Effects of Reducing Tariffs in the Democratic Republic of Congo (DRC): A CGE Analysis

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Abstract

In this paper, the effects of reducing tariffs are analysed through a Computable General Equilibrium (CGE) model of the DRC. The specific DRC Formal-Informal Model (DRCFIM) is a multi-sectoral computable general equilibrium model that captures the observed structure of the DRC's formal and informal economies, as well as the numerous linkages or transmission channels connecting their various economic agents, such as investors, firms, traders, and the government. The parameters of the CGE equations are calibrated to observed data from a social accounting matrix (SAM). In particular, this study draws the attention of policy makers to a different employment outcome when tariff reduction is taken into consideration. Tariff reduction increases formal employment and output but hurts informal producers. It considerably increases the output and employment of the formal sector by raising import competition without providing further opportunities for the informal sector to access foreign export markets. Nonetheless, it induces productivity improvements when local producers survive import competition by seeking importing input-saving technologies and production practices. These findings highlight the importance of differentiating between the formal and informal sector impacts of the DRC's socioeconomic policies.

JEL Classification: C68, D58, E26, F16

Key words: Informatl Sector, CGE Model, Democratic Republic of Congo

1 INTRODUCTION

Over the past two and a half decades, the Democratic Republic of Congo (DRC), along with several other developing countries, implemented the Structural Adjustment Program (SAP) proposed by the International Monetary Fund (IMF) and World Bank. Since the 1990s when war broke out in the DRC triggered

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by the control of natural resources, unemployment and poverty have been on the rise in the country. Despite this, ever since the Government Action Plan for Natural Resource Law Enforcement, Governance and Trade was implemented in 1992, the population blamed the SAP for causing the heightened poverty of the 1990s. During the reform period it was difficult to point out which policies had an adverse effect on unemployment, poverty and productivity growth, however. This is because a comprehensive range of policies were implemented, ranging from trade to countercyclical fiscal and monetary policies, exchange rate regulations, demand-side interventions, public employment programmes, employment guarantee schemes, labour-intensive infrastructure programmes, wage and training subsidies, and other specific socio-economic policies, frequently at the same time. Because of this uncertainty, it was likewise difficult for policy makers to respond to these growing issues. Evaluating the impact of policy effects does has the benefit of stimulating researchers and policy makers to consider how crucial an impact a policy has on unemployment, poverty and productivity growth, however, thus enabling enlightened informed policy making.

The DRC underwent significant trade liberalisation during the 1990s, however this did not result in any improvements and unemployment and poverty worsened. The economy started to lose impetus and many economic activities fell into the informal sector owing to the lack of opportunities in the formal sector. Economic activities were also hampered by weak institutional capacity that failed to maintain the sustainable development of a dynamic private sector. Tax laws were enforced arbitrarily, which resulted in the informal sector absorbing many people and enterprises. In fact, trade policies made up a significant part of the DRC's economic policies in the 1990s and considerably influenced the changes in economic growth, employment and business opportunities. These policies affected the terms of trade between agriculture and industry, business opportunities, wages, prices and structure of commodities, economic development, and employment within the economic system. These issues are interlinked, and in order to acquire a significant insight of their impacts on unemployment, poverty and productivity growth, a Computable General Equilibrium (CGE) technique is preferred in this paper. To the writer's knowledge there is no work yet that looks at the effects of reducing tariffs and poverty at the formal-informal level in a CGE model in the DRC.

The purpose of this paper is to evaluate the impact of a 5% tariff reduction on employment, poverty and productivity growth in DRC. This is done using a DRC Formal Informal Sector Model (DRCFIM) that is constructed based on ORANI model of the Australian economy. The generic edition of the model, ORANI-G, was developed for CGE modellers by Horridge (2005). The remainder of the paper is organised as follows: we first consider some important country information, and then we provide a brief review of the relevant literature. The next two sections describe the model, and then the simulation results. The last section discusses the paper's conclusions.

2 COUNTRY BACKGROUND

2.1 Introduction

The DRC gained independence from the Belgian colonial power in 1960. According to the IMF (2011), the DRC was one of the most highly developed countries in Africa in the 1960s, coming second after South Africa. Nonetheless, its economy was progressively ruined due to two disastrous wars, which caused the deaths of approximately five million people. In 2011 the country was still ranked among the poorest performers in Africa and ranked number twenty in terms of Gross Domestic Product (GDP). During the 1970s, the government of the DRC adopted a system of tight import regulations because of foreign currency scarcities (World Bank, 2000). In the 1980s, the pressure to open up trade was intensifying as the tight system of regulations had become gradually difficult to manage. Furthermore, low domestic production of commodities and heightening unemployment led to a resolution by the government to adopt a World Bank assisted SAP in 1990. Besides macroeconomic policy reform, the main constituent of the SAP was trade liberalisation, which required tariff reductions. Ever since, trade liberalisation in the DRC has heightened poverty as a result of the uneven distribution of resources and power. According to Mosley (2009), the DRC does not gain from international trade of its own natural resources because much of them are illegally exported. This limits the DRC's participation in the global economy while allowing for neighbouring countries and rebel groups to profit from these resources. High unemployment in the DRC is further attributed to an underperforming formal sector and to the inability of the unemployed to enter informal labour markets; formal sector job creation has failed to keep pace with growing labour force involvement. As expected, the unemployed have turned to the informal sector, with informal employment accounting for 80% of the job creation over the last decade (World Bank, 2010). A summary of the performance of macroeconomic indicators for the period between 1980 and 2013 is reported in Table 1. As seen in the table, the DRC's growth performance has been deteriorating over time, and the country has not progressed much in the last three decades. From 1990 to 2001, the DRC experienced a considerable period of economic recession, with an average GDP growth rate of -5.4%. Indeed the economy collapsed, reaching a growth rate of -13.5% in 1993. In the meantime, current GDP per capita dropped 37.9% from US$204.9 in 1990 to US$127.32 in 2001, and unemployment contracted to approximately 70% (World Bank, 2014). In 2002, economic growth resumed for the first time in thirteen years.

Figure 1 shows that real GDP growth in the DRC has been constantly increasing since 2011 when compared with Central Africa specifically and Africa generally, yet while macroeconomic indicators are positive, the social situation remains lugubrious. The labour market remains very small and real wages are not improving; despite its rich natural resources, the country remains one of the poorest in the world, with low participation in global value chains. One cannot help but suspect that at least part of the reason for economic growth lies in

the fact that high growth is driven by outside investment that could dry up, enhanced agriculture productivity and infrastructure development. Growth has also benefited from the recovery in some facets of the business environment, the development of infrastructure and strong demand. Recently, mining companies have shifted from exploration phase to production phase (World Bank, 2014).

It is important to note that agriculture output declined from the beginning of the reforms. Agriculture is the mainstay of the Congolese economy, accounting for 47.7% of GDP in 2006. The main cash crops include coffee, palm oil, rubber, cotton, sugar, tea, and cocoa. In 2008 the agriculture sector comprised 24.2% of GDP, but by the end of 2013, this had declined to 20.6%. The major drivers of economic growth in the country for the period between 2006 and 2013 were agriculture, mining, wholesale and retail trade, manufacturing and transport, as reported in Table 2. The performance of the mining sector has been stimulated by investment, demand, road construction and macroeconomic stability. The slight rising share of the manufacturing sector can be interpreted as de-industrialisation rather than simply the relative shifts in sector sizes. The other sectors which contribute little to growth are services, construction and electricity. The country is rich in natural resources; currently the country produces natural gas, lead, zinc, gold, copper, and magnesium, and has other resources not exploited to date.

2.2 Labour market

As indicated earlier, the labour market in the DRC is characterised by the high level of unemployment, caused by the underperforming formal sector and the ineffectiveness of the unemployed to penetrate labour markets. According to the IMF (2010), the underemployment rate is estimated at 81.7% of the population. Overall, unemployment and underemployment affect men and women proportionally, despite their level of schooling. Youth unemployment is a major concern because 28% of the unemployed are among the working population under 24 years of age. In addition, the employment rate is fairly low compared to the average rate in sub-Saharan Africa, at 63.1% (50.8% in urban areas as against 68.1% in rural areas). This situation is essentially a result of late entry into the labour market due to more years of education. Women, children and men are equally involved in the labour market (IMF, 2011), and the 1984 census revealed that wage employment accounted for approximately 30% of the total population in1984, which was estimated to be 18 million people (World Bank, 1999). The population increased to 27 million and 60.3 million in1997 and 2007 respectively. In 2009, the total labour force was 24,927,234.6 people, compared to 24,030,006.1 in 2008. In addition, in 2008 the labour force participation rate was 89.4% for males and 54.1% for females; the unemployment rate was estimated at 54.0% of the population for the year 2010. Table 3 reports that agriculture accounts for a considerable amount of wage employment in the DRC, at 53.6% (1984) and 40% (2013) of total employment, but contributed only 10% of GDP in 2006. Nonetheless, it may be of interest to point out that forestry is also a vital activity because 57% of the DRC's land area is covered

by forest. In contrast, industry, including mining, accounted for an insignificant amount of wage employment of 5.3% in 2006, although contributed 54% of GDP in 1996, with petroleum and petroleum products contributing 84.6% of total export revenues (IMF, 2010).

2.3 Structure of tariff rates and balance of trade

During the period of trade liberalisation in the 1980s, tariffs were mostly used as a revenue raising instrument, while specific industries were protected by exchange controls and the reduction of import demand. The tariff structure adopted in 1982 was in use until 2011, although the DRC liberalised its import and exchange controls from the beginning of the 1990s. The main purpose of the new tariff structure was to lower rates and rationalise the band structures, which are summarised in Table 4. The three bands are 5%, 10% and 20%. With the new tariff structure, the DRC government intended to reduce duties on raw materials and other inputs with a view to stimulating economic growth.

Vos and Jong (2003) pointed out that one of the reasons for the failure of major global trade negotiations is that they do not lead to free trade agreements. For a vast country such as the DRC, with an inadequate and inefficient infrastructure, there has been pressure to open up new markets in neighbouring countries. For this reason, the DRC has entered into various bi-lateral trade agreements and is a member of the Southern African Development Community (SADC), the Common Market for Eastern and Southern Africa (COMESA), the Central African Economic Community (CEEAC) and the World Trade Organisation (WTO). However the DRC does not get involved in the COMESA or the SADC free trade region because its government depends heavily on tariff revenues. According to the WTO (2013), the country's average applied tariff rate was 12% in 2008. All its tariffs are *ad valorem* and charged on a cost, insurance and freight (CIF) basis. A new value-added tax (VAT) ratio of 16% came into effect in 2012, replacing the previous consumption tax. VAT ratio was implemented in that year in order to meet the increased need for revenue by the government. The introduction of VAT should generate more revenues and appears to be more transparent than the previous consumption tax system. Nonetheless, enterprises fear that it could lead to price inflation. Despite the tariff structure and implementation of VAT, several taxes are collected on imported goods by different government agencies. These additional taxes paid by importers on goods and services average between 10% and 40%. Moreover, the DRC Customs Authority evaluates and collects tariffs and duties based on determined rates under the country's tariff band. On the other hand, the Import-Export Control Agency imposes a 2% tax on the CIF value of all imported goods with an excess of US$2,500, plus an extra charge of US$5 per ton of goods, and applies a sliding scale for imports valued less than US$2,500. Consequently, importers of duty-free goods must also pay an *ad valorem* administrative fee of 5% (WTO, 2013).

It may be of interest to point out that complex regulations, burdensome and complex bureaucracy, inefficient customs administration and corruption

add to the cost of trade, and there is substantial unrecorded trade in the DRC. According to the WTO (2010), fifteen points were deducted from the DRC's trade freedom score to account for non-tariff barriers. The weighted average tariff rate was 11.4% in 2010. Past moderation of trade constraints has been an element of concern in the DRC.

Figure 2 presents the DRC's balance of trade for the period between January 2005 and January 2014. The DRC Central Bank recorded a trade surplus of US$101.50 million in 2013. Balance of trade averaged US$63.30 million from 2001 until 2013, reaching a peak of US$556.30 million in 2011 and a record low of –US$578 million in 2009. The DRC's average trade surplus reflects the country's export of oil, diamonds, gold and other raw commodities. The DRC is a net importer of consumer goods and its main trading partners are the European Union, Belgium and France, followed by China, South Africa and the United States. As indicated earlier, there is significant unrecorded or under recorded trade in goods and services, especially in the east part of the country across the borders with Tanzania, Burundi, Rwanda, and Uganda (BCC, 2014).

Furthermore, the trade deficit worsened from 6.6% of GDP in 1998 to -5.6% in 2006. As soon as it decreased considerably by more than US$468 million, the shadow balance mounted at more than US$355 million in deficit. The profits balance likewise indicated a loss accumulated to US$293.7 million (IMF, 2011). For instance, the DRC was ranked the 136th export market for goods from the United States of America (US) in 2011. US goods exports in 2011 were US$166 million, up 78.3% from the previous year. Consequently, its imports from the DRC were US$606 million, up 14.8%. The US goods trade deficit with the DRC was US$439 million in 2011, up US$5 million from 2010. Its stock of US foreign direct investment (FDI) in the DRC was US$129 million in 2010, down from US$169 million in 2009 (WTO, 2013). In addition, the DRC's trade integration ratio was 45.9% during the 1990s compared to 92.8% in 2007—higher than the Sub Saharan African (SSA) countries (88.4%) and low-income groups' (80.1%) averages. With an absorption index of 38.4, the DRC's export base seems relatively varied, but nevertheless remains subjugated by primary commodities. The DRC's major products exports are nonferrous ores, diamonds, coffee, and crude oils. A prominent example is that services accounted for only 7.1% of total exports in 2007. The country's main imports are mining, machinery, transport equipment, and food products.

3 RELEVANT LITERATURE REVIEW

According to Wiley (2012), tariffs and duties imposed by countries to generate revenues and protect selected industries make cross-border trade less desirable; they shelter domestic producers and restrict consumers to local supplies. Scores of the benefits of increased trade, such as major choice, lower prices and stronger economic growth, could be realised even if tariffs were reduced unilaterally. Compared to lowering non-tariff barriers, it would be much easier for countries to cut tariffs and duties. Countries can easily boost trade by reducing

tariffs, thereby raising incomes and tax revenues. They can also attract foreign investment by reducing business and labour regulations, increasing transparency and accountability, and speeding up border traffic. In addition stronger trade links between countries promote peace, as trading nations that are economically dependent on each other are less likely to dispute and more likely to grow.

Tariffs and subsidies in the developed world are typically much lower than those in the developing world. The ability to import less expensive raw materials for use by an emerging industrial sector would boost the cost competitiveness of both domestic sales and exports (World Bank, 2001). According to the United Nations Conference on Trade and Development, Africa's share of world trade was tiny—only 3% in 2009. Intra-African trade made up only 10% of total African trade. This stands in stark contrast to 22% between developing countries in South America, and 50% between those in Asia (World Bank, 2013). Because of regional alliances, countries have been obligated to make trade easier by removing tariffs and other barriers to trade. Progress in removing tariffs has had some success in Africa, for instance SADC implemented a free-trade agreement in 2008, removing tariffs on 85% of goods traded between member states. Yet non-tariff barriers are even worse obstacles to greater African trade. Losses incurred by businesses and governments due to delays, complex documentation requirements and unpredictable procedures at borders caused higher costs than tariffs in 2010 (WTO, 2012).

Numerous theories have been formulated to explain the impact of trade liberalisation on employment, productivity growth, export performance and poverty. The traditional theory postulates that reducing import and export impediments can improve welfare due to specialisation gains and consumption gains. However, this theoretical framework requires that the assumption of perfect competition holds in addition to the absence of other market imperfections such as externalities, public goods or uncertainty. This is a condition that is unlikely to hold, particularly in developing countries. In such a situation, a second best alternative could be to restrict trade. The new trade theory relaxes the restrictive assumptions of perfect competition and the absence of market failures which underlie the traditional theory (Krugman, 1996; Klodt, 1986). Under imperfect competition setting, restriction on trade may improve welfare. The neoclassical growth theory predicts that trade liberalisation will increase the long run per capita income, but not the long run growth rate. In a sense it predicts that the impact of trade liberalisation on productivity growth is short lived (Slow, 1956; Barros, 19992; Swan, 1996). Endogenous growth models, however, are able to explain the long term impact of trade liberalisation on growth in terms of endogenous technical progress and positive externalities linked to constant, or even increasing, returns of diminishing returns of the accumulated factors (Romer, 1986; 1997). Positive externalities lead to the result that once-off improvements in efficiency can cause a permanent increase in growth rate of output (World Bank, 1997). However, under endogenous growth theory, trade liberalisation can also lower output in instances where a country has a comparative disadvantage in innovation and imitation. Bhattacharja (2000) has extended the Mankiew and Whinston model to an open economy, allowing for exit and

entry and the possibility of a divergence between social and private costs to cast doubts on the view that trade liberalisation promotes welfare. In fact one of his concluding remarks is that tariffs are superior to free trade. Similar results are obtained from the Dixit and Pindyck (1994) model reviewed in his paper.

Edwards (2001) used input-output analysis and showed that trade liberalisation has a positive effect on output growth with respect to South Africa. Although the opening of trade leads to a loss in domestic production, these are outweighed by exports. These findings were contradicted by Arias (2003), however. In his paper he considers both trade induced factors and localised endogenous growth factors, and defines the latter as the effect of the location of a particular urban manufacturing on Northern Mexico border close to where the markets are located. Using pooled data for the periods between 1975-1985 and 1985– 1993, he applied panel data analysis and concluded that economic activity of manufacturing centres in the largest cities did not experience a fall in productivity growth as firms relocated to the North where there was better access to foreign markets. Based on this he concludes that the North American Free Trade Agreement (NAFTA) did not promote a higher rate of productivity growth. The importance of exports in fuelling economic growth is contradicted by the findings of Ruiz-Napoles (2001) with respect to Mexico, who also used input output analysis to study the impact of exports in the production in Mexico. The findings suggest that the impact of exports on domestic production is insignificant and is offset by imports induced by exports. He also notes that the negative balance in the manufacturing sector has been growing independent of the exchange rate policy, due to an increase in inputs simulated by the opening up of trade.

Santos Paulino (2002) estimated the impact of trade liberalisation on export growth in developing countries using dynamic panel data, where he considered the removal of export duties. The econometric analysis also entailed the use of dummy variables to measure before and after trade liberalisation. He concludes that export duties as an indicator of trade distortions only negatively affects export growth marginally. On the other hand, trade openness has a strong positive impact on export performance. Furthermore, that liberalisation makes little difference to the sensitivity of exports to real exchange rate changes. Moreover, external demand has a strong positive effect on export growth, and that there is evidence that trade openness increases the sensitivity of exports to income changes.

Using micro simulations, Ianchovichina *et al.* (2002) measured the extent to which CGE models map factor income to different types of households with view to analyze different policy changes in several developing nations. Starting all tariffs at zero, the results shows a decline in most prices of various goods. Although return to labour capital increased that of land and natural resources declined. Demand increased in sectors where price level fell. Although average income increased skilled labour wages increased compared to the unskilled. Fall in price benefits the poor who in turn increase their consumption level. The simulation results also show that the incidence of poverty increased marginally.

Litchfield *et al.* (2003) used a conceptual framework which linked trade lib-

eralisation to poverty, and exploits detailed household survey data for more than one period to examine the impact of agriculture and other trade liberalisation in Vietnam, China and Zambia. He employed two key mechanisms from trade to household living standards identified as price changes, and wage distribution between skilled and unskilled labour and employment level. In the case of Vietnam the analysis shows that the incidence of poverty declined. As export levels increased, in certain sectors export prices also increased and fell in others such as fertilizers. In this case trade liberalisation was effective.

Regarding the DRC, the important structural change over the past two decades has been the progressive dismantling of tariff and non-tariff barriers that have sustained the manufacturing sector. Reducing tariffs can lead to a re-allocation of resources from import-competing to export sectors. Greenaway and Milner (1986) indicate that tariff reductions can serve as an influential instrument in enhancing intra-industry trade. Chitiga-Mabugu (2001) pointed out that during structural changes, various policies that include trade liberalisation have been implemented simultaneously in most developing countries. Consequently, trade reforms in the form of trade liberalisation are assumed to have led to increased unemployment and heightened poverty. Before we delve too far into an argument supporting tariff reductions, these findings have been applied in some cases to argue against specific policies incorporated in a reform package, along with trade liberalisation. Nonetheless, classical economic theory affirms that unemployment should drop following a liberalised trade system because remuneration of the unskilled labour increases proportionally to that of the capital and skilled labour in developing countries (Stifel *et al.*, 2003). Although Rajan and Bird (2002) mention a valid stimulating factor associated with increasing efficiency, they argue that trade liberalisation should improve growth and possibly reduce poverty. It is therefore imperative to test if it is trade liberalisation or other policies that influence the heightened poverty and unemployment characteristic of structural change phases. There are various means through which trade liberalisation influences incomes and poverty, yet Winters (2000) and Reimer (2002) indicate that the linkages between trade and poverty depend on factors such as the price, income, and availability of goods; changes in terms of trade; and government transfers affected by variations in revenue from trade taxes.

Davies and Thurlow (2011) point out that trade liberalisation adjusts the structure of the informal sector by shrinking product market capacity for informal entrepreneurs, providing opportunities for informal traders, and stimulating informal entrepreneurs to look for available jobs in the formal sector. Despite new employment opportunities in the formal sector, trade liberalisation has an adverse impact on the informal sector because it decreases employment in the country. This is supported by Bhorat (1999) and Edwards (2001), who found that trade liberalisation decreased industrial employment, although only marginally. Beyond their policy implications, this highlights the need for policies to support further employment creation and raise incomes among poor households.

Yet some researchers disagree about the existence of the relationship between trade liberalisation and poverty (Rajan and Bird, 2002; Rattsø and Torvik,

1998). They argue that assessing various linkages in one study is huge task, because the results of previous studies have hidden sharply divergent outcomes with no strong evidence that trade liberalisation will increase poverty or that the poor will definitely benefit from it. A CGE model has been used widely to empirically assess the effect of trade liberalisation in some countries. This model has the advantage of capturing linkages in labour markets, various economic actors and the rest of the world.

In this paper we developed a CGE model with a specific database composed of a 2007 SAM, which incorporated the formal and informal sectors. The main reason for this was that we did not find any previous research reports indicating the existence of linkages between the formal and informal sectors in the DRC, and limited studies on trade liberalisation in CGE models have been done in the DRC. Ngeleza and Muhammad (2009) studied the free trade agreement involving the Monetary Community of Central Africa and the European Union, and found that the DRC's trade agreements need to be harmonised and be in line with a trade partner's bilateral agreement. Their research did not focus on tariff reduction and competition in product markets in the formal and informal sectors. These shortcomings are directly addressed in this paper. Nonetheless, similar types of study were conducted in South Africa by Davies and Thurlow (2011) and Chitiga-Mabugu (2007). The Davies *et al.* (2011) CGE static model included the economy wide linkages between the formal and informal economies, while accounting for different types of informal activities. Their findings indicate that trade liberalisation reduces national employment, while at the same time increasing formal employment, hurting informal producers, and favouring informal traders who benefit from lower import prices. On the other hand, Chitiga-Mabugu (2007) investigated the short and long term effects of trade liberalisation using a dynamic micro simulation computable general equilibrium method. Their findings indicate that a complete tariff removal on imports has negative welfare and poverty reduction impacts in the short run, which turns positive in the long run due to the accumulation effects. Our paper assesses a policy of trade liberalisation, which implies a reduction of tariff rates to a lower uniform rate and the removal of foreign exchange controls. Our model, as with most of these models, can only provide results pertaining to average changes in income distribution after policy shocks.

4 MODEL DESCRIPTION

Previous CGE models (Pagan and Shannon, 1985; 1987; Wigle, 1991; Harrison and Vinod, 1992; Harrison, Jones, Kimbell and Wigle, 1992; DeVuyst and Preckel, 1997; Horridge, 2005; Logfrem, 2001) required a database, a description of the solution procedure, a brief description of the data, and software such as the General Equilibrium Model Package (GEMPACK) or the General Algebraic Modelling System (GAMS). Most of these models focussed on the values of exogenously assigned elasticity parameters, while the calibrated parameters – those that are obtained from combining elasticity information with

flow or stock data – have been essentially problematic to assess. We followed the technique used by Horridge (2005) and we used GEMPACK to construct a DRC Formal-Informal Model (DRCFIM) because of the considerable uncertainty surrounding the data used for calibration of parameter values. This uncertainty arises through measurement error and is amplified by the consistency adjustments made to the data so that they meet the equilibrium conditions of the model. We solved the uncertainty by using the neoclassical modelling tradition that was originally presented in Dixon *et al.* (1977). This framework has been extended to allow for several new features, such as the home consumption of non-marketed goods, the explicit treatment of transaction costs, and the ability of producers to produce more than a single commodity. Given that this paper offers a direct application of this generic model to the DRC context, the particularity of the DRCFIM is that it is a multi-sectoral CGE model that depicts the reflected structure of the DRC's formal and informal sectors, along with a diversity of linkages between various economic agents such as government, investors, traders and enterprises. This model is a system of equations that depicts the performance of the DRC economy, encompassing all major industry groups, markets and institutions. As indicated earlier, it is a comparative-static model by all accounts. Besides using its own core database, the DRCFIM is based on the 2007-SAM, which reconciles a wide variety of data sources such as national accounts, household surveys, and labour force surveys. The SAM consists of comprehensive data on demand and supply for 15 activities or commodities in both the formal and informal sectors. The labour component was divided between the formal and informal sector. Four labour groups were specifically identified in each of the formal and informal sectors, namely: (1) subsistence factor, (2) child labour, (3) female adult labour, and (4) male adult labour. The household sector of SAM was disaggregated according to income into rural and urban areas with four groups in both the formal and informal sectors, i.e. (1) rural poor households, (2) rural non poor households, (3) urban poor households, and (4) urban non poor households. The land component was also divided between the formal and informal sectors.

Further information provided by this particular economy-wide database relates to the differentiation between formal and informal economies in the areas of production, trade and incomes. Household consumption demand was divided into demand for formal and informal goods, using specified informal market consumption shares from the Household Survey (BCC, 2008). The model has a theoretical composition which is typical of a static model, and is comprised of equations portraying periodical equations such as producers' demands for produced inputs and primary factors, producers' supplies of commodities, demands for inputs to capital formation, household demands, export demands, government demands, the relationship of basic values to production costs and to purchasers' prices, market-clearing conditions for commodities and primary factors, and numerous macroeconomic variables and price indices. The database absorption matrix distinguishes the following economic agents:

(1) Local producers composed of various industries;

(2) Investors from various industries;

(3) One typical agent household;
(4) A comprehensive foreign purchaser of exports; and
(5) An 'other' demand type, generally equivalent to government.

As far as the modelling of different economic agents is concerned, one must take into account the relationship between commodities and activities. The database makes provision for two kinds of transactions on a sectoral level, namely the purchase of intermediate and primary inputs on the one side, and the supply of intermediate and final outputs on the other.

As described by Horridge (2005), the production structure of the model allows each industry to produce a number of commodities and make use of local and imported commodities, labour of different kinds, capital, and land as inputs. There is a distinction between the commodities selected for exports and those for local consumption. The production function is constrained to a system of nests based on particular assumptions. Figure 3 illustrates that the Leontief production function is used to combine commodity composites, primary factor composites and 'other costs'. In this respect, the commodity composite is basically an intermediate input represented as a constant elasticity of substitution (CES) function of a domestic good and the corresponding imported good. The primary-factor composite is a CES aggregation of land, capital and composite labour. In fact, formal and informal sectors consider this to be a general production system, but input shares and behavioural factors can differ between industries.

As mentioned above, the production function includes commodity composites, primary-factor composites and 'other costs', which are linked using a Leontief production function. Thus a proportional input is demanded for every single category of the intermediate, primary and other costs (Horridge, 2005).

As for the household, the structure of its demand indicates that commodity composites can be combined according to the Klein-Rubin utility function instead of the Leontief function, which leads to the linear expenditure system (LES). The outflow on every single product is a linear function of prices and expenditure.

The modeling of export demands is done through the subdivision of commodities into two categories. The first category consists of *conventional* exports composed of primary products, while the second category consists of *non-conventional* exports. The largest share of total output for most commodities goes to conventional exports, while the smallest share is total output for *non-conventional* export commodities. In this model, we exogenise the commodity composition of aggregate *non-conventional* exports by considering *non-conventional* exports as a Leontief aggregate.

The model contains numerous variables associated with every flow of goods and services between industries and final users. These variables are endogenous and exogenous. DRCFIM's detail related to both endogenous and exogenous variables is used to address the considerable number of questions of relevance with the formal and informal sectors.

Previous studies show that the shock in import prices has been used to analyse the effects of tariff reduction (Davies and Thurlow, 2011; Chitiga-

Mabugu, 2007). In this respect, we assess the effects of tariff reduction in the DRC by reducing import prices by 5% across all industries. Although Mai (2003) used the same percentage to analyse the tariff reduction in China, we could not find any previous study related to tariff reduction in the DRC. For this reason we applied a small tariff reduction based on the realities of the country, and the required impact is in line with the DRC's tariff composition. A 5% reduction in import prices can be used as a basis for developing 'what if' scenarios for the economy as part of designing and implementing trade liberalisation policies. We allowed the import price to decrease by shocking the variable "pImp" (import price) in the model. This variable is declared exogenous in our command file because in ordinary simulations the price variable is endogenous, and cannot therefore be shocked when the specific hypothesis that needs to be tested within a simulation is not appropriately specified in the closure. We solve the problem by imposing the import price on all imports from the rest of world uniformly across all industries. Moreover, it should be noted that the equations are in percentage changes form. The equations calculating the tariff reduction in the DRCFIM model are presented below:

$$\begin{array}{rcl} & & E\_xImp(all,e,IMP)(all,i,IND) \\ xImp(e,i) & = & xIMP\_e(i) - CESM(i) * [pImp(e,i) - pImp\_e(i)] \end{array} \tag{1}$$

$$\begin{array}{c} E\_wImp\_e(all,i,IND) \\ ID01[VIMP(i)] * wImp\_e(i) = sum\{e, IMP, SAM(e,i) \\ *[pImp(e,i) + xImp(e,i)]\} \end{array} \tag{2}$$

$$E\_pImp\_e(all,i,IND)wIMmp\_e(i) = pImp\_e(i) + xImp\_e(i) \tag{3}$$

Where

xImp(ei) is the firm demand for imports

pImp(ei) is the import prices

CESM(i) is the constant elasticity of substitution between ROW and ROD imports

pImp_e(i) is the price import composite

xImp_e(i) is the quantity import composite

wImp_e(i) is the expenditure on imports

- Equation (1) represents the trade liberalisation for industry i. It is determined by the quantity import composite less the multiplication of the constant elasticity of substitution between Rest of the World (ROW) and imports, with the differential obtained from subtracting the price import composite from the real import prices.

- Equation (2) represents the expenditure on imports. It includes the sum of import prices with the firm demand for imports multiplied by the firm import cost.

- Equation (3) represents the impact of the import prices. It considers the sum of the price import composite with the quantity import composite.

In our model, commodities destined for export are distinguished from those for local use. The multi-input and output production specification is kept manageable by a separability assumption. The assumption of *input-output separability* implies that the generalised production function for some industry represents an index of industry activity. According to the World Bank (2010), the DRC-applied simple and import weighted tariff averages are classified in the same category as the low-income country group means. Therefore, tariffs remain a dominant tool through which government can considerably influence global trade and product market incorporation, although they are not essentially the primary obstacle to economic incorporation. In addition, tariffs constrain imports and create a wedge between local and foreign prices.

4.0.1 Closure and shock

Within modelling methodology, the assumptions about exogenous and endogenous variables are known as 'model closure'. We established a suitable closure with a view to testing the effect of tariff reduction in the DRC economy. Many closures can be used for different purposes, and there is no unique natural or correct closure. Nonetheless, the hypothesis of testing the impact of a tariff reduction in the DRC economy was performed within a short and long run setting. The main reason for using a short run closure is that a number of sector studies find that trade liberalisation reduces industrial employment, albeit only slightly (Bhorat, 1999; Edwards, 2001).

4.0.2 Short run closure

Figure 4 below illustrates the main assumptions highlighting the relations between endogenous (oval) and exogenous (rectangular) macroeconomic variables in the model's short run closure. With the closure denoted in Figure 4, it was assumed that there were more variables than equations. Thus, to close the model, we chose which variables must be exogenous or endogenous. The exogenous variables were set while the endogenous variables are explained by the model. The number of endogenous variables must equal the number of equations.

On the national expenditure side, real household consumption, real aggregate investment, and real government consumption are exogenous. The trade balance is endogenous. Technological change variables and all tax rates are exogenous to the model. Furthermore, land, capital and imports are in elastic supply at fixed prices.

On the income side, GDP is obtained from labour, primary-factor efficiency, capital stocks and land. In a short run simulation we hold capital stocks fixed.

The idea is that capital stocks take some time to install - too long for them to be affected, in the short run, by the shocks. Short run closures often also allow for rigidities in the labour market: in this case by holding real wages fixed. The length of the 'short' run is not explicit, but is usually thought to be between one and three years. Constant real wages in the short run closure determine employment. The model allows the land to adjust and also allocates fixed investment following endogenously determined rates of return (ROR).

Horidge (2005) described the role of variables in the short run closure. The equations and variables in the model refer implicitly to the economy at some future time period. For instance Figure 5 illustrates the values of employment variable against time. A is the level of employment in the initial period and B is the level which it would reach in T years' time if a policy related to tariff reduction is not implemented. With the tariff shock employment would reach C, all other factors being equal. In a comparative-static simulation, our model might generate the percentage change in employment 100(C-B)/B, showing how employment *in period T* would be affected by the tariff shock only.

The effect of tariff reduction is better assessed through shocking the appropriate variable in the model. Usually there are no definite formulas for establishing the level of the shock and interpreting macroeconomic results, although one explanation can be provided to justify the choice of the shock (5%). It is essentially important to set the boundary within the scenario context and to identify the kind of variables, especially those which are affected by the shock, to provide realistic results from the simulation. Thus the government can provide a policy on trade liberalisation based on the effects of tariff reduction. In the command file, we perform the shock by setting "pImp (*"ImpROW"*, IND)" = **uniform** -5". As indicated earlier, the 'pImp' represents the import price variable for industry, "ind". The *"ImpROW"* is the import from the rest of the world and "-5" means that import price from the rest of the world is reduced uniformly across industries.

4.1 Long run closure

In the long run closure, capital stocks are free to adjust in such a way that fixed rates of return are sustained. An open capital market is implicitly assumed, since there is no link between capital formation and domestic saving. Standard modelling assumptions indicate that real wage rates adjust to keep employment fixed in the long run. This means that the tariff reduction has no long run effect in aggregate employment. Any long run changes in the labour market are revealed as changes in real wage rates rather than as changes in employment. This would be consistent with the idea that both the labour force and the rate of unemployment are, in the long run, determined by mechanisms outside of the model.

Household and government expenditure move together to accommodate a balance of trade as a fraction of GDP which is fixed. This means that in the long run, the rest of the world might be hesitant to sponsor a bigger trade deficit. Aggregate investment follows the aggregate capital stock (Horridge,

2005). Other exogenous variables include price and quantity shift variables, rates of production tax and technological coefficients.

4.2 SIMULATION RESULTS

4.3 Macroeconomic results

The simulation conducted is a tariff reduction in which import prices are reduced by 5% in the model. The results of short run (SR) and long run (LR) policy simulation on various macro-economic variables are reported in Table 5. As we would expect, gross domestic product, exports and employment rise. The policy simulation results show that the GDP increases by 0.57% and 0.61% in the SR and LR respectively from the baseline economy. This means that output increases and domestic prices drop in most sectors, reflecting more efficiency and lower costs per unit of output. Greater efficiency increases output in all formal sectors resulting in increased real GDP, both in the SR and LR. The domestic price is composed of the producer price and indirect tax. In this respect, the import price and the domestic price form the composite price for the composite commodity. The domestic import price is the world price adjusted by the exchange rate and import taxes. The effects of reducing tariffs will thus have an impact on the composite price. Output price affects the export price and is itself affected by input prices. Given constant real government consumption, the significant level of real GDP allows consumers to enjoy a higher level of consumption. The productivity improvements based on the tariff reduction causes the output prices to decrease, while also causing consumer inflation to decrease by 0.99% in the SR. In fact, the advantage of the tariff reduction is that it causes producers to improve competitiveness, which stimulates a considerable improvement in exports following an increase in export volumes by 12.1% and 5.73% in the SR and LR respectively. Our expectation is that export volumes should increase because tariff reduction plays an important role in trade liberalisation. All sectors benefit from the tariff reduction and increase in exports. This is also due to the terms of trade decrease as the price of exports decreases. Furthermore, import volume increases by 5.63% and 5.15% in the SR and LR respectively, which in turn improve the productivity capacity by showing an increase in GDP. This result is in line with the findings of the previous studies which show that the DRC economy is very import intensive (World Bank, 2007). The rise in income creates demand for imported goods, however the balance of trade is on the positive side with a slight increase of 1.47% and 0.82% respectively. Overall, tariff reduction has a considerable impact on GDP and employment. Households in the formal sector can consume more as employment increases in the SR and consumer price levels decline. Results of tariff reduction show output having a significant positive impact on employment in the SR. The expansionary economy, coupled with rising export demand, raises the demand for factors of production. The increase in employment (0.56%) represents an increase of labour in the production process, especially in the formal sector. Nonetheless, producers can protect their labour force by means of labour

saving technological change enhancements. In addition, the unit cost of labour can also be improved through tariff reduction without necessarily reducing the growth rate of the average real wage. In this respect the competitiveness can be stimulated from the production side, with a view to shifting from the local market to exports.

The simulation results show that the tariff reduction causes employment and production to increase in the formal sector. This is in line with the results of previous studies (Davies and Thurlow, 2011). The total production in the case of the DRC conceals divergent effects for formal and informal sectors. In this respect the total production increases considerably, showing a similar increase in employment. Consequently, formal sector producers and their workers profit from enhanced penetration to foreign export markets. The increase in the total GDP generates new formal sector employment opportunities in the SR. In the context of the current analysis, tariff reduction stimulated both the formal and informal sector to enhance trade in the country. Producers from the formal sector profit the most from the policy simulation shock because it is only the formal sector that is involved in foreign exports. Thus, while production increases in the formal sector, it also decreases in the informal sector due to the greater import competition. Usually the informal sector does not access foreign export markets directly. Instead, tariff reduction can play an important role in adjusting the structure of the informal sector. In addition, opportunity is given to the informal sector to move from being informal traders to formal traders. This is consistent with the observation that the DRC has a large informal sector and an excessively substantial informal trader sector (World Bank, 2010).

4.4 Sectoral output

We see that the agricultural sector is subjected to tariffs as well as all tradable manufacturing, mining and private services. We expect these sectors to be directly affected by the fall in the price of imports induced by a tariff reduction. The initial shares of imports, exports and total output will also influence the results. As reported in Table 6, the tariff reduction policy simulations show the changes in sectoral output. The overall economic impact of the tariff reduction has positive results on all formal sectors and negative results on a large number of informal sectors. The policy simulation results demonstrate that all formal sectors benefit from the tariff reduction. The formal sectors which benefit the most from the shock are transport and communications (17.4% in SR and 13.27% in LR), private services (12.4% in SR and 5.86% in LR), mining sector (3.2% in SR and 3.0% in LR) and manufacturing (2.5% in SR and 3.78% in LR) (see the first column in Table 6). The rise in output in the formal sector was especially driven by intensifying exports. This creates more opportunities for jobs in the formal sector, where skilled and semiskilled workers could be absorbed in those sectors which improved their output. It is further noticed that the demand for informally employed workers expanded in the formal sector, even though this profits mostly unskilled workers.

The simulation results show that tariff reduction increases demand for im-

ported goods, for example this shock significantly affects the textile and clothing sector. This sector is exposed to the biggest rise in import competition when tariffs are reduced. In the SR, the output of textiles and clothing increases by 1.37% for the formal sector and declines by 0.39% for the informal sector (see the first column in Table 6). The main reason could be that the producers from the textile and clothing sector in both the formal and informal sectors are negatively impacted by inexpensive imported goods. In fact, the general rise in imported goods has macroeconomic connotations, because it creates a burden to the current account balance which is influenced by the foreign currency. Consequently production increased in non-textile sectors, which are equipment and machinery, livestock, food processing and manufacturing. In view of this, the formal sector producers of food processing (0.38% in SR and 0.99% in LR), equipment and machinery (0.92% in SR and 0.89% in LR), livestock (0.99% in SR and 0.23% in LR) and manufacturing (2.48% in SR and 3.78% in LR) products benefit the most as the informal sector producers are not directly involved in the foreign exports. Thus the considerable import competition without any enhanced penetration to foreign export markets jeopardises the output of the informal sector producers.

Table 7 below reports changes in employment under tariff reduction policy simulations in the SR, and reflects a diverse distributional effect for both the formal and informal sectors. Increase in employment among formal producers is due to the growth in the formal sector's production. The main beneficiaries of this growth are the skilled and semi-skilled formal producers and workers operating extensively in the transport and communications (17.4%), private services (12.4%), mining (3.2%) and manufacturing sectors (2.48%). The main losers include the unskilled workers from the formal sector, and all the skilled, semiskilled and unskilled workers from the informal sector. Although employment decreases in the informal sector due to tariff reduction, more jobs opportunities are created in the formal sector. The formal sector will demand more employment, with a possibility of absorbing unemployed workers from the labour market. The policy simulation results demonstrate that policy makers should consider policies which promote employment creation, both in the formal and informal sectors. Those unskilled workers include child labour and female subsistence workers, as seen in the DRC labour markets. In addition, the decrease in the informal sector's output and foreign import prices stimulates consumers from the informal sector to depend on foreign imported products, therefore the change in consumer preferences stimulates the intensity of commerce between the informal and formal sectors. The traders from the informal sector benefit the most through the collection of fixed transaction margins from the trade's volume. In contrast employment decreases in the informal sector especially amongst skilled, semiskilled and unskilled workers, due to tariff reduction. Another reason is that the informal sector has more unemployed people when compared with the formal sector. While the semiskilled and skilled workers from the formal sector receive an increase in their incomes, all the informal sectors suffer decreasing incomes.

Table 8 below reports the results of the policy shock on the household in-

comes in the SR. It shows a general decrease across informal sectors in real household disposable incomes because of the declining employment. Nonetheless, impacts across household groups differ considerably. For instance, high wage employment composed of male labour increased by 0.52% in the formal sector while it decreased by 0.89% in the informal sector. The same trend is observed in the category of medium wage employment where female labour increased by 0.01% in the formal sector and decreased by 0.96% in the informal sector. Low wage employment composed of child labour and female subsistence decreased across both formal and informal sectors. Previous studies from countries such as South Africa established that trade liberalisation profited households from the middle income category (Thurlow 2007; Pauw *et al.* 2006). Our findings are consistent with this as incomes increase for middle and high salary income groups in the formal sector, but fall for the low income group, which is composed of child labour and female subsistence workers. The simulation result shows that efficient trade liberalisation must be promoted in the DRC economy in view of narrowing the income gap between high and low income households, as well as between formal and informal sectors.

In brief, tariff reduction has diverse effects on the formal and informal sectors in the DRC. It considerably increases the output of, and employment in, the formal sector by increasing import competition, without offering further opportunities for the informal sector to penetrate foreign export markets. The formal sector is stimulated and can therefore act accordingly based on the current foreign market opportunities as its output increases. In addition, tariff reduction adjusts the structure of the informal sector by tightening product market freedom for informal sectors, expanding opportunities for informal traders and motivating workers from the informal sector to seek descent jobs in the formal sector. Despite the negative impact that tariff reduction may have on the informal sector, there are still new job opportunities in the formal sector. This emphasises the need for policies to stimulate further job creation and improve incomes among low income households.

4.5 CONCLUSION AND POLICY IMPLICATIONS

This paper evaluates the effects of tariff reduction on unemployment, poverty and productivity growth in the DRC. An empirical DRCFIM was used to perform a policy simulation. In particular, this study draws the attention of policy makers to a different employment outcome when tariff reduction policy is taken into consideration. Tariff reduction increases formal employment and output but hurts informal producers, as output decreased in informal sectors such as livestock and clothing. It considerably increases the output of, and employment in, the formal sector, by raising import competition without proposing further opportunities for the informal sector to access foreign export markets. Furthermore, it induces productivity improvements when local producers survive import competition by seeking importing input-saving technologies and production practices. The formal sector is stimulated to boost exports based on the new foreign market opportunities as its output increases. In addition, tariff

reduction adjusts the structure of the informal sector by tightening product market freedom for informal sectors and motivating informal workers to seek decent jobs in the formal sector. These results highlight the consequence of differentiating between the formal and informal sector impacts of socioeconomic policies.

Regarding the welfare issues related to the tariff reduction policy, as consumption increases across all households in the DRC, it means that tariff reduction has a positive effect on welfare distribution. Considering the DRC's welfare issues, such a policy seems appropriate to policy makers. Our policy simulation results show that the DRC government can deal with the welfare issues by adopting a tariff reduction policy. Household demand shows mixed results however; only the high income households from the formal sector benefited as a result of the tariff reduction.

Finally, the DRC's government in the past may have failed to experience the success of the tariff reduction in generating a dynamic export industry, however it is not too late to do so now and it would be highly pertinent to take into account the benefits of further reducing tariff in the future. Committing openly to reducing tariffs would make a significant contribution to increasing the global competitiveness of the DRC economy, as well as remind the DRC that there are still considerable distances to travel before the economic health of the country produces the level of prosperity expected by the community.

References

[1] Anderson, J. E., and van Wincoop, E. (2004) Trade Costs. *Journal of Economic Literature*, Vol. 42, No. 3. (Sep., 2004), pp. 691-751.

[2] Arias, A. de Leon. (2003) Trade Liberalisation and Growth: Evidence from Mexican Cities. The International Trade Journal. Volume 17, issue 3.

[3] Banque Centrale du Congo (BCC). (2009) "Annual Report".

[4] Banque Centrale du Congo (BCC). (2009) "Annual Report".

[5] Banque Centrale du Congo (BCC). (2014) "Statistiques Economique".

[6] Bhattacharja, P. C. (2000) An analysis of rural-to-rural migration in India, Journal of International Development Volume 12, Issue 5, pages 655–667.

[7] Bhorat, H. (1999) *Decomposing sectoral employment trends in South Africa.* Paper presented at the Trade and Industrial Policy Strategies Annual Forum, 19-22 September, Muldersdrift, South Africa.

[8] Chitiga-Mabugu, M. (2001) Income distribution effects of trade liberalization: A CGE analysis, in: Mumbengegwi, C. (ed), *Macroeconomic and Structural Adjustment Policies in Zimbabwe*, (Palgrave: Houndsmill), pp.221-233.

[9] Chitiga, M. and Kandiero, T. (2006) "Trade openness and FDI in Africa" , *South African Journal of Economics and Management Sciences (SAJEMS*), Vol 9 No 3, pp355 -370

[10] Chitiga, M., Mabugu, R. and Kandiero, T. (2007) "Trade Policy and poverty: Results from a CGE Micro-Simulation Analysis*" Journal of Development Studies.* Vol. 43,:1105-1125, No. 6

[11] Davies, R. and Thurlow, J. (2011) Formal-Informal Economy Linkages and Unemployment in South Africa. South African Journal of Economics. Vol. 78(4):437-459.

[12] DeVuyst, E. A., and Preckel, P. V. (1997). "Sensitivity Analysis Revisited: A Quadrature-Based Approach." *Journal of Policy Modeling* 19, 175-185.

[13] Dixit, A. K. and Pindyck, R. S. (1994) Investment under Uncertainty, Princeton U. press, http://press.princeton.edu/titles/5474.html Date of access: 23 January 2014.

[14] Dixon, P.B., Parmenter, B.R., Ryland, G.J. & Sutton, J.M. (1977) ORANI, a general equilibrium model of the Australian economy: Current specification and illustrations of use for policy analysis. *First Progress Report of the IMPACT Project*, Vol. 2. Canberra: Australian Government Publishing Service.

[15] Edwards, L. (2001) *Globalisation and the occupational structure of employment in South Africa. South African Journal of Economics* 69 (1): 40–71.

[16] Erero, J. L., Pambudi, D. D. and Bonga Bonga, L. (2013) Wage Subsidy in the DRC: A CGE Analysis, ERSA working paper 373

[17] Greenaway, David and Milner, Chris (1986) *The Economics of Intra-Industry Trade.* Oxford, Basil Blackwell.

[18] Harrison, G. W., Jones, R. C., Kimbell, L. J., and Wigle, R. M. (1992). "How Robust is Applied General Equilibrium Analysis?" *Journal of Policy Modeling* 15, 99-115.

[19] Harrison, G. W., and Vinod, H. D. (1992). "The Sensitivity Analysis of Applied General Equilibrium Models: Completely Randomized Factorial Sample Designs." *The Review of Economics and Statistics* 74, 357-362.

[20] Horridge, M. (2005) *ORANI-G: A generic single-country computable general equilibrium model.* Paper prepared for the practical GE Modelling Course, February 7-11.

[21] Human Rights Watch (2009) The Democratic Republic of the Congo: Country Report 2009, available at: www.hrw.org/en/node/87600

[22] Ianchovichina, E. and Walmslev, T. (2002) Impact of China's WTO Accession on East Asia http://citeseerx .ist.psu.edu/viewdoc/summary?doi=10.1.1.3.5774 Date of access: 21 January 2014.

[23] International Monetary Fund (IMF). (2007) "Democratic Republic of the Congo: Poverty Reduction Strategy Paper." Country Report No. 07/330, September. IMF, Washington, D.C.

[24] IMF (2007) "Democratic Republic of the Congo: 2007 Article IV Consultation—Staff Report; Country Report No. 07/327, September. IMF, Washington, D.C.

[25] IMF (2010) *World Perspective*

[26] IMF (2011) *World Perspective*

[27] IMF (2012) *World Perspective*

[28] Institut National de la Statistique (INS). (2008) Labor Force Survey.

[29] Klodt, H. (1986) Statistics on labour productivity in West Germany: A guide to sources and methods.

[30] Krugman, P. (1996) " How the Economy Organises Itself in Space: A survey of the New Economic Geography," Working Papers 96-04-021, Santa Fe Institute.

[31] Lamy, P. (2002) Stepping stones or stumbling blocks: The EU's approach towards the problem of multilateralism vs. regionalism in trade policy. *World Economy* 25(10).

[32] Litchfield, J., McCulloch, N. and Alan Winters, L. (2003) Agriculture trade liberalisation and poverty dynamics in Three Developing Countries.

[33] Lofgren, H., Harris, R., Robinson, S., Thomas, M. and EL-SAID, M. (2001) A standard computable general equilibrium (CGE) model in GAMS. Microcomputers in Policy Research, 5. Washington DC: International Food Policy Research Institute.

[34] Mai, Y. (2003) *Effects of reducing tariffs and endogenous productivity growth*, Centre of Policy Studies, General Working Paper No, G-139: Monash University.

[35] Mosley, P., (2009) Wiley InterScience. Liberalisation and poverty in Africa since 1990: Why is the operation of the 'invisible hand' uneven? In Journal of International Development.

[36] Ngeleza, K. G. and Muhammad, A. (2009) Preferential Trade Agreements between the Monetary Community of Central Africa and the European Union, Stumbling or Building Blocks? A General Equilibrium Approach, IFPRI Discussion Paper 00859

[37] Oxley, A. (2000) Review of Australia's General Tariff Arrangements*: Submission to the Productivity Commission Inquiry into Tariffs. Australian APEC Study Centre.*

[38] Pagan, A., and Shannon, J. (1985). Sensitivity Analysis for Linearized Computable General Equilibrium Models. In J. Piggott and J. Whalley (eds.), *New Developments in Applied General Equilibrium Analysis*. Cambridge University Press: Cambridge.

[39] Pagan, A., and Shannon, J. (1987). "How Reliable are ORANI Conclusions?" *Economic Record* 63, 33-45.

[40] Panel of Experts on the Illegal Exploitation of Natural Resources, Report S/2003/1027, available at: www.zwnews.com/UNDRCreport2.doc

[41] Pauw, K., and L. Edwards. (2006) Evaluating the general equilibrium effects of a wage subsidy for South Africa. *South African Journal of Economics* 74 (3): 442-462.

[42] Rajan, R. and Bird, G. (2002) "Will Asian Economies Gain from Liberalizing Trade in Services?" http://books.google.co.za/books?id=fD0l9S5QUMwC&pg, date of access: 1 July 2014

[43] Rattso, J. and Torvik, R. (1998) "Economic openness, trade restrictions and external shocks: modelling short run effects in Sub-Saharan Africa," Economic Modelling, Elsevier, vol. 15(2), pages 257-286, April.

[44] Reimer, J. J. (2002) Estimating the poverty impacts of trade liberalization. Draft, Perdue University.

[45] Romer, P. M. (1986) "Increasing Returns and Long Run Growth," Journal of Political Economy, 94, 1002–37.

[46] Romer, P. M. (1987) Endogenous Technological Change. *Journal of Political Economy* Vol. 98, No. 5.

[47] Ruiz-Nápoles, P. (2001) "Liberalisation, Exports and Growth in Mexico 1978-1994: a structural analysis," *International Review of Applied Economics* Vol.15, No. 2, pp. 163-180.

[48] Santo-Paulino, A. (2002) The effects of trade liberalization on imports in selected developing countries, World Development 30 (6), 959-974.

[49] Stifel, D. and Thorbecke, E. (2003) A dual-dual model of an archetype African economy: trade reform, migration and poverty. Journal of Policy Modeling, 25, pp. 207-235.

[50] Stiglitz, J. and Charlton, A. (2005) *Fair Trade for All. How Trade Can Promote Development*. Oxford: Oxford University Press.

[51] Thurlow, J. and Van Seventer, D.E.N. (2002) A Standard Computable General Equilibrium Model for South Africa. Trade and Macroeconomics Discussion Paper No. 100, International Food Policy Research Institute, Washington, D.C.

[52] Thurlow, J. (2007) Trade liberalization and pro-poor growth in South Africa. *Journal for Studies in Economics and Econometrics* 3 (2): 161–179.

[53] Tull, D. M. (2003) 'A Reconfiguration of Political Order? The State of the State in North Kivu (DR Congo)', *African Affairs*, 102: 429–46.

[54] UNCTAD (2001) Economic Development in Africa: Performance, Prospects and Policy Issues. New York.

[55] Vos, R.P. and Jong, N. de (2003) Trade Liberalization and Poverty in Ecuador: A CGE Macro-Microsimulation Approach. *Economic Systems Research, 15*(2), 211-232.

[56] Wigle, R. M. 1991. The Pagan-Shannon Approximation: Unconditional Systematic Sensitivity in Minutes. In Piggott, J., Whalley, J. (eds.), *Applied General Equilibrium*. Physica-Verlag: Heidelberg; 35-49.

[57] Wiley, J. & Sons, Inc. (2012) New York Times, Congo. Retrieved October 6, 2012 from http://topics.nytimes.com/top/news/international/countriesandterritories/drc/index.html www://topicscongothedemocraticrepublicof/index.html

[58] Winters, A.L. (2000) Trade, trade policy and poverty: What are the links? Centre for economic policy research paper No. 2382

[59] Woods, N. (2010) 'International Political Economy in an Age of Globalisation', in J. Baylis, S. Smith and P. Owens (eds), *The Globalization of World Politics*, Oxford: Oxford University Press.

[60] World Bank (1997) World Development Report. Washington DC.

[61] World Bank. (1999) The Macroeconomic Foundation, World Development Report. Oxford University Press.

[62] World Bank (2000) World Bank Development Indicators.

[63] World Bank (2001) "Congo: Poverty Reduction Strategy Paper." Report No. 39615-ZR, April. World Bank, Washington D.C.

[64] World Bank (2007) "Democratic Republic of Congo—Country Assistance Strategy: For the Period FY08–FY11."Report No. 41474-ZR, November. World Bank, Washington D.C.

[65] World Bank (2008) World Trade Indicators 2008 Database, including the Trade At-A-Glance (TAAG) country table. World Bank, Washington, D.C. Available at: http://www.worldbank.org/wti2008.

[66] World Bank (2009) World Bank Development Indicators.

[67] World Bank (2010) World Bank Development Indicators.

[68] World Bank. http://www.worldbank.org/publications. Date of access: 05 April 2012

[69] World Bank (2011) World Economic Outlook. An update of the key WEO projections. World Bank, Washington, D.C. Available at: http://www.worldbank.org/weo2011.

[70] World Bank (2013) World Development Indicators, Washington, D.C. Available at: http://data.worldbank.org/country/congo-dem-rep Date of access: 23 January 2014.

[71] World Trade Organisation (WTO) (2010) Trade topics

[72] World Trade Organisation (WTO) (2012) Trade topics. http://www.wto.org/documents and resources. Date of access: 10 May 2014

[73] WTO (2013) Trade Monitoring Reports http://www.canberratimes.com.au/world/tariff-cuts-on-green-goods-get-thumbs-up-20111114-1v01m.html#ixzz1wXVWpEp3. Date of access: 01 June 2014

[74] http://www.smh.com.au/national/families-prosper-from-tariff-cuts-study-20090531-brqf.html#ixzz1wXdA4tWm. Date of access: 01 June 2014

Table 1: DRC Selected Macroeconomic Indicators, 1980-2013

	1980	1998	1999	2000	2001	2002	2010	2011	2012	2013
Real GDP growth	2.4	-2	-4	-7	-2	3	7.2	6.5	5.1	6
Real GDP per capita growth	6.8	-2.5	-4.7	-10,0	-4,7	0,7	4.5	3.8	2.5	3.4
CPI inflation	40	107	270	550	357	26	23.5	14.8	15.1	12.2
Budget balance % GDP	-	-	-	-	-7.1	-1.6	2.4	-6.3	-7.8	-1.1
Current account %GDP	-1.6	-9	-2.6	-4.6	-4.7	0.1	-11.7	-10.3	-3	-3
Real exchange rate	71.1	17.6	47.8	-18	-6	-58	-	-	-	-
Trade balance	-	-	4.0	-	-	-	2.1	2.3	0.6	-1.1
Exports of goods (f.o.b)	-	19.2	7.6	9.6	9.6	11.1	41.3	39.7	31.1	29.4
Imports of goods (f.o.b)	-	12.6	3.6	9.2	10.6	14.1	39.2	37.4	30.4	30.4

Source: World Bank (2014)

Table·2:·The·DRC's·GDP·by·sector·(percentage)¶

¶

Sector	2006	2008	2013
Agriculture	47.7	24.2	20.6
Mining	8.9	6.4	4.6
Manufacturing	5.2	23.4	27.4
Electricity, gas and water	3.2	1.4	1.4
Construction	5.2	4.3	4.6
Trade	16.6	11.3	14
Transport	4.2	13.7	14.4
Finance, real estate and business services	5.6	7.2	6.6
Public administration	3.8	7.9	4.1
Other services	0	0.3	2.3
Gross domestic product at basic prices/factor cost	**100**	**100**	**100**

Source: DRC Central Bank (2013)

Table 3: Employment (percentage)

Sector	1984	2006	2013
Agriculture	53.6	47.4	40
Industry	12.7	5.3	10
Services	33.7	47.3	50
Total	100	100	100

BCC (2008) and World Bank (2013)

Table 4: Structure of tariff rates

Goods	Tariff rates (%)
Equipment goods	5
Raw materials	5
Agricultural	5
Veterinary supplies	5
Unassembled equipment	5
Consumable food items	10
Industrial inputs	10
Spare parts	10
Hospital items	10
Clothing	20
Furniture	20
Cigarettes	20
Other finished products	20

Source: DRC customs (2012)

Table 5: Main macro variables under tariff reduction policy simulations

Main Macro Variables	Description	Simulation % change	
		Short run	Long run
RealGDP	Real GDP	0.57	0.61
AggEmploy	Employment	0.56	0
AveRealWage	Average Real Wage	0	1.52
ExpVol	Export Volume	12.11	5.73
ImpVol	Import Volume	5.63	5.15
RealHou	Real Household Consumption	0	1.09
RealInv	Investment	0	0
RealGov	Government Consumption	0	0
AggCapStock	Capital Stock	0.69	1.38
AggLand	Land	-0.02	0.9
GDPPI	GDP Price Index	-0.47	1.24
CPI	Consumer Price Effect	-0.99	0.53
ExportPI	Export Price Index	-2.26	-1.11
ImportPI	Import Price Index	-5	-5
BOT_GDP	Contribution of BOT to real GDP	1.47	0.82

Table 6: Sectoral production under tariff reduction policy shock

Sector	xTot		xExp		xFac_f		xHou	
	SR	LR	SR	LR	SR	LR	SR	LR
AGRIC_F	0.62254	0.37303	5.22391	-4.24057	0.55000	0.17276	0.01751	0.74593
AGRIC_I	0.06477	0.31318	3.14658	-3.73461	0.06000	0.27186	-0.38056	0.85217
LIVES_F	0.99930	0.23752	3.55698	-1.96158	0.98000	0.16563	-0.30141	1.22097
LIVES_I	-0.33145	0.41529	3.23156	-6.32448	-0.33000	0.38235	-0.36415	0.30358
MININ_F	3.18540	3.00103	6.75183	5.88937	2.72000	2.56516	0.30630	2.79256
MININ_I	0.07926	0.59079	0.43427	-0.18078	0.06000	0.59555	-0.91007	1.58604
FOOD_F	0.37837	0.99883	6.63516	-1.72773	0.14000	0.55594	0.28437	1.26921
FOOD_I	-0.37935	0.57101	3.09557	-5.18342	-0.38000	0.46909	-0.39041	0.54676
CLOTH_F	1.37188	1.92685	10.14438	2.56361	0.81000	0.90528	0.93589	2.13859
CLOTH_I	-0.38684	0.66927	2.84122	-4.79184	-0.40000	0.56876	-0.43961	0.62967
MANUF_F	2.48637	3.78257	21.28887	19.02470	1.20000	1.91943	2.90047	5.22493
MANUF_I	0.16684	0.93062	2.54951	-1.80437	0.10000	0.82266	-0.49615	1.25341
EQUIP_F	0.92135	0.89208	26.39973	26.29245	-0.64000	-0.64681	3.75341	6.47967
EQUIP_I	0.80600	1.45513	3.34941	0.73765	0.62000	1.31868	-0.34141	1.77230
UTILI_F	1.74456	2.30274	5.33929	-0.18164	1.46000	1.96769	0.03943	1.58587
UTILI_I	0.29666	0.20777	0.00000	0.00000	0.44000	0.31026	-0.99591	1.62281
CONST_F	0.19374	0.12133	7.75023	5.33929	-0.07000	-0.09137	0.49323	2.68554
CONST_I	-0.05607	0.32476	3.79911	-1.45031	-0.08000	0.17267	-0.25483	1.32632
TRADE_F	0.62061	0.59722	0.84844	-0.19272	0.58000	0.59458	-0.82848	1.58362
TRADE_I	-0.02514	0.57716	1.31009	-1.34578	-0.07000	0.60607	-0.73785	1.34781
HOTEL_F	1.85051	0.98666	4.33078	-0.70400	1.64000	0.85460	-0.15286	1.47932
HOTEL_I	-0.32846	0.90081	2.42041	-2.97407	-0.41000	0.91205	-0.52122	1.01103
TRANS_F	17.37035	13.27777	21.07958	16.11516	15.94000	10.94886	2.86493	4.70538
TRANS_I	0.16623	0.45391	1.55120	-1.17916	0.11000	0.48448	-0.69065	1.38202
ESTAT_F	0.88100	0.81850	5.79663	-10.29642	0.80000	0.25584	0.12615	-0.56182
ESTAT_I	-0.11541	0.39692	4.04634	-6.99481	-0.09000	0.14703	-0.20736	0.15962
ADMIN_F	1.45132	0.43370	7.64412	-3.03621	1.28000	0.03770	0.47343	0.99808
ADMIN_I	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.99591	1.62281
PRIVS_F	12.40923	5.86170	16.21125	7.39430	11.42000	4.00584	2.02410	3.08310
PRIVS_I	-0.11584	0.78029	2.32002	-2.85418	-0.16000	0.73599	-0.54073	1.03597

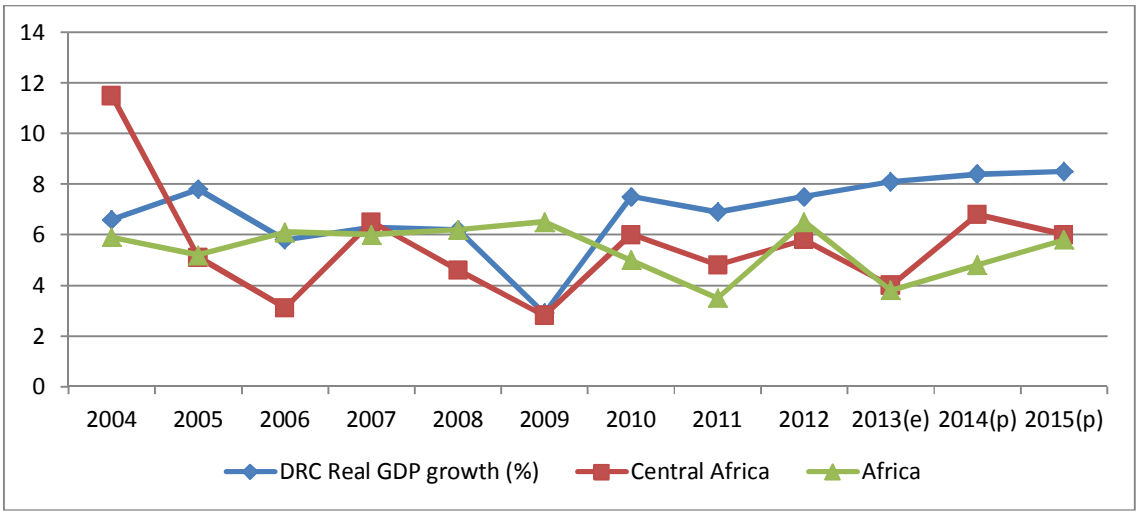
Table 7: Changes in employment under tariff reduction policy simulations

	Base employment (1,000s)	Change in employment from base (%)
Formal sector		
Unskilled (FSUB)	324	-0.31
Unskilled (LCHILD)	231	-0.25
Semiskilled (FEMLAB)	867	0.01
Skilled (MALELAB)	974	0.52
Informal sector		
Unskilled (FSUB)	5998.2	-0.94
Unskilled (LCHILD)	1532	-1.05
Semiskilled (FEMLAB)	122	-0.96
Skilled (MALELAB)	23	-0.89

Table 8: Changes in incomes under tariff reduction policy simulations

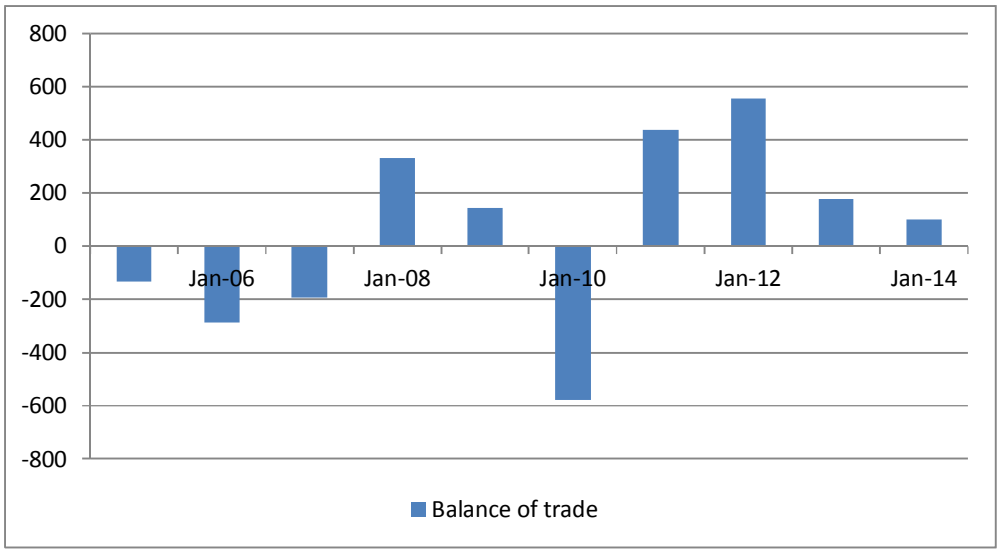
Employment by occupation	Description	Formal sector	Informal sector
MALELAB	High wage employment (Male)	0.52	-0.89
FEMLAB	Medium wage employment (Female)	0.01	-0.96
LCHILD	Low wage employment (Child)	-0.25	-1.05
FSUB	Low wage employment (Female sub)	-0.31	-0.94

Figure 1: Real GDP growth



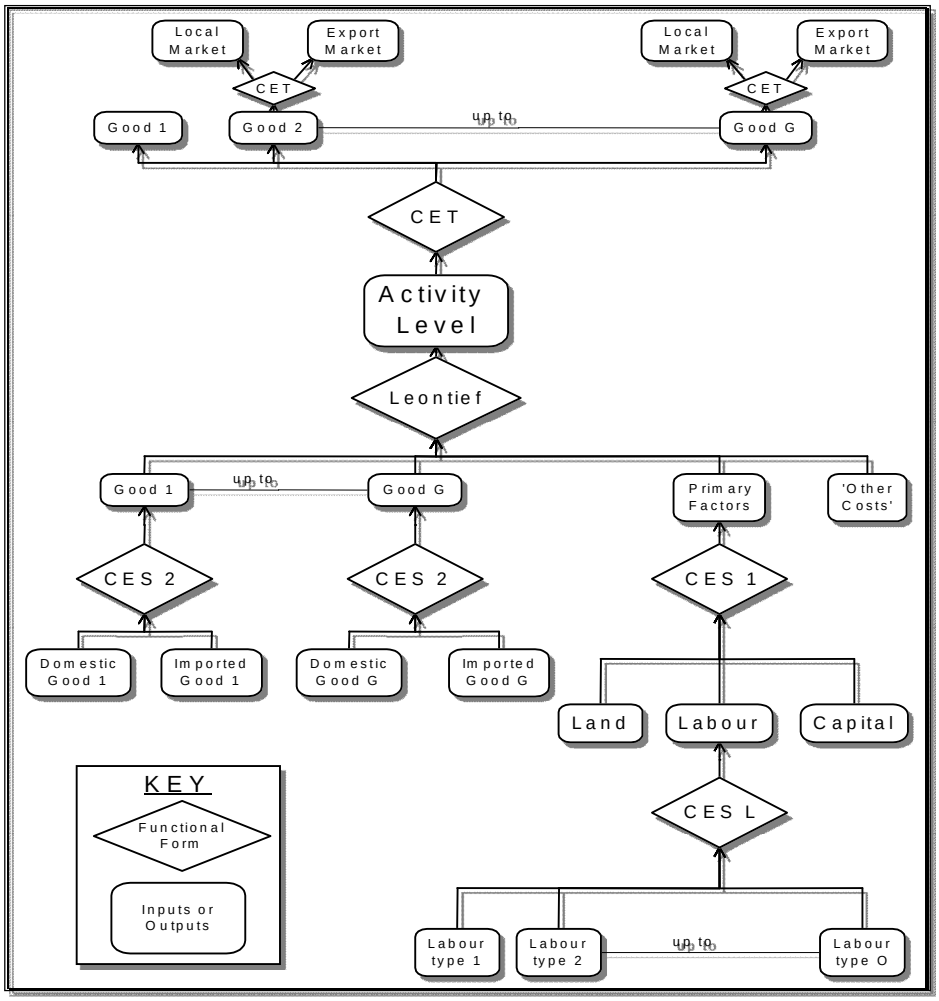
Source: AfDB, Statistics Department AEO. Estimates (e); projections (p)

Figure 2: DRC's balance of trade from January 2005 to January 2014



Source: World Bank (2014)

Figure 3: Structure of production



Source: Horridge (2005)

Figure 4: Assumption highlighting short run closure

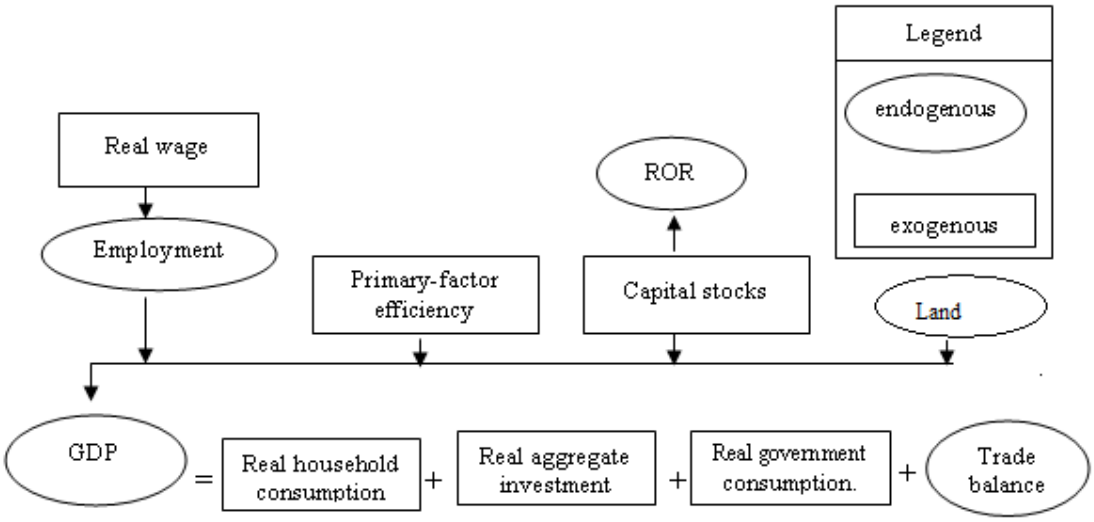


Figure 5: Relationship between variables (short run).