working paper
2016-12

Chinese investments: A blessing for the Central African economy?

Roger Yélé
Mélissa Huguet
Jean-Bertrand Kolondo
Raissa Théodile Mbouzeliko
Caprice Olivia Wili-Koe

March 2016

pep partnership for economic policy

PAGE policy analysis on growth and employment

IDRC CRDI pep partnership for economic policy UKaid

Chinese investments – A blessing for the Central African economy?

Abstract

China recently decided to invest $15 billion CFA francs in the Central African Republic to develop the cotton sector from the crop to the ginning and textiles industries. We analyze the economic impacts of such investment on the Central African Republic by accounting for euro versus dollar depreciation (the CFA franc is pegged to the euro). We build a 2012 social accounting matrix, considering the restoration of textile sector. We develop a computable general equilibrium model called CARCHINA based on the PEP 1.1 model. We note an increase in sectoral production, an improvement in household living standards and higher real GDP. Euro depreciation amplifies those effects.

JEL: C68, E16, F62

Keywords: CGE, SAM, Foreign direct investment, macroeconomic impacts

Authors

Mr Roger Yélé
Services Director, ICASEES
Bangui, Central African Republic
Roger_Yele@yahoo.fr

Mr. Jean-Bertrand Kolondo Penguilet
Department Head, ICASEES
Bangui, Central African Republic
kolpeng2004@yahoo.fr

Ms. Caprice Olivia Chancelle Wili-Koe
Executive, ICASEES
Bangui, Central African Republic
wilikoe_olivia@yahoo.fr

Ms. Mélissa Huguet
Doctoral student.
Université Laval &
Université Montesquieu Bordeaux IV
Québec, Canada
melissa.huguet.1@ulaval.ca

Ms. Raissa Théodile Mbouzeliko
Executive. ICASEES
Bangui, République centrafricaine
raissambouzeliko@yahoo.fr

Acknowledgements

This study benefitted from technical and financial assistance from the Partnership for Economic Policy (PEP) www.pep-net.org, financed by the Department for International Development (DfID) in the United Kingdom, and the Canadian Government through the International Development Research Center (IDRC). The authors also wish to express their thanks to Prof. Bernard Decaluwe (professor at Laval University) for technical aid, advice, comments and suggestions.

Table of Contents

List of Acronyms

FCFA	Franc of Financial Cooperation of Central Africa
ICASEES	Central-African Institute of Statistics and Economic and Social Stud
SAM	Social accounting matrix
CGE	Calculable general equilibrium (model)
GDP	Gross domestic product
CAR	Central African Republic
ROW	Rest of world
IOT	Input-output table
TRE	Supply-use table

I. Introduction

The Central African Republic (CAR) is one of the poorest countries in the world. We estimate that 62% of the population lives under the poverty line. It ranks 179th among 187 countries for the Human Development Index. The strong recent deterioration in the quality of life of Central African is explained in particular by a succession of political, economic and social crises. This situation is exacerbated by the vulnerability of the country to climate and its major exposure to external shocks such as variations in world prices of food and primary resources, the increase in oil prices and the international financial crisis of 2008. The CFA franc, the currency of the CAR, has a fixed exchange rate to the euro. The currency is thus subject to fluctuations in EUR/USD rates. The recent depreciation of the US dollar could have both beneficial and negative effects on the CAR's trade relations.

However, the CAR aims to have a viable and sustainable economic system as stated in the political objectives set which aim for economic growth and reduced poverty and inequality. But, the weak capacity to mobilize domestic savings makes it difficult for the CAR to carry out investments necessary to ensure economic development. The inflow of foreign capital, in particular foreign direct investment (FDI), is an alternative which contributes to sustained economic growth. Improved relations between China and the CAR have gone in this direction. In 1964, under the Dacko government, a special cooperation with China was established but was interrupted by the overthrow of this regime in 1965. Negotiations with China resumed in 1998 and in 2012 China committed to invest 15 billion CFA francs in the cotton industry in the form of foreign direct investment.

In the CAR, the cotton industry includes three main sectors: the cotton production sector, the cotton ginning sector (transformation of cottonseeds into fibre), and finally the textiles sector which uses the cotton fibres to produce fabric and cloths. We analyze the likely cross-sector effects of the Chinese presence in Central Africa. This study thus fills in on the existing literature on the impact of FDI in a developing economy for which we measure the effects using a calculable general equilibrium model. It adds to studies recently produced using this method in Africa by Latore (2014) in Tanzania, Arbenser (2004) in Ghana and Kinyondo and Mabugu (2014) in South Africa.

The growing presence of China in the Central African Republic has led us to ask about the opportunities provided by Chinese investment in Central Africa: (i) are Chinese

investments in the Central African Republic conducive to putting the country on a pathway to growth and development? (ii) Do they lead to improved welfare of households and in general? (iii) Are they adequately oriented to the cotton industry? Moreover, considering the vulnerability of the CAR to external world shocks, what are the risks of these investment policies with respect to EUR/USD fluctuations? Would euro depreciation increase the initial impact of Chinese investment?

The second section presents a literature review, and the 3rd explains the methodology. Section 4 analyzes the effects of Chinese investment on the cotton industry, and section 5 concludes with respect to social welfare.

II. Literature Review

FDI plays an increasingly important role in the world economy. According to Barba Navaretti and Venables (2004), it grew by more than trade and income through the last 15 years of the 20th century. FDI mostly originates from advanced economies, with a somewhat increasing tendency towards investment in developing economies. In 2011, 1612 billion dollars in FDI flows were recorded, as compared to 1400 billion in 2000, 200 billion in 1990 and 50 billion in 1985.

Many authors have shown that the presence of FDI affects the structure of production in host countries. Multinational firms (MNFs) set up in the host country (Kokko, 2000; Blomstrom and Kokko, 1997; Antras and Rossi-Hansberg, 2008) and bring relevant productivity gains. The heterogeneity of productivity is due to organizational forms (Helpman, 2006). Agarwal (1980) shows a positive relationship between FDI and market size of foreign firms. FDI promotes the expansion of exporting activities but reduces the number of domestic firms with products in the host market economy (Zhai, 2008; Deng et al., 2013; Jensen et al., 2007).

It is important to highlight that FDI does not always have the same effects in developing countries as in developed countries (Lipsey, 2002). In developing countries, FDI flows increase the growth of total factor productivity while in developed countries it tends

to increase production in the sectors where the FDI is made. Most sectors benefit from FDI because it tends to lead to higher production (Verikios and Zhang, 2001b; Brown and Stern, 2001). However, according to tendencies seen in the data on FDI, some sectors (Brown and Stern, 2001) in the host country may suffer. This is the case for financial sector liberalization (Verikios and Zhang, 2001b). Jensen et al. (2007) explain that production rises in sectors which had initially been exposed to barriers.

In investing abroad, MNFs can pursue many objectives. First, they may find productive and less costly workers. Then, this production can be directed toward their country of origin, contributing to the size of exports from the FDI host country to their country of origin (Brown and Stern, 2001; Banse et al., 2007). These firms also need intermediate goods or primary materials from their preferred country of origin, which tends to increase the imports of the host country (Brown and Stern, 2001). Second, MNFs may prefer to enter target markets by setting up production locally instead of exporting intermediate goods or primary resources from their country of origin in order to avoid transportation costs. In this case, exports could decrease (Morley and Piñeiro, 2013; Nunnenkamp et al., 2006). Finally, and without explicitly seeking to do so, MNFs may contribute to overall development of the host country. Along these lines, Nunnenkamp et al. (2006) observe that FDI entering into Bolivia promotes improvements of public infrastructure because they finance a share of the budget and thus reduce budgetary constraints.

Also, direct investment by MNFs play a key role in growth of countries, because they generally bring with them higher levels of technology and qualifications (Barba-Navaretti and Venables, 2004; Greenaway and Kneller, 2007). Moreover, those working for MNFs in the host country tend to have higher wages than those working for domestic firms, which by emulation pushes them to be more productive, either by improving product quality or by concentrating markets of domestic firms either stimulating innovation or technology transfer (Deng et al., 2013; Banse et al., 2007; Lipsey, 2002). Moreover, FDI brings productivity gains to all types of qualification, but the largest increases in wages are among qualified workers (Latorre, 2014; Kinyondo and Mabugu, 2014) while reducing the share of the informal economy (Morley and Piñeiro, 2013). We should also note that these productivity gains recorded across all levels of qualification increase inequalities between men and

women, the second of which mostly tend to have unqualified or semi-qualified employment (Latorre, 2014; Kinyondo and Mabugu, 2014). In Bolivia, inequality increased by between 0.2 and 0.4%, mostly affecting rural households, while inequality decreased in urban areas. Poverty declined by 1.4% to 3.2% pushed by the strong decrease in poverty in urban areas (between 2.3% and 5.2%) (Nunnenkamp et al., 2006).

Following these different effects of the presence of MNFs and inflows of FDI into the host country, overall and individual household welfare improves considerably. This is the case of APEC members (Petri, 1997), Russia (Jensen et al., 2007) and China (Deng et al., 2013). This results are also found for Ghana (Arbenser, 2004), in all countries in South Asia and in most countries in East and Central Asia (Brooks et al., 2008) and Thailand (Diao et al., 2005). Zhai (2008) corroborates the results of Brown and Stern (2001) and Verikios and Zhang (2001b), showing that the reduction in tariff barriers accompanying FDI improves global welfare of all geographic regions of the world.

From the theoretical perspective, analyses of effects of FDI on the economy by use of calculable general equilibrium models makes it possible to account for spillover effects and interactions in the economy (Shoven and Whalley, 1984 and 1992). So, Morley and Piñeiro (2013), Morley et al. (2011) and Nunnenkamp et al. (2006) use thedynamic recursive calculable general equilibrium model approach. Others prefer to analyze FDI using a static calculable general equilibrium model (Deng et al., 2013; Brown and Stern, 2001; Jensen et al., 2007). To better account for the economic impact of FDI throughout the world, Brown and Tern (2001), Verikios and Zhang (2001b), Banse et al. (2007), Morley and Piñeiro (2013), Morley et al. (2011) and Petri (1997) regionalize their models in order to study the transmission channels of FDI through different countries in the world or the different regions of countries studied. Changes in FDI can be formalized as a change in capital or foreign savings.

In this context, it is interesting to ask about the effects of 15 billion CFA inChinese investment in the cotton sector in Central Africa on household welfare, the production of firms and GDP. To do so, we present the value chains of the cotton sector in the following sector and the data used for the case of the CAR.

III. Methodology and Data

3.1. Specification of the CARCHINA model

The CARCHINA model is an adaptation of the PEP1.1_V2.1 from Decaluwe et al. (2013) from which we retain the following assumptions:

- The CAR is considered as a small open economy which does not influence the world market. World import and export prices are exogenous.
- Firms and family microenterprises, whether formal or informal, operate in an environment of perfect competition.
- The exchange rate is exogenous and is the numeraire of the economy.

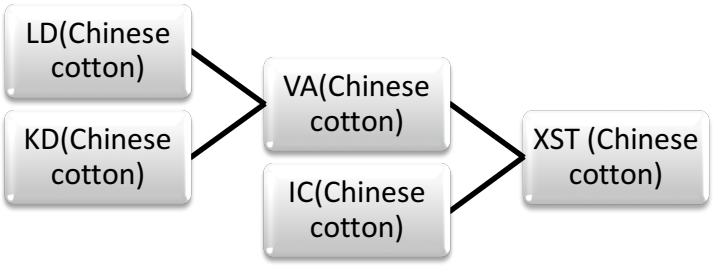
At the level of the cotton sectors, we consider that the elasticity of demand for exports from the CAR by China for products linked to cotton is infinite. In effect, all production from the value chain of the Chinese cotton sector is exported to China in order to satisfy Chinese demand. The Chinese investments are for regular supply of the Chinese market.

To evaluate the positive externalities of investment from China in the Central African cotton sector, we consider that the entry of FDI flows into the host economy brings an increase in the stock of capital.

3.1.1. Specification of the production function of the cotton harvest

In the Central African Republic, the cotton harvest is done by two types of firms: firms with mainly Chinese capital, and independent domestic microenterprises. There is a production sector of firms with mainly Chinese capital. Production in this sector is schematized as follows:

Figure 1: Production structure in Chinese cotton sector

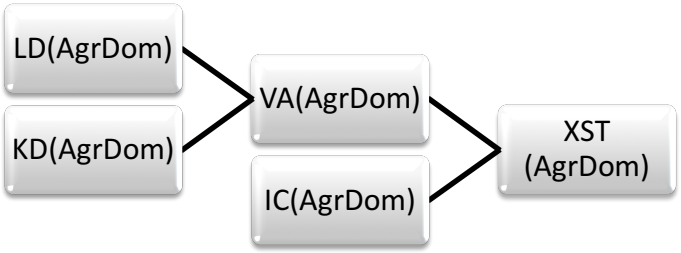


LD: labour; KD: capital; VA: value added; IC: intermediate consumption; XST: production

Cottonseed from firms with Chinese capital firms is treated as its own sector. For its production, the sector needs capital from China and workers, considered as the value added. Inputs are also needed, and so there is demand for intermediate inputs from the sector. The intermediate consumption and value added are complementary while labour and capital are imperfect substitutes.

Microenterprises also produce cottonseed. The domestic cotton-producing firms are accounted for with "food agriculture and other crops" (Agr Dom, where "dom" refers to "domestic" producers). The production structure in this sector is represented by the following figure.

Figure 2: Production structure of the "food agriculture and other crops"

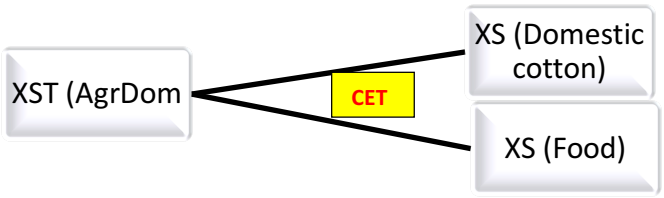


LD: labour; KD: capital; VA: value added; IC: intermediate consumption; XST: production

Similar to the Chinese cotton sector, the "Agr Dom" sector combines labour and capital which are imperfect substitutes. These factors are complementary in intermediate consumption in the production process. Production is then distributed between the cottonseed produced by domestic microenterprises which we refer to as domestic cotton and "food products".

The food agriculture sector decides to produce each good according to its profit maximization accounting for its cost constraints. However, food products for household production and domestic cottonseed for processing are imperfect substitutes.

Figure 3: Goods from production in the "food agriculture and other crops" sector



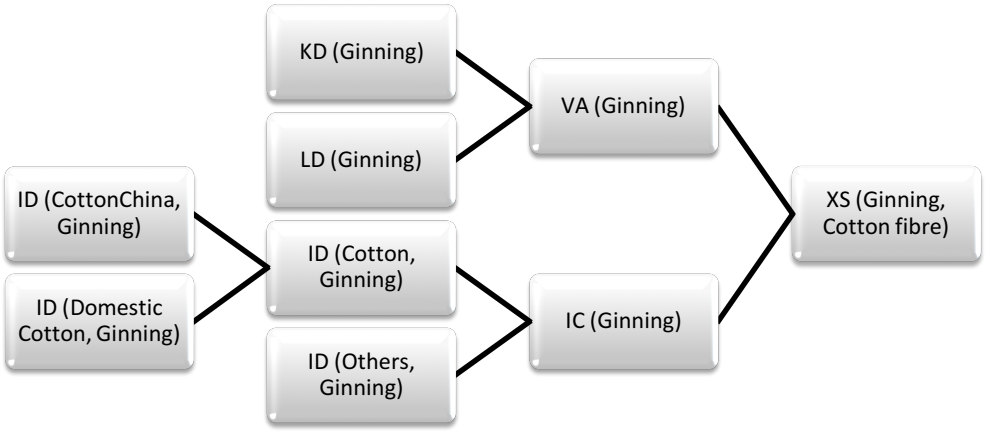
XST: production; XS: production

Firms in the CAR produce enough cottonseed to supply the domestic market, so imports of these goods is nil. Cottonseed is not used for final consumption or investment, and goes to intermediate consumption.[1] Thus, cotton from these two sectors is completely sold to the ginning sector which uses it as an intermediate input.

3.1.2. Specification of the production function in the ginning sector

The ginning sector buys all the cotton produced in the country, from both domestic and Chinese firms. It then processes the cottonseed into cotton fibres and cottonseed to produce oils and oil cake. The structure of production in this sector can be represented by the schematic below.

Figure 4: Structure of production in the ginning sector



ID: intermediate demand; KD: capital; LD: labor; VA: value added; IC: intermediate consumption; XS: Production

[1]In the SAM, a component of total demand for cottonseed is variations in stocks. However, for the simulations this component is exogenous and does not play a role in the analysis. Their presence in the data is thus neutral with respect to this modeling effort.

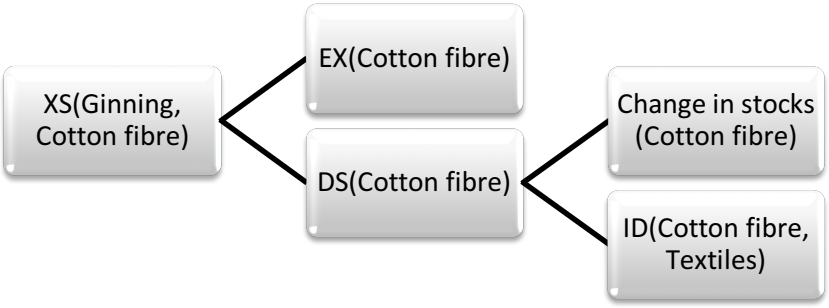
The ginning sector will use all the cotton available on the market, from both Chinese and domestic firms, to produce cotton fibers. The ginning sector decides how much to buy depending on costs, knowing that Chinese firms have most of the market share in cotton and that contracts with each supplier are known in advance. The elasticity of substitution between each type of cotton is fairly low (0.11). Also, firms need other intermediate goods to produce cotton fibres.

In addition to its demand for primary materials, the ginning sector also uses production factors. Labour and capital are considered imperfect substitutes. The elasticity of substitution is assumed to be fairly low (in the range of 0.2). Basically, while capital is an important production factor in the production process, it cannot entirely replace labour. The combination of labour and capital are the value added of the firm. Cotton fibres cannot be produced without the combination of intermediate factors and value added in the production process in the ginning sector.

The cotton fiber produced by the ginning sector goes to one of two markets: exported and domestic. The cotton fiber going to the external market is mostly exported to China, because Chinese investment aims to supply this market. As a result, we postulate that Chinese demand is infinitely elastic. However, it is important to highlight that the CAR seeks to diversify its foreign trading partners. At present, cotton fibre for external markets other than China is largely to countries in the European Union.

Cotton fiber which is not exported is sold on the domestic market. The presence of China enabling the restoration of the "textiles industry" sector means that a share of cotton fibre production serves as intermediate inputs into this sector. What is not sold on the domestic market is then stocked.[2]

Figure 5: Structure of supply in ginning sector



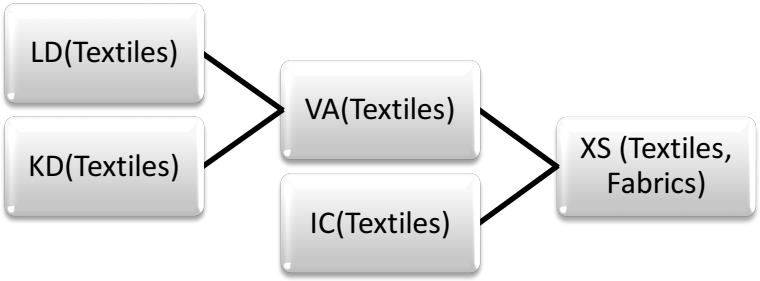
EX: Exports; XS: Production; DS: Supply in the domestic market; ID: Intermediate demand

[2]As indicated above, changes in stocks are exogenous in the simulations.

3.1.3. Specification of the textiles industry production function

Following the restoration of the textiles sector thanks to Chinese investments, we should make some specifications about the mode of production and behaviour of firms in this sector. Firms will produce fabrics and unbleached cloths by processing cotton. The textiles sector will demand intermediate inputs such as cotton fibres, other manufactured products, and market services. Total intermediate consumption is combined with the use of workers and capital to produce fabrics and unbleached cloths.

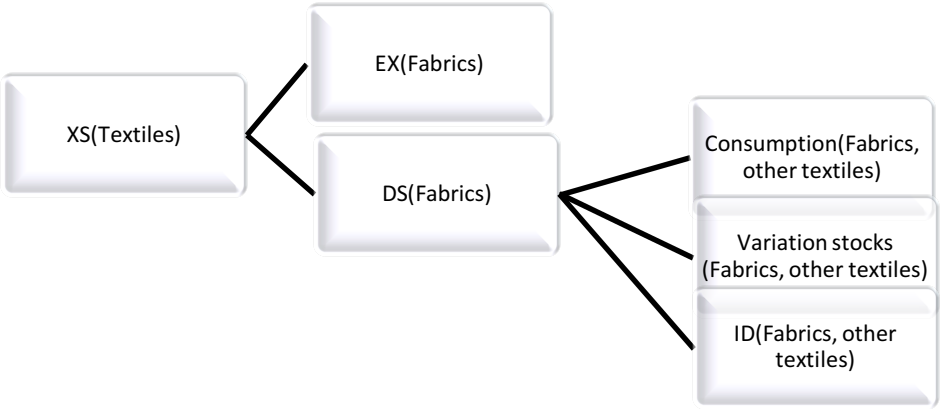
Figure 6: Structure of production in the textiles industry



LD: labor; KD: capital; VA: value added; IC: intermediate consumption; XS: production

Fabrics are then sold on a number of markets.

Figure 7: Structure of demand for fabrics



EX: Exports; XS: Production; DS: Supply in the domestic market; ID: Intermediate demand

Fabrics are exported on foreign markets to other countries in the rest of the world; the model does not specify their final geographic destination. On the domestic market, the demand for fabrics is met by two types of consumption: final consumption by households and intermediate consumption by other types of firms in the Central African economy. The remainder of total production which is not exported or consumed is stocked.

Equilibrium for markets in cotton fibers depends on household and firms' consumption and changes in stocks. There are no imports of cotton fibres because production in the CAR is self-sufficient in this respect. For some other contextual aspects of the model, we invite the reader to refer to the PEP 1-1 model.

3.1.4. Model closure

We assume that the wage rate on the labor market is rigid and that there is underemployment among workers. So, the needs of Chinese investors for workers can always be met by the reserve of underemployed workers. While the Central African economy has expanded in a way that requires more workers, there are still more workers to fill new positions. Workers thus leave the informal sector and enter into the formal sector. However, if the Central African economy declines, firms will tend to lay off workers to reduce production costs to earn more profit. In such a case, many workers who were in the formal market will return to the informal market and unemployment increases.

Finally, we consider that the capital stock in the sector, the current account balance, transfers from China to the government, as well as public expenditures and changes in stocks, are all fixed and exogenous in the model.

3.2. Constructing the 2012 CAR social accounting matrix

The social accounting matrix is deduced from the national account, the balance of payments (BoP) and the Table of Financial Operations. Recall that in 2012 the primary data did not specify a textiles sector. As a result, and in order to proceed with adequate parameterizing of the model, we need to do some work to bring it out of the data in order to construct the SAM. To do this, and with the goal of finding the technical coefficients of production, two practical solutions can be seen: either use data from a country similar to the Central African Republic but where the textiles sector is still present (for example, Chad), or use historical data from the textiles sector in the CAR. Despite our efforts it was not possible to obtain this information on Chad and so below we will show our use of the historical method.

Cultivation of cotton was introduced to the country in 1925. The highest recorded production was 58,743 tonnes in 1969/70 with an average yield of 441 kg/ha. The record yield was 762 kg/ha in 1990/91, with total production of 35,513 tonnes.

Many economic actors are involved in the process of restoration of the cotton sector in the CAR. In addition to the Ministry of Rural Development, which oversees the work, there are: (i) Cotton companies (cotton cell, Chinese firms and other domestic firms) which are responsible for their supply of inputs, season credit, transportation of cottonseed, ginning, marketing and processing cotton fibre; (ii) research structures devoted to improving total productivity of labor and inputs; (iii), private operators (private services or state services). Information on cotton production, ginning, and processing cotton into textiles products were obtained from different actors.

Table1: List of sources of information by sector of activity in the cotton sector

Sector	Sources of data
Growing cottonseed	Ministry of rural development, annual agricultural statistics, cotton cell
Cotton ginning	Ministry of rural development, annual agricultural statistics, cotton cell, statistics on external trade, balance of payments
Textiles	Tax records, production function and statistics of similar countries, statistics of external trade, former production structures, expert opinions

3.2.1. Division of the cotton sector into Chinese and domestic producers

The division of the cotton producing sector enables us to identify the main two groups of actors in the sector. First, we have Chinese firms which ensure production of cottonseed in the sector of Chinese production, and there are also independent domestic entrepreneurs grouped together into a domestic cotton sector. In 2012, the producer price was set by an inter-ministerial decree. The production function calculated based on that of 2005 accounts for the technical coefficients of the base year. The cotton from the two production sectors mentioned here are used either as intermediate consumption in the ginning sector or contribute to variation in stocks.

Accounting for the fact that the Chinese have invested more in cotton production areas, the distribution of total production between the Chinese production and that of domestic producers is in the range of 80/20.

In applying the technical coefficients of the base year using value-based data from the sector as well as the production of cotton, we obtain production, value added and intermediate consumption in these two production sectors.

3.2.2. Treatment of sector of activity: Cotton ginning

In including the cotton ginning sector, we consider the entire production chain by dividing the use of production factors which are labour, capital and intermediate consumption required in the production process. It is also important to account for the final destination of the product coming out of this process. Once produced, cotton fibres are either exported, sold on domestic markets, or are used as intermediate inputs by one or many other production sectors, in this case especially textiles.

For better treatment of this area of activity, we look at, among other things, the balance of payments and statistics on external trade.

The ginning production function is calculated using the 1995 structure, which is one year after the devaluation of the CFA franc, which led to a new expansion of cotton production.

Table 2: Structure of production function in the ginning sector in 1995 (as percentage of output)

Production	Part 100
Intermediate consumption	**45.37**
Cottonseed	24.05
Sawn and plywood	1.06
Other manufactured products	13.65
Buildings and public works	1.14
Market services	5.47
Value added	**54.63**
Total wages	14.61
Taxes on production	0.04
Gross operating profits	40.63

Sources: definitive national accounts: 1995 supply-use table

In 1995, all cotton fiber was exported because processing of cotton fibers was not done in the CAR at that time. So, we use data from 1990 to determine employment in this

production sector, because in that year firms in the cotton ginning sector were at full production capacity and amounted to a significant amount of economy activity.

The coefficients of the supply-use equilibrium of cotton fibers and seeds are as follows:

Table 3: Structure of supply-use equilibrium of cotton produced in 1990 (as percentage of output)

	Structure
Production	**100**
Intermediate consumption	15,96
Change in stocks	8,45
Exports	75,59

Sources: definitive national account: 1990supply-use

3.2.3. Some details on the industrial sector of textiles

As indicated above, since the "textiles industry" sector did not exist in the 2012 supply-use table, it received special treatment. Without the structure of expenditures in the textiles sector from another country with similar characteristics to the economy of the CAR, we used the 1990 TES to rebuild the "textiles industry" sector, knowing that there had already been processing of cotton fibres in the CAR between 1980 and 1990. Looking to the national accounts of 1989 and 1990 (1990 supply-use table), it is possible to recreate this sector of activity. It accounted for 7.1% of production in the "other manufacturing industries" category.

Table 4: Structure of production function in textiles sector in 1990 as percentage of output

	Part
Production	**100**
Intermediate consumption	**75.65**
Cotton fibres	18 .41
Other manufacturing products	49.44
Buildings and public works	1.29
Market services	7.38
Value added	**24.35**
Total wages	22.80
Gross operating profit	1.55

Sources: definitive national accounts: 1990 supply-use table

The structure of the supply-use equilibrium in textiles products is based on that of 1990. In terms of supply of resources, we discern between production, imports, customs tariffs and other taxes on imports and margins. In terms of use, textiles production is distributed between intermediate consumption, expenditures on final consumption, changes in stocks, taxes on exports, and exports.

Table 5: Structure of supply-use equilibrium of products from textiles and other cotton fibre in 1990

	Structure
Production	**100**
Imports	105.31
Taxes on imports	9.93
Margins	79.91
Intermediate consumption	178.51
Expenditures on final consumption	100.16
Change in stocks	-2.59
Taxes on exports	0.05
Exports	16.84

Sources: definitive national accounts: 1990 supply-use table

In combining this information, we obtain a new SAM which accounts for the industry which grows cotton among both Chinese and independent domestic firms, the ginning sector and the textiles sector. The Chinese and domestic cotton sectors include individual entrepreneurs from the export-based agro industry sector as well as ginning and textiles which are part of other manufacturing industries.[3]

IV. Application and Results

4.1. Scenarios simulated

In Table 6 we present the most relevant simulations which were retained. It should be noted that we start with Chinese investment towards the textiles sector.

[3]See annex for a presentation of the data in the final SAM.

The simulation exercises that we have performed show that when Chinese investments are only in the sectors upstream from the textiles sector, they do not produce the hoped for positive effects. This can be explained by the lack of destination markets for the cottonseed or cotton fibre production. In the case of cottonseed, an increase in production capacities and an increase in the supply of the product have not been met by an increase in demand. They are thus faced with a market constraint, due to a negative effect on prices. Also, Chinese investment increases the productive capital in the ginning sector, which leads to unrealistic price declines. Production being too high, the price effects impact both the real wage rate and employment. These simulations[4]show, on the one hand, that demand for cotton fiber or cottonseed are determinants on domestic factor markets, and on the other hand an absence of a textiles industry which may absorb an increase in production of cotton fibres; also, there is the issue that excess supply of cottonseed could lead to declines in prices if market prospects are insufficient. Thus, the Chinese strategy of getting directly involved in the cottonseed or ginning sector should not be relevant because it is not accompanied by involvement in the textiles sector.

For the purposes of this study, we limit ourselves to a presentation of the results of the scenario of investment in the textiles sector, because in creating a downstream market for cotton production, such as a CAR textiles sector, the Chinese investment is more likely to have strong spillover effects on other sectors in the cotton industry and on the economy as a whole.

We will combine the first scenario with euro devaluation to account for changes in international market conditions.

Table 6: Summary of scenarios

Themes	Scenarios	Variables and/or parameters impacted
FDI in cotton sector	Article I. Increased Chinese investment in TEXTILES sector in the CAR (**Sim1**)	Article II. A 10% increase in productive capital in the TEXTILES sector
External trade	Article III. Increased Chinese investment in textiles sector. The CAR faces a depreciation in the euro (**Sim2**)	Article IV. A 10% increase in productive capital in the textiles sector. A 10% increase in world prices due to euro depreciation.

Source: authors (2015)

[4]The results of these simulations are not reported in this document, but are available from the authors.

4.2. Description of macroeconomic and sectoral results

The analysis of the results is done along the lines of the two themes mentioned above. A third section compares the welfare of agents and GDP effects. The main results are presented in Table 7 in the annex.

4.2.1. Increase in Chinese investments in cotton industry

By investing in the textiles sector, China increases the stock of capital in this sector by 10%. Ex-ante, the demand for capital in the textiles sector is less than the supply of capital and the cost of capital declines significantly by 21.2%.

Ceteris paribus, we expect a decline in the demand for labor due to changing relative cost of production factors. But this is not a big deal because other factors will cause (in general equilibrium) employment creation in the textiles sector. Later we explain the origin of this phenomenon.

From the perspective of production, the increase in the stock of capital leads firms in the textiles sector to produce more fabrics, which leads them to increase their demand for intermediate inputs including cotton fibre.

Thus, this increase in demand for cotton fiber leads to an increase in domestic prices for cotton fibers (+4.7%), with the effect of increasing production among firms in the sector (+0.33%). This sector thus registers increases in value added and intermediate consumption in the same proportions as production (Leontief-type production function). This leads to an increase in the cost of productive capital in the ginning industry, due to an absence of new investments in this sector. The cost of capital in the ginning industry rises by 4.96%. Since capital and labour are imperfect substitutes and the stock of capital is fixed, the sector increases its demand for labour with a +0.97% effect on employment in the ginning sector. Alongside this, the demand for intermediate inputs also rises by 0.33% notably that of the two types of cotton.

The ginning sector sees additional production from the larger Chinese harvest, a non-negligible spillover effect. As a result, and ex-ante, Chinese demand for cotton will lead to an increase in the overall supply and induce a 2.91% increase in the price of Chinese-produced cottonseed. This increase in prices leads firms in the cotton sector to produce

more cottonseed. Production thus rises (+0.30%). In response to the additional demand, firms with Chinese capital will increase their production, which they would not have done without an increase in their value added and demand for intermediate inputs. This increase in production increases the productivity of capital (+6.49%) while causing a substitution effect which benefits workers. These combined effects lead firms in the sector to recruit additional workers (+1.27%). Also, prices for cottonseed produced by the sector in the country rise by 0.21% and intermediate demand from the ginning sector has a spillover effect on the other production sectors (+0.58%), thus promoting the development of domestic firms.

The ginning sector expands overall following a substantial increase in demand for primary materials from the textiles sector. The price of cotton fibre thus rises on the domestic market (+4.7%) and exports market (+0.96%). We observe a diversion of trade away from exports (-1.89%) to the benefit of the supply of the domestic market (+5.52%).

In terms of fabrics, the increase in their production leads to a decline in prices, both for exports (-4.55%) and on the domestic market (-5.54%). This decline leaves products from the CAR in a more competitive position which favours exports at a cost to the domestic market. The change in exports (+9.76%) is relatively greater than that of production (+8.4%) and the supply on the domestic market (+7.49%).

Also, the increase in Chinese cotton production and in the ginning and textiles sectors leads to an increase in demand for intermediate inputs (except for nonmarket services). Thus, the increase in demand for fabrics, as intermediate goods in production processes in other sectors, amplifies the production of the textiles sector (+8.4%). At the same time, a better supply of the domestic market enables a decrease in imports of fabrics (-2.68%).

Chinese investments in the textiles sector thus have positive overall effects, in particular in the cotton industry where employment is created in textiles (+4.88%), ginning (+0.97%), production by firms with mainly Chinese capital (+1.26%) and in other sectors of the economy.

These spillover effects and the increase in demand for all goods due to interactions with processes related to production induce an increase in production in all sectors except for extraction, wood industries and nonmarket services.

Along with an analysis of Chinese involvement in the cotton sector in the Central African Republic, we should also look into the exchange rate effects as a vulnerability factor faced by the CAR.

4.2.2. Exchange rate and effects on international trade

The recent depreciation of the euro vis-à-vis the US dollar influences export prices and causes an increase (in domestic currency) in the export price of cotton fibres and fabrics. We postulate that this increase in prices benefits exporters to the tune of 10% and ask whether the exchange rate effects amplify or dampen the impact of the Chinese involvement in the Central African cotton sector. We compare the impact of the increase in world prices with the preceding simulation on the national economy. The main results of interest relate to) the effects on the cotton industry and b) the depreciation of the euro and thus the FCFA vis-à-vis the dollar, and the overall effects in terms of higher prices of imports than in exporting sectors.

A 10% increase in the world price of cotton fibres, all else equal, leads to a 10.57% increase in the FOB export price of cotton fibres and exports prices. Also, a 10% increase in the world price of fabrics leads to a 4.45% increase in the FOB export price of fabrics.

This increase in prices encourages the ginning sector and the textiles sector to export their production onto the world market rather than sell on the domestic market. We observe that the change in exports of fabrics is higher than in simulation 1 (+10.9% as compared to +9.67%). We also see the role of depreciation in terms of the incentive to export as reflected by the smaller decline compared to the previous scenario (-1.89% compared to -1.04%).

To be able to export goods, the textiles sector must increase production, which positively impacts (+9.31%) value added and total intermediate consumption in the textiles sector. This increase in production thus leads to greater usage of capital invested by China which reduces the cost of capital noted in the preceding scenario (-10.34% compared to -21.20%). Also, the sector creates more employment and increases demand for labour by +7.62% (as compared to +4.78%).

The spillover effects of Chinese investments, discussed in the previous scenario, are now amplified by the decline in the value of the euro. The increase in demand for cotton fibres thus increases the impact on prices (+14.49% as compared to +4.7%) and leads to increases in both production (+1.08% compared to +0.33%) and employment creation (+3.36% compared to +0.97%). The rate of return to capital is also positively affected. The spillover effects of the expansion of the ginning sector are also felt in terms of cottonseed production. Specifically, demand for Chinese-and domestic-produced cottonseed respectively rises by 1.01% and 0.85%, causing upwards pressure on Chinese- and domestic-produced cottonseed prices respectively by 14.7% and 7.19%. This increases in prices induces Chinese and domestic firms to produce more cotton (+1.01% and +0.85%), leading to an increase in the productivity of capital and hiring of more workers (+4.54% new hires as compared to +1.27%).

At the level of the ginning sector, cotton fibres are more highly demanded, especially as intermediate inputs into the textiles sector. Total demand for cotton fibres increases by 5.98%, somewhat more than in simulation 1. The relative price of exports with respect to sales on domestic market decreases, thus promoting sales on the domestic market to supply the textiles sector and reduce exports. Meanwhile, the increase in international prices of cotton fibres leads to lower exports of cotton fibres than in simulation 1 (-1.04% compared to -1.88%). Firms in the ginning sector are thus encouraged to sell their production on the domestic market rather than on the world market. The depreciation of the euro promotes exports of fabrics, as it does in most sectors in the Central African economy. The resulting increase in the labour supplied is greater in the euro depreciation scenario than in simulation 1.

We also observe that euro depreciation positively affects many other sectors. Higher prices for imports cause a shift in overall demand towards domestic products, which has a significant positive impact on production and job creation. The same holds for investment demand because an increase in the value of exportable products leads to major realignment in macroeconomic equilibria.

4.2.3. Welfare analysis

The Chinese involvement combined with euro depreciation induces positive crowding-in effects which are greater than the effects of the Chinese investment along (+16.9% vs. +0.14%).

Also, the income of economic agents increases. The Chinese investment in the textiles sector leads to high income on capital in the ginning sector and in cotton production industries. The income of firms rises slightly as a result (0.062%). It is larger with the increase in supply of exports associated with euro depreciation (+7.42%).

The Chinese investment combined with exchange rate depreciation (simulation 2) strongly improves household income (+7.18%). This can be explained by higher income on capital (+7.45%) following the strong increase in returns to capital in the sector and the increase in labour income (+6.1%) due to increased entry of workers onto the labour market. The combination of the price effect and income effect improves the purchasing power of households whose consumption budget increases by 7.18%.

Government revenues are also higher in simulation 2 (+8.73%) as a result of higher receipts from direct taxes on the incomes of households and firms, indirect taxes on products, customs tariffs and production taxes. The increase in production in almost all sectors thus also contributes to higher government receipts through production taxes, thus reducing the deficit by 30%.

Finally, GDP at production factor cost is higher in the case where China invests in textiles industries in addition to the CAR facing euro depreciation vis-à-vis the US dollar. The change in GDP at production factor cost is 7.21% in this case compared to 0.07% in simulation 1. The increase in income of all agents, combined with the increase in government revenues from taxes on products and imports, altogether increase GDP at market prices by 7.53% in simulation 2 as compared to 0.07% in simulation 1.

V. Conclusions and Policy Implications

In this study, we have highlighted the importance of the Chinese investment to the economy of the Central African Republic. We have assumed that the involvement of this country can enable the Central African economy to reopen firms in the textiles sector. In an absence of sufficient data, work to recompile data was necessary to create a fictitious matrix. Further work to account for the specificities of each sector linked to the cotton sector was also performed.

This enables us to show that the Chinese foreign direct investments improve the welfare of all groups of economic agents in the Central African Republic. Households see their purchasing power rise as a result of depreciation of the euro compared to the US dollar. The budget deficit declines, firms register increase revenues, and GDP rises strongly.

These results lead us to conclude that the Central African Republic would gain by promoting the textiles sector in negotiations aiming at greater Chinese investment in this sector.

References

AGARWAL, J.P. (1980). Determinants of Foreign Direct Investment: ASurvey, *Weltwirtschaftliches Archive*, 116(4):739-773.

ANTRÀS, P. and E. ROSSI-HANSBERG (2009). Organizations and Trade, *Annual Review of Economics, Annual Reviews*, 1(1):43-64.

ARBENSER, L. (2004). A General Equilibrium Analysis of the Impact of Inward FDI in Ghana: The Role of Complementary Policies. Working Paper, Wirtschafts- und Sozialwissenschaften an der Landwirtschaftlich-Gärtnerischen Fakultät, Humboldt-Universität zu Berlin 69/2004.

BALDWIN, R.E. and P. MARTIN (Jan 1999).Two Waves of Globalization: Superficial Similarities, Fundamental Differences, NBER Working Paper No. 6904, NBER Program(s): ITI.

BANSE M., S.H. GAY, S. MCDONALD, R. M'BAREK and J. SWINNEN (2007). *Competitiveness in the Food Industry: A CGE Modelling Approach to Assess Foreign Direct Investment in Transition Countries*, Paper prepared for presentation at the joint IAAE- 104th EAAE Seminar Agricultural Economics and Transition: "*What was expected, what we observed, the lessons learned.*" Corvinus University of Budapest (CUB), Budapest, Hungary. September 6-8, 2007.

BARBA NAVARETTI, G. and A.J. VENABLES (Dec 2004). Multinational Firms in the World Economy, Princeton University Press, *Journal of International Economics*, 67(2):520-524.

BLOMSTROM, M. and A. KOKKO (2000). Outward Investment, Employment and Wages in Swedish Multinationals, *Oxford Review of Economic Policy*, 16(3):76-89.

BROOKS, D.H., D.R. HOLTS and F. ZHAI (Feb 2008). Behavioral and Empirical Perspectives on FDI: International Capital Allocation Across Asia. *Journal of Asian Economics*, 19(1):40-52.

BROWN, D.K. and R.M. STERN (2001). Measurement and Modeling of the Economic Effects of Trade and Investment Barriers in Services, *Review of International Economics*, 9(2):262-286.

DECALUWÉ, B., A. LEMELIN, V. ROBICHAUD and H. MAISONNAVE (Jul 2013). PEP-1-1, "The PEP Standard Single Country, Static CGE Model", Version 2.1.

DENG, Z., R. FALVEY and A. BLAKE (2013). Quantifying Foreign Direct Investment Productivity Spillovers in China: A Computable General Equilibrium Model, *Asian Economic Journal*, 27(4):369-389.

DIAO, X., R. JØRN and S. HILDEGUNN E (2005). International Spillovers, Productivity growth and openness in Thailand: An Intertemporal General Equilibrium Analysis, *Journal of Development Economics*, 76:429-450.

GREENAWAY, D. and R. KNELLER (2007). Firm Heterogeneity, Exporting and Foreign Direct Investment, *The Economic Journal*, 117: F134-F161.

HELPMAN, E. (Sep 2006). Trade, FDI, and the Organization of Firms, *Journal of Economic Literature*, 44(3):589-630.

JENSEN, J., T. RUTHERFORD and D. TARR (2007).The Impact of Liberalizing Barriers to Foreign Direct Investment in Services: The Case of Russian Accession to the World Trade Organization, *Review of Development Economics*, 11(3):482-506.

KINYONDO, G. and M. MABUGU (2009). The General Equilibrium Effects Of A Productivity Increase On The Economy And Gender In South Africa, *South African Journal of Economic and Management Sciences*, 12(3) (2009):307-326.

KOKKO, A. (2000). FDI and the Structure of the Home Country Production. Centre for International Economic Studies, Policy Discussion Paper No. 0018.

LATORRE, M.C. (2014). CGE Analysis of the Impact of Foreign Direct Investment and Tariff Reform on Female and Male Wages. World Bank, Policy Research Working Paper 7073.

LIPSEY, R.E. (2002). Home and Host Country Effects of FDI, NBER Working Paper 9293.

MARKUSEN, J. (1995). The Boundaries of Multinational Enterprises and the Theory of International Trade, *Journal of Economic Perspectives*, 9:169-89.

MARKUSEN, J. R. (2000). Foreign Direct Investment and Trade, Centre for International Economic Studies, Policy Discussion Paper No. 0019.

MORLEY, S. and V. PIÑEIRO (Mar 2013). A Regional Computable General Equilibrium Model for Honduras, Modeling Exogenous Shocks and Policy Alternatives, IFPRI Discussion Paper 01252.

MORLEY, S., V. PIÑEIRO and S. ROBINSON (Nov 2011). External Shocks and Policy Alternatives in Small Open Economies, The Case of El Salvador, IFPRI Discussion Paper 01134.

NUNNENKAMP, P., R. SCHWEICKERT and M. WIEBELT (Jun 2006). Distributional Effects of FDI: How the Interaction of FDI and Economic Policy Affects Poor Households in Bolivia, Kiel Working Paper No. 1281.

PETRI, P.A. (1997). Foreign Direct Investment in a Computable General Equilibrium Framework, communication presented at the conference *"Making APEC work: economic challenges and policy alternatives"*, Brandeis-Keio Conference, Keio University, Tokyo.

SHOVEN, J.B. and J. WHALLEY (1984). Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey, *Journal of Economic Literature*, 22(3):1007-51.

SHOVEN, J. and J. WHALLEY (1992). Applying General Equilibrium, Cambridge University Press.

VERIKIOS G. and X-G. ZHANG (Oct 2001). Global Gains from Liberalising Trade in Telecommunications and Financial Services, Productivity Commission Staff Research Paper, AusInfo, Canberra.

ZHAI, F. (Sep 2008). Armington Meets Melitz: Introducing Firm Heterogeneity in a Global CGE Model of Trade, *Journal of Economic Integration*, 23(3), Special Issue:575-604.

Annex 1: Simulation results

Table 7: Simulation results – variations in %

VARIABLES	BASE	SIM1	SIM2
General variables			
Household consumption budgets (CTH)	919437	0.071	7.181
Total wages (YHL)	183073	0.1	6.107
Household income (YH)	963753	0.071	7.181
Household savings (SH)	22173	0.071	7.181
State revenues (YG)	249495	0.067	8.731
Public savings (SG)	61682	0.246	30.575
Firms' income (YF)	133347	0.063	7.419
Firms' savings(SF)	66856	0.062	7.416
Total investment budget(IT)	150711	0.139	16.860
GDP at base price	1018875	0.073	7.213
GDP at market price	1093055	0.075	7.531
Current operation account (YROW)	278111	0.06	9.752
Production (XS)			
VIVRIER	355912.000	0.005	0.315
COTPAYS	780.000	0.277	0.850
APAEX	99223.000	0.002	0.705
COTCHINE	3581.000	0.301	1.017
GRUME	42812.000	0.004	1.711
DIAM	42085.000	-0.001	4.813
PALIM	281570.000	0.003	0.362
BOITRAV	13798.000	-0.001	3.865
FIBRCOT	9929.000	0.327	1.086
TISPAGNE	9452.000	8.447	9.311
APRODM	63059.000	0.019	0.802
BTP	63783.000	0.089	7.034
SERVM	648232.000	0.030	2.342
SERNM	164476.000	-0.006	-1.319
Labour demand (LD)			
AGRIV	15333.000	0.124	10.909
COTCHINA	491.000	1.266	4.543
EXPLFOR	2406.000	0.035	17.171
EXTRACT	12629.000	-0.003	14.998

INDALIM	2725.000	0.117	15.184
INDBOIS	2595.000	-0.004	12.761
EGRENAGE	1115.000	0.974	3.362
TEXTILE	1042.000	4.883	7.624
AIND	1888.000	0.482	21.621
CONSTRUCT	7156.000	0.285	23.553
SERM	67886.000	0.107	8.402
SERNM	67807.000	-0.011	-2.185
Total labour supply (LS)	183073.000	0.100	6.107
Imports (IM)			
VIVRIER	403.000	0.142	-4.793
APAEX	1730.000	0.129	-3.742
PALIM	67336.000	0.109	-2.479
TISPAGNE	9954.000	-2.681	-3.449
APRODM	134835.000	0.208	3.590
SERVM	48177.000	0.132	-6.196
Household consumption by product (C)			
SERNM	13738.000	0.052	3.910
VIVRIER	221740.084	0.005	0.192
APAEX	87783.322	0.007	0.179
GRUME	6542.060	0.045	-0.493
PALIM	290561.506	0.026	-0.622
BOITRAV	584.224	0.043	1.671
TISPAGNE	7560.088	1.404	-0.129
APRODM	41999.435	0.039	-1.836
SERVM	111827.898	0.027	1.049
Demand for goods for investment (INV)			
VIVRIER	1775.440	0.066	9.628
APAEX	2963.590	0.069	9.600
APRODM	56111.750	0.106	6.639
BTP	61454.820	0.081	7.205
Exports (EXD)			
APAEX	5209.000	-0.073	3.051
GRUME	32703.000	-0.004	1.951
DIAM	35690.000	-0.002	5.616
PALIM	1911.000	-0.062	1.858
BOITRAV	9339.000	-0.010	5.448

FIBRCOT	7000.000	-1.887	-1.043
TISPAGNE	3964.000	9.761	10.906
APRODM	3804.000	-0.094	-1.151
SERVM	35330.000	-0.032	5.479
Market price of goods (PC)			
SERNM	1.000	0.012	1.872
VIVRIER	1.100	0.072	6.803
COTCHINE	1.000	2.766	14.713
COTPAYS	1.000	0.212	7.196
APAEX	1.250	0.069	6.830
GRUME	1.250	0.024	7.896
DIAM	2.250	0.027	5.090
PALIM	1.240	0.049	8.076
BOITRAV	1.510	0.027	4.969
FIBRCOT	1.000	4.700	14.493
TISPAGNE	1.250	-1.686	7.393
APRODM	1.410	0.032	9.796
BTP	1.110	0.057	9.216
SERVM	1.010	0.045	5.728
Export prices (PE)			
APAEX	1.000	0.036	8.359
GRUME	1.000	0.002	8.942
DIAM	1.000	0.001	7.036
PALIM	1.000	0.031	8.992
BOITRAV	1.000	0.005	7.120
FIBRCOT	1.000	0.957	10.578
TISPAGNE	1.000	-4.550	4.452
APRODM	1.000	0.047	10.638
SERVM	1.000	0.016	7.105
Price of goods excluding taxes (PL)			
SERNM	1.000	0.012	1.872
VIVRIER	1.000	0.075	6.911
COTCHINE	1.000	2.766	14.713
COTPAYS	1.000	0.212	7.196
APAEX	1.000	0.076	7.049
GRUME	1.000	0.019	8.396
DIAM	1.000	0.004	4.294

PALIM	1.000	0.063	8.183
BOITRAV	1.000	0.018	4.581
FIBRCOT	1.000	4.700	14.493
TISPAGNE	1.000	-5.541	3.146
APRODM	1.000	0.107	11.795
BTP	1.000	0.057	9.216
SERVM	1.000	0.049	5.406
Price of goods excluding taxes and margins(PD)			
SERNM	1.000	0.012	1.872
VIVRIER	1.100	0.072	6.799
COTCHINE	1.000	2.766	14.713
COTPAYS	1.000	0.212	7.196
APAEX	1.250	0.070	6.788
GRUME	1.250	0.024	7.896
DIAM	2.250	0.027	5.090
PALIM	1.220	0.060	7.762
BOITRAV	1.510	0.027	4.969
FIBRCOT	1.000	4.700	14.493
TISPAGNE	1.190	-4.845	3.468
APRODM	1.290	0.097	10.831
BTP	1.110	0.057	9.216
SERVM	1.010	0.049	5.406
Cost of value added (PVA)			
AGRIV	1.000	0.079	6.861
COTCHINA	1.000	4.904	18.718
EXPLFOR	1.000	0.021	9.892
EXTRACT	1.000	-0.001	6.378
INDALIM	1.000	0.076	9.618
INDBOIS	1.000	-0.002	5.632
EGRENAGE	1.000	3.264	11.774
TEXTILE	1.000	-15.387	-7.483
AIND	1.000	0.309	13.334
CONSTRUCT	1.000	0.130	10.041
SERM	1.000	0.051	3.910
SERNM	1.000	-0.003	-0.586
Cost of intermediate consumption (CIC)			
AGRIV	1.200	0.042	7.691

COTCHINA	1.370	0.012	9.555
EXPLFOR	1.160	-0.012	7.487
EXTRACT	1.330	0.029	9.120
INDALIM	1.150	0.055	7.282
INDBOIS	1.200	0.028	7.464
EGRENAGE	1.090	1.513	11.756
TEXTILE	1.200	1.600	11.021
AIND	1.340	-0.539	6.685
CONSTRUCT	1.290	0.017	8.756
SERM	1.070	0.045	6.435
SERNM	1.140	0.045	7.219
Rate of return to capital (R)			
AGRIV	1.000	0.083	7.147
COTCHINA	1.000	6.492	24.877
EXPLFOR	1.000	0.023	11.142
EXTRACT	1.000	-0.002	9.764
INDALIM	1.000	0.078	9.882
INDBOIS	1.000	-0.003	8.336
EGRENAGE	1.000	4.965	17.978
TEXTILE	1.000	-21.195	-10.344
AIND	1.000	0.321	13.939
CONSTRUCT	1.000	0.190	15.143
SERM	1.000	0.071	5.526
SERNM	1.000	-0.007	-1.462
Price of imports (PM)			
VIVRIER	1.188	0.142	9.627
APAEX	1.246	0.129	9.156
PALIM	1.310	0.109	9.314
TISPAGNE	1.287	-2.681	9.508
APRODM	1.457	0.208	9.397
SERVM	1.014	0.132	10.000

Annex 2: System of equations representing the cotton industry

A2.1 Production and destination of production of cottonseed and domestic cotton

j = Chinese cottonand "AgrDom".

1. $VA_j = v_j XST_j$
2. $CI_j = io_j XST_j$
3. $VA_j = B_j^{VA}\left[\beta_j^{VA} LDC_j^{-\rho_j^{VA}} + \left(1-\beta_j^{VA}\right) KDC_j^{-\rho_j^{VA}}\right]^{-\frac{1}{\rho_j^{VA}}}$
4. $XST_{AgDom} = B_{Agriv}^{XT}\left(\beta_{AgrDom,DomCot}^{XT} XS_{AgrDom,DomCot}^{\rho_{Agriv}^{XT}} + \left(1-\beta_{AgrDom,DomCot}^{XT}\right) XS_{AgrDom,Food}^{\rho_{Agriv}^{XT}}\right)^{1/\rho_{Agriv}^{XT}}$
5. $DD_{ChinCot} = DIT_{ChinCot} + VSTK_{ChinCot}$
6. $DD_{DomCot} = DIT_{DomCot} + VSTK_{DomCot}$
7. $DIT_{DomCot} = DI_{DomCot,Ginning}$
8. $DIT_{ChinCot} = DI_{ChinCot,Ginning}$

A2.2 Production and distribution of production of cotton fibre

1. $D_{i2,Ginning} = a_{i2,Ginning} CI_{Ginning}$
2. $DICOT_{Ginning} = bij_{Ginning} CI_{Ginning}$
3. $DICOT_{Ginning} = B_{GIN}^{DIT}\left[\beta_{Egr}^{DIT} DI_{DomCot,Gin}^{-\rho_{Egr}^{DIT}} + \left(1-\beta_{Gin}^{DIT}\right) DI_{ChinCot,Gin}^{-\rho_{Egr}^{DIT}}\right]^{-\frac{1}{\rho_{Egr}^{DIT}}}$
4. $\frac{DI_{CDomCot}}{DI_{ChinCot}} = \left[\frac{\beta_{Gin}^{DIT}}{1-\beta_{Gin}^{DIT}} \cdot \frac{PC_{ChinCot}}{PC_{DomCot}}\right]^{\sigma^{DIT}}$
5. $VA_{Ginning} = B_{Ginning}^{VA}\left[\beta_{Ginning}^{VA} LDC_{Ginning}^{-\rho_{Egrenage}^{VA}} + \left(1-\beta_{Ginning}^{VA}\right) KDC_{Ginning}^{-\rho_{Ginning}^{VA}}\right]^{-\frac{1}{\rho_{Ginning}^{VA}}}$
6. $VA_{Ginning} = v_{Ginning} XS_{Ginning,CotFibre}$
7. $CI_{Ginning} = io_{Ginning} XS_{Ginning,CotFibre}$
8. $XS_{Gin,Fibr} = B_{Gin,Fibr}^{X}\left[\beta CH_{Gin,Fibr}^{X} EXCH_{Gin,Fibr}^{\rho_{Egr,Fibr}^{X}} + \beta RDM_{Gin,Fibr}^{X} EXRDM_{Gin,Fibr}^{\rho_{Gin,Fibr}^{X}} + \left(1-\beta CH_{Gin,Fibr}^{X} - \beta RDM_{Gin,Fibr}^{X}\right) DS_{Gin,Fibr}^{\rho_{Egr,Fibr}^{X}}\right]^{1/\rho_{Gin,Fibr}^{X}}$
9. $DD_{CotFire} = DS_{CotFibre} = DIT_{CotFibre} + VSTK_{CotFibre}$
10. $DIT_{CotFibre} = DI_{CotFibre,Textiles}$

A2.3 Production of fabrics

1. $D_{i,Textile} = a_{i,Textile} CI_{Textile}$
2. $VA_{Textile} = B_{Textile}^{VA}\left[\beta_{Textile}^{VA} LDC_{Textile}^{-\rho_{Textile}^{VA}} + \left(1-\beta_{Textile}^{VA}\right) KDC_{Textile}^{-\rho_{Textile}^{VA}}\right]^{-\frac{1}{\rho_{Textile}^{VA}}}$
3. $VA_{Textile} = v_{Textile} XS_{Textile,Fabric}$
4. $CI_{Textile} = io_{Textile} XS_{Textile,Fabric}$

5. $XS_{Textile,Fabric} = B^{X}_{Textile,Fabric}\left[\beta^{X}_{Textile,Fabric} EX_{Textile,Fabric}{}^{\rho^{X}_{Textile,Fabric}} + \left(1 - \beta CH^{X}_{Textile,Fabric}\right) DS_{Textile,Fabric}{}^{\rho^{X}_{Textile,Fabric}}\right]^{1/\rho^{X}_{Textile,,Fabric}}$
6. $DS_{Fabric} = DD_{Fabric} = C_{Fabric} + DIT_{Fabric} + VSTK_{Fabric}$
7. $DIT_{Fabric} = \sum_{j} DI_{Fabric,j}$

Annex 3: Analysis of the CAR's SAM

Table 8: Sectoral share of production, value added and value added rate in percentage

	Sectoral share of production	Sectoral share of value added	Value added rate in total production	Value added rate in production
Food products and other agricultural products	25.35	39.62	22.44	88.55
Chinese cotton	0.20	0.20	0.11	56.30
Forestry	2.38	2.37	1.34	56.30
Extraction	2.34	3.75	2.13	90.89
Food industries	15.65	10.73	6.08	38.84
Wood industries	0.77	0.87	0.49	64.24
Ginning	0.55	0.32	0.18	33.04
Textiles	0.53	0.37	0.21	39.64
Other manufacturing industries	3.51	4.69	2.66	75.82
Construction	3.55	2.24	1.27	35.86
Market services	36.04	23.77	13.46	37.36
Nonmarket services	9.14	11.06	6.26	68.51
Total	**100,00**	**100,00**	**56,65**	**56,65**

Source: authors' calculations from 2012 SAM

Table 9: Share of capital and labour in value added, by sector (in %)

	Share of capital in value added of sector	Share of labour in value added of sector
Food products and other agricultural products	96.20	3.80
Chinese cotton	75.64	24.36
Forestry	85.48	9.98
Extraction	66.67	33.01
Food industries	97.38	2.49
Wood industries	64.73	29.28
Ginning	65.56	33.98
Textiles	71.92	27.81
Other manufacturing industries	95.96	3.95
Construction	68.44	31.29
Market services	70.62	28.03
Nonmarket services	39.80	60.18
Total	**81.51**	**17.97**

Source: Authors' calculation using 2012 SAM

Table 10: Structure of domestic demand

	Trade and transport margins	Intermediate consumption	Household spending n final consumption	Final consumption expenditures of the public administration	Total fixed capital formation	Change in stocks
Food products	8.60	31.32	56.88		0.46	2.75
Chinese cotton		100.00				
Domestic cotton		48.21				51.79
Other agricultural products for export	16.49	7.35	76.56		2.58	-2.99
Logs	15.59	29.78	54.63			
Diamonds and gold	35.70	14.08				50.22
Food products	14.32	19.70	71.75			-5.76
Worked wood	25.27	19.42	9.79			45.53
Cotton fibre		65.38				34.62
Fabric	10.21	33.37	43.96			12.46
Other manufactured products	11.83	43.60	19.08		25.49	
Building and public works		3.65			96.35	
Market services		76.68	23.32			
Non-market services		1.79	8.35	89.86		
Total	**8.43**	**35.74**	**42.14**	**6.77**	**7.00**	

Source: authors' calculations using 2012 SAM

Table 11: Import shares and penetration rates by product

	Import share	Penetration rate
Food products	0.154%	0.10
Chinese cotton	0%	0.00
Domestic cotton	0%	0.00
Other agricultural products for export	0.659%	1.45
Logs	0%	0.00
Diamonds and gold	0%	0.00
Food products	25.658%	15.64
Worked wood	0%	0.00
Cotton fibre	0%	0.00
Fabric	3.793%	51.48
Other manufactured products	51.378%	49.36
Building and public works	0%	0.00
Market services	18.358%	7.19
Nonmarket services	0%	0.00
Total	**100%**	**12.03**

Source: authors' calculations using 2012 SAM

Table 12: Export intensity, sectoral dependence rate and external coverage rate by product

	Share of exports	Export intensity	Dependence rate	External coverage rate
Food products	0.00%	0.00	0.11	0.00
Chinese cotton	0.00%	0.00	0.00	
Domestic cotton	0.00%	0.00	0.00	
Other agricultural products for export	3.86%	5.25	6.99	301.10
Logs	24.23%	76.39	76.39	
Diamonds and gold	26.45%	84.80	84.80	
Food products	1.42%	0.68	24.59	2.84
Worked wood	6.92%	67.68	67.68	
Cotton fibre	5.19%	70.50	70.50	
Fabric	2.94%	41.94	147.25	39.82
Other manufactured products	2.82%	6.03	219.86	2.82
Building and public works	0.00%	0.00	0.00	
Market services	26.18%	5.45	12.88	73.33
Nonmarket services	0.00%	0.00	0.00	
Total	**100.00%**	**10.08**	**29.67**	**51.42**

Source: authors' calculations using 2012 SAM

Table 13: Sectoral customs tariffs

	Tariff rates
Food agriculture and other crops	0.04
Chinese cotton	0.00
Forestry	2.64
Extraction	1.17
Food industries	14.87
Wood industries	1.90
Ginning	0.02
Textiles	2.15
Other manufacturing industries	53.42
Construction	8.69
Market services	15.09
Nonmarket services	0.03
Total	100.00

Source: authors' calculations using 2012 SAM