Manufacturing in Africa: an example from Zambia

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Abstract: Structural change in the development process usually involves the decline of agriculture and the rise of manufacturing. Structural change in Sub-Saharan Africa (and some other developing countries) has altered with agriculture declining as a share of GDP and total employment, but manufacturing as a share actually declining or remaining stagnant. It is argued in this paper that this is at least partly the result of liberalising reforms beginning in the late 1980s and partly the result of a significant dependence on a natural resource, in this case copper. However, it is further hypothesised in this paper that growth in agricultural productivity is critical to the development of manufacturing. Specifically, growth in this sector's productivity restrains the cost of agricultural goods and thus allows the manufacturing sector to expand. If agricultural productivity lags relative to manufacturing productivity rising relative agricultural costs make it extremely difficult for manufacturing to expand. These ideas are illustrated by examining the experience of Zambia.

Keywords: structural change; agriculture; manufacturing; price distortions; policy.

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1 Introduction

It was not long ago that the Economist (2000) Magazine viewed Sub-Saharan Africa as a hopeless place economically, where the standard of living for a large number of people not only did not increase over the last several decades of the 20th century, but may have actually declined. However, at about the time the above article was published economic growth in the continent was already turning around. One can see this by looking at data on the growth of real GDP per capita for the region. During the period 1980 to 1989, this was –0.7%, from 1990 to 1999, it was –0.2%, and for 2000–2010 it rose to 2.8%. Since 2010 this has slowed to 0.8% (2011–2017) (World Bank, 2018). This dramatic turnaround has led to the conclusion that finally Sub-Saharan Africa is on the rise in terms of economic development.

However, the process of economic development and growth which has recently evolved in the region is quite different from the process as it unfolded in both East and Southeast Asia, regions that have rapidly developed prior to Sub-Saharan Africa. The development process has usually been accompanied by dramatic structural change. Initially, very poor economies are dominated by the agricultural sector both in terms of GDP and employment. However, rapid economic development is associated with a decline in the importance of agriculture, with its share in GDP and employment falling (with the former falling faster than the latter at least initially). Labour intensive manufacturing grows rapidly along with modern sector services (finance, telecommunications, etc.). Thus, the share of labour intensive manufacturing in GDP, employment and exports rises rapidly. This type of structural change seems to have characterised the process of economic growth and development in East and Southeast Asia (Henley, 2015).

However, economic growth and development in Sub-Saharan Africa seems to be unfolding in a different manner. Manufacturing, especially labour intensive manufacturing, does not seem to be fulfilling its historical role. Rapid economic growth there seems to have been accompanied by rapid growth in the service sector (deVries et al., 2013). One can divide this sector into two types, modern and traditional. The former is human and physical capital intensive while the latter is labour intensive. While both have grown rapidly, it is the latter which has absorbed significant amounts of labour. Manufacturing seems to have stagnated or actually declined in relative importance.

Dualistic models of economic development first developed in the work of Lewis (1954) and Ranis and Fei (1961) view a developing country as being made up of sectors (agriculture and manufacturing, for example) in which labour productivity differs dramatically. Often manufacturing is presumed to be a high labour productivity sector while agriculture is a low labour productivity sector. These differences tend to persist and may actually increase through time (Timmer, 2014). One can thus view the development process as composed of two parts. Labour productivity can rise as the result of innovation and/or capital accumulation within a sector and/or it can rise by shifting resources out of a low labour productivity sector (agriculture) and into a high labour productivity sector (manufacturing, usually labour intensive in nature). This structural change is quite important in the early stages of development and represents a comparative static gain in overall labour productivity. If Sub-Saharan Africa does not experience this structural change because manufacturing has failed to expand, the economies in this region will then lose out on this comparative static productivity gain.

However, Rodrik (2013) pointed out that there is also a dynamic gain resulting from the shift of resources out of agriculture and into labour intensive manufacturing. That is, once a country has allocated a significant share of resources to the high productivity, labour intensive manufacturing sector, then this sector's productivity seems to exhibit absolute convergence to levels of productivity similar to those found in already developed countries. This convergence seems to be the result of rapid adoption of newer technologies. This sector, manufacturing, would seem to be like a technological escalator in which once one begins labour intensive manufacturing activities then one moves up in terms of technology with the result being a rapid rise in labour productivity. If Sub-Saharan Africa does not experience the structural shift from agriculture to manufacturing, then it will miss out on this dynamic gain.

Others have argued that the current growth process in Sub-Saharan is not sustainable in terms of providing jobs and reducing inequality (Obeng-Odoom, 2015). As manufacturing has faltered, the service sector, as discussed above, has grown both as a share of GDP and employment. The growth of the modern service sector has resulted in little growth in employment since it is intensive in the use of physical and human capital while in this region it is unskilled labour that is relatively abundant. The latter has found employment in traditional sector services and traditional sorts of manufacturing which are labour intensive in nature, generally informal in nature and have low labour productivity (although it appears that productivity may be somewhat higher than in agriculture) (McCullough, 2017). Thus, there are concerns that inequality will worsen dramatically and productive, formal sector employment may fail to develop.

So what has happened to manufacturing in Sub-Saharan Africa? Some have argued that technological innovation and globalisation have significantly increased the difficulty of rapidly expanding manufacturing, even labour intensive manufacturing, in many developing countries. Baldwin (2011) argued that the process of globalisation has significantly altered the process of structural change. This has allowed for a dramatic unbundling of the manufacturing process. Throughout much of post-war economic development the creation of a competitive manufacturing sector required the construction of a domestic supply chain which ultimately culminated in the production of finished manufactured goods. As a result, the share of manufacturing in GDP and employment rose dramatically. However, technical innovation combined with globalisation has allowed the manufacturing process to be unbundled. The supply chain has been split into different parts with each segment locating in parts of the world where costs are lowest. Thus, any particular developing country becomes host to only a small part of the supply chain. Thus, the share of manufacturing in employment and GDP would not dramatically rise (Baldwin, 2011).

Technological innovation has contributed to the difficulties of expanding employment in manufacturing in a different way. Even labour intensive manufacturing techniques have experienced rapid growth in labour productivity. Thus, any specific growth rate in manufacturing generates less employment. One could describe this as capital using technical innovation and this implies that employment in manufacturing, especially labour intensive manufacturing, as a share of total manufacturing is likely to be reduced (Rodrik, 2015).

These factors, globalisation and capital using technical innovation, are likely important factors explaining the increased difficulty developing nations in general and Sub-Saharan Africa in particular have had in promoting the rapid expansion of manufacturing. However, this paper will make a different argument. Most developing

nations followed import substitution strategies of economic development in the 1960s, 1970s and 1980s. These policies involved the protection of manufacturing which required the implicit taxation of agriculture. This policy structure promoted the shift of resources from agriculture to industry and manufacturing. However, beginning in the late 1980s and early 1990s a policy shift began to occur promoted by international development agencies such as the World Bank and the International Monetary Fund. These liberalisation policies involved a sharp reduction in the extent to which manufacturing was protected and agriculture was taxed. For agriculture relative prices of output tended to rise and the cost of inputs fell. This increased the difficulty of establishing manufacturing and expanding its share of output and employment. As Shafaeddin (2005, 2009) has argued, it seems that firms that were near maturity were able to survive and in some circumstances export their products in the new environment. However, firms at earlier stages of development could not compete and did not succeed. Overall, liberalisation tended to support static comparative advantages in primary product production. Empirical support for these types of ideas has been fairly limited. Thus, this will be the first hypothesis to be examined; did changes in policy (liberalisation) make it difficult for manufacturing to expand?

The second argument to be made in this paper is that this effect of liberalisation could have been mitigated had agricultural productivity grown rapidly in developing countries in general and Sub-Saharan Africa in particular. Rapid productivity growth in agriculture would have driven down per unit costs and through competitive price reductions mitigating the effects of liberalisation. In addition, rapid technical innovation in agriculture, as long, as it was broadly based, would have had an expenditure effect which would expand the demand for manufacturing, especially labour intensive manufacturing. It was the combination of liberalisation without rapid productivity growth in agriculture which retarded the development of manufacturing. Thus the second hypothesis is that low productivity growth in agriculture (relative to manufacturing) made it difficult for expansion of manufacturing.

The third argument made in this paper is focused on the fact that many developing nations in Africa are relatively abundant in a particular natural resource. In this context a boom in the natural resource sector will draw resources away from manufacturing. This is of course similar to the resource curse or Dutch disease argument (Corden, 1984) that is sometimes made with respect to a number of countries in the developing world. Thus, these booms make it difficult for the manufacturing sector to expand. This topic has been the subject of a vast literature in both economics and political science (a good critical survey of this literature is provided by the work Badeep et al., 2017). That it seems to be particularly relevant for the countries of Sub-Saharan Africa is supported by the work of Mulwa (2017). However, similar to the discussion of the liberalisation process discussed above, the Dutch disease effects of a resource boom can be offset by rapid agricultural productivity growth. This will reduce the relative price of agricultural goods and if these goods are critical inputs for manufacturing (say food), then manufacturing becomes more profitable, thus offsetting the effects of a resource boom.

The analysis leads to several hypotheses. First, rapid growth in agriculture relative to manufacturing lowers the price of agricultural relative to manufactured goods and this in turn spurs the expansion of manufacturing. Second, a natural resource boom will tend to inhibit the growth of manufacturing (unless offset by rapid agricultural growth). Third, the elimination of import substitution policies (liberalisation) will tend to have a negative effect on manufacturing (unless offset by rapid agricultural growth). These hypotheses will be tested using the experience of Zambia.

This paper unfolds in the following manner. Section 2 will review in more detail the experience of developing countries in general and Sub-Saharan Africa in particular with respect to the development of manufacturing. Section 3 will develop a simple four sector model to analyse the impact of policy on the development of manufacturing. In addition, it will be argued that agricultural productivity growth has a significant influence on the extent to which the manufacturing sector can expand. Section 4 will examine the case of Zambia in some detail and present the results of empirical analysis of the hypotheses put forward in the paper. Finally, Section 5 will summarise the paper and its main conclusions.

2 Structural change and manufacturing

As discussed in the introduction, historically the process of structural change has involved a shift from agricultural production to manufacturing with the latter rising as both a share of GDP and total employment. This resulted in a rise in overall labour productivity as resources are shifted out of agriculture, where labour productivity is low and into manufacturing where labour productivity is high. However, in the last several decades evidence has arisen suggesting that this process has altered significantly. McMillan and Rodrik (2011) found that the process of structural change in Africa and Latin America has been very different from that found in East and Southeast Asia. In the latter region, labour moved from low productivity sectors to high productivity sectors. In the former regions, the opposite occurred with labour shifting into low productivity sector (agriculture and traditional services).

The outlines of the structural change process have also altered. Empirical work developed by Rodrik (2015) and Felipe et al. (2018) showed that the typical relationship between GDP per capita and the share of manufacturing in GDP and total employment has changed considerably. Historically, this was an inverted U relationship indicating that as GDP per capita rose the share of manufacturing in GDP and employment rose to a peak and then fell. The empirical evidence indicates that this relationship has weakened peaking at a lower GDP per capita than before and at a lower maximum share of GDP and employment. In other words, manufacturing in developing countries seems to be playing a much less important role than it has in the past.

This pattern seems to be even stronger in the case of Sub-Saharan Africa. Recently, de Vries et al. (2015) developed a data set for examining this issue for eleven Sub-Saharan African nations for the period 1960 to 2010. Summary data is presented on value added, employment, and relative labour productivity by sector of the economy. With respect to relative productivity levels, this represents the ratio of a particular sector's productivity level to the total economy's productivity level (labour productivity). Examining the data one can see that agriculture certainly followed the typical pattern with its share of GDP and of total employment declining over time. Labour productivity in this sector has lagged behind that of the rest of the economy.

Table 1 Summary data

Sector	*Sectoral shares*								*Relative productivity levels*			
	Value added				*Employment*							
	1960	1975	1990	2010	1960	1975	1990	2010	1960	1975	1990	2010
Agriculture	37.6	29.2	24.9	22.4	72.7	66.0	61.6	49.8	0.5	0.4	0.4	0.4
Industry	24.3	30.0	32.6	27.8	9.3	13.1	14.3	13.4	4.4	3.7	3.5	2.6
Mining	8.1	6.2	11.2	8.9	1.7	1.5	1.5	0.9	15.7	22.4	23.3	19.5
Manufacturing	9.2	14.7	14.0	10.1	4.7	7.8	8.9	8.3	2.5	2.8	2.4	1.6
Other industry	7.1	9.2	7.3	8.9	3.0	3.8	3.9	4.2	8.5	5.8	5.3	2.9
Services	38.1	40.7	42.6	49.8	18.0	20.9	24.1	36.8	2.7	2.5	2.4	1.6
Total economy	100	100	100	100	100	100	100	100	1.0	1.0	1.0	1.0

Source: de Vries et al. (2015)

Looking at the industrial sector as a whole, the share of value added rises from 1960 to 1990. However, after that it declines. The same pattern holds with respect to the share of industrial employment in total employment. With respect to manufacturing, again the same sort of pattern prevails.

The sector that has expanded the most has been the service sector, both in terms of value added and employment shares. Looking at relative labour productivity, one can see that this sector is more productive than the average for whole economy, but not to the same extent as industry. Finally, while the service sector has grown, much of this has involved the expansion of traditional sector services. Modern sector services have high labour productivity, but require very high levels of human capital, input which is scarce in Sub-Saharan Africa.

The data for the analysis in the previous few paragraphs and Table 1 ends with the year 2010. Thus for later years one must rely on a different source. Specifically, World Bank (2018) has data on manufacturing as a share of GDP for Sub-Saharan Africa, but no data on employment in manufacturing as a share of total employment. This data tells a very similar story to that presented in Table 1. The share of manufacturing in GDP has fallen from 12.6% to 10.3% from 2010 to 2018. Thus it would seem that manufacturing development in Sub-Saharan Africa continues to stagnate in terms of the share of total production.

So what has happened to manufacturing in Sub-Saharan Africa? As pointed out in the introduction several explanations involve the globalisation process and technical change. However, in this paper it will be argued sluggish agricultural growth combined with policy liberalisation and the effects of natural resource booms plays an important role in explaining what happened to manufacturing in Sub-Saharan Africa.

3 A simple model

A simple dualistic model of development was constructed in the work of Lewis (1954) and Ranis and Fei (1961). These models utilised the notion of surplus labour in their analysis. The traditional sector has usually been identified as agriculture and traditional service activities. It is assumed that labour and land are the key inputs, no capital is utilised. Labour is available for production elsewhere at a constant wage. The modern

sector is assumed to represent manufacturing and this sector utilises capital and labour. Focusing on structural change the simplest form of the model ignores technical change.

Since saving and capital accumulation occur only in manufacturing, this sector is the driver of growth by drawing labour out of agriculture, where labour productivity is low, and moving it to manufacturing where labour productivity is higher and since the labour can be drawn out of agriculture without a reduction in output there, the terms of trade, the price of agricultural goods divided by the price of manufactured goods, remains constant. Thus, a period of growth ensues with structural change representing the driving force (manufacturing increasing the share in value added relative to agriculture; manufacturing increasing its share in total employment relative to agriculture).

Difficulties may arise in this process once surplus labour is exhausted, since agricultural production may then fall and if this sector's output is a crucial input (raw materials, labour) or output (such as food) for manufacturing, then manufacturing expansion will be slowed, perhaps halted, as the terms of trade turn in agriculture's favour.

Modern versions of dualistic development have similar implications. Work by de Souza (2017) involved the creation of a multi-sector growth model characterised by under-employed labour in the agriculture sector and endogeneity of the inter-sectoral terms of trade. The latter implies that domestic factors can influence the relative price of agricultural goods. In this context growth in agricultural productivity, especially labour-using, land-saving technical change, promotes structural change with manufacturing employment rising as a share of total employment.

There are a number of criticisms that can be made of these models (Wong and Piesse, 2013). Of course surplus labour has been a much debated topic since the original publication of Lewis' paper (1954). However, the concept of surplus labour is not crucial for the focus of this paper. If surplus labour does not exist, the constraint that agriculture poses for the expansion of manufacturing bites immediately. The terms of trade turn against manufacturing immediately as that sector begins expansion.

However, the implicit assumption in the above analysis is that the economy is closed, at least with respect to agriculture. If instead agriculture is open to trade and the small country case prevails, then agricultural prices are exogenously determined and thus the manufacturing sector does not face the prospects of terms of trade moving against it.

There are reasons to think that this assumption (exogenous agricultural prices) does not hold for many developing countries. First, landlocked countries are likely to find that international trade is a very costly activity, especially for bulky commodities. Thus, it is more likely that the openness to trade of the agricultural sector in such countries is likely to be limited. Second, governments rarely allow free trade in important agricultural commodities. Policy is used to try and insulate the domestic market for important agricultural commodities from the international market. This is accomplished via tariffs, quotas, exports bans or limitations, subsidies, taxes, etc. This isolation from international markets implies that the prices for agricultural goods are endogenously determined via policy (Gollin et al., 2007).

Another example of this is provided by the import substitution strategy of development. This strategy, prevalent from the 1960s to late 1980s in many developing nations sought to protect and subsidise the expansion of the manufacturing sector via the use of tariffs and quotas to provide protection for this sector. This tended to raise the price of manufactured relative to agricultural goods thus drawing resources into the manufacturing sector. This in effect was indirect taxation of agriculture. Thus, the

relative price of agricultural goods (and manufactured goods) was made endogenous via policy. In the 1990s to the present, policy was altered via a process of liberalisation that has involved, among other things, the dismantling of the protection of manufacturing allowing for a fall in the relative price of manufactured goods or a rise in the relative price of agricultural goods. This represented a reduction in the indirect taxation of agriculture. Thus, policy served as a mechanism by which government policy could alter relative prices and thus the allocation of resources in order to try and achieve particular development goals.

Up to this point the analysis has been developed within the context of two sectors. However, one can easily incorporate two additional sectors: a natural resource sector and a service sector. It will be assumed that the service sector is intensive in the use of labour and produces a non-tradable output. Thus the price of services is endogenously determined. Now one must of course recognise that this sector represents traditional services which produce mainly for the home market. The modern service sector tends to utilise significant amounts of human and physical capital. Thus, rapid expansion of this sector is not likely to generate a rapid expansion of employment. Thus, for the purposes of the analysis of this paper this modern service sector will be ignored. The natural resource sector utilises little labour in the production process and is, of course, open to trade. Now it is possible to look at several scenarios that can provide insight into the difficulties faced by developing countries, including Sub-Saharan Africa, with respect to expanding the manufacturing sector.

One scenario that can be utilised to illustrate the difficulties in rapidly expanding the manufacturing sector involves the economic reforms involved in the liberalisation process followed by many developing countries in the late 1980s and early 1990s. This involved a number of policies that sought to reduce the extent of protection provided to the manufacturing sector. An alternative way of stating this is that these reforms tended to reduce the taxation of the agricultural sector. In the analysis developed above this would cause labour to flow out of manufacturing thus reducing production in that sector. If the country under discussion was initially exporting these goods, these exports would decline and if the nation involved was importing manufactured goods, these imports would increase as domestic production declined. Thus, liberalisation would have reduced the comparative advantage this country possessed in manufacturing or increased the comparative disadvantage. Liberalisation would have increased the difficulties manufacturing faced. In addition the growth in income in agriculture would increase the demand for services and this sector would expand.

A second scenario involves a boom in resource production via an external demand shock. In this case a rapid expansion of production in this sector would not significantly draw labour from the rest of the economy. However, Gollin et al. (2016) argued that resource booms tend to rapidly increase incomes in this sector. The increased income is often spent on manufactured goods and services, the latter being non-tradable. The service sector would have to draw labour from the rest of the economy, in particular manufacturing, in order to expand production and this would reduce the comparative advantage or increase the comparative disadvantage of manufacturing. This makes expanding manufacturing very difficult.

The impacts of liberalisation and/or a natural resource boom could be mitigated via rapid growth in agricultural productivity. Rapid agricultural growth influences manufacturing in two ways. Agriculture provides raw materials and food to manufacturing. Rapid productivity growth would lower the relative prices of these things

(agricultural prices are endogenous). This reduces the cost of domestically produced manufactured goods thus reducing the comparative disadvantage facing manufacturing (or allowing for the emergence of a comparative advantage). In addition, the higher incomes in agriculture will (if broadly distributed) expand the demand for simple, labour intensive manufactured goods. This creates potential for the growth of domestic manufacturing. Thus liberalisation and /or a natural resource boom would have increased the difficulty of manufacturing, but rapid productivity growth in agriculture would have made the expansion of manufacturing easier.

Perhaps the above conclusions are not very surprising, but it is interesting that the literature concerning premature deindustrialisation has not recognised that the liberalisation process and natural resource booms within the context of slow productivity growth in agriculture has been a cause for the relative decline or stagnation in manufacturing in regions such as Sub-Saharan Africa. In addition, the literature has failed to comprehend that the effects of liberalisation and/or resource booms on manufacturing could have been mitigated via rapid productivity growth in agriculture. If the output of agriculture is important to manufacturing (either in terms of providing raw material inputs or food), then rapid productivity growth in the agriculture will increase the relative advantage of producing manufactured goods (reducing costs). In addition, the increased income earned in agriculture if broadly distributed will increase the demand for domestically produced labour intensive manufactured goods. It will be this scenario that will be applied to the experience of Zambia in the next section of the paper.

In order to do this it will be necessary to measure the extent to which agriculture is taxed (manufacturing subsidised) or subsidised (in effect taxing manufacturing). What the previous analysis argues is that the policy shift involving the reduction of the taxation of agriculture (liberalisation) reduces the extent of manufacturing. Measures of the type of policy adopted with respect to agriculture and manufacturing are provided by the nominal rate of assistance to agriculture (NRA_{ag}), the nominal rate of assistance to non-agriculture (NRA_{nonag}), and the relative rate of assistance to agriculture (RRA) (Anderson, 2009).

The NRA_{ag} is defined as the percentage by which government policy has raised the gross returns to farmers above what they would have been without government intervention. This involves policies aimed at altering the price of inputs and outputs. If such policies lower the price of inputs and raise the price of outputs then the $NRAag > 0$ and one can characterise this as the protection (or subsidising) of agriculture. Alternatively if policy raises the prices of inputs above international levels or lowers the price of outputs below international levels, the $NRA_{ag} < 0$ and one can describe this as taxation of agriculture (Anderson, 2010).

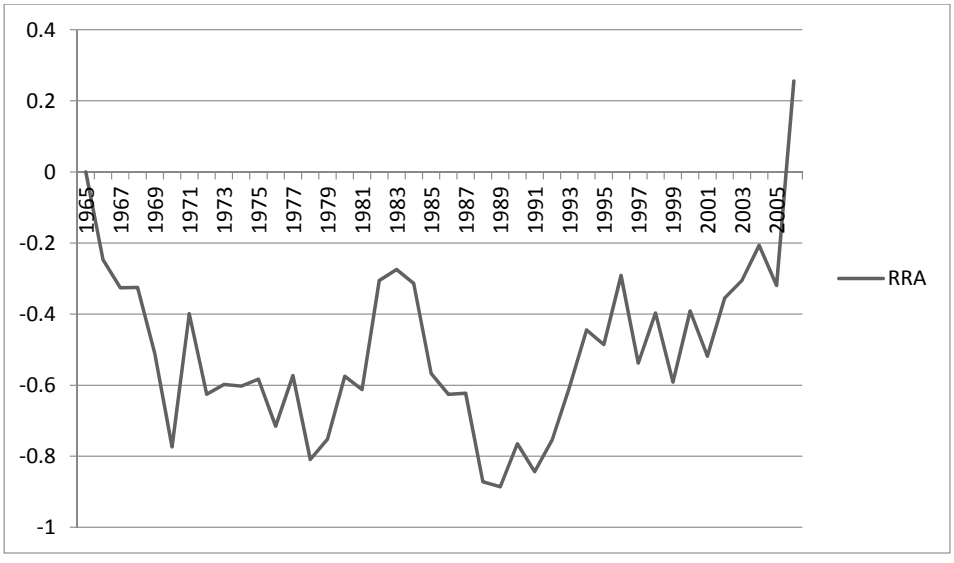
Agriculture is also impacted by the policies that are applied to the non-agricultural sector. This implies that the broadest measure of government policy towards agriculture has to also include the NRA_{nonag}. This is captured by the *RRA* (relative rate of assistance to agriculture) which can be written as

$$RRA^t = 100\left[\left(1 + NRA^t_{ag}/100\right)/\left(1 + NRA_{nonag}/100\right) - 1\right] \quad (1)$$

If the NRA_{ag} exceeds the NRA_{nonag}, then the $RRA > 0$ implying that agriculture is being protected relative to international prices and relative to the non-agricultural sector. In this case policy will induce a flow of resources out of manufacturing and into agriculture. If the $RRA < 0$ this implies that agriculture is being taxed relative to non-agriculture and

therefore resources will flow into manufacturing. These measures can then be used to determine whether policy tends to favour agriculture (at the expense of manufacturing or vice versa). Figure 1 shows the RRA for Zambia. As one can see from the mid-1960s to the early 1990s the RRA is negative implying that the indirect taxation of agriculture was increasing. Beginning in the early 1990s a liberalisation process was undertaken in which the extent of indirect taxation was reduced and by 2005 the RRA had actually become positive. Thus, a policy shift occurred which reduced the taxation of agriculture (subsidising non-agriculture).

Figure 1 Relative rate of assistance to agriculture



Source: Anderson and Nelgen (2013)

In summary, three specific hypotheses will be tested. Did the liberalisation process represented by an increase in the RRA lead to increases in the relative price of agricultural goods and inhibit the expansion of manufacturing? Have resource booms in copper for Zambia) been associated with difficulties in the expansion of manufacturing? Has growth in agricultural productivity relative to manufacturing productivity (measured as labour productivity) led to lower relative agricultural prices and an expansion in manufacturing and vice versa?

The last hypothesis is of particular importance. Empirical analysis of the impact of productivity growth in agriculture on the process of structural change has been extensive. However, the results of this empirical work are not consistent. Using a novel instrumental approach McArthur (2017) found that agricultural growth promotes overall growth and structural change, the shift of labour out of agriculture. Alternatively, Moscana (2018) focused on the impact of the "Green Revolution", which occurred in the 1980s and 1990s, on growth and structural change. This involved the development of high yielding seed varieties combined with fertiliser and expanded irrigation. Rapid productivity growth in agriculture resulted. Utilising a different sort of instrumental variable for agricultural productivity growth Moscana's work indicates that technical innovation and

productivity growth in agriculture actually slowed the structural change process. Neither of these papers focuses on the mechanism by which agricultural productivity growth influences the process of structural change. This paper specifies the mechanism, the terms of trade effect of agricultural productivity growth, by which agricultural productivity influences structural change. Thus, it is hoped that the analysis will shed light on the impact of agricultural productivity growth on structural change.

4 The case of Zambia

Zambia is chosen for study for several reasons. First, it is a landlocked country in southern Africa. Thus, it is likely that agricultural prices are endogenous in nature. That is, domestic agricultural prices are likely to be significantly influenced by domestic factors. Second, it has gone through a policy cycle similar to that discussed above, beginning with a period of import substitution followed by a period of liberalisation. Third, it has, throughout much of its recent economic history, been significantly dependent on copper production and exports. Thus, natural resources have played an important role in the economy. Finally, agriculture has played and continues to play a significant role in the economy, especially in terms of employment (Chitonge, 2016).

Although dependent on copper, this dependency has changed over time. Mining and quarrying made up over half of all output in 1965, but this declined to 7.1% in the early 2000s. The employment share of the sector declined from around 20% in 1964 to around 1.3% in 2010. However, copper is still very important in terms of exports still accounting for 84% of export volume and 76% of export earnings in 2012 (Chitonge, 2016).

The measure of structural change used in this paper will focus on the share of manufacturing employment in total overall employment. Thus the share of manufacturing production as a share of total GDP will not be the focus of the analysis. This is because the main problem facing many Sub-Saharan countries is the inability to create enough jobs for their rapidly growing labour force. In addition, recent empirical work indicates that industrialisation in employment terms is much more important for eventual prosperity than industrialisation in output terms (Felipe et al., 2018).

Two equations will be estimated. The first involves looking at those factors influencing the share of manufacturing employment as a share of total employment. This is given by,

$$Mfge/Tote_t = a_0 + a_1 GDPP_t + a_2 \left(GDPP_t\right)^2 + a_3 PA/PM_t + a_4 Copper * Mining\ Value\ \ Added + \varepsilon_t \tag{2}$$

In equation (2) above, the share of manufacturing employment in total employment (*Mfge/Tote*) is assumed to be dependent on real GDP per capita (*GDPP*), real GDP per capita squared ($GDPP^2$), the price of agricultural goods divided by the price of manufactured goods (*PA/PM*), and an interaction term formed by multiplying the international price of copper by mining value added as a share of total value added (*Copper*Mining Value Added)*. The first two variables are included in almost all studies seeking to examine the determinants of manufacturing as a share of total employment (Felipe et al., 2018; Rodrik, 2015). The hypothesis is that as GDP rises, employment initially shifts into manufacturing, but then as GDP per capita continues to rise, manufacturing employment as a share of total employment declines. This is due to the

fact that service employment starts to grow and evolve as income growth alters the demand structure of the economy. Empirical analysis in the studies cited above confirm the hypothesis that the sign on GDP per capita is positive while that on GDP per capita squared is negative. It is one of the hypotheses of this paper that a rise in *PA*/*PM* will reduce the share of manufacturing employment in total employment since it would tend to draw resources out of manufacturing. Finally, it has been hypothesised that a boom in copper resulting either from a rise in price and/or an increase in mining's share of value added will reduce employment in manufacturing as a share of total employment.

The second equation focuses on the determinants of *PA*/*PM*. It is given by

$$PA/PM = b_{0\ +} b_1 \left(AGRIP - MANFGP \right)_t + b_2 RRA_t + e_t \tag{3}$$

Here, it is hypothesised that the difference in productivity between agriculture and manufacturing (*AGRIP-MANFGP*) has a negative influence on PA/PM. That is, if agricultural productivity rises faster than manufacturing productivity (the difference becomes greater) agricultural goods should become relatively cheaper. Lacking data on total factor productivity, labour productivity for each of the sectors is used. In addition, PA/PM is hypothesised to be positively related to the measure of policy towards agriculture discussed earlier in the paper (the relative rate of assistance to agriculture, *RRA*). That is as RRA rises, this should push up the price of agricultural goods relative to manufactured goods (PA/PM).

For the empirical analysis the Dynamic Ordinary Least Squares (DOLS) approach developed by Stock and Watson (1993) is used to test for a cointegrating relationship between the variables. Their method improves on OLS by coping with small sample and dynamic sources of bias. The Stock Watson method is a robust single equation approach which corrects for regressor endogeneity by the inclusion of leads and lags of first differences of the regressors, and for serially correlated errors by a GLS procedure.

The data comes from several sources. The share of employment in manufacturing relative to total employment, agricultural labour productivity, and manufacturing labour productivity are from Timmer et al. (2015). Data on PA and Pm are derived from the same data source. Data on RRA are from Anderson and Nelgen (2013). Data on GDP per capita comes from World Development Indicators. Finally data on the real price of copper comes from World Bank Commodity Price Data (The Pink Sheet) and the share of mining in total value added is again from Timmer et al. (2015). Equation three covers the period 1967 to 2004 while equation two covers the period 1967 to 2010. The time periods are determined by the availability of data. It should be noted that the data used to calculate agricultural and manufacturing labour productivity ends in 2010 and there is no additional time series data available. In addition, the data for RRA ends in the year 2005 and there is no additional time series data available for this variable.

Before the DOLS technique can be carried out, one needs to address stationarity issues. Each variable is tested for unit roots by utilising a variety of unit root tests[1] and all variables are found to possess unit roots. Thereafter a DOLS estimation technique is utilised to test for cointegrating relationships between the variables. The estimated cointegrating relationship is imposed in an error-correction formulation, to assess the speed of adjustment of the dependent variable towards its long-run equilibrium relation. It is important to remember that if the results indicate the presence of a long-run relationship it should be interpreted as an equilibrium relationship, not a causal one. One might expect the presence of reverse causality between the dependent variable and some

of the explanatory variables. One possible way of avoiding such reverse causality would be to take the lagged values of the dependent variable. However, this would mean further loss of observations in a sample with a relatively limited number of observations to begin with.[2] In the results that are presented here we acknowledge that if there is any reverse causality bias it is likely to reduce the size and the significance of the variable.

Table 2 presents the descriptive statistics associated with the variables being utilised for the empirical analysis. One can see that the sample size is not large and the number of available observations vary between 41 and 53. One can also see the difference in the magnitude of the variables from this table.

Table 2 Summary statistics

	Mean	*Median*	*Maximum*	*Minimum*	*Std. Dev.*	*Observations*
AGRIP-MANFGP	–31889.3	–31378.1	–26665.1	–42225.9	4636.9	46
PA/PM	0.545	0.432	1.229	0.163	0.292	52
GDPP	1283.95	1284.25	1722.08	903.89	265.66	53
Mining value added	0.171	0.155	0.396	0.045	0.375	46
Copper	4185.6	3345.5	7950.6	1951.6	1.94e+08	53
RRA	–0.513	–0.567	0.256	–0.886	0.224	41
Mfge/Tote	0.033	0.033	0.042	0.017	0.006	46

Table 3 presents DOLS results relating to equation (2). Here, it can be seen that a linear trend has also been incorporated in the estimation. One can see from the results presented here that per capita GDP had a statistically significant and positive impact on manufacturing employment as a share of total employment. The results also show that the impact of GDP increased at a decreasing rate as can be seen from the negative sign on the quadratic per capita GDP term. This is quite different from estimated results in many previous studies (see Felipe et al., 2018; Rodrik, 2013). They found that as GDP per capita increased, the extent of manufacturing employment as a share of total employment first rose, but then fell. However, many of these previous studies examined a wide variety of countries at a wide variety of different levels of development. However, if one focuses on very poor countries exclusively one would expect to find that the relationship between GDP per capita and manufacturing employment as a share of total employment to be positive. That is, as development is beginning one would expect very poor countries to be on the rising part of the upside-down U-shape found in other studies. In addition, the price ratio PA/PM is found to have a statistically significant and negative impact on manufacturing employment as a proportion of total employment. Finally, the interaction term encompassing the impact of the copper sector has a negative sign and is statistically significant. Thus, copper booms will reduce the share of manufacturing employment in total employment.

Table 4 presents DOLS results relating to equation (3) with *PA/PM* as the dependent variable. As can be seen, the RRA is positive and statistically significant. Thus, as the level of indirect taxation on agriculture declines (RRA rises), the relative price of agricultural goods rises relative to that for manufactured goods. This supports one of the hypotheses of this paper. Liberalisation policies tended to be associated with an increase in the relative price of agricultural goods and this in turn would be associated with a decline in the share of manufacturing employment in total employment (see Table 3). In

addition, the greater the productivity differential in agriculture's favour is associated with a fall in the relative price of agricultural goods and thus a rise in manufacturing employment as a share of total employment. This supports the second hypothesis made in this paper.

Table 3 Dynamic OLS results: dependent variable manufacturing employment as a proportion of total employment

GDPP	0.0001***
	(0.000)
$(GDPP)^2$	–3.32E-08**
	(0.000)
PA/*PM*	–0.02***
	(0.009)
*Copper*Mining value added*	–8.39E-06***
	(0.000)
Linear trend	0.0003***
	(0.0002)
Constant	–0.04**
	(0.016)
Observations	44
R-square	0.92

Note: Standard errors in parentheses; ***, **,* denote statistical significance at 99%, 95% and 90%, respectively.

Table 4 Dynamic OLS results: dependent variable: ratio of the price of agriculture to the price of manufacturing goods

AGRIP-MANFGP	–1.88E-05***
	(0.000)
RRA	0.292**
	(0.103)
Linear Trend	0.019***
	(0.003)
Constant	–0.43**
	(0.182)
Observations	38
R-square	0.93

Note: Standard errors in parentheses; ***, **,* denote statistical significance at 99%, 95% and 90%, respectively.

When looking at the coefficient for the differential between agricultural productivity and manufacturing productivity one may be struck by the fact that the coefficient, which is statistically significant, is very small. However, it must be remembered that that the

productivity measures for the two sectors are measured as the ratio of real gross value added measured in millions of real units of the local currency divided by employment. So a difference of three would represent three million real units of the local currency per person. Thus, the differential numbers are very large.

5 Summary and Conclusions

In this paper, it has been shown that the typical process of structural change does not seem to be occurring in many less developed countries. Manufacturing seems to be failing to perform its historical role. In much of East and Southeast Asia rapid growth in labour intensive manufacturing drew labour out of agriculture such that the latter sector contracted (in terms of share of GDP and employment) as the former expanded. However, in other developing regions (including Sub-Saharan Africa) manufacturing has failed to perform this role.

There are a number of explanations involving changing technology and globalisation that have been put forward. However, this paper has focused on a simpler explanation. Historically, many developing countries, including those in Sub-Saharan Africa, have followed import substitution strategies which effectively tax agriculture while subsidising manufacturing. Policy liberalisation (occurring in the late 1980s) eliminated many policies which protected indigenous manufacturing. As a result, the indirect taxation of agriculture declined as did the subsidies provided to manufacturing. Thus, the implication is that manufacturing would likely decline as a share of total employment. This conclusion presumes that agricultural productivity does not rapidly grow. If indeed it does grow rapidly relative to that in manufacturing the negative effects of liberalisation on manufacturing employment are likely to be mitigated. In addition, countries heavily dependent on natural resources are likely to find that booms in this resource are likely to create Dutch disease problems that will inhibit the developing of manufacturing. However, once again, rapid agricultural growth can mitigate this effect. Extending this argument, policies aimed at promoting the expansion of manufacturing are likely to fail if agricultural productivity does not grow rapidly.

The experience of Zambia was used to illustrate these ideas. In the late 1980s liberalisation occurred and the extent of the taxation of agriculture and the protection of manufacturing declined. In addition, Zambia has also been subject to booms and busts in copper which played and still plays an important role in its economy. This occurred in an environment in which agricultural productivity was stagnant. Indeed manufacturing as a share of GDP and total employment declined. Focusing on the share of manufacturing employment in total employment, empirical analysis indicates that liberalisation of policies with respect to agriculture and industry was associated with a rise in the relative price of agricultural goods which in turn was associated with a fall in the share of manufacturing employment in total employment. In addition an increase in agricultural productivity relative to that in manufacturing was associated with a decline in the relative price of agricultural goods which in turn was associated with a rise in the share of manufacturing employment as a share of total employment. Finally, booms in the copper sector were indeed associated with a decline in manufacturing employment as a share of total employment.

The main policy implication of this paper concerns the key role that agriculture plays in the process of structural change. Thus, policies aimed at raising agricultural productivity are critical for the development process. They would tend to keep agricultural prices relatively low and thus enhance the expansion of manufacturing.

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Notes

1 Levin et al. (2002) and Im et al. (2003) as well as Fisher-type tests using Augmented Dickey Fuller (ADF), and Phillips and Perron (PP) tests (Maddala and Wu, 1999).

2 Estimations utilising the lagged values of the explanatory variables were carried out and the results were not seen to change in any meaningful way.