How to design the future? An economywide analysis of key industrial policies to boost pro-poor growth in DRC

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Abstract

The economic growth between 2005 and 2012 significantly increased the income of the rich, but also left the poor behind. This paper uses a CGE-microsimulation model to study the pro-poor effect of industrial policies—that have been proven to be relevant for engineering productive transformation, such as skill upgrade as well as those that are likely to strengthen the competitiveness of DRC agro-food products. The relevance of skill upgrading is clearly supported by the findings. The evidence showed that labor upskill has not only produced strong absolute and relative pro-poor effects, but also has the potential to lead to income convergence, where poor households' gains were higher than the richer ones. The analysis has revealed the underestimated contribution of agro-food marketing and transportation efficiency. The major finding is that marketing efficiency favors the middle class, and households at the 5th percentile benefit less than the average population. The reason for this is that the improved marketing efficiency of agro-food products generates strong income growth that expanded the demand of food, other manufacturing products, and imports. Middle income groups benefited the most due to differences between domestic prices and import prices. With regard to transportation efficiency, the analysis found that efficiency growth in transportation of agro-food products generates strong pro-poor effects in absolute and relative terms and is likely to be particularly effective in leading to income convergence. The analysis indicated that the improved transportation efficiency has the potential not only to increase income and employment, but also to provide positive price impacts for both agro-food producers and consumers and benefits to all households, particularly for low-income households.

Key words: Industrial development and policy, CGE-microsimulation, pro-poor growth, afro-food processing

JEL Classification: C68; O25; I32; O55

1. Introduction

The recovery of the economy of the Democratic Republic of Congo (DRC) has gained momentum over the past 7 years, with high growth rate, significant FDI inflow and lower aggregate poverty incidence. As the commodity price picked up and FDI poured in the country, DRC achieved the fastest expansion since independence in 1960, supported by prudential macroeconomic management and peace. The growth rate has been maintained at an average of 6 percent for more than 10 years while the stock of inwards FDI increased 3 times compared to its 2000 level. However, poverty and employment outcome was relative poor. The elasticity of growth to employment was 0.71 in 2000-2004 and 0.53 in 2004-2008. Poverty incidence fell from 71.3 percent to 63.4 percent between 2005 and 2012, with an annual rate of 1.66 percent. Subjective poverty figures show that almost half of the households perceive themselves as in worse economic conditions compared to the previous year. Subjective poverty, which is estimated at 73 percent, is very alarming as 55.62 percent of households believe that their living standard is decreased. 42.98 percent of households have seen their purchasing power decreased, 48.83 percent cannot feed themselves, and 74.14 percent are unable to save. The weak translation of growth into poverty reduction and better living standard raises the level of urgency with which industrial policy should be treated as the boom in the commodity boom cannot last longer. How can DRC have a bright future? How can DRC translate this unprecedented growth into better employment and higher living standards? What are the key industrial policies that facilitate this transformation?

This paper tries to shed some light on these questions using a top-down/bottom-up CGE-microsimulation model for DRC. To sustain and translate growth into job creation and higher living standard in the future, it is imperative that DRC embraces industrial policy that develops shared capabilities required to engineer growth in the manufacturing sector (Otchia, 2015). Previous research (Otchia, 2013) has found clear evidence of the importance of creating agricultural value chains and establishing a competitive agro-food industry in DRC. The analysis suggested that increasing value addition in and processing capacity of agricultural products will generate the most important volume change in DRC's economy, and improving the efficiency of financial

intermediation will have an important additional scale effect. On the other hand, the findings by Otchia (2013) pinpointed the role of investment in transportation infrastructure and trade institutions in creating domestic and regional markets for competitive agro-food products. These researches have concluded that investing in industrial skills and infrastructure of transportation and communication is the potential vehicle for DRC to leapfrog from natural resource poor country to industrial and diversified economy.

This paper adds to the empirical literature on industrial policy and value chains analysis by examining the core underlying factors that can foster DRC's competitiveness and efficiency to produce and export high value agro-food products. These factors include upgrading and transforming the structure of production by upskilling the labor, and boosting the efficiency in the service (marketing and transportation) industries. In this new era of globalization, characterized by a multipolar world and international fragmentation of production,[1] it is becoming increasingly difficult to ignore the key role of competitive agro-food sectors in creating employment, reducing poverty and food security. The need to increase food production and productivity has become a central issue due to the recent global food price crisis and financial crisis. In relation to this renewing interest, the World Development Report 2008: Agriculture for Development (World Bank, 2007) emphasizes the role of high-value agricultural products and the non-farm economy in sustaining development. Another reason is that the increase in consumer purchasing power in developing countries due to rising incomes. Indeed in Africa, for example, the size and the income of the middle income rose to 34 percent within the population in 2010, from 27 percent in 2000, where it had remained since 1980 (AfDB, 2011). In addition to sustaining growth and jobs, food production has the potential to increase food access, which also leads to a reduction of food security concerns (The World Bank Group, 2011). However, there are few empirical studies that assess the economywide effects of increased food production in Africa and only few is known on how efficient trade and transportation system of agro-food products affect the

[1] See Hummels, Ishii, and Yi (2001), Feenstra and Hanson (1999), and Los, Timmer, and Vries (2013) for a discussion on the concept and measurement of international fragmentation of production.

economy. This paper, for instance, is able to show that efficient transportation of agro-food products matters much more than marketing in terms of benefiting the poor.

This paper also adds to the literature of CGE-microsimulation model in two ways. First, I develop a social matrix account of DRC to identify agro-food value chain at the level of marketing and transportation services. Second, this study applies a top-down/bottom-up CGE-microsimulation model augmented to incorporate the concepts of skill upgrade and pro-poor growth. The disaggregation of the trade and transportation services consist of separating trade and transportation services used in wholesale and retail sales of agro-food products from all other trade and transportation services. The treatment of trade and transportation in this paper is very close to Landes and Burfisher (2009). The authors focused on the effects of reforms that achieve efficiency gains in agricultural marketing in a CGE where households are disaggregated by rural, urban, and income class. The conclusions of this paper regarding agro-food marketing efficiency are consistent with theirs, but some differences are worth noting. For instance, the pro-poor growth framework gives detailed effect on the income distribution, such that the findings make it clear that marketing efficiency tends to benefit the middle class, rather than the poorer.

The paper proceeds as follows. In section 2 I examine the extent to which the recent growth in DRC has been pro-poor. In section 3 I define a framework for policy analysis, while section 4 presents the model and data sets. Section 5 presents and discusses the results, and section 6 concludes.

2. Strong growth without industrialization has left the poor behind

In this section, the objective is to examine whether the recent economic growth in DRC has been pro-poor. An examination of the pro-poorness of growth has to start with a review of the growth pattern and structure, since the effect of growth on poverty depends on how growth affects households' source of income.

2.1. Strong growth without industrialization

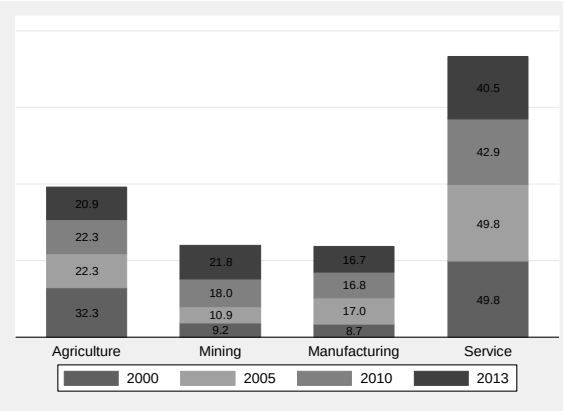
The economic growth records show that DRC experienced an economic disaster some years after its independence from Belgium in 1960. The GDP per capita collapsed from US$350 to US$82 between 1973 and 2001, due to mismanagement, rent-seeking activities, and conflicts. The end of conflicts in 2001 and the establishment of a transitional government composed of representatives of former belligerents gave rise to the implementation of structural reforms that sought to stabilize the economy and create conditions for growth and poverty alleviation. The period of 2002-2012 saw a resurgence of growth, accelerated by the external demand for natural resources by China. The GDP recorded a growth of 5.36 percent per year between 2001 and 2005 and of 5.38 percent between 2006 and 2010. More recently, economic growth averaged 6.92 percent, which is high compared to the Sub-Saharan Africa average of 5.41 percent during the same period. The primary sectors (agriculture and mining) and services remain as the backbone of the DRC economy, contributing 82.3 percent of the GDP in 2013 (Figure 1a).

Despite these notable developments, certain important features of the growth pattern, especially in relation to structural change and poverty, are worth noting. The first is the contraction of the other-manufacturing sub-sector (Figure 1b). The real growth of other manufacturing fell at a rate of 8.16 percent between 2011 and 2013. In constant US$, the other-manufacturing sub-sectors grew the least since 2001, specifically by 0.60 percent in 2006-2010 and by 2.86 percent in 2001-2005. One important explanation for this is the lack of growth of labor productivity. In 2001, labor productivity in manufacturing ranked 3rd, after the transportation and communication and mining sectors. However, it decreased by 9 percent in 2000-2005 and by 12 percent between 2005 and 2012. It is only recently that labor productivity in manufacturing has increased, by about 1.3 percent. Another reason for the contraction of the other-manufacturing sub-sector is the obsolete manufacturing base and the high competitiveness of imports. Other manufacturing represents about 15 percent of the manufacturing sector, which in turn is dominated by the production of food, beverages, and tobacco. The output of the food, beverages, and tobacco sub-sector grew by 12 percent in 2011-2013 and by a lesser extent in the previous years. Part of the reason is the low substitutability with

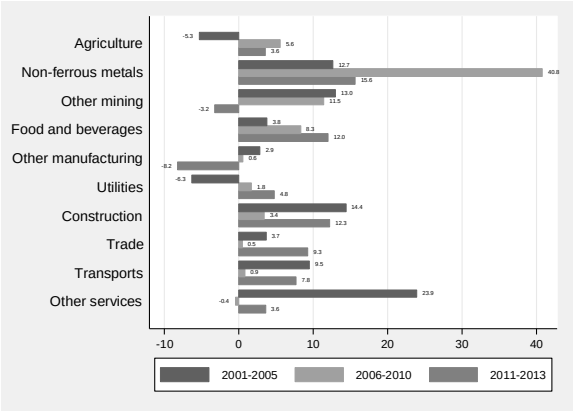
imported goods and the improvement in trade, transportation, and communication services, which helped the domestic food and beverages sub-sector to take advantage of the high domestic demand. It is also interesting to observe that the non-ferrous metals sub-sector is the highest growing sub-sector, driven by the demand from China. However, other mining is the one affected by the recent slowdown of the Chinese economy, as it grew by more than 10 percent in 2001-2005 and 2006-2010. Note that this branch, together with non-ferrous metals, accounted for almost 22 percent of the GDP in 2013.

The second salient feature is the small growth in manufacturing employment, probably associated with the contraction of the other-manufacturing sub-sector and the decreasing labor productivity. Figure 1c shows the sectoral division of labor in 2005 and 2012 based on household survey data. The share of manufacturing in total employment rose marginally from 7.5 percent in 2005 to 8.3 percent in 2012, while during the same period, the sector's share in GDP increased annually by about 5.42 percent. The service sector registered the highest employment gains of about 2.2 percent points. Although employment in service has grown more rapidly than in manufacturing, a majority of service employment is provided in lower productive services such as hotels and personal services. In fact, DRC has not succeeded yet to shift labor from the primary sector into more high productive jobs. The share of employment in the primary sector has decreased only slightly, while trade contracted by 2.7 percent points.

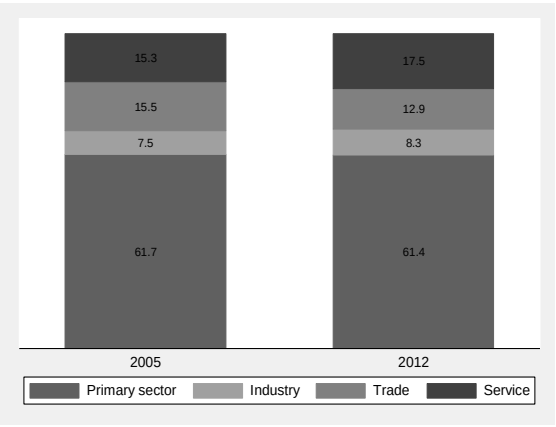
a. Sectoral contribution to GDP



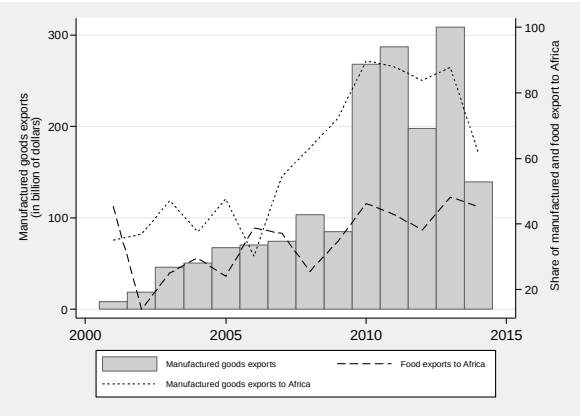
b. Real GDP growth



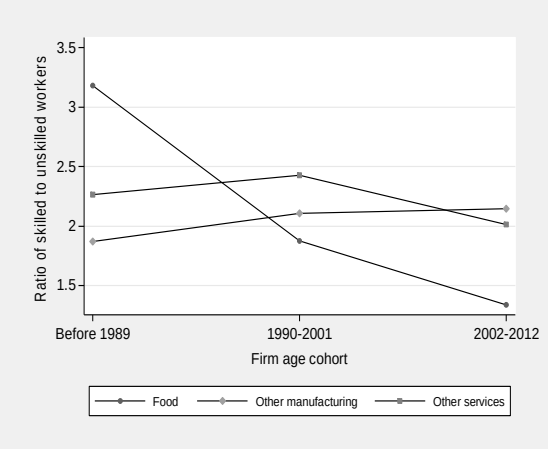
c. Employment share



d. Manufacturing goods exports



e. Ratio of skilled to unskilled workers



f. Major obstacles faced by DRC firms (Ranks)

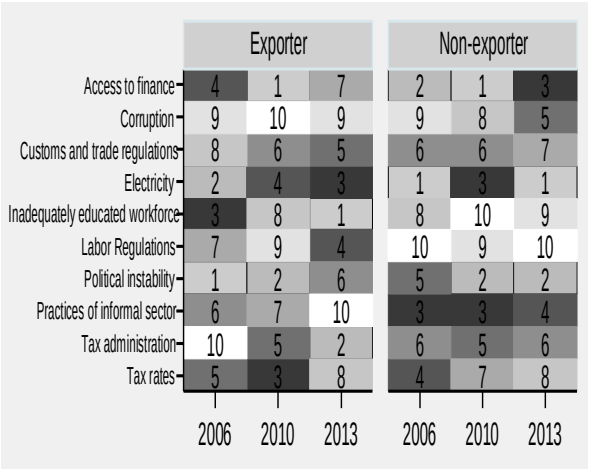


Figure 1: DRC's economy activity

The third notable feature of the economic development over the last ten years is associated with manufacturing growth and is related to exports. There are considerable variations of manufacturing exports between different years (Figure 1d). DRC's total manufactured goods exports to Africa as the share of total manufacture export show the greatest variation, ranging from 35.1 percent in 2001 to 61.6 percent. However, the share of food exports to Africa as the total share of food exports has remained stable. In 2001, food exports to Africa represented almost 45.4 percent, but it dropped to 14 percent in 2002 before picking up again. From a policy perspective, this indicates that food has not been competitive. There are several possible reasons for this, the most plausible being that the food, beverage, and tobacco industry faces the highest transaction costs within the manufacturing sector. According to Otchia (2013), transaction costs in this sub-sector reaches 34.9 percent of the total value of the supply of marketed output, while transaction costs in textiles, chemicals, and wood products are 27.2, 15.9, and 13.3 percent, respectively.

The fourth economic feature worth noting to understand structural change in DRC is the change in the skill mix among newer firms, especially in the food sector, where the ratio of skilled to unskilled workers has been dramatically decreasing. Figure 1e presents the ratio of skilled to unskilled workers in three sectors and across three firm age cohorts, based on the World Bank Enterprise Survey data. Firms created in 1980s use a relatively higher ratio of skilled to unskilled workers, except for other manufacturing, in which the demand of skilled workers relative to unskilled workers has been increasing. Other manufacturing provides better job opportunities for skilled workers due to technological upgrades. Newer firms in the food and service sectors demand more unskilled workers relative to skilled workers, but the changes in the skill composition happens at various speeds. The ratio of skilled to unskilled workers in the service industry increased slightly from 2.3 to 2.4 among firms founded earlier than the 1990s and those entered in 1990-2001, but then decreased to 2 for firms founded after 2002. Part of the reason is that growth in service was driven by ICT and absorbed most of the workers who moved from manufacturing after the looting of 1991 and 1993. The skilled-unskilled relative demand within the food sub-sector, which started at 3.2 and fell to 1.9 in 1990-2001, and from then onward, the ratio continued downward to an all-time low of 1.4. The

steep decline in the ratio of skilled to unskilled workers in the food sector means that newer firms specialized in low-skilled jobs, which reduce their competitiveness against imports. In general, the change in the skilled to unskilled wage ratio equals the change in the ratio of unskilled to skilled labor. In countries like DRC, with ineffective minimum wages and a weak union, these dramatic changes may contribute to national inequality changes, as wage income represents 40 percent of the source of income.

The fifth and final notable feature of growth is the lack of adequate educated workforce, which remains the major obstacle to improving the productivity and competitiveness of export-oriented firms. Figure 1f shows that the inadequately educated workforce was ranked 3rd in 2006 as the major obstacle faced by exporting firms. In 2013, it ranked 1st, indicating a worsening situation for firms who need to recruit workers with appropriate skills to remain competitive in the export market. The recent experience of some African countries like Ethiopia shows the existence of a strong and positive correlation between firm productivity and workers' education and training. In addition, the number of vocational workers is increasing at a low pace of 16 percent between 2006 and 2013.

2.2. The poor has been left behind

Now I turn the attention to whether the growth described above has been pro-poor, which refers to a growth that reduces inequality and in which the consumption of the poor increases more than the population average. I conduct the distribution analysis in two parts. In the first part, I examine the 2005 and 2012 consumption data from the household surveys to compute the distribution of household expenditure based on the Lorenz curves and the Gini coefficient for the two periods. This is an important step, as inequality influences how economic growth translates into poverty reduction. Next, I use the growth decomposition framework, which has been popularized by Kakwani (2010), to estimate the pro-poorness of the 2005-2012 growth and measure its contribution to poverty reduction.

The income distribution in Figure 2 clearly shows that, during the period of 2005-2012, DRC experienced a sharp increase in inequality. The degree of inequality, measured by the Gini coefficient, increased from 0.43 in 2005 to 0.47 in 2012. The difference

between the Gini coefficients is statistically significant, meaning that DRC is becoming a more unequal country. For instance, the poorest 40 percent of the population in 2005 consumed 15.1 percent of total consumption while in 2012, the poorest 40 percent consumed 13.9 of total consumption. However, comparing these estimates with the other countries in the region, one finds that DRC inequality is quite high but just below the top 15 unequal countries. According to IMF (2007), the initial high inequality in DRC is due to the existence of distributive injustice, discrimination, and virtually endemic exclusion in the country.

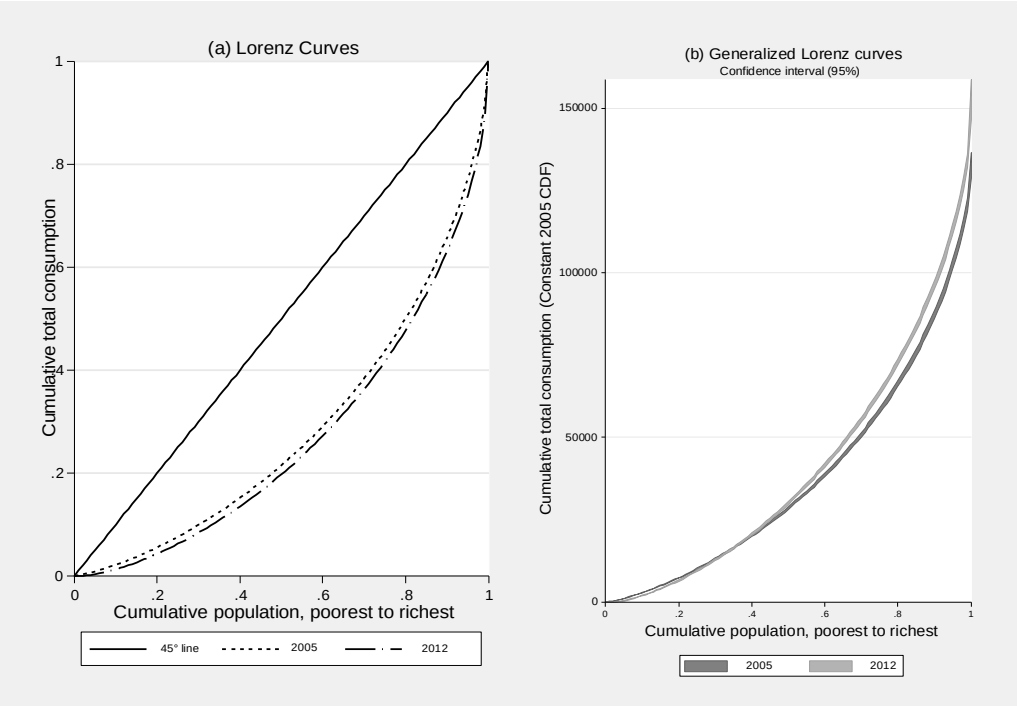


Figure 2: Inequality changes

On the other hand, the increase in inequality is somehow related to the changes in the composition of income source, due to structural change. In 2005, the wage income represented 42.54 percent of household income. Self-employed in agriculture and non-agriculture accounted respectively for 26.85 and 28.24 percent, and transfers for 2.38 percent. Recently, self-employed non-agriculture has become the main source of income with 39.40 percent, followed by wage income (37.44%), self-employed agriculture (21.49%), and transfers (1.67%). The wage income gap between 10th decile

and 1st decile has also increased. Looking to the changes in total consumption across the distribution, Figure 5 shows that growth has led to a significant increase in the income of the richest 50 percent, as the real consumption is higher from the top 50 percent of the population in 2012 than it was in 2005.

However, growth has also left the poor behind and the consumption of the poorest has partially deteriorated: the real consumption of the population between 20th and 50th percentile has not statistically changed whereas that of the poorest 20 percent is slightly decreased. Despite the fact that the higher income part of the population received higher income, the 2005-2012 growth has led to poverty reduction. Table 1, which depicts the poverty profile in DRC in this period, indicates that in 2005 71.3 percent of the RDC population lived in households with incomes below the poverty line. From 2005 to 2012, poverty fell annually by 1.66 percent for an overall annual growth of 6 percent. To understand the source of the poverty reduction, I decompose the annual poverty change into the pure growth effect and the redistribution effect, and present the estimates in Table 4. The growth-redistribution decomposition indicates that the growth effects contributed to alleviating poverty whereas the redistribution effects contributed to increasing poverty. If inequality did not increase, the 2005-2012 growth would have reduced poverty by 1.70 percent. Thus, the recent increase in inequality was responsible of 0.04 percentage points of poverty.

Table 1: Growth-redistribution decomposition

	P_0	P_1	P_2
Growth-redistribution decomposition			
Annual poverty change	-1.66	-2.76	-3.06
Growth	-1.80	-3.21	-3.73
Redistribution	0.14	0.45	0.67

4. Policy framework for value capture and competition analysis

The policy framework identifies a set of policies and institutional arrangements to transform production structure into more efficient and higher value-added activities. The move a natural resource poor country to an industrial and diversified economy requires

investment to upgrade the production structure, improve production efficiency, and educate the workforce to be able to adapt in the subsequent technological development phase (Zoltan, Desai, & Hessels, 2008). According to UNCTAD (2013), the development of productive capacities occurs through three closely related core economic processes that all countries have to undergo if they are to achieve sustained development. These are the investment necessary to build domestic capital stock (physical capital, human capital, and so forth), which economists refer to as capital accumulation; structural change (or structural transformation); and building of the capabilities in the domestic enterprise sector. The main hypothesis of this paper is that developing productive capacities along local value chains can provide a meaningful approach to structural transformation and inclusive growth.

The conceptual framework for the empirical analysis draws upon value chain theory, the *filière* approach (Duruflé G., Fabre R., & J.M, 1988; Hugon, 1985; Moustier & Leplaideur, 1999), and the pro-poor growth framework. The filière approach is of particular interest, as it clarifies the dynamic of value capture and creation along local value chains. Figure 2 below illustrates the major stages of the value chain and identifies key stakeholders and policies to capture value at each stage. This study defines capturing a value as any process or service in the supply chain that involves adding or enhancing the market value of agricultural products to consumers. The concept of value capture within the value chain involves upgrading the product and the process, which can be attained by increasing productivity and value-added produced within the existing local value chain segments. This allows the producer to gain higher value and increases the profitability of traders.

Producing higher value-added food products requires a lot of capabilities and country-specific policies. The most recurrent generic policies in the literature (Felipe, Kumar, & Abdon, 2010; Page, 2012) have highlighted policy intervention to address market failures by developing skills and infrastructure as a basis to manufacture and export high-value products. For instance, Felipe et al. (2010) in their study on how rich countries became rich, in which they categorized 779 products based on their sophistication and connectivity to other products, found that DRC and 74 other

countries belong to the "low product" trap as they mostly export unsophisticated and unconnected products. They conclude that countries in the "low product" need to acquire skills, technology, knowledge, and improve organizational capabilities. Similarly, Page (2012) discussed policies for African economies to reallocate resources to higher productivity activities in the agro-industry, manufacturing, or tradable services. He argued that Africa should focus on pushing exports, building capabilities, and supporting agglomeration in addition to investment climate reforms that aim to reduce the skill and infrastructure gaps. In the same vein, Lin and Treichel (2012) argued that technological innovation, industrial diversification, and industrial upgrading are typically accompanied by changes in capital and skills requirements for firms as well as by changes in their market scope and infrastructure needs due to the evolving nature of production that is embodied in the process of innovation. Put differently, diversification is typically accompanied by changes in hard and soft infrastructure requirements.

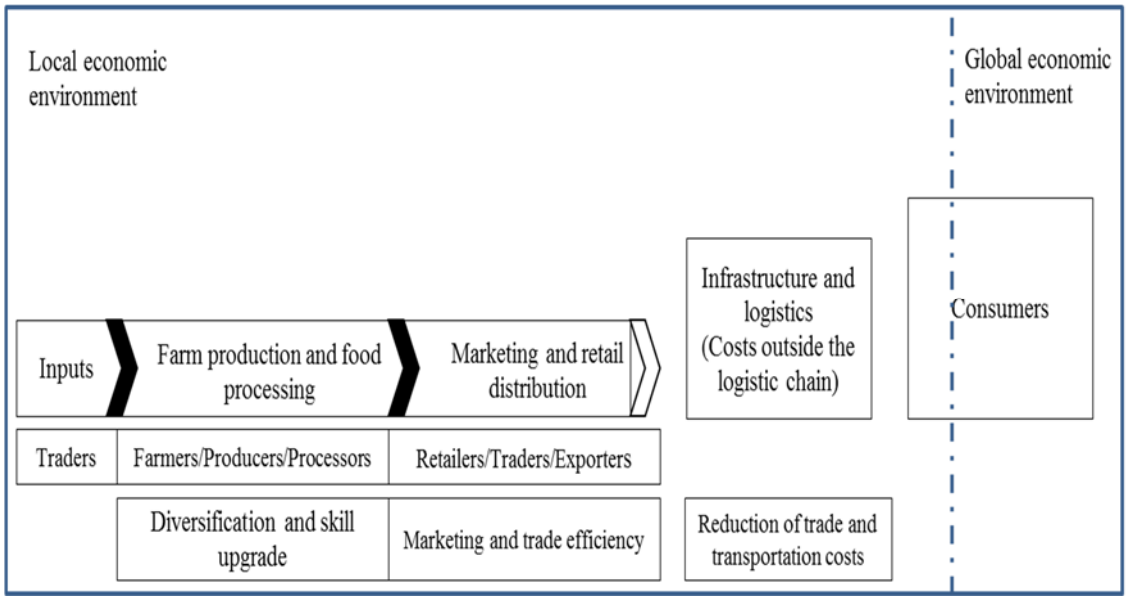


Figure 3: Policy framework of value added capture and competition

Source: Author's creation.

Improved skills enable producers to gain higher value. For example, better technical skill can enable processors to reduce post-harvesting waste and master standard procedures about packaging. In the conceptual framework, labor quality improvements create value for agro-food processors.

The stage of distribution includes transportation, wholesaling, and retailing. Distributors – retailers, traders, and exporters – do not conduct significant physical transformation to the product. They contribute to connect producers to consumers through storage, transportation, and marketing services. The frame thinking on the role of wholesale and retail distribution of agro-food products considers the role of marketing and transportation efficiency. Food marketing includes topics such as segmentation, positioning, brand building, targeting, consumer research, and market-entry strategy. Food transportation deals mainly with a perishable product whose quality and availability varies as a function of the current harvest conditions. Food marketing and transportation efficiency refer to providing consumers with the desired levels of service at the lowest cost possible.

Consumers represent the last stage of the value chain, as they represent the end buyers concluding the chain. However, they play an important role as producers and distributors work for their need. This means that the consumer can act as "pull" factor through demand. Consumers represent an opportunity in favor of diversification as producers succeed in creating the perception of value, it is likely that consumers will pay a premium price for high-value products. Empirically, one can assess the effects of the demand pull factor through the changes in export prices. The change in price is particularly interesting, as it tells whether demand can be met by domestic substitute for products, for which domestic demand is increasing due to a rise in international prices.

Finally, the pro-poor growth framework is valuable to study the distribution of benefits in the economy. The analysis focuses on how the poor benefit relative to the rich as a contribution to the scarce literature on the pro-poorness of value chains. The section that follows presents the empirical methodology in terms of both the model and data and explains how the different economic incentives affect activities and households.

5. A top-down/bottom-up CGE-microsimulation model augmented with a pro-poor growth framework

This section introduces the analytical framework and data used to simulate the effects of institutional arrangements and policies to create value and foster competition in DRC. From a methodological perspective, this study applies a top-down/bottom-up CGE-microsimulation model augmented to incorporate the concepts of skill upgrade and pro-poor growth. The empirical approach proceeds in three steps. First, I assess the economy-wide impacts of policies to create value and foster competition on the DRC's economy using a CGE model. Second, I use the top-down/bottom-up approach to connect the CGE model with the microsimulation model and transmit the CGE output (changes in wages and prices) to the microsimulation model to simulate the welfare changes for all households. Finally, I apply the pro-poor growth framework on the welfare changes in order to examine the pro-poorness of the policy scenarios.

5.1. CGE model

The model applied in this study is a single-country, static CGE model for the DRC economy. The CGE model follows the description in Otchia (2015). In this paper, I will emphasize the presentation of the most important feature of the CGE model, which is the behavior of production activities that integrates the concept of skill upgrade. The specification of production function borrows heavily from Lofgren, Cicowiez, and Diaz-Bonilla (2013) and takes the following form:

$$QV_a = \alpha_a^p \sum_f \left(\delta_{fa}^p \cdot \left(fpr_{fa} \cdot QF_{fa} \right)^{-\rho_a^p} \right)^{-1/\rho_a^p} \quad (1)$$

In this equation, QF denotes the factor (labour, capital, and land) demand quantity, while δ_{fa}^p is the CES value-added function share parameter, fpr_{fa} the productivity of factor, and ρ the substitution parameter. α_a^p is the efficiency parameter.

The CGE model has 21 production sectors and assumes constant returns to scale technology and perfect competition. The model includes three factors of production – agricultural land, capital and composite labor, which in turn, is a nested constant elasticity of substitution (CES) aggregation of 3 different labor types based on formality

(formal and informal) and location (urban and rural). Production in each of the 21 industries is represented by a Leontief function of intermediate inputs and value added. Each sector produces outputs with fixed yield coefficients and allocates them to market sale or home consumption. With regard to marketed production, producers are assumed to optimally deliver output to the domestic and export markets, given the relative prices and the imperfect transformability between exports and domestic sales expressed by a constant elasticity of transformation (CET) function. The producer price of exported goods (called the export price) is the world price adjusted by the exchange rate, export taxes, and transaction costs.

Similar to the export side, the model adopts the Armington assumption of imperfect substitutability between imported and locally produced goods on the consumer side. The consumer price of imports (called the import price) is the world price adjusted by the exchange rate and tariffs, plus the transaction costs per unit of import. Finally, as the DRC accounts for a very small share of world trade, the small-country assumption is adopted for both import and export markets. This implies that the DRC faces perfectly elastic world supply and demand at fixed world import and export prices. On the demand side, the model also makes it possible to account for home consumption of own-production. This property allows modeling the consumption by households of some of their own production instead of selling it at a low price or purchasing similar goods at a high price. Final household demand follows a linear expenditure system (LES) derived from the maximization of the Stone–Geary utility function subject to a budget constraint. Optimization leads to demand functions for marketed commodities and for home-produced commodities. Demand for marketed commodities is represented by an LES function of total household consumption expenditure, a commodity's composite market price, and other commodity prices. Demand for home-produced commodities is free of transaction costs and uses producer prices.

Model database

The database for the CGE model is the 2005 DRC SAM (Otchia, 2013). The construction of the SAM aimed to analyze the basic structure of the DRC economy; hence, the most interesting disaggregation is the production activities. To evaluate

policies for establishing a competitive agro-food industry, I further extended the 2005 DRC SAM in two ways: in terms of trade and transportation service sectors and in terms of the labor market. The methodology to disaggregate the trade and transportation services adopted in this paper is very close to Landes and Burfisher (2009) and consists of separating trade and transportation services used in wholesale and retail sales of agro-food products from all other trade and transportation services.

Table 2: Sectoral analysis for DRC SAM, 2005 (in percentage)

	Production (Q)	Value added	Home consumed share of production	Imports (M)	Exports (X)	M/Q	X/XS
Agriculture	15.55	20.85	31.12	2.57	0.93	3.16	1.32
Forestry	1.72	1.90	54.22	0.02	0.59	0.31	10.07
Mining	10.59	11.82	0.14	7.89	68.18	57.78	98.23
Processed foods	15.39	11.04	29.03	19.51	0.80	15.73	1.02
Textiles	2.21	1.58	0.31	2.35	0.12	15.39	0.69
Wood	0.54	0.52	0.23	0.16	1.59	9.97	51.80
Chemicals	4.70	3.04	0.84	22.71	2.62	40.98	8.53
Non-metals	0.57	0.44	0.12	2.55	0.57	37.71	14.79
Other manufacture	1.83	1.45	0.62	22.46	8.82	62.97	72.81
Utilities	1.10	1.08	0.00	0.02	1.12	0.36	15.47
Construction	5.28	3.90	0.00	0.85	0.03	2.59	0.08
Agro-food trade	1.28	1.45	0.00	0.00	0.00	0.00	0.00
Other trade	9.42	11.75	0.00	0.00	0.00	0.00	0.00
Hotels and catering	2.76	0.57	0.00	1.93	0.15	10.35	0.81
Agro-food transportation	1.95	2.38	0.00	0.97	0.33	1.16	0.42
Other transportation	11.06	11.61	0.00	7.11	3.29	8.48	3.81
Education and health	2.46	3.06	0.00	0.00	0.00	0.00	0.00
Financial intermediation	1.17	0.85	0.00	1.00	0.14	12.44	10.24
Other services	6.44	7.30	38.44	4.77	2.64	18.13	31.88
Personal and other community services	3.88	3.29	0.00	3.13	8.10	16.27	17.41
Private households with employed persons	0.08	0.13	0.00	0.00	0.00	0.00	0.00
All	100	100	12.82	100	100	16.88	19.78

Source: Author's calculations based on the 2005 DRC SAM

Note: M/Q=Imports as a share of domestic demand, X/XS=Export as share in sector output

Table 2 provides basic data on the structure of DRC economy, where agro-food trade and transportation are included as separate accounts identifying agro-food value chain at the level of marketing and transportation services. The table shows small contribution of agro-food trade and transportation to total production, with share of 1.1.45 and 2.48 percent, respectively. Agriculture contributes 15.55% to total production, processed foods 15.59%, transportation 13.1%, but 31.12 percent of agricultural products and 29.03 percent of food are home-consumed. In terms of international trade, imports are mainly for Chemical, other manufacturing, and processed food, which together account for 64.68 percent of total imports. However, imported processed food constitute a small

share of domestic demand as 15.73 percent is compared to 40.98 percent for chemicals and 62.97 percent for other manufacturing. With regard to exports, mining represents about 68.18 percent, and export almost the entire of its production.

Table 3: Sectoral labor shares

Sectors	Urban formal	Urban informal	Rural	Total
Agriculture	0.17	19.63	80.19	100
Forestry	10.48	33.33	56.19	100
Mining	12.50	38.15	49.35	100
Processed foods	11.27	55.74	32.99	100
Textiles	4.50	77.16	18.34	100
Wood	19.01	38.73	42.25	100
Chemicals	35.71	53.57	10.71	100
Non-metals	7.14	64.29	28.57	100
Other manufacture	11.16	63.22	25.62	100
Utilities	68.57	20.00	11.43	100
Construction	19.18	69.86	10.96	100
Agro-food trade	14.21	68.64	17.15	100
Other trade	4.04	83.42	12.54	100
Hotels and catering	16.08	62.24	21.68	100
Agro-food transportation	42.78	45.12	12.10	100
Other transportation	39.49	51.09	9.42	100
Education and health	53.34	7.63	39.03	100
Financial intermediation	53.73	43.28	2.99	100
Other services	38.46	51.65	9.89	100
Personal and other community services	83.82	3.05	13.13	100
Private households with employed persons	28.57	54.20	17.23	100
All	9.61	33.84	56.56	100

Source: Author's calculations based on the *Enquête 1-2-3*, DRC (2005).

As for the disaggregation of labor, I used data from the 2005 *Enquête* 1-2-3. The labor classification in this paper distinguishes three labor types: urban formal, urban informal, and rural. To disaggregate labor, I applied to the total labor value added to the estimated labor shares shown in Table 3. Upon review of the data, one can observe that processed foods, trade, and transportation are mainly urban informal activities.

5.2. Microsimulation model

The aim of the microsimulation model is to generate the distribution of income changes for the 12,098 households from the 2005 household and informal producer survey included in the simulation. The distributional change depends on household endowment and socioeconomic characteristics, the returns to these factors, and the behavior of socioeconomic agents with respect to resource allocation subject to institutional

constraints (Bourguignon & Ferreira, 2005; Essama-Nssah et al., 2007). To account for these effects, the microsimulation model has two components: an envelope model of household welfare and a labor participation model.

Labor participation model

I use the labor participation model to estimate a labor supply model on the rural and urban (formal and informal) markets and identify the main characteristics differentiating these markets. The methodology for the labor market segmentation follows the non-competitive model proposed by Magnac (1991), Savard (2003), Cogneau and Robilliard (2008), and more recently by Atuesta and Hewings (2012).

Table 4 presents the labor market characteristics. These results show that the rural sector accounts for most of the workers (54.03%). This is due to the importance of agriculture in DRC economy, from which most of the activities are located in rural areas. 7.44 percent of workers belong to the urban formal sector, while 38.53 percent belong to the urban informal sector. Table 4 also indicates the choices of workers to participate or not in the labor market. Workers can decide to participate in the urban formal sector, participate in the urban informal sector, or simply not participate in an urban sector. On the other hand, workers who don't participate in the urban labor market can decide to move and to be employed in rural areas.

Table 4: Distribution of employment by sector and labor market

Labor markets	Working hours	Log wage	Migrant (%)	Female (%)	Other job
Urban					
Formal	46.20	11.82	0.49	0.19	0.12
	(18.11)	(1.78)	(0.50)	(0.39)	(0.33)
Informal	43.44	10.94	0.63	0.55	0.11
	(20.77)	(2.24)	(0.48)	(0.50)	(0.31)
Rural	36.45	10.34	0.77	0.50	0.06
	(17.46)	(2.39)	(0.42)	(0.50)	(0.24)
Total	40.90	10.80	0.72	0.49	0.08
	(19.61)	(2.30)	(0.45)	(0.50)	(0.27)

Source: Author's calculations based on the *Enquête 1-2-3*, DRC (2005).

To estimate the potential wages for each labor market and the reservation wage for those who decide to be unemployed, I use the Heckman's sample selection model. This method is a two-step statistical approach to correct for selection bias. This study assumes that, in order to decide whether to work in the formal, informal, or rural labor market or simply to be unemployed, workers must first migrate to either urban or rural areas. Therefore, in the first stage, I estimate a Bivariate Probit model for the joint decision to live in urban or rural areas and to participate in any of the intra-labor markets or to be unemployed. In addition to estimating the probability of a worker to choose a labor market or to be inactive, I calculate the Mills ratio to adjust the covariance matrix during the second stage. In the second stage, I run an OLS with the Mills ratio on the wage equations to estimate the labor supply in each market. Other predictors include household demographics and socioeconomic characteristics. Table 5 presents the results of the labor supply model.[2] The inverse Mills ratio is significant for the two markets, and therefore I cannot reject the absence of selection bias or the fact that the relationship between what is unobservable in the selection has negative effect on wages in either formal and informal markets.

[2] The results of the Bivariate Probit model can be provided upon request.

Table 5: Labor supply model

	Urban informal	Urban formal	Rural employed	Reservation wage
Age	0.0166	0.0147	0.0206	0.0154
	(0.0136)	(0.0139)	(0.0134)	(0.0155)
Age square	-0.000253	-0.000213	-0.000282*	-0.000201
	(0.000163)	(0.000175)	(0.000150)	(0.000206)
Male	0.696***	0.608***	0.638***	0.513**
	(0.193)	(0.219)	(0.133)	(0.248)
Education (year)	-0.171***	-0.162**	-0.0857***	-0.131
	(0.0581)	(0.0725)	(0.0329)	(0.0831)
Education square	0.00672***	0.00700***	0.00154	0.00652***
	(0.00184)	(0.00199)	(0.00193)	(0.00208)
Married	0.00173	-0.0574	-0.0240	-0.0939
	(0.107)	(0.111)	(0.0847)	(0.124)
Household size	0.0322***	0.0369***	0.0326***	0.0402***
	(0.0119)	(0.0122)	(0.0109)	(0.0129)
Mills ratio	-1.659***	-1.287**	1.441***	-1.037
	(0.536)	(0.581)	(0.290)	(0.690)
Constant	12.07***	11.75***	9.163***	11.36***
	(0.685)	(0.783)	(0.355)	(0.864)
Observations	7,150	7,150	7,146	7,150
R-squared	0.021	0.020	0.022	0.020

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Author's estimations based on the *Enquête 1-2-3*, DRC (2005)

Given the potential wages, the cost of entry, and the reservation wages computed using the microeconometric model, workers can choose to migrate to different labor markets based on the following set of conditions:

- rural sector if $w^R > w^E$;
- unemployed if $w^0 > w^E$, $w^0 > w^I$, and $w^0 > w^F - cost_f$
- informal sector if $w^I > w^R$, $w^I > w^0$, and $w^I > w^F - cost_f$ (2)
- formal sector if $w^F - cost_f > w^R$, $w^F - cost_f > w^0$, and $w^0 > w^F - cost_f > w^I$

where w^R is the rural potential wage of worker i; w^0 is the urban reservation wage of worker i; w^I is the informal potential wage of worker i; and $w^F - cost_f$ is the formal potential wage of worker i minus the cost of entry into the formal market,

which is also estimated econometrically. The concept of expected wage used here follows Harris and Todaro (1970), as calculated by Atuesta and Hewings (2012), and it is computed as the product of urban wages and the probability of finding a job in urban areas. Finally, the labor supply is the sum of the workers in each labor market, weighted by the expansion factor of the household survey. They will serve as an input to the CGE model.

Envelope model of household welfare

It is assumed that policy change affects household welfare through the change in domestic market prices, producer prices, and factor income. This assumption in turn implies that the welfare effects depend on household consumption patterns and factor endowments. Changes in labor income (dw_l/w_l), marketed commodities prices (dp_g/p_g), and producer prices (dp_{hg}/p_{hg}) from the CGE model are fed into the microsimulation model to determine the welfare gains or losses of each of the 12,098 households. The first-order welfare change function dW_h/y_h is given as

$$dW_h/y_h = \sum_l \emptyset_h^l (dw_l/w_l) - \sum_g \theta_h^g \left(dp_g/p_g\right) - \sum_{hg} \theta_h^{hg} \left(dp_{hg}/p_{hg}\right) \qquad (3)$$

where $\emptyset_h^l$ is the share of labor category l in labor income of household h,[3] θ_h^g is the share of marketed good g in the total consumption expenditure of household h, θ_h^{hg} is the share of home-produced good g in the total consumption expenditure of household h, and y_h is household income.

5.3. Macro-micro linkages

This study integrates the CGE model and the microsimulation module in a top-down/bottom-up fashion (Savard, 2003). This method creates a bi-direction link between the CGE model and the microsimulation model, which brings consistency between macro and micro levels. This approach starts by solving the CGE model and

[3] Factor income of households includes income from labor, land, and capital. Production income of households does not go to households directly, but through production factors.

transmits its output (changes in price and wages) to the microsimulation model. Once the microsimulation is solved, the output (labor supply and consumption demand) is brought back to the CGE model, and the interactions are done until the two models produce convergent results. In this case, the two models converged after 5 interactions.

5.4. Pro-poor growth analysis

The pro-poor growth framework is used to measure whether a policy change is absolute pro-poor or relative pro-poor. This study defines growth as pro-poor in relative terms if the proportional change in the incomes of the poor is no less than the growth rate in mean income. To be absolutely pro-poor, the incomes of the poor should grow by an absolute amount that is no less than zero. The theoretical framework applied for the pro-poor growth analysis follows the same approach as Duclos (2009) and Araar, Duclos, Audetz, and Makdissi (2009).

Let F_0 and F_1 denote the cumulative distribution function of income before and after a policy intervention. Also let $y_1(p) = F_1^{-1}(p)$ be the p-th quantile function for distribution F_1. Then the growth rate $g_1(p)$ of the p-th quantile after a policy change can be defined by:

$$g_1(p) = \frac{y_1(p)}{y_0(p)} - 1 \tag{3}$$

Now let us recall the FGT indices (Foster, Greer, & Thorbecke, 1984) as given by,

$$P_1(z;\alpha) = \int_0^{F_1(z)} (1 - y_1(p)/z)^{\alpha}\, dp \tag{4}$$

where z is the poverty threshold and α is the poverty aversion parameter. Let us define the poverty headcount index at z as $P_1(z;\alpha = 0)$ and the average poverty gap as $P_1(z;\alpha = 1)$. These poverty indices allow us to define the order of stochastic dominance as indicated in Table 6. Using FGT indices, Araar et al. (2009) show that growth is pro-poor in relative terms if the initial cumulative distribution is larger than the headcount index in the posterior cumulative distribution when that distribution is normalized by $1 + g$. Similarly, absolute pro-poor growth refers to a situation in which the poor gain in absolute terms.

Table 6: Pro-poor growth analysis

Type of growth	Order	Condition
Absolute pro-poor	First	$P_1(z;\alpha=0) \leq P_0(z;\alpha=0),\ \mathrm{z} \in [0, z^+]$
	Second	$P_1(z;\alpha=1) \leq P_0(z;\alpha=1),\ \mathrm{z} \in [0, z^+]$
Relative pro-poor	First	$P_1\big((1+g)z;\alpha=0\big) \leq P_0(z;\alpha=0),\ \mathrm{z} \in [0, z^+]$
	Second	$P_1\big((1+g)z;\alpha=1\big) \leq P_0(z;\alpha=1),\ \mathrm{z} \in [0, z^+]$

Source: Author's creation.

In the empirical analysis, I make use the growth incidence curve (GIC) (Ravallion & Chen, 2003) to assess the pro-poorness of policy experiments. The GIC basically plots the growth rate in the mean income for all percentile of income distribution. In this case, growth is pro-poor if the GIC lies above the null horizontal line for most of the distribution of the poor. In addition, if the slope of GIC is downward, then economic growth contributes to equalizing the distribution of income.

6. Skill upgrade and trade and transportation efficiency are found to be pro-poor industrial policy

6.1. Simulation scenarios

In order to investigate the pro-poor effects of industrial policies that aim to create and add value to agro-food products, I experiment with three different rounds of simulations. On one hand, there are simulations of the upgrading of value-added production, which takes the form of skill upgrade. The first experiment (Scenario 1) simulates a policy intervention that aims to upgrade the skill of workers in the agriculture and food sectors. In the simulation, I depict the upskill scenario as a 10 percent increase in labor productivity. On the other hand, I conduct simulations on the upgrading of value-added distribution. The first simulation (Scenario 2) assumes that DRC adopts innovative methods of marketing agro-food products which creates the perception of value to consumers. The innovative marketing activities aim also to capture value by creating on-farm stores, farmer markets, mail orders, or Internet sales. I implement this

simulation as a 50 percent increase in agricultural marketing efficiency. Finally, in the last scenario simulation (Scenario 3), I assume that DRC adopts modern transportation technology to preserve perishable products and improve the transport logistics system. Policies to modernize the transportation system include refrigerated transport infrastructure, Internet connection, GPS systems, or the intense use of mobile phones in transportation planning, among others. Table 7 provides a summary of policy experiments.

Table 7: Simulation scenarios

Scenarios	Description	Design
1	Skill upgrade	● 10% increase in labor productivity of agro-food sector
2	Marketing efficiency	● 50% increase in agro-food marketing efficiency
3	Transport Efficiency	● 50% increase in agro-food transport efficiency

Source: Author's construction.

6.2. Macroeconomic effects

Table 8 reports the economy-wide impacts of the three scenarios. Scenario 1 postulates regarding the potential contribution of improving labor productivity in agro-food sectors. Theoretically, improved labor productivity has the potential to reduce the effective wage and increase the demand for workers – relative to capital and land – for a given level of output. On the other hand, a fall in production costs due to increased productivity is passed to consumers through lower producer prices, which in turn leads to higher demand, production levels, and actual wages.[4] The results of the model indicate that labor productivity produces the expected positive effects on factor income, with higher benefit going to urban informal workers. The macro results in Table 6 show that a 10 percent improvement of labor productivity in agriculture and food sector would increase the income of urban informal workers by 1.19 percent, while the income of urban formal and rural workers would increase by 0.95 and 0.67 percent, respectively. Under this scenario, capital return increases by 0.58 percent and land return by 0.46 percent.

[4] See Burfisher (2011) for a theoretical analysis of the effect of an increase in labor productivity on employment and wage.

Table 6 further indicates that DRC would see a 0.84 percent increase in GDP if labor productivity in the agriculture and food sector rises by 10 percent.

Table 8: Simulation results – Changes in macroeconomic variables

	Scenario 1: Labor productivity	Scenario 2: Marketing efficiency	Scenario 3: Transportation efficiency
Gross domestic product	0.84	0.95	0.54
Absorption	0.83	0.93	0.53
Private consumption	0.97	0.88	0.51
Investment	0.10	1.34	0.60
Government consumption	0.24	0.74	0.72
Exports	0.37	1.00	0.69
Imports	0.34	0.93	0.64
Exchange rate	0.41	1.16	-0.15
Urban formal	0.95	1.55	0.64
Urban informal	1.19	0.25	0.99
Rural	0.67	2.04	0.59
Capital	0.58	1.46	0.65
Land	0.46	0.61	0.21

Source: Author's calculations.

Scenario 2 stimulates the effects of improved marketing efficiency, which increases the total primary factor productivity in the production of wholesale and retail trade services used for food and agricultural products by 50 percent. Looking at changes in factor earnings in Table 8, one can see that improvement of marketing efficiency in agriculture and food sector generates increases in wages and capital and land returns. The major improvements are found for rural workers (2.04%) and urban formal workers (1.55%) as well as capital return (1.46%). These significant changes in the factor income for the three factors are partly driven by the increase in the value-added prices of the trade sector, which is the second employer in the urban area and employs these factors intensively. Land used in agriculture benefits highly from marketing efficiency, as its return increases by 0.61 percent compared to the 0.25 percent increase in the wages of urban informal workers.

With regard to Scenario 3, which is a scenario of improvement of the transportation efficiency of agro-food products, Table 8 indicates that factor income generally

increases in this scenario, but there is a little variation in the distribution across labor categories. The point of interest of this scenario is that it favors urban informal workers relative to formal workers and rural workers. For example, the income of urban informal workers improves by 0.99 percent, while urban formal and rural workers' income grows by 0.64 and 0.59 percent, respectively. In the same token, capital return increases by 0.65 percent and land return increases by 0.21 percent.

6.3. Sectoral effects

Moving on to the sectoral effects, Table 9 presents the results of the policy experiments on the commodity shown for agricultural products and processed food. Skill upgrade in agriculture and food sector (Scenario 1) generates higher competitiveness gains for domestic producers, as it boosts exports of agro-food products. Table 9 shows that agricultural exports increase to a lesser extent than processed food, which increase by 16 percent, as compared to 15.75 percent for agricultural products. The combined effects of lower consumer price and higher income due to labor productivity growth lead to an increase in the composite commodity supply of agro-food products, which increase by 1.24 percent for agricultural products and 0.89 percent for processed food. Interestingly, the composite supply of agricultural products is fueled by domestic demand, because agricultural imports decrease by 0.51 percent.

Table 9: Simulation scenarios

		Scenario 1: Labor productivity	Scenario 2: Marketing efficiency	Scenario 3: Transportation efficiency
Composite commodity	Agriculture	1.24	1.11	0.34
	Food	0.89	1.72	0.50
Domestic demand	Agriculture	1.29	1.11	0.32
	Food	0.96	1.85	0.48
Exports	Agriculture	15.75	7.19	4.87
	Food	16.00	4.43	3.41
Imports	Agriculture	-0.51	1.02	1.10
	Food	0.52	0.99	0.62

Source: Author's calculations.

Table 9 also reports the results of Scenario 2, which is a simulation of marketing efficiency of agro-food products. According to the model results, domestic demand of agricultural and food products increases by 1.11 and 1.85 percent, respectively. This scenario also leads to an increase of agricultural and food imports by 1.02 and 0.99 percent, respectively. Concerning the transportation efficiency of agro-food products (Scenario 3), Table 9 indicates that improved agro-food marketing efficiency leads to an increase in domestic demand and imports and food and agricultural products as a result of increased income and lower consumer price. Composite supply of these commodities increases by 0.34 percent for agricultural products and 0.50 percent for food products.

6.4. Distributional effects

I now turn the analysis to the pro-poorness of the policy experiments to test whether the policy experiments benefited lower percentiles in the income distribution more than upper percentiles. For this purpose, I make use of the GIC, which allows for plotting the growth rate of living standards across the entire range of percentile of income. In this context, one can conclude that a policy change is pro-poor when the income growth curves lie above the null horizontal line for the p-th lowest percentile of income distribution. In addition, if the slope of the distribution curve is downward, then the policy change leads to income convergence. For each policy experiment, I estimate the distributional effects for the absolutely and relatively pro-poor and conclude that growth is absolutely pro-poor if all percentiles undergo a rate of growth that is positive, while the relatively pro-poor occurs when the income growth of the households at the lowest tail of income distribution is larger than the growth rate in the mean income.

Figure 4 shows the pro-poor effects of skill-upgrade in the agriculture and food sector (Scenario 1). Starting from the absolute pro-poor growth, one can see that the income growth curve lies above the null horizontal line along the income distribution, meaning that changes in income observed at all percentiles in the income distribution are positive. These findings indicate that upgrading skill agro-food products is first-order absolutely pro-poor. In addition, Figure 4 reveals that upgrading skill of workers in the agro-food sector is almost certainly first-order relatively pro-poor. In addition, the findings show that upskilling labor in the agro-food sector leads almost certainly to income

convergence. The First-order relative GIC is positive along all income distribution and downward from the 37th percentile. From a policy standpoint, this shows that upskilling labor reduces national inequality and leads at the same time to an emergence of a middle class.

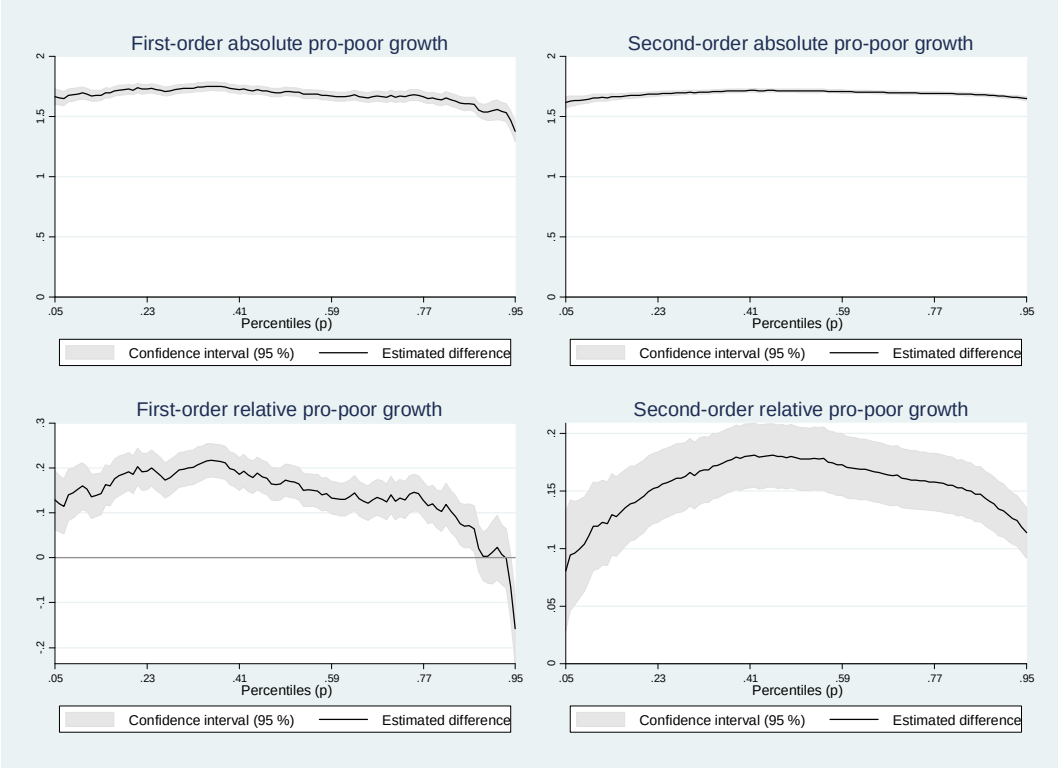


Figure 4: Pro-poor growth: Scenario 1

Source: Author's computations.

Figure 5 presents the pro-poor growth analysis of improving the marketing efficiency of agro-food products. The top panel of this figure, which depicts the first-order absolute pro-poor growth effects, indicates that the distributive changes are absolutely pro-poor. The mean growth rate of the percentile increases by more than 2.5 percent for all of the population. However, the distributive change due to marketing efficiency is not relatively first-order pro-poor. In fact, the bottom panel of Figure 5 indicates that the GIC for the relative pro-poor judgment lies below the zero line for households below the 10th percentile. This means that the income growth of the households below the 10th

percentile is lower than the mean income. This policy scenario benefits mostly households in the middle of the income distribution.

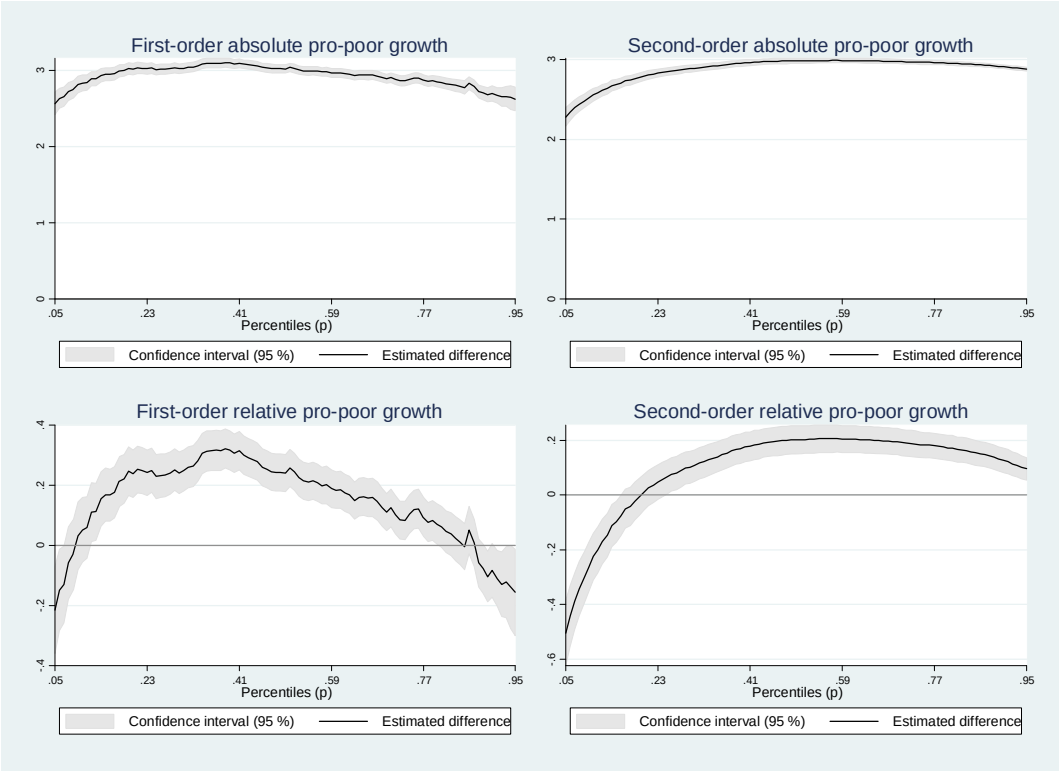


Figure 5: Pro-poor growth: Scenario 2

Source: Author's computations.

With regard to improving transportation efficiency for agro-food products, Figure 6 indicates that the distributive changes are relatively pro-poor as the change increases the incomes of the poor at a higher rate than that of the rest of the population. This is because the GIC lies below the zero line for households below the fiftieth percentile. In absolute terms, the graph portrays that improved agro-food transportation efficiency is pro-poor as the GIC lies below the zero line. Furthermore, it strongly leads to income convergence, since the slope of the GIC is downward.

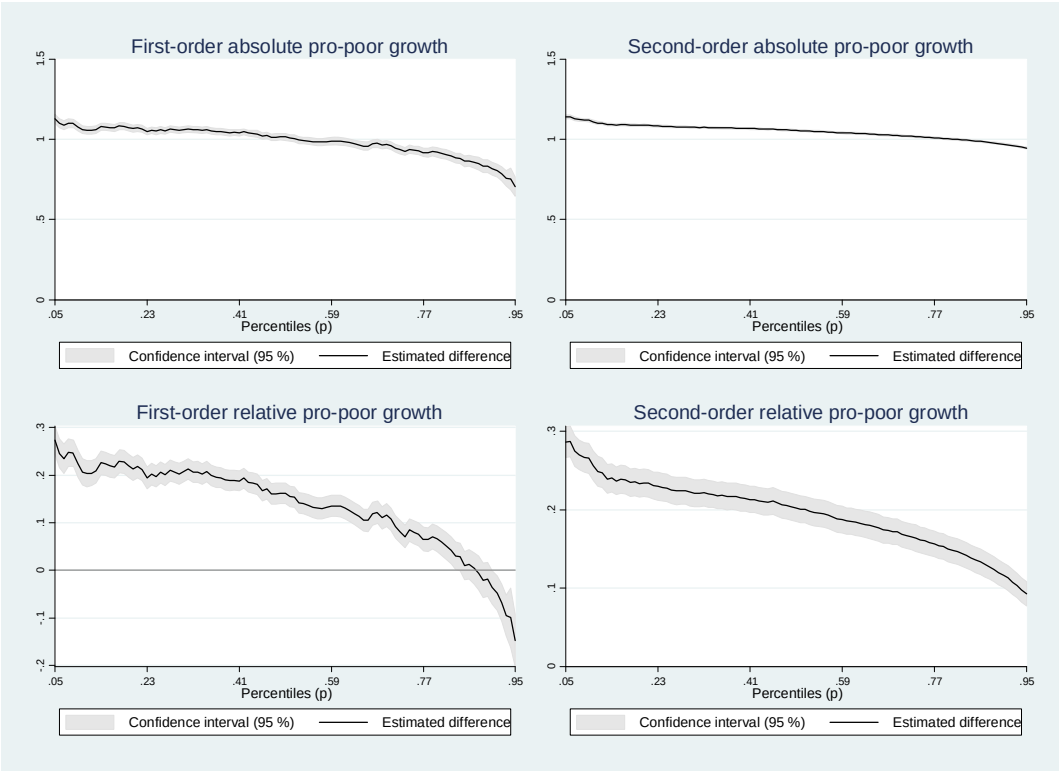


Figure 6: Pro-poor growth: Scenario 3

Source: Author's computations.

7. Conclusions and policy recommendations

7.1. Conclusions

This study used an analytical framework combining CGE and microsimulation models to analyze the growth and distributional implications of institutional arrangements and economic policies to create value and foster competition in DRC. The CGE model was linked to the microsimulation model through a top-down/bottom-up approach, where the CGE top model delivered changes in factor and goods prices to the microsimulation bottom model. Once the microsimulation is solved, the output (labor supply and consumption demand) is brought back to the CGE model, and the interactions are done until the two models produce convergent results. Unlike many other studies on policy experiments using CGE microsimulation, this study went a step further by considering integrating into the CGE model the concept of diversification into higher value added

and by augmenting the microsimulation model to incorporate the concepts of skill upgrade and pro-poor growth.

The results suggest that reforms directed to agro-food sectors would be growth enhancing by making growth more inclusive and boosting consumption, which will also foster structural transformation. Likewise, measures to improve efficiency along agricultural local value chains generate strong pro-poor effects in absolute and in relative terms. The investigation of upskilling labor in agriculture and food sector has shown that this policy has strong absolute pro-poor and almost certainly first-order relatively pro-poor effects. The evidence shows that labor upskill has not only produced strong absolute and relative pro-poor effects, but has also the potential to lead to income convergence, in which poor households' gains were higher than the richer ones.

Another major finding was that marketing efficiency favors the middle class and households at the 5th percentile benefit less than the average population. The reason for this is that improved marketing efficiency of agro-food products generates strong income growth that expanded the demand of food, other manufacturing products, and exports. Middle income groups benefited most due to the difference between domestic prices and import prices. This suggests that improving competition in the local agro-food chains is particularly effective in boosting food demand and exports.

In the case of transportation efficiency, the analysis found that efficiency growth in the transportation of agro-food products generates strong pro-poor effects in absolute and relative terms and is likely to be particularly effective in leading to income convergence. The analysis points to the fact that improved transportation efficiency has the potential not only to increase income and employment, but also to provide positive price impacts for both agro-food producers and consumers and benefits to all households, particularly for low-income households.

7.2. Policy recommendations

DRC government has succeeded to keep inflation in the single digits, specifically at 1 percent through the close of 2013, despite the increase of GDP growth at about 8

percent. Remember that inflation was at 49 percent in 2009 and 11 percent in 2011. DRC has also been able to stabilize other macroeconomic indicators such as the exchange rate, sound fiscal policies, sustainable current account on the balance of payments, and sustainable debt ratios. DRC policy makers should maintain sound macroeconomic fundamentals to mitigate the negative effects of exchange appreciation due to inflows. But more importantly, the government should engage in the following actions:

1. DRC should pursue institutional reforms that would increase its capacity to implement effective industrial policies and strategies and reduce the risk of failure.

The mismanagement of natural resource, the rent-seeking activities since the 1970s, and the extensive corruption and violence that occurred as a result sent DRC down the path of failure.[5] This is because rent-seeking activities moved resources away from growth-enhancing innovation. The experience of East Asia has demonstrated the positive use of rents such that the competition for rents led to learning firms that innovate to become more competitive in the global market. Past development policies have mostly failed in DRC because they were poorly implemented. Recent findings show that governance issues are important as they determine the nature of industrial policy and the instruments to be used. An implication of this is the possibility that industrial policy will be successful when:

- DRC government takes concrete actions to improve its accountability.
- DRC establishes institutions to avoid conflict.
- DRC creates a natural resource fund to finance industrial policy
- DRC increases the effectiveness of institutions to implement policies, especially in manufacturing.

2. DRC should increase the physical and economic access of producers to higher-value markets by investing in infrastructure and market development.

One of the major findings of this paper is that infrastructure development is crucial to increase DRC competitiveness and may create synergetic effects with policy aiming to

[5] State failure here refers to the inability of the state to provide to its people basic services such as health care, security, effective state institutions, human rights, education, and rule of law, among others.

increase value addition. However, DRC is a landlocked, fragile developing country – approximately four times the dimension of France – and is surrounded by nine neighboring countries. This situation poses many challenges but also creates opportunities for trade and development. The following is a set of recommendations for DRC to develop efficient multimode transport infrastructure and increase producers' access to markets:

A) The government should build and maintain rural feeder roads and markets.

B) DRC could implement economic and institutional reforms to improve market access through transit transport and corridors. Given the limitation of funds, DRC should cooperate in the regional infrastructure. In this context, DRC may consider taking the following action:

- Strengthen regional cooperation on infrastructure projects. For example, DRC should show stronger commitment and leadership to the SADC transport corridor project.
- Foster bilateral cooperation to improve transit systems. It is important for DRC to maintain friendships and establish long-term relationships with Angola, Congo-Brazzaville, and Rwanda. RDC should harmonize and standardize trade-related documentation, especially with Angola, due to the language difference.
- Set rules and regulations as well as free trade agreements with Rwanda, Uganda, and Burundi for cross-border trade in the eastern part of DRC to reduce illegal trade and smuggling of agricultural and mineral commodities.

C) Considering its huge network of navigable rivers, DRC should consider the most effective approach to promote domestic rive transportation.

D) DRC should make use of the existing rail network. DRC inherited a fairly large rail network from colonialism. However, the lack of investment and maintenance has reduced operations. Since restoring the rail system requires tremendous investment, DRC may need to make the political decision to privatize the rail network.

3. DRC should improve the quality of education and invest in skill and technological upgrade.

Education in DRC is among the most sectors affected by the 32-year crisis faced by the country. From the 1960s until the early 2000s, the national budget for education declined from 25 percent to 5 percent, creating a decrease of 96 percent in spending per pupil per year in primary and secondary schools (from US$109 in 1980 to US$4 in 2002). In 2010, DRC policy makers decided to make primary education free in public schools and increased the share of the public budget spent on education to 15.02 percent by 2013. Despite this renewed commitment to education as one of the priority sectors, the DRC government should show greater political will in the design and implementation of education programs. On the basis of the findings in the empirical analysis, this study put forward the following three recommendations to improve the contribution of education to productive transformation and inclusive development in DRC:

A. The government should remove the direct and indirect cost barriers for the poor to access free primary education.
B. DRC should develop agro-industry capacity and technological capabilities. DRC may consider performing the following actions:
    - promote vocational training and apprenticeship;
    - accelerate technology transfer in the field of food processing, food packing, and post-harvesting;
    - target scholarships for agro-industry technology and food logistics;
    - target subsidies for food science institutions (schools, universities, etc.);
    - and encourage the acquisition of competency skills through in-firm training.

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