Rethinking the Effect of Cutting Red Tape in Egypt: A Dynamic CGE Analysis*

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Preliminary version

March, 2009

Abstract

This paper develops a dynamic computable general equilibrium (CGE) model incorporating Trade Facilitation aspects in Egypt. This paper's contribution is twofold: theoretical and empirical ones. First, this paper estimates ad valorem tariff equivalents for time of imports and documents for exports which 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. Meanwhile, its impact remains higher than trade liberalization. Moreover, some sectors witness a significant expansion more than others, especially processed food, garments and textiles.

JEL classification: D58, F10, F12, F15, F17.

Keywords: CGE Models, Trade Facilitation, Trade liberalization, Egypt.

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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 trade a country's integration into global trade which, in turn, reinforce economic development. Therefore, Trade Facilitation has become a crucial aspect of trade policy. Currently, the real barrier to trade in many countries, and especially developing ones, is 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. That is why Trade Facilitation is considered one of the most important Doha's Round elements 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.

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.
Regarding economic interests, first, after reducing tariff and non-tariff barriers, trade partners have discovered that there exists other impediments to trade (OECD, 2002a). Reduction of such non-official barriers is likely to have more impact on trade than the reduction of classical ones. Obviously, such impediments involve transaction length, bureaucracy, customs fraud, etc. 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 a quite important determinant of the production process. Third, the cost of non-facilitation is very high. These barriers account for 2 to 15% of the exchanged goods value. Hence, those economic explanations show to what extent Trade Facilitation process is a crucial issue.

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, Egypt is still ranked 26 overall for Trading Across Borders (Doing Business, 2008) but it is much better that many other comparator 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 and the related services and a relatively good quality of roads. Despite importing goods is neither costly nor time consuming, importers raise concerns about the efficiency of customs and other border agencies. This why the number of days and documents to export or to import have a significant negative impact on 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, empirical literature on Trade Facilitation measures has had so far three common shortcomings. First, Trade Facilitation has never been explicitly modeled in CGE models. Consequently, the shock introduced did not incorporate properly Trade Facilitation aspects. For instance, the shock induced by Trade Facilitation was simulated through a technical progress in transport sector (Hertel et al, 2001 and Fox et al, 2003). Clearly, all these studies assessed the impact of Trade Facilitation in an implicit way. Moreover, some studies neglected some Trade Facilitation aspects, such as Minor and Tsigas (2008) who assessed the impact of time reduction without taking into account other aspects like the number of documents. Finally, to our best knowledge, the empirical literature has shed the light on the gains of such a process without taking into account its cost. This is why in this paper, I try to assess simultaneously the gains as well as the costs induced by Trade Facilitation. This paper contribution are threefold: analyze Trade Facilitation effects in an explicit and theoretical way, take into account many aspects of red tap costs simultaneously, i.e. time and documents and finally assessing also the cost of such a process in order to avoid an overestimation of its benefits. In addition, the parameters introduced in the CGE model have not been imposed in an arbitrary way but estimated from a gravity model (Zaki, 2008). This is why my paper has a quite important empirical achievement as it estimates ad valorem equivalents of time and documents.

Therefore, this paper evaluates explicitly the impact of Trade Facilitation on Egypt using a dynamic CGE. 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 of 2000/2001. Three main scenarios are simulated. The first one present the effect of the classical trade liberalization by lowering tariffs. The second scenario involves two simulations: the first one simulates implicitly the impact of Trade Facilitation as it has been assessed in the literature. The third scenario includes three simulations: the first one assesses the Trade Facilitation by shocking the ad valorem tariff equivalent of import time which has been calculated from my gravity model (Zaki, 2008). The second one shocks the tariff equivalent of documents. Finally, the third simulation combines the two previous simulations and takes into account the cost of Trade Facilitation through increasing the public expenditure on transport and communication. A final scenario combines the four simulations simultaneously, i.e. reducing time, documents, tariffs and increasing public expenditure in transport and communication.

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 used. 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 only by seven days and the time to export only by five. Table 3 and 4 exhibit to what extent red tap procedures for exports and imports remain high and are costly in Egypt. In 2007, the former request 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 practise countries in Trade Facilitation aspects.

[Table 3 and 4 about here]

Table 5 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 of export and import would be highly reduced. Recall that one of the most important objectives of the "Trade Facilitation" initiatives is twofold: making international trade easier through a *paperless world*.

[Table 5 about here]

The following figure shows that Egypt's situation in Trade Facilitation has improved: between 2006 and 2008, 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 goes down from U.S.$1,014 to U.S.$714 and the latter from 1,049 to U.S.$729 . Consequently, Egypt's position in the ease of doing business increased from the 86th to the 21st. However, its situation deteriorated between 2008 and 2009 as it became the 24th and both the cost to export and to import have increased to reach U.S.$ 737 and U.S.$ 823 respectively.

[Figure 1 about here]

As to 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 percent to 40 percent and consolidated rates of 35 to 45 percent to 30 percent. EgyptŠs average trade-weighted tariff was 15 percent in 1998. Moreover, in 1998 the Government amended a 1964 law establishing the General Egyptian Maritime Organization to permit the private sector to carry out most maritime transport services. This measure ended the GovernmentŠs long-standing monopoly in this sector. Egypt also passed a law permitting private firms to build and operate new airports. Despite all these efforts, Egypt has to enhance its procedures efficiency to ease trade, because, as we have seen, its situation has deteriorated in the end of 2008 after a high improvement in 2008.

2.2 Egypt's Position vis-à-vis Other Countries

Regarding the ease of doing business, figure 2 shows that Egypt 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 (9) and United Arab Emirates (14) while Egypt is the 24st. Singapore is the top ranked economy followed by Denmark, Hong Kong, China and Norway.

[Figure 2 about here]

The table below presents Egypt's position vis-à-vis other countries concerning the time, documents and cost of exports and imports. Regarding these aspects, it is found that Egypt has a performance slightly higher than the average of the region. However, red tap barriers to trade remain a serious issue in Egypt. According to the World Economic Forum that issued its first "Global Enabling Trade Report", 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 and the related services and a relatively good quality of roads. Despite importing goods is neither costly nor time consuming, importers raise concerns about the efficiency of customs and other border agencies pointing out to the fact that bureaucracy and transaction length are significant impediments to trade.

[Table 6 about here]

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. Yet, 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.

According to the Enabling Trade Index developed by the World Economic Forum (2008), Egypt has been ranked 87th amongst 118 countries with a score of 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 in a sample of 118 countries. It 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[1]. It is worth noting that border adminstration indices show that Egypt's is not well positioned neither for efficiency of customs administration (ranked 84) nor for transparency of border administration (71). Yet, efficiency of exports and imports is located in a middle position (49). Hence, two problems could characterize the Egyptian case: inefficient customs administration and bureaucratic and complicated customs authorities.

To put in a nutshell, Egypt has highly improved its situation regarding red tap 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 do not have any revenues. The last point shows to what extent Egypt would gain by eliminating such barriers. As Fox et al. (2003) have shown, the improvement in a country's welfare is due to the technical efficiency gains from reducing time in transit (iceberg tariffs).

3   Literature Review

Briefly, 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, 2008)[2] or CGEs. This section will present a literature review od Trade Facilitation studies using CGEs to show the main limitations of such studies and hence the contribution of mine.

Studies using the CGE methodology have suffered from three main shortcomings. First, Trade Facilitation has never been explicitly modeled in CGEs. Consequently, the shock introduced did not incorporate properly Trade Facilitation aspects. For instance, the shock induced by Trade Facilitation is associated with a technical progress in transport sector. In other terms, this shock is simulated via an increase in transport sector productivity. Another technique is the decrease in exports or imports charges which is a decrease in the import or export price.

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[1]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

[2]For a detailed literature review of gravity models used to estimate the effect of Trade Facilitation, see Zaki (2008).

Hertel et al (2001) modified the GTAP[3] model in their analysis of the Japan-Singapore free trade agreement by introducing time costs as a technical shift in the Armington import demand function. Fox et al. (2003) followed them using the variable ams, representing import-augmenting technical change of the GTAP model which allowed them to simulate the removal of an iceberg tariff by applying a positive shock to the technical efficiency of the trade flow. they have shown that removal of such barriers would benefit the Mexican economy by $1.8 billion per year, while the U.S. economy would see a welfare increase of about $1.4 billion per year. APEC (1999) modeled, using also GTAP model, the shock by an increase in the productivity of the international transportation sector to capture the downward shift in the supply line of imports resulting from the implementation of cost-reducing measures. Their main result shows that Trade Liberalization and Trade Facilitation increase GDP real income by 0.16% and 0.25% respectively for APEC countries and by 0.1% and 0.15% for the world. Moreover, Dennis (2006), using GTAP model, argued that welfare gains induced by an integration with the European Union are observed to triple when the implementations of the agreement are complemented with Trade Facilitation improvements. Similarly, Eby Konan and Maskus (1996) 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 Eby 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) 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, welfare gains may increase from 4% to 20% growth in real GNP. Finally, Francois et al. (2003 and 2005) showed that one of the most important issue of the Doha Development Round is Trade Facilitation as it explains one third of the gains taking into account that such barriers are "pure deadweight loss", especially for Asia-Pacific developing countries. Clearly, all these studies assessed the impact of Trade Facilitation in an implicit way.

The second limitation is related to the fact that some studies neglected some Trade Facilitation aspects, such as Minor and Tsigas (2008) who simulate the impact of Trade Facilitation by halving the time to trade across borders for all countries. Thus, they assessed the impact of time reduction without taking into account other aspects like the number of documents. Finally, to our best knowledge, the empirical literature has shed the light on the gains of such a process without taking into account its cost, which in turn overestimates the positive effect of Trade Facilitation.

This paper's contributions are threefold: analyze Trade Facilitation effects in an explicit and theoretical way, take into account many aspects of red tap costs simultaneously, i.e. time and documents and finally assessing also the cost of such a process in order to avoid an overestimation of its benefits. In addition, the parameters introduced in the CGE model have not been imposed in an arbitrary way but estimated from a gravity model. This is why my paper has a quite important empirical achievement as it estimates ad valorem equivalents of time and documents.

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[3]Global Trade Analysis Project

4 Methodology

4.1 Why CGE Models?

This paper uses a dynamic CGE model adapted to the Egyptian economy and modified to take into account Trade Facilitation aspects. A very important question arises: "Why CGE Models?". Three main reasons explains the relevance of such a tool for my study.

First, in 1838, in his *Research on the mathematical principles of the theory of wealth* , Augustin COURNOT argued that:

> *"The economic system is a set in which all parties are held and react on each other."*

CGE models are an application of neoclassical theory and, considered in its international trade dimension, 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 model the effect of economic policies taking into account the numerous economic interactions between different sectors, markets and agents within the same economy. On the other hand, multinational CGE models assesses the impact of an economic policy taking place in a certain country on other countries.

Second, CGE models represent a very important tool in modeling especially for developing countries. This is due to the fact that developing countries, Egypt being one of them, suffer from several problems regarding statistical data such as lacking data, unreliable sources or inconsistent long time series, etc. In contrast, as CGE models use the Social Accounting Matrix only, they do not need a lot of statistical data, that is why developing countries always use them.

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 and thus welfare. All these effects could not be studied in a partial equilibrium framework as economic interactions between different markets, sectors and agents are quite important.

That is why in order to determine Trade Facilitation impact on the Egyptian economy, it is suitable to use a CGE model. The model used (EXTER) has been developed by Decaluwé et al (2001) as shown in the next subsection.

4.2 The EXTER Model

4.2.1 The Model Assumptions

This model is constructed by Decaluwé et al. (2001) to quantify the impact of different policies on developing countries. It is based on a series of assumptions as follows:

- The central assumption is that the economy is a small open one which has no influence on world prices (Price taker). Obviously, this is consistent with the Egyptian economy which is a small economy globally.

- It is a perfect competition model, therefore the profit maximization condition implies that the price of production factor is equal to its marginal productivity.

- It is a real model. These models are models where the currency is an instrument of exchange and a unit of account only. Therefore, the currency remains neutral, which means that price changes affect only the decisions of production and consumption. All Prices are normalized in the benchmark scenario.

- The 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 with the Rest of the World. Furthermore, the existence of foreign savings has no impact on the volume of productive capital.

- The industries use not only production factors but also intermediate products from other activities.

- Households and firms save. Here savings are supposed to be the residual of their revenues.

- Goods exported and sold locally are not identical, which leads to an elasticity of transformation among the two commercial products.

- Reflecting the nature of the classical framework, competition and resource allocation are adjusted through the flexible movement of prices.

- It is a sequential dynamic model[4]. This means that households have a myopic behavior.

4.2.2   The Model Structure

This CGE model has common features with other CGE models as follows[5]. Production factors (labor and capital) are complementary in the value added following a Constant Elasticity Substitution (CES) function (with constant returns to scale). A perfect complementarity (à la Leontief, 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 Cobb-Douglas utility function subject to their income constraint. Domestic production is distributed between domestic consumption and foreign exports through a Constant Elasticity of Transformation (CET) function. Imports are differentiated by

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[4]Another type of dynamic models could be identified which is the inter-temporal one. This type of models are 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 constraint to determine their consumption over the time horizon. Regarding firms, they determine their investment decisions through a cash flow maximization over the same horizon.

[5]Figure3 shows the model structure

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). Appendices 3 and 4 present respectively the model structure; its notation and its equation.

4.2.3 Incorporating Trade Facilitation in the Model

In order to capture the explicit effect of Trade Facilitation, the administrative barriers have been introduced as a tariff imposed on the world prices. Hence, ad valorem equivalents have been calculated for such barriers as shown later.

Regarding time of imports, import prices will be higher than world prices due to tariff barriers tm_j and the ad valorem equivalent of imports time tt_j as follows:

$$Pm_{j,t} = e_t Pwm_{j,t}(1 + tm_j + tt_j)(1 + tx_j) \qquad (1)$$

where

$Pm_{j,t}$	Domestic price of the imported good j
e_t	Nominal exchange rate
$Pwm_{j,t}$	International import price of product j (foreign currency)
tx_j	Indirect taxes on sector j products
tm_j	Import tariff rate on sector j products
tt_j	Tariff equivalent of import time on sector j products

As to document for exports and imports:

$$Pe_{j,t} = \frac{e_t Pfob_{j,t}}{(1 + te_j + td_j)} \qquad (2)$$

where

$Pe_{j,t}$	Producer price of the exported good j
$Pfob_{j,t}$	Fob price of the exported good j
te_j	Export tariff rate on sector j products
td_j	Tariff equivalent of export document on sector j products

A CGE model must be squared, i.e. all expenditures paid by an agent should be captured as revenues by other agents. As Trade Facilitation measures are a pure deadweight loss, an agent called "inefficiency" has been created. revenues of time and documents as follows:

$$TIT_{j,t} = tt_j Pwm_{j,t} e_t M_{j,t} \qquad (3)$$

$$TID_{j,t} \quad = \quad td_j Pe_{j,t} EX_{j,t} \tag{4}$$

where

$TIT_{j,t}$	Import time reciepts on imported goods j
$TID_{j,t}$	Export documents revenues on exported goods j
$M_{j,t}$	Import demand of product j
$EX_{j,t}$	Export supply of product j

Finally, to realize the model equilibrium, these flows have to be absorbed by other agents. Regarding time receipts, I have created a domestic agent called "*Inefficiency*" whose revenues are the sum of the time receipts on imported goods as the latter must be absorbed by the domestic market and he spends his revenue on local consumption, as follows:

$$YH_{inef,t} \quad = \quad \sum_{j}^{17} TIT_{j,t} \tag{5}$$

and his consumption:

$$C_{i,inef,t} \quad = \quad \gamma_{i,inef} YH_{inef,t}/Pc_{i,t} \tag{6}$$

where

$YH_{inef,t}$	Income of the inefficiency agent
$C_{i,inef,t}$	Consumption of good i of the inefficiency agent
$\gamma_{i,inef}$	Budgetary share of good i in the inefficiency agent income
$Pc_{i,t}$	Composite price of good i

As to receipts coming from documents on exports, as they are associated to flows going out of the local market, they are not absorbed by domestic agents. Hence, they can not be treated as the time receipts, that is why I considered them as transfers going to the rest of the world. In other terms, they are captured by an external inefficiency agent. Thus, they have been by added to the following equation:

$$IT_t \quad = \quad \sum_{h=hu}^{hr} SH_{h,t} + SF_t + SG_t + CAB_t + \sum_{j}^{17} TID_{j,t} \tag{7}$$

where

$SH_{h,t}$	Household h savings
SF_t	Firms savings
SG_t	Government savings
CAB_t	Current account balance

The dynamics of the model takes into account the capital accumulation and population growth. It is given by the following equations:

$$\frac{Ind_{i,t}}{KD_{i,t}} \quad = \quad [\gamma_{1i}(\frac{r_{i,t}}{U_t})^2 + \gamma_{2i}(\frac{r_{i,t}}{U_t})]savadj_t \tag{8}$$

$KD_{j,t}$ Capital demand by sector j
$IND_{i,t}$ Investment by destination
γ_{1i} Parameter 1 of the investment demand equation
γ_{2i} Parameter 2 of the investment demand equation
U_t Capital user cost
$r_{j,t}$ Capital return in sector j
$savadj_t$ Adjustment variable for investment and savings

$$ITVOL_t \;\; = \;\; \frac{IT_t}{Pinv_t} \tag{9}$$

IT_t Gross fixed capital formation
$ITVOL_t$ Volume of total investment
$Pinv_j$ Investment price index

$$KD_{i,t+1} \;\; = \;\; (1-\delta)KD_{i,t} + Ind_{i,t} \tag{10}$$

ir Real interest rate
δ Capital depreciation rate

$$LS_{t+1} \;\; = \;\; (1+ng).LS_t \tag{11}$$

LS_t Labor supply
ng Population growth rate

$$U_t \;\; = \;\; Pinv_t(ir+\delta) \tag{12}$$

This model is run using GAMS. It is applied on the model shown in appendix 5. Hence, 16 sectors and 20 periods are taken account, which yields 15583 endogenous variables determined by 15583 equations and 1357 exogenous variables as shown in table 1.

Table 1: Summary of the Model

Blocks of equations	51	Blocks of variables	63
Single equations	15583	Single variables	16940
Fixed equations	15583	Free variables	15583
Exogenous variables	1357	Endogenous variables	15583

Source: Constructed by the author.

5 Data

5.1 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, an institute attached to the Ministry of Planning. In this part, I will undertake a brief presentation of the matrix structure, the main characteristics of the Egyptian economy that emanate from it and the main amendments that has been done to the matrix for modeling reasons.

The structure of the matrix is as follows: it consists of six major accounts: the account of production factors, the economic agents, the industries one, the composite products one, the capital one and finally the taxes account which is an independent account of the government one. The SAM 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.

Regarding sectors included in the SAM, it takes into account 17 branches structured as follows: two agricultural sectors (crop production and animal production), eleven industrial sectors (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 as well as investment by sector. Finally, the last account is the taxes one that includes: direct taxes, indirect taxes, subsidies and tariffs on imports.

For reasons of simplicity and adaptation to the EXTER model, four changes have been made in the structure of the matrix as follows:

1. The two types of firms have been merged into a single account entitled firms including private and public firms.

2. Indirect taxes have been added to subsidies considering subsidies as negative taxes.

3. The construction and electricity sectors have been merged with the one of other productive services in order to facilitate the model resolution on GAMS and avoid zero values in the cells.

4. The taxes account was introduced in the government revenues: at the intersection of Government Account (row):

   - with the composite products (column) for income tariffs on imports,
   - with the branches of activity (column) for net indirect taxes.

- with the economic agents (column) for direct taxes.

A very brief analysis of the Egyptian economy through the matrix flows shows that it is characterized by several key aspects, namely: a significant taxation, an important productive services sector, a high rate of imports, high exports of services. That is why the two main sources of foreign exchange in Egypt are: tourism and revenues of the Suez Canal to which a third source, transfers from Egyptian workers abroad, is added.

5.2 Calibration and Other Sources of the Data

Along with the SAM of 2000/2001, I have used some other sources of data for investment by destination, tariffs and Trade Facilitation. Regarding the first variable, the national accounts coming from the Egyptian Central Bank reports (2001)have been used to determine the destination of investment.

In the Egyptian matrix, we have the sum of indirect taxes and import duties imposed on composite commodities without distinguishing them. That is why, in the calibration, I have used the applied tariffs coming from the WTO and "Trade and Production" database in order to calculate the import duties for each sector[6]. Then, I deduced the tariffs revenues from the total revenues to obtain the indirect taxes receipts which have been used to calibrate the indirect tax rate.

Finally, for Trade Facilitation, ad valorem equivalents have been estimated using my gravity model (Zaki, 2008) as will be shown later to determine the tariff rate imposed on exported and imported products and then introduced in the CGE model.

6 Towards an Estimation of Tariff Equivalents for Time and Documents

In order to evaluate the impact of Trade Facilitation, tariff equivalent for time and documents 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 gravity model. Similarly, relying on my gravity model (Zaki, 2008), I follow the same methodology to estimate tariff equivalent for time and document.

As shown below, the following model (Zaki, 2008) has been used to estimate the ad valorem equivalents of time and documents:

$$
\begin{aligned}
\ln(\frac{m_{ij,n}}{m_{ii,n}}) &= \ln(\frac{\nu_{j,n}}{\nu_{i,n}}) - \sigma \ln(\frac{p_{j,n}}{p_{i,n}}) - (\sigma - 1)\ln(1 + t_{ij,n}) + \delta(\sigma - 1)\ln(\frac{d_{ij}}{d_{ii}}) \\
&+ (\sigma - 1)\lambda L_{ij} + (\sigma - 1)(\theta - \beta)PTA_{ij} \\
&+ (\sigma - 1)\zeta Conti_{ij} + (\sigma - 1)(\eta - \beta)E_{ij}
\end{aligned}
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[6]This was done by multiplying the tariff rate by the value of imports given in the matrix.

$$+(\sigma - 1)\mu_2(TF_{i,n} + TF_{j,n}) + \epsilon_{ij} \tag{13}$$

As Olarreaga et al. (2009) argue, to make Trade Facilitation aspects comparable with ad valorem equivalents, we have to transform the quantity impact into price equivalents. This would be the ad valorem equivalent of time and coument and noted as $ave_{TF} = dlog(p_i, n)$. Hence, the gravity equation is differentiated with respect to $TF_{i,n}$ and $TF_{j,n}$ where TF is the imports time and exports documents for sector n:

$$\frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{dTime_{i,n}} = \frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{d\ln(p_{i,n}^d)} \cdot \frac{d\ln(p_{i,n}^d)}{dTime_{i,n}} = \varepsilon_{i,n}.ave_{i,n}^{Time} \tag{14}$$

$$\frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{dDoc_{j,n}} = \frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{d\ln(p_{j,n}^d)} \cdot \frac{d\ln(p_{j,n}^d)}{dDoc_{j,n}} = \varepsilon_{j,n}.ave_{j,n}^{Doc} \tag{15}$$

where:
$ave_{j,n}^{Doc}$ and $ave_{i,n}^{Time}$ are ad valorem equivalent of exports documents and import time respectively imposed on good n in country j and i.
$p_{j,n}^d$ and $p_{i,n}^d$ are the domestic price in country j and i respectively.
$\varepsilon_{j,n}$ imports demand elasticity of good n in country j

Hence, solving (14) and (15) for $ave_{j,n}^{Doc}$ and $ave_{i,n}^{Time}$, we have:

$$ave_{i,n}^{Time} = \frac{1}{\varepsilon_{i,n}} \cdot \frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{dTime_{i,n}} \tag{16}$$

$$ave_{j,n}^{Doc} = \frac{1}{\varepsilon_{j,n}} \cdot \frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{dDoc_{j,n}} \tag{17}$$

In other terms:

$$ave_{i,n}^{Time} = \frac{(\sigma - 1)\mu_2^{Time_{i,n}}}{\varepsilon_{i,n}} \tag{18}$$

$$ave_{j,n}^{Doc} = \frac{(\sigma - 1)\mu_2^{Doc_{j,n}}}{\varepsilon_{j,n}} \tag{19}$$

I have calculated the ad valorem tariff equivalents (AVE) at the HS6 level for 125 countries[7]. Table 8 in appendix 5 presents the aggregated tariff equivalents for Egypt. It is quite obvious that some sectors have higher ad valorem tariffs than others. For instance, food (which are perishable goods), garments (seasonal goods) and professional and scientific equipment (high value added products) are characterized with high AVE than othes (such as wood products, rubber or footwear). Those tariffs have been introduced in the CGE model with some assumptions. First, as the

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

databases that have been used to estimate tariff equivalent is Trade and Production (2004), only manufacturing sectors are taken into account. Yet, in the Egyptian SAM, I have 2 agricultural sectors (animal and vegetable) and 3 service sectors. For agricultural sectors, I have applied the same tariff equivalents obtained for foods sector as they share many common characteristics with agricultural ones. As to services, social services and other productive services have zero tariff equivalent for time and document like the tariff calibrated from the SAM. Concerning transport sectors, I have used the same tariff equivalent of the machinery sector.

7 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 six simulations through three main scenarios. The first scenario assesses the impact of Trade Liberalization (TL). Thus, an unconditional trade liberalization is adopted in this scenario assuming that Egypt extends 100 percent tariff reductions to all countries. The second scenario encompasses three simulations which simulate the impact of Trade Facilitation on the Egyptian Economy:

- The first assesses Trade Facilitation by shocking the tariff equivalent of import time. (Time)

- The second one does this for documents requested for exports (Document)

- The simultaneous impact of these two simulations (TF)

The third scenario includes two simulations:

- This simulations assesses the impact of TF coupled with its cost (TF+cost)

- Finally, the last simulation tries to take into account the cost of Trade Facilitation through increasing the public expenditure on transport and communication (All).

The last simulation is the most exhaustive and the most realistic as it simulates the simultaneous effect of trade liberalization, Trade Facilitation (elimination of barriers induced by time and documents) and the cost of this process.

Table 2: Simulation Experiments

Notation	Scenario Definition	Shocked Parameter
TL	An unconditional full trade liberalization	$tm_j = 0$
TIME	Shocking the tariff equivalent of imports time	$tt_j = 0$
DOC	Shocking the tariff equivalent of document for exports	$td_j = 0$
TF	Combining the two simulations: Time + Doc.	$tt_j = td_j = 0$
TF+COST	Adding to TF the cost of Trade Facilitation	$tt_j = td_j = 0$ and $G_{SERTRA} \uparrow by 50\%$
ALL	Combining TL + TF + cost	$tt_j = td_j = tm_j = 0$ and $G_{SERTRA} \uparrow by 50\%$
BAU	Business As Usual scenario	No shock

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 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.

7.1 A Static Analysis of the Trade Facilitation Effects

7.1.1 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 and document) in Egypt yields high positive effects for the whole economy. On the internal level, total consumption of rural and urban households increase by 2.7% and 2.6% respectively. These figures are lower when trade is simply liberalized (cutting tariffs) as consumption increases also by 1.6% and 1.4% respectively. Regarding external level, when trade is facilitated, total exports and total imports increase by 4.1%. Meanwhile, eliminating tariff barriers in Egypt increases exports by 4.7% and imports by 2.14%.

Having a quick glance on the household behavior, it is worth noting that TF produces higher gains then TL does. This is due to the fact that, in TL, price effects and income ones operate in two different directions as both prices and wages decrease, hence the net effect on real income should be ambiguous. However, consumption increases because the former is higher than the latter. As to TF, income effect is reinforced by prices one as wages increase and prices decrease, boosting the purchasing power of both rural and urban households. Figure 5a to 5c illustrate those patterns. As composite prices decreases for almost all the sectors, rural and urban consumption increase. Combining all these effects, it is worth noting that Trade Facilitation (Trade Liberalization) boosts rural welfare[8] by 2.33% (1.40%) and urban one by 2.26% (1.22%).

7.1.2 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 time and bureaucracy. When such barriers are eliminated, export prices increase, exporters are encouraged to boost their exports and hence increase their production. These facts are reflected in figures 6a to 6d. The upper right hand side figure exhibits an increase in all exports prices. In the mean time, the figure below shows that sectoral exports rise, especially for agricultural products (vegetable and animal ones), processed foods, textiles, chemical industries, enginery and machinery equipments [9]. Regarding ex-

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[8]Equivalent variation is calculated as percentage of the household income.

[9]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

port diversification, I have found similar results to the one obtained by Minor et al. (2008) who have found 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. As shown in figures 6b and 6d, the exports coming from many sectors increase. Such results are consistent with the hypothesis that long delays to cross borders impede export diversification of developing countries. Finally, for exports as well as for exports prices, Trade Facilitation impact is higher than Trade Liberalization one for all the sectors without any exception.

The left hand side figures illustrate the impact on imports. Obviously, import prices decrease as trade transactions become quicker. Thus, Egyptian consumers find imported goods cheaper and increase their consumption. As mentioned above, some sectors expand more than others especially textiles and clothes, processed food, agricultural products and engineering industries. Such a point is quite important for Egypt as these sectors represent 4%, 8.6%, 15% and 22% respectively of total imports. Consequently, these imported products highly increase when trade is facilitated.

Therefore, combining those patterns of exports and imports, once trade is facilitated, exporting sectors increase relatively their production (processed food, textiles, garments and chemical industries as shown in figure 4a) 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 (figure 4c). Simultaneously, importing sectors should decrease their production as imported products (in particular vegetable and animal agricultural ones) become more competitive.

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ones as they represent 69.4% of total exports thanks to tourism and canal suez revenues.

7.2   Long Term Gains with a Dynamic Modeling

7.2.1   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 [10]. The model simulates a 20 year horizon. Looking at my dynamic simulations in figures 8 to 16 reveals many aspects. First, it is quite obvious that the way Trade Facilitation has been modeled in the literature overestimates its impact for two reasons: first, the shock has been ad-hoc as it simulates an increase in the CES parameter not the tariff equivalent of time and document. Second, it does not take into account the cost of Trade Facilitation. Taking into account TF cost (increasing public expenditure of transport and communication by 50%) changes slightly my results. 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 and enhancing customs environment. 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 the figures of appendix 6.

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. As exhibited in the simulation figures, TF impact is always stronger than trade liberalization one. Figures 9a to 10h 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 as exchange rate is more depreciated. When documents for exports are eliminated, export prices should rise (figure 12) and production is boosted (figure 8). Simultaneously, imports (figure 11) increase also for two reasons. First, thanks to the reduction of imports time, import prices should decrease (figure 13), which in turn stimulates imports. From a modeling point of view, the macroeconomic closure of the model encompasses a constant current account, therefore an increase in exports should be accompanied by an increase in imports.

7.2.2   Government and Households: Major Winners

It turns out that the prices decrease as import prices (figure 13) and composite prices (figure 14) decline when red tape costs are eliminated. On the long term, as demand increases, prices rise. Meanwhile, in Trade Facilitation they remain less then in trade liberalization. Recall that I have simulated Trade Facilitation through the elimination of the ad-valorem equivalents of time for imports and document for exports. Less prices (composite prices decline significantly in all simulations) means more consumption for both rural and urban households as shown in figure 16a and 16b. Therefore, even in its dynamic version, my simulation results show that the

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[10]A time element is included to solve the model sequentially: an updating capital stock to simulate investment and depreciation, the labor stock to simulate population growth and productivity parameters to simulate advances in technology. As mentioned above, these models are recursive (or sequential) dynamics. Hence, they optimize in each period the agents behavior but the intertemporal 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.

welfare effects for both rural (figure 16c) and urban (figure 16d) households are higher in the Trade Facilitation scenario than in the trade liberalization one. The reason behind is quite clear as Trade Facilitation does not have any lost revenues like trade liberalization. Hence, all red tape costs are a deadweight loss. Recall that its impact is slightly reduced as, here, I take into account the cost of Trade Facilitation. Hence, the sequential dynamic approach adopted here allows us to take into account the pro-competitive effects of trade liberalization and facilitation.

Having a quick glance on the agents revenues, some observations worth to be mentioned. First, households income increase thanks to the increase in wages as labor demand increases in many sectors, in particular processed food, agricultural animal products, clothes and transport services. However, the income increase in Trade Facilitation is less then in trade liberalization or in the benchmark scenario as wages increase less in the former then in the latter. In addition, the government revenues (figure 15d) 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. That is why, in the simulation incorporating Trade Facilitation and its cost, the transport services sector expands significantly as its output is used in Trade Facilitation projects 8d.

In conclusion, as all projects put in place to facilitate trade (i.e. improving transport infrastructure and communication) improve the economic efficiency and productivity of the whole economy, it is quite obvious that Trade Facilitation has a large impact on Egypt.

8 Conclusion

This paper develops a dynamic computable general equilibrium model incorporating Trade Facilitation aspects in Egypt. This paper contribution is twofold: theoretical and empirical ones. First, this paper estimates ad valorem tariff equivalents for time of imports and documents for exports which are then introduced in my 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 of Trade Facilitation. Meanwhile, its impact remains higher than trade liberalization. Moreover, some sectors witness a significant expansion more than others, especially food, garments and textiles.

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 Trade Facilitation is a deadweight loss, hence all agents should gain from such a process. Moreover, its cost, despite being relatively high, it is not very costly as all projects put in place to facilitate trade (i.e. improving transport infrastructure and communication) improve the economic efficiency and productivity of the whole economy. Finally, such a process is different from Trade Liberalization as there are no concessions between negotiating countries. It is a positive sum game.

Yet, 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 time and document for these sectors. Finally, it would be also interest to calculate the cost of Trade Facilitation in a more precise way taking into account different types of costs.

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Appendix 1: Tables and Figures

Table 3: Export procedures in Egypt, 2007

Nature of Export Procedures	Duration (days)	US$ Cost
Documents preparation	13	104
Inland transportation and handling	3	850
Customs clearance and technical control	1	10
Ports and terminal handling	3	50
Totals:	20	1,014

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

Table 4: Import procedures in Egypt, 2007

| Nature of Import Procedures	Duration (days)	**US$ Cost**
Documents preparation	19	104
Customs clearance and technical control	2	10
Ports and terminal handling	2	185
Inland transportation and handling	2	750
Totals:	25	1,049

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

Table 5: 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.

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

■ 2006   ☐ 2007   ☐ 2008   ■ 2009
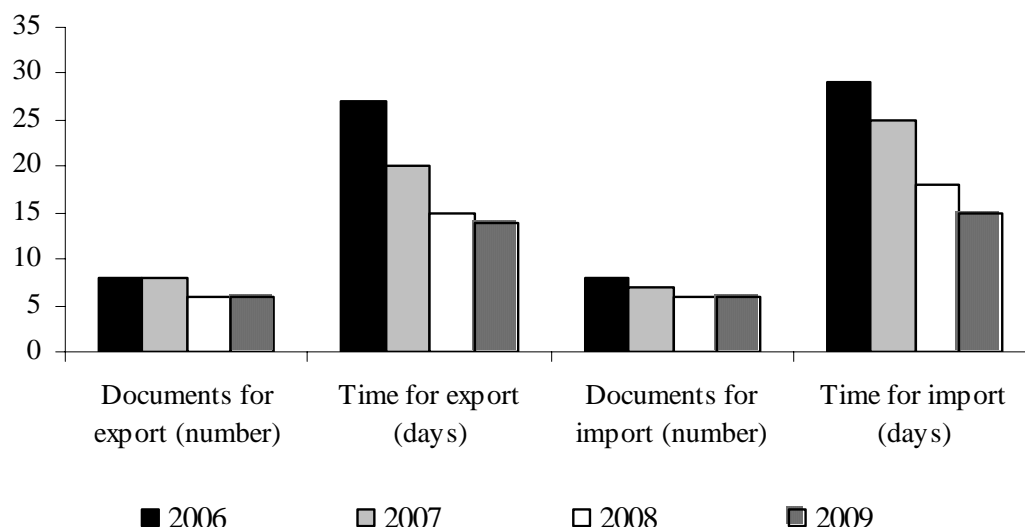
Source: Doing Business, 2009, The World Bank.
Notes: (i.) Documents are defined as all documents required to export and import the goods. It is assumed that the contract has already been agreed upon and signed by both parties. Documents include all official documents exchanged between the concerned parties. For more details, see appendix 1.
(ii.) Time is recorded in calendar days. The time calculation for a procedure starts from the moment it is initiated and runs until it is completed. It is assumed that neither the exporter nor the importer wastes time and that each commits to completing each remaining procedure without delay. For more details, see appendix 1.

Figure 2:
Trade Across Borders in Egypt and Some Comparator Countries
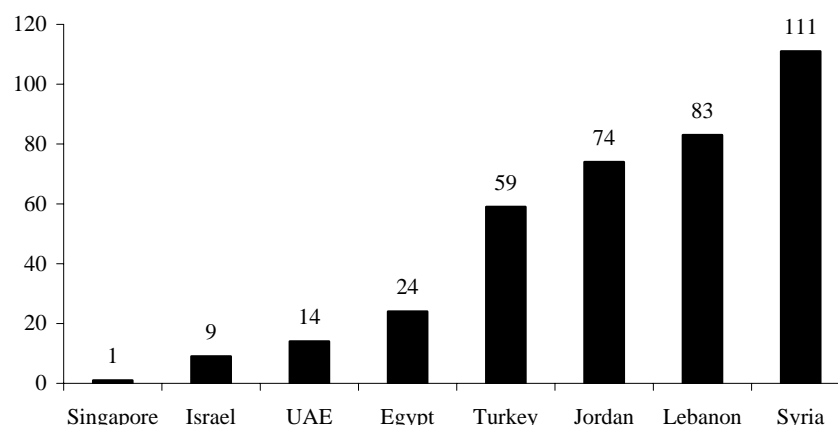
Source: Doing Business, 2009, The World Bank.

Appendix 2: The Egyptian SAM: A Descriptive Analysis of the Economy

2.1. Revenues and Expenditures of Economic Agents

Regarding **households**, dividends from private companies constitute the major portion of household income (representing 56.78% and 52.82% of the urban house-

Table 6: Egypt's Position vis-à-vis Other Countries

	Documents for export	Time for export	Cost to export	Document for import	Time for import	Cost to import
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.

holds and rural ones total income respectively). The second income source 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 in Egypt.

Concerning **private firms**, on the one hand, capital income are the largest portion of their revenue (88.62% of the firms revenues). On the other hand, 14.11% of their revenues are intended to savings and 76.13 % 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.

As for **the government**, its income is composed mainly of direct taxes (L.E. 38040, or 57.02% of the total revenue) with 66.04% 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. 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 represent the third largest source of government revenue: three sectors are not subject to import tariffs (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 used for expenses related to transfers

for 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 salaries of public functionaries. This high percentage of the wage bill is explained by the magnitude of public employment in Egypt, characterized by high stability which is absent from private jobs. Finally, the government is still in deficit, which explains why its savings is negative which, in turn, displaces private investors.

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). As for the other productive services sector, its share is 27.5% and 28.8% in the total production and the value added respectively. This fact, namely a dominant service sector, applies on all of the sections following: the intermediate demand, exports, imports as well as final demand.

- *The production factors demand*: The government is the largest employer of labor (21.2% of total labor). Then, the second employer is the crop production sector followed by the productive services one. This sector also uses a lot of capital, since 33.8% of the capital is demanded by this sector.

- *Interactions between economic activities*: From the first glance, the input/output table in the social accounting matrix shows that 19% of the table cells are zeros, showing relatively weak interactions between economic activities. However, upstream and downstream linkages are relatively high between certain sectors. Obviously, the tobacco sector is not among the sectors with high interactions since its production is not used as an input for other industries, and its intermediate demand is also low. Notwithstanding, the sector characterized by significant upstream and downstream linkages, is the services one in general and in particular the other productive services one. In fact, most 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 28.25% of their expenditures to it. Likewise, the demand of this sector addressed to the other sectors is also high, especially addressed to himself (24.01% of its intermediate demand), to non-metal industries (16.6%) and basic metals industries(15%). These percentages represent significant shares in the revenue sectors: 88.07% 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 and the government is focused primarily on productive services (15.7% and 47% respectively) 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).

As for government demand, the figures analysis shows that the government allocates almost half of its consumption expenditure to productive 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 streams, on the one hand, with the economic agents and on the other hand with other economic activities. 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). Withal, the structure of imports is a little different, because the import of equipment and machinery occupies the first position (21.77%), followed by chemical industries (12.52%) and crop production (12%, particularly wheat).

Second, relations between the rest of the world economic agents are represented by the transfers between the two sides. The transfers from the rest of the world to the national agents represent 2.97% of the income of urban households, 3.24% of the rural ones, 3.72% of government revenues and 2.65% of the firms earnings. The government transfers to the rest of the world represent 4.41% of government expenditures.

2.5. The Capital Account

The major contributing actor in aggregate savings is firms (their share in the total savings is 55.5%), followed by urban households (37.5%), which certainly save more than rural ones (27.5%). Admittedly, the government being in deficit, public savings are negative, with a share of -20% in 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 7: 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 waving 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 3:
Structure of the Model
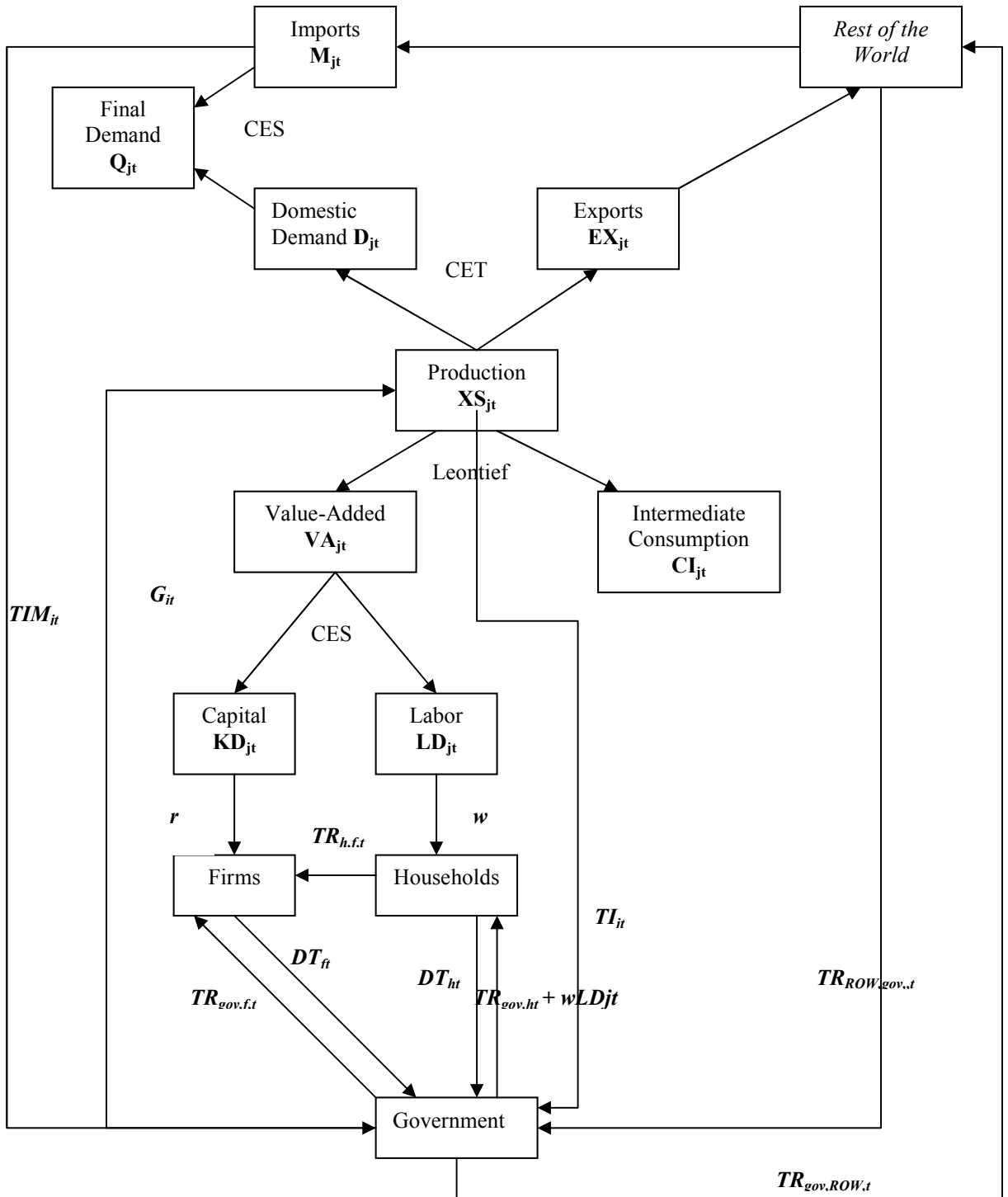
Appendix 5: The Model Notation

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

4- Tax rates

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

5- CES function between imports and domestic production

A_j^m	Scale parameter of the Armington CES function
α_j^m	Share parameter of the Armington CES function
ρ_j^m	Substitution parameter
σ_j^m	Substitution elasticity (Armington function)

6- CET function between exports and domestic production

B_j^e	Scale parameter of the CET production function
β_j^e	Share parameter of the CET production function
τ_j^e	Transformation elasticity (CET production function)
ε_j^e	Price elasticity
κ_j^e	Transformation parameter
EXD_j^o	Scale parameter of exports

7- Trade Facilitation

tt_j	Tariff equivalent of imports time for sector j products
td_j	Tariff equivalent of documents for exports of sector j products
$\gamma_{i,inef}$	Budgetary share of good i in the inefficiency agent income

8- Other parameters

ng	Population growth rate
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
$Pc_{j,t}$	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
$Pinv_j$	Investment price index
U_t	Capital user cost
e_t	Nominal exchange rate

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

$TDH_{h,t}$	Direct taxes on household h
TDF_t	Direct taxes on firms
$TI_{j,t}$	Indirect taxes on products belonging to sector j
$TIM_{j,t}$	Import tariffs on imported goods j
$TIE_{j,t}$	Export tariffs on exported 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

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

$TIT_{j,t}$	Import time revenues on imported goods j
$TID_{j,t}$	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

$savadj_t$	Adjustment variable for investment and savings
$Leon_j$	Walras law verification variable

B- Exogenous variables

$G_{i,t}$	Public consumption of product i
$LD_{G,t}$	Labor demand by public sector
$TG_{h,t}$	Transfers made by the government to household h
$DIV_{h,t}$	Dividends distributed by firms to household h
$Pwm_{j,t}$	International import price of product j (foreign currency)
$Pwe_{j,t}$	International export price of product j (foreign currency)
$Pindex_t$	GDP deflator, numéraire
CAB_t	Current account balance (external savings)
$TR_{ROW,h,t}$	Transfers from the Rest of the World to household h
$TR_{h,f,t}$	Transfers from household h to the firms
$TR_{ROW,f,t}$	Transfers from the Rest of the World to the firms
$TR_{G,f,t}$	Transfers from the government to the firms
$TR_{ROW,G,t}$	Transfers from the Rest of the World to the government
$TR_{G,ROW,t}$	Transfers from the government to the Rest of the World

The Model Equations

1- Production Bloc

$$XS_{j,t} = min[(\frac{CI_{j,t}}{io_j})(\frac{VA_{j,t}}{\nu_j})] \tag{20}$$

$$XXS_{j,t} = XS_{j,t}.tp_j \tag{21}$$

$$VA_{j,t} = A_j^{va}[\alpha_j^{va}LD_{jt}^{-\rho_j^{va}} + (1-\alpha_j^{va})KD_{jt}^{-\rho_j^{va}}]^{\frac{-1}{\rho_j^{va}}} \tag{22}$$

$$CI_{j,t} = io_j XS_{j,t} \tag{23}$$

$$DI_{ij,t} = aij_{ij}CI_{j,t} \tag{24}$$

$$LD_{j,t} = (\frac{\alpha_j^{va}}{1-\alpha_j^{va}})^{\sigma_j^{va}}(\frac{r_{j,t}}{w_t})^{\sigma_j^{va}}KD_{j,t} \tag{25}$$

2- Revenues and Savings Bloc

$$YH_{h,t} = \lambda_w^h \sum_{j=1}^{16} LD_{j,t}.w + TR_{G,h,t} + DIV_{h,t} + TR_{ROW,h,t} + \lambda_w^h.LG_{G,t} \tag{26}$$

$$YDH_{h,t} = YH_{h,t} - TD_{h,t} - TR_{h,e,t} \tag{27}$$

$$YF_t = \sum_{j=1}^{16} r_{j,t}KD_{j,t} + TR_{ROW,f,t} + \sum_{h=hu}^{hr} TR_{h,f,t} + TR_{G,f,t} \tag{28}$$

$$SH_{h,t} = \varphi_h YDH_{h,t} \tag{29}$$

$$SF_t = YF_t - \sum_{h=hu}^{hr} DIV_{h,t} - TDF_t \tag{30}$$

3- Government Revenues and Savings

$$TIP_{j,t} = tp_j P_{j,t} XS_{j,t} \tag{31}$$

$$TI_{j,t} = tx_j(Pl_{j,t}D_{j,t}) + tx_j(1 + tm_j + tt_j)e_t Pwm_{j,t}M_{j,t} \tag{32}$$

$$TIM_{j,t} = tm_j Pwm_{j,t}e_t M_{j,t} \tag{33}$$

$$TIE_{j,t} = te_j Pe_{j,t} EX_{j,t} \tag{34}$$

$$TDH_{h,t} = tyh_h YH_{h,t} \tag{35}$$

$$TDF_t = tyf YF_t \tag{36}$$

$$YG_t = \sum_{j=1}^{16} TIM_{j,t} + \sum_{j=1}^{16} TIE_{j,t} + \sum_{j=1}^{16} TI_{j,t}$$
$$+ \sum_{h=hu}^{hr} TDH_{h,t} + TDF_t + TR_{ROW,G,t} \tag{37}$$

$$SG_t = YG_t - \sum_{j=1}^{16} G_{i,t} - \sum_{h=hu}^{hr} TR_{h,t} - TR_{G,f,t} - wLD_{G,t} - TR_{G,ROW,t} \tag{38}$$

4- Final Demand Bloc

$$C_{i,h,t} = \gamma_{i,h} YDH_{h,t}/Pc_{i,t} \tag{39}$$

$$INV_{i,t} = \frac{\mu_i IT_t}{Pc_{i,t}} \tag{40}$$

$$DIT_{i,t} = \sum_{j=1}^{16} DI_{ij,t} \tag{41}$$

5- Prices Bloc

$$Pv_{j,t} = \frac{P_{j,t} XS_{j,t} - \sum_{i=1}^{16} Pc_{i,t} DI_{i,j,t}}{VA_{j,t}} \tag{42}$$

$$r_{j,t} = \frac{Pv_{j,t} VA_{j,t} - w_t LD_{j,t}}{KD_{j,t}} \tag{43}$$

$$Pm_{j,t} = e_t Pwm_{j,t}(1 + tm_j + tt_j)(1 + tx_j) \tag{44}$$

$$Pe_{j,t} = \frac{e_t Pfob_{j,t}}{(1 + te_j + td_j)} \tag{45}$$

$$Pc_{j,t} = (1 + tx_j)\frac{Pl_{j,t} D_{j,t} + Pm_{j,t} M_{j,t}}{Q_{j,t}} \tag{46}$$

$$P_{j,t} = \frac{Pl_{j,t} D_{j,t} + Pe_{j,t} EX_{j,t}}{XS_{j,t}} \tag{47}$$

$$Pinv_j = \prod(\frac{Pc_{j,t}}{\mu_j})^{\mu_j} \tag{48}$$

$$Pindex_t = \sum_{j=1}^{16} Pv_{j,t}\delta_j \tag{49}$$

6- International Trade Bloc

$$XS_{j,t} = B_j^e[\beta_j^e EX_{j,t}^{-\kappa_j^e} + (1 - \beta_j^e)D_{j,t}^{-\kappa_j^e}]^{-\frac{1}{\kappa_j^e}} \tag{50}$$

$$EX_{j,t} = [(\frac{1 - \beta_j^e}{\beta_j^e})(\frac{Pe_{j,t}}{Pl_{j,t}})]^{\tau_j^e} D_{j,t} \tag{51}$$

$$EXD_{j,t} = EXD_j^o(\frac{Pwe_{j,t}}{Pfob_{j,t}})^{\varepsilon_j^e} \tag{52}$$

$$Q_{j,t} = A_j^m[\alpha_j^m M_{j,t}^{-\rho_j^m} + (1-\alpha_j^m)D_{j,t}^{-\rho_j^m}]^{-\frac{1}{\rho_j^m}} \tag{53}$$

$$M_{j,t} = [(\frac{\alpha_j^m}{1-\alpha_j^m})(\frac{Pd_{j,t}}{Pm_{j,t}})]^{\sigma_j^m}D_{j,t} \tag{54}$$

$$CAB_t = e\sum_{j=1}^{16}Pwm_{j,t}M_{j,t} + TR_{G,ROW,t} - TR_{ROW,h,t} - TR_{ROW,G,t} -$$

$$TR_{ROW,f,t} - e_t\sum_{j=1}^{16}Pfob_{j,t}EX_{j,t} \tag{55}$$

7- Trade Facilitation

$$TIT_{j,t} = tt_j Pwm_{j,t}e_t M_{j,t} \tag{56}$$

$$TID_{j,t} = td_j Pe_{j,t}EX_{j,t} \tag{57}$$

$$YH_{inef,t} = \sum_{j}^{16}TIT_{j,t} \tag{58}$$

$$C_{i,inef,t} = \gamma_{i,inef}YH_{inef,t}/Pc_{i,t} \tag{59}$$

8- Equilibrium Equations Bloc

$$LS_t = \sum_{j=1}^{16}LD_{j,t} + LD_{G,t} \tag{60}$$

$$Q_{i,t} = DIT_{i,t} + \sum_{h=hu}^{hr}C_{i,h,t} + INV_{i,t} + G_{i,t} \tag{61}$$

$$IT_t = \sum_{h=hu}^{hr}SH_{h,t} + SF_t + SG_t + CAB_t + \sum_{i}^{16}TID_{i,t} \tag{62}$$

$$IT_t = Pinv_t.\sum Ind_{i,t} \tag{63}$$

$$EXD_{j,t} = EX_{j,t} \tag{64}$$

$$EV_{h,t} = (\prod_{i}(PCO_i/PC_{i,t})^{\gamma_{i,h}} * YH_{h,t}) - YHO_h \tag{65}$$

9- Dynamic Bloc

$$\frac{Ind_{i,t}}{KD_{i,t}} = [\gamma_{1i}(\frac{r_{i,t}}{U_t})^2 + \gamma_{2i}(\frac{r_{i,t}}{U_t})]savadj_t \tag{66}$$

$$ITVOL_t = \frac{IT_t}{Pinv_t} \tag{67}$$

$$KD_{i,t+1} = (1-\delta)KD_{i,t} + Ind_{i,t} \tag{68}$$

$$LS_{t+1} = (1+ng).LS_t \tag{69}$$

$$U_t = Pinv_t(ir+\delta) \tag{70}$$

Appendix 6: Tariff Equivalents for Time and Document

Table 8: Estimated Ad valorem Tariff Equivalents for Trade Facilitation Barriers

ISIC	Time for import (%)	Document for export (%)
Food	0.22	26.61
Beverages	0.05	6.27
Tobacco	0.19	22.22
Textiles	0.17	20.20
Garments	0.37	43.83
Leather	0.10	11.70
Footwear	0.04	4.79
Wood products	0.08	9.50
Furniture	0.12	13.82
Paper and products	0.17	20.14
Printing and Publishing	0.40	47.54
Industrial Chemicals	0.23	27.67
Other chemicals	0.25	29.95
Petroleum refineries	0.17	19.75
Misc. Petrol	0.24	29.19
Rubber	0.08	9.27
Plastic	0.11	12.43
Machinery	0.22	26.08
Machinery electric	0.68	81.00
Prof and scien. equipment	0.23	26.87
Other ind.	0.64	76.06

Parameters values

$$\sigma^m_{AGR} = 2$$
$$\sigma^m_{IND} = 0.6$$
$$\sigma^m_{SER} = 0.2$$
$$\tau^e_{AGR} = 1.5$$
$$\tau^e_{IND} = 0.5$$
$$\tau^e_{SER} = 1.0$$
$$\varepsilon^e_j = 3$$
$$\sigma^{va}_j = 0.9$$
$$ng = 1.8\%$$
$$ir = 11.5\%$$
$$\delta = 2.5\%$$

Appendix 7: Results

Figure 4:
Static Results: Production, Labor demand and Capital rents
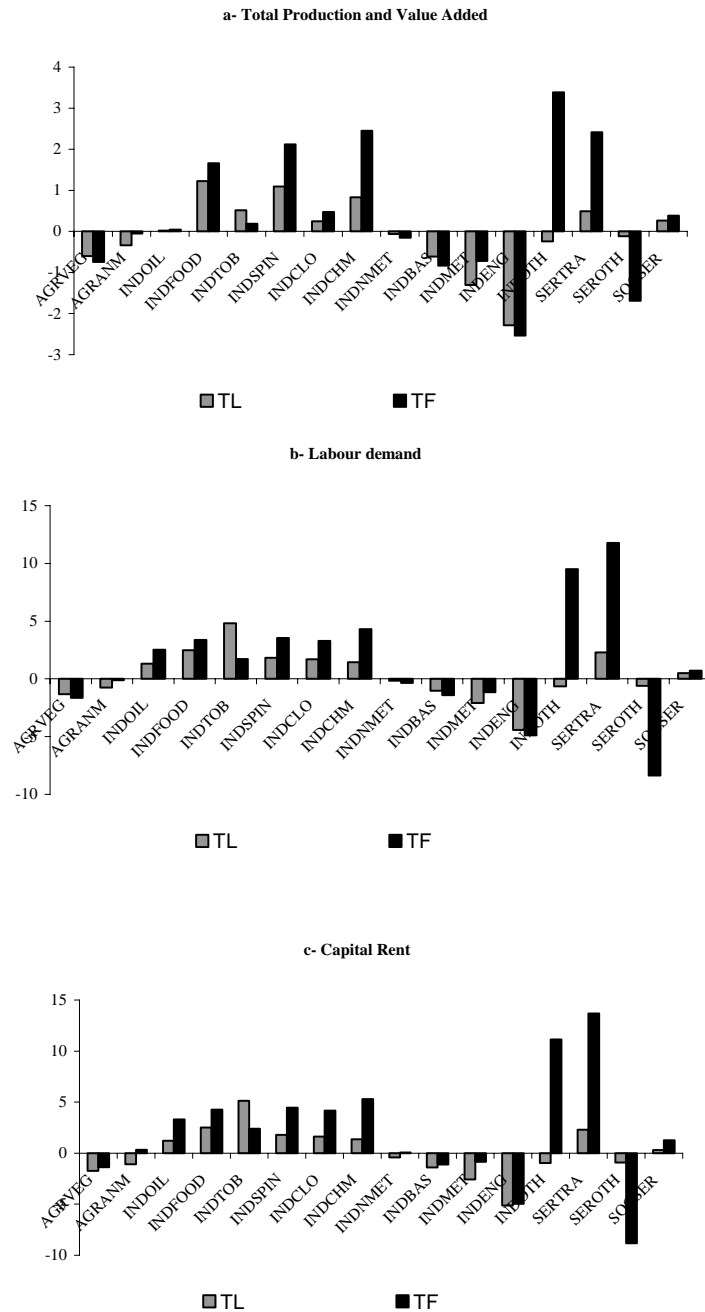
a- Total Production and Value Added

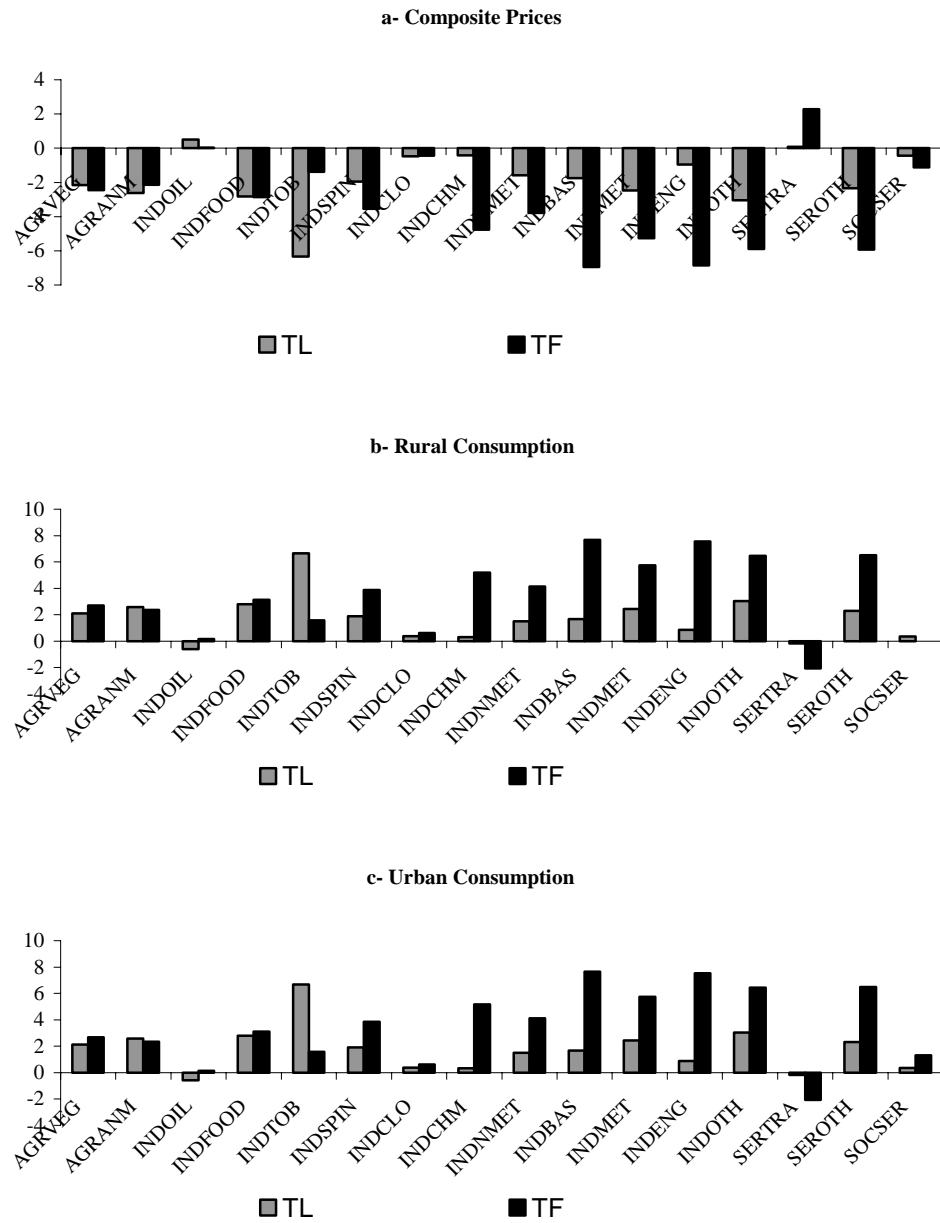**b- Labour demand**

c- Capital Rent

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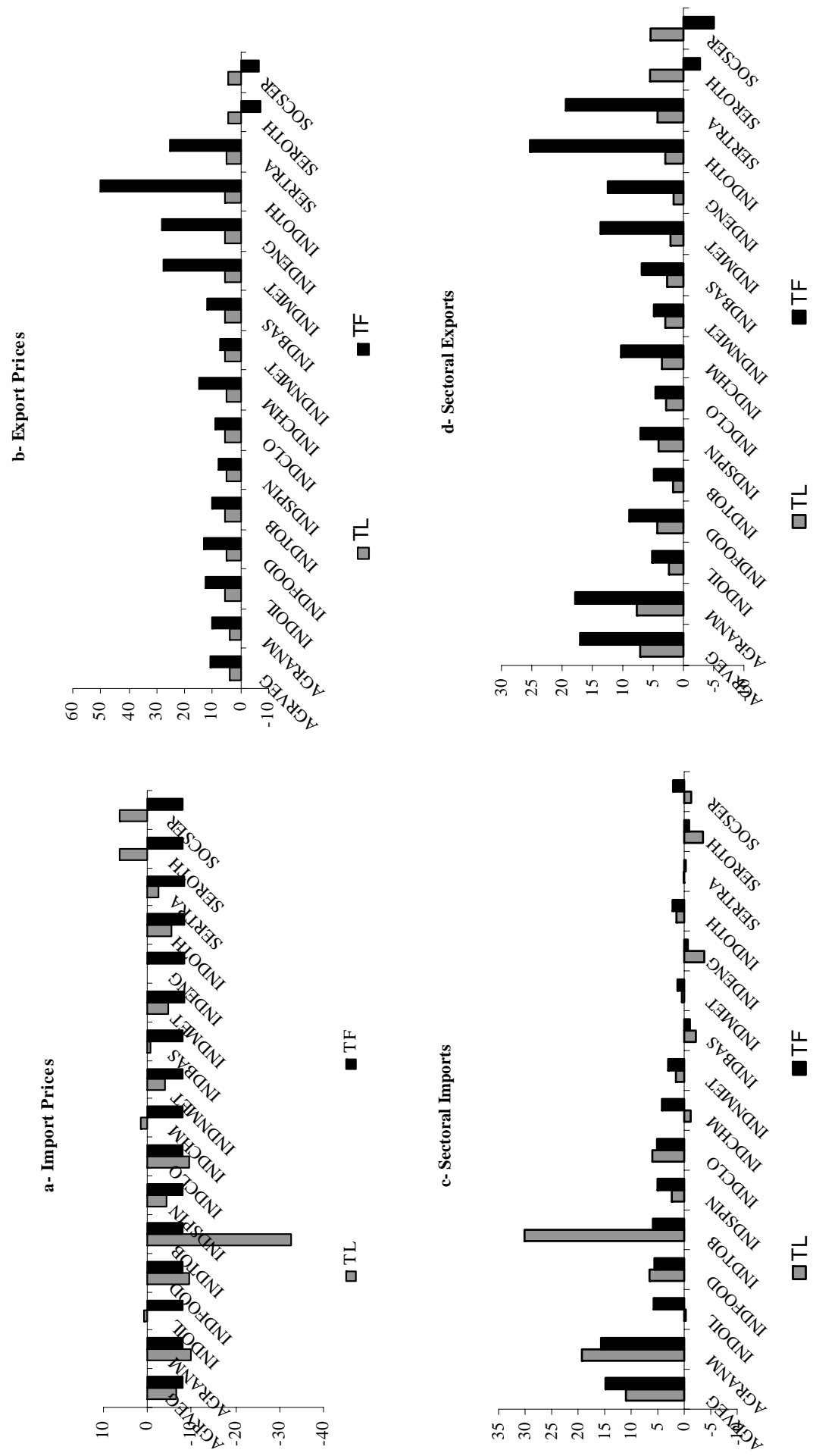Note: Figures shown here are percentage change with respect to the benchmark scenario.

Figure 5:
Static Results: Consumption and Prices

a- Composite Prices

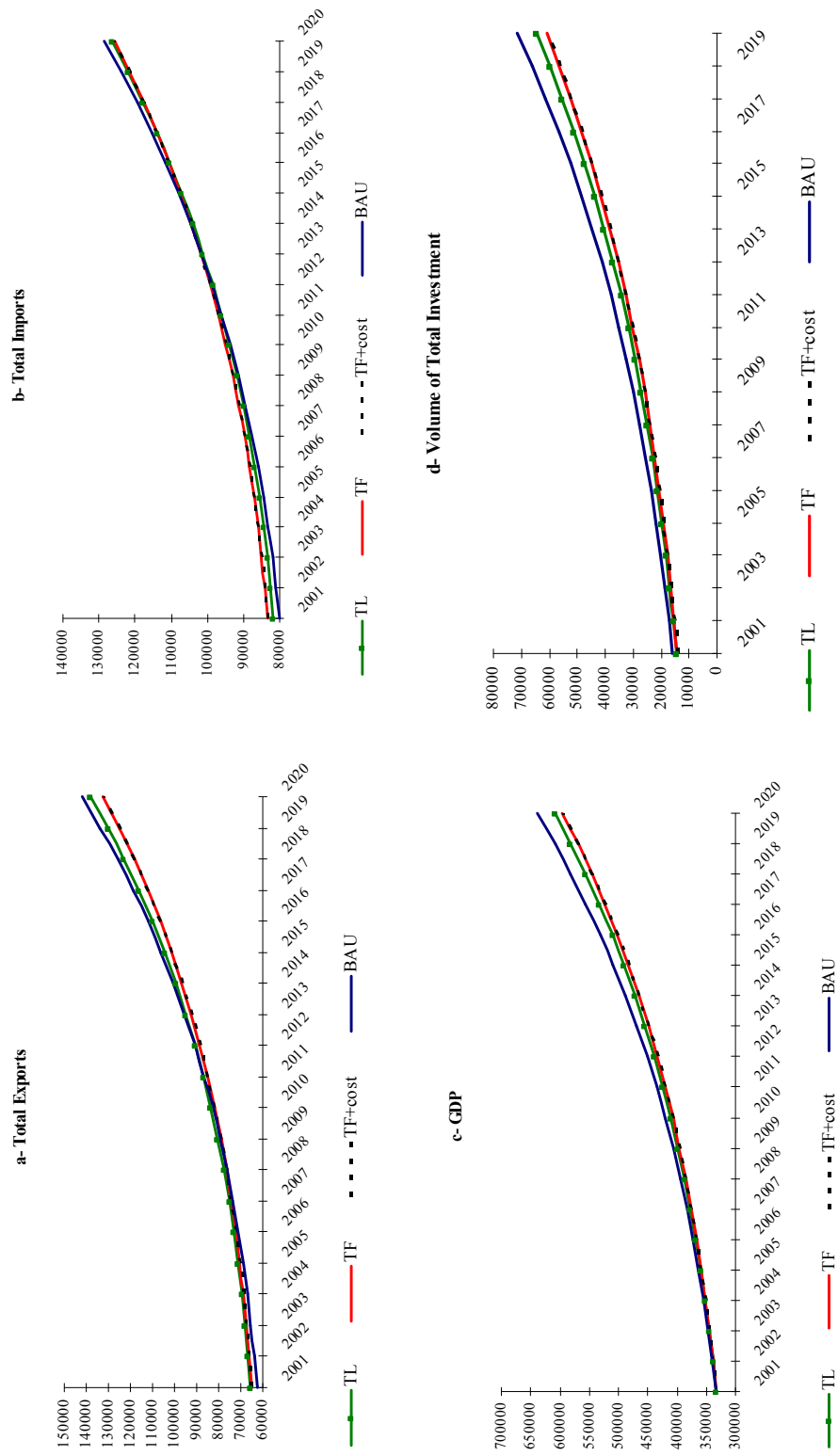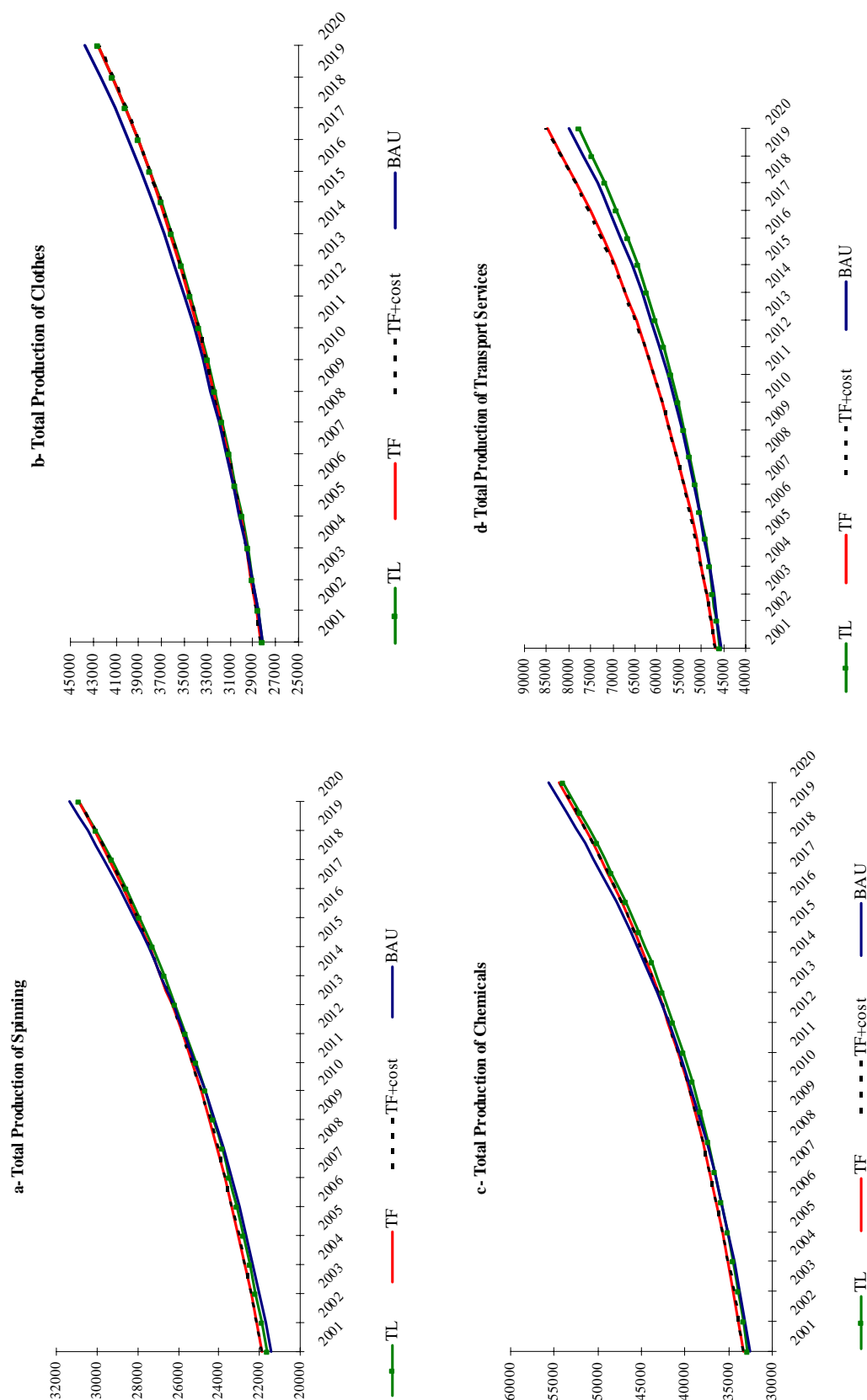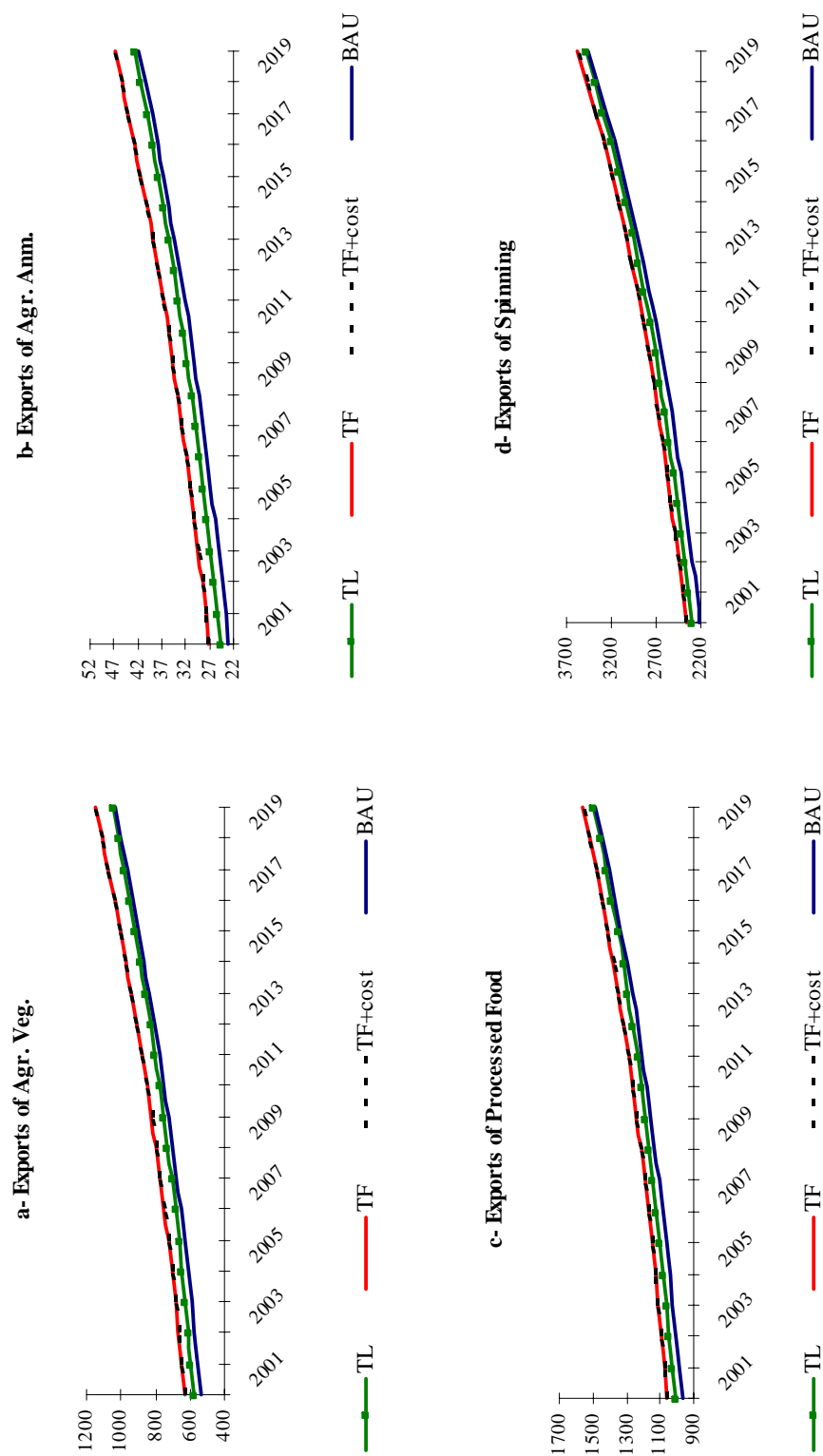**b- Rural Consumption**

c- Urban Consumption

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

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Figure 6:
Static Results: Sectoral Exports and Imports

a - Import Prices

b - Export Prices

c - Sectoral Imports

d - Sectoral Exports

Figure 7:
Dynamic Results: Macroeconomic Variables

a- Total Exports

b- Total Imports

c- GDP

d- Volume of Total Investment

Source: Author's calculations.
Note: Figures shown here are in million of Egyptian Pounds.
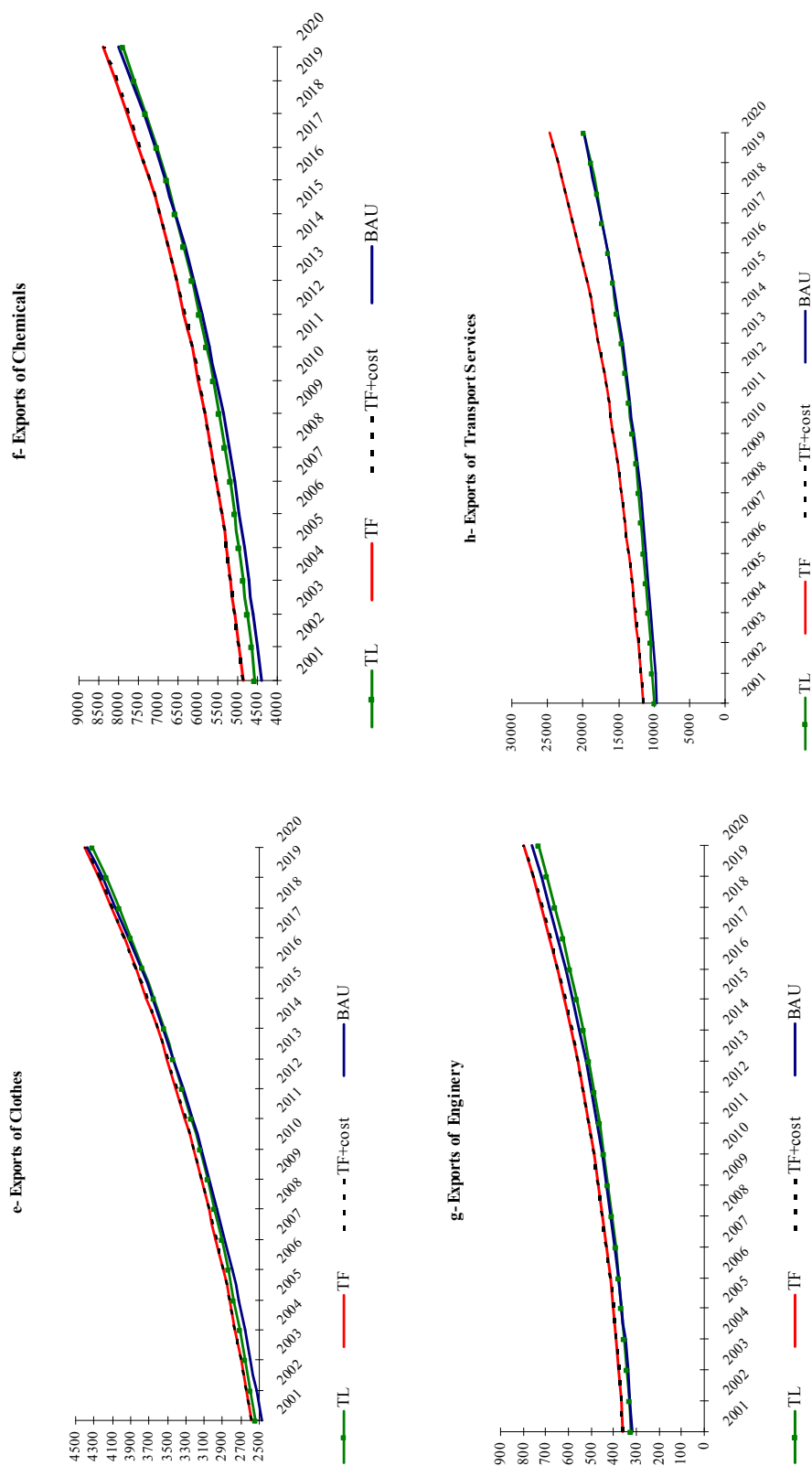
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Figure 8:
Dynamic Results: Sectoral Production

a- Total Production of Spinning

b- Total Production of Clothes

c- Total Production of Chemicals

d- Total Production of Transport Services

Source: Author's calculations.
Note: Figures shown here are in million of Egyptian Pounds.

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Figure 9:
Dynamic Results: Sectoral Exports (1)

a- Exports of Agr. Veg.

b- Exports of Agr. Anm.

c- Exports of Processed Food

d- Exports of Spinning

Source: Author's calculations.
Note: Figures shown here are in million of Egyptian Pounds.

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Figure 10:
Dynamic Results: Sectoral Exports (2)

e- Exports of Clothes

f- Exports of Chemicals

g- Exports of Enginery

h- Exports of Transport Services

Source: Author's calculations.
Note: Figures shown here are in million of Egyptian Pounds.

Figure 11:
Dynamic Results: Sectoral Imports
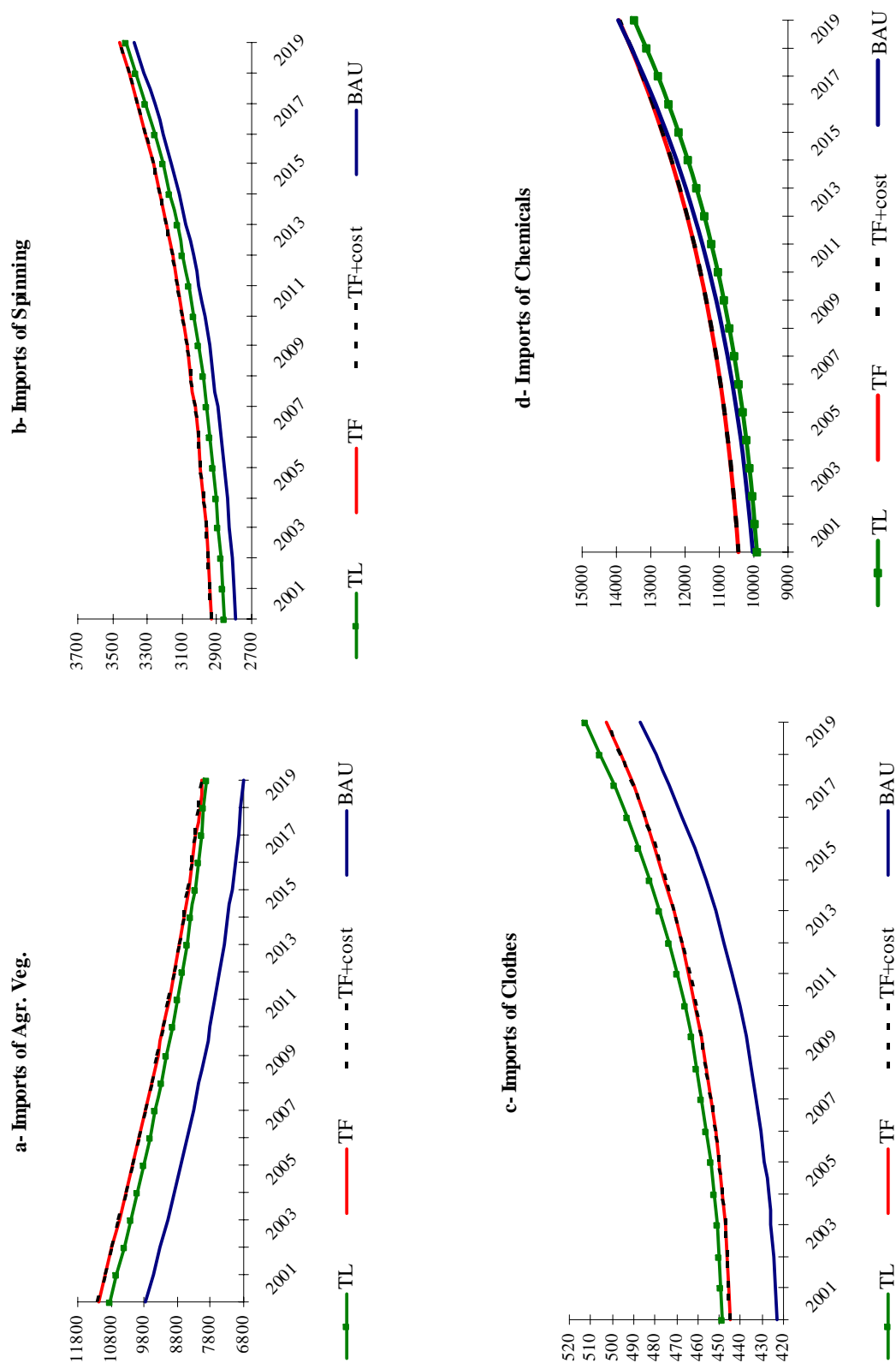
a- Imports of Agr. Veg.

b- Imports of Spinning

c- Imports of Clothes

d- Imports of Chemicals

Source: Author's calculations.
Note: Figures shown here are in million of Egyptian Pounds.

Figure 12:
Dynamic Results: Exports Prices
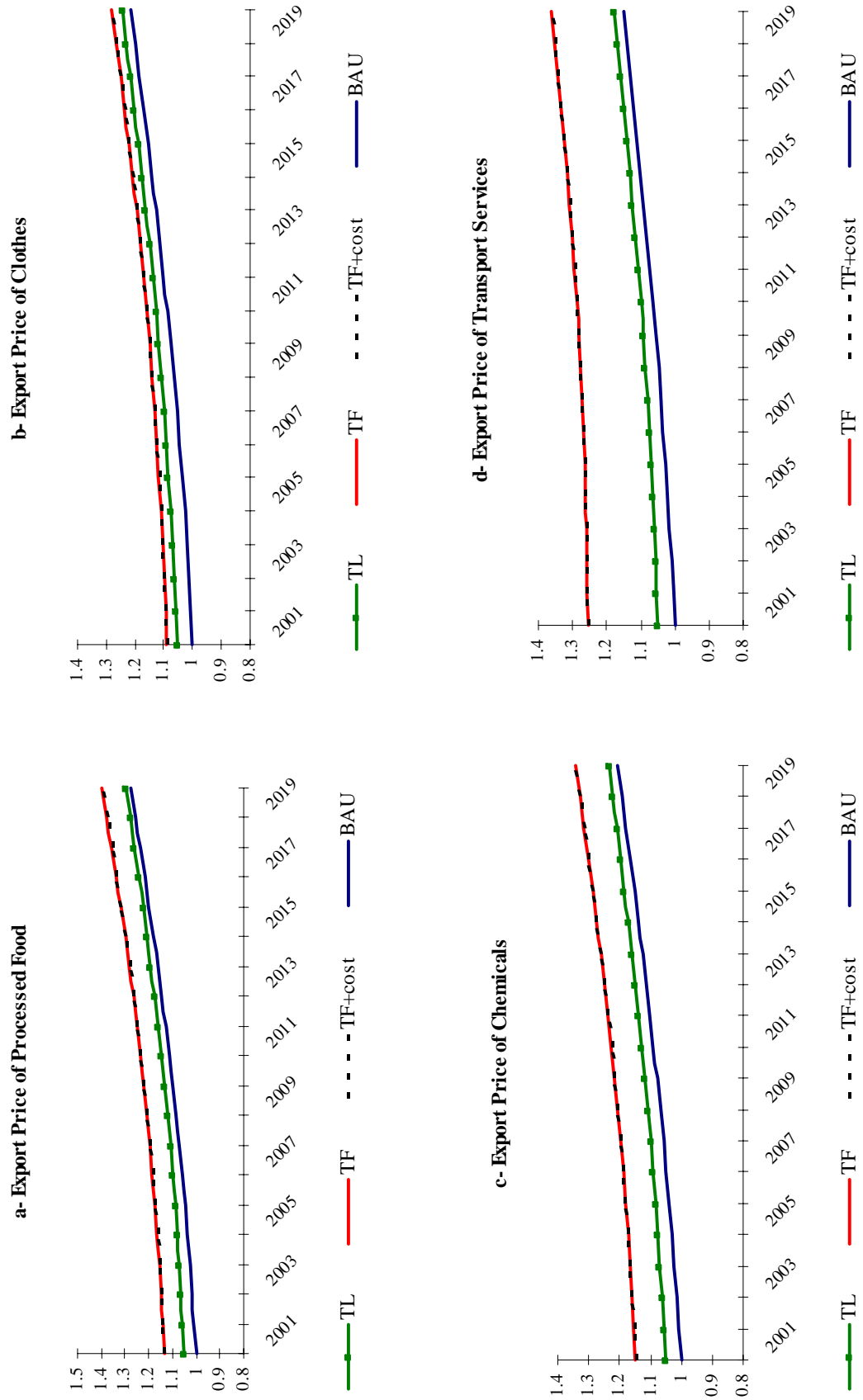
Source: Author's calculations.
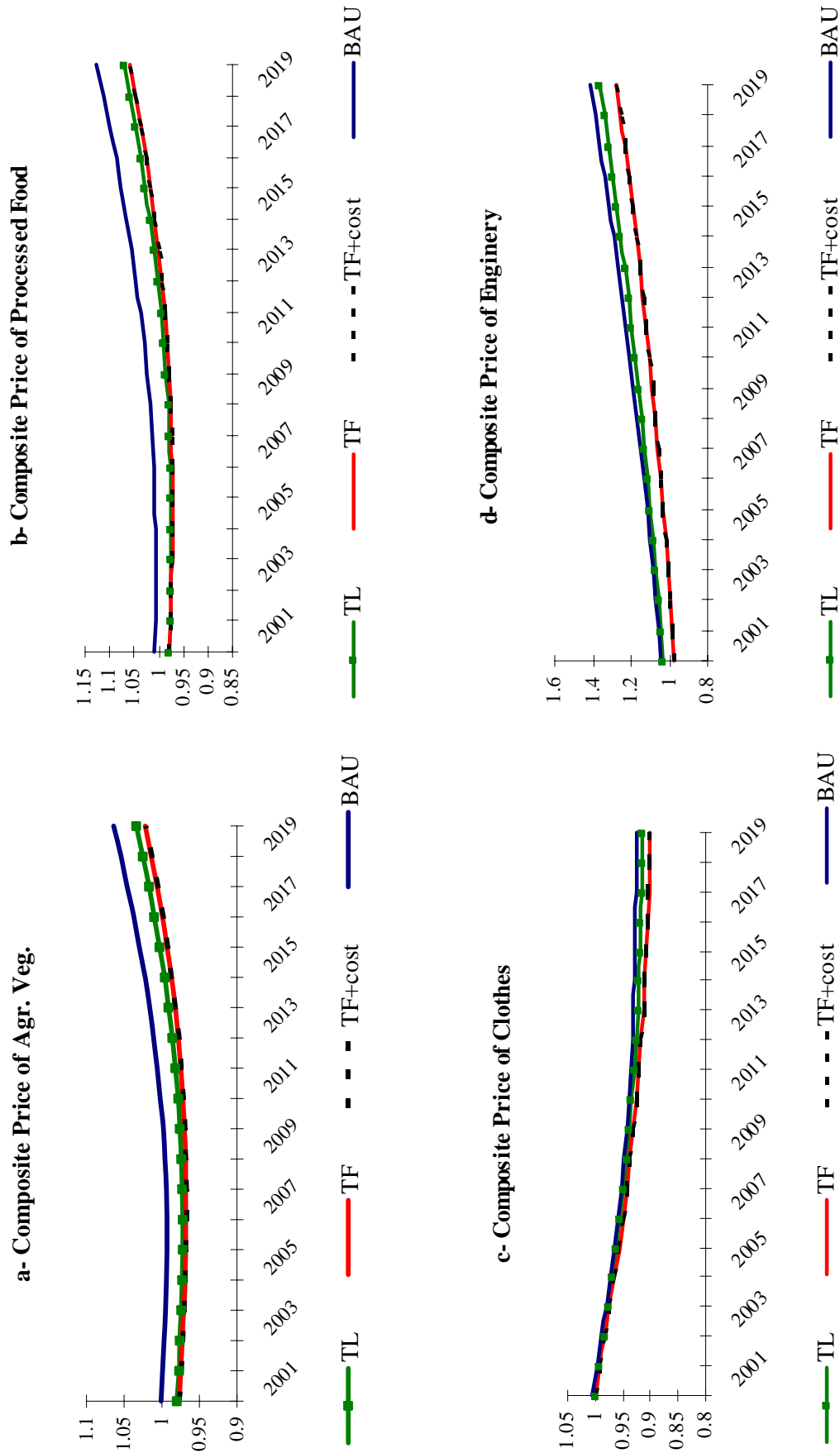Note: Figures here show the prices level.
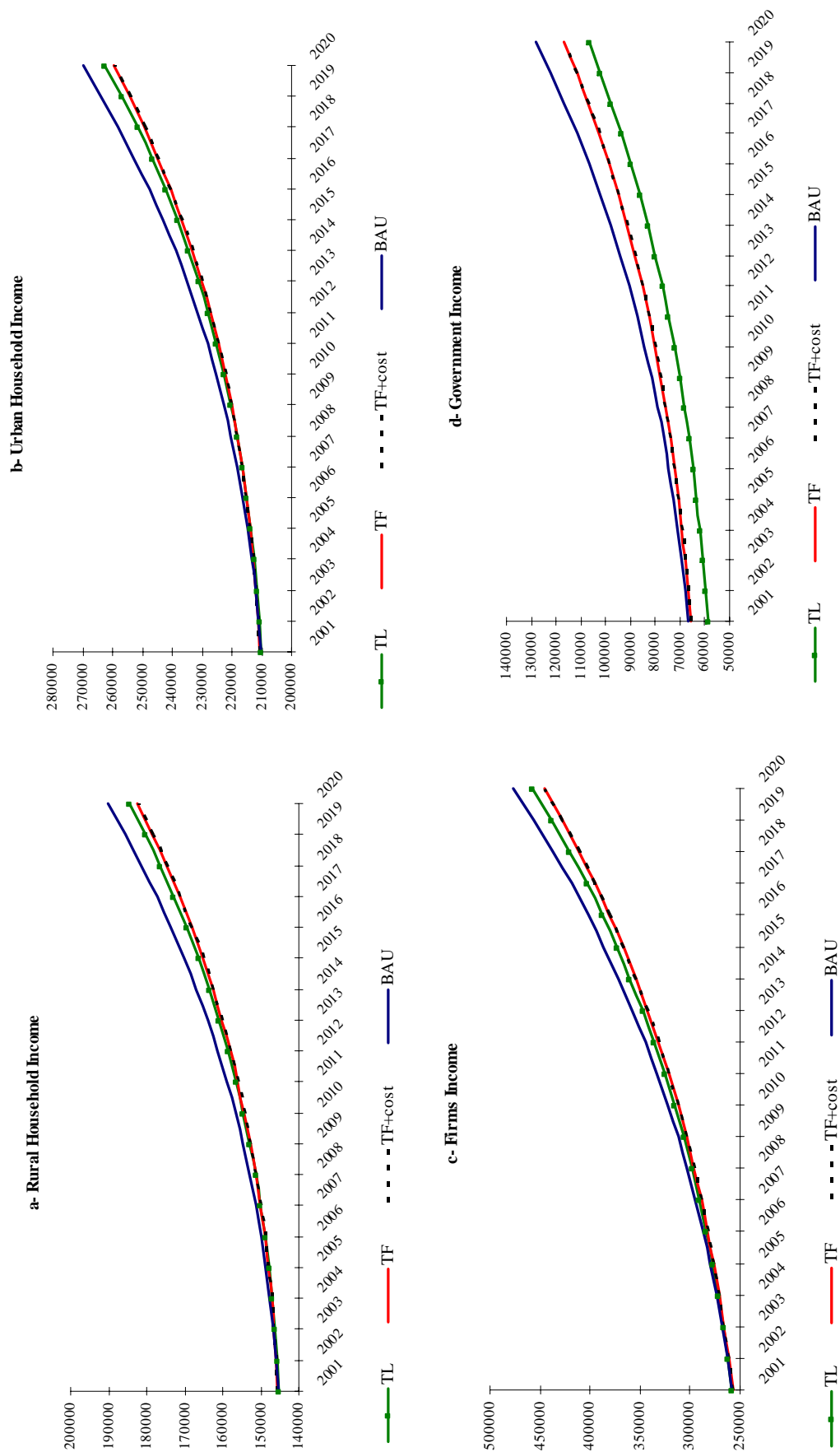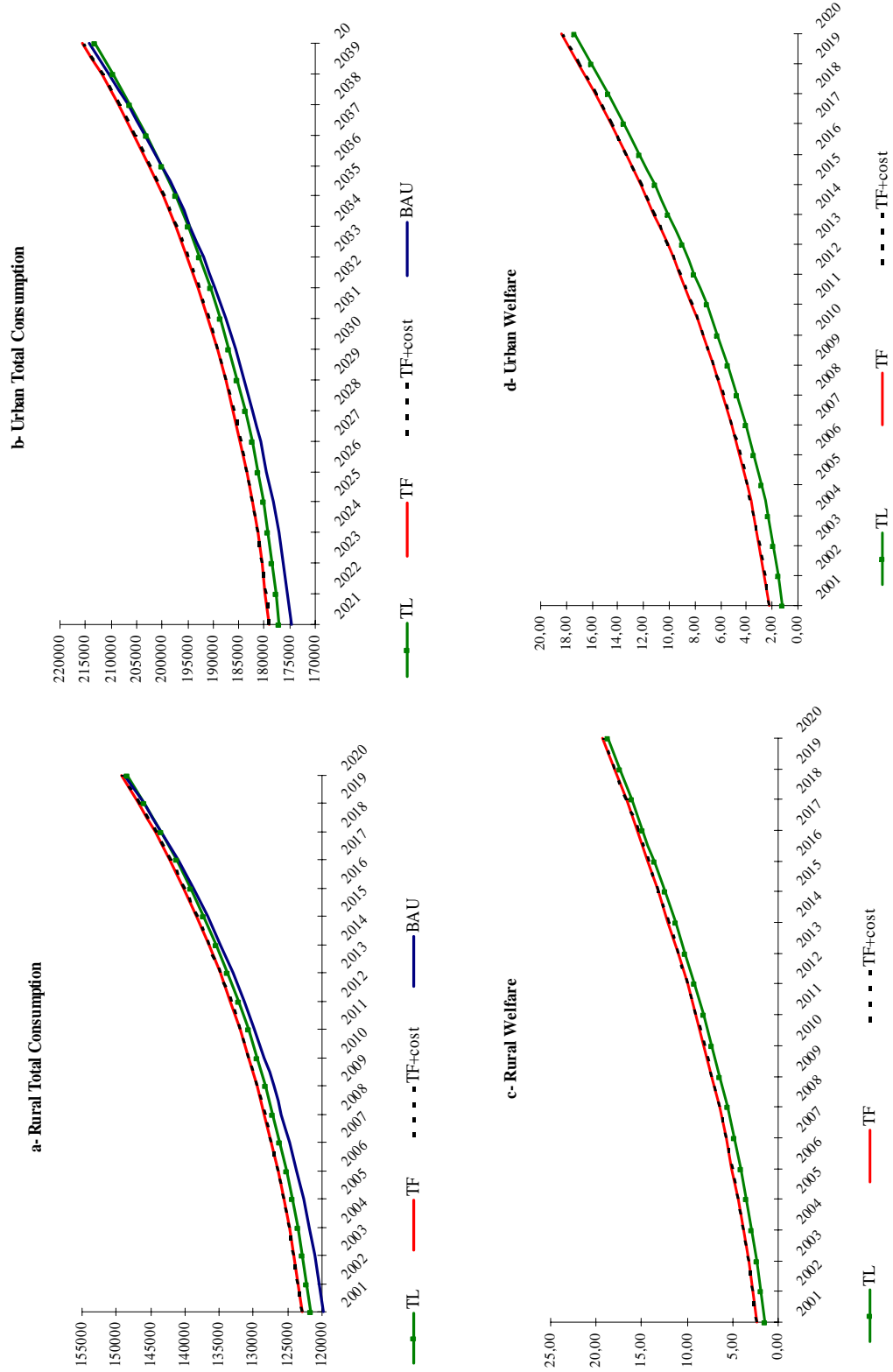
Figure 13:
Dynamic Results: Imports Prices

a- Import Price of Agr. Veg.

b- Import Price of Spinning

c- Import Price of Chemicals

d- Import Price of Enginery
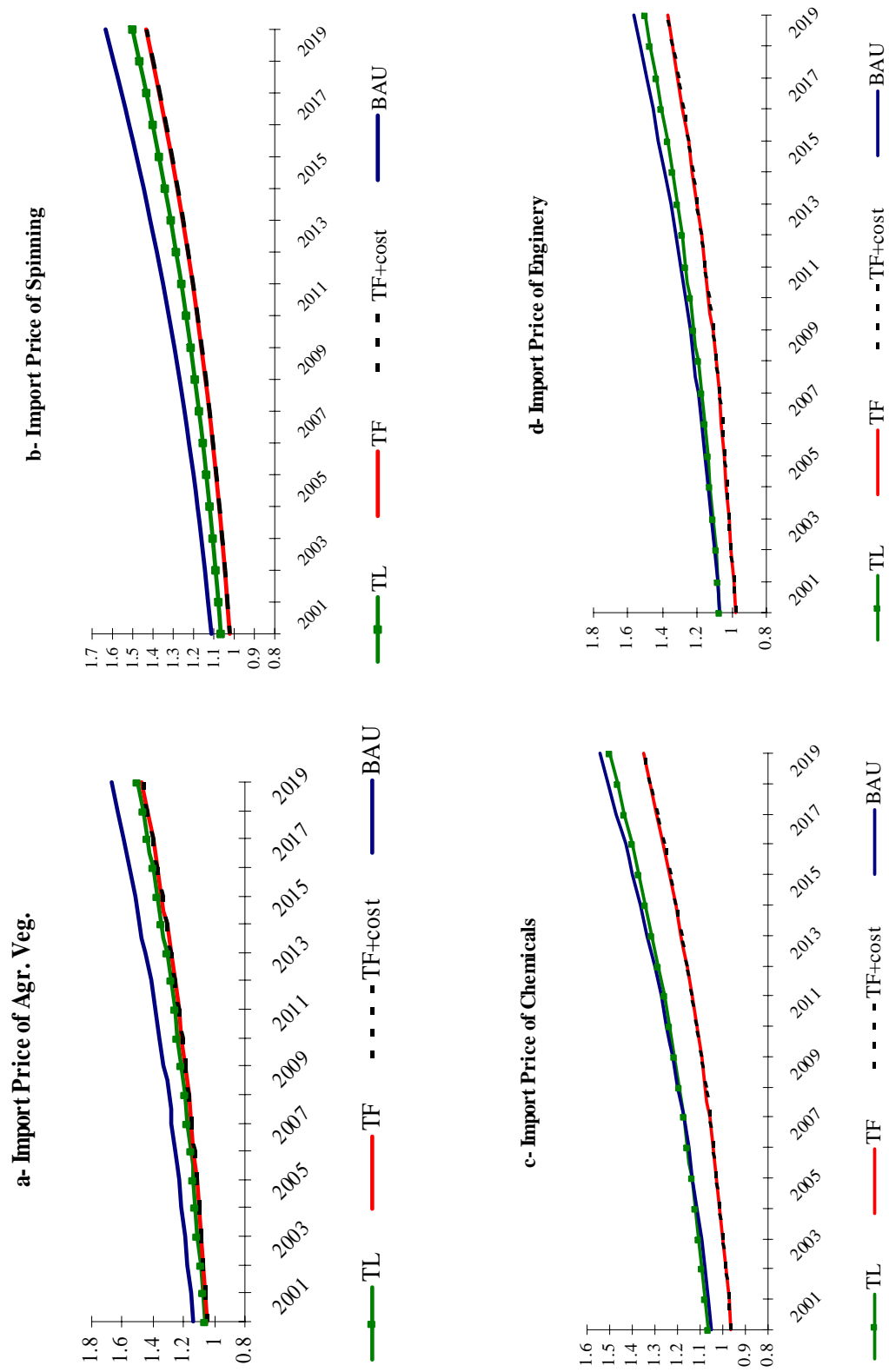
Source: Author's calculations.
Note: Figures here show the prices level.

Figure 14:
Dynamic Results: Composite Prices

a- Composite Price of Agr. Veg.

b- Composite Price of Processed Food

c- Composite Price of Clothes

d- Composite Price of Enginery

Source: Author's calculations.
Note: Figures here show the prices level.

Figure 15:
Dynamic Results: Agents Revenues

Figure 16:
Dynamic Results: Welfare and Total Consumption

Source: Author's calculations.
Note: (i.) Figures shown here are in million of Egyptian Pounds.
(ii.) Equivalent variation is calculated as percentage of the household income.