Agriculturally led development: Ethiopia

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Abstract

Much of Sub-Saharan Africa is characterised by premature deindustrialisation. In this paper, it is argued that the difficulty experienced by this region with the expansion of manufacturing is related to the fact that most of these countries are land-abundant and thus there is a comparative advantage for agriculture. An agriculture-based model of development thus is most appropriate. The expansion of agricultural production can have both direct and indirect effects on the growth of output and employment in manufacturing. The Ethiopian experience is used to illustrate these ideas. Time-series analysis indicates that agriculture has indeed played a key role in the growth of manufacturing and services.

Key words: agriculture; Ethiopia; manufacturing

1. Introduction

The rapid economic rise of East Asia (Japan, Taiwan and South Korea) has resulted in the conception of a model of economic development based on this experience. This model seems to come in a variety of forms, but most of them incorporate the following ideas. The process of economic development is led by the rapid growth of labour-intensive manufacturing utilising labour drawn out of agriculture, where labour productivity is very low. The rapid growth in manufacturing is sustainable over long periods of time due to the development of labour-intensive manufactured exports, and thus the development of a comparative advantage in this sector. Thus, structural change plays a significant role in the development process (Ho 1978; Dinh *et al*. 2013; Francks 2015). From this perspective it is also argued that the rapid development of human capital played a significant role in industrial upgrading, and many argue that this upgrading was promoted via the policies of a developmental state (Wade 1990).

The agricultural sector did not play a passive role in this process of structural change and economic development. In most of these countries, rapid agricultural growth preceded or occurred concurrently with the growth in manufacturing. Agriculture provided the food, savings, labour and market for the rapid expansion of manufacturing (Johnston 1962; Lee 1971). In these countries, technological innovation in agriculture played a significant role, with this new technology being biased towards the use of biochemical inputs and labour (Hayami & Ruttan 1971). One can think of agriculture as a key to the development of the economy as a whole, and thus the necessity, as Mosher (1966) so aptly put it, to get agricultural moving, meaning raising agricultural productivity.

Recently, significant doubt has been cast on whether this type of development process is still possible for today's developing countries. Rodrik (2016a) and others have coined the phrase premature deindustrialisation to characterise the present situation. This phrase, and the discussion surrounding it, imply that developing labour-intensive manufacturing and using this to drive an economic catch-up process faces severe difficulties as a result of the globalisation process and modern technical innovation. If true, this would seem to imply that rapid-development miracles, such as those that occurred in East Asian and, to some extent, Southeast Asian economies, may be a thing of the past. Thus, poor countries today will have to settle for slower rates of growth and development that come from institutional reform and capital accumulation.

Although it may indeed be more difficult to promote rapid expansion in manufacturing now than in the past, the difficulties faced by manufacturing in developing countries, especially in Africa, seem likely due to a change in the policy environment. Prior to the 1980s, most poor countries followed import substitution policies (tariffs and quotas on imported manufactured goods, indirect taxes on agriculture, etc.) designed to encourage manufacturing and indirectly discriminate against agriculture. However, the liberalisation that occurred in the late 1980s and 1990s reduced the discrimination against the agricultural sector (reducing subsidies provided to domestic manufacturing). This was bound to have a negative impact on manufacturing in poor countries, at least in the short run. Shafaeddin (2005, 2009) has shown that, in many less-developed countries, firms that were near maturity were able to survive and sometimes export, but firms at earlier stages of development could not compete and did not succeed. Overall, liberalisation has tended to support static comparative advantages in agriculture. This is supported in the work by Bennell (1998), which shows that growth in value added in manufacturing had slowed in a majority of Sub-Saharan countries following policy liberalisation.

The argument made above, combined with the recent growth experience in Sub-Saharan Africa, suggests a possible alternative or complementary model of development. Specifically, over the last several decades, much of this region has experienced very rapid rates of economic development. Some have attributed this to a resource boom powered by the rapid growth of China, which is likely to wilt as the boom subsides (Rodrik 2016b).

There have, however, been a number of instances in which rapid growth occurred (over the last 10 to 15 years) in Sub-Saharan countries that do not have abundant natural resources. Ethiopia is a good example. Rapid growth there has been based on rapid growth in agriculture and infrastructure, with structural change involving the movement of production, in terms of share of GDP, and employment, in terms of share of total employment, into the service sector (World Bank 2016). Again, this has been criticised as being an unsustainable pathway for economic development. Much of the service sector is non-tradable in nature, although this is changing via technical innovation and foreign investment. A growth in services will be limited, to a large extent, by the expansion of the domestic market. In addition, the most dynamic services (banking, financial services, etc.) are relatively human-capital intensive, a factor of production that is quite limited in Sub-Saharan Africa (Rodrik 2016b).

However, there is another development model that may provide a mechanism for the long-run development of manufacturing. Wood (2017) has argued that most developing nations in Africa are still relatively land-abundant and labour scarce, thereby having a comparative advantage in agricultural production. It has long been argued that agricultural growth can serve as a basis for the expansion of the rest of the economy, especially manufacturing. Johnston and Mellor (1961) long ago argued that agricultural growth can provide the food necessary to feed workers in manufacturing and services, provide surplus labour to manufacturing and services, provide savings to finance investment in manufacturing and services, and provide a growing market for domestically produced manufactured goods and services. Timmer (1995) has argued that there are a whole host of indirect linkages whereby agriculture can support the expansion of the non-agricultural economy. The implication is that the rapid expansion of agricultural production can lead to the rapid growth of the non-agricultural economy and thus promote successful structural change in which both employment and resources shift from the agricultural to the non-agricultural sectors of the economy, including manufacturing. It should be emphasised that the key issue here is that investment must raise the social productivity of the agricultural sector.

There are critics of this strategy for development. Perhaps one of the most important critiques is provided by Matsuyama (1992). In an open economy, a country that devotes additional investment to agriculture may actually experience a slowdown or even a decline in the structural change process if such investment reduces the comparative disadvantage or increases the comparative advantage of the agricultural sector. This would draw additional resources and labour into the agricultural sector, thus reducing the relative size of the non-agricultural segment of the economy. In addition, any rapid expansion of the manufacturing and service sectors need not be constrained by the level of productivity in agriculture in an open economy setting, since agricultural goods could be imported (small country case).

In Sub-Saharan Africa, Ethiopia has embarked on an agriculture-led development strategy, involving significant investment in agriculture and related infrastructure. Rates of growth of GDP per capita have increased. This paper focuses on whether this agriculture-centred growth process has stimulated the development of the rest of the economy, in particular manufacturing and services. The paper unfolds in the following manner. Section 2 presents a model of economic development in which agriculture and services can play a role in the development of manufacturing. Section 3 applies the analysis to the experience of Ethiopia, and section 4 conducts an empirical analysis of the hypotheses proposed. Finally, Section 5 summarises the paper.

2. A three-sector model

The model utilised here is based on the dualistic model developed by Lewis (1954). Lewis saw developing countries as being made up of at least two sectors, namely traditional agriculture and modern manufacturing, with the labour productivity of agriculture being below that of manufacturing. Thus, economic growth resulted from a shift in labour from agriculture to manufacturing via investment in the latter sector.

One could expand this approach by envisioning developing countries as being composed of multiple sectors of varying labour productivity. Growth thus results from labour moving from lower to higher productivity sectors. In the past, these models have focused on labour-abundant countries with a potential (or actual) comparative advantage in labour-intensive manufacturing. Structural change is seen as involving investment in manufacturing raising productivity there and causing a shift in labour from agriculture to labour-intensive manufacturing and the export of such products. However, the model used here presumes that the country under consideration begins with a comparative advantage in agriculture, and that development involves an increased investment in agriculture, which provides the basis for the expansion of manufacturing and services.

The analysis in the preceding paragraph is supported by the extensive empirical work of Wood (2017). He argues that the Hecksher-Ohlin theory provides a useful basis for analysing structural change within the context of the falling barriers to trade that accompany the globalisation process. According to this theory, in the absence of trade barriers, countries tend to export those goods that make intensive use of the factors of production with which they are endowed relatively abundantly. Thus, as barriers fall, land-abundant countries are likely to find that their comparative advantage lies with land-intensive products, labour-abundant countries find that it lies with labour-intensive products, etc.

Wood's (2017) analysis classifies countries according to their land-to-labour ratios and their skilled labour-to-total labour ratios. He shows that many Sub-Saharan African countries (including Ethiopia) are land abundant compared to large parts of Asia. Thus, the reduction in trade costs accompanying globalisation should have resulted in these countries' export structure becoming increasingly oriented towards land-intensive commodities. Wood's evidence supports this conclusion, with land-abundant countries' exports becoming increasingly composed of primary commodities. Even more importantly, the land-abundant regions tend to experience a decline in the share of manufactured goods in total production and employment.

Using these results as a backdrop, we present a model of development appropriate for relatively land-abundant countries that have a comparative advantage in agricultural goods, building on the work of Eswaran and Kotwal (2002). Assume that the economy can be divided into three sectors, namely agriculture, manufacturing and services. Agriculture utilises land and labour to produce output, is competitive in nature, and may or may not be open to international trade. If the country is completely open to trade, the price of output from this sector is determined exogenously. Alternatively, if the agricultural sector faces some trade barriers, the price is determined endogenously. Given the landlocked nature of Ethiopia and its limited infrastructure, we assume that agricultural prices are set endogenously. We also assume that this economy possesses a comparative advantage (or potential comparative advantage) in agricultural production.

The manufacturing sector uses labour and services, and the agriculture sector output, to produce manufactured goods. It is characterised by competition and is assumed to be open to trade, with prices determined exogenously. The country lacks a comparative advantage in manufacturing and thus imports these goods.

The service sector utilises labour and agricultural output in the production process. The sector is closed to trade, with prices determined endogenously.[1]

Following Lewis (1954), the model assumes that surplus labour, or significantly underemployed labour, exists in much of the economy. Thus, dramatic expansion in all three sectors can occur without running into a labour constraint, and thus wages will not immediately rise with productivity growth.

Such a semi-open model of the economy was first developed in the work of Mellor (1976) and Myint (1975). This sort of model is very flexible in that the extent of tradability allowed can be varied given the circumstances of the particular country.

Within the context of this model, rapid growth in agriculture can provide a mechanism for sustainable economic development. A rise in agricultural growth, resulting from investment in the adaptation of technology, extension services and the provision of rural infrastructure, has a number of different effects. Growth in agriculture lowers the cost of inputs (in particular food) to both manufacturing and services, enhancing their profitability. This, in turn, reduces the comparative disadvantage faced by manufacturing, thus favouring import substitution. However, the initial expansion of agricultural output requires an initial increase in resources invested in agriculture to bring about productivity growth. This will tend to reduce manufacturing and service production (the Matsuyama effect discussed earlier). Thus, manufacturing and service sector growth are directly stimulated by growth in agriculture if the profitability exceeds the Matsuyama effect. Agricultural

[1] In reality, parts of this sector are open to trade and these tend to be the more dynamic parts of the service sector. However, given the scarcity of human capital, and the lack of rapid employment growth likely to follow from the expansion of this dynamic segment, the analysis ignores these aspects of the service sector.

growth can also have an indirect effect on manufacturing, since the expansion of the service sector would in turn lower the cost of manufacturing (since services are an input in manufacturing), leading to more investment and growth in manufacturing. There is also the possibility of a feedback effect, in which growth in manufacturing and services stimulates further growth in agriculture through the provision of crucial inputs.

As growth occurs in agriculture, it also has employment effects. Rising investment in agriculture (raising marginal productivity there) increases employment in this sector. This tends to reduce employment in the rest of the economy. Again, this is the Matsuyama effect. However, the increased income in agriculture is assumed to be disproportionately spent on manufacturing and services, which tends to increase employment in these sectors. With respect to manufacturing, the expansion in employment will only occur if domestic production displaces imports, and this is most likely to occur if cost reduction occurs in manufacturing due to increased agricultural production, as discussed above. As long as this effect outweighs the Matsuyama effect, employment in services and manufacturing will increase. One can think of this as a direct effect of employment expansion in agriculture. There is also a possible indirect effect. The expansion of employment and income in services can result in further increased spending on manufactured goods, leading to further increases in employment in manufacturing. As a result, employment in all sectors grows, as long as surplus labour (or significantly under-employed labour) is assumed to exist. Finally, there may also be feedback effects of employment growth in manufacturing and services on employment in agriculture.

In summary, the argument in this section is as follows. In land-abundant countries, comparative advantage is likely to exist for agricultural production. Thus, these types of goods are likely to be produced and exported, while the manufacturing sector is likely to be small. However, the expansion of production and employment in agriculture can directly cause the expansion of production and employment in manufacturing and services (if the Matsuyama effect is more than offset). Expansion of production and employment in agriculture can also have an indirect effect on manufacturing. Increased production and employment in services (stimulated by agricultural expansion) can generate further expansion in manufacturing. The experience of Ethiopia will be used to illustrate these ideas.

3. An Ethiopian example

The imperial regime in Ethiopia was toppled in 1974 and replaced by the Derg (committee of soldiers). The ideology of the new regime was socialist, implying that reliance on the market was to be dramatically reduced, if not eliminated, and the state was to control resources and their allocation. This involved the utilisation of state-owned enterprises, high import tariffs, export taxes, currency overvaluation, and marketing boards for agricultural commodities. The net effect of these policies was the indirect taxation of agriculture. This was a significant burden, considering that the bulk of the population and the poor relied on agriculture for a living. When this was combined with problems involving periodic droughts, it created situations within which hunger and famine periodically spread through large parts of the country. GDP per capita shrank throughout the Derg period. Although the regime was overthrown in 1991, civil war plagued the country, finally ending with the secession of Eritrea (Shiferaw, 2017).

The new regime's policy evolved into an economic strategy that emphasised investment in infrastructure (much of it in rural areas) and agriculture. There was significant investment by the state in the agricultural sector. From 2003 to 2008, these expenditures made up 17% of the total budget. One result was a large-scale expansion of the agricultural extension system, with the number of farmers using the extension system rising dramatically. A more favourable price environment was also provided for farmers. Crop price to fertiliser price ratios rose for most major crops. There was also significant expansion in the all-weather road network, with the total length of such roads tripling in less than 15 years. Farmers' education also increased, with the share of illiterate farmers declining by 1.8% annually between 2005 and 2014. Between 2005 and 2013, the growth rate in per capita gross value added was highest in the agricultural sector (World Bank, 2016). In addition to these specific policies, reliance on markets in general increased, tariffs reduced, and the extent of state ownership declined. From 1993 to 2004, GDP per capita grew at 4.5% per year and from 2004 to 2014 at a rate of 8% (World Bank, 2016).

This rapid growth has had significant socio-economic effects. In 2000, Ethiopia had one of the highest poverty rates in the world, with 55.3% of the population living below the international poverty line. By 2011 this had fallen to 33.5%. Life expectancy increased significantly and is now higher in Ethiopia than the average in low-income countries in general and Sub-Saharan Africa in particular. The total fertility rate fell from 7.0 in 1995 to 4.1 in 2014. The prevalence of stunted children was reduced from 58% in 2000 to 40% in 2014. The number of households with improved living standards measured by access to electricity, piped water and water in residence doubled from 2000 to 2011 (World Bank, 2016).

However, Ethiopia is still a very poor place, despite the structural change that has unfolded. Figure 1 presents the shares of manufacturing (*MFG*), services (*SERV*) and agriculture (*AGRI*) in GDP for the period 1961 to 2012. The share of agriculture has declined significantly. The share of the service sector has risen dramatically, while that of manufacturing has risen very slowly.

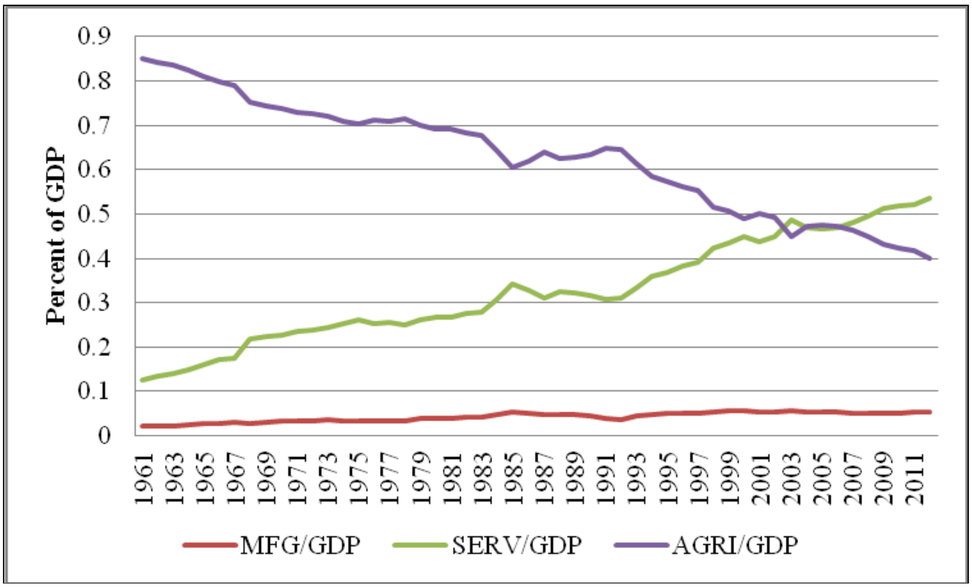

Figure 1: Sector shares in GDP (%)
Source of data: Timmer *et al*. (2015)

The shares of services (*SERVE*), agriculture (*AGRIE*) and manufacturing (*MFGE*) in total employment are presented in Figure 2. The speed of structural change in terms of employment has been much slower and more gradual than that of GDP. Employment in agriculture has declined over the period, with the share in manufacturing and services rising, especially from the mid-1990s to 2012.

The rise of the service sector's share of GDP and employment is a characteristic that Ethiopia shares with much of Sub-Saharan Africa. This may indicate that, because employment opportunities have failed to expand rapidly enough in either agriculture or manufacturing, the service sector has acted merely as a reservoir of labour that has nowhere to go and contributes very little to productivity. This is partly true in Ethiopia, with productivity in retail trade declining over time. However, transportation and government productivity have risen, and financial productivity, while declining somewhat recently, is very high (higher than any other service sector). Thus parts of the service sector have been able to attain high and growing labour productivity over the last decade. The fact that the service sector's share of GDP has risen faster than its share of employment implies that, on average, productivity in this sector has risen.

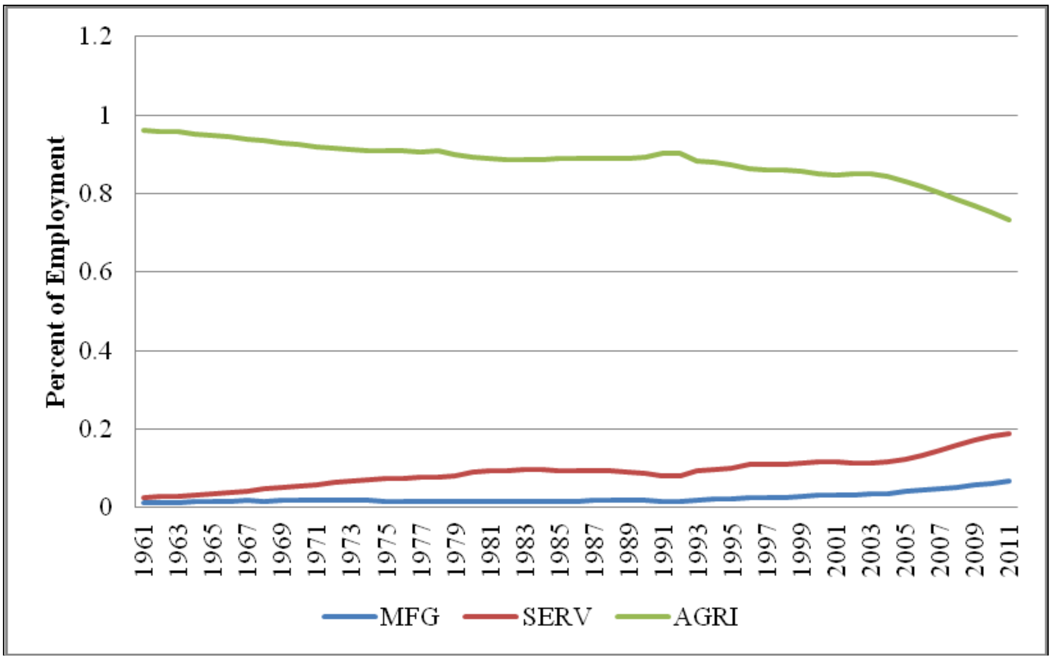

Figure 2: Sector shares of employment (%)
Source of data: Timmer *et al*. (2015)

More information can be gained by looking at the growth rates of value added and employment for each sector (rather than shares). The data for the manufacturing sector is presented in Figure 3. In the 1990s, the growth rate was unstable, but it became more consistent in the 2000s. More importantly, the growth rate per year in the 2000s was 10% or better. Thus, although manufacturing rose slowly as a share of GDP, this did not imply that manufacturing was stagnant.

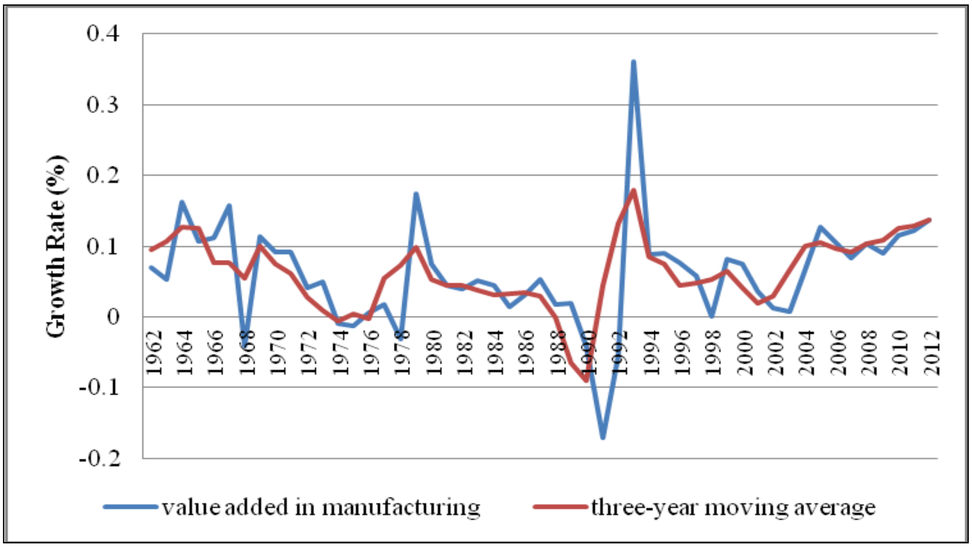

Figure 3: Growth rate in value added: Manufacturing
Source of data: Timmer *et al*. (2015)

Looking at the data on the growth of employment in manufacturing presented in Figure 4, the dynamism of the sector is clear. From the 1990s through the 2000s, the growth rate of employment in manufacturing was frequently above 10%. From the early 2000s it was significantly above 10%.

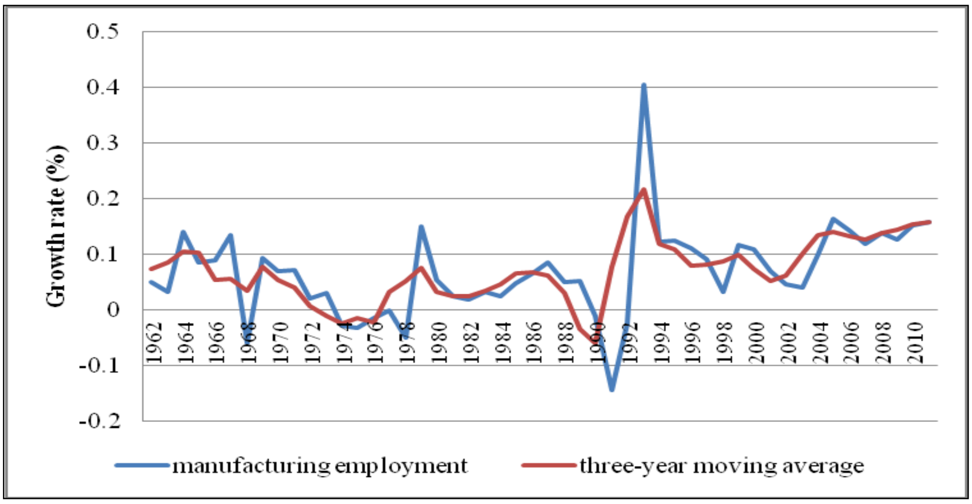

Figure 4: Growth in manufacturing employment
Source of data: Timmer *et al*. (2015)

The service sector has increased in importance. Figure 5 presents data on the real rate of growth of value added in this sector, showing that rapid service sector growth began in the early 1990s and accelerated into the 2000s.

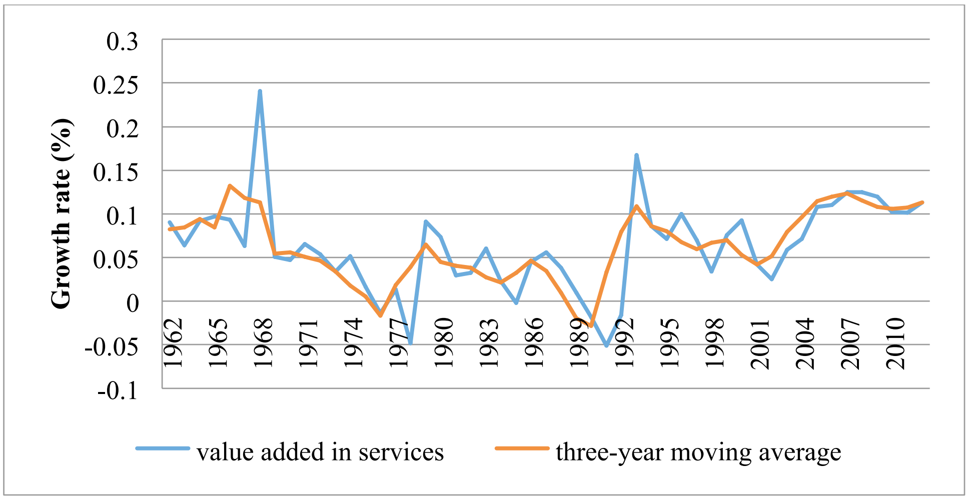

Figure 5: Growth rate of value added: Services
Source of data: Timmer *et al*. (2015)

Figure 6 presents data on the growth of employment in services. Service sector employment growth was rapid, but unstable, in the 1990s, but rose to high levels in the 2000s, simultaneously with the growth in employment in manufacturing.

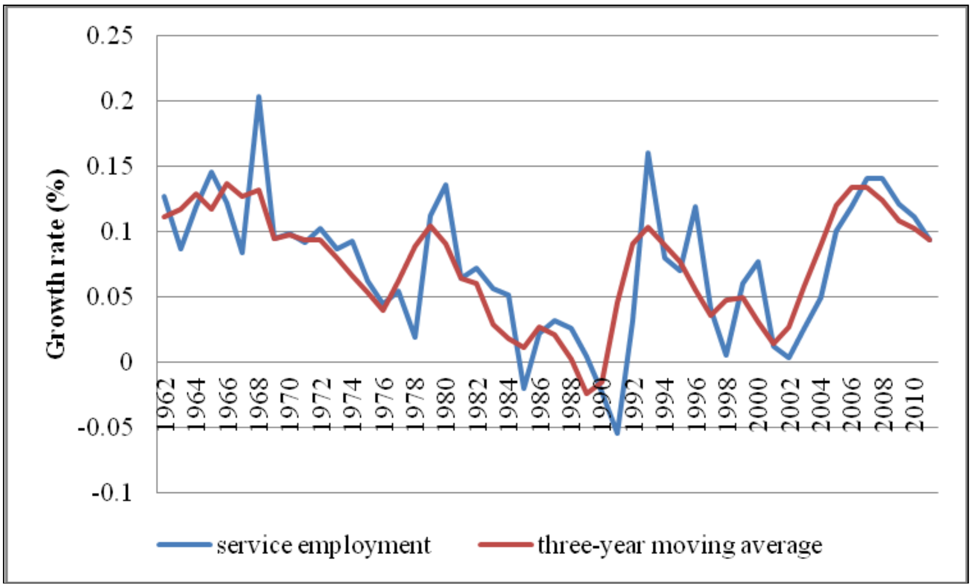

Figure 6: Growth in service employment
Source of data: Timmer *et al*. (2015)

For the agricultural sector, employment growth was steady, at a little over 2% per year, but much lower than that found in manufacturing and services. This accounts for the decline in the share of agriculture in total employment compared to that of manufacturing and services. Figure 7 presents data on growth in agricultural value added. During the imperial era, growth was approximately 2% per year. During the Derg period it declined precipitously, but it rebounded significantly at the beginning of the 1990s.

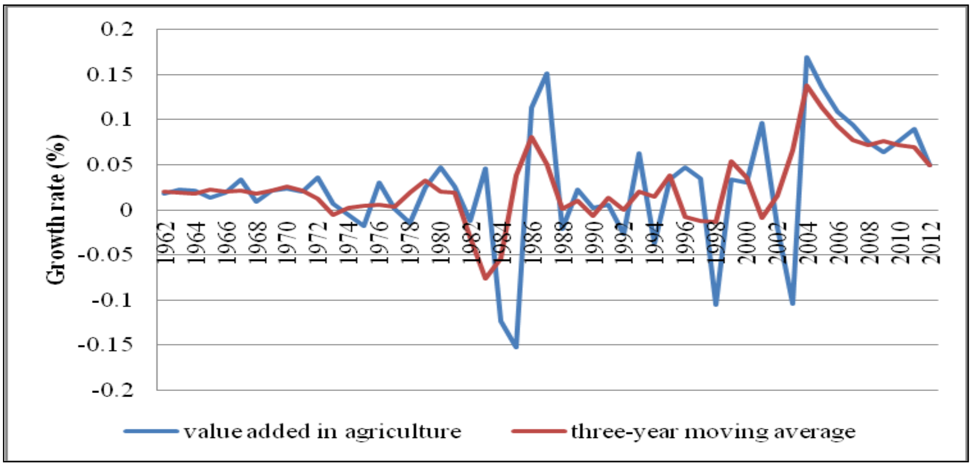

Figure 7: Growth rate of value added: Agriculture
Source of data: Timmer *et al*. (2015)

Thus the return to economic growth in Ethiopia occurred within the context of dramatic improvements in the growth of agriculture, services and manufacturing. Up until 2007, the rate of growth in agriculture exceeded that in services, while after this date the growth rate in services rose above that in agriculture. Thus one could conclude that growth initially was driven by agriculture, with services becoming important in the late 2000s. The growth in manufacturing began to pick up in the 2000s with the acceleration of the service sector. It thus appears that, both in terms of growth in output and in employment, a dynamic process of development involving all three sectors has occurred, initiated by agricultural growth. This tends to support the theoretical analysis carried out above. However, in order to determine more precisely whether the theoretical analysis presented earlier is valid, section 4 of this article presents a detailed time series analysis that seeks to shed light on several issues. Specifically, is growth in agriculture conducive to growth in manufacturing?

Is growth in agriculture conducive to growth in services, and is growth in the latter also conducive to growth in manufacturing? Does employment growth in agriculture stimulate employment growth in manufacturing and services? Finally, does employment growth in services stimulate employment growth in manufacturing, and vice versa?

4. Data and methodology

This section analyses the long-run and short-run relationship between the agricultural, manufacturing and service sectors. Given that all variables are time-series in nature, we used cointegration analysis, involving two different sets of variables, that allowed us to discern the long-run and short-run relationship among these variables. To begin with, annual measures of value added in agriculture (*Ag_valu*), manufacturing (*Manuf_valu*) and services (*Serv_valu*) were constructed. Value added is measured as gross value added at constant (2005) prices in millions of dollars The time period covered is from 1961 to 2012. The second set of measures includes annual employment in the agriculture (*Ag_empl*), manufacturing (*Manuf_empl*) and service sectors (*Serv_empl*), spanning the same time frame. The source of the data is Timmer *et al*. (2015).

In addition to the variables of interest explained above, several dummy variables were used in the empirical analysis to capture changes in political regimes, as well as changes in the agricultural sector. Using dummy variables to indicate the beginning of reforms and political changes is a crude mechanism for analysing their effects, as it presumes that the reforms and changes have full effects immediately. In reality, it takes time for such changes to have effect; given the limited amount of data, however, a more sophisticated empirical approach is not possible. The *Pol_dummy* is a bivariate dummy variable that captures the change in political regime in Ethiopia, starting in 1991, taking a value of 0 until 1990 and 1 thereafter. *Agri_dummy* attempts to capture the change that seems to have affected the agricultural sector starting in 2004, taking the value 0 until 2003 and 1 thereafter.

The concept of cointegration was introduced by Granger (1981) and was further extended and formalized by Engle and Granger (1987). According to Engle and Granger (1987), a linear combination of two of more non-stationary series of the same order of integration may be stationary. A necessary condition for cointegration is that each of the variables should be integrated of the same order (greater than 0), or that both series should contain a deterministic trend (Granger 1988). In order to verify whether these preliminary conditions are met, all the variables of interest are tested for the presence of unit roots by utilising the augmented Dickey-Fuller tests (Dickey & Fuller 1979). The results of these tests indicate that *Ag_valu*, *Manuf_valu* and *Serv_valu* are nonstationary in level and first differences, but are stationary in second differences. Thus, the first differences of all three variables are individually *I(1),* and these variables are used in the empirical analysis. Of the employment variables, *Ag_empl* is nonstationary in levels but stationary in first differences, while *Manuf_empl* and *Serv_empl* are nonstationary in levels and first differences, but stationary in second differences. Thus, *Ag_empl* in levels and *Manuf_empl* and *Serv_empl* in first differences are used, such that each variable is individually *I(1)*.

Once it was established that all the time-series variables being utilized are *I(1)*, we carried out cointegration tests using Johansen's method (1988, 1991), extended by Johansen and Juselius (1990). This method provides a multivariate framework and allows for more than one cointegrating vector in the estimated model. In this method, two tests are commonly used to determine the number of cointegrating vectors: the trace test and the maximum eigenvalues test. If there is divergence of results between these two tests, it is generally recommended that one should rely on the maximum eigenvalues test, since the results of this test are more reliable (Banerjee *et al*. 1986, 1993).

The cointegration tests were carried out under two different assumptions, one assuming no linear deterministic trend in the data and the second assuming such a trend. Table 1 presents the results for *Ag_valu*, *Manuf_valu* and *Serv_valu,* while Table 2 does so for *Ag_empl*, *Manuf_empl* and *Serv_empl*. The presence of a stationary linear combination/s between the three variables would imply that there is a long-run equilibrium relationship or a long-run steady-state equilibrium relationship among the variables. The results in Table 1 indicate that there are two cointegrating equations between *Ag_valu*, *Manuf_valu* and *Serv_valu* under either assumption regarding the deterministic trend in the data. However, according to the results in Table 2, we can see that there are two cointegrating equations between *Ag_empl*, *Manuf_empl* and *Serv_empl*, assuming no deterministic trend in the data, but only one cointegrating equation when we assume there is a linear deterministic trend in the data. The results comparing the trace test versus the maximum eigenvalues test are consistent regardless of assumptions being made about the trend in the data.

Table 1: Johansen cointegration estimation results between series *Ag_valu, Manuf_valu* and *Serv_valu*

Assuming no deterministic trend				
Rank test (trace)				
Number of cointegrations	Eigenvalues	Trace stat	5% critical value	P values **
None *	0.537524	66.0442	35.1927	0.0000
At most 1*	0.379775	28.2574	20.2618	0.0003
At most 2	0.094265	4.8514	9.1645	0.3001
Rank test (max eigenvalues)				
Number of cointegrations	Eigenvalues	Max-Eigen stat	5% critical value	P values **
None*	0.537524	37.7868	22.2996	0.0002
At most 1*	0.379775	23.4059	11.2248	0.0027
At most 2	0.094265	4.8514	9.1646	0.3001
Assuming a linear deterministic trend				
Rank test (trace)				
Number of cointegrations	Eigenvalues	Trace stat	5% critical value	P values **
None *	0.53707	62.7792	29.7971	0.0000
At most 1*	0.37251	25.0400	15.4947	0.0014
At most 2	0.0440	2.20495	3.84146	0.1376
Rank test (max eigenvalues)				
Number of cointegrations	Eigenvalues	Max-Eigen stat	5% critical value	P values **
None*	0.53707	37.7392	21.1316	0.0001
At most 1*	0.37251	22.8351	14.2646	0.0018
At most 2	0.0440	2.20498	3.84146	0.1376

* denotes rejection of the hypothesis at the 5% level; ** Mackinnon-Haug-Michelis (1999) p values

Table 2: Johansen cointegration estimation results between series *Ag_empl, Manuf_empl* and *Serv_empl*

Assuming no deterministic trend				
Rank test (trace)				
Number of cointegrations	Eigenvalues	Trace stat	5% critical value	P values **
None *	0.534501	50.31023	24.27596	0.0000
At most 1*	0.233651	13.60722	12.32090	0.0303
At most 2	0.017217	0.833602	4.129906	0.4168
Rank test (max eigenvalues)				
Number of cointegrations	Eigenvalues	Max-Eigen stat	5% critical value	P values **
None *	0.534501	36.70301	17.79730	0.0000
At most 1*	0.233651	12.77362	11.22480	0.0265
At most 2	0.017217	0.833602	4.129906	0.04168
Assuming a linear deterministic trend				
Rank test (trace)				
Number of cointegrations	Eigenvalues	Trace stat	5% critical value	P values **
None*	0.44326	39.4847	29.7971	0.0028
At most 1	0.20535	11.3733	15.4947	0.1896
At most 2	0.00706	0.3402	3.8415	0.5597
Rank test (max eigenvalues)				
Number of cointegrations	Eigenvalues	Max-Eigen stat	5% critical value	P values **
None *	0.44326	28.1114	17.79730	0.0044
At most 1	0.20535	11.0331	11.22480	0.1526
At most 2	0.00706	0.3402	3.8415	0.5597

* denotes rejection of the hypothesis at the 5% level; ** Mackinnon-Haug-Michelis (1999) p values

Since the variables included in the VAR model are cointegrated, a vector error-correction model (VECM) is used to estimate the short-run dynamics. The link between the cointegration method and the error-correction model is formalised in the Granger Representation Theorem (Engle & Granger 1987). The error-correction model was first introduced by Sargan (1964). The error-correction term expresses the speed of adjustment of each variable in response to a deviation from the steady-state equilibrium. The results from the VECM model relating to *Ag_valu*, *Manuf_valu* and *Serv_valu* are presented in Tables 3A and 3B. In Table 3A, the political dummy, *Pol_dummy*, is introduced as an additional exogenous variable. In Table 3B, the *Agri_dummy* variable is introduced to capture the upsurge of investment in the agricultural sector. Tables 4A and 4B relate to the employment variables in the agricultural, manufacturing and service sector, with Table 4A including *Pol_dummy* and Table 4 B including *Agri_dummy* as a second exogenous dummy variable in the system. For the productivity variables VECM, two lag lengths are utilised, while one lag length is used for the employment variables VECM. These lag lengths are determined by the AIC and Schwartz criteria.

The results presented in Tables 3A and 3B are quite consistent. Within the group of lagged endogenous variables, $\Delta\ Ag\_valu_{t-1}$, $\Delta\ Manuf\_valu_{t-1}$ and $\Delta\ Manuf\_valu_{t-2}$ are statistically significant for the first equation, while $\Delta\ Ag\_valu_{t-1}$ and $\Delta\ Ag\_valu_{t-2}$ are statistically significant in the second equation, establishing that there is a bi-directional causal relationship between expansion in the agricultural sector and expansion in the manufacturing sector. However, there is no statistically significant causal short-run relationship between the agricultural and the service sector. The Ag-dummy in Table 3B indicates that it had a statistically significant positive impact on both manufacturing and service output. That is, the surge in agricultural investment in the early 2000s generated expansion in manufacturing and service value added.

Table 3A: Estimation 1 of the VECM of *Ag_valu, Manuf_valu* and *Serv_valu*

	Δ *Ag_valu* equation		Δ *Manuf_valu* equation		Δ *Serv_valu* equation	
	Coefficient	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Δ Ag_valu_{t-1}	0.4437**	2.1081	0.0417**	2.3741	0.0063	0.0679
Δ Ag_valu_{t-2}	0.0679	0.4164	0.0254*	1.8634	-0.0116	-0.1626
Δ $Manuf\_valu_{t-1}$	4.9705*	1.9531	0.0628	0.2959	1.2126	1.0835
Δ $Manuf\_valu_{t-2}$	4.9401*	1.9569	-0.3038	-1.4421	-0.7396	-0.6662
Δ $Serv\_valu_{t-1}$	-0.6885	-1.3394	-0.0425	-0.9901	-0.445*	-1.9685
Δ $Serv\_valu_{t-2}$	-0.5747	-1.1364	0.0139	0.3283	-0.2584	-1.1622
Pol_dummy	-875.9264	-0.9351	51.8943	0.6645	373.3321	0.9072
Obs after adj	47		47		47	
R^2	0.608		0.4268		0.3675	

Note: The constant was included but is not presented here; * and ** imply statistical significance at 10% and 5% respectively

Table 3B: Estimation 2 of the VECM of *Ag_valu, Manuf_valu* and *Serv_valu*

	Δ *Ag_valu* equation		Δ *Manuf_valu* equation		Δ *Serv_valu* equation	
	Coefficient	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Δ Ag_valu_{t-1}	0.4859**	2.3759	0.0382**	2.1435	0.0033	0.0362
Δ Ag_valu_{t-2}	0.0985	0.6212	0.0232*	1.7567	-0.0137	-0.1936
Δ $Manuf\_valu_{t-1}$	4.4291*	1.8563	-0.0096	-0.0462	1.7793	1.1007
Δ $Manuf\_valu_{t-2}$	4.4892*	1.8456	-0.3372	-1.5904	-0.7465	-0.6843
Δ $Serv\_valu_{t-1}$	-0.6472	-1.3175	-0.0325	-0.7604	-0.4378*	-1.9875
Δ $Serv\_valu_{t-2}$	-0.5302	-1.0815	0.0154	0.3602	-0.2589	-1.1778
Pol_dummy	-787.9871	-1.2407	-8.8174	-0.1592	258.2230	0.9065
Agri_dummy	3094.98**	3.0644	193.4734**	2.1973	1216.04**	2.6845
Obs after adj	47		47		47	
R^2	0.529		0.249		0.214	

Note: The constant was included but is not presented here; * and ** imply statistical significance at 10% and 5% respectively

The empirical results can be interpreted as follows. First, agriculture has a direct influence on manufacturing in that expansion in agricultural production stimulates expansion in manufacturing value added and vice versa. In addition, the upsurge of investment in agriculture as represented by the agricultural dummy variable drove expansion in both services and manufacturing value added. However, there is no evidence of an indirect influence of agricultural value added on manufactured value added via services.

Tables 4A and 4B present the results involving employment. Table 4A indicates that employment in the agricultural sector has a statistically significant positive impact on employment in the manufacturing sector, but the causality does not run the other way. Growth in service sector employment has a statistically significant effect on employment in manufacturing, but the reverse does not hold. Finally, expansion in service sector employment seems to have a negative and statistically significant effect on employment in agriculture. Thus, employment expansion in services seems to draw labour out of agriculture.

In Table 4B, expansion in agricultural employment has a statistically significant positive impact on employment in manufacturing, but the reverse does not hold. Agricultural employment also has a significant impact on employment in services, but the expansion of the latter has a negative impact on employment in agriculture. Thus, expansion in service sector employment seems to draw labour out of agriculture. Finally, the dummy variable for rapid agricultural expansion has a positive and significant impact on employment in manufacturing and services, but not employment in agriculture.

Table 4A: Estimation 1 of the VECM of *Ag_empl, Manuf_empl* and *Serv_empl*

	Δ *Ag_empl* equation		Δ *Manuf_empl* equation		Δ *Serv_empl* equation	
	Coefficient	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Δ Ag_empl_{t-1}	-0.3469**	-2.0023	0.08862**	2.1158	0.1422	1.3036
Δ $Manuf\_empl_{t-1}$	-0.5142	-0.6543	-0.0974	-0.5127	0.0167	1.3036
Δ $Serv\_empl_{t-1}$	-0.8976**	-2.7425	0.1235*	1.6078	0.1901	0.9224
Pol_dummy	-255.6934**	-3.0555	8.2602	0.4083	81.712	1.5507
Obs after adj	48		48		48	
R^2	0.5653		0.2347		0.0901	

Note: The constant was included but is not presented here; * and ** imply statistical significance at 10% and 5% respectively

Table 4 B: Estimation 2 of the VECM of *Ag_empl, Manuf_empl* and *Serv_empl*

	Δ *Ag_empl* equation		Δ *Manuf_empl* equation		Δ *Serv_empl* equation	
	Coefficient	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Δ Ag_empl_{t-1}	-0.2846*	-1.7256	0.0996**	2.6927	0.1798*	1.9557
Δ $Manuf\_empl_{t-1}$	-0.7819	-0.9698	-0.1085	-0.5997	0.0441	0.0981
Δ $Serv\_empl_{t-1}$	-0.7583**	-2.3239	0.0998	1.3639	0.1177	0.6472
Pol_dummy	-244.647**	-2.9711	25.3834	1.3738	136.42**	2.9726
Agri_dummy	-138.12	-1.4878	56.944**	2.7337	177.733**	3.435
Obs after adj	48		48		48	
R^2	0.573		0.353		0.30	

Note: The constant was included but is not presented here; * and ** imply statistical significance at 10% and 5% respectively

The empirical analysis of the employment estimations tends to support many of the aspects of the agricultural-led development model presented earlier. The expansion of agricultural output and employment has a positive effect on manufacturing output and employment. The expansion of agricultural employment also has a positive effect on employment in services and manufacturing.

5. Summary and conclusion

We have argued that a different sort of development model seems to apply to parts of Sub-Saharan Africa. In comparison with much of Asia, many areas in Sub-Saharan Africa are land abundant and therefore possess a comparative advantage or potential comparative advantage in land-intensive commodities, especially agricultural production. This implies that it will be extremely difficult to begin producing and exporting labour-intensive manufactured goods. However, in this context, an agriculturally driven model of development is likely to be relevant.

In an agriculturally based model of development, the state would devote significant resources to investments in agricultural infrastructure, extension systems for the diffusion of agricultural technology, the development of technological packages for farmers (including access to fertiliser), and the adaptation of new technologies. Such growth will enhance the profitability of manufacturing and lead to increased investment and productivity growth in this sector, as well as employment expansion. In addition, the profitability of service production will also increase, leading to increased investment and enhanced productivity and employment in this sector.

Ethiopia provides an example of such a development strategy. Government policy has been orientated towards raising agricultural productivity. Using data on value added and employment by sector, a time-series analysis of the Ethiopian experience indicates that there is ample evidence to support the direct route explanation of the impact of agricultural growth. That is, agricultural growth does indeed stimulate the expansion of production and employment in manufacturing and services. However, the results do not support an indirect path by which agricultural expansion could stimulate the expansion of manufacturing through the service sector.

Thus, for countries that are land-abundant and have comparative advantages (or potential comparative advantages) in agricultural goods, there does seem to be a development path resulting in the expansion of production and employment in manufacturing and service – it lies with an agriculturally based development strategy.

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