



The economic complexity of African countries and opportunity costs of not exporting unprocessed products using the ICP data¹

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Abstract:

This paper attempts to measure the level of complexity of African economies by adopting the approach recently introduced by Hidalgo et al. (2007) and Hidalgo and Hausmann (2009). We used the method of reflection to compute countries economic complexity (ECI) and product economic complexity (PCI). A new dataset is generated and includes detailed information related to technology intensiveness of African countries exports, their revealed comparative advantages, indicators related to their diversity, and ubiquity.

Countries are classified according to their economic complexity. About 217 countries are taken into account in the computation but a focus is given in particular to African countries. Hausmann, Hidalgo et al. (2007-2011) analyzed a few African countries but this study accounts for almost all African countries for which data are available. We found that not only are African economies not complex, but their exports are weakly diversified and weakly sophisticated.

We also measure product complexity index and classified export products according to their level of sophistication. Our empirical results show that African countries do not export complex products compared to the rest of the world. Countries are specialized in the export of raw materials. Their share of sophisticated products in total exports is the lowest compared to other developing regions in the world. Yet export of low or medium technology manufacturing goods contribute to increase income and reduce poverty significantly. However, exports of raw material reduce income and increases poverty significantly on the continent. On the other side, countries spend a large share of their budget to import sophisticated or processed goods from the rest of the world. Yet, there is an opportunity cost of imported transformed goods which could have been produced domestically. To assess this opportunity cost, the international comparison program (ICP) data (2011) on prices are also used. Empirical results show that high level of ICP increases poverty and reduces GDP or GNI per capita. This can be addressed by increasing domestic production in the manufacturing which will create less vulnerable jobs. But this will require to invest in improving their productive capabilities. By doing so, African countries will structurally change from raw material exporters to manufacturing producers and exporters and move the majority of its poor people from poor status to non-poor status.

Key words: Products sophistication, poverty, employment, inequality

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1. Methodology and concept

1.1. Economic complexity

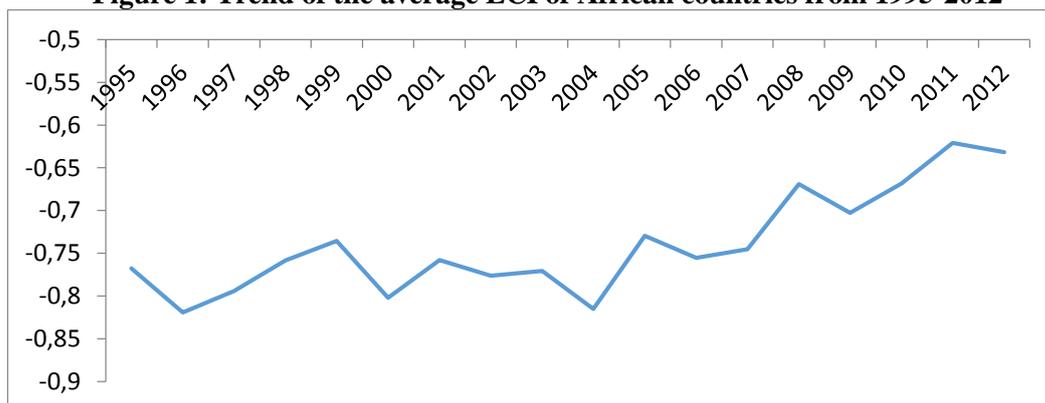
The economic complexity is a measure of the knowledge in a society that gets translated into the products it makes (Hausmann and Hidalgo, 2010). According to Hausmann et al. (2011), the complexity of the productive structure of a given country is reflected through the number of products the country can make and the amount of knowledge these products require in their manufacturing processing. If the manufacturing of a given product requires a substantial technological knowledge, it is obvious that the product cannot be made everywhere and by everybody. Only a limited number of countries will be able to make such product.

However, it should be noticed that some rare natural resources such as precious stones, diamonds are available in very few places around the world. For these products, scarcity does not really mean a greater complexity in their manufacturing, but it reflects the geographical availability of such products. In sum, the scarcity of a product can be explained either by the complexity required in its processing, or either its geographical availability. But in this paper, we focus on the complexity of the product.

Economic complexity of a country is measured by combining the sophistication of the export product it's producing and the diversification the countries' export basket. The measure has been computed for 53 African country in Yameoga et al (2014).

Figure 3 presents the trend in the average economic complexity index of all African countries from 1995 to 2012. On average, the ECI is negative in Africa but has improved since 1995. Between 1995 and 2005, the trend was a bit stable but since 2005, we can observe an upward trend in the average ECI. This means that African countries on average have improved the complexity of their economies. This improvement can be directly attributed more to their effort to diversify their exports than their efforts to make them less ubiquitous.

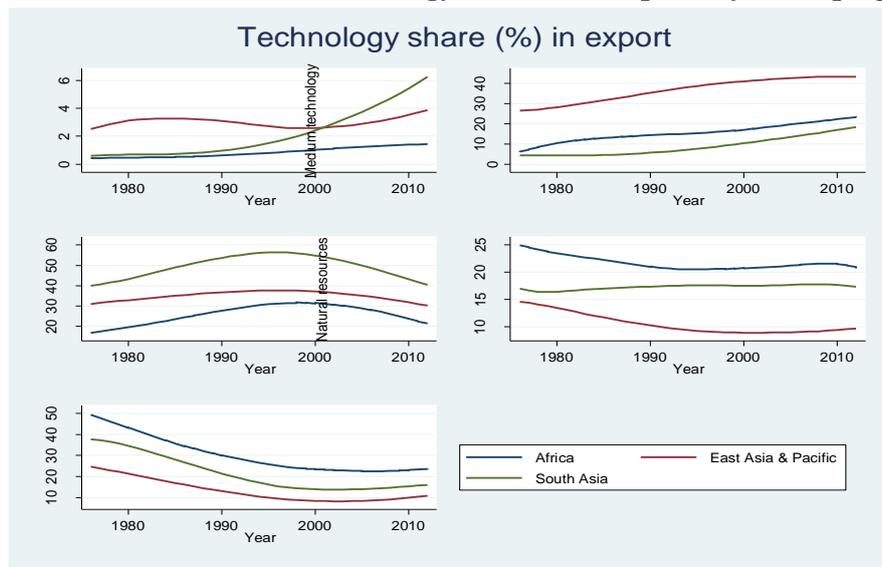
Figure 1: Trend of the average ECI of African countries from 1995-2012



As shown in Figure 6, since the 1970s, African countries are lagging behind compared to other developing regions in terms of incorporating high technology or low technology processing in their exports. However, the continent is doing much better in medium technology exports. But when it comes to natural resources or raw materials in general, Africa at the top of the group of developing regions. On

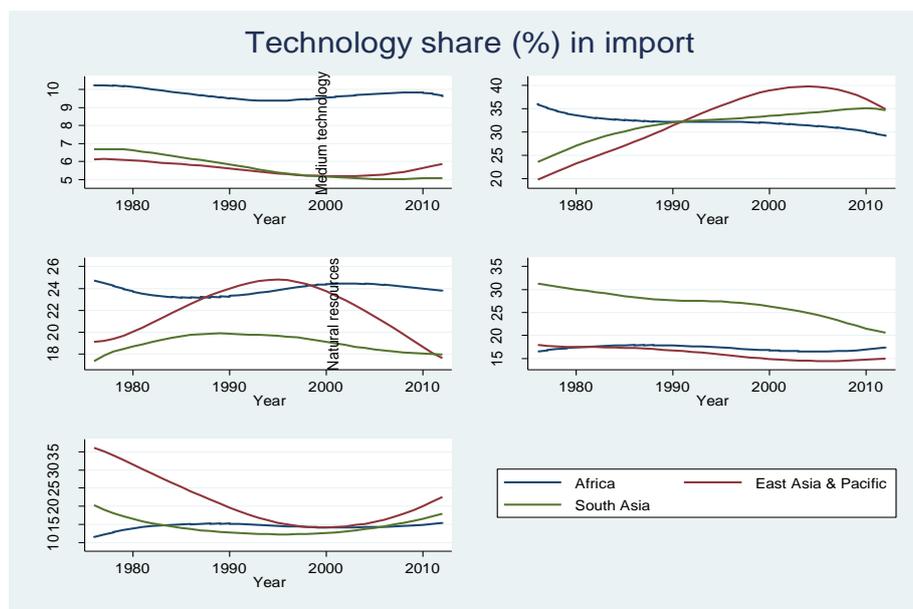
the opposite, as mentioned previously, Figure 7 shows that in terms of imports, Africa has always has the highest share of high technology in its total imports compared to other developing regions in the world. These facts imply indirectly that the continent is losing the opportunity to create new jobs and also loses in terms of foreign revenues when it focuses more on the export of raw material and the export of manufacturing products.

Figure 2 : Trend in the share of technology intensive in exports by developing regions



Source: Authors' computation using COMTRADE data

Figure 3: Trend in the share of technology intensive in imports by developing regions



Source: Authors' computation using COMTRADE data

1.2. Data for the Estimation Models: Survey Data from the International Comparison Program for Africa (ICP-Africa)

Data used for the models are obtained from price survey data collected by the Statistics Department of the African Development Bank under its International Comparison Program for Africa (ICP-Africa) conducted monthly in 50 African countries over the period January 2011 to March 2012. The ICP-Africa price collections were conducted monthly in parallel with existing consumer price index (CPI) collection activities regularly conducted by African countries as part of their macroeconomic management systems. The ICP coverage in terms of products and outlets was larger than the CPI coverage to reflect the specific requirements of the ICP program. In total, about 1,400 data collection centers across Africa, ranging from about seven centers in Liberia to 120 in Zimbabwe, were used for the price data collection exercises. Approximately 60 percent of the centers were located in urban areas and 40 percent in rural areas.

The main surveys conducted included the principal household consumption items: food and non-alcoholic beverages; alcoholic beverages, tobacco and narcotics; clothing and footwear; housing, water, electricity, gas and other fuels; furnishings, household equipment and routine household maintenance; health; transport; communication; recreation and culture; education; restaurants and hotels; miscellaneous goods and services and net purchases abroad. As indicated in Table 1, over a thousand products were grouped into 110 basic headings and defined for subsequent pricing. Given the diversity of the continent, there was some variation in the geographic representativity of individual products, but, taken as a whole, the selection was deemed to adequately represent the consumption patterns of all 50 participating countries.

Table 1: Number of Basic Headings and Products for the 2011 ICP-Africa Update

Category	Number of Basic Headings	Number of Products
Food and non-alcoholic beverages	29	356
Alcoholic beverages, tobacco and narcotics	5	41
Clothing and footwear	5	128
Housing, water, electricity, gas and other fuels	7	12
Furnishings, household equipment and maintenance	13	124
Health	7	158
Transport	13	55
Communication	3	19
Recreation and culture	13	49
Education	1	9
Restaurants and hotels	2	51
Miscellaneous goods & services & net purchases abroad	12	34
Total Household Final Consumption Expenditure	110	1,036

The surveys were designed to provide national coverage and included both urban and rural areas. Most countries used a stratification based on administrative areas. Outlets were selected through a two-stage purposive sampling approach. First, the administrative center of an administrative area

and - when feasible -one or more adjacent rural areas were chosen as primary sampling units. Second, outlets were selected within each primary sampling unit on the basis of a pre-survey.

1.3. What do we mean by opportunity cost?

Regarding trade and industrial development issue, each country has two choices; the first is to export commodities—Agriculture (cocoa, coffee, corn, wheat ...), livestock product (live animal, goat, skin...), oil and mineral product—and the second is to develop local manufacture to transform these products in finished or semi-finished product before exporting them. Both choice has an opportunity cost, we focus on the opportunity cost of the first choice which Africa case. The opportunity cost of exporting unprocessed goods can be divided into three components.

The direct cost can be the lost in export outcome because of the difference in value added between processed and unprocessed goods. Processed goods have more value added than raw materials and their export lead to more marginal benefice than unprocessed goods. This shortfall is the margin difference between the two categories of goods and can result in relatively less export revenues. The second component of the opportunity cost is the additional amount allocate to import the transformed product usually produced from what the country has been exporting as commodities.

The third component is the cost in jobs creations. Manufacturing or processing activities can generate more employment than producing simple raw material. By exporting unprocessed goods (and importing transformed goods) African countries are in a certain way losing the opportunity to create many potential jobs. The indirect cost of exporting unprocessed and importing processed goods is the number of jobs in the manufacture sector that could have been created but are not in the actual process.

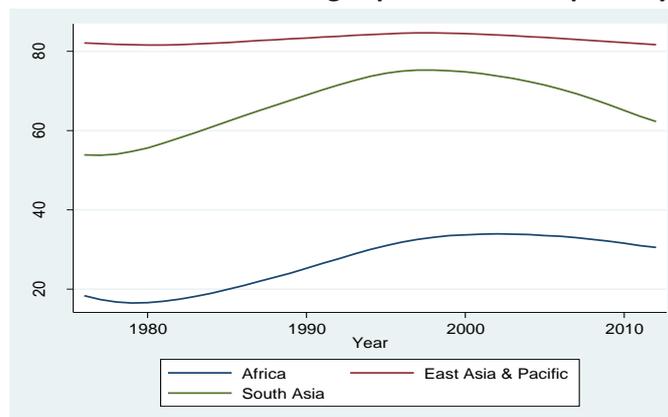
But, due to lack of capabilities, many countries do not have the choice other than importing sophisticated or complex products. In the following section, we focus on measuring the direct costs which include: loss in terms of export revenue, loss in terms of higher import costs of sophisticated goods, and loss in GDP in total. How do we measure these costs? The following section tries to asses these costs.

2. Measuring opportunity cost

2.1. Direct cost: national income loss

As shown in Figure 11, Africa is lagging behind other developing regions in terms of manufacturing exports as a share of total exports. The continent has the lowest share compared to other developing regions in the world and the gap has remained wider since the 1980s.

Figure 4: Share of manufacturing exports in total exports by region



Source: Authors' computation using WDI 2013

To assess the impact of not exporting manufacturing products on Africa, we first assess the loss in terms of GNI (gross national income) per capita. Let us assume that GDP depends on initial income, consumption, investments, exports and imports. Exports and imports are split following their degree of technology intensity.

The results indicate that initial GNI per capita and investment have positive and significant impact on GNI per capita, but the impact is relatively lower when it comes to Africa. High technology exports have significant and positive impact on GNI per capita however, for Africa, the effects is positive and insignificant. Medium tech exports have positive effects on GNI per capita but the impact is relatively smaller in Africa.

On the opposite, low tech exports have higher positive impact on Africa compare to the global effect. This implies that, for Africa, increasing LT exports will have more impact on GNI per capita than increasing high tech or medium tech manufacture exports. But when African countries export raw material intensive exports, this has negative impact on GNI per capita. In terms of imports, we expected a negative impact on GNI per capita. Only medium tech exports have positive impact, but insignificant for Africa.

We conducted the same exercise using GDP per capita and the same conclusions remain. In these specifications, medium tech exports have the expected negative and significant sign globally but insignificant for Africa.

Table 2: Pooled OLS of Per capita GNI and export technology intensity

	Full sample 1	Africa 1	Full sample 2	Africa 2	Full sample 3	Africa 3	Africa 4
Log initial pc GNI	0.926*** (0.0105)	0.892*** (0.0121)	0.875*** (0.0104)	0.867*** (0.0133)	0.958*** (0.0102)	0.886*** (0.0115)	0.848*** (0.0115)
Log of Investment	2.021*** (0.166)	1.565*** (0.153)	1.675*** (0.151)	1.438*** (0.156)	1.703*** (0.171)	1.100*** (0.151)	1.456*** (0.150)
X_HT	2.855** (1.117)	0.176 (0.429)					
M_HT	-2.666*** (0.225)	-1.680*** (0.212)					
X_MT			1.013*** (0.0944)	0.719*** (0.138)			
M_MT			0.926*** (0.102)	0.167 (0.117)			
X_LT					0.639*** (0.0384)	0.745*** (0.0703)	
M_LT					-0.519*** (0.0898)	-0.241** (0.104)	
X_RW							-0.334*** (0.0354)
Cons	0.454*** (0.0677)	0.615*** (0.0767)	0.269*** (0.0694)	0.531*** (0.0807)	0.0699 (0.0664)	0.515*** (0.0733)	0.913*** (0.0845)
R-sq	0.925	0.903	0.932	0.901	0.925	0.918	0.907
N	1215	844	1215	844	1215	844	844

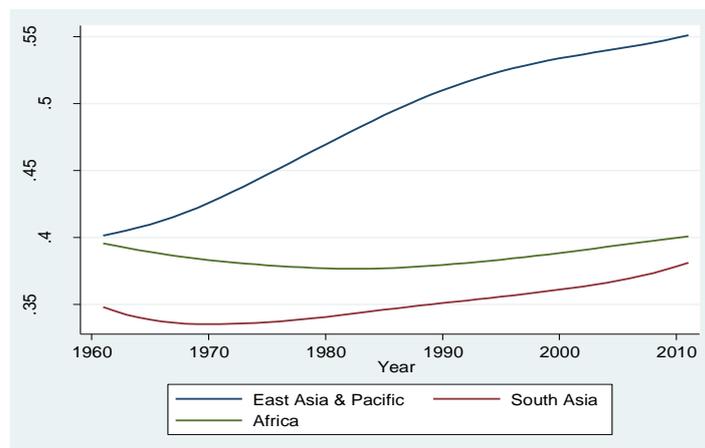
Standard errors in parentheses and significance level are coded as * p<0.10, ** p<0.05, *** p<0.01

1.1 Loss in terms of employment opportunities

Export of raw material without transformation has an opportunity cost in terms of job creation. In fact, the production of sophisticated products contribute to more job creation, in quantity and quality in all the sectors of the economy. The increasing demand for more raw materials to feed the industrial and manufacturing sector in the country should boost the production in both sectors and generate more well-paying jobs, as this was the case in many emerging Asian countries. In turn, other indirect jobs can be created in sectors such as services, finance, food, etc.

As a consequence, countries where manufacturing is well developed tend to have more job employment opportunities for their citizens than countries that export mainly raw material. In Figure 12, we can observe that Africa has low employment ratio compared to EAP region, even though this ratio is relatively high compared to South Asia; in addition, in Africa, the ratio has stagnated since the 1960s and have reached 40% recently, the same level as in early 1960. This goes in line with the stagnation in the manufacturing sector (figure 11) which did not expand during the same period, despite the fact that Africa has kept exporting increasingly raw materials.

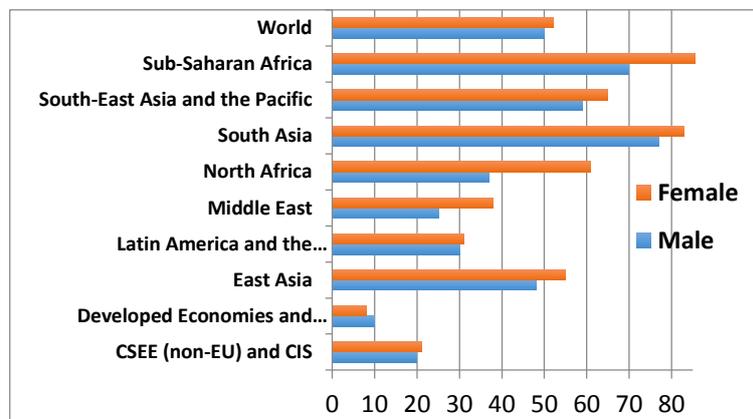
Figure 5: Employment ratio by region



Source: Authors' computation using Penn world table 8

Even for those who have employed, many of them have vulnerable jobs and Africa is one of the continent with the highest ratio of vulnerable jobs (Figure 13). In SSA, more than 85% of women have vulnerable jobs while this share is about 70% for men. Many African are in fact employed in the informal sector without any security, social protection or retirement plan, making most of them vulnerable to losing their income revenues one day or another.

Figure 6: share of men and women in vulnerable employment

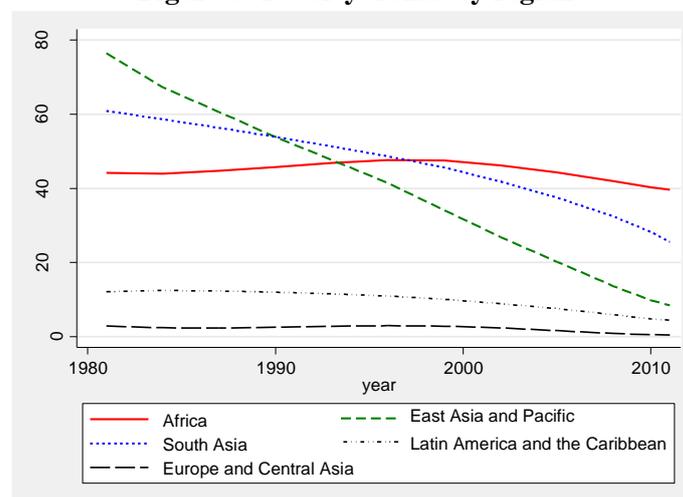


Source: adapted for ILO 2012

1.2 Opportunity for poverty reduction in Africa

One of the goals of any development policy is to improve household welfare and to reduce consequently poverty and inequality in the society. From the figure 14 below, the question that comes in mind is how South Asia and East Asia& Pacific went from higher poverty rates (higher than Africa) in the 1980s to lower poverty rate after the mid-1990s in comparison to Africa?

Figure 7: Poverty trends by region



Source: African Development Report, 2015

One reason might come from the change in productive structures, since Asian countries have made quite substantial progress in exporting manufacturing goods and attracting FDIs. To capture the impact of producing and exporting more sophisticated product, we used the simple model where we regress mean poverty indicator—poverty headcount, poverty severity and poverty depth—on the export and import sophistication controlling for usual control variables.

Our main variables of interest in the model are the export technology intensity—higher, medium and low technology— and the price level capturing by the ICP household consumption price level. The first

group is to capture the impact of producing and exporting more sophisticated production. The second variable is the household consumption price level from ICP which is a measure of the cost of living compared to other African countries, is expected to have negative impact household

Results are reported in Table 6-8 below. In these tables, we estimated the headcount poverty equation for African countries using different covariates. In Table 6 for instance, we included household total consumption price as a proxy to the cost of living, while in Table 7 and 8, we used food price, and cereals/bread price, respectively as proxy to the cost of living.

Results show that high inequality tends to increase poverty incidence, but secondary school enrollment helps to reduce poverty. In all the estimations, the cost of living tends to increase poverty on the continent. More importantly, export of raw materials increases poverty incidence in Africa while export of low technology of medium technology manufacturing goods reduce poverty incidence. This means that by exporting raw materials, African countries are losing an opportunity to reduce poverty. Efforts need to be done to transform their natural resource potential by using low technology or medium technology manufacturing process to produce goods that can meet domestic demand.

Table 6: Poverty headcount, Export technology and ICP total price level

	1	2	3	4
Log of Gini index	1.740*** (0.456)	1.674*** (0.444)	1.730*** (0.463)	1.699*** (0.452)
Log of Secondary school enrolment	-0.169* (0.0976)	-0.253*** (0.0926)	-0.0912 (0.116)	-0.168 (0.113)
Log of mean income	-1.972*** (0.151)	-1.937*** (0.154)	-1.990*** (0.169)	-1.907*** (0.165)
Log of HH consumption price level	0.642*** (0.115)	0.701*** (0.123)	0.558*** (0.132)	0.648*** (0.138)
RW	0.467*** (0.119)			0.212 (0.172)
MT		-1.514*** (0.534)		-1.055* (0.592)
LT			-0.627* (0.358)	-0.240 (0.421)
Cons	4.338** (2.010)	4.055* (2.103)	5.591*** (2.023)	4.209* (2.124)
R-sq	0.882	0.883	0.878	0.886
N	109	109	109	109

Standard errors in parentheses and significance level are coded as * p<0.10, ** p<0.05, *** p<0.01

3. Concluding remarks

In this paper, we tried to assess in various ways the opportunity costs of not exporting sophisticated products in Africa. We used the economic complexity approach developed recently by Hausmann, Hidalgo and al, to analyze the level of the productive capabilities of African countries. Most of African countries do not have sophisticated productive structures which could allow them to produce high value addition products they can export. For that reason, African countries have kept exporting much of their natural resources, which do not contribute to reduce poverty, but instead has increased poverty.

However, export of manufacturing products based on low technology or medium technology manufacturing process reduce poverty incidence on the continent. This means that African countries need to invest in their production capabilities for the coming years in order to realize a structural change in the composition of their export basket, from mainly raw materials to higher value addition products. It is known that the manufacturing sector can generate lot of well paid jobs that are less vulnerable than the current structure of employment in Africa.

Empirical results show that high level of living cost (measured by ICP household consumption price level) moderate the countries poverty reduction effect. This can be addressed by increasing domestic production where the country increases its domestic supply of necessary goods, such as food items. To do so, it is necessary to improve the country's capabilities, which include its physical and human capital. Human capital can be trained in a way that it meets the labor market demand. Our results also showed that secondary school enrollment reduce poverty incidence. Well trained workers can participate in the production of sophisticated goods to meet domestic demand in manufacturing products and also international markets. By doing so, African countries will be able to realize a real structural transformation of their economy and move the majority of its poor people from poor status to non-poor status.

Reference

- Balassa, B. (1979), 'A **'Stages Approach' to Comparative Advantage**', in I. Adelman (ed.), *Economic Growth and Resources*, London: Macmillan, 121-156.
- De Hoyos, R. and Medvedev D (2009). "**Poverty Effects of Higher Food Prices A Global Perspective**" Policy Research Working Paper 4887, The World Bank
- De Hoyos, R. and Lessem, R. (2008) "**Food Shares in Consumption: New Evidence Using Engel Curves for Developing Countries**", Background Paper for the Global Economic Prospects 2009, The World Bank
- Hausmann, R, Hwang, J, and D. Rodrik (2007) "**What You Export Matters.**" *Journal of Economic Growth*. 12:1-25.
- Hausmann, R., Hidalgo, C., 2011, "**The network structure of economic output**", *Journal of Economic Growth*, 16, 309-342.



Hausmann, R., Hidalgo, C., Bustos, S., Coscia, M., Chung, S., Jimenez, J., Simoes, A., Yildirim, M., 2011, “**The Atlas of Economic Complexity**”, Puritan Press.

Hidalgo, C., Klinger, B., Barabasi, A.L. and Hausmann, R., 2007, “**The Product Space Conditions the Development of Nations**”, Science, 317(5837), 482-487.

Hidalgo, C., and Hausmann, R., 2009, “**The building blocks of economic complexity**”, Proceedings of the National Academy of Sciences of the United States of America, 106(26), 10570-10575.

Felipe, J., Kumar, U., Abdon, A. and Bacate, M., 2012, “**Product complexity and economic development**”, Structural Change and Economic Dynamics, 23(1), pp. 36-68.

Martin Ravallion (2010) “**Price Levels and Economic Growth : Making Sense of the PPP Changes between ICP Rounds**”. Policy Research Working Paper 5229, The World Bank

Yaméogo, Nadège Désirée & Nabassaga, Tiguéné & Abebe Shimeles & Mthuli Ncube, 2014. “**Diversification and Sophistication as drivers of structural transformation for Africa: The Economic Complexity Index of African Countries**,” Journal of African Development, African Finance and Economic Association, vol. 16(2), pages 1-3

Yaméogo, Nadège Désirée & Nabassaga, Tiguéné & Ncube, Mthuli, 2014. “**Diversification and sophistication of livestock products: The case of African countries**,” Food Policy, Elsevier, vol. 49(P2), pages 398-407.

World Bank, 2008a,” **Global Purchasing Power Parities and Real Expenditures**”. 2005 International Comparison Program, (www.worldbank.org/data/icp), World Bank, Washington DC.

World Bank, 2008b,” **Comparisons of New 2005 PPPs with Previous Estimates**”. (Revised Appendix G to World Bank 2008a), (www.worldbank.org/data/icp), World Bank, Washington DC.

World Bank, 2014, World Development Indicators, World Bank, Washington DC.