ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية
2010

working paper series

TOWARDS AN EXPLICIT MODELING OF TRADE FACILITATION IN CGE MODELS: EVIDENCE FROM EGYPT

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Working Paper No. 515

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April 2010

I would like to thank Lionel Fontagn´e, Bernard Hoekman and Bernard Decaluw´e for their important comments. I am also grateful to Fida Karam and Rodrigo Paillacar. I also thank participants at the University of Paris 1 Panth´eon Sorbonne seminars, Global Trade Analysis Project, European Trade Study Group, Economic Research Forum and Globalization and Economic Policy annual conferences. All the relevant data and computation files are available upon request from the author. Any remaining errors are mine. This work has benefited from a financial support from the Economic Research Forum (ERF). It does not reflect the opinion of the ERF.

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First published in 2010 by
The Economic Research Forum (ERF)
7 Boulos Hanna Street
Dokki, Cairo
Egypt
www.erf.org.eg

Abstract

This paper develops a dynamic computable general equilibrium (CGE) model incorporating trade facilitation aspects. This paper's contributions are twofold: theoretical and empirical. First, this paper attempts to model trade facilitation explicitly in a dynamic CGE model applied. On the empirical side, I estimate, not assume, the tariff equivalent of red tape and related procedures at sectoral level. I use the ad valorem tariff equivalents of time to import and to export that have been estimated in a companion paper and I take into account the cost of such a process. To do so, I modify the Exter model that is calibrated on the Egyptian social accounting matrix of 2000/2001. My main findings show that, when trade facilitation is modeled precisely, i.e. by taking into account its cost as well as the tariff equivalents of its aspects, the impact of such a process is reduced. Meanwhile, its impact remains higher than trade liberalization. Moreover, some sectors witness a significant expansion more than others, especially processed food, garments and high value added products.

ملخص

تقدم هذه الورقة تطوراً لنموذج توازن عام تطبيقي فعال يجسد اوجه التيسيرات في القطاع التجاري في مصر. و تتضمن الورقة اسهامات تنقسم إلي قسمين رئيسيين: قسم نظري و أخر تجريبي. أولا: تحاول هذه الورقة أن تصوغ نموذجا للتيسيرات في القطاع التجاري بشكل واضح من خلال نموذج توازن عام تطبيقي فعال يمكن تطبيقه علي الاقتصاد المصري .و من الناحية التجريبية: فانني استخدم القيم المكافئة للتعريفة التي تقدر حسب القيمة في فترة زمنية معينة تتم فيها عمليات تصدير و استيراد. وقد تم تقييمها في ورقة مصاحبة لهذه الورقة و أخذت في الاعتبار تكلفة هذه العملية. و لهذا فإنني قمت بتعديل نموذج جون اكستر و الذي يمكن تغييره تدريجيا حتى يناسب مصفوفة الحسابات الاجتماعية المصرية لعام 2001/2000. و تشير النتائج الرئيسية التي توصلت لها إلي أنه عندما يصاغ نموذج دقيق للتيسيرات التجارية، بمعني أن يؤخذ في الاعتبار تكلفة هذه التيسيرات و التعريفة المكافئة، فان تأثير هذه العملية ينخفض. وفي الوقت نفسه، فإن تأثير التيسيرات التجارية لا يزال أعلى من اثر تحرير التجارة. وعلاوة على ذلك، فإن بعض القطاعات تشهد توسعا كبيرا أكثر من غيرها، وخصوصا المواد الغذائية المصنعة والملابس الجاهزة والمنتجات ذات القيمة المضافة المرتفعة.

1. Introduction

Improving the efficiency of trade logistics is a critical priority for trade promotion. Hence, relaxing the constraints "behind-the-border" that increase the cost of doing business would contribute much to a country's integration into global trade. That is why trade facilitation has become a crucial aspect of trade policy. Currently, the real barriers to trade in many countries, and especially developing ones, are no longer tariffs or quotas, but other impediments such as high corruption, lengthier time to deliver or to clear traded goods, more complicated bureaucracy and poor infrastructure. This shows to what extent trade facilitation is considered one of the most important Doha Development Round's issues that has to be promoted. The "Trade Facilitation" definition adopted here is the one defined in Zaki (2008). This definition splits trade facilitation aspects into four major parts: simplification of commercial procedures; harmonization of commercial rules; transparent information and procedures and the recourse to new technologies allowing trade promotion. In this paper, I only focus on the impact of bureaucracy, trade length on commerce and corruption.

Three main motivations explain the importance of quantifying such a topic through a CGE model in the Egyptian context: economic interests, empirical reasons and more specifically the Egyptian case. First, reduction of the administrative barriers is likely to have more impact on trade than the reduction of classical ones as such impediments involve transaction length, bureaucracy, customs fraud, etc. In other terms, they do not have any receipts like tariffs or quotas. Second, with the increased supply chains interdependency, imported products delivery delays have turned into a severe constraint on production. This is why customs clearance and delivery of imported products have become quite an important determinant of the production process. Third, the cost of non-facilitation is very high: it accounts for 2 to 15% of the exchanged goods value.

As to the Egyptian case, in 2008, Egypt has been the top reformer in the region and worldwide as it greatly improved its position in the global rankings on the ease of doing business. Yet, it is still ranked 26th for Trading Across Borders (Doing Business, 2008) but it is much better than many other comparable economies such as Turkey, Lebanon, Jordan or Syria. In addition, the World Economic Forum issued its first "Global Enabling Trade Report" in which Egypt ranks a low 87th for the ease of getting goods across the border. The report underlined the positive as well as the negative aspects of Egypt's trade facilitation aspects. On the one hand, it has a fairly well developed transport infrastructure, including the associated services, good maritime connectivity thanks to Suez Canal and the related services and a relatively good quality of roads. Despite the fact that importing goods is neither costly nor time consuming, importers raise concerns about the efficiency of customs and other border agencies. In particular, the number of days and documents to export or to import still hinder the Egyptian trade. Hence, from a policymaking point of view, eliminating such barriers would have a highly significant effect on Egypt's trade and welfare.

Finally, trade facilitation has not been studied much in a robust empirical way. The most common tools used to estimate the effect of such a process are: gravity models (Wilson et al, 2003 and 2004; Zaki, 2009)1 or CGEs. Yet, the empirical literature of CGE on trade facilitation measures has had so far three common limitations. First, trade facilitation has never been explicitly modeled in CGE models. More specifically, the shock introduced did not incorporate properly trade facilitation aspects. For instance, the shock induced by trade facilitation is associated with technical progress in transport sector or an increase in its productivity (Hertel et al. 2001; Fox et al, 2003 and Decreux and Fontagn´e 2009). For instance, Fox et al, (2003) have shown that removal of such barriers would benefit the Mexican economy by U.S.$1.8 billion per year, while the U.S. economy would see a welfare increase of about U.S.$1.4 billion per year. Another technique is the decrease in exports or imports charges which is reflected in a decrease of the export or import prices. Moreover, several studies neglected some trade facilitation aspects, such as Minor and Tsigas (2008) who assessed the impact of time reduction2 without taking into account other aspects like the number of documents,

the Internet, the corruption or the geographic aspects. This point should underestimate the trade facilitation benefits as the latter is primarily based on a paperless world. Moreover,

Finally, trade facilitation has not been studied much in a robust empirical way. The most common tools used to estimate the effect of such a process are: gravity models (Wilson et al, 2003 and 2004; Zaki, 2009)[1] or CGEs. Yet, the empirical literature of CGE on trade facilitation measures has had so far three common limitations. First, trade facilitation has never been explicitly modeled in CGE models. More specifically, the shock introduced did not incorporate properly trade facilitation aspects. For instance, the shock induced by trade facilitation is associated with technical progress in transport sector or an increase in its productivity (Hertel et al. 2001; Fox et al, 2003 and Decreux and Fontagn´e 2009). For instance, Fox et al, (2003) have shown that removal of such barriers would benefit the Mexican economy by U.S.$1.8 billion per year, while the U.S. economy would see a welfare increase of about U.S.$1.4 billion per year. Another technique is the decrease in exports or imports charges which is reflected in a decrease of the export or import prices. Moreover, several studies neglected some trade facilitation aspects, such as Minor and Tsigas (2008) who assessed the impact of time reduction[2] without taking into account other aspects like the number of documents, the Internet, the corruption or the geographic aspects. This point should underestimate the trade facilitation benefits as the latter is primarily based on a paperless world. Moreover, Decreux and Fontagn´e (2009) have used the same data in Mirage model that was modified in order to incorporate trade costs that add up to ordinary freight costs. Their simulation experiment consisted of dividing by two the processing time exceeding the median level. They have shown that trade facilitation would add each year some US$99 billion gains to the world GDP in the long run. Finally, to our best knowledge, the empirical literature has shed light on the gains of such a process without taking into account its costs. Yet, the disagreement between developed and developing countries on this cost is still raised on the Doha Development Agenda and complicates its conclusion. Hence, neglecting the cost may be misleading as it overestimates the gains coming from eliminating administrative barriers. This is why in this paper, I try to assess simultaneously the gains as well as the costs induced by trade facilitation.

Therefore, this paper's contributions are threefold. First, it analyzes trade facilitation effects in an explicit and theoretical way. Furthermore, in order to have consistent estimates of administrative barriers, ad valorem equivalents of time to export and to import have been estimated from a theoretical gravity model (Zaki, 2009) and introduced in the CGE model. The particularity of those estimates is that they take into account many aspects of red tape costs simultaneously, i.e. time, document, corruption, Internet and geographic aspects[3]. Finally, a very simple way of costs modeling is proposed in order to avoid an overvaluation of the trade facilitation benefits.

In this paper, I modify a dynamic CGE model to assess the impact of trade facilitation through an empirical evidence from Egypt. The"Exter" model is adjusted to the Egyptian economy and modified to take into account the trade facilitation aspects. It has been calibrated using the Egyptian Social Accounting Matrix (SAM) of 2000/2001. Two main scenarios are simulated. The first one presents the effect of the classical trade liberalization by lowering tariffs. The second scenario involves two simulations: the first shock is very ambitious as it reduces the tariff equivalents of time to export and to import to reach the level of the best practice, namely the USA. The second simulation adds the cost of trade facilitation to the previous simulation. To do so, an increase in

[1] For a detailed literature review of gravity models used to estimate the effect of trade facilitation, see Zaki (2009).

[2] Minor and Tsigas (2008) measure the cost of time through the preference for air transport towards sea transport.

[3] For further details on the way those ad valorem equivalents have been estimated, see Zaki (2009). In this paper, estimation is done in two steps. First, time to export and to import are regressed on their determinants, namely number of documents to export and to import, the Internet widespread, geographic variables (begin landlocked or an island and other institutional variables). In a second step, once time to export and to import are estimated, their predicted values are introduced in the gravity model and finally ad valorem equivalents are computed from this model

public wages and public expenditure on transport and communication are simulated. The rationale behind this is as follows: on the one hand, increasing wages reduces bribes, customs fraud and therefore facilitates trade. On the other hand, if the government increases its expenditure on transport sector, transport infrastructure becomes more efficient and boosts trade.

This paper is organized as follows: Section 2 analyzes trade facilitation in the Egyptian case. Section 3 presents a brief review of the empirical literature of CGE models on trade facilitation. Section 4 develops theoretical foundations of the model. Section 5 is devoted to data analysis. Section 6 discusses the simulations results and Section 7 concludes.

2. Trade Facilitation Landscape: Some Stylized Facts

2.1. The Egyptian Case

Egypt's situation of trade facilitation has highly improved during last years. In 2008, Egypt has been the top reformer in the region and worldwide as it greatly improved its position in the global rankings on the ease of doing business. Egypt reduced the minimum capital required to start a business, from L.E. 50,000 to just L.E. 1,000 and halved the time and cost of start-up. It cut down fees for registering property from 3% of the property value to a low and fixed amount. Moreover, it eased the bureaucracy that builders face in getting construction permits. Meanwhile, regarding trade procedures, it launched new one-stop shops for traders at Egyptian ports, and it reduced the time to import by only seven days and the time to export by only five. Despite all these reforms, red tape barriers still hinder trade in Egypt. Table 1 exhibits to what extent red tape procedures for exports and imports remain high and are costly in Egypt. In 2007, the former required 20 days costing U.S.$ 1,014 and the latter 25 days adding some U.S.$ 1,049 to the value of imported goods. Consequently, Egypt still has a long way to reach better rankings in the ease of doing business or best practice countries in trade facilitation aspects.

Table 2 compares the numerous documents requested for exports and imports for Egypt in 2007. Obviously, these documents increase transaction length as they have to be completed before customs clearance or the delivery of imported goods. However, if these documents become computerized in a single window, time to export and to import would be highly reduced. Simultaneously, corruption of customs agents and the errors of typing customs data would significantly decrease. Recall that one of the most important objectives of the "Trade Facilitation" initiatives is twofold: making international trade easier through a paperless world

Figure 1 shows that Egypt's situation in trade facilitation has improved: between 2006 and 2009, number of documents to be filed for exports decreased from 8 to 6 documents and from 8 to 6 for imports. The same pattern is observed for time as number of days for exports has fallen from 27 to 15 and from 29 to 18 for imports. This high enhancement for Egypt's situation is reflected in the export and import costs. The former went down from U.S.$1,014 to U.S.$714 and the latter from U.S.$ 1,049 to U.S.$729. Consequently, Egypt's position in the ease of doing business increased from the 86th to the 21st . According to the Trade Policy Review (WTO, 2005), the Customs Administration has stepped up efforts to improve inspection and clearance activities. Thus, advanced clearance centers have been established at the ports of Alexandria, Cairo, Port Said, and Suez to simplify entry procedures. Those centers (in Egypt, there are six main customs offices: Alexandria - Al Mahmodeia (6,266 staff), Cairo (4,194), Damietta (350), Port Said (2,949), Sinai (581), and Suez (1,100)) are endowed with computers and x-ray equipment to improve efficiency. However, Egypt's situation has deteriorated between 2008 and 2009 as it became the 24th and both the cost to export and to import have increased to reach U.S.$737 and U.S.$823 respectively.

As for Egypt's efforts to liberalize and facilitate trade, the following initiatives could be cited. In 1998, Egypt reduced, unilaterally, the maximum tariff rate on most products from 50% to 40% and consolidated rates of 35 to 45% to 30%. Moreover, in 1998 the Government amended the 1964 law establishing the General Egyptian Maritime Organization to permit the private sector to carry out

most maritime transport services. This measure ended the Government's long-standing monopoly in this sector and increased the efficiency of transport services. Egypt has also passed a law permitting private firms to build and operate new airports.

Yet, the picture in Egypt is not that optimistic. According to the Enabling Trade Index issued by the World Economic Forum (2008), Egypt has been ranked a low 87th amongst 118 countries for the ease of getting goods across the border. On the one hand, Egypt has a fairly well developed transport infrastructure, including the associated services, good maritime connectivity and the related services and a relatively good quality of roads. Despite the fact that importing goods is neither costly nor time consuming, importers raise concerns about the efficiency of customs and other border agencies pointing out that bureaucracy and transaction length are significant impediments to trade. Its score was 3.51 (the first country is Hong Kong with a score of 6.04 and the last is Chad with some 2.6). This index determines the aspects that enable trade, and breaks the enablers into four overall issue areas, or subindexes: (1) market access, (2) border administration, (3) transport and communications infrastructure, and (4) the business environment[4]. It is worth noting that border administration indices show that Egypt is not well positioned neither for efficiency of customs administration (ranked 84th) nor for transparency of border administration (71th). Efficiency of exports and imports is located in a middle position (49th).

2.2. Egypt's Position vis-`a-vis Other Countries

Figure 2 shows that Egypt's performance is much better that many other comparator economies such as Turkey, Lebanon, Jordan or Syria. According to the Doing Business Report (2009), the only two MENA countries that are better than Egypt are Israel (9th) and United Arab Emirates (14th) while Egypt is the 24th . Singapore is the top ranked economy followed by Denmark, Hong Kong, China and Norway.

Table 3 presents Egypt's position vis-`a-vis other countries concerning the time, documents and cost of exports and imports. It is found that Egypt has a performance slightly higher than the average of the region. Having a quick glance to other countries of the region, it is note worthy that many disparities could be observed. For instance, Saudi Arabia sped up trade, reduced the number of documents required for importing and cut the time needed for handling at ports and terminals by two days for both imports and exports. In contrast, in Algeria, the costs associated with exporting are about 80% higher than world averages, due to excessive costs of customs clearance and technical control. In Syria, although costs are higher than average, the greatest impediment to exporting is the time required for export clearing processes (almost two thirds higher than the world average). Finally, several countries (e.g. Djibouti, Iraq, Syria, Algeria and Oman) maintain particularly taxing export policies in terms of time and cost.

To put it in a nutshell, Egypt has highly improved its situation in decreasing red tape costs impeding trade comparatively to similar countries of the region. However, such impediments remain significant barriers to trade as they are resource wasting, time consuming and, theoretically do not have any revenues. However, in the Egyptian case and certainly in many other developing countries, such red tape barriers may generate some revenues for the customs agents who receive bribes to accelerate the delivery of imported or exported goods. From a policymaking standpoint, this has two implications. On the one hand, governments should increase the customs agents wages to reduce the incentive of such agents to accept bribes, and on the other, they should implement computerized

[4] To calculate these subindexes, 10 aspects have been taken into account as follows: 1. Tariffs and non-tariff barriers; 2. Proclivity to trade; 3. Efficiency of customs administration; 4. Efficiency of import-export procedures 5. Transparency of border administration; 6. Availability and quality of transport infrastructure; 7. Availability and quality of transport services; 8. Availability and use of ICTs; 9. Regulatory environment; 10. Physical security.

agencies to handle efficiently the exchanged goods and to avoid artificial delays as well as supplementary amounts paid by the traders to the customs agents.

3. Methodology

This paper uses a dynamic CGE model adapted to the Egyptian economy and modified to take into account trade facilitation aspects. Three main factors explain the relevance of using a CGE model to assess the impact of such a process. First, CGE models are an application of the neoclassical theory, considered in its international trade dimension, and of the classical trade theory. For several years, they have been constituting a major tool to assess the impact of economic policies in a general equilibrium framework. Hence, they take into account the numerous economic interactions between different sectors, markets and agents within the same economy. Multinational CGE models assess the impact of an economic policy taking place in a certain country on other countries. This shows to what extent such a tool is a quite important tool to evaluate the impact of trade policies, which is the case of this paper. Second, CGE models represent a quite satisfying tool in modeling especially for developing countries. This is due to the fact that the latter suffer from several problems regarding statistical data such as lacking ones, unreliable sources or inconsistent long time series, etc. By contrast, as CGE models use only the Social Accounting Matrix (SAM), they do not need a lot of data, that is why they can be used in developing countries. Finally, trade facilitation, as well as trade liberalization, should be studied in a CGE framework as its elimination has many effects not only on Egypt's trade, but also on sectors expansion or contraction, employment, investment, consumption and thus welfare. All these effects could not be studied in a partial equilibrium framework. That is why in order to determine the trade facilitation impact on the Egyptian economy, it is appropriate to use a CGE model. Exter model is used and adapted to be more suitable to the Egyptian economy in order to assess the impact of trade facilitation.

3.1. The Model Assumptions

I have used the Exter model along with its more updated versions (Annabi et al. 2004; Fofana et al. 2006) and the Pep1-1 model (Decaluw´e et al. 2009). Exter model was originally constructed by Decaluw´e et al. (2001) to assess the impact of different economic policies on developing countries. This model presents a small open economy. Clearly, such an assumption is consistent with the Egyptian economy as it has no influence on the world prices (price taker). It is a real model where the currency is only an instrument of exchange and a unit of account. Therefore, the currency remains neutral, meaning that price changes affect only the decisions of production and consumption. All prices are normalized in the benchmark scenario.

Moving to the production factors, the model has a perfect competition framework, therefore the profit maximization condition implies that the price of production factors is equal to its marginal productivity. Labor is perfectly mobile between production sectors, while capital is specific to each one of them. The production factors are internationally immobile. Hence, factor endowments are not affected by resources transfers from or to the Rest of the World.

Furthermore, the existence of foreign savings has no impact on the volume of productive capital. Industries use not only production factors but also intermediate products from other activities. Households allocate their revenues between consumption and savings and firms allocate them between investment and savings. Reflecting the nature of the classical framework, competition and resource allocation are adjusted through the flexible movement of prices. Finally, it is a sequential dynamic model[5]. This means that households have a myopic behavior.

[5]Another type of dynamic models could be identified which is the inter-temporal one. This type of models is based on optimal growth theory where the behavior of economic agents is characterized by perfect foresight. Households know all about future changes in prices and they maximize their inter-temporal utility function under a wealth constraints to

3.2. The Model Structure

This CGE model has some common features with other CGE models as follows. Production factors (labor and capital) are imperfect substitutes in the value added following a Constant Elasticity Substitution (CES) function (with constant returns to scale). A perfect complementarity (`a la Leontieff, i.e. technical substitution elasticity is zero) exists between, on the one hand, intermediate inputs and, on the other between intermediate inputs and production factors or value added. Households maximize their utility function represented by a linear expenditure system of preferences (LES)[6] subject to their income constraint. Thus, there is a minimal level of some good that has to be consumed irrespective of its price or the consumer's income. Moreover, expenditure on the ith commodity consists of expenditure on the minimum required quantity for that commodity plus the proportion of the budget which is left over after paying for all minimum requirements. This proportion is the marginal budget share that determines the allocation of supernumerary income. Domestic production is distributed between domestic consumption and foreign exports through a Constant Elasticity of Transformation (CET) function. Imports are differentiated by origin following an Armington-function. The latter is combined with domestic production through a CES function to satisfy domestic demand. Firms have revenues coming from capital remuneration and transfers. Their expenditures are divided between investment cost and transfers to households. Households and firms pay taxes to government. Moreover, many transfers are made among economic agents, i.e. households, firms, government and the rest of the world.

As mentioned before, the dynamic model is recursive (sequential) which means that this model is based on a series of static CGE models that are linked between periods by exogenous and endogenous variables updating procedure. Hence, the model is solved sequentially over time. In dynamic models, the economy grows even without a policy shock, which is called "Business As Usual" (BAU). The latter is generated under the following assumptions: public wages, public employment and public expenditures increase with an exogenous growth rate. Total factor productivity by activity is taken into account. Population, minimum consumption, as well as transfers to and from households are all updated exogenously. Capital stock is updated endogenously on the basis of previous investment and depreciation. A quadratic investment function is adopted as follows:

$$\frac{Ind_{j,t}}{KD_{j,t}} = [\gamma_{1j}(\frac{r_{j,t}}{U_t})^2 + \gamma_{2i}(\frac{r_{j,t}}{U_t})]savadj_t \quad (1)$$

where $KD_{j,t}$ is the capital demand by sector j, $Ind_{j,t}$ investment by destination, γ_{1j} and γ_{2j} parameters of the investment demand equation, U_t capital user cost, $r_{j,t}$ capital return in sector j and $savadj_t$ adjustment variable for investment and savings.

The volume of total investment $ITVOL_t$ is equal to the gross fixed capital formation IT_t divided by the investment price index $Pinv_t$

$$ITVOL_t = \frac{IT_t}{Pinv_t} \quad (2)$$

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determine their consumption over the time horizon. Regarding firms, they determine their investment decisions through a cash flow maximization over the same horizon.

[6] This function is theoretically consistent as it permits imposing some general restrictions of the classical demand theory which are: adding-up (value of total demands equals total expenditure); homogeneity (demands are homogenous of degree zero in total expenditure and prices); symmetry (cross-price derivatives of the Hicksian demands are symmetric); and negativity (direct substitution effects are negative for the Hicksian demands).

Capital in $t+1$ depends on the capital volume in t depreciated by δ to which investment in t is added.

$$KD_{i,t+1} = (1-\delta)KD_{i,t} + Ind_{i,t} \quad (3)$$

Capital user cost Ut equals to the sum of the real interest rate ir and the depreciation one δ multiplied by the investment price index

$$U_t = Pinv_t(ir + \delta) \quad (4)$$

Finally, macroeconomic closure is an important determinant of the CGE model results. These constraints have to be satisfied by the economic system, but are not considered in the decisions of any microeconomic agent. Normally, they are determined according to what fits the economy. Installed capital is sector-specific, so that the rental rate of capital varies across sectors. The exchange rate index is the num´eraire. Direct and indirect tax rates are constant. The share of current account to GDP is fixed exogenously. For each household, savings are a fixed share of its disposable income. Firms' savings are also determined by the model. Therefore, the model is savings driven.

3.3. Incorporating Trade Facilitation in the Model

In order to capture the explicit effect of trade facilitation, the administrative barri¬ers have been introduced as a tariff imposed on the world prices. Hence, ad valorem equivalents have been calculated for such barriers as will be shown later.

On the import side, domestic import prices $Pm_{j,t}$ will be higher than world prices $P\,wm_{j,t}$ (in foreign currency) due to tariff barriers tmj and the ad valorem equivalent of the time to import tfm_j as follows:

$$Pm_{j,t} = e_t\,P\,wm_{j,t}(1 + tm_j + tfm_j)(1 + tx_j) \quad (5)$$

where e_t is the nominal exchange rate and tx_j is indirect taxes rate on sector j products.

Recall that those ad valorem equivalents of the time to import and to export include many trade facilitation aspects, namely bureaucracy, the Internet widespread, corruption and geographical impediments.

As usual, receipts coming from tariffs and indirect taxes are captured by the government. By contrast, the total revenues originating from the administrative barriers $TFM_{j,t}$ to trade are not captured by the government. This is why a domestic agent called "Inefficiency" has been created and its revenues $Y\,H_{inef,t}$ are the sum of the time receipts on imported goods as follows:

$$T\,F\,M_{j,t} = t\,f\,m_j\;Pwm_{j,t}\,e_t\,M_{j,t} \quad (6)$$

$$Y\,H_{inef,t} = \sum_{j}^{16} T\,F\,M_{j,t} \quad (7)$$

where $M_{j,t}$ is the import demand of product j.

Theoretically, this revenue is a deadweight loss as it is notperceived neither by the Government, nor by firms, nor by households. Yet, in the real world, part of such revenues is presumably captured by customs agents and public servants who work for the border agencies in order to simplify the commercial procedures, obtain requested signatures and speed up the delivery time. Once this agent will perceive non-efficient revenues, he will spend them on his consumption $C_{i,inef,t}$ that follows a Cobb-Douglas function differently to other agents who have a LES function. Such a difference is explained by the fact that this agent does not necessarily need a minimal level of consumption like

other households. Hence, once his revenues are cut to a zero level, his consumption also is vanished as follows:

$$C_{i,inef,t} = \gamma_{i,inef}\, Y H_{inef,t} / P c_{i,t} \quad (8)$$

where $\gamma_{i,inef}$ is the budgetary share of good *i* in the inefficiency agent income and $Pc_{i,t}$ is the composite price of good *i.*

On the export side, export taxes te_j and *tariff* equivalent of the time to export tfx_j increase the Fob prices of exported goods $P\,fob_{j,t.}$ Hence, the producer price of the exported good $Pe_{j,t}$ is given by:

$$Pe_{j,t} = \frac{e_t\, P\, fob_{j,t}}{(1 + te_j = t\, f\, x_j)} \quad (9)$$

Similarly, the total revenues coming from the time to export $TFX_{j,t}$ are computed as follows:

$$TFX_{j,t} = t\, f\, x_j\, Pe_{j,t}\, EX_{j,t} \quad (10)$$

where $EX_{j,t}$ is the export supply of product *j.*

Those revenues are associated to flows going out of the local market and are not absorbed by domestic agents. Hence, they cannot be treated in the same way as the receipts coming from the time to import, that is why I consider them as transfers going to the rest of the world. In other terms, they are captured by an external inefficiency agent or the foreign customs agents.

Hence, introducing explicitly this agent in the economic cycle shows to what extent those barriers are a loss in the economy as they are not perceived explicitly by neither the government, nor the firms, nor the households and therefore can be isolated from the rest of the economy. Therefore the welfare of the nation is not affected by the welfare of the *"inefficiency agent"*.

This model is run using GAMS[7]. Hence, 16 sectors and 20 periods are taken account, which yields 17601 endogenous variables determined by 17601 equations and 799 exogenous variables.

4. Data

4.1. The Matrix Structure

The model presented above is calibrated on the Social Accounting Matrix (SAM) of Egypt 2000/2001. This matrix was built by the National Institute of Planning attached to the Ministry of Planning. The matrix consists of six major accounts: production factors, economic agents, industries, composite products, capital and finally taxes. It incorporates two production factors: labor and capital, six economic agents: households (rural and urban), companies (private and public), government and the rest of the world.

The SAM includes 17 sectors structured as follows: two agricultural ones (crop production and animal production), eleven industries (oil and mining, tobacco, food industries, spinning and weaving , clothing (including leather), chemical industries, non-metal industries, industries of basic metals, metal industries, machinery and equipment and other industries) and finally four services sectors (construction and electricity, communication and transport, other productive services and social services). The composite products account includes the same sectors mentioned above. The capital account shows the investment demand by sector. Finally, the last account is the taxes one that comprises: direct taxes, indirect taxes, subsidies and tariffs on imports.

[7] The model's notation and mathematical formulation are available upon request

For the sake of simplicity and modeling consideration, four changes have been made in the structure of the matrix as follows. First, private and public firms have been merged into a single account including entitled firms. Second, indirect taxes have been added to subsidies considering the latter as negative taxes. Then, the construction and electricity sectors have been merged with the one of other productive services in order to facilitate the model resolution in GAMS and to avoid zero values in the cells. Finally, the taxes account was introduced in the government revenues.

A very brief analysis of the Egyptian economy through the matrix flows shows that the latter is characterized by several key aspects, namely: a significant taxation, an important productive services sector (contributing by some 50% to the Egyptian growth), a high rate of imports, and high exports of services thanks to Suez canal and tourism receipts. To these two main sources of foreign currency in Egypt, a third source, being transfers from Egyptian workers abroad, is added.

4.2. Calibration and Other Sources of the Data

Along with the SAM of 2000/2001, some other sources of data for investment by destination, key parameters, tariffs and trade facilitation have been used.

First, the national accounts coming from Central Agency for Public Mobilization and Statistics (CAPMAS) reports (2001) have been used to determine the implemented investment by destination.

In the Egyptian matrix, we have only the sum of indirect taxes and import duties imposed on composite commodities without disaggregating them. That is why, in the calibration, I have used the applied tariffs coming from the World Trade Organization and "Trade and Production" database in order to calculate the import duties for each sector[8]. Then, tariffs revenues are deduced from the total revenues to obtain the indirect taxes receipts which have been used to calibrate the sales tax rate.

Some other parameters have been taken from previous studies. First, the nominal interest rate (11.5%) has been taken from the Central Bank of Egypt database. In addition, the population growth rate (1.8%) has been acquired from the CAPMAS data. Growth rates for total factor productivity, transfers, public wages and employment have been taken from the World Bank and the CAPMAS datasets. Last but not least, according to Miketa (2005), I adopt the depreciation rate that is equal to 4%. I follow Rutherford et al. (1993) in selecting the benchmark elasticities. Labor-capital substitution varies across sectors, ranging from 0.43 to 1.99. Trade elasticities are taken from Konan and Maskus (1997). The substitution elasticity between domestic and imported goods (both intermediates and consumption) is set at 2.0. The transformation elasticity between domestic and exported output is set to 5.0.

Finally, for trade facilitation, ad valorem equivalents of time to export and to import have been estimated using my gravity model (Zaki, 2009) as will be shown later in order to introduce them in the CGE model.

5. Estimating Tariff Equivalents for Administrative Barriers

In order to better evaluate the impact of trade facilitation, tariff equivalent for administrative barriers to trade should be calculated. To do so, I follow the methodology adopted by Olarreaga, Nicita and Kee (2009) where they estimate ad-valorem tariff equivalent for non-tariff barriers based on a gravity model. Similarly, I rely on a gravity model (Zaki, 2009) that determines the impact of trade facilitation on bilateral trade in two steps. First, time to export and to import are regressed on their determinants, namely number of documents to export and to import, the Internet widespread, corruption, geographic variables (being landlocked or an island and other institutional variables). In a second step, once time to export and to import is estimated, their predicted values are introduced in the gravity model. The rationale behind this is to take into account the part of transaction time that is

[8] This was done by multiplying the tariff rate by the value of imports given in the matrix.

only explained by trade facilitation aspects. Lastly, the gravity outcome is used to compute ad valorem equivalents for these two variables.

As Olarreaga et al. (2009) argue, to make trade facilitation aspects comparable with ad valorem equivalents, the quantity impact should be transformed into price equivalents. This yields the ad valorem equivalent of one day to export and to import. To determine the AVE specific to each country, the AVE of one day is multiplied by the number of days to export and to import available in "Doing Business" dataset. Recall that those tariff equivalents take into account other administrative barriers such as number of documents, the Internet widespread, corruption, as well as the geographic impediments to trade. Hence, they could be perceived as more exhaustive AVE of "trade facilitation". I have calculated the AVE at the ISIC 3-digits level for 138 countries[9] . Table 4 displays the aggregated tariff equivalents for Egypt.

It is quite obvious that some sectors have higher ad valorem tariffs than others. For instance, food and beverages (which are perishable goods), garments and textiles (seasonal goods), machines (used as inputs in the production process) and professional and scientific equipment (high value added products) are characterized by higher AVE than others such as wood products or footwear. Those tariffs have been introduced in the CGE model with some assumptions. First, as the data that have been used to estimate tariff equivalents is "Trade and Production" (2004), only manufacturing sectors are included in this dataset, consequently, AVE have been estimated only for manufacturing sector. Yet, the Egyptian SAM encloses two agricultural sectors (animal and vegetable) and three service sectors. For agricultural sectors, I have applied the same tariff equivalents obtained for food sector as they share many common characteristics with agricultural ones (mainly, both of them being perishable products). As to services, social services have zero tariff equivalent for time as they are not tradeable. Finally, I have used the same tariff equivalent of the machinery sector as for the transport one as the latter deals with machines and infrastruc-ture issues. Clearly, it would be much more interesting if AVEs of trade facilitation are estimated separately for agriculture and service sector, but for data consideration, it was difficult to do it. Computing AVE for agriculture and services is on my research agenda once data availability allows it.

6. Simulations Results

The core of my analysis is structured around a set of scenarios meant to illustrate the implications of alternative approaches to trade liberalization and facilitation. Hence, I perform three simulations through two main scenarios. The first scenario assesses the impact of trade facilitation. It involves two simulations: the first one assesses the impact of trade facilitation by shocking the ad valorem tariff equivalent of time to import and to export. This simulation (TF) reduces the tariff equivalents to reach the level of the best practise, namely the United States (whose AVE is 1%). The second simulation (TFCOST) adds the cost of trade facilitation to the previous simulation. To do so, an increase of the public expenditure on transport and communication (to assess the effect of more efficient transport infrastructure) is simulated along with an increase of public wages (to reduce corruption). The second scenario determines the impact of trade liberalization (TL). Thus, an unconditional trade liberalization is adopted assuming that Egypt extends 90 percent tariff reductions to all countries. Clearly, it is a very optimistic scenario but it is simulated for the sake of comparison between trade liberalization and facilitation effects. The following table summarizes those simulation experiments.

[9] All ad valorem tariff equivalent for the whole sample are available upon request

Notation	Scenario Definition	Shocked Parameter
BAU	Business As Usual scenario	No shock
TL	An unconditional full trade liberalization	tmi ↓ by 90%
TF	Reducing the AVE of time to exp. and to imp. to the best practise	tfmi and tfxi ↓ by 90%
TF+COST	Adding to TF the cost of Trade Facilitation	tfmj = tfxj ↓ by 90% and GSERT RA ↑ by30% and wG ↑ by10%

Source: Constructed by the author.

In the following section, I will begin with a static analysis of the trade facilitation effects in order to take into account all the sectoral and the microeconomic aspects of such a process. For the sake of simplicity and comparison, I will present only the results of trade liberalization (TL) and trade facilitation (TF). Later, I will proceed to a dynamic analysis assessing the long term effects of trade facilitation.

6.1. A Static Analysis of the Trade Facilitation Effects

6.1.1. Trade Facilitation: A Positive Sum Game for the Economy

This section objective is to compare the static effects of the trade facilitation (TF) and trade liberalization (TL). Eliminating red tape costs (cutting the ad valorem equivalents of time to export and to import to reach the level of the best practice) in Egypt yields high positive effects for the whole economy. On the external level, when trade is facilitated, total exports and total imports are boosted by 5.8% and 5% respectively. Meanwhile, eliminating tariff barriers in Egypt increases exports only by 1.4% and imports by 11%. It worth mentioning that the effect of trade liberalization on imports is higher than that of trade facilitation because Egypt's applied tariffs are higher: when they are eliminated, imports are boosted significantly. By contrast, trade facilitation yields high effects on exports.

Having a quick glance at the household behavior, it is worth noting that TF produces high gains for the following reasons. Removing red tape barriers increases households real revenues by 1.94%, decreases prices by 2.06% boosting the total consumption of urban and rural households by 1.8% and 2% respectively. The government revenues raise by 0.04% as there are no tariff receipts that disappear once trade is facilitated. Firms revenues decline by 0.3% due to a 1.9% decrease in capital remuneration.

Combining all these effects, it is worth noting that trade facilitation boosts rural welfare[10] by 1.8% and urban welfare by 1.6%. Clearly, such high positive results could be explained by several reasons: first, lower prices, higher revenues, no government loss in TF which allows the government to redistribute revenues in the economy and finally more imports and exports. Table 5 illustrates those patterns.

This big difference between trade facilitation and trade liberalization is similar to what Eby Konan and Maskus (1996) have found. They have shown that, in Egypt's integration with E.U., trade diversion effects would outweigh trade creation ones worsening welfare by some 0.2%. Yet, reduction in administrative costs should increase the Egyptian welfare.

In a similar paper, Hoekman and Konan (1999) assessed the impact of a deep integration between Egypt and the E.U. They showed that a shallow agreement (elimination of Egyptian tariffs or simply TL) with the E.U. would lead to a welfare decline. Meanwhile, if deep integration efforts are pursued by eliminating regulatory barriers and red tape costs (TF), welfare gains may increase significantly. This is why, in this model, when trade is liberalized and facilitated simultaneously, welfare doubles going up from 2.3% to 4.3%.

[10]Welfare is computed as a percentage of the household's disposable income on the basis of the equivalent variation.

6.1.2. Expanding Sectors

Removing administrative barriers does not affect all the sectors in the same way. The trade facilitation literature has evidenced that seasonal products such as garments, perishable ones like processed food and high value added goods (either equipments that are necessary for the production process or high technology ones with short market lifetime) are highly sensitive to transaction time and bureaucracy. When such barriers are eliminated, export prices increase, exporters are encouraged to boost their exports and hence increase their production. In the mean time, Figure 3a shows that sectoral exports rise, especially for agricultural products (vegetable and animal ones), processed foods, textiles, chemical industries, machinery equipments and transport services[11]. Such results are consistent with the hypothesis that long delays to cross borders impede the export diversification of developing countries. This is similar to the results obtained by Minor et al. (2008) who have shown that the reduction in the time to trade across borders results in increased shares of light, medium and heavy manufactures of between 7 and 26% in total exports. Finally, for exports as well as for export prices, trade facilitation impact is higher than trade liberalization is for almost all the sectors.

Figure 3b illustrates the impact on imports. Import prices decrease as trade transactions become quicker. Thus, Egyptian consumers find imported goods cheaper and increase their consumption. As mentioned above, when trade is facilitated, imports of some sectors expand more than others especially processed food (7.4%), and agricultural products (7.6%). Such a point is quite important for Egypt as these sectors represent 8.6% and 15% respectively of total imports. Generally, trade facilitation has also a lower effect than trade liberalization as tariffs are higher than the AVEs of the administrative barriers. Interestingly, tobacco which is highly protected in Egypt is not affected by trade facilitation as it is not sensitive to time.

Combining those patterns of exports and imports, once trade is facilitated, exporting sectors increase relatively their production with respect to importing ones. Increasing production means more demand of production factors. With constant capital (as capital is specific to each sector), sectors which are highly intensive in capital will demand more of it which in turn increase the capital rent, especially in transport services and garments. Simultaneously, importing sectors should decrease their production as imported products (in particular vegetable and animal agricultural ones) become more competitive.

6.2 Long Term Gains with a Dynamic Modeling

6.2.1 A Macroeconomic Analysis of the Dynamic Model

The literature of CGE models has evidenced that static models underestimate the effects of policy changes as they do not take into account capital accumulation and productivity gains[12]. The model is simulated on a 20 year horizon.

A cross comparison of the different scenarios that have been simulated shows different results in Table 5. First, as mentioned before, trade facilitation effects on exports are always higher than trade liberalization ones. Second, trade facilitation has a negative effect on agents revenues as wages and capital remuneration decrease. Yet, on the long run, as prices decline significantly, total consumption increases by 2.6%. On the other hand, on the long run total exports as well as total imports increase

[11] The main exporting manufacturing sectors in Egypt are textile and garments (7.5% of total exports) and chemical industries (7%). Meanwhile, services sectors export more than manufacturing ones as they represent 69.4% of total exports thanks to tourism and Suez canal revenues.

[12] A time element is included to solve the model sequentially: an updating capital stock to simulate investment and depreciation and an increasing labor stock to simulate population growth. As mentioned above, these models are recursive (or sequential) dynamics. Hence, they optimize in each period the agents behavior but the inter-temporal allocation of goods and sources will not be optimal in general.
Other type of CGEs take into account such an aspect especially inter-temporal dynamic CGEs.

by 9.1% and 4.8% respectively. Therefore, trade facilitation yields higher gains on the long run especially for total exports.

Meanwhile, such a liberalization or facilitation is taking place in a unilateral way, i.e. Egypt is liberalizing and facilitating unilaterally. Clearly, a country gains more when it liberalizes or facilitates its trade simultaneously with its partners. Here, only a unilateral trade liberalization and facilitation are simulated. A multinational model would be more appropriate to determine the effect of a multilateral trade facilitation that has quite a higher positive effect.

Moreover, the more ambitions the facilitation process, the higher are the gains generated. In other words, the trade facilitation gains are proportional to the level of facilitation, i.e. the highest gains are produced when Egypt facilitates its trade to the best practice level, while lower gains are generated when trade facilitation is implemented through a 50% decrease in the administrative barriers[13].

Finally, taking into account TF cost (increasing public expenditure of transport and communication by 30% and public wages by 10%) changes slightly the benefits. This may be a little bit controversial, but in fact, it is not for two reasons: first, because TF cost is not a true cost as it involves many projects improving infrastructure, increasing wages, etc., hence it is a sort of an income redistribution made by the government. This is why welfare increases from 1.7% (without cost) to 2% (with the cost of TF) and reaches 2.4% on the long run. In other terms, these costs are beneficial for the economy that is why they do not highly reduce the gains coming from TF as shown in Table 5.

Second, as mentioned before, the way I have simulated trade facilitation costs does not take into account all of the cost aspects, for instance customs computerization, establishing single windows, etc. However, it is quite obvious that even when I model TF costs in a simple way through an increase in public expenditure of the transport sector and in public wages, TF benefits are reduced, especially for exports (that increase by 4.7% (5.8%) in the short run and by 7% (9.1%) in the long run when the cost is taken into account (without cost of TF)). But how can such projects be financed? Actually, as will be shown later, unlike trade liberalization, government receipts coming from imports tariffs should not decrease. Moreover, as TF increases imports, tariffs revenues will increase which boosts government's receipts and hence enables it to fund new TF projects. Table 5 shows that TL reduces government revenues by 11% in the short run and by 10% on the long run.

By contrast, TF raises them by 0.04% in the short run and decreases them by 0.19% in the long run.

On the other hand, a second important remark that has been mentioned above is related to the dynamic impact of trade facilitation vs. trade liberalization. Figure 7 show some selected results for the most important exporting sectors in Egypt. It is quite clear that exports increase more when trade becomes easier and more simplified than when it is liberalized. When days to exports are eliminated, export prices should rise. Simultaneously, imports (Figure 6) increase also for two reasons. First, thanks to the reduction of imports time, import prices should decrease, which in turn stimulates imports. From a modeling standpoint, the macroeconomic closure of the model encompasses a constant share of current account in the GDP, therefore an increase in exports should be accompanied by an increase in imports. Therefore, improved terms of trade boosts the gains coming from trade facilitation and explains significantly the welfare increase.

6.2.2 Government and Households: Major Winners

It turns out that consumption prices decrease as import prices and domestic prices decline when red tape costs are eliminated. Less prices mean more consumption for both rural and urban households as shown in Table 5. Therefore, even in its dynamic version, the simulation results show that the

[13] For the sake of simplicity, the results of this simulation are not here but they are available upon request. In summary, all gains are reduced when Egypt reduces its administrative barriers by 50%

welfare effects for both rural and urban households are quite high in the trade facilitation scenario (1.67% in the short run and 2.26% in the long run) thanks to decreasing prices as the consumer price index is cut by 3% in the long run.

Some observations regarding the agents revenues worth to be mentioned. First, house¬holds real income increase in the long run by 2.6% thanks to less prices boosting their purchasing power. In addition, as mentioned above, the government revenues decrease less in trade facilitation then in trade liberalization as it would not lose the receipts coming from import duties. This in turn will not reduce public revenues and the government should be able to fund new projects improving infrastructure and to increase the customs agents wages. That is why, in the simulation incorporating trade facilitation and its cost, the transport services sector expands significantly (its exports increase from 3.7% in the short run to 9.3% in the long run) as its output is used in the trade facilitation projects.

To put it in a nutshell, it is quite clear that the trade facilitation process is very beneficial on the internal as well as external level. Those benefits are higher in the long run than in the short run, especially for exports, households and government revenues. Moreover, all projects that should be put in place to facilitate trade (i.e. improving transport infrastructure and communication, higher wages for customs agents) should also improve the efficiency and the productivity of the whole economy.

7. Conclusion

This paper develops a dynamic computable general equilibrium model incorporating trade facilitation aspects in Egypt. This paper's contributions are twofold: theoretical and empirical ones. First, this paper uses ad valorem tariff equivalents for barriers associated with trade facilitation aspects estimated from a gravity model (Zaki, 2009) taking into account bureaucracy, the Internet widespread, corruption and geographical impediments to trade. Such AVE are then introduced in a CGE model. Thus, the second contribution of the paper is the direct modeling of such barriers in a dynamic CGE model applied on the Egyptian economy. I modify the Exter model in order to take into account trade facilitation facets in an explicit way. The model is calibrated on the Egyptian social accounting matrix of 2000/2001. My main findings show that, when trade facilitation is simulated precisely, i.e. by taking into account its cost as well as the tariff equivalents of its aspects, the impact of such a process is reduced with respect to the way it has been modeled in the empirical literature. Meanwhile, its impact remains higher than trade liberalization for exports. Moreover, some sectors witness a significant expansion more than others, especially food, garments, textiles, high value added products and transport services.

From a policy implication point of view, my analysis sheds the light on some crucial aspects of trade policy for developing countries. First, recall that, literally, barriers associated to trade facilitation are a deadweight loss, hence all agents should gain from such a process. Yet, taking into account the corruption aspects, the welfare of customs agents should be reduced as they will lose revenues coming from bribes. That is why the government should increase public servants wages to reduce incentives of receiving such bribes in order to speed up import and export procedures. In addition, the government should also computerize all customs agencies to reduce such corruption and avoid errors in handling exchanged goods. Although TF costs are relatively high, they are not very costly as all the projects put in place to facilitate trade (i.e. improving transport infrastructure and communication) promote the efficiency and the productivity of the whole economy. Recall that trade facilitation is necessary to boost trade but not sufficient: more performing infrastructure and computerized customs authorities are important to guarantee an efficient process of trade facilitation. Finally, such a process is different from trade liberalization as there are no concessions between negotiating countries. In other words, it is a positive sum game for all the economies.

From an empirical standpoint, the main shortcomings of this study are threefold. First, Egypt's main trade partners should be taken into account, i.e. the rest of the world should be divided into many countries, such as the United States of America, the European Union and the Arab countries. This disaggregation should be useful to assess the trade diversion and trade creation effects coming from trade facilitation. Moreover, the gravity model should be applied on data taking into account the agricultural as well as the services sectors to obtain consistent tariff equivalents of administrative barriers for these sectors. Finally, it would be also of interest to calculate the cost of trade facilitation in a more precise way taking into account different types of costs. These aspects are on my research agenda.

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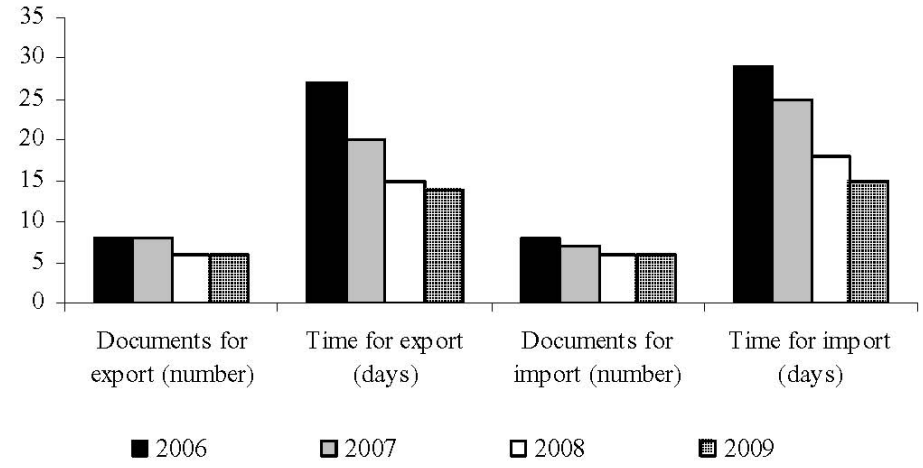
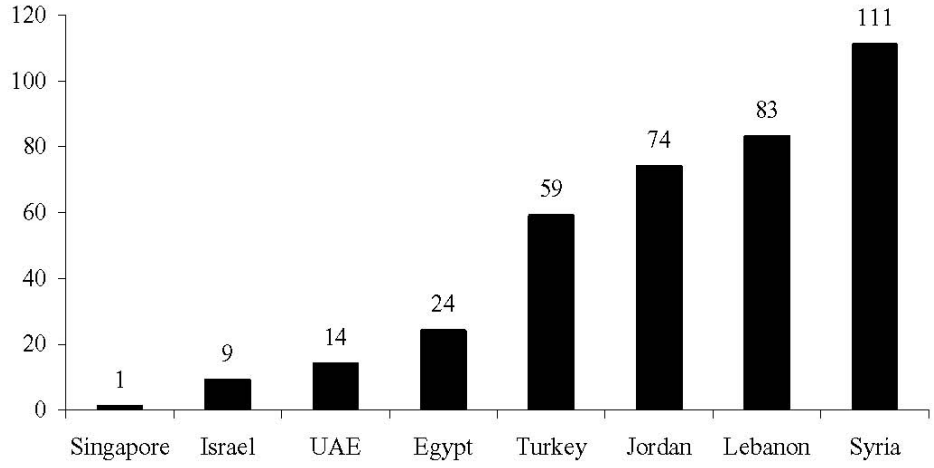
Descriptive Statistics

Figure 1: Evolution of Document and Time for Export and Import in Egypt



Source: Doing Business, 2009, The World Bank.

Figure 2: Ranking of Trade across Borders in Egypt and Some Comparator Countries



Source: Doing Business, 2009, The World Bank.

Table 1: Export and Import Procedures in Egypt, 2007

	Import Procedures		Export Procedures	
	Duration (days)	**US$ Cost**	**Duration (days)**	**US$ Cost**
Documents preparation	19	104	13	104
Inland transportation and handling	2	750	3	850
Customs clearance and technical control	2	10	1	10
Ports and terminal handling	2	185	3	50
Totals:	25	1.049	20	1.014

Source: "Doing Business", the World Bank, 2007.

Table 2: Types of Requested Documents for Exports and Imports in Egypt, 2007

Import documents	**Export documents**
Bill of lading	Bill of lading
Certificate of origin	Certificate of origin
Commercial invoice	Commercial invoice
Customs import declaration form	Customs export declaration form
Packing list	Packing list
Inspection report	Technical standard/health certificate
Cargo manifest	Pre-shipment inspection clean report of findings
Ship arrival notice/Terminal charges receipt	Shipping note

Source: "Doing Business", the World Bank, 2007.

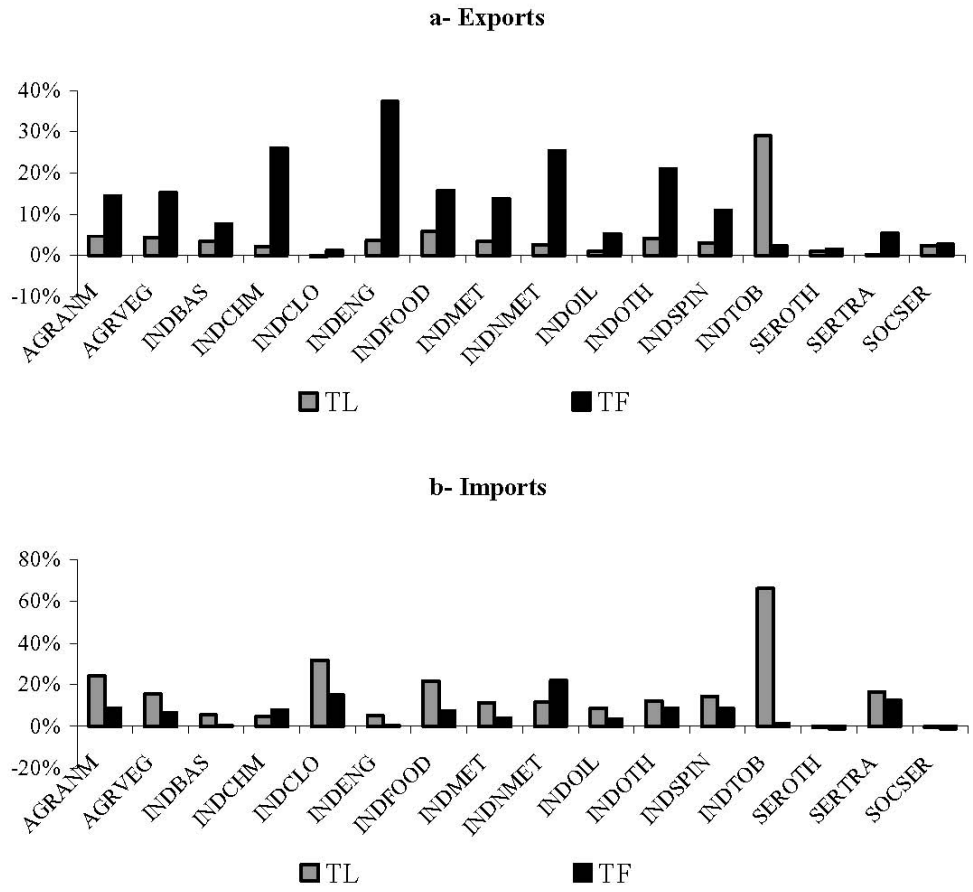
Table 3: Egypt's Position vis-`a-vis Other Countries

	Doc. for exp.	**Time to exp.**	**Cost to exp.**	**Doc. for imp.**	**Time to imp**	**Cost to imp.**
Best Practice Economies						
Denmark		5				
France	2			2		
Malaysia			450			
Singapore					3	439
Comparator economies						
Israel	5	12	665	4	12	605
Jordan	7	19	730	7	22	1290
Lebanon	5	27	872	7	38	1073
Syria	8	15	1190	9	21	1625
Turkey	7	14	940	8	15	1063
UAE	5	10	618	7	10	587
Selected economy						
Egypt	**6**	**14**	**737**	**6**	**15**	**823**

Source: Doing Business, 2009, The World Bank.

Results

Figure 3: Sectoral Exports and Imports



Source: Author's calculations.

Table 4: Estimated Ad valorem Tariff Equivalents for Trade Facilitation Barriers

	AVE of Time to Exp.	AVE of Time to Imp.
Food	3.37	6.49
Beverage	8.43	11.56
Tobacco	2.08	0.00
Textiles	4.28	8.47
Wearing Apparel	0.01	14.10
Leather	0.56	1.83
Footwear	0.00	11.86
Wood product except furniture	0.00	1.14
Furniture except metal	0.01	14.21
Paper	11.29	10.64
Printing	8.91	20.09
Industrial Chemicals	4.16	6.04
Chemicals	21.02	17.68
Petroleum refineries	0.59	0.95
Misc. Petro./ coal	3.68	6.04
Rubber	11.32	33.74
Plastic	12.21	15.51
Iron and Steel	2.39	3.69
Non Ferrous Metals	8.55	27.02
Fabricated Metal Products	5.37	8.23
Machinery expect electric	20.34	0.01
Machinery electric	13.36	9.62
Transport equipment	3.73	6.78
Prof and Scientific equi	19.70	7.13
Other Industries	12.69	11.28

Source: Author's calculations.

Table 5: Key Macroeconomic Results

	Trade Liberalization				
	t	**t+5**	**t+10**	**t+15**	**t+20**
Total Exports	1.36	2.09	2.92%	3.56%	4.08%
Total Imports	10.91%	11.20%	11.46%	11.53%	11.56%
Total Investment	-0.71%	-0.80%	-0.90%	-0.93%	-0.94%
Total Consumption	2.74%	2.88%	3.02%	3.05%	3.11%
Wages	-0.60%	-0.81%	-0.94%	-1.02%	-1.18%
Capital Rem	-2.32%	-2.06%	-1.84%	-1.72%	-1.71%
HH Real Rev.	2.71%	2.85%	2.99%	3.03%	3.09%
Firms Rev.	-0.61%	-0.66%	-0.72%	-0.70%	-0.68%
Gov. Rev	-11.06%	-11.71%	-12.17%	-11.55%	-10.46%
CPI	-2.79%	-2.98%	-3.13%	-3.27%	-3.27%
Welfare	2.38	2.35	2.40	2.51	2.62

	Trade Facilitation				
	t	**t+5**	**t+10**	**t+15**	**t+20**
Total Exports	5.83%	6.87%	7.92%	8.55%	9.11%
Total Imports	4.99%	4.86%	4.75%	4.81%	4.82%
Total Investment	-0.49%	-0.72%	-0.97%	-1.04%	-1.11%
Total Consumption	1.89%	2.12%	2.36%	2.48%	2.59%
Wages	-0.70%	-1.02%	-1.32%	-1.49%	-1.63%
Capital Rem	-1.94%	-1.94%	-2.01%	-1.94%	-2.01%
HH Real Rev.	1.94%	2.15%	2.37%	2.50%	2.62%
Firms Rev.	-0.30%	-0.47%	-0.66%	-0.69%	-0.71%
Gov. Rev	0.04%	-0.05%	-0.16%	-0.18%	-0.19%
CPI	-2.06%	-2.38%	-2.69%	-2.87%	-3.00%
Welfare	1.67	1.75	1.92	2.09	2.26

	Trade Facilitation + Cost				
	t	**t+5**	**t+10**	**t+15**	**t+20**
Total Exports	4.74%	5.44%	5.63%	6.36%	7.03%
Total Imports	6.07%	6.27%	7.06%	7.07%	7.01%
Total Investment	0.15%	0.13%	0.41%	0.32%	0.22%
Total Consumption	2.33%	2.71%	3.33%	3.46%	3.56%
Wages	-0.10%	-0.20%	0.09%	-0.19%	-0.36%
Capital Rem	-1.34%	-1.21%	-0.82%	-0.84%	-0.97%
HH Real Rev.	2.38%	2.74%	3.35%	3.48%	3.59%
Firms Rev.	0.27%	0.28%	0.56%	0.50%	0.44%
Gov. Rev	0.70%	0.82%	1.27%	1.16%	0.99%
CPI	-1.52%	-1.74%	-1.68%	-1.93%	-2.09%
Welfare	2.03	2.17	2.35	2.39	2.43

Note: Figures shown here are percentage change with respect to the BAU scenario.
Source: Author's calculations.

Table 6: Selected Sectoral Results: Imports and Imports Prices

		Trade Liberalization				
		t	**t+5**	**t+10**	**t+15**	**t+20**
Imports	AGRANM	24.25%	24.09%	24.13%	24.29%	24.36%
	AGRVEG	15.65%	16.01%	16.38%	16.75%	16.95%
	INDENG	5.20%	5.29%	5.32%	5.32%	5.32%
	INDFOOD	21.80%	21.75%	21.87%	22.08%	22.20%
	INDNMET	11.56%	11.80%	11.83%	11.80%	11.73% -
Import Prices	AGRANM	-12.82%	-12.82%	-12.82%	-12.82%	12.82% -
	AGRVEG	-10.10%	-10.10%	-10.10%	-10.10%	10.10% -
	INDENG	-5.18% -	-5.18% -	-5.18% -	-5.18% -	5.18% -
	INDFOOD	12.55% -	12.55% -	12.55% -	12.55% -	12.55% -
	INDNMET	7.04%	7.04%	7.04%	7.04%	7.04%
		Trade Facilitation				
		t	**t+5**	**t+10**	**t+15**	**t+20**
Imports	AGRANM	8.77%	8.68%	8.61%	8.62%	8.57%
	AGRVEG	6.59%	6.95%	7.26%	7.56%	7.69%
	INDENG	0.71%	0.52%	0.37%	0.44%	0.49%
	INDFOOD	7.35%	7.32%	7.35%	7.45%	7.48%
	INDNMET	22.08% -	23.71%	25.08% -	26.34% -	26.98% -
Import Prices	AGRANM	6.37% -	-6.37% -	6.37% -	6.37% -	6.37% -
	AGRVEG	6.60% -	6.60% -	6.60% -	6.60% -	6.60% -
	INDENG	4.55% -	4.55% -	4.55% -	4.55% -	4.55% -
	INDFOOD	6.39% -	6.39% -	6.39% -	6.39% -	6.39% -
	INDNMET	17.63%	17.63%	17.63%	17.63%	17.63%
		Trade Facilitation + Cost				
		t	**t+5**	**t+10**	**t+15**	**t+20**
Imports	AGRANM	10.44%	10.73%	11.82%	11.65%	11.44%
	AGRVEG	8.00%	8.74%	10.13%	10.37%	10.39%
	INDENG	1.42%	1.47%	1.94%	2.01%	2.03%
	INDFOOD	8.78%	9.11%	10.20%	10.19%	10.10%
	INDNMET	23.19% -	25.20%	27.60%	28.88% -	29.48% -
Import Prices	AGRANM	6.37% -	-6.37% -	-6.37% -	6.37% -	6.37% -
	AGRVEG	6.60% -	6.60% -	6.60% -	6.60% -	6.60% -
	INDENG	4.55% -	4.55% -	4.55% -	4.55% -	4.55% -
	INDFOOD	6.39% -	6.39% -	6.39% -	6.39% -	6.39% -
	INDNMET	17.63%	17.63%	17.63%	17.63%	17.63%

Note: Figures shown here are percentage change with respect to the BAU scenario.
Source: Author's calculations.

Table 7: Selected Sectoral Results: Exports and Export Prices

		Trade Liberalization				
		t	**t+5**	**t+10**	**t+15**	**t+20**
Exports	INDCHM	2.15%	2.56%	3.11%	3.56%	3.96%
	INDENG	3.63%	3.59%	3.73%	3.91%	4.12%
	INDFOOD	5.82%	5.68%	5.62%	5.56%	5.61%
	INDSPIN	3.06%	3.38%	3.82%	4.14%	4.44%
	SERTRA	0.31%	1.25%	2.36%	3.19%	3.84%
Export Prices	INDCHM	-0.70%	-0.86%	-0.95%	-1.07%	-1.29%
	INDENG	-1.20%	-1.16%	-1.24%	-1.27%	-1.30%
	INDFOOD	-1.90%	-1.82%	-1.80%	-1.76%	-1.80%
	INDSPIN	-1.00%	-1.05%	-1.23%	-1.27%	-1.50%
	SERTRA	-0.10%	-0.38%	-0.85%	-0.97%	-1.20%

		Trade Facilitation				
		t	**t+5**	**t+10**	**t+15**	**t+20**
Exports	INDCHM	26.09%	26.54%	27.00%	27.09%	27.27%
	INDENG	37.33%	37.32%	37.48%	37.44%	37.55%
	INDFOOD	15.75%	15.82%	16.00%	16.06%	16.24%
	INDSPIN	10.84%	11.49%	12.18%	12.57%	12.95%
	SERTRA	5.37%	7.34%	9.27%	10.43%	11.34%
Export Prices	INDCHM	2.90%	2.78%	2.75%	2.72%	2.58%
	INDENG	4.10%	4.15%	4.11%	4.11%	4.10%
	INDFOOD	0.30%	0.29%	0.19%	0.20% -	0.10%
	INDSPIN	0.40%	0.19%	0.00%	-0.10%	-0.30%
	SERTRA	1.50%	0.95%	0.28%	0.00%	-0.30%

		Trade Facilitation + Cost				
		t	**t+5**	**t+10**	**t+15**	**t+20**
Exports	INDCHM	24.92%	24.95%	24.36%	24.47%	24.73%
	INDENG	36.15%	35.71%	34.84%	34.81%	34.97%
	INDFOOD	14.54%	14.35%	13.74%	13.99%	14.32%
	INDSPIN	9.71%	10.01%	9.82%	10.31%	10.82%
	SERTRA	3.70%	5.42%	6.61%	8.10%	9.27%
Export Prices	INDCHM	3.20%	3.16%	3.42%	3.40%	3.28%
	INDENG	4.40%	4.53%	4.78%	4.79%	4.80%
	INDFOOD	0.60%	0.67%	0.85%	0.78%	0.60%
	INDSPIN	0.70%	0.67%	0.66%	0.58%	0.30%
	SERTRA	2.10%	1.52%	1.13%	0.68%	0.30%

Note: Figures shown here are percentage change with respect to the BAU scenario.
Source: Author's calculations.

Appendix 1: Legal Framework of Import and Export Procedures in Egypt

This appendix is split from the Trade Policy Review (WTO, 2005) which displays the legal framework of import and export procedures in Egypt. For the sake of clarity, it is divided in three parts: first, laws regulating such procedures are displayed; second, the concerned parties are mentioned and finally, the characteristics of some goods are exhibited in a third stance.

Which laws? Egypt's customs regime is based on Law 121/1982, Law 66/1963 (the Customs Law), Law 118/1975 (which, together with its Executive Regulations (Ministerial Decree 275/1991), is also known as the Import and Export Regulations), and a number of Ministerial Decrees.

Who is concerned? In accordance with Law 121/1982, all persons or companies importing goods into Egypt must register with the General Organization for Export and Import Control within the Ministry of Foreign Trade and Industry. The Law also requires that all registered importers be Egyptian nationals and fulfil a number of other conditions, including financial reliability and the presentation of a proven record of past commercial activities. When registering, importers must also provide details of the products they intend to import. Importers must pay for imports through a bank operating in Egypt.

Which goods? All goods imported into Egypt, except those destined for the free zones, must be accompanied by a customs declaration, irrespective of their value. Other documents required are the original commercial invoice, bill of lading, packing list, pro-forma invoice, a form specifying the mode of payment, delivery order from the carrier in return for the bill of lading, and, if appropriate, a content analysis of the commodity. In certain cases, additional certificates may be required by the customs authorities, including chemical certificates for imports of food additives and other material used in the food processing industry; quality control certificates for a number of products; and a disinfection certificate for shipments of shaving brushes and bristles. Sanitary certificates are also required for a number of products, and plant and animal products are subject to inspection by the Agriculture Quarantine Body and the Animal Quarantine Body. Ministerial Decree 619/1998 requires that all imported consumer goods be shipped directly from the country of origin to Egypt. Ministerial Decree 423/1999 exempts from these provisions goods shipped from the producing country through a transit port and goods assembled from intermediate products of different origins. The authorities indicate that the decrees are intended to prevent the entry of products of unknown source into the Egyptian market. Various imported goods are liable to quality control inspection by the General Organization for Export and Import Control within one week of the date of import. The Organization is entitled to examine a random sample of 1% of the total number of packages in each consignment and up to 2% of the contents of the chosen packages. The procedures for sampling are laid down in Ministerial Decree 1186/2003; as a main principle, the customs officials must ensure that the samples examined are representative for the consignment. If the chosen samples are not in conformity with regulations, the Organization may search up to 2% of the remaining number of packages in the sample before rejecting a consignment. Rejected goods must be re-exported or destroyed.

Appendix 2: A Descriptive Analysis of the Egyptian Economy

This sections analyzes the main features of the Egyptian economy through the SAM flows. It focuses on five main aspects: the agents revenues and the expenditures, the economic activities, the structure of the final demand, relations with the rest of the world and the capital market.

2.1. Revenues and Expenditures of Economic Agents

Regarding the households account, dividends from private companies constitute the major source of household income (representing 56.8% and 52.8% of the total income of urban and rural households respectively). The second source of income is wages (on average 37% of their income). These wages are those levied by national workers, to which transfers from Egyptian workers abroad are added and from which those of foreign workers in Egypt are subtracted. On the other hand, consumption represents 84% of the households income. These figures show an important fact: having a huge consumption, Egyptian population are characterized by low savings (12% of their income), which in turn weakens the investment potential.

Concerning private firms, on the one hand, capital income constitutes the largest source of their revenue (88.6%). On the other, 14.1% of their revenues are intended to savings and 76.1% distributed as dividends to households. For this, the bulk of household income comes from dividends paid by companies in the form of interest and distributed profits.

The government's income is composed mainly of direct taxes (L.E. 38040, or 57% of the total revenue) with 66% coming from direct taxes imposed on private firms. Secondly, indirect taxes represent 25.5% of government revenue. Among the most taxed sectors, productive services one is ranked first[14]. Its contribution is equal to 63.5% of revenues coming from indirect taxes. By contrast, the most subsidized sector is the social services one, with a share of indirect taxes net of subsidies -16.7%. Revenues from import tariffs and sales taxes represent the third largest source of government revenue: three sectors are not subject to such taxes (services sectors). However, the biggest contributor to revenue of tariffs is the chemical industries sector (24.64%), which is one of the biggest importers in Egypt, after the equipment and machinery sector and the crop production one. The government expenditures are structured as follows: 55% of the revenues are allocated to transfers of households (pensions, insurance and other current transfers) and businesses (the domestic debt interest paid to public companies and other current transfers to the private ones) and 42% for the salaries of public servants. This high percentage of the wage bill is explained by the magnitude of public employment in Egypt, characterized by high stability. Finally, the government is still in deficit, explaining why its savings are negative.

2.2. Economic Activities

- The contribution of each sector in total output and value-added: The total contribution of the three services sectors either in total production or in the value added is very high (45 % and 50% respectively of which 27% and 28% are due to productive services sector). Thanks to tourism and the Suez Canal, Egypt is characterized by a dominant services sector.
- The demand of production factors: The government is the largest employer of labor (21.2% of total labor). The second employer is the crop production sector followed by the productive services one. This sector also uses a lot of capital, since its demand represents 33.8% of the total capital.
- Interactions between economic activities: The input/output table in the SAM shows that 19% of the table cells are zeros, pointing out relatively weak interactions between economic activities. However, upstream and downstream linkages are relatively high between certain sectors.

[14] 14The services sector is a very important contributor to the Egyptian growth as its contribution varies between 45% and 50% of the GDP. The remaining of the growth is divided between agriculture (10%) and industries (40%)

Obviously, the tobacco sector is not among the sectors with high interactions since its production is not used by other industries, and its intermediate demand is also low. Notwithstanding, the services one in general and in particular the other productive services one figure among the sectors with high upstream and downstream linkages. In fact, several sectors uses its output as input for their production as the productive services sector includes electricity, tourism, finance, insurance and construction. This sector figures as an intermediate good in all other sectors: on average, the top ten sectors that consume its output attribute 28.3% of their expenditures to it. Similarly, the demand coming from this sector to the others is also high, especially addressed to itself (24% of its intermediate demand), to non-metal industries (16.6%) and basic metals industries(15%). These percentages represent significant shares of these sectors revenues: 88% of non-metal industries revenues, 68.5% of transport and communication revenues and 47.6 % of basic metals revenues.

2.3. The Final Demand

On the one hand, consumption of urban households is focused primarily on productive services (15.7%) as electricity, insurance and finance, as well as transportation and communication are essential elements of life in the city. On the other hand, consumption of rural households is focused on crop production goods (13%): these households living in the countryside, self-consume their production. The food industry ranks second for both types of households (on average 11% of total consumption for each type of household).

The government allocates almost half of its consumption expenditure (47%) to pro¬ductive services. This sector includes services that are used in all public institutions such as electricity.

2.4. The Rest of the World

The presence of a "Rest of the World" (RoW) gives birth to several flows, on the one hand, with the economic activities and on the other hand with the economic agents. First, relations between economic activities and the RoW are represented by trade exports and imports. The structure of trade is as follows: for exports, those of productive services (transport, communication and other productive services) are ranked first, with a share of 70% (because they include tourism and Suez Canal revenues), followed by chemical industries (7%) and finally those of spinning and weaving and garments (3.5% and 4% respectively). Yet, the structure of imports is a bit different, because the import of equipment and machinery occupies the first position (21.8%), followed by chemical industries (12.5%) and crop production (12%, particularly wheat) as Egypt is a net importer of food and agricultural crops.

Second, relations between the rest of the world and the economic agents are represented by the transfers between the two sides. The transfers from the rest of the world to the national agents represent 3% of the urban households income, 3% of the rural one, 3.7% of government revenues and 2.7% of the firms earnings. The government transfers to the rest of the world represent 4.4% of government expenditures.

2.5. The Capital Account

The major contributor in aggregate savings is firms (their share in the total savings is 55.5%), followed by urban households (37.5%), who certainly save more than rural ones (27.5%). Admittedly, the government being in deficit, public savings are negative, with a share of -20% to total savings. The foreign savings (which is equal to the current account deficit) is low, amounting to L.E. 98 million (0.14% of total savings). Regarding the investment demand, the other productive services sector occupies the first position with a share of 61% of the total demand for investment, followed by equipment and machinery one (17.6%).

Appendix 3: List of sectors

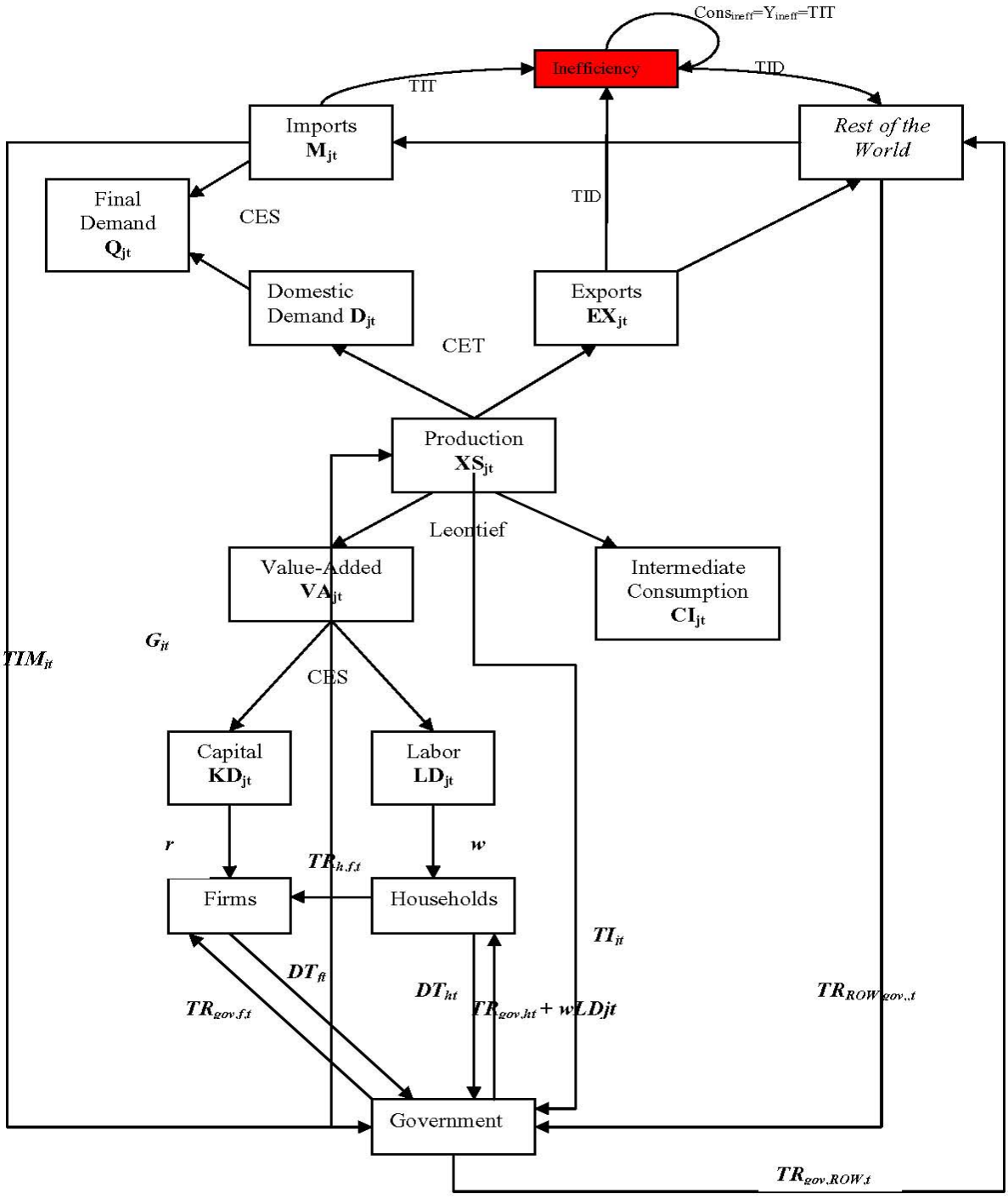
The Egyptian SAM includes 17 sectors. For the sake of modeling, two service sectors have been merged in order to avoid zero values present in the SAM. Those sectors are distributed as follows: 2 agricultural sectors, 11 industrial ones and 3 services sectors as follows:

Table 8: List of sectors included in the SAM

Abbreviation	Sector
AGRVEG	Agriculture vegetal production
AGRANM	Agriculture animal production
INDOIL	Oil and extraction industry
INDFOOD	Food industry
INDTOB	Tobacco industry
INDSPIN	Spinning and weaving industry
INDCLO	Clothes(includes leather)
INDCHM	Chemical industries
INDNMET	Non-metal industries
INDBAS	Basic metal industries
INDMET	Metal industries
INDENG	Enginery and machinery industries
INDOTH	Other industries
SERTRA	Transport and communication services
SEROTH	Other services
SOCSER	Social services

Appendix 4: The Model Structure

Figure 4: Structure of the Model



Appendix 5: The Model Notation

Definition of Different Sets

h	Household of type h
I and j	Sectors of the economy (16 sectors)
t	Time index

Parameters Definition

1. Production Functions

ν_j	Share of the value added in the production (Leontief) of sector j
io_j	Share of intermediary consumption in the production (Leontief) of sector j
aij_{ij}	Intermediary consumption of good i by unity of production of sector j
δ_j	Share of sector j value added of in GDP at factor cost

2. CES Function Between Capital and Labor

A_j^{va}	Scale parameter of the value added CES function of sector j
α_j^{va}	Share parameter of the value added CES function of sector j
ρ_j^{va}	Substitution elasticity between labor and capital
σ_j^{va}	Substitution parameter (value added function)

3. Demand Functions

φ_h	Household h propensity to save
γ_{ih}	Budgetary share of good i in the income of household h
μ_i	Share of investment demand of sector i in total investment
λ_W^H	Share of Household h in the wages bill
$C_{i,h}^{\min}$	Minimal consumption of good i by household h

4. Tax Rates

tx_j	Indirect taxes rate applied on sector j products
tm_j	Import tariff rate applied on sector j products
te_j	Export tariff rate applied on sector j products
tp_j	Production tax rate applied on sector j
tyh_h	Direct tax rate applied on household h income
tyf	Direct tax rate applied on firms income

5. CES Function Between Imports and Domestic Production

A^m_j Scale parameter of the Armington CES function

α^m_j Share parameter of the Armington CES function

ρ^m_j Substitution parameter

σ^m_j Substitution elasticity (Armington function)

6. CET Function Between Exports and Domestic Production

B^e_j Scale parameter of the CET production function

β^e_j Share parameter of the CET production function

τ^e_j Transformation elasticity (CET production function)

ε^e_j Price elasticity

κ^e_j Transformation parameter

EXD^o_j Scale parameter of exports

7. Trade Facilitation

tfm_j Tariff equivalent of time to import for sector j products

tfx_j Tariff equivalent of time to exports of sector j products

$\gamma_{i,inef}$ Budgetary share of good i in the inefficiency agent income

8. Growth Rates

gn_t Population growth rate

tfp_t Total factor productivity growth rate

gg_t Public consumption growth rate

gpt_t Growth rate of private transfer coming from RoW

ggt_t Growth rate of public transfer coming from RoW

wgg_t Public wages growth rate

ldg_t Public employment growth rate

9. Other Parameters

ir Real interest rate

δ Capital depreciation rate

γ_{1i} Parameter 1 of the investment demand equation

γ_{2i} Parameter 2 of the investment demand equation

Variables Definition

A-Endogenous variables

1. Production

$VA_{j,t}$	Value added of sector j
$XS_{j,t}$	Production of sector j
$XXS_{j,t}$	Production of sector j at basic prices
$CI_{j,t}$	Total intermediary consumption of sector j
$DI_{i,j,t}$	Intermediary demand of product *i* by sector j

2. Production Factors

$LD_{j,t}$	Labor demand by sector j
$KD_{j,t}$	Capital demand by sector j
LS_t	Labor supply

3. Prices

w_t	Average wage
$r_{j,t}$	Capital return in sector j
$Pv_{j,t}$	Value added price of sector j
$Pci_{j,t}$	Intermediate consumption of sector j
$Pc_{j,t}$	Market price of the composite good belonging to sector j
$P_{j,t}$	Production price on factor cost of sector j
$Pl_{j,t}$	Producer price of sector j product sold on the domestic market
$Pfob_{j,t}$	Fob price of the exported good j
$Pm_{j,t}$	Domestic price of the imported good j
$Pe_{j,t}$	Producer price of the exported good j
$Pinv_{j,t}$	Investment price index
$PCI_{h,t}$	Consumer price index for household h
U_t	Capital user cost
$Pindex_t$	GDP deflator

4. Revenues and Savings

$YH_{h,t}$	Household h income
$YDH_{h,t}$	Disposable income of household h
YF_t	Firms income
YG_t	Government income
$SH_{h,t}$	Household h savings
SF_t	Firms savings
SG_t	Government savings

5. Tax Revenues

$TDH_{h,t}$	Receipts from direct taxes of household h
TDF_t	Receipts from direct taxes of firms
$TI_{j,t}$	Receipts from indirect of sector j
$TIM_{j,t}$	Receipts from import tariffs of goods j
$TIE_{j,t}$	Receipts from export tariffs of goods j
$TIP_{j,t}$	Receipts from production taxes

6. External Trade

$EX_{j,t}$	Export supply of product j
$EXD_{j,t}$	Export demand of product j
$M_{j,t}$	Import demand of product j
$D_{j,t}$	Domestic production of sector j sold on the domestic market
$Q_{j,t}$	Supply of composite product belonging to sector j
CAB_t	Current account balance (external savings)

7. Final Demand

$C_{i,h,t}$	Consumption of good i by household h
$INV_{i,t}$	Investment demand of product i
$DIT_{i,t}$	Total intermediary demand of input i
IT_t	Gross fixed capital formation
$ITVOL_t$	Volume of total investment
$IND_{i,t}$	Investment by destination
$EV_{h,t}$	Equivalent variation of household h

8. Trade Facilitation

$TFM_{j,t}$	Import time revenues on imported goods j
$TFX_{j,t}$	Export documents revenues on exported goods j
$C_{i,inef,t}$	Consumption of good i of the inefficiency agent
$YH_{inef,t}$	Income of the inefficiency agent

9. Other variables

GDP_t^{BP}	GDP at basic prices
GDP_t^{FD}	GDP at purchasers prices from the perspective of final demand
GDP_t^{IB}	GDP at market price (income based)
GDP_t^{MP}	GDP at market prices
$savadj_t$	Adjustment variable for investment and savings
$Leon_j$	Walras law verification variable
$CLO1$	First closure (fixed share of current account to GDP)

B. Exogenous variables

$P\,wm_{j,t}$	International import price of product j (foreign currency)
$P\,we_{j,t}$	International export price of product j (foreign currency)
e_t	Exchange rate, numeraire
$G_{i,t0}$	Public consumption of product i
LD^G_{t0}	Labor demand by public sector
w^G_{t0}	Wage rate in public sector TRf,h,t0 Dividends distributed by firms to household h
$TR_{f,h,t0}$	Dividends distributed by firms to household h
$TR_{h,f,t0}$	Transfers from household h to the firms
$TR_{ROW,h,t0}$	Transfers from the Rest of the World to household h
$TR_{ROW,f,t0}$	Transfers from the Rest of the World to the firms
$TR_{ROW,G,t0}$	Transfers from the Rest of the World to the government
$TR_{G,h,t0}$	Transfers made by the government to household h
$TR_{G,f,t0}$	Transfers from the government to the firms
$TR_{G,ROW,t0}$	Transfers from the government to the Rest of the World

The Model Equations

1-Production Bloc

$$\mathrm{XS}_{j,t} = \min\ [(\frac{CI_{j,t}}{io_j})(\frac{VA_{j,t}}{v_j})] \tag{A1}$$

$$\mathrm{XXS}_{j,t} = \mathrm{XS}_{j,t}\,.\,\mathrm{tp}_j \tag{A2}$$

$$VA_{j,t} = A^{va}_j\ [\alpha^{va}_j\ LD_{jt}^{-\rho_j^{va}} + (1-\alpha^{va}_j)\ KD_{jt}^{-\rho_j^{va}}\ ]^{\frac{-1}{\rho_j^{va}}} \tag{A3}$$

$$\mathrm{CI}_{j,t} = \mathrm{io}_j\,\mathrm{X}\,\mathrm{S}_{j,t} \tag{A4}$$

$$\mathrm{DI}_{ij,t} = \mathrm{aij}_{ij}\mathrm{CI}_{j,t} \tag{A5}$$

$$LD_{j,t} = (\frac{\alpha^{va}_j}{1-\alpha^{va}_j})^{\sigma^{va}_j}\ (\frac{r_{j,t}}{w_t})^{\sigma^{va}_j}\ KD_{j,t} \tag{A6}$$

2. Revenues and Savings Bloc

$$YH_{h,t} = \lambda^h_w \sum_{j=1}^{16} LD_{j,t}.w + TR_{G,h,t} + TR_{f,h,t} + TR_{ROW,h,t} + \lambda^h_w\,.\,LG_{G,t} \tag{A7}$$

$$YDH_{h,t} = YH_{h,t} - TD_{h,t} - TR_{h,f,t} \tag{A8}$$

$$YF_t = \sum_{j=1}^{16} r_{j,t}\,KD_{j,t} + TR_{ROW,f,t} + \sum_{h=hu}^{hr} TR_{h,f,t} + TR_{G,f,t} \tag{A9}$$

$$SH_{h,t} = \varphi_h\ YDH_{h,t} \tag{A10}$$

$$SF_t = YF_t - \sum_{h=hu}^{hr} TR_{f,h,t} - TDF_t \tag{A11}$$

3. Government Revenues and Savings

$$TIP_{j,t} = tp_j P_{j,t} X S_{j,t} \quad \text{(A12)}$$

$$TI_{i,t} = tx_i(Pl_{i,t} D_{i,t}) + tx_i (1 + tm_i + tt_i) e_t P wm_{i,t} M_{i,t} \quad \text{(A13)}$$

$$TIM_{i,t} = tm_i P wm_{i,t} e_t M_{i,t} \quad \text{(A14)}$$

$$TIE_{i,t} = te_i P e_{i,t} EX_{i,t} \quad \text{(A15)}$$

$$T D H_{h,t} = tyh_h Y H_{h,t} \quad \text{(A16)}$$

$$T D F_t = tyf Y F_t \quad \text{(A17)}$$

$$Y G_t = \sum_{j=1}^{16} T I M_{i,t} + \sum_i T I E_{i,t} + \sum_i TI_{i,t} + \sum_{h=hu}^{hr} T D H_{h,t} + T D F_t + TR_{ROW,G,t} \quad \text{(A18)}$$

$$SG_t = YG_t - \sum_{j=1}^{16} G_{i,t} - \sum_{h=hu}^{hr} TR_{G,h,t} - TR_{G,f,t} - w L D_{G,t} - TR_{G,ROW,t} \quad \text{(A19)}$$

4. Final Demand Bloc

$$PC_{i,t} C_{i,h,t} = PC_{i,t} C^{\min}_{i,h} + \gamma_{ih} (Y D H_{h,t} - \sum_i P C_{i,t} C^{\min}_{i,h}) \quad \text{(A20)}$$

(A21)

$$INV_{i,t} = \frac{\mu_i IT_t}{PC_{i,t}} \quad \text{(A22)}$$

$$DIT_{i,t} = \sum_{j=1}^{16} D I_{i,j,t} \quad \text{(A23)}$$

5. Prices Bloc

$$P v_{j,t} = \frac{P_{j,t} XS_{j,t} - \sum_{i=1}^{16} Pc_{i,t} DI_{i,j,t}}{VA_{j,t}} \quad \text{(A24)}$$

$$Pci_{j,t} = \frac{\sum_j PC_{j,t} DI_{i,j,t}}{CI_{j,t}} \quad \text{(A25)}$$

$$r_{j,t} = \frac{Pv_{j,t} VA_{j,t} - w_t LD_{j,t}}{KD_{j,t}} \quad \text{(A26)}$$

$$Pm_{i,t} = e_t \, Pwm_{i,t} (1 + tm_i + tfm_i)(1 + tx_i) \quad \text{(A27)}$$

$$Pe_{i,t} = \frac{e_t \, P\,fob_{i,t}}{(1 + te_i + t\,f\,x_i)} \quad \text{(A28)}$$

$$PC_{i,t} = (1 + tx_i) \, \frac{Pl_{i,t} D_{i,t} + Pm_{i,t} \, M_{i,t}}{Q_{i.t}} \quad \text{(A29)}$$

$$P_{i,t} = \frac{Pl_{i,t} D_{i,t} + Pe_{i,t} E\,X_{i,t}}{X\,S_{i.t}} \quad \text{(A30)}$$

$$Pinv_i = \Pi \left(\frac{PC_{i,t}}{\mu_i} \right)^{\mu i} \quad \text{(A31)}$$

$$Pindex_t = \sum_j PV_{j,t} \, \delta_j \quad \text{(A32)}$$

$$PCI_h = \sum_i \gamma_{hi} \, PC_i \quad \text{(A33)}$$

6. International Trade Bloc

$$\mathrm{XS_{i,t}} = \mathrm{B}^{e}_{i} \left[\beta^{e}_{i} \; EX^{-\kappa^{e}_{i}}_{i,t} + (1 - \beta^{e}_{i}) \; D^{-\kappa^{e}_{i}}_{i,t} \right]^{-\frac{1}{K^{e}_{i}}} \quad \text{(A34)}$$

$$EX_{i,t} = \left[\left(\frac{1 - \beta^{e}_{i}}{\beta^{e}_{i}} \right) \left(\frac{Pe_{i,t}}{Pl_{i,t}} \right) \right]^{\tau^{e}_{i}} D_{i,t} \quad \text{(A35)}$$

$$EXD_{i,t} = EXD^{o}_{j} \left(\frac{Pwe_{i,t}}{P\,fob_{i,t}} \right)^{\varepsilon^{e}_{i}} \quad \text{(A36)}$$

$$Q_{i,t} = \mathrm{A}^{m}_{i} \left[\alpha^{m}_{i} M^{-\rho^{m}_{i}}_{i,t} + (1 - \alpha^{m}_{i}) D^{-\rho^{m}_{i}}_{i,t} \right]^{-\frac{1}{p^{m}_{i}}} \quad \text{(A37)}$$

$$M_{i,t} = [(\frac{\alpha^{m}_{i}}{1-\alpha^{m}_{i}})(\frac{Pd_{i,t}}{Pm_{i,t}})]^{\sigma^{m}_{j}} D_{i,t} \quad \text{(A38)}$$

$$CAB_t = e\sum_i Pwm_{i,t} M_{i,t} + TR_{G,ROW,t} - TR_{ROW,h,t} - TR_{ROW,G,t} - TR_{ROW,f,t} - e_t\sum_i Pfob_{i,t} EX_{i,t} \quad \text{(A39)}$$

7. Trade Facilitation

$$TFM_{i,t} = tfm_i Pwm_{i,t,e_t} M_{i,t} \quad \text{(A40)}$$

$$TFX_{i,t} = tfx_i Pe_{i,t} E X_{i,t} \quad \text{(A41)}$$

$$YH_{inef,t} = \sum_{i=1}^{16} TFM_{j,t} \quad \text{(A42)}$$

$$C_{i,inef,t} = \gamma_{i,inef} Y H_{inef,t} / Pc_{i,t} \quad \text{(A43)}$$

8. Equilibrium Equations Bloc

$$LS_t = \sum_{i=1}^{16} LD_{j,t} + LD_{G,t} \quad \text{(A44)}$$

$$Q_{i,t} = DIT_{i,t} + \sum_{h=hu}^{hr} C_{i,h,t} + I N V_{i,t} + G_{i,t} \quad \text{(A45)}$$

$$IT_t = \sum_{h=hu}^{hr} S H_{h,t} + S F_t + SG_t + CAB_t + \sum_{i=1}^{16} T F X_{i,t} \quad \text{(A46)}$$

$$IT_t = P_{invest_t}.\sum Ind_{i,t} \quad \text{(A47)}$$

$$EXD_{i,t} = EX_{i,t} \tag{A48}$$

$$EV_{h,t} = (\prod_i (PCO_i / PC_{i,t})^{\gamma_{i,h}} YH_{h,t}) - YHO_h \tag{A49}$$

$$GDP^{Bp}_t = \sum_j Pv_{j,t} VA_{j,t} + \sum_j TIP_{j,t} \tag{A50}$$

$$\text{GDP}^{Mp}_t = GDP^{Bp}_t + \sum_i TIM_{i,t} + \sum_i TI_{i,t} \tag{A51}$$

$$\text{GDP}^{FD}_t = \sum_i [PC_{i,t} (\sum_h C_{i,h,t} + G_{i,t} + INV_{i,t})] + \sum_j Pfob_{i,t} EXD_{i,t} - \sum_i Pwm_{i,t} M_{i,t} e_t \tag{A52}$$

$$\text{GDP}^{IB}_t = \sum_j w_t LD_{j,t} + \sum_j r_{j,t} KD_{j,t} + \sum_j TIM_{i,t} + \sum_j TI_{i,t} + \sum_j TIP_{j,t} \tag{A53}$$

9-Closure

$$CLO2 = \frac{CAB_t}{GDP_t} \tag{A54}$$

10. Dynamic Bloc

$$\frac{Indi_{,t}}{KD_{i,t}} = [\gamma_{1i} (\frac{r_{i,t}}{U_t})^2 + \gamma_{2i} (\frac{r_{i,t}}{U_t})] savadj_t \tag{A55}$$

$$ITVOL_t = \frac{IT_t}{Pinv_t} \tag{A56}$$

$$KD_{i,t+1} = (1 - \delta) KD_{i,t} + Ind_{i,t} \tag{A57}$$

$$LS_t + 1 = (1 + gn_t) . LS_t \tag{A58}$$

$$U_t = Pinv_t (ir + \delta) \tag{A59}$$

$$G_{i,t+1} = (1 + gg_t) \,.\, G_{i,t} \tag{A60}$$

$$C^{\min}_{i,hh,t+1} = (1 + gn_t) \,.\, C^{\min}_{i,hh,t} \tag{A61}$$

$$A^{va}_{j,t+1} = (1 + tfp_t) \,.\, A^{va}_{j,t} \tag{A62}$$

$$TR_{h,f,t+1} = (1 + gn_t) \,.\, TR_{h,f,t} \tag{A63}$$

$$TR_{f,h,t+1} = (1 + gn_t) \,.\, TR_{f,h,t} \tag{A64}$$

$$TR_{ROW,h,t+1} = (1 + gpt_t) \,.\, TR_{ROW,h,t} \tag{A65}$$

$$TR_{ROW,f,t+1} = (1 + gpt_t) \,.\, TR_{ROW,f,t} \tag{A66}$$

$$TR_{ROW,G,t+1} = (1 + ggt_t) \,.\, TR_{ROW,G,t} \tag{A67}$$

$$TR_{G,f,t+1} = (1 + gn_t) * TR_{G,f,t} \tag{A68}$$

$$TR_{G,h,t+1} = (1 + gn_t) * TR_{G,h,t} \tag{A69}$$

$$TR_{G,ROW,t+1} = (1 + ggt_t) \,.\, TR_{G,ROW,t} \tag{A70}$$

$$w^{G}_{t+1} = (1 + wgg_t) \,.\, w^{G}_{t} \tag{A71}$$

$$LD^{G}_{t+1} = (1 + ldg_t) \,.\, LD^{G}_{t} \tag{A72}$$