes. Bulow and Sorensen conducted a study of the Kenya Tea Development Authority (KTDA) and discovered that contracts were awarded mostly to male household heads even though women and children provided most of the labor (Bulow & Sorensen, 1993). This often leads to household conflicts and women sometimes neglect plantations as a negotiating mechanism. Productivity of KTDA farmers has therefore been found to be consistently lower than that found in plantations partly because of the conflicts associated with household labor. Selection of outgrowers is also biased toward wealthy smallholders or large farmers who have land rights thereby excluding asset and land-poor farmers (Baumann, 2000, p. 15). Outgrower schemes are therefore not as inclusive as they are made out to be. The ongoing land reforms in several African countries will hopefully make it easier for women to hold title deeds which would allow them to participate in outgrower schemes. Contracting companies can also be evaluated on their inclusiveness as part of Corporate Social Responsibility.

D. Marketing boards

Marketing boards are parastatals or government entities that control all aspects of the agricultural value chain from production to marketing. They are monopolistic providers of farm inputs such as seeds and fertilizers and monopsonistic buyers of farm outputs. They also regulate the sale of outputs to internal and external markets.
Marketing boards date back to the post-World War II period when the colonial empire was undergoing a financial crisis. In a bid to meet British needs, Commodity Boards were formed to maintain a monopoly on export crops. The boards controlled prices thereby maximizing profits and reducing demand for imports (Williams, 1985). Marketing boards were also set up to protect producers from exploitation by middle-men and moneylenders.

Post-independence, African governments maintained the Boards to help stabilize commodity prices and insulate farmers from international price volatility. They would do this by accumulating reserves when prices were high in order to offer farmers higher prices when world prices plummeted.

Price stabilization is highly beneficial in contexts where social safety net programs are inadequate and where people rely so heavily on agricultural incomes. Further, the monopolistic nature of Marketing Boards hedges against the risk of non-delivery and undersupplies. As a result, external buyers are confident enough to engage in forward purchases thus making marketing much easier than in atomistic setups. Also, many marketing boards were highly effective in assuring quality of outputs. Ghana for instance is reputed for its high quality cocoa – a direct result of the COCOBOD subsidiary, Quality Control Division. The quality of cocoa in other contexts with free-market systems such as Indonesia, have been found to be much lower than Ghana. In these areas, buyers compete for limited supplies from farmers and are therefore more lax with their quality requirements. As a result, farmers ferment cocoa for two or three days as opposed to the recommended five days.

Problems Associated with Marketing Boards

1. **Diseconomies of scale:**
   Even though marketing boards (MB) were set up to protect farmers, they mostly served as a revenue-generating mechanism to finance government expenditures. Governments also used them to buy products from farmers at depressed prices. Often, MB provide rents to political allies by offering them positions in the marketing boards. As a result, most of the boards were bloated with an unsustainably large number of employees – many of them ghost workers. In many cases, there were significant diseconomies of scale as efficiency was consistently sacrificed in favor of scope.

   Figure 15 below shows a typology of top cocoa producers along with their business models. The subsequent graphs show performance both in terms of scope (production/export of cocoa) and efficiency (output per area of land).

Fig 14. Author's compilation of marketing boards

Country	Marketing Boards	Evolution of business models
Indonesia	No	
Malaysia	No	Marketing Board(1989)→ Free Market
Brazil	No	
Nigeria	No (since 1986)	Regional marketing boards → national marketing board → Free market system
Cameroon	No (since 1994-95)	Stabilization fund (ONCC)→ Free Market system with warehouse receipts
Cote d'Ivoire	No (since 1999)	Stabilization fund (CAISTAB)→ Free Market system
Ghana	Yes	Cocoa. Complete monopsony→ Private sector involvement in procurement and transportation (since 1992-93) but prices are still determined administratively
Burkina Faso	Yes	Cotton. Complete Monopoly -> Division into 3 georgraphical regions and privatization of two board -> privatization of the processing. Introduction of price smoothing mechanism.

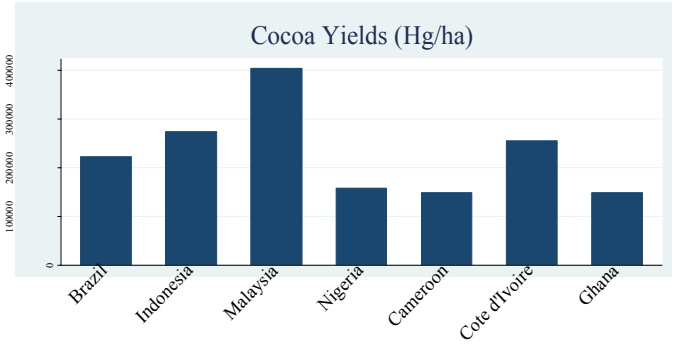


Fig 15. Cocoa yields for select countries

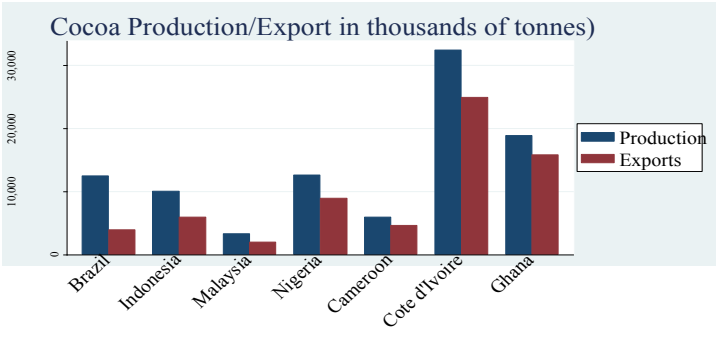


Fig 16. Cocoa production/exports for select countries

As Figure 19 above shows, Ghana is second to Cote d'Ivoire in terms of production and export of cocoa. However, in terms of efficiency, Ghana is the least efficient of the top producers of cocoa (Figure 18). One could argue that the Ghanaian government has placed a higher premium on the ability to increase scope (create greater employment for its people) regardless of the efficiency of the model. Indeed, cocoa has accounted for a significant share of Ghana's agricultural growth and has been a major source of poverty reduction. However, the Ghana cocoa sector still operates well below potential with a large scope for productivity and quality improvement. Cote d'Ivoire, on the other hand, has managed to achieve both scope and

efficiency without a marketing board. The following innovations could help the Ghana COCOBOD, and other Marketing Boards, to maintain the advantages of these organizations while avoiding some of the demerits.

A. **Private sector participation:** One way would be to partially liberalize the marketing boards in order to introduce competition. The Ghana COCOBOD has done this quite successfully.

Case Study: COCOBOD in Ghana

Prior to 1992, COCOBOD was in charge of the domestic supply chain using three subsidiaries: the Produce Buying Company (exercised monopsony powers), Quality Control Division and Cocoa Marketing Company (in charge of exports). CMC has remained the only authorized exporter of cocoa in Ghana and COCOBOD still sets producer prices even though it is no longer a monopsony for cocoa. After 1992 other buying companies were allowed to operate following issuance of a license by COCOBOD. These Licensed Buying Companies received credit from COCOBOD at lower interest rates than market rates to LBCs. Currently, there are roughly 20 LBCs in Ghana but only 10 are highly active. Olam and Kuapa (both foreign-owned) have commanded significant market share but other Ghanaian LBCs still have a marginal market share. COCOBOD remains the dominant actor in the cocoa industry. Prices are still set administratively by national farmers' organizations, haulers, transporters and the Price Review Committee (consisting of COCOBOD, government officials and representatives of the LBCs). In 2000, PBC was privatized and qualifying LBCs were allowed to export 30% of their shares. In order to qualify, the LBC has to have been in operation for more than two years, have technical experience with the crop, purchased at least 10,000 tons of cocoa in two consecutive years and prove access to financial

B. **Introducing competition:** As was mentioned earlier, the monopolistic nature of marketing boards could result in great inefficiencies since the institutions are both economic and political entities. As a result, success or failure is measured, not merely in terms of profit but also in terms of social welfare, political legitimacy etc. Efficiency could be introduced by breaking up marketing boards into geographical monopolies rather than national hegemonic entities. Each marketing board would cater for a specific region and would provide farmers with the full bundle of goods and services in an aggregated manner. This is the technique followed by Burkina Faso to improve the productivity of its cotton sector. This would create competition between the regional marketing boards and communities can demand for better treatment based on comparisons with other regions. A third way of dealing with efficiency issues is to have farmers organize in cooperatives to hold the parastatals accountable.

E. Cooperatives

Cooperatives have been cited as a way of holding both outgrowers and marketing boards accountable. They are also potentially useful ways of providing bundles of services to farmers thereby connecting them with input and output markets. Cooperatives could also enable farmers to coordinate planting and harvesting schedules in order to avoid saturating markets. They also create economies of scale; farmers can aggregate crops and sell in bulk to an exporter or processor and command a higher price. Farmers could also collectively hire trucks and drivers to collect their produce at harvest time, rent a warehouse/storage space, pay for

extension services, information and technology services to determine prices and demand elsewhere etc. Cooperatives could also give farmers credit to allow them to purchase farm inputs. Nongovernmental organizations and other international organizations can be instrumental in encouraging the growth and efficiency of cooperatives. The main challenge with cooperatives is governance issues.

Case Study: National Smallholder Farmers' Association of Malawi (NASFAM)

NASFAM was started in 1997 with the support of the Agricultural Cooperative Development International (ACDI/VOCA) – a US-based organization that also provides technical and financial assistance to developing countries to help develop and manage their farmers associations. NASFAM was initially intended to coordinate smallholder production of tobacco but has since expanded to other cash and food crops. NASFAM is now the "largest independent smallholder-owned membership organization in Malawi". The cooperative has over 100,000 members and owns farm supply shops to avail high quality inputs to farmers at competitive prices. They also facilitate transportation of outputs to internal and external markets and monitor the quantity of goods transported to prevent losses. Prices are set by the members of NASFAM by monitoring trends in domestic and international prices.

Case Study: Kuapa Kokoo Farmers' Cooperative

Kuapa Kokoo was established in 1993 shortly after Ghana partially liberalized COCOBOD to allow private licensed buying companies in the procurement of cocoa. Kuapa Kokoo, operates as a private, licensed buying company and currently has a share of 10% of total cocoa purchases in Ghana. Within Cocobod, a special channel exists for fair-trade cocoa sourced and exported from Kuapa Kokoo, although the system traces such cocoa back to the cooperative rather than to the individual farmer. The profits earned from cocoa exports are reinvested in community development projects.

Conclusion

Using empirical evidence, we determined that agriculture exhibit unconditional divergence. For agricultural productivity to converge to technological frontier at the country level, good policies must be implemented, and capital made available. While the challenge for the sector as a whole can be overwhelming, we have also discovered that many crops behave like industries, and converge unconditionally. The central question in this paper has been to find business models that fit the conditions of crops and country circumstances so as to make parts of agriculture more like an industry and less like a country, constituting islands of quality where agricultural productivity is not held hostage to a country's economic state.

The goal of all business models should be to vertically and/or horizontally integrate farmers so as to create islands of quality that can help increase agricultural productivity. This is done to create enclaves of profitable private firms that deal with bundles of the input and services needed for production, processing, and marketing rather than with individual items. This paper outlined how five well-known business models could attain this goal and also explored some of the challenges associated with each one. Growth corridors can create islands of quality by

concentrating highly productive capital-endowed farmers and investors around the necessary infrastructure such as roads, in order to create markets in inputs and outputs. Plantations are vertically integrated operations in activities in which a comparative advantage can be developed around climatic conditions. Out-grower schemes/contract farming offer a way to increase scale and therefore increase market power without interfering with property rights. Marketing boards are a dying model, especially in the wake of the structural adjustment period that conditioned aid on the demolition of these institutions. However, old marketing boards can be reformed and modernized to become globally competitive. Finally, cooperatives are yet another model that could be used to integrate farmers horizontally thus creating economies of scale.

All these models suffer from weaknesses but there are also solutions, and these models can progress towards denser markets and expanding growth poles. Growth corridors are increasingly becoming developed around public private partnerships, where the rights and responsibility of each partner is clearly defined at the outset. In the next few years, a new generation of high productivity irrigation schemes are likely to get developed around such a model, for example to grow rice in West Africa, or cereals in East and South Africa.

In the face of intense competition, outgrower schemes are not stable as they rely on monopolistic power since when competition start coming in, these models tend to be weakened by side-selling. However, this then puts pressure on mitigation mechanisms developing, such as mechanisms to blacklist defaulting farmers, such as in group credit schemes. The development of group accountability can then become the basis for the development of a rural banking system that can start offering more products over times, such as risk sharing opportunities.

Marketing boards and plantations offer another path for progress. The Ghana COCOBOD or Burkina Cotton Board have grown into a successful multi-national corporation offering some of the highest quality cocoa in the world. Some large plantations for tea or coffee for example are thriving and have created an growing ecology of small firms around them that service parts of their needs. To face global competition especially by free-market cocoa, cotton, or tea exporters these vertically integrated systems have had to start privatizing parts of the value chain and by experiencing with partial by breaking the marketing board up by geographical regions while pooling public goods such as price stabilization funds.

Cooperatives have typically struggled with governance problems and other difficulties associated with socially-driven institutions. But some, such as the Potato Growers of the Fouta Djallon in Guinea have thrived and became increasingly organized along professional corporate lines.

The analysis of business models highlights the importance of public policy in unleashing Africa's agricultural potential. Even in instances where the private sector has succeeded in commercializing agriculture, the government has played a catalytic role. It is therefore important that governments continue thinking of new kinds of public private partnerships that can expand the set of possibilities in agriculture in an innovative yet feasible manner.

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Appendix

Table 1 – Growth of labor productivity in agriculture, industry, and growth in income per capita.

	Agriculture value added per worker (constant 2000 US$) 10yr avg. annual growth		Industry value added per worker (constant 2000 US$) 10yr avg. annual growth		GDP per capita (const. 2000 US$) 10yr avg. annual growth	
	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture value added per worker, Log	1.473***	-16.57***				
	(0.228)	(1.363)				
Industry value added per worker, Log			-1.378**	-15.31***		
			(0.583)	(0.997)		
GDP per capita, Log					0.160	-11.50***
					(0.164)	(1.261)
Constant	-2.260***	46.71***	8.648***	66.87***	1.463**	32.62***
	(0.711)	(3.570)	(2.536)	(4.502)	(0.605)	(3.701)
Country fixed effects		Yes		Yes		Yes
Time fixed effects		Yes		Yes		Yes
N	3312	2734	723	611	7035	5891
R-sq	0.105	0.745	0.057	0.875	0.001	0.659
adj. R-sq	0.105	0.727	0.056	0.856	0.001	0.645
F	41.87		5.581		0.947	

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Notes – All the values added are in to constant 2000 US$ and the growth rates are in percent.
Sources of data: aggregated data from FAOSTAT, WDI, ILO, 2012.

Table 2 – Determinant of growth in labor productivity in agriculture.

	Agriculture value added per worker (constant 2000 US$) 10yr avg. annual growth				
	(1)	(2)	(3)	(4)	(5)
Agriculture value added per worker, Log	1.473***	-12.44	-13.54**	-16.57***	-0.953**
	(0.228)	(15.72)	(4.509)	(1.363)	(0.464)
Agricultural machinery (tractors per ha arable)		32.11	46.76		2.157
		(79.96)	(36.25)		(1.642)
Landlocked (1 if landlocked)		-4.065	-5.071***		-0.512*
		(3.187)	(1.454)		(0.268)
Arable land (hectares per pers.)		-0.533	-0.533***		-0.0206
		(0.506)	(0.196)		(0.0125)
Land area (sq. km)		-2.23e-6	-2.14e-6***		6.94e-8
		(2.69e-6)	(6.19e-7)		(1.11e-7)
Livestock production index (2004-2006 = 100)		0.0527	0.0401*		0.00569
		(0.0518)	(0.0198)		(0.00957)
Fertilizers consumption (tons/ha arable land, Log)		-17.19	-48.02**		-1.520*
		(30.23)	(18.69)		(0.827)
Average precipitation in depth (mm per year)		-0.00650	-0.00489**		2.90e-4
		(0.00751)	(0.00208)		(2.93e-4)
Agricultural labor (Millions pers.)		-3.877	-2.836**		-0.0282
		(2.801)	(1.095)		(0.0404)
Labor force, total (Millions pers.)		2.18	1.79**		0.0136
		(1.77)	(0.762)		(0.0135)
Rural population (% of total population)		0.188	0.120		0.00392
		(0.148)	(0.0865)		(0.0124)
Urban population growth (annual %)		1.640	1.802**		-0.159
		(1.959)	(0.721)		(0.177)
Inflation, consumer prices (annual %)		0.00191	-0.00288*		-0.00685***
		(0.00432)	(0.00147)		(8.64e-4)
Real exchange rate index (Y2005=100)		-0.0761	-0.0954***		-0.0321**
		(0.0635)	(0.0314)		(0.0122)
External Debt service const2000 US$ Million		-3.19e-4*	-3.10e-4**		
		(1.83e-4)	(1.07e-4)		
Road density (km per 100sq km land)		0.267	0.194**		3.46e-5
		(0.229)	(0.0916)		(1.10e-3)
Roads, total network (km)		-9.78e-5	-8.25e-5		-5.76e-7*
		(1.12e-4)	(5.14e-5)		(3.29e-7)
Electric power consumption (kWh per capita)		0.00221	0.00227		2.25e-5
		(0.00432)	(0.00206)		(2.66e-5)
Agri.VA per worker 10yr gr.			0.999***		0.900***

(lagged var. previous year)			(0.224)		(0.103)
Constant	-2.260*** (0.711)	44.44 (57.54)	51.93*** (17.38)	46.71*** (3.570)	7.244** (3.419)
Country fixed effects				Yes	
Time fixed effects				Yes	
N	3312	30	30	2734	67
R-sq	0.105	0.750	0.940	0.745	0.879
adj. R-sq	0.105	0.340	0.827	0.727	0.833
F	41.87	.	.	.	263.1

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Notes – All the values added are in to constant 2000 US$ and the growth rates are in percent. Arable land area is in hectares per person. Agricultural labor is in Millions pers. Agricultural machinery is expressed in tractors per hectare of arable land area. Fertilizer consumption is in tons per hectare of arable land. Road density is in km of road per 100sq km=10,000ha of land area.
Sources of data: aggregated data from FAOSTAT, WDI, ILO, 2012.

Table 3. Crop specific beta coefficients of convergence – Ascending order

	Unconditional convergence			Conditional convergence w/ Countries fixed effects Time fixed effects		
	Beta	Std deviation		Beta	Std deviation	
Jojoba Seeds	-178.159	(0)	***	-315.302		
Broad beans, horse beans, dry	-99.2286	(98.43861)		-767.213	(424.6275)	*
Poppy seed	-72.6981	(32.55737)	**	-76.3777	(26.07251)	***
Ramie	-41.9911	(26.83387)		-58.9416	(31.68041)	*
Karite Nuts (Sheanuts)	-40.3383	(17.67248)	**	-15.508	(13.21434)	
Mustard seed	-38.1583	(24.94814)		-55.9691	(20.40704)	***
Triticale	-37.3598	(20.21325)	*	-89.9361	(30.09694)	***
Tallowtree Seeds	-32.3312	(0)	***	0		
Pome fruit, nes	-32.09	(7.429661)	***	-32.09	(7.429661)	***
Sweet potatoes	-31.5792	(19.94747)		-117.267	(74.53013)	
Chick peas	-28.0502	(30.42996)		229.2186	(283.9611)	
Pyrethrum,Dried	-26.872	(14.87126)	*	-38.4745	(13.92474)	***
Kiwi fruit	-24.7478	(6.125988)	***	-57.5583	(7.654563)	***
Cauliflowers and broccoli	-24.3793	(19.99699)		-76.0339	(35.71132)	**
Linseed	-24.1297	(11.81369)	**	-126.37	(93.04314)	
Rapeseed	-21.1	(6.416072)	***	-46.6956	(11.17619)	***
Chestnuts	-19.2693	(14.28349)		-88.3282	(35.66053)	**
Garlic	-18.4772	(12.69849)		-155.743	(59.12915)	***
Sesame seed	-16.585	(5.927568)	***	-17.3834	(10.98442)	
Citrus fruit, nes	-16.5473	(11.91177)		-114.444	(62.74088)	*
Quinoa	-16.3784	(1.360308)	***	-30.1848	(2.916315)	***

	Unconditional convergence			Conditional convergence w/ Countries fixed effects Time fixed effects		
	Beta	Std deviation		Beta	Std deviation	
Pulses,Total	-14.9008	(12.76968)		-45.5697	(13.75907)	***
Buckwheat	-14.5478	(8.164284)	*	-38.4504	(9.238441)	***
Beans, dry	-14.2128	(9.285079)		-24.8006	(8.549945)	***
Sunflower seed	-13.3695	(6.552054)	**	-60.5561	(14.17334)	***
Raspberries	-12.5546	(6.368024)	**	-43.8802	(4.766285)	***
Sorghum	-11.9036	(5.245278)	**	-47.2888	(13.37009)	***
Beans, green	-11.6734	(9.02825)		-117.763	(68.83935)	*
Pineapples	-11.253	(9.618122)		-88.1708	(59.27503)	
Walnuts, with shell	-10.9101	(7.427275)		-72.7653	(31.75661)	**
Millet	-10.3142	(3.031609)	***	-29.2122	(3.332203)	***
Vetches	-10.1396	(7.209219)		-50.9873	(16.81283)	***
Maize, green	-9.87759	(5.243531)	*	-27.1452	(6.024698)	***
Cassava	-9.79639	(2.779009)	***	-23.5761	(11.79617)	**
Flax fibre and tow	-9.56407	(6.545548)		-50.1272	(10.78823)	***
Mushrooms and truffles	-9.5412	(3.518002)	***	-88.5024	(35.61941)	**
Mixed grain	-9.50785	(4.158805)	**	-16.7894	(7.39765)	**
Papayas	-9.32209	(7.534842)		-88.3826	(52.5047)	*
Kapok Fruit	-9.0836	(0.4620638)	***	-18.9789	(0.000000249)	***
Melonseed	-9.04613	(6.555877)		-49.1929	(19.08502)	***
Kapokseed in Shell	-8.14844	(0.4490507)	***	-18.9793		
Maize	-8.0426	(3.060011)	***	-50.7762	(15.33636)	***
Lupins	-7.69393	(6.318018)		-9.76214	(11.39211)	
Artichokes	-7.53993	(3.014956)	**	-45.1556	(12.06856)	***
Leeks, other alliaceous veg	-7.337	(3.916398)	*	-94.7099	(42.8489)	**
Strawberries	-7.03988	(2.289883)	***	-32.1269	(6.052869)	***
Peas, green	-6.93714	(3.113768)	**	-32.2116	(6.036309)	***
Stone fruit, nes	-6.92562	(5.931794)		-75.8466	(43.06173)	*
Lentils	-6.88568	(7.106387)		-8.30841	(19.91183)	
Yams	-6.86462	(3.886942)	*	-23.7827	(8.415941)	***
Cherries	-6.74381	(2.795162)	**	-34.4407	(9.638166)	***
Rye	-6.74008	(3.333959)	**	-38.1976	(9.056332)	***
Asparagus	-6.72234	(5.591758)		-25.8313	(3.91018)	***
Pears	-6.66251	(6.750418)		-59.1636	(33.84093)	*
Mate	-6.49611	(0.1587156)	***	-16.9602	(7.311385)	**
Kapok Fibre	-6.19204	(3.138044)	**	-32.6406		
Sugar beet	-6.18893	(2.363518)	***	-32.9355	(9.046636)	***
Palm kernels	-6.11663	(5.839529)		-61.6568	(43.98155)	
Oats	-6.10249	(2.528354)	**	-25.4893	(3.816596)	***
Pistachios	-5.80816	(5.20437)		-80.1387	(33.85318)	**
Oilcakes Equivalent	-5.77908	(4.842926)		-20.0964	(3.751197)	***
Peas, dry	-5.7707	(2.783668)	**	-29.1807	(4.073002)	***
Tea	-5.59043	(1.223964)	***	-28.0436	(5.050205)	***
Lettuce and chicory	-5.3319	(3.013728)	*	-30.5376	(4.465062)	***
Mangoes, mangosteens, guavas	-5.30956	(2.54817)	**	-22.2623	(7.753995)	***
Cereals, nes	-5.30348	(4.122109)		-40.8556	(15.34445)	***
Groundnuts, with shell	-5.09735	(1.949027)	***	-25.6191	(2.353995)	***

	Unconditional convergence			Conditional convergence w/ Countries fixed effects Time fixed effects		
	Beta	Std deviation		Beta	Std deviation	
Chillies and peppers, green	-5.09234	(2.149073)	**	-44.5732	(15.42302)	***
Fruit Fresh Nes	-5.00437	(3.11373)		-23.0099	(5.821571)	***
Berries Nes	-4.94292	(2.672831)	*	-32.7481	(8.60645)	***
Other melons (inc.cantaloupes)	-4.87758	(2.927137)	*	-27.9633	(5.147056)	***
Rice, paddy	-4.78388	(1.957862)	**	-32.0313	(9.766853)	***
Okra	-4.78115	(4.165545)		-31.4413	(2.465506)	***
Cow peas, dry	-4.76759	(6.836585)		-23.5389	(11.08384)	**
Watermelons	-4.59458	(2.207373)	**	-24.9223	(2.233907)	***
Quinces	-4.52646	(1.839828)	**	-30.9186	(5.344132)	***
Fonio	-4.26297	(2.138938)	**	-18.8065	(5.216966)	***
Leguminous vegetables, nes	-4.21172	(2.035093)	**	-20.9987	(3.891379)	***
Bananas	-4.1472	(2.063858)	**	-30.8774	(5.946095)	***
Currants	-4.13112	(1.079722)	***	-22.3568	(7.64307)	***
Cloves	-4.12497	(4.537245)		-0.49939	(15.79085)	
Soybeans	-4.0742	(1.63339)	**	-33.6614	(5.219644)	***
Fibre Crops Primary	-4.06415	(1.38506)	***	-24.8158	(3.021267)	***
Hops	-4.01376	(2.405125)	*	-33.458	(10.74742)	***
Gooseberries	-4.01305	(2.003858)	**	-14.1147	(2.001257)	***
Plantains	-4.00766	(2.240146)	*	-34.0678	(4.566698)	***
Nuts, nes	-3.98002	(2.466902)		-51.8872	(17.85262)	***
Olives	-3.97104	(4.822475)		-38.9182	(9.213221)	***
Fruit, tropical fresh nes	-3.95345	(1.419937)	***	-28.567	(13.42833)	**
Hempseed	-3.87581	(3.457932)		-14.8817	(5.432796)	***
Other Bastfibres	-3.7918	(2.799108)		-36.4441	(15.26194)	**
Jute	-3.74867	(1.828576)	**	-12.2146	(9.503929)	
Safflower seed	-3.64004	(5.699403)		-26.7519	(9.742892)	***
Almonds, with shell	-3.63986	(5.177321)		7.275853	(26.05503)	
Cereals,Total	-3.31147	(2.192335)		-31.9446	(5.879097)	***
Pulses, nes	-3.27557	(1.465419)	**	-24.9643	(4.577189)	***
Arecanuts	-3.10612	(5.533853)		-43.6553	(12.41371)	***
Cereals (Rice Milled Eqv	-3.09471	(2.114493)		-32.1586	(5.941856)	***
Coffee, green	-3.09358	(0.8680922)	***	-19.0837	(2.799925)	***
Coarse Grain, Total	-3.06432	(1.632212)	*	-31.2	(4.348586)	***
Coir	-3.05046	(2.322622)		-6.30035	(10.41697)	
Blueberries	-3.00033	(3.266438)		-61.1938	(14.63535)	***
Castor oil seed	-2.98589	(2.481068)		-12.6454	(10.29174)	
Tobacco, unmanufactured	-2.92419	(1.121129)	***	-22.5005	(2.75158)	***
Onions (inc. shallots), green	-2.87733	(3.44046)		-46.2586	(11.6824)	***
Spices, nes	-2.71606	(1.591137)	*	-22.1495	(3.77498)	***
Taro (cocoyam)	-2.71561	(1.618887)	*	-26.0141	(3.18846)	***
Pepper (Piper spp.)	-2.69465	(2.159167)		-38.7968	(6.219862)	***
Roots and Tubers,Total	-2.68403	(0.751193)	***	-23.9119	(2.410571)	***
Cocoa beans	-2.66937	(0.9327577)	***	-23.713	(4.635511)	***
Figs	-2.61007	(1.790772)		-29.4666	(4.371807)	***
Roots and Tubers, nes	-2.54603	(0.9383855)	***	-46.3681	(26.62035)	*
Avocados	-2.49638	(1.322054)	*	-26.1081	(3.7151)	***

	Unconditional convergence			Conditional convergence w/ Countries fixed effects Time fixed effects		
	Beta	Std deviation		Beta	Std deviation	
Wheat	-2.47682	(2.021391)		-32.1777	(10.82643)	***
Treenuts,Total	-2.27759	(1.029124)	**	-30.0781	(3.812481)	***
Citrus Fruit,Total	-2.25401	(1.057055)	**	-30.9798	(7.78806)	***
Cotton lint	-2.17818	(1.003562)	**	-24.5828	(5.331486)	***
Potatoes	-2.15322	(0.558634)	***	-24.1977	(3.072699)	***
Cucumbers and gherkins	-2.07125	(2.686341)		-28.6342	(4.655318)	***
Seed cotton	-2.06361	(0.9828166)	**	-24.4192	(5.074726)	***
Cottonseed	-2.00861	(0.9883239)	**	-23.842	(4.953853)	***
Carrots and turnips	-2.00144	(1.205673)	*	-32.4578	(3.951633)	***
Coconuts	-1.93627	(1.068539)	*	-16.9007	(1.489276)	***
Grapefruit (inc. pomelos)	-1.92919	(0.8178804)	**	-19.6324	(2.524847)	***
Cashew nuts, with shell	-1.83413	(3.901935)		-23.8738	(4.480062)	***
Dates	-1.81816	(1.484873)		-37.3756	(10.24636)	***
Anise, badian, fennel, corian.	-1.78232	(2.857838)		-37.3622	(13.68033)	***
Barley	-1.74162	(2.007438)		-54.5628	(19.77461)	***
Cinnamon (canella)	-1.73983	(0.9318684)	*	-11.3448	(7.348657)	
Cabbages and other brassicas	-1.69282	(0.8125758)	**	-29.8244	(5.878467)	***
Ginger	-1.64163	(1.649412)		-24.8433	(3.618714)	***
Natural rubber	-1.58307	(1.006886)		-20.9559	(1.771201)	***
Persimmons	-1.57306	(2.373826)		-38.2523	(9.445432)	***
Pumpkins, squash and gourds	-1.44806	(1.029755)		-29.9813	(4.791342)	***
Lemons and limes	-1.43909	(0.9344391)		-34.09	(11.05116)	***
Kolanuts	-1.40577	(2.462385)		-32.4923	(8.73112)	***
Yautia (cocoyam)	-1.39293	(1.031314)		-27.0281	(12.37847)	**
Apples	-1.37753	(1.293074)		-24.8422	(4.587724)	***
Sugar crops, nes	-1.36419	(6.864001)		-18.1722	(4.008115)	***
Oil palm fruit	-1.31668	(1.338545)		-16.8966	(1.542979)	***
Eggplants (aubergines)	-1.31308	(1.69995)		-24.0321	(4.864156)	***
Sugar cane	-1.22699	(0.5251237)	**	-32.0436	(4.346807)	***
Palm oil	-1.20801	(1.37397)		-18.2391	(1.910706)	***
Oilcrops Primary	-1.19175	(0.8766878)		-23.7732	(1.780138)	***
Vegetables fresh nes	-1.14824	(0.9993164)		-24.7368	(3.954318)	***
Chicory roots	-1.12921	(2.253967)		-21.7105	(3.486072)	***
Jute & Jute-like Fibres	-1.09382	(1.22674)		-21.3717	(3.00587)	***
Hemp Tow Waste	-1.0832	(6.192317)		-41.9065	(18.09819)	**
Chillies and peppers, dry	-0.95131	(1.222358)		-28.148	(2.406527)	***
Plums and sloes	-0.88472	(1.734866)		-32.09	(7.429661)	***
Tomatoes	-0.84678	(0.5755944)		-26.5977	(2.062156)	***
Hazelnuts, with shell	-0.8225	(3.860619)		-35.2606	(19.99992)	*
Canary seed	-0.72642	(2.536275)		-14.9112	(7.58903)	**
Peaches and nectarines	-0.70117	(0.7710255)		-20.2948	(1.994948)	***
Grapes	-0.52918	(0.6117998)		-22.3533	(3.554472)	***
Oranges	-0.44507	(0.6074108)		-25.0151	(3.10962)	***
Nutmeg, mace and cardamoms	-0.31658	(0.7668599)		-16.2093	(2.848332)	***
Onions, dry	-0.31068	(0.9674037)		-26.339	(2.682035)	***
Cranberries	-0.28857	(1.510189)		-16.3321	(8.002421)	**

	Unconditional convergence			Conditional convergence w/ Countries fixed effects Time fixed effects		
	Beta	Std deviation		Beta	Std deviation	
Manila Fibre (Abaca)	-0.28358	(0.9209102)		-28.7343	(4.202766)	***
Sisal	-0.18208	(0.572706)		-14.6037	(2.78053)	***
Fruit excl Melons,Total	-0.14649	(0.3490376)		-14.6334	(2.945228)	***
Sour cherries	-0.11911	(2.49947)		-44.4657	(11.23363)	***
Oilseeds, Nes	0.024819	(1.004073)		-36.8771	(12.42815)	***
Fibre Crops Nes	0.309249	(0.7731943)		-25.7529	(4.580394)	***
Tangerines, mandarins, clem.	0.801625	(0.5803173)		-20.0167	(2.508549)	***
Vegetables Primary	0.821814	(0.3683849)	**	-21.5363	(1.931295)	***
Vegetables&Melons, Total	0.821814	(0.3683849)	**	-21.5363	(1.931295)	***
Apricots	1.142582	(1.147203)		-19.8457	(3.487993)	***
Agave Fibres Nes	1.317721	(3.316288)		-20.2092	(8.758094)	**
Pigeon peas	1.704302	(1.496238)		-18.5906	(4.430071)	***
String beans	1.94817	(1.551186)		-19.0574	(3.958147)	***
Vanilla	2.249959	(3.413643)		-26.0998	(8.546476)	***
Carobs	2.394956	(2.755741)		-18.3201	(1.413612)	***
Cashewapple	2.893406	(2.789601)		-34.9428	(10.16788)	***
Gums Natural	3.031419	(0.2119327)	***	-16.2459	(2.257741)	***
Peppermint	3.628301	(3.980061)		-17.432	(0.4319234)	***
Tung Nuts	4.344744	(4.879275)		-28.343	(11.11314)	**
Brazil nuts, with shell	6.619935	(2.287613)	***	-6.48238	(3.615573)	*
Spinach	6.817636	(7.507472)		-24.1967	(5.348279)	***
Bambara beans	8.180369	(5.381767)		-27.5773	(5.208809)	***
Cassava leaves	52.88836	(0)	***	0		
Popcorn						

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Notes – The crop production per worker in agriculture is used as a proxy of the crop specific value added per worker. For each crop, the beta represents the regression coefficient of the 10yr average annual growth rate of the production per worker (in tons) as a function of the logarithm of this production per worker, while controlling for other explanatory variables.
Sources of data: aggregated data from FAOSTAT, WDI, ILO, 2012.