

**A CGE model to assess the effects of the AfCFTA in the
economy of the least developed countries of Africa: the
case of Chad.**

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Acronym and abbreviation

AfCTFA: african continental free trade area
AfDB : African Development Bank
BAC : Baccalaureate
BEPC : Undergraduate study certificate
BT : Technical patent
CEMAC : central Africa economic and monetary community
CEN-SAD : Community of Sahel and Sahara States
CEPE : primary school certificate
CGEM : Computable General equilibrium Model
DEA : Advanced studies diploma
DESS :Specialized higher education diploma
DEUG : Diploma of general university studies
EAC : East African Community
ECCAS : Economic Community of Central African States
ECOSIT 4 : Survey on Consumption in the informal sector in Chad 4th edition
GDP : Growth domestic product
HDI : Human Developement Index
IMF : International Monetary found
LDC : Least developed countries
PhD : Doctorate
REC : Regional Economic Communities
SAM : Social Accounting Matrix
WB : world Bank
WTO : world Trade Organisation

Abstract :

The purpose of the study focused on the analysis of the effects of the implementation of the Continental Free Trade Area (AfCFTA) on the Chadian economy. Indeed, Chad, classified among the least developed countries, benefits from a reduction in the implementation of liberalization according to the liberalization schedule. A recursive dynamic computable general equilibrium model adapted from the PEP-t model of Décaluwé et al (2013) was used to model the Chadian economy. The accounting basis of the model is the SAM of Chad developed by Décaluwé in 2008. This SAM which has 5 economic agents, 19 branches and 19 products has been adapted to our model with a breakdown of capital into public capital and private capital then a breakdown of work in formal work and informal work.

The period chosen for the study is 10 years. The simulations carried out over this period show that liberalization induces an increase in imports and exports with a drop in domestic prices. Domestic prices are driven down by the abolition of customs duties and the influx of more competitive products on the local market. This influx of products from African countries is not without consequences on the sectors of activity and the labor market. As a result, we note that some sectors (agriculture, forestry, etc.) have added values which increase while other sectors such as non-food industry, construction, etc. recorded declining added values. This situation has the same consequences in terms of jobs. Even if globally, the implementation of the AfCFTA induces an increase in labor demand, the disparities at the level of the sectors of activity are clearly visible. Thus the sectors of activity for which the added value is positive have an increasing demand for employment while those whose added value is falling experience a drop in the demand for work. This situation is manifested by the mixed evolution of the GDP which is sometimes positive sometimes negative.

Government revenues have dropped considerably according to the results of the simulations due to the elimination of customs duties and the reduction of activities in some sectors of

activity. It is up to the State to undertake the necessary strategies to take advantage of comparative advantages.

Keyword : African continental free area, Computable general equilibrium model, Least developed countries, Chad.

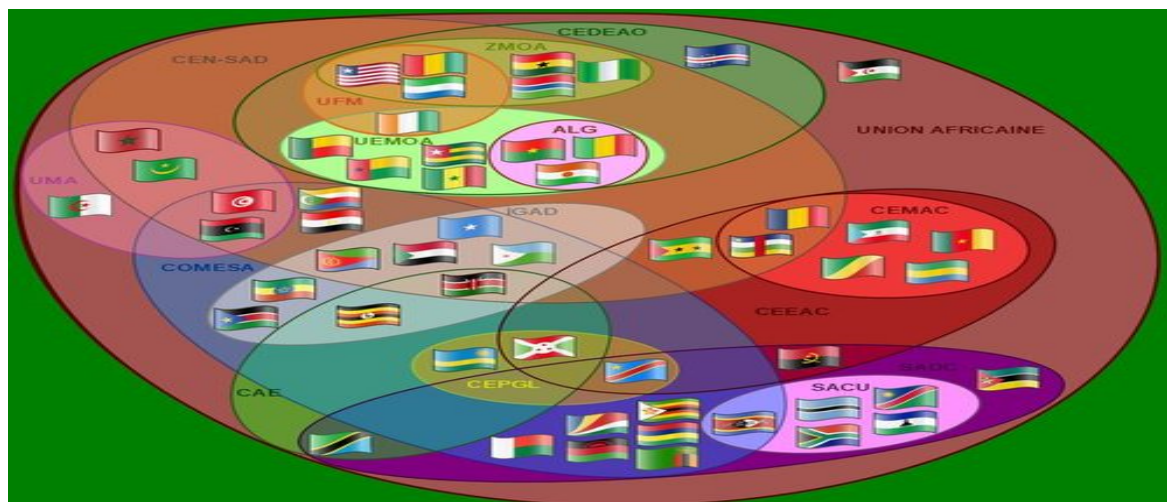
Introduction

In a global context of trade liberalization, where States seek to intensify trade for products for which they have comparative advantages, Africa is still lagging behind and is struggling to find the exits necessary for its take-off compared to other continents (American and European) who have considerably liberalized their trade. It is with a view to intensifying intra-African trade and enabling member countries to reap the benefits of this liberalization that AfCFTA was born. Free trade or free trade treaty is an agreement signed between two (2) or more States in the context of international trade through the removal of tariff barriers (customs duties) or any national regulations likely to obstruct the import of goods, services, capital, etc. It has the advantage of allowing member countries to specialize in the production of goods and services for which they have a comparative advantage and to exploit economies of scale, thanks to the removal of non-tariff barriers, which makes it possible to boost productivity and growth (Parshotam, 2018). In addition to the creation of regional supply chains (Heuser and Matoo, 2007), it also promotes structural transformations by ensuring the diffusion of knowledge and technologies (IMF, 2016).

Coming into force after ratification by the 22nd Member State, the AfCFTA is considered to be one of the largest free trade areas in view of the number of Member States. While African integration was initially driven by political rhetoric around Pan-Africanism, economic considerations now seem to have taken over. Trade integration offers industrialization opportunities for African states. This would make it possible to move from the status of countries exporting raw materials to countries exporting manufactured products with high added value. Knowing the link between productivity, job creation and the fight against poverty, it is possible that Africa has the opportunity to turn the page on underdevelopment through economic integration and trade.

Different Regional Economic Communities (RECs) have prevailed in the African trade arena and have been the basis for the construction of the AfCFTA (see Figure 1).

Figure 1: The Spaghetti Bowl of African Regional Communities



Source: www.iris-france.org

If the goal of African Union is political union, which is the fifth and final phase of African integration, it is clear that the road is long and difficult, in view of the bowl of spaghetti illustrating the different regional economic communities. Africa represents 2.5% of world exports in 2018. This is clearly low given Africa's trade potential. The East African Community (EAC) is the best performing African REC with an average trade intensity of 20.21% while it is 15.5% on average in the regions¹. The Economic Community of Central African States (ECCAS) records the lowest intensity at 2%. A major challenge to African integration is the lack of coordination at different levels of the integration mechanism between RECs, between RECs and national governments, between government departments and between government and the private sector.

African member countries of the AfCFTA have considerable economic disparities, with very poor populations living from agriculture in rural areas. Following the example of Chad, one of the poorest countries in the world with a GDP/capita of \$900 and a rural population of nearly 80%, with an HDI of 0.4, ranked among the last on the list (World Bank, 2018).

Thus, it is important to study the benefits that could accrue to the least developed countries of Africa, such as Chad, through the following research question: to what extent will the AfCFTA impact incomes, employment and welfare in least developed countries such as Chad?

This research aims to contribute to the empirical literature, particularly on the issue of free trade in Africa. By setting as its main objective the analysis, through a CGEM, of the effects of the

¹ www.iris-france.org

AfCFTA on the Chadian economy. More specifically, the study focuses on analyzing the effects of the AfCFTA on employment, income and household well-being. It is assumed beforehand that the AfCFTA will negatively impact government revenues but positively employment.

The study will consist of a first section which will deal with the characteristics of the Chadian economy, a second section on the literature review, a third section on the methodology and a fourth section which will focus on the results analysis.

I-Characteristics of the Chadian economy

1-1 Socio-economic situation

Chad is a landlocked Central African country with no access to the sea. Covering an area of 1,284,000 km², it shares its border with Libya to the north, Sudan to the east, Nigeria and Niger to the West, Cameroon and the Central African Republic in the South. The nearest port is that of Douala in Cameroon, located 1700 km from the Chadian capital. Chad is ranked 184th out of 186 countries in terms of the United Nations human development index despite the exploitation of oil.

It became an oil-exporting country in 2003. This oil windfall had a strong impact on the economy, causing the GDP to almost double, thus making Chad's economy structurally dependent on the primary sector, driven by oil and the tertiary sector. If the Chadian oil sector has become the main source of revenue, the same is not true for employment. Chad is heavily dependent on oil with 79% of export earnings. These also represent 37% of budget revenue in 2019.

It continues to face major security challenges, despite recent efforts thanks to the support of technical and financial partners, thus undermining its growth and development efforts.

The country returned to growth in 2018 (+2.4%) after two years of recession (2016 and 2017) caused by the fall in world oil prices. However, the inflation rate is 3% in 2019, thus remaining within the limit of the CEMAC standard which is set at 3%.

However, there are good prospects with a GDP growth rate of 5.5% for 2020 and 4.9% for 2021². The country is making the necessary efforts to remedy budgetary and external imbalances in accordance with the regional strategy launched in 2017 by CEMAC member countries. It has considerable agricultural potential estimated at 35% of GDP and employs between 70 and 80% of the population.

According to the World Bank, almost half of Chad's population lives in poverty. Living mostly in rural areas. The poorest populations live from agriculture and livestock and have limited access to markets and services. The dependence of Chadian agriculture on rainfall and climatic hazards keeps rural populations in a situation of poverty and economic inactivity for a good part of the year. While the poverty rate fell (from 55 to 47%) between 2003 and 2011, the number of poor people increased by 15%, to the detriment of the poorest households in rural

² Chad Economic Outlook Report 2018, African Development Bank

areas³. At the international and sub-regional level (CEMAC), trade between the various countries and Chad remains quite low, despite the presence of the regional economic community. The trade balance in relation to GDP represents 9.18% in 2018. This sufficiently demonstrates Chad's low trade openness.

1-1 Chad's trade

According to figures from the World Bank, Chad's trade is relatively low (73.9% of GDP) with a restriction on imports due to non-tariff barriers and a customs duty of around 15.1 %. This despite a common external tariff for the Economic and Monetary Community of Central Africa (CEMAC) and the Community of Sahel and Sahara States (CEN-SAD).

Chad's trade balance is heavily dependent on oil, representing 78% of total exports between 2016 and 2017 and 89% in 2018 according to AfDB figures⁴. Given the fall in the price of a barrel of oil, the balance was slightly in deficit, due to the increase in imports (2.1 billion USD of imported goods against an export of 2 billion USD)⁵. To illustrate this statement, the table below shows us that from the year of exploitation of Chadian oil, (2003), the trade balance began to show positive results. It took 2014 for the trend to reverse. This is due to the oil crisis marked by the fall in the price of a barrel of oil. However, we note a timid recovery from 2017.

³ Report No. 96537-TD World Bank SYSTEMATIC COUNTRY DIAGNOSIS (DPS) September 2015

⁴ African Development Bank Report 2018

⁵ WTO report

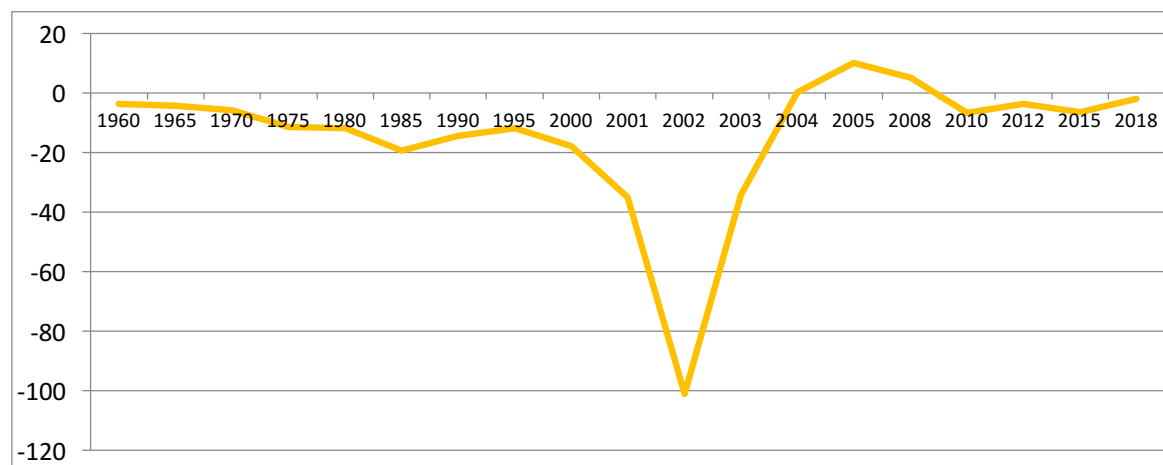
Table 1: Evolution of the trade balance

Year	Trade Balance (Millions of Euros)	Trade Balance (% GDP)
2018	876	9,18%
2017	395,2	4,43%
2016	-339 ,1	-3,68%
2015	-1148,2	-11,63%
2014	-155,3	-1,47%
2013	602,4	6,16%
2012	1556,7	16,11%
2011	1077,6	12,31%
2010	905,2	11,21%
2009	573,6	8,59%
2008	1474,4	20,79%
2007	1361,7	21,48%
2006	1594,4	26,87%
2005	1712,8	31,92%
2004	995,3	24,75%
2003	-167,1	-6,09%
2002	-1545,1	-64,73%
2001	-547,1	-25,31%
2000	-145,1	-8,52%
1999	-68,5	-4,2%

Source: Author based on data from countryeconomy.com

Chad's trade balance was in deficit from independence (1960) until the era of oil exploitation (2003) when it experienced a positive result as shown in the graph below. This highlights the importance of oil production in Chad's trade balance. However, from 2011 with the fall in oil prices, the balance began to return to deficit.

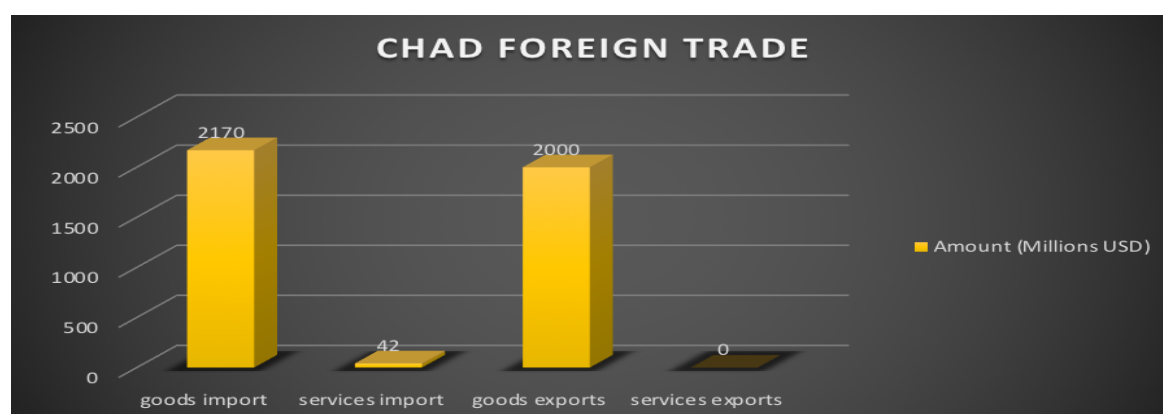
Figure 1: Evolution of the trade balance as a percentage of GDP



Source: Author based on World Bank data

Chad's foreign trade is marked by the goods market. Because most of the exchanges carried out relate to this type of market. This is valid for both imports and exports. The services market, on the other hand, is less developed, as shown in the graph below. The export of services is almost non-existent. This shows that the Chadian services market is less in demand abroad.

Figure 2: Chad's foreign trade



Source: Author based on WTO 2018 data

Chad maintains trade relations with all the continents of the world⁶ (see Tables 2 and 3). However, its imports come largely (36.9%) from Africa, followed by Europe (27.8%) and then Asia (24.8%).

⁶ WTO data 2018

Table 2: Origin of imports by continent

Continent	Imports (%)
America	7,4
Europe	27,8
Africa	36,9
Middle East	2,2
Asia	24,8
Common Wealth of Independent States	0,9
Total	100

Source: Author from WTO data, based on data extracted from UN comtrade, mirror statistics

Tableau 3 : Export destination by continent

On the other hand, in terms of exports, the American continent is the country's leading destination with 68.2% of exports, followed by Asia (16.8%) and then Africa (9.3%). The latter are largely made up of petroleum products (crude oil). If Chad imports more from the African continent, its exports to African countries are lower (9.3%). This is partly explained by the nature of Chad's exports, which consist mainly of raw materials (oil, cotton, gum arabic, etc.).

Continent	Exports (%)
America	68,2
Europe	5,6
Africa	9,3
Middle East	0,1
Asia	16,8
Total	100

Source: Author based on data from WTO, based on data extracted from UN comtrade, mirror statistics

1-2-1: Exchanges by country

Chad maintains trade relations with several countries outside of Africa. However, the most important are: The United States as the first destination for Chad's exports (57%), followed by India (8.9%) then China (6.7%) and France (6.4%), as illustrated by the graph below.

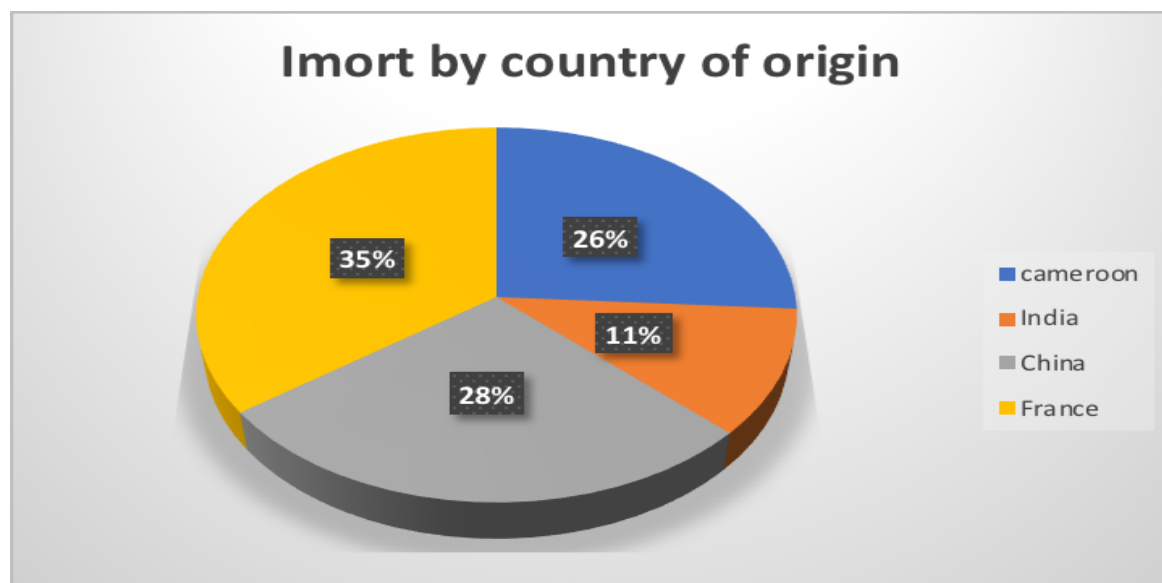
Figure 3: Exports by main destinations



Source: Author based on WTO 2018 data

Imports, on the other hand, come mostly (in this order) from France (35%), China (28%), Cameroon (26%) and India (11%).

Figure 4: Imports by country of origin



Source: Author based on WTO 2018 data

1-2-2 Structure of exports and imports

Chad's main exports after oil are: cotton, cattle and acacia. However, it should be noted that 92.4% of the country's exports are made up of primary products, of which 88.5% come from the extractive industries sector (oil) and only 3.9% from agricultural raw materials. Manufactured products, on the other hand, represent 7.1% of exports. The predominance of exports through raw materials testifies to the low level of industrialization of the country. This low level of industrialization has a strong impact on the country's ability to win sub-regional and regional markets as well as employment.

Table 4: Structure of exports

Main products	Exports (%)
Primary products	92,4
Agriculture	3,9
Foodstuffs	0
Agricultural raw materials	3,9
Extractive industries	88,5
Ores and other minerals	0
Non-ferrous metals	0
Fuels	88,5
Crude petroleum oils	88,5
Manufactures	7,1
Iron and steel	0
Chemical products	2,6
Other semi-finished products	4,2
Machinery and transport equipment	0,1
Textiles	0
Clothes	0,2
Others	0,5

Source: Author based on data from WTO, based on data extracted from UN comtrade, mirror statistics.

On the other hand, it imports machinery and transport equipment, industrial products, foodstuffs and textiles (see Table 5). They are marked by manufactured products which represent 63.6% of total imports, thanks to the massive importation of machinery and transport equipment (about 36%) which constitute more than half of manufactured products. In second place come extractive industry products followed by food products (10.7%).

Table 5: Structure of imports

Main Products	Imports (%)
Primary products	33,9
Agriculture	11,4
Foodstuffs	10,7
Agricultural raw materials	0,7
Extractive industries	22,5
Ores and other minerals	0,2
Non-ferrous metals	0,2
Fuels	22
Manufactures	63,6
Iron and steel	6,3
Chemical products	7,3
Other semi-finished products	5,7
Machinery and transport equipment	36,7
Machines for energy production	3,3
Other non-electric machines	17,9
Other machines and telecom equipment	3,2
Other electric machines	6,3
Automotive industry products	5
Other transport equipment	1
Textiles	0,8
Clothes	0,4
Other consumer goods	6,5
Others	2,5

Source: Author based on data from WTO, based on data extracted from UN comtrade, mirror statistics

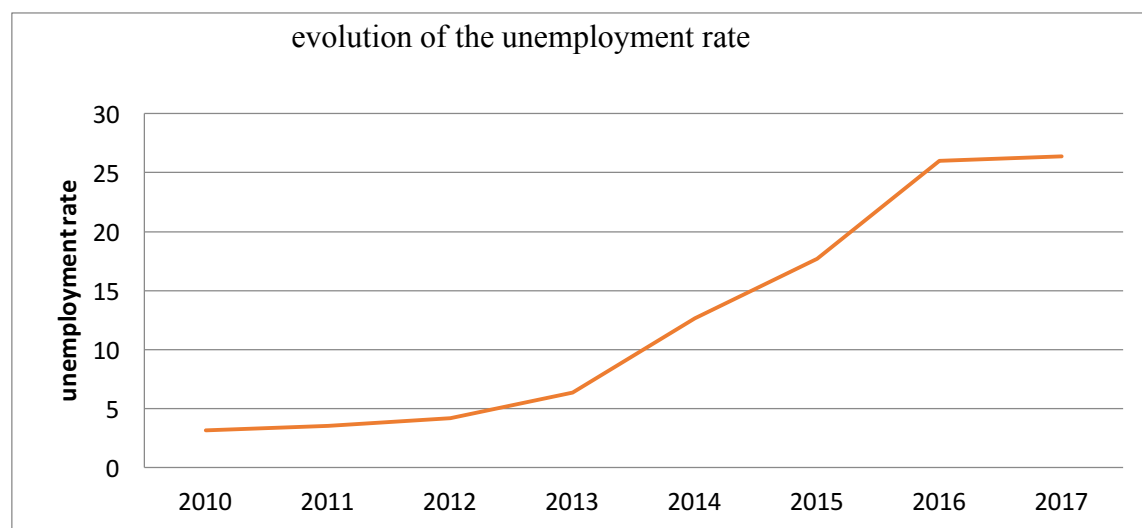
1-3 the job market

Like most Central African states, Chad's unemployment curve is scalable, as the curve below illustrates so well. Since 2007, the number of unemployed has continued to increase despite the

various policies put forward by the State. Between 2013 and 2016, the unemployment rate quadrupled, rising from 6% to 26% (see graph 5), for a population of working age of 6,000,000 people. This makes the situation alarming, especially when Chad is a landlocked country and dependent on a depleting resource. The industrial fabric is underdeveloped, which makes it even more difficult to absorb unemployment.

The problem of employment is recurrent and retains a prominent place in the political program of Chad in view of its inclusion in successive national development plans.

Figure 5: Curve of the evolution of unemployment



Source: Draft Chad Survey Report, University of N'Djamena

1-3-1 Unemployment by level of education

The distribution of unemployment by level of education is elucidated by the table below. The latter tells us that people with the CEPE are the most vulnerable to unemployment (23.4%) followed by people with no diploma (19.2%). Women are more exposed to unemployment than men, regardless of the diploma obtained. Similarly, unemployment affects women more than men for DEUG holders (10%). Unemployment is less accentuated among holders of a Master's degree/DEA/DESS.

Table 6: Unemployment by level of education

	Unemployment belong ILO					expanded unemployment				
Highest degree obtained	Sex		Place of residence			Sex		Place of residence		
	M	F	Urban	Rural	together	M	F	Urban	Rural	together
No	1.8	1.4	3.4	1.2	1.6	9.5	27.3	20.3	13.6	19.2
CEPE	3.1	1.4	4.5	1.6	2.5	19.4	29.4	24.1	21.8	23.4
BEPC	3.5	3.4	6.9	0.4	3.5	12.2	23.5	17	12.8	15.1
CAP	3	0	5.7	0	2.4	10.5	0	0	18.6	8.5
BT	0	58.6	0	24.3	16.5	0	58.6	24.3	0	16.5
BAC	4.2	8.2	7.3	0	4.9	13.1	17.5	14.9	13.5	14
DEUG,DU T,BTS	3.7	23.1	12.1	0	10.2	5.7	24.8	0	14.2	12.1
License	8.3	17.2	11.6	0	9.6	11.2	19.2	12.4	12.4	12.4
Maitrise	5.7	15.1	8.2	0	7.6	8.1	15.1	0	10.2	9.5
Master/DE A/DESS	6.9	0	7	0	5.9	6.9	0	0	7	5.9
Doctarat/p hd	0	100	13.4	0	13.4	0	100	0	13.4	13.4
Total	2.3	1.7	4.8	1.2	2	10.7	27.2	20.4	14.3	19.1

Source: Author based on Ecosit 4 household survey data

1-3-2 Activity rate by age, place of residence and gender

In the light of the table below, it can be seen that active men represent 72.9% of the total number of men against 49.3% for women. The active population of Chad is 60%, of which 63.7% is in rural areas against 50.2% in urban areas. In addition, the activity rate of women is lower (49%) compared to that of men; whether in rural or urban areas. The level of activity is higher in rural areas for both sexes (76.7% against 63.2% for men and 53.1% against 38.3% for women).

Table 7: Activity rate of people aged over 15 by place of residence and gender

Place of residence	Male	Feminine	Together
N'Djamena	59,3	31	45,2
Other Urbans	66,1	43,1	53,7
Together urban	63,2	38,3	50,2
Rural	76,7	53,1	63,7
Tchad	72,9	49,3	60

Source: Author based on data from Ecosit 4

1-3-3 Breakdown of jobs by sector of activity

The results of the ECOSIT 4 survey show a clear distribution of sectors of activity between men and women. Thus agriculture is the sector which concentrates the bulk of active men (72.1), then trade (8.1%), other industries (5.7%) and livestock/forestry/fishing (4.3%). On the other hand, among women, the majority are in the other industries sector (77.2% of the total workforce in the sector of activity), restaurant/hotel (67.1%), agriculture (54.2%) and trade (52.5%).

Table 8: Distribution of jobs by sector of activity

Activity sector	Distribution of jobs	Percentage of women
Agriculture	72,1	54,2
Livestock/forestry/fishing	4,3	32,2
Extractive industry	0,2	7,1
Other industries	5,7	77,2
Construction and public works	1,2	1
Trade	8,1	52,5
Restaurant/Hotel	0,5	67,1
Transport/Communication	1,4	1,7
Education/Health	1,9	22,1
Personal services	1,6	28,5
Other services	3,1	23,1
Together	100	51,1

Source: Author based on data from Ecosit 4

II- Literature review

Adam Smith's theory of absolute advantages (1776) initiated the literature on international trade and free trade. This theory justifies that in terms of free trade, a country specializes in the production of a certain number of goods while leaving the latitude to other countries to specialize in the production of goods of which they hold the advantage in terms of production cost. Thus each country will have the opportunity to import products whose local production would be more expensive. However, there are situations where a country derives no benefit from opening up to international trade. This is how David Ricardo (1846) highlighted relative costs and therefore makes a more optimistic analysis by overcoming the main limit of absolute benefits. For him, production should only be oriented towards products from which an advantage can be drawn through the cost of production. The HOS theory of Heckscher, Ohlin and Samuelson (20th century), develops Ricardo's theory by introducing the notion of specialization in production according to the structure of production factors. Thus the authors argue that depending on the amount of labor or capital held, a country must specialize in the production of goods. If, for example, a country has a more abundant labor force (as is the case in developing countries), it must specialize in the production of goods that require more labor. As a result, this country will have an advantage by producing this type of good rather than by producing another good which would require more capital than labor. LIST (18th century) put forward the theory of protection in the context of infant industries. It promotes educational protectionism to enable lagging countries to catch up in sectors where there is strong external competition. According to him, for the benefits of free trade to benefit all players, their respective levels of production are equal. This theory would like some flexibility to be granted to the least advanced countries in terms of production so that they can narrow the gap that separates them from the other countries with which they trade. Thus the least developed countries will be protected through customs duties in order to encourage the emergence of infant industries.

Antras and Ai (2017), studying the case of the United States, showed that companies that import a large part of their intermediate consumption (inputs) from several different countries, reduce their production costs and record higher sales than businesses whose inputs are purchased locally. Even that “a company that imports 47% of its inputs saves 30% and increases its sales by 176% by sourcing from around the world. Similar results are obtained by other researchers, notably Kashasa and Rodrique (2008) for Chile and Goldgerg et al (2010) for India.

It is important to know how trade affects the level of aggregate employment and average wages in a given country. The fact that trade induces net losses in the labor market does not imply a negative overall effect, since trade also impacts market welfare through other channels besides its influences on wages and labor. 'use. Amiti et al (2017) demonstrated that imports of products from China to the United States of America reduced the producer price index in the latter by nearly 8% between 2000 and 2006. This is to say that trade can lead to a fall in the price on the markets and particularly that of inputs even if competition from imports has a direct negative substitution effect on employment.

The indirect effects are quite numerous and sometimes positive. For example, the drop in input prices is favorable to local production and would lead to the creation of local jobs (Hummels et al 2001). Just as the fall in the cost of imports leads to an increase in the disposable income of consumers and therefore an increase in consumption expenditure on local products.

Dutt et al (2013), Felbermayer et al (2011) econometrically estimated the effects of changing customs duties or trade liberalization on the evolution of employment. They showed that unemployment may rise after a trade shock but fall below the initial level over the medium term. A 1% reduction in customs duties would lower the unemployment rate by around 0.35% and a 10 percentage point increase in trade openness would reduce unemployment by 3 quarters of a percentage point.

Caliendo et al (2015) found that in the United States of America, aggregate employment and wages have benefited from imports from China since the 1990s. Some sectors such as electronics or textiles declined while food and beverages grew. According to the authors, taking into account the reaction of labor supply to the evolution of real wages, trade has positive effects on employment and real wages in the different sectors.

According to the results of simulations made by the World Bank Group team (2020), the AfCFTA would have a greater impact on women's employment and wages. Women's wages would increase faster than men's in all countries except South Africa. It would increase by 0.17 percentage points in Central Africa, 0.11 percentage points in North Africa, 0.09 percentage points in West Africa and 0.07 percentage points in East Africa. This increase relates more to the main female-intensive industries. Thus the salary of women would increase more rapidly than that of men in 19 countries. In addition, the results of the scenarios show a welfare gain of 5%. However, the overall gains are lower due to export costs. On the other hand, another scenario shows a lower limit of the estimated gains in the absence of commercial cost reductions for partners outside AfCFTA. In this specific case, the continent would only experience a welfare gain of 1.2%. As a result, the biggest winners would be the countries that trade the most within the continent such as Morocco, Namibia and Senegal⁷.

⁷ world bank team 2020

III- Methodology and data

The analysis of public policies very often involves econometric or economic techniques and methods depending on the types of results expected. To this end, CGEMs, since their generalization in the early nineties (1990), have been popular for analyzing the impacts of public policies in general and trade liberalization policies in particular. This craze for CGEMs stems from the relevance of calculating the order of magnitude of the effects of policy reforms in a real economy based on simple macro or microeconomic theory.

3-1 Model specification and data

In this study, the basic dynamic PEP-T model developed by Decaluwé and al (2013) is used, integrating additional characteristics specific to the study carried out. This involves taking into account human capital, research and development, physical investments and the externalities of public capital for the specification of the production functions of the market sectors through the introduction of a total productivity function of the factors⁸. The labor market is disaggregated into formal and informal work. A salary curve is also introduced.

The model in question is dynamic recursive to better take into account the effects of liberalization over several years and the analysis of structural changes over time. It is applied to a country considered less advanced (Chad). It is composed of five (5) categories of institutions (households, firms, government, rest of the world Africa and rest of the world outside Africa). Since the rest of the world is disaggregated into rest of the world Africa and outside Africa (the other continents). The model takes into account two (2) types of capital factor (private capital and public capital), nineteen (19) branches of activity and nineteen (19) products/services.

3-1-1 Production structure

In perfect competition, production is carried out by the branches of activity by maximizing profit while taking into account the prices of inputs and factors. The production technology is described by the production and value added equations for each period t . Thus within each

⁸ Cabral 2017

sector, production (XS) is expressed by a Leontief function accumulating fixed shares of value added and intermediate consumption (IC):

$$XS_{j,t} = \min \left[\frac{CI_{j,t}}{io_j}, \frac{VA_{j,t}}{v_j} \right] \quad (1)$$

For tradable sectors, value added is a CES function that combines composite labor (LDC) and capital (KDC):

$$VA_{j,t} = BA_j^{VA} \left[\beta_j^{VA} LDC_{j,t}^{-\rho_j^{VA}} + (1 - \beta_j^{VA}) KDC_{j,t}^{-\rho_j^{VA}} \right]^{-\frac{1}{\rho_j^{VA}}} \quad (2)$$

On the other hand, in the non-profit sector, the added value is a CES function which combines composite labor and public capital.

The total intermediate consumption (IC) of a sector is a fixed part of its output:

$$CI_{j,t} = io_j XS_{j,t} \quad (3)$$

The demand for the composite good (DI) is a fixed part of the total intermediate consumption of sector j. Each product i constitutes a fixed share (aij) of the total intermediate consumption of sector j:

$$DI_{i,j,t} = aij_{i,j} CI_{j,t} \quad (4)$$

The factors of production (composite labor and composite capital) are combined according to a constant elasticity of substitution function (CES), while the various intermediate inputs are used in fixed proportions (Leontief function). The demand for labor and capital of each branch is determined by the first order condition of profit maximization.

The productivity factor (B_j^{VA}) is a function of human capital $(KH_{j,t})$, research and development $(RD_{j,t})$, physical investment $(IP_{j,t})$ and the ratio of aggregate public capital to

private capital in the sector $\left(\frac{KD_{pub}G_t}{KD_{priv}_{j,t}} \right)$ and the sensitivity of productivity to these different

arguments, given by the respective elasticities , and ε_k , ε_r et ε_i .

The overall stock of public capital creates $(KD_{pub}G_t)$ for each productive activity a positive externality that impacts the overall productivity of the sector's factors.

The productivity factor B will thus be affected by the distribution of the flow of public investment between human capital, research and development and physical investment, but also by the magnitude of the externalities from which the sector benefits and the elasticity of the productivity to different arguments:

$$B_j^{VA} = \bar{B}_{j,t} \left[\left(KH_{j,t} \right)^{\varepsilon_k} \left(RD_{j,t} \right)^{\varepsilon_r} \left(IP_{j,t} \right)^{\varepsilon_i} \left(\frac{KD_{pub}G_t}{KD_{priv}_{j,t}} \right)^{\varepsilon_k} \right] \quad (5)$$

3-1-2 Labor market modeling

The modeling of the labor market is done in such a way that it integrates a segmentation into formal work and informal work. A certain mobility within the different segments of the labor market is assumed. On the other hand, there is no labor mobility between the different segments of the labor market.

The wage curve approach developed by Blanchflower and Oswald (1994) is used to model the labor market. This approach describes a negative relationship between unemployment levels and wages. It reflects the fact that areas and/or sectors characterized by high unemployment rates are associated with low wages, while those with low unemployment rates are associated with high wage levels.

3-1-3 Foreign Trade Modeling

In order to take Chad's exports into account, an export demand function (EXD) is introduced into the model. This demand has a finite elasticity and is a function of the relationship between the world price and the fob price.

$$EXD_{i,t} = EXD_i^0 pop_t \left[\frac{e_t P W X_{i,t}}{P E_{i,t}^{FOB}} \right]^{\sigma_i^{XD}} \quad (6)$$

Producers maximize their profit, taking into account the constraints of the internal and external markets (CET function). They substitute local sales for external ones and vice versa, taking into account the relative shares of their sales on the two markets, the internal and external sales prices and the elasticity of transformation of the CET function.

$$EX_{j,i,t} = \left[\frac{1 - \beta_{j,t}^X}{\beta_{j,t}^X} \frac{P E_{i,t}}{P L_{i,t}} \right]^{\sigma_{j,i}^X} D S_{j,i,t} \quad (7)$$

The domestic product supply of import branches (Q) is a combination of imports (IM) and locally sold production (DD), defined according to a constant elasticity of substitution (CES) function, also called "d function". 'Armington' in which are, respectively, the scale parameter, the relative shares of imports and the elasticity of substitution of the CES function.

$$Q_{i,t} = B_i^M \left[\beta_i^M IM_{i,t}^{-\rho_i^M} + (1 - \beta_i^M) DD_{i,t}^{\rho_i^M} \right]^{\frac{-1}{\rho_i^M}} \quad (8)$$

The level of imports is derived from the cost minimization of the Armington function. Domestic agents can substitute imports for products sold locally and vice versa, taking into account the relative shares of imports, prices and the elasticity of substitution of the Armington function.

$$IM_{i,t} = \left[\frac{\beta_i^M}{1 - \beta_i^M} \frac{P D_{i,t}}{P M_{i,t}} \right]^{\sigma_i^M} D D_{i,t} \quad (9)$$

In addition, within the framework of this study, a distinction is made between imports and exports from and to the African continent on the one hand and imports and exports from and to other continents on the other hand. The same is true for duties in order to distinguish customs duties on products from Africa from those on products from other continents (outside Africa). This is to direct the simulations towards exchanges between African countries to better assess the effects of the AfFCTA.

3-1-4 Model dynamics

As the economy is driven by capital accumulation and population growth, these are the main sources of economic growth. Investment, on the other hand, covers the depreciation of capital and contributes to its accumulation from one period to another.

The sectoral private capital stock at the end of the period $(KD_{k,j,t+1})$ is equal to the stock at the beginning of the period $(KD_{k,j,t})$ net of the consumption of fixed capital (or depreciation) of the period at a rate $(\delta_{k,j})$, to which is added the volume of capital accumulated during the period $(IND_{k,j,t})$.

$$KD_{k,j,t+1} = KD_{k,j,t} (1 - \delta_{k,j}) + IND_{k,j,t} \quad (10)$$

Public investment demand is the product of the average price of public capital and the sum of investment demand from the public sector.

$$IT_t^{PUB} = PK_t^{PUB} \sum_{k,pub} IND_{k,pub,t} \quad (11)$$

Private investment demand is the product of the average price of private capital and the sum of investment demand from the private sector.

$$IT_t^{PRIV} = PK_t^{PRIV} \sum_{k,bus} IND_{k,bus,t} \quad (12)$$

The average price of capital (private or public) is a weighted sum of consumer prices, the weighting coefficient being the relative share of demand for good or service i in overall investment demand (by origin):

$$PK_t^{PUB} = \frac{1}{A^{K-PUB}} \prod_i \left[\frac{PC_{i,t}}{\gamma_i^{INVPUB}} \right]^{\gamma_i^{INVPUB}} \quad (13)$$

$$PK_t^{PRIV} = \frac{1}{A^{K-PRIV}} \prod_i \left[\frac{PC_{i,t}}{\gamma_i^{INVPRIV}} \right]^{\gamma_i^{INVPRIV}} \quad (14)$$

The sectoral rate of accumulation of private capital $\left(\frac{IND_{k,bus,t}}{KD_{k,bus,t}}\right)$ in period t is an increasing function of the cost-benefit ratio of capital $\left(\frac{R}{U}\right)$ in the same period, but the rate of increase in the rate of accumulation, under the effect of this ratio, is decreasing

$$\frac{IND_{k,bus,t}}{KD_{k,bus,t}} = \varphi_{k,bus} \left[\frac{R_{k,bus,t}}{U_{k,bus,t}} \right]^{\sigma_{k,bus}^{INV}} \quad (15)$$

The user cost of capital in a sector is equal to the average price of capital (PK) multiplied by the sum of the interest rate (IR) and the depreciation rate $(\delta_{k,.})$:

$$U_{k,pub,t} = PK_t^{PUB} (\delta_{k,pub} + IR_t) \quad (16)$$

$$U_{k,bus,t} = PK_t^{PRIV} (\delta_{k,bus} + IR_t) \quad (17)$$

3-1-5 Parameters of functional forms

The specification of the functions of production, household consumption and import and export demands require parameters, in particular: the income elasticity of demand for products, the Frisch parameter, the elasticity of substitution between capital and labor, the elasticity of substitution between imported and local products, the elasticity of transformation between foreign sales and local sales, and the elasticity of foreign demand.

Some parameters could not be found in the country and had to be taken from the literature on CGEMs and their sensitivities were tested. The remaining parameters were calibrated using the SAM data while ensuring the consistency of the base year data.

3-1-6 Model Looping Procedure

In order to complete the model, public expenditure is assumed to be fixed in real terms, in the first period, but increases at the same rate as the population. Similarly, the supply of labor increases at the rate of population growth. The savings-investment balance is achieved through the introduction of an endogenous indirect tax which allows the State to collect the additional resources necessary for investments.

Also, the current account balance is assumed to be fixed. Thus local producers are compelled to reduce their export prices in order to increase their market share abroad. The exchange rate and inventory change are also fixed.

3.2 Model Accounting Framework: The Social Accounting Matrix

The model's accounting framework is provided by the Social Accounting Matrix (SAM). This draws its data from the input-output table (TES), the government financial operations table (TOFE), the resource-use balance table by product (TRE), the balance of payments (BDP) and data from surveys on consumption in the informal sector in Chad (ECOSIT). This SAM was built by Decaluwe in 2008 on behalf of Chad. It is structured as follows: five (5) categories of institutions (household, firm, government, rest of the world Africa and rest of the world outside Africa). The disaggregation of the rest of the world (in Africa and outside Africa) was made possible thanks to data from Chad's foreign trade statistics provided by the General Directorate of the National Institute of Statistics for Economic and Demographic Studies (INSEED). Thus, based on the weight of the origins and destinations of the products, a distribution key is created to segment the products from Africa and those from other continents. The SAM has 19 sectors of activity and 19 products/services, two (2) types of capital factors (private capital and public capital) and two (2) types of labor factors (formal labor and informal labor).

IV- Simulation and comments on the Results

The simulations are made on the different characteristics of the Chadian economy from the base scenario (without shock).

4.1 Simulation scenario

The simulations relate to a gradual liberalization of products traded with African countries over a period of ten (10) years. This implies a gradual abolition of customs duties on at least 90% of goods traded between countries on the African continent. With regard to sensitive products, liberalization is only effective from the sixth year of the implementation of AfCFTA. It thus extends until the 13th year. On the other hand, a horizon of 10 years is set for this study, which would not make it possible to reach the last three years of liberalisation. The reduction rates are calculated on the basis of the dismantling practice tables adopted during the negotiations. Chad, the subject of this study, being considered a less advanced country, belongs to the category which will totally liberalize in 10 years all products considered non-sensitive and in 13 years sensitive products and no reduction for excluded products.

Table 9: Schedule of the envisaged liberalization

	For non-sensitive products	For sensitive products	For excluded products
Countries not belonging to the category of least developed countries	Total liberalization in 5 years (Linear reduction)	Total liberalization in 10 years (linear reduction)	No reduction
Least developed countries	Total liberalization in 10 years (linear reduction)	Total liberalization in 13 years (Linear reduction)	No reduction

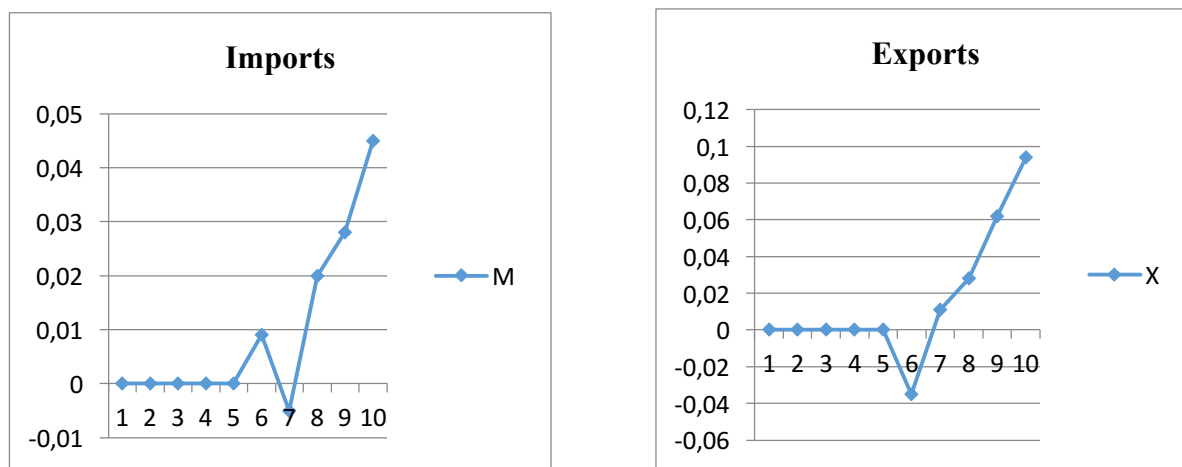
Source: AfCFTA Negotiating Forums

4.2 Discussion of simulation results

The shock being the gradual abolition of customs duties over 10 years, it is therefore analysed, the direct effects first and the indirect effects second, through the transmission channels.

We therefore find that progressive liberalization has induced an increase in imports and exports in Chad.

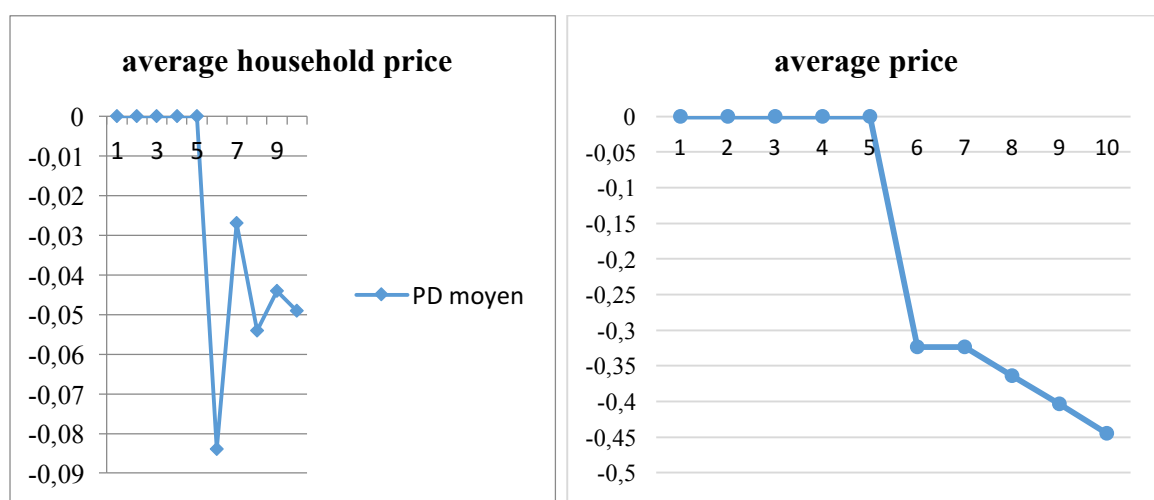
Figure 6: Change in Imports and Exports



Source: Simulation results

On the other hand, this situation led to a fall in average prices and domestic prices. This is explained by the fact that the abolition of customs duties led to the massive entry into the local market of new, more competitive products, which led to a drop in prices on the domestic market.

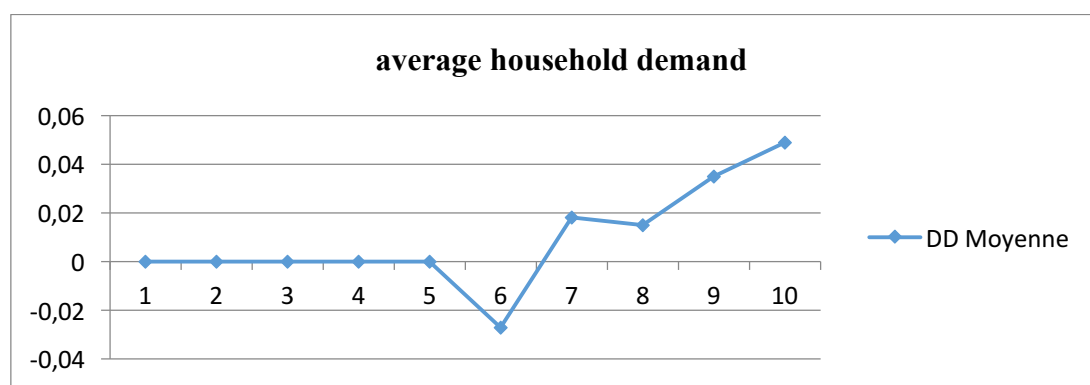
Figure 7: Price Change



Source: Simulation results

So, drained by the fall in domestic prices, average domestic demand has increased.

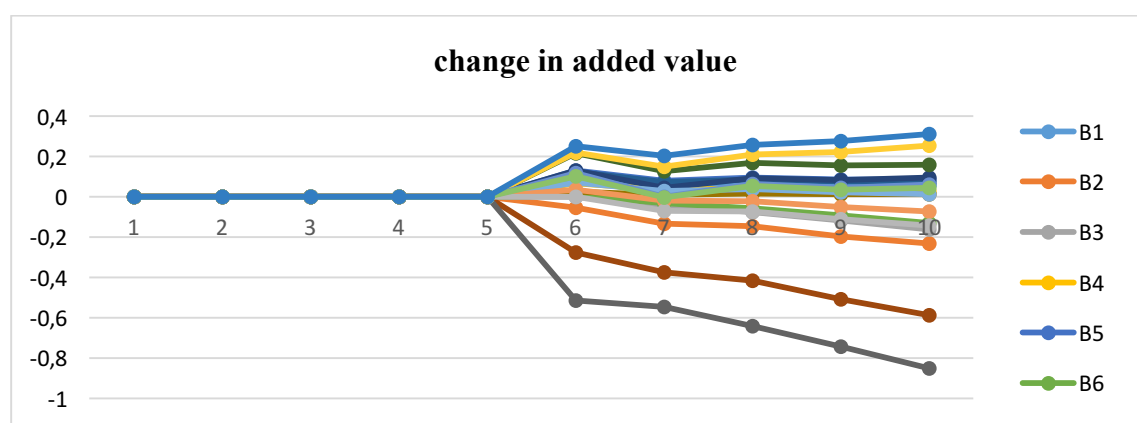
Figure 8: average household demand



Source: Simulation results

The liberalization of African trade certainly has repercussions which vary according to the sectors of activity. This is due to competition, comparative advantages and other advantages in the production process. Thus the results of the simulations show that the added value varies from one sector to another. As a result, some branches of activity have seen their added value increase. These include the branches of subsistence agriculture, forestry, transport, hotels and restaurants and health. On the other hand, the branches of construction, industry, cash crop agriculture and real estate activities are experiencing a decline in added value. The branches whose added value increases are those whose liberalization leads to an improvement in activities, either thanks to the fall in the prices of inputs or thanks to the competitiveness of these branches on the African market. However, it can be said that the branches for which liberalization is unfavorable are the least competitive on the common market because of their low production capacity; for example the branches of construction, industry or real estate activities which are branches that require greater technological capacity and human resources adapted to face competition. In addition, the geographical position of Chad (landlocked) not helping, it is not easy to compete in these branches because of the different costs related to the delivery of inputs.

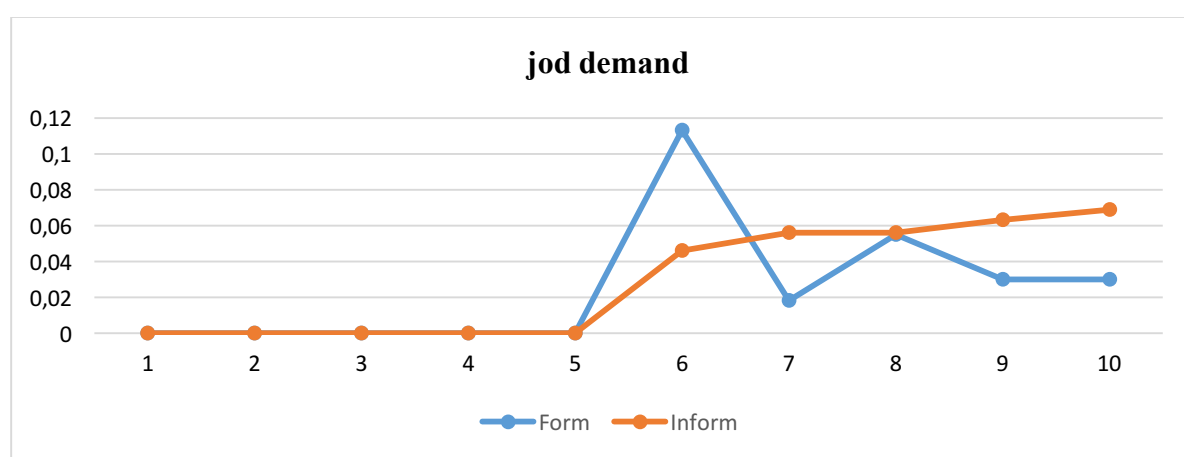
Figure 9: change in added value



Source: Simulation results

On the Chadian labor market, following trade liberalization, the demand for labor varies according to the categories (formal or informal). The results of the simulations show that both formal and informal work generally increase over the simulation periods, but with different levels of variation. It can be seen that formal work records a considerable increase in the 6th year of liberalization but evolves unevenly over the rest of the period, while informal work records a rather constant progression. Overall, it can be said that the implementation of the AfCFTA induces an increase in the demand for labor in both categories even if in the category (formal work), the evolution is less constant with certain levels on the rise and others down.

Figure 10: job demand

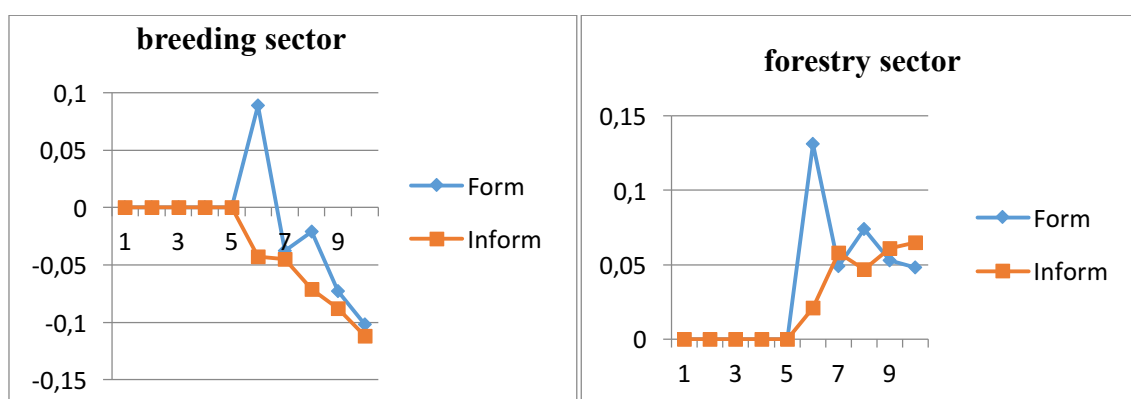


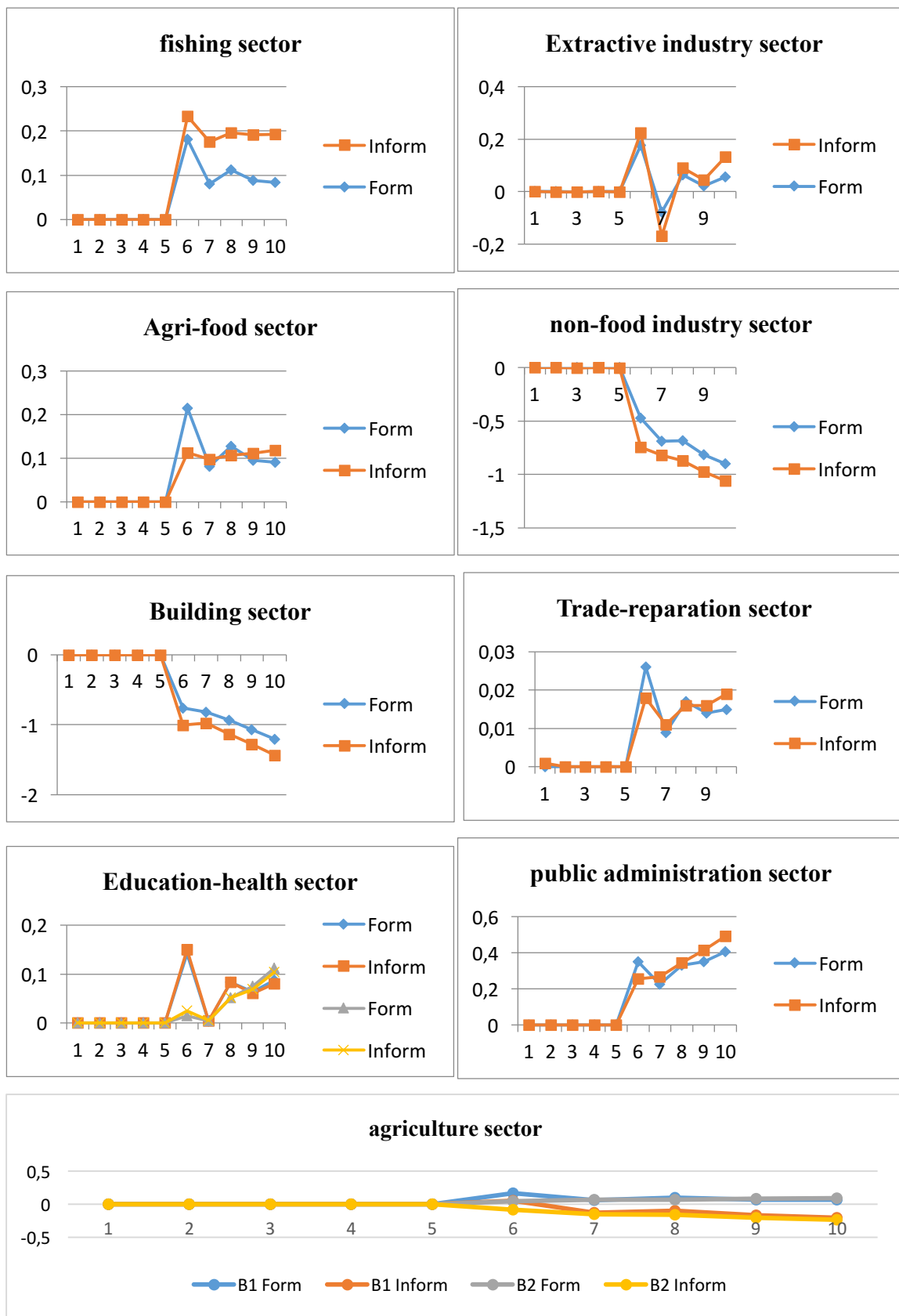
Source: Simulation results

To better understand the labor demand curve, an analysis of the evolution of labor demand by sector but also by type of qualification (formal or informal) is carried out. This distinction by sector will help to see the branches that employ the most and those whose jobs will be lost.

In the light of the simulations, we notice a correlation between the sectors whose added value is positive following the implementation of AfCFTA and the sectors whose labor demand is on the rise. To this end, the sectors of subsistence agriculture, forestry, fishing and trade are experiencing an increase in their demand for labour. This is valid for formal work as well as for informal work. On the other hand, sectors such as industry, cash crop agriculture and construction are registering a declining demand for labor (all types of work combined). However, some sectors, such as Livestock, recorded a demand for labor which evolved sometimes upwards and sometimes downwards over the period. These analyzes lead to the conclusion that the implementation of AfCFTA would imply job gains and losses depending on the sector. However, overall, the labor demand curve is positive compared to the reference period (BAU) for both types of work (formal and informal) over the study period. It would therefore be relevant to analyze through the wage curve the financial implications of the jobs created on household income and the wage rate.

Figure 11 : Variation of LD by sectors



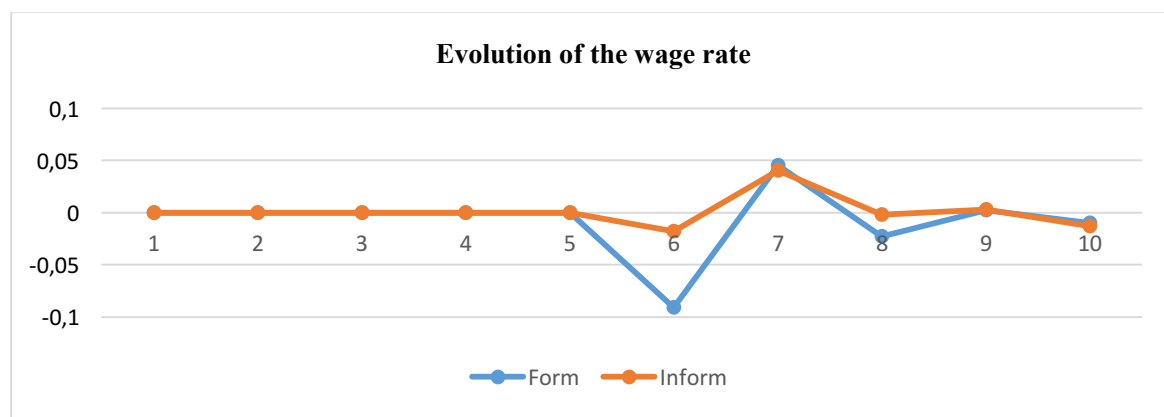


Source: Simulation results

We note that the wage rate decreases over period 5 to 6 before rising in the 7th period to go down again in the following period and approach the rate of zero (0) thereafter. This is valid

for both types of jobs (see graph 13). Even if the implementation of liberalization induces an increase in labor demand, its impact on wages remains mixed. As a result, the recorded job losses have a negative impact on direct taxes and indirectly on State revenues.

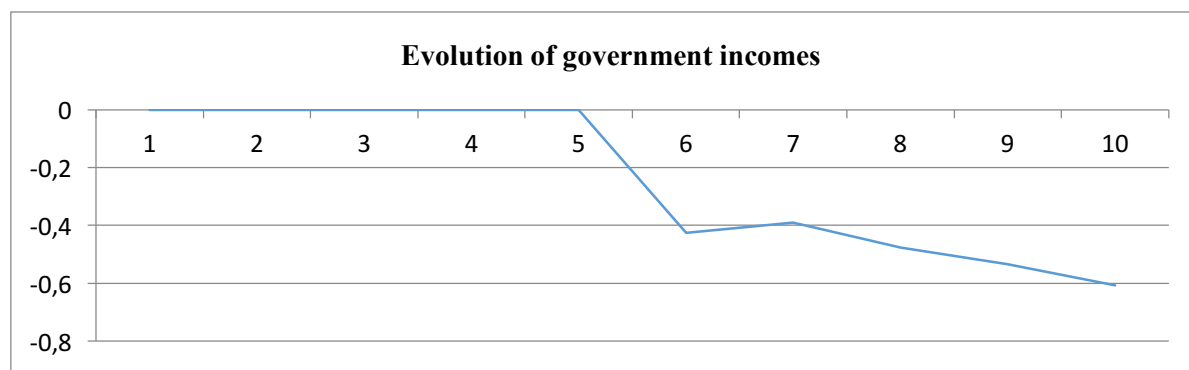
Figure 12 : Evolution of the wage rate



Source: Simulation results

The Government loses direct taxes but also indirect taxes. Customs revenue will gradually decrease to zero at the end of the period indicated in the liberalization timetable. This situation has a strong impact on the budget of the least developed States such as Chad, for which customs revenue accounts for approximately 15 to 25% of total revenue. A decline in state revenue necessarily impacts public spending and therefore the well-being of households.

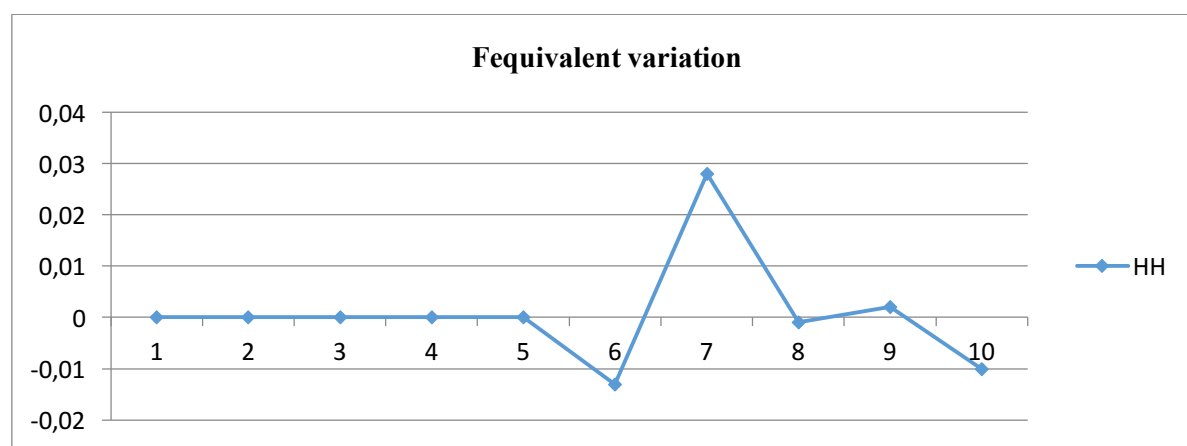
Figure 13: Evolution of government incomes



Source: Simulation results

The intervention of the State in the economic chessboard in a context of less advanced countries, is taught by the economic literature. As far as Chad is concerned, the reduction in State revenue will have a considerable impact on public expenditure insofar as the subsidies granted by the State will decrease. The consumption of a segment of the population will deteriorate. The results of the simulations show a sawtooth evolution of the equivalent variation. At period 6, there is a decrease in the equivalent variation then an increase in the 7th period before stabilizing between the 8th and 9th period (see figure 15). This mixed evolution according to the periods is explained on the one hand by the fall in domestic prices which generates an improvement in the purchasing power of households and on the other hand by the fluctuation of the labor market which is linked to the health of the branch of activity.

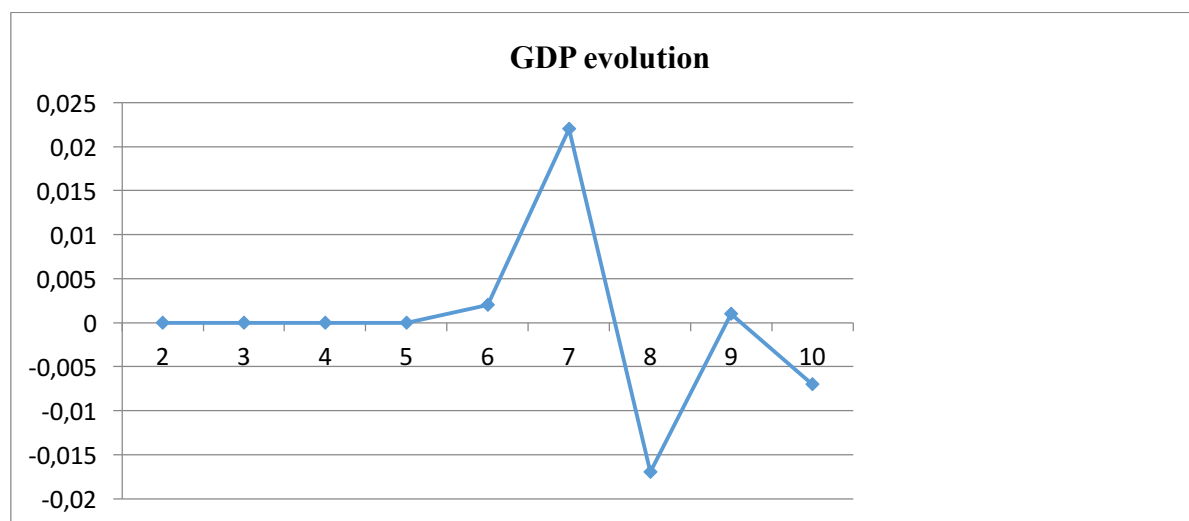
Figure 14: equivalent variation



Source: Simulation results

The introduction of African trade liberalization impacts gross domestic product (GDP) in an altered way. Over the first two periods (6 and 7) the GDP increases sharply then drops in the 8th period before taking off again in the 9th period. The removal of tariff barriers led to an increase in activities in a number of sectors and a decline in activities in other sectors. This situation has manifested itself in a growing economy at one time, but in a declining economy at another. However, the GDP evolves sometimes upwards, sometimes downwards, thus testifying to the irregularity of growth over the period of the study.

Figure 15: GDP evolution



Source: Simulation results

Conclusion

The study focused on the effects of the implementation of the African Continental Free Trade Area (AfCFTA) on the Chadian economy through a recursive dynamic computable general equilibrium model (DCGEM). It is adapted from the basic PEP-t model developed by DECALUWE et al (2013).

At the end of the simulations made over a period of ten (10) years, the results of the study show that the implementation of AfCFTA leads to an increase in imports and exports in the Chadian economy. The increase in imports led to a drop in domestic prices. However, a drop in local prices also means a reduction in production costs. Since production is linked to added value, a reduction in costs would imply a reduction in labor and/or capital factors. As a result, the activity of certain sectors has decreased compared to the reference scenario and that of other sectors has increased.

As the factor market is affected by liberalisation, there has been a fluctuation in the demand for formal as well as informal labour. However, there is a correlation between the added value and the demand for labor in the same sector of activity. When the sector records an increase in added value, the demand for labor in this sector increases and vice versa. Overall, the labor market recorded an increase over the period studied. As a result, within the Chadian labor market, informal work is growing more than formal work, and therefore likely to create more jobs.

To this end, the State is called upon to structure the informal economy and adjust taxes (or even introduce new taxes), following the drop in of business sectors to produce positive growth.

Ultimately, the lesson of economic policy is that the implementation of AfCFTA implies targeted investment in the sectors of the economy in order to take advantage of comparative advantage. Even if this targeted investment would lead to job losses in certain sectors that are not very competitive on the African market, such as the construction and non-food industry sectors, other sectors are promising and can create jobs and create growth.

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