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S.S.D: SECS-P/01, SECS-P/02

THE MOZAMBICAN PARTICIPATION IN SADC.
A LIBERALIZATION PROCESS THROUGH DIFFERENT MODELS AND DIFFERENT CLOSURES

Tesi di Dottorato di: Elisa Delpiazzo
Matricola: 3580124

Anno Accademico 2009/2010

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Elisa Delpiazzo

Abstract

To define what a CGE is, scholars usually refer to closure rules to make the system square. This should affect the model's results and consequently the policies to be undertaken. In this thesis, the main goal is to detect and assess this issue, firstly as a theoretical problem and secondly in an empirical application.

Starting from the famous 1963 paper of Amartya Sen, literature presents many papers on this topic, both theoretical and empirical. However, currently, the closure rule problem is not central in the CGE debate, but more a secondary problem because of their codification under well - defined labels. Here, after a brief introduction on CGEs in their development and their structure, a series of simple *maquette* is presented. They have the exemplary role of introducing the concept of closure in order to explain how it affects the results of a simulation and how this modeller's choice is strictly connected to the macroeconomic foundation of the economic system. In other words, this choice reflects the modeller's beliefs on "how the system works."

After having demonstrated that these choices on macro - aggregates (savings, investments, government deficit ad current account) matter, we move into the real World analyzing through different models (Neoclassical, "Bastard Keynesian", and Structuralist/ Post- Keynesian), and through different closure rules: those on macro - variables and the impact of the Regional Trade Agreement of SADC with respect to the Mozambican economy.

In fact, theoretically the *maquette* were largely simplified in their structure to simply capture the interconnections between the demand - and the supply - side for instance. In this step, the economic structure is more complex. There are many productive sectors, (defined as agriculture, including forestry, fisheries, and breeding, mining, industry and manufacturing, trade services, and services in general) each one linked to the others; heterogeneous households (disaggregated according to location into rural and urban), enterprises and the central government in the Mozambican system. Moreover, this is a multi- country model where three specific trading partners are recognized: the Republic of South Africa, the rest of the SADC Free Trade Area members, and the rest of the World.

In this way, the analysis may capture different aspects of the trade liberalization process: changes in demand patterns and domestic production, which ultimately all reflect on changes in poverty and public policies to be pursued.

The analysis does not only assess the effects of trade liberalization as a reduction in import prices but also as a useful policy to attract investments and to better allocate resources.

Quantitatively, the framework consists of a 2003 Social Accounting Matrix, which collects data from National Accounts and surveys on households and enterprises, fiscal data and other data from different sources.

The simulation will be implemented using MPSGE/ GAMS.

Riassunto

Nel definire cosa sia un CGE, gli studiosi di solito riferiscono di un cosiddetto "problema di chiusura" come se si trattasse solamente di un problema pratico per rendere il modello solvibile e il sistema quadrato. Questa scelta, però, influenza i risultati della simulazione di un modello e di conseguenza le indicazioni di policy da perseguire. In questa tesi lo scopo principale è l'analisi e la definizione di questa questione tanto dal punto di vista teorico quanto da quello empirico.

Ad incominciare dall'articolo di Amartya Sen apparso nel 1963, la letteratura presenta molti articoli sia con un focus teorico sia pratico sul problema. Ciò nonostante, in questo periodo il problema delle regole di chiusura del modello non appare centrale nel dibattito come se fosse una questione secondaria dopo la loro codificazione in ben precise definizioni.

Qui, dopo una breve introduzione sui CGEs, il loro sviluppo, e la loro struttura, viene presentata una serie di *maquette* (esempi). Essi hanno uno scopo puramente illustrativo per introdurre il concetto di chiusura, per spiegare come influenzano i risultati ottenuti durante la simulazione e come la scelta del *modeller* è strettamente connessa con i fondamenti macroeconomici che egli ritiene siano alla base del sistema economico. In altre parole, questa scelta riflette le sue convinzioni su "come funziona il sistema".

Dopo avere dimostrato che queste scelte sugli aggregati macroeconomici (risparmio, investimenti, deficit di governo, e conto corrente) sono cruciali, l'attenzione si sposta sul mondo reale con un'analisi attraverso diversi modelli (neoclassico, "bastardo Keynesiano" e strutturalista/ post- Keynesiano) e diverse chiusure dell'impatto dell' area di libero scambio del SADC rispetto all'economia mozambicana.

Infatti, dal punto di vista teorico, le *maquette* sono ampiamente semplificate nella loro struttura per catturare solamente alcuni elementi, come le connessioni tra il lato della domanda e quello dell'offerta. In questa fase, invece, la struttura economica appare più complessa. Ci sono diversi settori produttivi (definiti come agricoltura, che include anche pesca, allevamento e sfruttamento delle risorse boschive, industria estrattiva, industria manifatturiera, servizi al commercio, e servizi in genere), ciascuno dei quali è strettamente interconnesso con gli altri, consumatori eterogenei (disaggregati sulla base dell'area di residenza e quindi catalogati come rurali o urbani), imprese e governo centrale nel sistema

economico mozambicano. Inoltre questo è un modello *multi- country* e quindi sono specificati tre partner commerciali: la Repubblica del Sud Africa, i restanti membri dell'area di libero scambio del SADC e il resto del mondo.

In questo modo l'analisi permette di analizzare diversi aspetti della liberalizzazione commerciale: cambiamenti nella composizione della domanda e nella produzione domestica, che si riflettono in ultima istanza sul livello di povertà dei diversi consumatori e sulle politiche da attuare.

L'analisi non soltanto valuta gli effetti della liberalizzazione commerciale come una riduzione nel prezzo delle importazioni ma anche come una politica utile per attrarre nuovi investimenti e per meglio allocare le risorse.

Quantitativamente il contesto è rappresentato da una matrice di contabilità sociale del 2003, che raccoglie i dati della contabilità nazionale, censimenti della popolazione e delle imprese, dati fiscali, e infine dati derivanti da altre fonti.

La simulazione è svolta con l'utilizzo di MPSGE/ GAMS.

Introduction

Computable General Equilibrium models are multi- sectoral models based on the concept of Walrasian equilibrium theory. This tool is suited for analysis of policy shocks on the whole economic structure. For this reason they may be applied both for national context and for a global system. As applied models, CGEs trace their origins from linear programming (1960s) and input - output analysis (1950s). Both constructions reflect a "pure command economy" (Dervis, De Melo, Robinson, 1982). Namely, input - output analysis answers specifically to the material balancing issue in the productive sector of a centrally planned economy. The scholar who was the first to link the concept of centralized planning and the scarcity price problem was the Soviet Kantorovich, whose theory was developed and extended by Dantzig.

However, these first attempts were not applicable to real policy analysis since they needed a number of compromises and *ad hoc* assumptions which limited their applicability.

Historically, scholars recognize three generations of models from the groundbreaking work of Adelman and Robinson in 1979. In the late 1970s CGEs were mainly implemented to solve income allocation issues. This application was due to the explicit introduction of prices and income, two distinctive features of the CGE framework. Examples of this class of models are Adelman and Robinson (1978) for Korea and Taylor and Lysy (1980) for Brazil.

At the end of that decade the World experienced the second oil crisis (1977-78), so attention was turned to the question of structural adjustment. Policy- makers were concerned about issues of foreign debt for developing countries. In this context, CGEs became the main instrument used to evaluate a "structural adjustment program" because they were able to detect both compositional effects on the production side and changes in macroeconomic aggregates. Under the aegis of OECD, a number of models were built. Modelling examples from this second generation are Thorbecke (1991) for Indonesia, de Janvry, Sadoulet and Fargeix (1991) for Ecuador, Morrison (1991) for Morocco, and Chia, Wahba and Whalley (1992) for the Ivory Coast.

In that period CGEs were also applied in different fields. For instance they became valuable tools for taxation, such as the work of Ballard *et al.* (1985) on optimal taxation, or in international trade analysis both as single- country and multi- country models[1].

Nowadays CGEs are applied to environmental issues to identify multi- sectoral and intergenerational effects of policies such as cuts in toxic emissions or raising green taxes, as in Rutherford et al. (2007a,b), Böhringer and Rutherford (2002), and Carbone, Helm and Rutherford (2006).

However, this is not the only criterion used to distinguish different classes of models. They may be classified according to their theoretical background. Literature usually distinguishes them according to macroeconomic properties of CGE models, mainly the two broadest classes, Walrasian and non- Walrasian models. This distinction is based on the so- called "closure rule" issue. Since the first applied models for Korea and Brazil, this topic has been widely discussed, developing a debate on macro closure in economy- wide models. The first works mostly focus on how equilibrium might be achieved between savings and investments, largely ignoring other macro- aggregates such as government and foreign accounts[2].

As already cited, CGEs are based on the Walrasian theory of general equilibrium. In this context, agents are utility maximizing consumers and profit maximizing producers, and the model specifies equilibrium wages and prices as any market clears. Supply and demand equations are homogeneous of degree zero so that the absolute price level does not matter. Moreover the model displays neutrality of money. All the markets clear so that the model always achieves full employment of all factors and the economy is always at its possibility frontier. In this case, inefficiency has to be interpreted as starting from a wrong point on the frontier itself and not from an interior point.

In the closure rule debate, scholars were widely concerned with analysing the relationships between macro- aggregates in order to classify each model under a specific label. Sen's work focuses on the relationship between saving and investment as the fundamental criterion to distinguish "Neoclassical" and "Keynesian" systems[3]. According to this classification, the main

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[1] Typical examples of trade- focused single- country models are the IFPRI models while multi- country model examples are the GTAP model (Purdue University) or the LINKAGE model (World Bank).

[2] Fundamental contributions to the early debate on "closure rules" were the works of Sen (1963), Taylor and Lysy (1980), Rattsø (1982), and Lysy (1983), which survey the different closures analysing the macroeconomics behind. Then Decaluwe, Martens, and Monette (1987) and Dewatripont and Michel (1983) present different approaches to closure rules. Finally an interesting paper focused on the dichotomy between Neoclassical and Keynesian model is provided by Robinson (2003).

[3] These two labels are quite general. They represent a wide range of models. To be more accurate they may be defined as "supply- driven" and "demand- driven" models.

thing to be detected is if the amount of savings determines the total investments or if it is the other way around. Typically Neoclassical macroeconomics assumes a fixed exogenous level of investments which is balanced by savings. So, it is the households' decision as to how much to consume and save which ultimately affects the macro- aggregates. However, there is no a clear mechanism which leads households to increase or not to increase their savings. There may be an interest rate mechanism which makes savings more remunerative or another unspecified mechanism[4]. In contrast, Keynesian models assume a reverse causality between the two macro aggregates. Actors have a fixed propensity to save and investments move to reach equilibrium.

However, the seminal work of Sen had didactical purposes therefore not fitting into the real World. In his model there was a productive sector, two households – one owning labour and the other capital – who consume and save. There is no reference to government or foreigners. In the real World these two actors are fundamental and subsequent works deal with these additional elements.

Government treatment does not clearly contribute to the distinction between Neoclassical and Keynesian models because both models may assume different closures. When "Government closures" are investigated, it means that the modeller has to decide on the causality between tax receipts and recurrent expenditures, in other words if the government deficit is endogenous or not. This choice should rely on a strong assumption about how the political decisions are made. Supposing that government deficit is fixed, a change in real public expenditure makes tax receipts to modify and close the gap. However, assuming an endogenous tax is a strong presumption. Are the political decisions made rapidly in response to a shock? Are the policy makers able to answer opportunely? Is the bureaucratic course particularly complex and time consuming? Everyday life shows that to enact a bill, a governing body requires a long time period so it is less likely to assume endogenous tax. The other possibility is an endogenous government deficit with fixed recurrent expenditures. Here, a change in tax receipts means a change in deficit and it could be defined as a responsibility rule for government behaviour. The logic is to assume a minimum level of expenditures, which cannot be reduced, and then when taxes increase, it saves more to compensate for periods of tax decline.

The introduction of this new agent modifies the saving- investment balance as well. Now, available savings are both private and public, so that the sum of these two sources has to

[4] This is the case of the Johansen model (1960) where consumption becomes endogenous because of a government whose expenditures and taxes are designed to maintain a target level of investment. This mechanism is not explicit because the model does not include the government as an actor.

balance total investments. It is a straightforward conclusion that the closure choice affects the savings performance.

Applying the same logic as before on saving- investment balance, "Neoclassical" models assume endogenous tax rates (in other words exogenous government deficit)[5] while "Keynesian" models assume exogenous expenditures (or endogenous deficit). However, it is correct not to strictly follow this classification. In this work both the government closures are assumed in each model to evaluate whether or not they affect final simulation results or not.

The third relation to analyse is the foreign sector. A notably broad consensus has been reached on the general outlines of a trade- focused model. It usually takes the Armington approach[6], which incorporates imperfect substitutability between foreign commodities and domestic marketed commodities. More precisely, import demand is based on sectoral CES (Constant Elasticity of Substitution) "aggregation" function and export supply is based on CET (Constant Elasticity of Transformation) "transformation" functions[7]. In this way price advantages may be considered and different substitutability assumed instead of a rigid dichotomy between tradable and non- tradable goods.

But, with the introduction of foreigners arises a new crucial issue: the trade balance. Trade theory usually assumes this balance is zero. However, looking at data, it is quite impossible to assume this. So, the modeller has to make another decision on this aggregate: he could presume it exogenous, a decision made abroad, or endogenous. To overcome this problem it is usually assumed exogenous and a fully autonomous entity makes this decision. In other words, the modeller supposes that it is the foreigners who decide how much to save independently of what happens in the world. This interpretation brings to light a number of questions as Robinson (2003) suggests. From a macroeconomic point of view, treating this flow as exogenous imposes questions about why foreigners assume to save more today if there is not any explicit reference to assets or time inside the CGE model. Saving today means, coherently deciding to consume more in the future (i.e. higher future exports). Other scholars assume that trade balance is endogenous. This is the position of Taylor (2004), who recognizes a different behaviour of trade balance if it is referring to a developing or a developed country. In fact, he states that foreign savings (or trade balance) represent the "net foreign position" of a State. In this accounting definition there are not solely the financial assets held by

[5] Nowadays, the most widely used Neoclassical models assume endogenous tax rates (i.e. IFPRI models, LINKAGE model).

[6] This approach is based on the 1969 paper of Paul Armington.

[7] Examples of trade focused CGEs based on the Armington assumption are Robinson et al. (1999), Devarajan, Go, Lewis, Robinson, and Sinko (1994), Devarajan, Lewis, and Robinson (1990), Dervis, de Melo, and Robinson (1982).

foreigners but also the assets in foreign currencies held by wealthy domestic agents. If the analysis regards a developed economy, foreign savings may be considered endogenous if we consider that when actors change their tastes, for example, and ask for a lower amount of foreign assets, foreigners have enough power to reduce their savings supply. Otherwise, in a developing country endogenous foreign savings are justified according to the existence of rich agents, perhaps fewer, which may decide to reduce their foreign assets and use them domestically as their own choice.

This position, however, raises a question as well: is it possible to interpret foreign savings as a financial bowl even if the framework includes only real variables?

As in the other cases, “Neoclassical” models usually assume exogenous foreign savings while “Keynesian” models make them endogenous. However, as in the case of government closure, this choice does not strictly define the nature of the model itself.

Moreover, a micro- constraint should be added: the market closure factor. Modellers mainly presume that capital market clears and all the capital is full employed when the crucial issue is the behaviour of the labour market. Walrasian in spirit models, such as the “Neoclassical” models, suppose full employment of labour as well, and that the market clears at the equilibrium wage rate. “Keynesian” systems, instead, are characterized by under- employment of labour, or wage rigidities, so that the market is not always cleared and the wage rate may be different from its equilibrium value.

Many scholars, such as Llunch (1979), reduce the closure rule debate to this issue: only the labour market closure strictly defines the nature of the model. Later contributions recognize the role of the labour market closure but do not forget to highlight the crucial role of the macro- closures. In fact, nowadays, the labour market specifications allow for interpretation of the relationship between demand and supply. Typically, supply- driven systems, such as the “Neoclassical” one, assume full employment of resources, and only changes in their total endowments may affect total production. Demand- driven systems, such as the “Keynesian” ones, infer under- employment level for labour, so that demand injections cause changes in the employment level and eventually total production changes.

In this thesis two more models are presented as special cases of these two broad categories: the Johansen closure, a particular case of “Neoclassical” model, and the “Structuralist/ Post-Keynesian”, a special case of demand- driven system.

The choice of applying these different closure rules to analyse the empirical case of the Mozambican participation in the SADC Free Trade Area is mainly due to the author’s participation in a research project sponsored by the CICOPS – Interfaculty Centre for

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The work is organised as follows. There are two parts.

Part1 is a literature survey on the main concepts at the basis of CGE modelling and a simple numerical representation useful for didactical purposes.

The first chapter deals with Computable General Equilibrium theory as a development of linear programming and input - output analysis based on the Walrasian context of general equilibrium. Then, the mathematical interpretation of this class of model is presented both in the standard format and in an MCP format.

The second chapter focuses on a specific issue: the closure rule problem, already identified in the previous chapter. Here the topic is investigated more deeply, analysing the different closures for macro aggregates in a step- by- step procedure. Moreover, next to a purely theoretical discussion, (based on literature evidence) a series of examples is presented to describe the rationale behind the models applied in the next part of the work.

Then, part 2 is composed of five chapters and is an empirical application of the theoretical issues discussed earlier. Chapter 3 is an introductory chapter whose goal is to present Mozambique, the Southern African Development Community (SADC) and the main provisions for the Free Trade Area.

Chapter 4 presents how the 2003 Social Accounting Matrix was built, from National accounts to the final SAM.

Then, chapters 5 to 7 discuss the three models presented in chapter 2. Each chapter deals with a different model and the different closures inside the model itself. In this way the objective is to evaluate a trade liberalization shock inside the Mozambican economy.

Finally, chapter 8 shows the principal results of this analysis.

PART 1

A Theoretical Presentation: CGEs and Closures Problem

1. Computable General Equilibrium Models: History, Theory and Applications

General equilibrium theory starts with the classical economists (Smith, Ricardo, Mill, and Marx), who adopted a theory of value driven by production costs and zero profit conditions. Although this is recognized as the initial idea of general equilibrium, it limits its analysis in one aspect: the supply side of the system, therefore ignoring the effects of demand on value. Having them in mind, many scholars tried to present a coherent explanation without any reference to demand.

In the 19th century Cournot was the first who clearly recognized the role of demand in a general equilibrium framework. However, only Leon Walras incorporated demand into the model and considered it to be central in the relationships among markets. Nowadays, a version of the Walrasian theory is still applied and considered one of, if not the, "*most useful conceptual framework[s] available*" (Duffie, Sonnenschein, 1989). To sum up, they define this theory with these words: "*A refined version of the Walrasian theory survives today as our best expression of the forces that determine relative value.* […] *The Walrasian theory has the capacity to explain the influence of taste, technology, and the distribution of wealth and resources on the determination of value*" (Duffie, Sonnenschein, 1989). Over the course of 80 years, the ideas of Walras were refined and many scholars have followed his intuition. However it was not until Arrow- Debreu and McKenzie that a complete set of conditions for general equilibrium was provided.

Historically, Computable General Equilibrium models, the application of general equilibrium theory, portray their origin in input-output (1950s) and linear programming models (1960s). Both constructions reflect a "*pure command economy*" (Dervis, De Melo, Robinson, 1982). Namely, input-output analysis answers specifically to the material balancing issue in the productive sector of a centrally planned economy. The scholar who first linked the concept of centralized planning and the scarcity price problem was the Soviet Kantorovich, whose theory was developed and expanded by Dantzig.

However, these first attempts were not applicable to real policy analysis since they needed a number of compromises and *ad hoc* assumptions which limited their applicability.

Namely, there were three main problems. Firstly, the linearity formulation was not able to represent the agents' behaviour therefore making the model appear unrealistic. Secondly, when the model is dynamic, problems will arise for terminal constraint. And finally, there is a major problem concerning how to interpret shadow prices.

It was soon clear that the idea of a centrally controlled economy had to be abandoned and some type of endogenous pricing and quantity variables should be introduced. These features are not captured by a linear programming system. The reason lies in the construction itself of this class of models and in the relationship between the solution of a linear program and other relations including the budget constraint.

Here, the problem is that the linear programming solves the productive sphere through the definition of "shadow prices," where the demand side does not depend on the factor income implicit in the solution so there is not any price mechanism which guarantees the equality between the demand and the supply side[8]. In other words, linear programming (hereto LP) is solved by imposing an exogenous price vector. The solution corresponds to an output and a factor price vector. However, this solution solves only the supply side of the economy. The demand side depends on income and output prices. But income itself comes from the solution of the LP and depends on the initial choice value. Therefore, the price vector is both the solution of the supply side via LP and the solution of the demand side.

Starting from this gap, CGEs contain this mechanism and so are also known as "price-endogenous models": "*all prices must adjust until the decisions made in the productive sphere of the economy are consistent with the final demand decisions made by households and other autonomous decision makers*" (Dervis, De Melo, Robinson, 1982). Moreover, according to the theory, "*the essence of general equilibrium is* […] *an enphasis on inter-market relations and the requirement that variables are not held fixed in an ad hoc manner*" (Duffie, Sonnenschein, 1989).

In this context CGEs appeared as a "*natural out-growth of input-output and LP models*" (Robinson, 1989) in the early 1970s. Building a coherent system that was realistic, solvable, and useful for policy analysis was a long process, parallel to the evolution in mainframe and more powerful computers.

[8] For a detailed and mathematical exposition of the issue see Dervis, De Melo, Robinson pages 133-136.

I. The Arrow- Debreu general equilibrium theory

The Arrow- Debreu model was historically preceded by Cassel's model of competitive equilibrium (1924). His system was based on four main principles: first, demand for each good is a function of the prices of all final goods; second, producers are subject to a zero profit condition; third, input and final output are related through a fixed technical coefficient; and, fourth, demand equals supply on each market. Formally, this model may be written as a system of this kind:

$$x_i = f_i(p_1,...,p_n) \qquad (1)$$

$$\sum_j a_{ij} q_j = p_i \qquad \textit{for all } i, \qquad (2)$$

$$\sum_i a_{ij} x_i = r_j \qquad \textit{for all } j. \qquad (3)$$

However, many scholars discovered failures and gaps. Firstly, they noticed that the Casselian system solved for negative values of prices and quantities. Negative quantities are meaningless from an economic point of view, and negative prices, at least for primary factors, are not acceptable solutions.

Others pointed out that the system may be undeterminable when resources are more than commodities. In fact, the third equation of the system above represents a set of linear equations. In this case the number of equations would be greater than the number of unknowns and therefore the system would have no solution.

In their famous 1954 paper, Kennet Arrow and Gerard Debreu demonstrated the existence of equilibrium for a competitive economy without any loss of generality and that further solved the problems resulting from Cassel's model[9]. They started from Wald's demonstration (1936) of equilibrium[10] for an "*integrated model*", where both the production side and the markets are

[9] Although this paper is usually remembered as the corner stone in general equilibrium theory, it is worth noting that both authors had written a paper on general equilibrium independently in 1951 reaching the same conclusions on this argument.

[10] Wald's demonstration, however, is not as general as the one of Arrow and Debreu. Firstly, he maintained Cassel's assumption on fixed coefficients (or proportions) between output and input. Then, he imposed assumptions on demand functions and finally on utility functions where the marginal utility of a good depends only on that good and it is a strictly non- decreasing function.

in equilibrium. Moreover, "*integrated model*" means the contemporaneous presence of producers and consumers who influence each other.

Their starting point is a Walrasian economy of this fashion: "*the solution of a system of simultaneous equations representing the demand for goods by consumers, the supply of goods by producers, and the equilibrium condition that supply equal demand on every market*" (Arrow, Debreu, 1954). Moreover, the fundamental assumptions are the same: "*each consumer acts so as to maximize his utility, each producer acts so as to maximize his profits, and perfect competition prevails, in the sense that each producer and consumer regards the prices paid and received as independent of his own choice*" (Arrow, Debreu, 1954). Although Walras clearly had defined the mechanism of this theoretical economy, he had not analyzed the assumptions on equations in order to have a solution. As Arrow and Debreu stated "*one check of the empirical usefulness of the model is the prescription of the conditions under which the equations of competitive equilibrium have a solution*". They derived two theorems that state very general conditions for equilibrium. The first one asserts that if individuals have a certain positive quantity of each commodity as its initial endowment, then equilibrium exists. The second states that there should be two properties of labour: first, each individual should own at least one type of labour (supposing there may be more than one labour type); second, this type of labour should be employed for the production of commodities.

This reasoning allows for a generalized set of assumptions that are useful and applicable to a wide variety of models (Arrow and Debreu, 1954; Duffie and Sonnenschein, 1989). Arrow and Debreu's work is structured as follows. First, their attention is devoted to the production side, defining some basic concepts (i.e. commodity, production units) and the three fundamental assumptions about production. Then, they move further to the consumption side with the definition of consumption units, and a set of three other conditions on utility functions. Finally, they present the market clearing conditions.

For a complete mathematical treatment, the reader is invited to see the original 1954 paper. Here we state the fundamental relationships and their implications.

In this competitive economy there is a finite number of commodities[11], each one characterized with respect to location and time, so that the same commodity sold or bought in two places is treated as two distinct commodities and the same happens for a commodity sold or bought today and tomorrow. We assume that L is the number of commodities and l, going

[11] The concept of commodity is a fundamental primitive concept in economic theory. Particularly, in general equilibrium studies the concept of commodity is strictly linked to its nature. As Geanakoplos (2004) underlies "*general equilibrium theory is concerned with the allocation of commodities.* […] *The Arrow-Debreu model studies those allocations which can be achieved trough the exchange of commodities at one moment in time*".

from 1 to L, designates different commodities. All vectors with l components are included in a Euclidean space, R^L, of l dimension.

Each of these vectors l is produced in a productive unit, or in other words a firm, designated by the letter j. Each firm is characterized by its initial distribution of owners and a specific technological production process. This means that there is a specific Y_j for each firm that represents the input - output combination[12] for producing the commodity of firm j, and there is a Y that is the summation of the different Y_j over j. Therefore it represents all possible input - output combinations seeing as the whole economy is a unique productive sector. So there are three assumptions about the nature of the set Y_j.

First, increasing returns to scale, divisibility in production, and gains from specialization are completely ruled out. Second, each aggregate production possibility vector, Y, must have at least one negative component. This assumption is intuitive: each input is treated as a negative entry (or component) so that this assumption simply states that each productive technology requires at least one input. (There could not be any output without input). Finally, it is likely to have a productive sector whose output is equal to the exact input for another production process.

So, the starting point is the definition of the properties of the "technological aspects of production," which we may sum up mathematically:

1a) *Y_j is a convex subset of R^L containing 0 ($j = 1, \ldots, n$)*,

1b) $Y \cap \Omega = 0$

1c) $Y \cap (-Y) = 0$

However, the technological aspects are not all that affect production. Productive decisions also depend on the game rules. As usual, Arrow and Debreu assumed perfect competition so that "*the motivation for production is the maximization of profits taking prices as given*". Formally speaking, this assumption leads to the first condition for general equilibrium:

I) *y^*_j maximizes $p^* \cdot y_j$ over the set Y_j, for each j.*

Analogously, they assume the existence of another group of individuals called consumers who are typically families or individuals. Let us denote with M the number of consumption

[12] Each component is composed of a positive entry which denotes output and a negative entry which is input.

units, *i* defines the different consumption units that belong to the Euclidean space R^i. For any marketed commodity, the rate of consumption is non negative[13]. Mathematically speaking:

(2) *the set of consumption vectors X_i available to individual i (= 1,…,M) is a closed convex subset of R^i which is bounded from below; i.e. there is a vector ξ_i such that* $\xi_i \leq x_i$ *for all* $x_i \in X_i$.

However, with this definition a new concept becomes relevant. The set X_i represents the combination of all feasible consumption vectors[14] where there is no budget constraint. Moreover, it does not contain impossible combinations, such as the supply of more than 24 hours of labour (even of different types). According to Neoclassical theory, consumption choices are assumed to be made according to a preference function called "utility indicator function", $u_i(x_i)$. As for the production possibility function, the utility function is characterized by three assumptions about its properties.

First is the continuity requirement for function u_i. This is a standard hypothesis in consumers' demand theory and follows the idea that consumption choices are made following an order. Second, there is no consumption vector that is preferred over all others. This is called the no saturation (or non-satiation) assumption. Finally, there is the usual assumption on indifferent surfaces that are convex. However, convexity implies that commodities are infinitely divisible and that any commodities' combination is at least as good as the extreme.

Formally, these three conditions may be expressed this way:

3a) $u_i(x_i)$ *is a continuous function on X_i.*
3b) *For any* $x_i \in X_i$ *there is an* $x_i^{'} \in X_i$ *such that* $u_i(x_i^{'}) > u_i(x_i)$.
3c) *If* $u_i(x_i) > u_i(x_i^{'})$ *and* $0 < t < 1$*, then* $u_i[tx_i + (1-t)x_i^{'}] > u_i(x_i^{'})$.

Moreover, a new condition must be assumed. As Arrow and Debreu pointed out, "*to have equilibrium it is necessary that each individual possess some asset or be capable of supplying*

[13] The only exception is labour. Supplied labour services are in fact counted as the negative of the rate of consumption.

[14] It is worth noting that when we speak of consumption we define consumption vectors that ultimately are basket of commodities. In fact, consumption choices are made on the basis of a group of commodities and not with respect to a single good. A single commodity has value only if compared to other commodities that may be sold or bought. Together with the assumptions on transitivity and completeness this representation of consumers' preferences is precisely the neoclassical one.

some labour service which commands a positive price at equilibrium". Presuming that ζ_i is the initial endowment of the *i*th consumption unit, composed of the initial available commodities, following the 1954 paper we may define this condition as:

4) $\zeta_i \in R^l; \textit{for some } x_i \in X_i,\ \ x_i < \zeta_i$.

The necessity of this condition is straightforward. To have exchanges in an economy, agents should be endowed with some initial amount of commodities that they may sell. Moreover, expression (4) draws attention to the possibility of consuming a fraction of this initial endowment up to when a positive amount of each trading commodity is still available for exchange.

Also in the consumer's case, not only mathematical properties of the utility function affect the results, but we have to analyse the logic behind consumer behaviour. Choosing a consumption vector means maximizing utility among all of these to satisfy the budget constraint. In other words, consumers have to choose a consumption basket whose cost at market prices does not exceed their income. Assuming, as Arrow and Debreu did, that an individual's income is composed of wages, dividends from firms' profits, and receipts from initial held stock of commodities, when in equilibrium, the following condition must hold:

II) x^*_i *maximizes* $u_i(x_i)$ *over the set* $\left\{x_i \middle| x_i \in X_i, p^* \cdot x_i \le p^* \cdot \zeta_i + \sum_{j=1}^{n} \alpha_{ij} p^* \cdot y_j^* \right\}$

Where the asterisk denotes an equilibrium value, a_{ij} is the share of profits claimed by individual *i* from firm *j*.

Conditions (I) and (II) are the equilibrium of the production and consumption units for given p^*, respectively. Moreover, we have to specify that prices must be non-negative and not all zeros. Formally:

(III) $p^* \in P = \left\{p \middle| p \in R^l, p \ge 0, \sum_{h=1}^{l} p_h = 1\right\}$

Now we have to move further to consider when equilibrium takes place in the commodities' markets. Each market is considered to be in equilibrium when supply equals demand. It is the standard "law of supply and demand" that can be rewritten as:

(IV) $z^* \le 0, p^* \cdot z^* = 0$

Here, z is a vector whose components are the excess demand over supply for the various commodities.

The law mentioned above shows the relationship between the excess demand and prices: if demand increases, prices get higher, and when supply exceeds demand, prices fall. Therefore, the first part of condition (III) states that equilibrium is not compatible with excess demand on any market. The second part demonstrates that no price can fall below zero. When a commodity price is zero, then the related excess demand is lower than zero. The equilibrium price vector p^* is a function of consumer demand and firms' supply as well as of the primitive data such as taste, technology and endowments (Duffie, Sonnenschein, 1989).

Now we have all the conditions and assumptions needed to define a general equilibrium. First, the equilibrium is defined in terms of consumption quantities, produced output, and final prices for different commodities. According to conditions (I) and (II), the maximizing elements are quantities, production and consumption respectively, while condition (IV) refers to prices. So Arrow and Debreu obtained a definition: "*A set of vectors* $(x_i^*,...,x_m^*, y_1^*,..., y_n^*, p^*)$ *is said to be a competitive equilibrium*[15] *if it satisfies Conditions* [(I)-(IV)]".

In addition, this reasoning allows the authors to derive a theorem: "*For any economic system satisfying Assumptions* [1-4] *there is a competitive equilibrium*".

It may be helpful to stress some aspects of the Arrow-Debreu general equilibrium model and some logical implications. Firstly, in this framework consumer and firm act independently of each other within the same time period. This implies that both of these two groups act according to their own rationale and they are motivated only by self- interest. At the same time no agent acts before the other in the market, so that no one affects the price level by for example setting prices. When the reasoning is expanded at the aggregate level, supply and demand are equal and therefore determine the price level which guarantees equilibrium.

As Geanakoplos (2004) states, it is interesting to note that in the Arrow-Debreu model there is a kind of "*rational expectation*". This means that when agents act in the market, they know every price to better allocate their choices. But, they also predict all future prices at the end of the time period.

Although Arrow and Debreu's model demonstrates the existence of a single equilibrium, it also recognizes the possibility of multiple equilibria. The model, in fact, is adequate for determining the value of the price vector on the basis of its primitives. As it is likely to

[15] The existence proof of the equilibrium employs the fixed-point theorem. To simply sum up the reasoning, their demonstration follows three steps; first, they interpreted the economy as an abstract economy or a generalised game, then they give the proof of the existence of at least one equilibrium of this generalized game and finally they demonstrate that this equilibrium satisfies the clearing condition on all markets.

demonstrate, there are the possibilities of multiple equilibria in a Walrasian system. As Duffie and Sonnenschein (1989) point out, "*the equilibrium price set may be an essentially arbitrary subset of the set of relative prices*". Therefore, it does not "*tell us how to relate tastes, technology, and the distribution of wealth to a single set of relative values. Rather, they tell us that there is at least one vector (and possibly many more) of relative values compatible with the data of the model*".

From a methodological point of view, this model innovation is a representation of a class of assumptions that are necessary to have equilibrium, but at the same time are applicable to a wide variety of models inside the marginalistic school. However to further extend the applicability of the theorem, in 1971 Arrow and Hahn defined four presuppositions that must be satisfied in order to reach an equilibrium.

These are the definition and construction of the excess-demand functions, their homogeneity of degree zero, their continuity, and their satisfaction of Walras's law. In this way there is no reference to the marginalistic school, but only three technical hypotheses and an accounting identity. Therefore, the applicability of this approach is extended to other economic systems.

As Tucci (1997) points out, the approach is unique but it leads to a theory of multiple equilibria. In this context, it means that the assumptions may be satisfied by many different models. Each of them may be defined as general economic equilibrium characterized by a specific economic context. The theorem appears as a minimum model so poor of economic characteristics that may be easily applied in many contexts.

II. A standard representation of a CGE

The standard representation of a CGE model is nothing more than the transposition of the Arrow-Debreu model in its simplest version. Therefore, the building of the model follows the basic elements of the theoretical framework we have already discussed. In the simplest case when the economy is closed and there is not any public sector, the applied model has only two agents: firms and households (or consumers); both of them are considered to be price takers. Then, each firm has a unique profit maximizing production plan, which affects commodities' supply (and by aggregation the total supply). Each household's income is a function of initial endowments and their consumption is a function of income distribution and prices. Finally, there is the usual excess-demand condition so that the difference between demand and supply for each commodity is zero[16].

[16] More generally, Robinson (1989) defines that a CGE model must have four fundamental components. "*First, one must specify the economic actors or agents whose behaviour has to be analyzed.* [...] *Second,*

In the productive sphere, we suppose there are n firms, and each of them (called i) produces a good j. This assumption is typical of input-output analysis. Then, there are two primary factors: capital and labour. Gross sectoral output is a function of these factors according to a certain degree of substitutability. So, formally the production function is often a CES (Constant Elasticity of Substitution) function, which captures most of the interactions a modeller wants to analyse. These two components create the value added component which is embodied in the final product.

However, in reality, production employs not only primary factors but also intermediate goods. The intermediate consumption is modelled in a Leontief fashion: its demand is proportional to the total planned output. So, intermediate demand of sector i becomes

$$INT_{ij} = a_{ij} X_j \qquad (1)$$

where a_{ij} is the input-output coefficient. Then, if we aggregate intermediate demands to obtain the total demand by sector of origin we get:

$$INT_i = \sum_j INT_{ij} = \sum_j a_{ij} X_j \qquad (2)$$

Therefore gross sectoral output may be expressed in these terms:

$$X_i = f_i(K_i, L_i, V_i) \qquad (3)$$

In a more precise form, following our example, the gross output for sector i is a double-stage CES function[17].

First, there is the aggregation of capital and labour according to a certain suitable degree of substitution into a value added component, and then it is combined in a fixed proportion with the intermediate demand[18].

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behavioural rules must be specified for these actors that reflect their assumed motivation. [...] *Third, agents make their decisions based on signals they observe.* [...] *Fourth, one must specify the rules of the game according to which agents interact- the institutional structure of the economy*".

[17] Modellers may choose to represent the production function in a variety of functional forms, not only CES function but also Cobb-Douglas, or generalised Leontief translog, or a multilevel version of these forms.

[18] The described version is the simplest one. Supposing there is more than one labour type, for instance because of different locations or for different skills, the aggregation process becomes more complex and becomes known as "multistage production function". In fact, there should be a new step added to the basis with the aggregation of the different labour types becoming a generic composite "labour".

To summarize, we use the words of Dervis, De Melo, and Robinson (1982), "*the production technology exhibits a number of special characteristics. It is a CES or Cobb-Douglas function of aggregate capital and aggregate labour. Capital is a fixed-coefficient aggregation of investment goods. Labour is a CES or Cobb-Douglas aggregation of labour of different skills. The production function is thus a two-level function. Intermediate goods are required according to fixed coefficients and so can be treated separately*".

With respect to the Arrow-Debreu conditions on production, it is instinctive to understand that this modelling satisfies the assumptions *1a*, *1b*, and *1c* presented in the previous paragraph. In fact, the CES function (or the Cobb-Douglas as a particular case) presents decreasing returns to scale, so that the first assumption is satisfied. Then, the construction of the production function implies that there is at least one input to produce a certain amount of output and whenever input is zero, production is also zero. Finally, it is likely that a productive sector's output is completely devoted to intermediate consumption.

With the production function, the modeller describes the technological conditions under which production takes place. But other assumptions should be made on factors of production, in particular on their mobility among sectors. Capital is usually assumed to be fixed at the beginning of each period. This seems quite reasonable: an increase in capital is due to an increase in investments which can take place only at the end of the time period, so that a higher capital stock is available only in the next time period. However, labour is mobile across sectors.

The production set is incomplete if we do not define a set of factor availability constraints. They may be written as demand excess functions for the productive factors. For instance, labour constraint may be written as:

$$\sum_i L_{is} - \overline{L}_i = 0 \tag{4}$$

Here, sectoral labour supply L_i is fixed and equals the sum of different labour skill categories employed in the *i* sector.

Until now we have described the "production possibility set" that is the "*technical description of attainable combinations of output*" (Dervis, de Melo, Robinson 1982). But to complete the supply side we have to consider the market behaviour too. In this way we derive the "transformation set".

According to the marginalistic paradigm, producers are supposed to be maximizing agents. Their objective is to maximize their profits assuming that the market acts in perfect competition so that firms take prices as they are given. As previously emphasized, in this simplified example there is no Government. Therefore, the profit equation may be written as:

$$\Pi_i = PN_i - \sum_i w_i L_{is} \tag{5}$$

Here, PN_i is the net price, or in other words, the output price minus the intermediate component. From the *Shepard's lemma*, we know that wages equal the value of marginal products for each different labour category. Furthermore, we may derive the labour demand function as a function of wages, net prices, and capital for each sector:

$$L_{is} = F_{is}(w_1,...,w_m, PN_i, \overline{K}_i) \tag{6}$$

There is a labour demand function for each sector (the sectors' total is n) and for each labour type (labour types are m), so that in the model there are $n \cdot m$ labour demand functions. If full employment is assumed, wages for each labour group adjusts until the summation of labour demand over sectors equals the fixed supply of that skill category.

Capital payments are defined residually after having paid labour and intermediate inputs. In other words, total factor payment (capital and labour) equals total value added generated.

To sum up, Dervis, de Melo, and Robinson (1982) define: "*given an arbitrary vector of allowable commodity prices leading to a non-negative vector of net prices, each sector will maximize profits subject to its capital stock, its technology, and the wages of the various types of labour*".

As Arrow and Debreu stated, the demand side must be determined. In this simplified world, the agents, who demand commodities, are only households and firms. The former demands goods to consume and the latter demands intermediate and capital goods. For the sake of simplicity, let us assume that each household owns only one factor of production: s households own the different s labour types and one household owns capital. For this reason we may simplify the income constraints in this way:

$$Y_s = \sum_i w_s L_{is} \tag{7}$$

$$Y_k = (\sum_i PN_i X_i - \sum_i \sum_s w_s L_{is}) \tag{8}$$

The first relation says that households, owning only a labour type, have an income equal to the wage rate for that labour category multiplied by the labour demand of such a type expressed by the whole economy. The second represents the capital payment as a residual post labour payment.

Therefore, there are (m+1) income constraints. Then, agents have to decide how to allocate this income. They firstly decide which fraction to save and then consume the remaining fraction. The saving decision means they decide on a proportion of their income that will be saved. So, total savings are:

$$TS = \sum_s s_s Y_s + s_k Y_k \tag{9}$$

So, we formalize the consumption functions[19] as functions of price level for the different commodities, and the available income after saving decisions. Therefore we have:

$$C_{is}^D = C_{is}[P_1,..., P_n, (1-s_s)Y_s] \tag{10}$$

$$C_{ik}^D = C_{ik}[P_1,..., P_n, (1-s_k)Y_k] \tag{11}$$

Then, aggregating the demand functions we have the total demand:

$$C_i^D = \sum_s C_{is}^D [P_1,..., P_n, (1-s_s)Y_s] + C_{ik}[P_1,..., P_2, (1-s_k)Y_k] \tag{12}$$

At first glance we may say that consumption depends upon commodities' prices and personal income (or in other words the factors' payments). But, although this idea is correct, we may simply state that demand functions depend only on the price level. Recalling the definition of Dervis *et al.*, the first step in CGE is to give a final price factor. Once given, the factor payment is the consequence. So the consumption vector function may be simplified as:

$$C^D = C(P_1,..., P_n) \tag{13}$$

To quote Dervis, de Melo and Robinson (1982): "*it is understood that behind the equation lies the solution of factor market as well as the various equations defining disposable income. Fundamentally, however, there is a simple chain of causality leading from the price vector to the vector of consumption demand*".

From the discussion about consumption we have derived a new aggregate, total savings. It is usually assumed to be completely devoted to investments. It is likely to write the investment demand function as a function of the initial price vector:

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[19] Functionally, there are many different consumption functions. The simplest one is the Cobb-Douglas function. Probably the most used is the linear expenditure system.

$$Z_i = Z(P_1,...,P_n) \tag{14}$$

Finally, the third condition in the Arrow-Debreu model regards market equilibrium or in other words the excess demand equations for commodities. Up to this point we have concluded that the price vector defines on one hand the supply side and on the other the demand components. These two effects are independent of each other. However, as the two scholars defined in 1954, equilibrium exists if and only if the same price vector ensures that demand equals supply, or, if for each sector the excess demand function equals zero:

$$EX_i = X_i^D - X_i^S = 0 \tag{15}$$

These functions have two fundamental properties. First, they are homogeneous of degree zero in all prices, and second, they are not independent. Now we briefly describe the meaning and the role of these properties while for a more detailed presentation see Dervis *et al*. (1982). The first assumption means that in doubling all prices the excess demand function always equals zero. As a consequence, "*if a vector (P_1,…,P_n) constitutes a solution to the system of n excess demand equations, any vector λ(P_1,…,P_n) proportional to it (λ>0) will also constitute a solution. There seems to be an infinite number of solutions to a system of n equations in n unknowns*" (Dervis *et al*., 1982). Now the second property is fundamental and this is also known as Walras's law. It states that nominal demand minus nominal supply is equal to zero. From some mathematical manoeuvres, we derive that this is nothing else than an accounting identity. In fact, when we built and described the model, we said that each agent demands commodities up to its nominal income value, so that for each agent the income constraint holds. But, we have also recognized that total income in the economy is simply the rate of value added at market prices. Therefore, the Walras's law holds. "*There are thus only (n-1) independent excess demand equations to determine (n-1) relative price ratios*" (Dervis *et al*., 1982).

Among these excess demand functions there is one function which holds particular importance. It considers the excess demand of savings with respect to its supply. It is called as "*the savings- investments balance*" and it is fundamental to say that the system is in equilibrium. How we handle this condition modifies the model and its behaviour[20].

[20] For a detailed description of how the saving - investment balance may be closed and the effects of this choice, see chapter 2.

The last step is the choice of a *numeraire*, or the *n*-th price, to define relative prices with respect to this one. This choice is made by the modeller. He may choose to fix the wage rate and express all the other prices respecting it, or otherwise he may decide to express prices respecting a specific commodity price. Each choice is virtually possible and correct since the theory does not impose any restrictions on the *numeraire*. Some modellers, however, prefer "*a non-inflation benchmark*". They create a weighted average of the prices in the economy using an index that may be remain stable, or may be changed over time in order to reflect projected changes in some price indexes.

Until now we have considered the simple case when, in the economy only *s* households and *i* productive sectors exist. We may easily extend the model to introduce a new agent, the Government, and analyze how it affects these relationships. Firstly, like any agent, the Government has an income. It draws not only from factors' property but also from tax payments. It may impose many different taxes; for instance a taxation on household nominal income, or a tax on factor uses, or indirect taxes on commodities' consumption. To simplify our analysis we assume only a tax on household income.

This modifies the functions inside the model but not the core of the model itself. An income tax only changes the disposable income for households and consequently consumption and decisions about savings. Therefore, equations (7) and (8) become:

$$Y_s = \sum_i w_s L_{is}(1 - t_s) \tag{7b}$$

$$Y_k = (\sum_i PN_i X_i - \sum_i \sum_s w_s L_{is})(1 - t_k) \tag{8b}$$

where t_s and t_k are the direct tax rate applied respectively to the labour workers (according to their skill category) and the capital owner.

But there is one more income constraint now because of Government presence:

$$Y_g = \sum_s t_s (w_s L_{is}) + t_k (\sum_i PN_i X_i - \sum_i \sum_s w_s L_{is}) \tag{16}$$

As usual on the basis of the disposable income, agents make decisions about savings assuming there is a fixed saving propensity, so that total final savings are the sum of the agent's savings:

$$TS = \sum_s s_s Y_s (1 - t_s) + s_k Y_k (1 - t_k) + s_g Y_g \tag{9b}$$

Instead of having only two spending agents, now we have to consider the Government. Like any other agent, its demand function depends on final prices, and its income on net of savings:

$$C_{ig}^D = C_{ig}[P_1, ..., P_n, (1 - s_g) Y_g] \tag{17}$$

Finally, the aggregate demand function has not two but three addends because we have to consider demand for the different household categories and for the Government.

In this chapter we limit the exposition of standard CGE models to the case of a closed economy with Government. However, this tool may also be applied and used for open economy issues. These kinds of models will be analyzed in details in the following chapter where we present many different ways of interpreting and modelling the foreign sector.

Below, there is a simple example of the standard exposition of a CGE model in a closed economy both with and without Government.

Box 1: A practical example of a CGE model

Here we suppose that final output, only one good, is produced employing only primary factors which are paid according to their marginal productivity. The production function is a Cobb-Douglas production function. Then, there are two household classes, workers and capitalists. The former owns labour and the latter capital. Each of them saves a fraction of his income, and, when Government is introduced, they pay direct taxes. The remaining income is completely spent, as residual. Finally, savings are completely devoted to investments.

A STANDARD CLOSED ECONOMY WITHOUT GOVERNMENT	**A STANDARD CLOSED ECONOMY WITH GOVERNMENT**
Supply side	**Supply side**
Production function	Production function
$GDP = LD^{\beta} \cdot KD^{(1-\beta)}$	$GDP = LD^{\beta} \cdot KD^{(1-\beta)}$
Factors' demand	Factors' demand
$LD = GDP \cdot \beta \cdot \left(\frac{r}{w}\right)^{(1-\beta)}$	$LD = GDP \cdot \beta \cdot \left(\frac{r}{w}\right)^{(1-\beta)}$
$KD = GDP \cdot (1-\beta) \cdot \left(\frac{w}{r}\right)^{\beta}$	$KD = GDP \cdot (1-\beta) \cdot \left(\frac{w}{r}\right)^{\beta}$
Demand side	**Demand side**
Consumption demand	Consumption demand
$WORK = LS(1 - s_w)$	$WORK = LS(1 - s_w)(1 - t_w)$
$RENT = KS(1 - s_r)$	$RENT = KS(1 - s_r)(1 - t_r)$
	$GOVT = (t_w LS + t_r KS) - GSAV$

(Box 1 continues)

Excess demand constraints	Excess demand constraints
$GDP = (WORK + RENT)\,/\,PX + INV$	$GDP = (WORK + RENT + GOVT)\,/\,PX + INV$
$LD = LS$	$LD = LS$
$KD = KS$	$KD = KS$
$(s_w LS + s_r KS) - PX \cdot INV = 0$	$(s_w LS + s_r KS + GSAV) - PX \cdot INV = 0$

GDP= nominal production, *LD*= labour demand, *KD*= capital demand, *LS*= labour supply, *KS*= capital supply, *r*= rental rate of capital, *w*=wage rate, *WORK*= nominal workers' consumption, *RENT*= nominal capitalists' consumption, s_w= saving propensity for workers, s_r= saving propensity for capitalists, *INV*= real investments, *PX*= output price, *GOVT*= nominal government consumption, t_w= direct tax rate on workers, t_r= direct tax rate on capitalists, *GSAV*= nominal government saving.

III. Partial vs General Equilibrium

The effects of an economic shock are usually studied and evaluated using two different methods: partial equilibrium analysis and general equilibrium analysis. As already described, general equilibrium analysis exploits inter-market relationships in order to analyze economy-wide effects on the whole economic structure. Partial equilibrium analysis, following the tradition of Alfred Marshall, focuses on a single market so that it can explore the effects on one market and no second round effects on other markets. It is usually referred to as the "*ceteris paribus*" assumption, where all relevant variables, except the price in question, are constant. In this case, prices of substitutes, complements, and consumers' income are assumed to be constant.

This tool is useful when the goal is to analyse a single commodity market whose size is small compared to the economy as a whole.

This approach is mainly based on the demand - supply analysis, assuming the existence of a supply curve and a demand curve, which respectively represent the marginal social cost curve and the marginal social benefit curve. Let us explore the effects of a reduction in production costs for a specific sector. Let's suppose that starting in a position of equilibrium, a cost reduction means an increase in supply because of the lower unitary cost.

Therefore, if the firm wants to spend the same amount of money, it should produce a higher level of output. But, higher supply lowers final prices. When prices go down, consumers have an incentive to buy more. In this way, at a new price level, the economy reaches equilibrium.

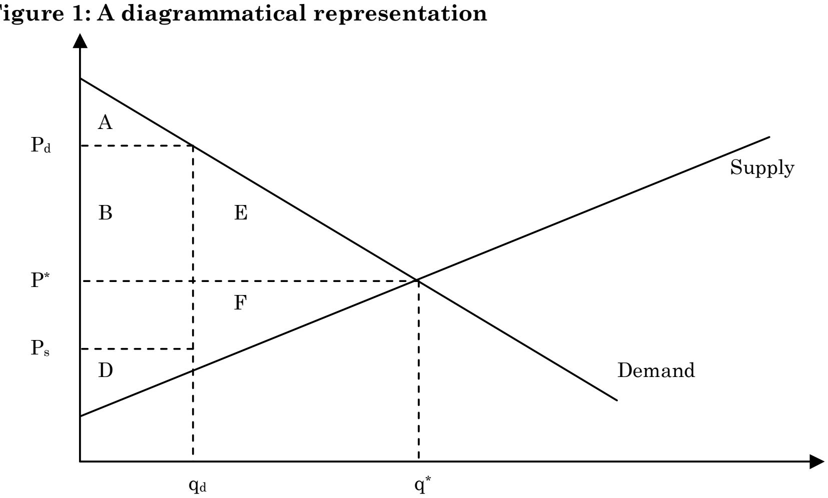
Typically, partial equilibrium analyses are applied in welfare analysis when a single market is involved. This is the case, for example, of a change in import duties for a specific good, or the imposition of a sales tax for a good.

To better define the differences and which elements are captured by the two approaches, we concentrate on the case of a new import tax on a specific good. Let us suppose this good is called *A*, which is both produced domestically and imported. This analysis is based on the usual downward sloping demand curve and the upward sloping supply curve in the space (P,q). The diagrammatical description is provided in graph 1 according to the contemporary version of the theory. As it is defined, the demand curve represents the willingness of customers to pay, in other words each combination (P, q) represents the price P consumers are willing to pay for the quantity q. The supply curve represents, given the price, the total amount of output firms want in order to supply in the market. In this case these curves represent the demand and supply at the national level for good *A*. At the starting point price equals P^* and the quantity is q^*. However, the introduction of the tariff, with a rate tm, increases the prices up to the level $P(1+tm)$, here defined as P_d. As a consequence, demand has been reduced to level q_d. Because of the higher price, consumers reduce their consumption and at the same time producers reduce their surplus. In fact, at the quantity level q_d, they obtain only P_s as price. The wedge between P_s and P_d represents the exact tax rate imposed by the Government.

The economy reaches a new equilibrium position with a lower marketed quantity and a higher price. Usually this framework is employed to answer questions like: who gains from the imposition of an import tax? How much is the loss of consumers?

To answer these, and similar questions, we have to analyse what is commonly defined as the "*little triangles*" (von Arnim, Taylor, 2006). The fundamental concepts are the consumer and the producer surpluses. The former consists of the benefit accumulated by consumers in the market from buying the good, while the latter is the benefit accumulated by producers selling the same good. To solve the welfare calculations we refer to the graph below.

Figure 1: A diagrammatical representation



Source: ***Taylor, von Arnim (2006)***

Graphically, the consumer surplus is the area below the demand curve delimited by the vertical axis and price level. The producer surplus is the area above the supply curve. In our graph, at the starting point the consumer's surplus is the area (*A*+*B*+*E*) while the producer's surplus is (*C*+*D*+*F*).

In this situation there are only these two agents but in a situation where a tax is imposed, Government is now put into the mix and its impact on the equilibrium must be studied. Therefore, after the tax imposition, we have to calculate three welfares. Consumer's surplus is reduced to area *A* and producer's surplus to area *D*. The welfare loss is now equal to (*B*+*C*+*E*+*F*). However, this loss is in part gained by Government as tariff revenue (area *B*+*C*). Therefore, the private sector's loss is partially the public sector's revenue.

As the schematic representation below in box 2 shows, a comparison between the starting point, a position of equilibrium, and the after-tax scenario demonstrates that there are two areas (*E*+*F*) which are not gains either for government or private sector. This area is usually referred to as "*deadweight loss*" and it is composed of the two "*little triangles*", to suggest that both private actors lose after the tax imposition.

Box 2: The welfare calculation

	Ex-ante	**Ex-post**
Consumer's surplus	A+B+E	A
Producer's surplus	C+D+F	D
Government surplus	-	B+C
	A+B+C+D+E+F	A+B+C+D
Deadweight loss		E+F

In their critique on partial analysis, Taylor and von Arnim (2006) stress that the existence of a collective demand function as a collective supply function may be realistic if and only if we assume producers and consumers act with the same rationale and the same behaviour. Their existence, furthermore, depends upon the assumption of a representative agent. This approach is plausible if each agent has a unitary income elasticity of demand and their income is fixed and independent of prices. Plus, producers and consumers have different taste and technologies available so it is not easy to define which is the maximizing agent. These critiques are reasonable and demonstrate lack in this approach both in its methodological and philosophical aspects.

Turning to our comparison between PE and GE, it is easy to present situations that will complicate the analysis presented.

Using the partial equilibrium theory we have solved issues on the specific market *A*. However, if we add a complementary good, *B*, the analysis becomes more complex. For instance, there should be a change in the compositional demand of the two goods. In other words, if the price of *A* increases, it is impossible to determine how consumers will decide to allocate their income. Furthermore, when a change in the demand pattern happens, firms consequently have to modify their production plans. Therefore a change in employment levels in the different sectors may occur. Finally, to give an example, the complementary good's price may move and consumers may shift their consumption to another good. We must only imagine the presence of a complementary good to complicate the picture. If we continue to consider other aspects or interactions, partial equilibrium analysis becomes less useful to describe the effects of a shock.

To sum up, partial equilibrium analysis may be an accurate way to evaluate economic shocks in a single market even if it is small compared to the rest of the economy. This does mean that the effects on this market have no relevant secondary effect on the whole economic structure. But, if the market is considerably large and if it is correlated with many other markets, partial equilibrium is not capable of capturing all the relevant effects and its results are not realistic. Ignoring the effects on other markets may be seriously misleading. However, to have a more precise and comprehensive picture of the situation, the general equilibrium approach is usually assumed to be more useful. An example may better clarify the issue: Let us suppose that an economic system produces only two goods, *A* and *B*. Then let us suppose that the government decides to levy an import tax on imports of good *A*. Here, imported goods have a higher price so that domestic production for good *A* increases. This may divert the production against product *B*. Moreover, there may be effects on employment and household income with additional effects on demand. This simple example demonstrates that a GE approach is able to pinpoint feedback and effects on flow if a policy changes.

IV. CGE models as Complementarity Problems

Until the 1970s, scholars' interest was focused on proof of existence of a general equilibrium or the feasibility of such a model. Subsequently, researchers developed a new approach to modelling and new methods for solution.

In 1985 Lars Mathiesen presented a new approach to Arrow-Debreu general equilibrium models[21] formulating them as Complementarity Problems with three sets of central variables: a price vector, an activity level vector, and an income vector.

[21] Using Mathiesen's (1985) words, the Arrow-Debreu model he referred to is described as "*The equilibrium problem of an economy is traditionally stated in terms of excess demand functions*

As he demonstrated, equilibrium among these three variables satisfies a system of three classes of nonlinear inequalities commonly defined as zero profit conditions, market clearance conditions, and income balance conditions. However, these three conditions have already been recognized as fundamental elements for defining general equilibrium since Arrow-Debreu works (paragraph II).

Here, we present each of these groups, analysing how the final relations are derived from a mathematical point of view, and the economic meaning of each relation.

Let us suppose that in this economic system there are n commodities, m productive units, and p consumers. Each of them is indexed respectively by i, j, and k.

There are many ways in which scholars demonstrate how to derive equilibrium conditions. Here we apply the one in Dixit- Norman (1980). As they affirm: "*as the ultimate objective of equilibrium theory is to examine how the actions of different price taking agents fit together, the natural building blocks should use prices as independent variables. This is best done using duality i.e. modelling consumer behaviour by means of expenditure or indirect utility functions, and producer behaviour by means of cost, revenue or profit functions*".

a. The zero profit condition

The zero profit condition for each productive unit stems from the assumption of perfect competition. It simply represents the condition that each productive sector has costs higher than, or equal to, revenues at equilibrium. In this case, we define a unit profit function, Π_j, the relative unitary cost function C_j and revenue function R_j, as a function of prices, and so the condition becomes:

$$-\Pi_j(p) = C_j(p) - R_j(p) \geq 0 \qquad \forall j$$

The cost function and the revenue function are both results of a minimizing and maximizing process, respectively:

$$C_j(p) = \min\left\{\sum_i p_i x_i \middle| f_j(x) = 1\right\}$$

$$R_j(p) = \max\left\{\sum_i p_i y_i \middle| g_j(y) = 1\right\}$$

---

determined by the endowments of the economy, the preferences of its members, and its technology. To simplify [...] *we will restrict ourselves to an economy with competitive behaviour throughout with no price distortions*".

Where *f(x)* is the aggregating function for input, and *g(y)* is the aggregating function for final production.

b. The market clearing condition

Like the previous group of relations, commodities' and factors' markets also act as perfectly competitive markets. Here, the central function is an excess demand function which aggregates the demand of each household in the economy:

The left- hand side represents the total supply of the *i*th commodity present in the market. This supply is derived partly from the productive sector *j* (whose value is obtained by applying the Shepard's lemma), and partly from the initial endowment of commodity *i* owned by agent *k*. The right- hand side is the total final demand, a function of the price level for good *i* and income for agent *k*.

Moreover, the final demands are derived from a utility maximization process of this kind:

$$d_{ik}(p, M_k) = \arg\max\left\{ U_k(x) \middle| \sum_i p_i x_i = M_k \right\}$$

As usual, total demand is derived from the utility maximization process depending on budget constraint.

c. Income balance condition

The third class represents a series of equalities which state that at equilibrium, each agent's level of income is exactly equal to the level of his factor endowments:

$$M_k = \sum_i p_i \omega_{ik}$$

This class of constraints is also known as Walras' s law, and from it complementarity arises.

The Walrasian equilibrium is defined in terms of a pair (p, y) which satisfies the following complementarity conditions:

1) Every sector in the economy earns non-positive profits[22]. In particular, if a firm has strictly negative profits, the good will not be produced.

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[22] This condition is described by Ferris and Pang (1997) using these words: "*This is due to the fact that if some sector were to make a positive profit, then by replicating its activity, the sector would make twice the*

2) Supply minus demand for each good is non-negative. However, if supply exceeds demand then the relative price will be zero.

There are other observations to be made. First, supposing that the utility function that we derive the demand function from exhibits non-satiation, according to Walras's law expenditures exhaust agents' budgets:

$$\sum_i p_i d_{ik} = M_k = \sum_i p_i \omega_{ik}$$

Combining the conditions above and if the excess demand function satisfies Walras' s law, then complementary slackness conditions are automatically satisfied. Moreover, they are a feature of equilibrium itself and not a condition for it.

Formally:

$$p_i \left(\sum_j y_j \frac{\partial \Pi_j(p)}{\partial p_i} + \sum_k \omega_{ik} - \sum_k d_{ik}(p, M_k) \right) = 0 \qquad \forall i$$

Next, the demand function is homogenous of degree zero so that if the pair (p, y) is an equilibrium, then the pairs (λp, y), for all $\lambda > 0$, are other equilibria. Therefore "*relative rather than absolute prices determine an equilibrium*" (Rutherford, 1987).

Box 3: A 2X2X2 model

In this case we have two productive sectors in the economy (A, B) each of them produces one specific output (X, Y respectively). Then there are two consumers we assume to be workers (W) and rentiers (R) so that the former owns labour and the second capital. Moreover, P_x and P_y are the prices of the final commodities, P_L and P_K, instead, are the factor prices. Y_w and Y_r stand for income of workers and rentiers respectively.

The problem we have to solve in the productive sectors is a maximization profit problem subject to a technological constraint, or, in its dual representation, a minimization cost problem subject to a non-profit condition. We apply the second approach so that the problems for the two sectors become

Sector A:
$$\min_{q_L, q_K} c_A(p_L, p_K)$$
$$st \begin{cases} c_A(p_L, p_K) \geq \pi_A \\ q_L, q_K \geq 0 \end{cases}$$

Sector B:
$$\min_{q_L, q_K} c_B(p_L, p_K)$$
$$st \begin{cases} c_B(p_L, p_K) \geq \pi_B \\ q_L, q_K \geq 0 \end{cases}$$

The relative zero-excess profit conditions are

$$\frac{\partial c_A(p_L, p_K)}{\partial p_L} X + \frac{\partial c_A(p_L, p_K)}{\partial p_K} X \geq p_x \qquad \perp X \geq 0$$

$$\frac{\partial c_B(p_L, p_K)}{\partial p_L} Y + \frac{\partial c_B(p_L, p_K)}{\partial p_K} Y \geq p_y \qquad \perp Y \geq 0$$

(Box 3 continues)
When we consider the two consumers we have to solve a maximization problem as well. They want to maximize the utility they derive from consumption subject to a budget constraint that is represented by their income. Or, as in the case above, the problem may be interpreted in its dual formulation. The problem becomes a minimizing cost problem given a certain level of utility they want to obtain:

Consumer W: $$\max_{q_x, q_y} u_W(q_x, q_y) \quad st \begin{cases} e_W(p_x, p_y) \le M_W \\ p_x, p_y \ge 0 \end{cases}$$

Consumer R $$\max_{q_x, q_y} u_R(q_x, q_y) \quad st \begin{cases} e_R(p_x, p_y) \le M_R \\ p_x, p_y \ge 0 \end{cases}$$

When solving these problems we obtain four demands: a pair for each consumer:

Demand for consumer W of good X: $\xi_{x,W}(p_x, Y_W)$
Demand for consumer W of good Y: $\xi_{y,W}(p_y, Y_W)$
Demand for consumer R of good X: $\xi_{x,R}(p_x, Y_R)$
Demand for consumer R of good Y: $\xi_{y,R}(p_y, Y_R)$

These demands enter the market clearance conditions for each commodity market:

$$X \ge \xi_{x,W}(p_x, Y_W) + \xi_{x,R}(p_x, Y_R)$$
$$Y \ge \xi_{y,W}(p_y, Y_W) + \xi_{y,R}(p_y, Y_R)$$

But there are another two markets, the factors markets, where supply and demand exist:

$$L \ge \frac{\partial c_A(p_L, p_K)}{\partial p_L} X + \frac{\partial c_B(p_L, p_K)}{\partial p_L} Y$$
$$K \ge \frac{\partial c_A(p_L, p_K)}{\partial p_K} X + \frac{\partial c_B(p_L, p_K)}{\partial p_K} Y$$

Therefore, the market clearing conditions and the related slackness conditions are:

$$X \ge \xi_{x,W}(p_x, Y_W) + \xi_{x,R}(p_x, Y_R) \qquad \perp p_x \ge 0$$
$$Y \ge \xi_{y,W}(p_y, Y_W) + \xi_{y,R}(p_y, Y_R) \qquad \perp p_y \ge 0$$
$$\partial c_A(p_L, p_K) \qquad \partial c_B(p_L, p_K)$$

To sum up, the GE equilibrium conditions have become a NLCP (Non Linear Complementarity Problem), whose general formal representation is the following:

Given $F : \Re^N \to \Re^N$

Find $z \in \Re^N, z \ge 0$ such that $F(z) \ge 0 \qquad z' F(z) = 0$

This formal statement is nothing other than the definition of the Karush- Khun- Thucker (KKT) conditions for the solution of max/min problems with inequality constraints. This specification is useful when we want to detect how empirically we may derive the GE conditions. This is the goal of box 3 below. We focus on the productive sector and we derive its equilibrium condition. We exploit the KKT conditions to demonstrate that what we obtain is exactly the zero profit condition we have previously presented in its general format.

Box 4: An example on how to derive the KKT conditions (or the equilibrium conditions in MCP)
In this example we focus on a productive sector which employs labour and capital in its production. To derive the complementarity conditions, we exploit the Karush- Khun- Tucker (KKT) conditions.
Theory assumes productive units act within a perfect competitive framework. This implies that producers want to maximize their profits depending on cost condition, or in other words, the problem may be interpreted as a minimization cost problem dependent upon a non-profit condition. Supposing it has a linear cost function, the problem becomes:

$$\min_{Q_L, Q_K} P_L Q_L + P_K Q_K$$

$$st \begin{cases} P_L Q_L + P_K Q_K \geq P_x \\ Q_L, Q_K \geq 0 \end{cases}$$

The modified Lagrangean becomes: $L^* = [P_L Q_L + P_K Q_K] - \lambda [P_L Q_L + P_K Q_K - P_x]$

Now it is possible to derive the KKT conditions:

1) The first condition states that the arguments (Q_L, Q_K) in the minimization problem should be positive, the first derivative of function L^* with respect to these variables should be lower than or equal to zero and each control variable multiplied by the respective partial derivative must be equal to zero.

A) $Q_L \geq 0$ This assumption is satisfied by definition because labour is a productive factor, and if there is production the employed factors are strictly positive.

$\frac{\partial L^*}{\partial Q_L} \geq 0$ $\frac{\partial L^*}{\partial Q_L} = P_L - \lambda P_L \geq 0$ since $Q_L > 0$ then $Q_L \left(\frac{\partial L^*}{\partial Q_L} \right) = 0$ only if $P_L (1 - \lambda) = 0$ and therefore $\lambda = 1$

B) $Q_K \geq 0$ This assumption is satisfied by definition, as in the case of Q_L.

$\frac{\partial L^*}{\partial Q_K} \geq 0$ $\frac{\partial L^*}{\partial Q_K} = P_K - \lambda P_K \geq 0$ since $Q_K > 0$ then $Q_K \left(\frac{\partial L^*}{\partial Q_K} \right) = 0$ only if $P_K (1 - \lambda) = 0$ and therefore $\lambda = 1$

2) The second condition implies that the Lagrangean multiplier, λ, should be greater than or equal to zero, the partial derivative of the L* function must be positive, and λ multiplied by the partial derivative must be equal to zero.

C) $\lambda \geq 0$ This assumption is already satisfied because of the previous conditions.

$\frac{\partial L^*}{\partial \lambda} \leq 0$ $\frac{\partial L^*}{\partial \lambda} = -(P_L Q_L + P_K Q_K - P_x) \leq 0$ changing the signs, the inequality becomes: $P_L Q_L + P_K Q_K \geq P_x$

This is the binding KKT condition for the production side. It states precisely that costs are higher than the final price like the zero profit condition we have described in the text.

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(Box 4 continues)

A) $Q_L \geq 0$ This assumption is satisfied by definition because labour is a productive factor, and if there is production the employed factors are strictly positive.

$$\frac{\partial L^*}{\partial Q_L} \geq 0 \qquad \frac{\partial L^*}{\partial Q_L} = P_L - \lambda P_L \geq 0 \quad \text{since} \quad Q_L > 0 \quad \text{then} \quad Q_L\left(\frac{\partial L^*}{\partial Q_L}\right) = 0 \quad \text{only if} \quad P_L(1-\lambda) = 0$$

and therefore $\lambda = 1$

B) $Q_K \geq 0$ This assumption is satisfied by definition, as in the case of Q_L.

$$\frac{\partial L^*}{\partial Q_K} \geq 0 \qquad \frac{\partial L^*}{\partial Q_K} = P_K - \lambda P_K \geq 0 \quad \text{since} \quad Q_K > 0 \quad \text{then} \quad Q_K\left(\frac{\partial L^*}{\partial Q_K}\right) = 0 \quad \text{only if} \quad P_K(1-\lambda) = 0$$

and therefore $\lambda = 1$

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Although originally applied for Walrasian equilibria, this interpretation may be modified in order to be applied in different contexts, for instance when a public sector exists. In this case, taxes modify the relationships between prices and the allocation of income. For example, tax imposed on factors modifies their employment because they become more expensive and their prices are unable to move independently to clear their markets. Instead, if an income tax is imposed, income will not be equal to total expenditures because households have to pay a certain amount to the Government. As Ferris and Pang (1997) point out "*when taxes are applied to inputs or outputs, the profitability of the corresponding sectors and how the sectors technology is operated may be affected*".

Let us consider a tax on inputs and a tax on final production, whose tax rates are *tl*, *tk* and *tx*, respectively. Let us suppose this makes the producer's problem change. He already wants to maximize his profits but this time the revenue function and the cost function are altered by the presence of these two taxes. Namely, inputs have higher costs now because their prices become (*1+tl*)*Pl* and (*1+tk*)*Pk*, instead of *Pl* and *Pk*.

The opposite happens for final products: their prices are lowered because a certain rate accrues to the Government so that producers' revenues are lowered.

In this case the producer problems become:

$$-\Pi_j(p) = C_j(p) - R_j(p) \geq 0 \qquad \forall j$$

But, this time the revenue and the cost functions are:

$$C_j(p) = \min\left\{\sum_i p_i x_i (1+t_i) \middle| f_j(x) = 1\right\}$$

$$R_j(p) = \max\left\{\sum_i p_i y_i (1-t_i) \middle| g_j(y) = 1\right\}$$

If the Government is a new actor inside the model, it must have an income balance condition. It demands goods and it owns an income from tax imposition, therefore its budget balance is:

$$\sum_i t_i x_i + \sum_i tx_i y_i = M_g$$

In box 5 below, there is the summary of all the possible equilibrium conditions when taxes are inserted into the model.

This is not the only example of how the fundamental Walrasian system may be modified to adapt to different cases. There may be, for instance, restrictions on quantity or price rigidity that, although not assumed in the basic format, may be introduced through some little variations or through the introduction of the concept of "*auxiliary variable*". As Rutherford (1987) states, there are different kinds of auxiliary variables but they have a common feature: "*they are linear in commodity prices,* [so that] *the constraints are invariant under scaling of the numeraire price*". The associated auxiliary variable is non negative unless the constraint is binding.

Box 5: The equilibrium conditions with taxes
We assume in this economy only one productive unit acts, using labour and capital as input. Government collects a tax on their use and the tax rate is *tl* and *tk*. Moreover, the Government itself decides on another tax on final products with rate *tx*. There is only one consumer and the Government, whose income comes entirely from tax collection. As in box 2, c is the cost function and ξ represents the demand of the consumer. The Government consumes a fixed quantity G.

Zero profit condition

$$(1+tl)\frac{\partial c}{\partial p_L}+(1+tk)\frac{\partial c}{\partial p_K}\geq(1-tx)\,p_x \qquad \perp X\geq 0$$

Market clearing condition

$$X\geq\xi(p_x,Y)+G \qquad \perp p_x\geq 0$$

Income balance conditions

$$L+K=Y \qquad \text{(Household income)}$$

$$tl\frac{\partial c}{\partial p_L}+tk\frac{\partial c}{\partial p_K}+tx(p_x X)=Y_G \qquad \text{(Government income)}$$

Non- linear complementarity problems are not enough to study the wide variety of different assumptions on variables: they may be free, bound, or non-negative, for example.

Researchers have introduced and investigated a new class of problems, the MCP (Mixed Complementarity Problem), which, using Ferris's and Kanzow's (1998) words, may be described in the following way: the problem may be reduced to find a vector $x\in[l,u]$ such that exactly one of the following holds:

$$x_i=l_i \quad \text{and} \quad F_i(x)>0$$

$$x_i=u_i \quad \text{and} \quad F_i(x)<0$$

$$x_i\in[l_i,u_i] \quad \text{and} \quad F_i(x)=0$$

To conclude and compare the standard traditional format for CGE and the MCP format, we present the two archetype economies already shown in box 1. However, this time the fundamental relations are expressed in the new format.

Box 6: The translation of CGE in box 1 into MCP format

Here, we present the MCP version of the CGEs presented in box 1. The theoretical assumptions are the same. We only note that in this case we manifestly implement that the share of each consumer's savings respect to total private savings is constant. Here we only translate the model into a Mixed Complementarity Problem highlighting the constraints and the conditions for equilibrium.

A STANDARD CLOSED ECONOMY WITHOUT GOVERNMENT	A STANDARD CLOSED ECONOMY WITH GOVERNMENT
Zero profit condition	**Zero profit condition**
$w^{\beta} \cdot r^{(1-\beta)} = G = PX$	$w^{\beta} \cdot r^{(1-\beta)} = G = PX$
Market clearing conditions	**Market clearing conditions**
$GDP = G = \left(\left(WORK + RENT\right)/PX\right) + INV$	$GDP = G = \left(\left(WORK + RENT + GOVT\right)/PX\right) + INV$
$LS = G = GDP \cdot \beta \cdot \left(\frac{r}{w}\right)^{(1-\beta)}$	$LS = G = GDP \cdot \beta \cdot \left(\frac{r}{w}\right)^{(1-\beta)}$
$KS = G = GDP \cdot (1-\beta) \cdot \left(\frac{r}{w}\right)^{\beta}$	$KS = G = GDP \cdot (1-\beta) \cdot \left(\frac{r}{w}\right)^{\beta}$
Income balance conditions	**Income balance conditions**
$WORK = E = wLS - alphaz(PX \cdot INV)$	$WORK = E = wLS(1-tw) - alphaz(PX \cdot INV)$
$RENT = E = rKS - (1-alphaz)(PX \cdot INV)$	$RENT = E = rKS(1-t_r) - (1-alphaz)(PX \cdot INV)$
	$GOVT = E = (t_r \cdot KS + t_w LS) - PX \cdot GSAV$
Accounting check	**Accounting check**
$WORK = L = (1-s_w) \cdot w \cdot LS$	$WORK = L = (1-s_w) \cdot \left(w \cdot LS(1-t_w)\right)$
$RENT = L = (1-s_r) \cdot rKS$	$RENT = L = (1-s_r) \cdot \left(r \cdot kS(1-t_r)\right)$

GDP= real production, *LD*= labour demand, *KD*= capital demand, *LS*= labour supply, *KS*= capital supply, *r*= rental rate of capital, *w*=wage rate, *WORK*= nominal workers' consumption, *RENT*= nominal capitalists' consumption, s_w= saving propensity for workers, s_r= saving propensity for capitalists, *INV*= real investments, *PX*= output price, *GOVT*= nominal government consumption, t_w= direct tax rate on workers, t_r= direct tax rate on capitalists, *GSAV*= nominal government saving.
= *G* = means greater than, = *E* = means strictly equal, and = *L* = means lower than.

V. The Mathematical Programming System for General Equilibrium (MPSGE)

Formally, General Equilibrium remains the same in both the standard format and in the MCP (Mixed Complementarity Problem) format. The three basic relations that characterize an equilibrium are the same and the same role is played by the fundamental variables. This evolution in GE representation has been a great gain.

As we have already discussed, GEs are implemented in the real World to evaluate policies and economic shocks. In this way they become AGE, or Applied General Equilibrium models. They are usually large - scale models, and are more complicated than theoretical ones.

Modellers need a tool in order to implement their models and have quantitative results. In the late 1980s GAMS (General Algebraic Modelling System) became available for the economic community, after having been a tool only at the World Bank since 1983 (when Meeraus developed this programming language). It was a program useful for solving a wide variety of mathematical problems and one of its applications was on GE. However, its structure and its rules make it too complicated to employ for large- scale models[23]. Therefore, in 1987 Rutherford created a new tool which he thought may be useful in the GAMS framework but which was specifically for GE problems. As the author himself declared: "*MPSGE is a language for concise representation of Arrow- Debreu economic equilibrium models.* […] *MPSGE provides a short-hand representation for the complicated system of non-linear inequalities which underlie general equilibrium models. The MPSGE framework is based on nested constant elasticity of substitution utility functions and production functions, the data requirements for a model include hare and elasticity parameters, endowments, and tax rates for all the consumers and production sectors included in the model*". Rutherford (2005) asserts that these two programs have different philosophies: "*MPSGE was (and is) appropriate for a specific class of nonlinear equations, while GAMS is capable of representing any system of algebraic equations*".

The great innovation of this system is double. It is an interface of GAMS. Indeed contemporaneously modellers may exploit the easier data handling and report writing facilities of GAMS and the lower data requirement of MPSGE[24]. It is also a system that "*thinks*" like an economist. It is not only able to solve mathematical systems but it organizes data according to an MCP. This is the innovation: having demonstrated that the Arrow-Debreu model may have at least two different formal representations, Rutherford has built a program which reconstructs the complementarity conditions as we have presented them in the previous paragraph. To empirically demonstrate these statements, we present in boxes 6 and 7 both the GAMS and the MPSGE versions of a simple program. We should demonstrate firstly that the GAMS version is time- consuming while in MPSGE is less so in writing down the program. Secondly, GAMS requires the extensive written record of all the equalities and inequalities. MPSGE automatically recognizes CES function (and nested CES functions). It is sufficient to point out the function and the elasticity of substitution (which is a piece of information, we can say, on the slope of the curve) thus MPSGE recognizes exactly which of the infinite CES functions is the correct one. It is evident that both programs run the MCP solver because the solution statement is common, as is the variable declaration in both cases.

Referring to the examples, at first glance the reader may rebut our thesis and say that GAMS code is shorter and therefore it requires less time to be written. If we count the lines of the codes (54 against 75) this rebut is correct, but if we analyse the contents of the model, the

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[23] To have information on the features of GAMS, see Rosenthal's (2008) user's guide.

[24] Using the words of its inventor: "*the interface between GAMS and MPSGE combines the strengths of both programs. The system uses GAMS as the "front end" and the "back end" to MPSGE, facilitating data handling and report writing. The language employs an extended MPSGE syntax based on GAMS sets, so that model specification is concise*" (Rutherford, 2005).

great advantages of the MPSGE code are clear. The fundamental element is the definition of equilibrium conditions. In GAMS the modeller has to write down the whole functional form of each condition. In our example, which has only an illustrative aim, the chosen functions are simple: Cobb-Douglas production functions. Many times, there are more complex functions, even multistage functions. In these cases, writing down the functional form is time consuming and prone to error. In MPSGE, functions are not required to be written extensively because it is sufficient to give limited information and the program is already able to solve the problem. What we need is only the benchmark data.

This advantage makes MPSGE useful both for experts and novice modellers: "*the expert knowledge embodied in MPSGE is of particular use to economists who are interested in the insight provided by formal models but who are unable to devote many hours to programming. MPSGE provides a structured framework for novice modellers. When used by experts, MPSGE reduces the setup cost of producing an operational model and the cost of producing an operational model and the cost of testing alternative specifications*" (Rutherford, 2005).

Box 7: The GAMS code for the solution of an illustrative CGE

```
$TITLE: SIMPLE CGE IN GAMS

Parameters

sw              Worker propensity to save
sr              Rentier propensity to save
alphaz          Worker savings share on total savings
INV             Exogenous real investment level
;

sw=0.125;
sr=0.25;
alphaz=0.25;
INV = 100*(sw*(40/100)+sr*(60/100)) ;

Positive Variables

V               Acivity level for productive sector
Q               Price index for commodity (value added)
r               Profit rate
w               Wage rate
WORK            Consumer Expenditures
RENT            Rentier Expenditures

Equations

ZPC_V           Zero profit condition productive sector
MC_V            Market clearing commodity
MC_L            Market clearing factor L
MC_K            Market clearing commodity K
IWORK           Worker expenditures
IRENT           Rentier expenditures;
```

(Box 7 continues)

```
ZPC_V..  100 * w**0.4 * r**0.6 =G= 100 * Q ;

MC_V..   100 * V =G= ((WORK+RENT)/Q) + INV ;

MC_L..   40 =G= 100 * V * 0.4 * w**0.4 * r**0.6/w ;

MC_K..   60 =G= 100 * V * 0.6 * w**0.4 * r**0.6/r ;

IWORK..  WORK =E= 40*w - alphaz*(INV*Q);

IRENT..  RENT =E= 60*r - (1 - alphaz)*(INV*Q);

Model CGE1   /ZPC_V.V, MC_V.Q, MC_L.w, MC_K.r,
              IWORK.WORK, IRENT.RENT /   ;

w.fx = 1 ;

V.L=1;
Q.L=1;
r.L=1;
WORK.L=35;
RENT.L=45;

Solve CGE1 using MCP ;
```

Box 8: The MPSGE code for the solution of an illustrative CGE

```
$TITLE: SIMPLE CGE IN MPSGE

Parameters

sw          Worker propensity to save
sr          Rentier propensity to save
alphaz      Worker's share of private savings
INVZ        Benchmark real investment level
WORKZ       Benchmark real worker consumption
RENTZ       Benchmark real renter consumption
GDP         Benchmark real GDP
L           Employment level in the benchmark
K           Employment level in the benchmark
;

sw = 0.125 ;
sr = 0.25 ;
alphaz = 0.25;
INVZ = 20 ;
WORKZ = 35 ;
RENTZ = 45;
GDP = WORKZ + RENTZ + INVZ ;
L = 40 ;
K = 60;

$ontext
$model:CGE1

$SECTORS:

V       ! Activity level for productive sector
```

(Box 8 continues)

```
$COMMODITIES:

Q        ! Price index for commodity
r         ! Profit rate
w        ! Wage rate

$CONSUMERS:

WORK     ! Worker expenditures
RENT      ! Renter expenditures

$PROD:V s:1

        O:Q     Q:GDP
        I:r       Q:K
        I:w      Q:L

$DEMAND:WORK

        D:Q    Q:WORKZ
        E:Q    Q:(-(alphaz*(INVZ)))
        E:w    Q:L

$DEMAND:RENT

        D:Q      Q:RENTZ
        E:Q      Q:(-(1-alphaz)*(INVZ))
        E:r       Q:K

$REPORT:

        V:RWORK         D:Q              DEMAND:WORK
        V:RRENT          D:Q              DEMAND:RENT
        V:RGDP           O:Q              PROD:V
        V:EL                I:w               PROD:V

$offtext
$sysinclude mpsgeset CGE1
$include CGE1.gen
Solve CGE1 using MCP;
```

Therefore, defining general equilibrium as an MCP is not only a theoretical innovation but it is translated into a new instrument for empirical analysis[25].

Here, we present the main features of this system since we will employ it in our further simulations. We will start with the benchmark, how to build it and its importance, and then move on to the syntax.

Like any tool used for policy evaluation, we need an initial benchmark to calibrate our model; to check the benchmark replication in order to affirm that the system is well written and ready to be employed for analysis. Any AGE requires a benchmark that is commonly represented by a SAM (Social Accounting Matrix), which in a compact format (a square

[25] Although the theoretical foundation of MPSGE is the MCP representation of general equilibrium, the evolution of MPSGE requires another innovation: the SLCP (Sequence of Linear Complementarity Problems) algorithm, created by Mathiesen in 1985. For information see Mathiesen (1985, 1987).

matrix) represents the situation in a specified country at a specified time[26]. When we employ MPSGE, the benchmark becomes something similar to a SAM but it is a rectangular matrix called MCM (Micro- Consistency Matrix). It is composed of rows and columns. Rows represent commodities (final goods, factors of production, taxes, savings) while columns are either production sectors or agents (consumers, Government, rest of the World). Entries may be positive or negative; positive entries define a receipt (or sale) for a market, while negative entries signify an expenditure (or purchase) by a market.

There are some accounting rules to follow just like in a SAM. Using Markusen's (2004) words: "*a rectangular matrix MCM is balanced or micro- consistent when row and column sums are zeroes*". Moreover, "*a row sum is zero if the total amount of commodities flowing into the economy equals the total amount of commodities flowing out of the economy* […] *a production sector column sum is zero if the value of outputs equals the cost of inputs*" and "*a consumer column is balanced if the sum of primary factor sales equals the value of final demands*". As these definitions suggest, these three rules interpret the principle of Walras's law, the zero profit theorem, and the product exhaustion theorem respectively. In fact, the first condition declares the market clearance for each commodity in the model. Therefore, there is a positive entry which represents the total sales and with negative signs, the different components of its final demand. The production column has a positive entry, the total production, and negative entries, the inputs used in the productive process. Finally, for each consumer, his final demand for the different commodities (negative entry) is equal to his total income (positive entry).

Like in the SAMs, each entry represents a value, which is price times quantity. This means the modeller may decide how to model prices. Usually, prices are set equal to one in order to interpret the value of the entries as quantities.

If it is possible, the use of MCMs is opportune. "*This format emphasizes how the MPSGE program structure is connected to the benchmark data*" (Rutherford, 2005). The benchmark equilibrium is expressed in the row and column sums. Columns corresponding to productive sectors have the sum of zero, reflecting the zero profit condition, as specified in the theoretical framework. Columns corresponding to consumers have the sum of zero in order to represent the income balance conditions where total income is devoted to final demand, savings, and

[26] A very concise description of a SAM is provided by Rutherford (2005): "*The input data is presented in the form of a balanced matrix, the entries in which represent the value of economic transactions in a given period. SAMs can be quite detailed in their representation of an economy, and they are also quite flexible. Traditionally, a SAM is square with an exact correspondence between rows and columns.* […] *The numbers which appear in a conventional SAM are typically positive, apart from very special circumstances* […]".

eventually tax payments. Row sums are each zero, indicating the last equilibrium condition: the market clearing condition.

In box 8 there are two MCMs. The first one is the benchmark for the codes presented above (which ultimately are the codes for the simple closed economy model without Government presented in box 1 and 5). The second one is a likely benchmark for the closed economy with Government as an example.

Box 9: Two illustrative MCMs

	Productive sector	Consumers			Row sum
Markets	**GDP**	**WORK**	**RENT**	**INV**	
PX	100	-35	-45	-20	0
PK	-60		60		0
PL	-40	40			0
SAV		-5	-15	20	0
Column sum	0	0	0	0	

	Productive sector	Consumers				Row sum
Markets	**GDP**	**WORK**	**RENT**	**GOVT**	**INV**	
PX	100	-30	-40	-10	-20	0
PK	-60		60			0
PL	-40	40				0
SAV		-5	-10	-5	20	0
TAX		-5	-10	15		0
Column sum	0	0	0	0	0	

After having assigned values in the benchmark, the code should be written in the proper way for the program to be able to read the instructions. As we have already cited, the MPSGE program is inserted in the GAMS program. There is a specific command which tells the program to pass to the MPSGE subsystem and a similar command which returns to GAMS. They are $ONTEXT and $OFFTEXT. Moreover the modeller must assign a name to the model because at the end of the code, it is necessary to refer to that name. The declaration of variables follows. There are four blocks of required information:

1) $SECTOR: in this block the modeller defines the productive sectors where the zero profit condition must hold for equilibrium. Here, the corresponding complementarity variables are shown. In this case they are the activity levels.

2) $COMMODITIES: in this block the markets that should clear are listed. Each of them is characterized by a complementarity variable, which is the price of the commodity itself.

3) $CONSUMERS: in this block there is the definition of the agents whose income balance holds. The related complementarity variable is the nominal expenditure level.

These three declaration blocks are fundamental for a CGE representation while the fourth block depends on the model specifications.

4) $AUXILIARY: in this case we must employ the definition of auxiliary variables when want to model constraints or non - Walrasian systems.

After the declaration of sectors and variables, the program requires us to assign values to each block. The key element is $PROD: when we want to assign values for a productive sector, and $DEMAND: when we want to assign values for each consumer. Let us now describe firstly the $PROD: block. The first line includes the command, the name of the productive sector and the elasticity of substitution between inputs, and elasticity of transformation when a combined production in a single sector occurs. Then the second line includes three fields; the O: field refers to which one is the produced commodity, Q: is the field for the produced quantity and P: is the price. We may read this line as follows: "*the sector whose output is a commodity such that its price is what we have fill in the* O: *field and whose quantity is inserted in the* Q: *field. Then, its final price is the one in* P:". The following lines are quite similar but the first field is now I: which stands for inputs.

As an example, in box 7, the productive sector is called *V* and produces a commodity whose price is *Q*. The final production is 100. There is not any P: field since we assume the default value to be 1. To produce that good, the sector employs two inputs whose prices are *r* and *w* in quantities 60 and 40 respectively. There is no elasticity of substitution between inputs because we assume a Cobb - Douglas function whose elasticity is unitary (one is the default value).

The $DEMAND: block should be referred to an agent in the first line. Then, in the D: field there is the price of the demanded commodity and in Q:, the related quantity. In the following lines the first field is the E: field, which means endowments, and then as usual the Q: field is where the quantity is inserted.

In our example there are two $DEMAND: blocks one for workers and one for renters but both of them present the same scheme: the definition of the agent ($DEMAND:WORK, $DEMAND:RENT), the definition of the demands (D:Q Q:WORKZ and D:Q Q:RENTZ), and the definition of the endowments (E:Q Q:(-(alphaz*(INVZ))), E:w Q:L, E:Q Q:(-(1-alphaz)*(INVZ)), and E:r Q:K).

This block may be read in this way: "*there is an agent who demands for a good whose price is in the* D: *field in quantity* Q: *field. He is endowed with commodities whose prices are in* E: *fields and in quantity* Q: *fields*".

If an $AUXILIARY: block has been defined, there should be a $CONSTRAINT:, an equation that is set to give a value to the auxiliary variable. It must be written in GAMS language.

Finally, a useful tool is the $REPORT: block. It is not necessary to solve the model but it could be useful in the output file. In fact, in this block we build a variable V: which refers to one of the variables we have used before. For example, in the box above, in the report file we have created a variable whose name is RGDP, which means real GDP. But we must tell the program where to find this value. In this case we say: "*go to the output field of a commodity whose price is Q in the producer block PROD:V*". Therefore, in the output file these useful values are directly shown.

2. Computable General Equilibrium Models: Macroeconomics and Closures

The debate on macroclosures became popular in the late 1970s and in the early 1980s because of two contemporary events. The first is that Amartya Sen published his famous paper discussing four fundamental closures for a simple CGE model in 1963 on the wave of the strong academic debate between Neoclassicals and Neokeynesians. The second is that the first large- scale applied models were constructed (Adelman and Robinson for South Korea (1977), and Taylor *et al.* for Brazil (1980)) and their results were surprising.

With the improvements in computer science and more powerful mainframes, large- scale applied models were built. First attempts were made to conduct these analyses with Walrasian models interpreting any solution's deviation as the measurement of imperfect competitive behaviour and market failures. However, each country was a different case. Each of them had a different structure and different relationships among macroeconomic aggregates. So, each modeller's aim was to construct a more country- specific model. To succeed, the closure problem was crucial. As Taylor (1990) said: "*a sense of institutions and history necessarily enters into any serious discussion of macro causality*".

The debate started when Sen (1963) analysed a simple version of a closed CGE model and stated that "*it is no longer possible* […] *to simultaneously maintain the value of public consumption expenditures at a predetermined level, to compensate the economic agents according to marginal productivity in terms of the value of the factors of production they hold and to satisfy the labour market equilibrium*" (Decaluwé, Martens, and Savard, 2000). From a mathematical point of view, the system was over-determined and this meant it had more than one solution. Practically speaking, the problem was to have a squared system with an equal number of endogenous variables and equations. In this specific case the modeller had to choose to drop a specific assumption.

Depending on which assumption is dropped, the model has a different closure[27]: Neoclassical, Keynesian, Johansen, or Kaldorian[28]. Thus, the problem, from Sen's point of view, was theoretical and was derived from an extensive debate after Kaldor's review on income distribution.

A further step in the closure debate was the 1979 paper of Taylor and Lisy. Their work was based on the intuition that the results of an applied CGE model are affected by an aspect which is not usually analysed. Based on their experience with an applied model for Brazil, they were particularly concerned with distributional changes. We may describe their aim using Llunch's (1979) words: "*they wanted to see why policy experiments with their Brazil model had a large impact on the price level, a minor one on the labour share and almost none on aggregate output. with the model stripped down to the bare essentials, they found that in the hurry to disaggregate over commodities and agents, a different dimension had been forgotten: the disaggregation over closing rules*". They compared a traditional neoclassical system with two other Keynesian closures to see how the same model works. Effectively, when this happens many changes take place. The Keynesian closures allow for changes in output through the multiplier when changes in wages, and consequently in prices, occur.

Moreover, the core version of Sen's model was extended to include government (Rattsø, 1982, Robinson, 2003), and the external sector (Taylor and Lisy, 1979; Decaluwé, Martens, and Monette, 1987; Dewatripont and Michel, 1983; Robinson, 2003)[29]. In this case, the closure problem still holds, but becomes more complex. When the modeller closes a model, it refers to *ex- ante* equilibriums in different markets. For instance it should determine how the savings-investments market works, which aggregate is predetermined and which one moves to reach the equilibrium. In a closed economy, the only *ex- ante* equilibrium conditions to specify are the labour and the saving- investments markets. In an open economy we have to introduce a new equilibrium condition in the foreign exchange rate and to count for new sources of savings in the savings- investments balance.

---

[27] Llunch (1979) simply reduces the problem to the dichotomy between Neoclassical and Keynesian closures. He states that the closure problem may be solved dropping one equation. If the modeller chooses to drop the exogenous fixed investments' assumption he obtains a Neoclassical closure. If the full employment assumption is dropped he has the Keynesian closure.

[28] These labels do not strictly trace the original work of the corresponding authors, but each of these definitions has its own variants. What is defined as "Kaldorian" is not properly related to the work of Nicolas Kaldor but it contains many different approaches: Neo- Keynesian, Neo- Marxian, Structuralist and obviously Kaldorian in a strict sense.

[29] A concise summary of the state- of - the - art in the closure debate is presented in table 1.

The aim of this chapter is dual. First, we want to describe in a theoretical way the different macroclosures that may be applied in a CGE model, focusing on the adjusting mechanism at the base of each one and how the structure of the model itself changes as a response to a change in the closures. Second, we want to quantify the effects of a closure rule choice. Therefore, we develop three simplified models. Two are for a closed economy, both with and without Government, and one is for an open economy. We apply the different closures and we discuss the final results. We are particularly interested in describing how the closures affect the result of a model, and furthermore to understand the impact of opening the model while applying the same closure. In other words, we are interested in comparing the results of the closed and open economy model with the same closure.

In the following pages, a brief summary of the state- of- the- art in macroclosure debate is presented. Here, fundamental papers are cited and for each of them we highlight which kind of model is investigated (i.e. closed or open), the nature of the analysis (i.e. theoretical or empirical application), which closure rules are applied (according to our distinction into the four fundamental closures) and final results.

Table 1: The State- of- the- Art in the Macroclosure Debate

Author	Framework	Problem	Closure	Result
Sen (1963)	Closed Economy	He recognizes a theoretical problem in the mathematical structure of a closed CGE: the system is over-determined thus it has more than one solution. It is impossible while fixing investments to have marginal productivity remuneration and full-employment.	He recognizes four main closure rules: Neoclassical, Keynesian, Johansen, and Kaldorian. Each of them drops one specific assumption.	Applying each of these closures the system is now determined with a unique solution.
Taylor, and Lisy (1979)	Open Economy	Analysis of the impact of different closure rules in a CGE with a distributional focus, as the large- scale model for Brazil they have already developed.	Neoclassical vs Keynesian closures.	The closure choice matters. The results of the Neoclassical approach are very different from the ones of the Keynesian. Moreover, the effects of a Keynesian closure are mitigated when any macroeconomic aggregate is fixed in nominal terms.
Llunch (1979)	Open Economy (more precisely the same of Taylor and Lisy (1979))	Analysis of few alternative closures on a simplified version of the Taylor and Lisy (1979) model.	Neoclassical with full employment as the reference. Classical unemployment and Keynesian unemployment.	The closure rule matters. However the author reduces its role. He supposes as sufficient how the modeller closes the labour market. The labour market rules characterize the closure of the model.
Rattsø (1982)	Closed and Open Economy	Analysis of the different closures and application to the original Johansen model.	He applies the four closures Sen had already classified.	He quantitatively analysed the effects of a different closure choice.
Dewatripont, and Michel (1983)	Open Economy	Study the closure rule problem in different exchange rate regimes.		When there is fixed exchange rate, the model has already closed. So, the closure rule is crucial only in a case of floating exchange rate.
Decaluwé, Martens, and Monette (1987)	Open Economy	Study in an open economy framework, the possibility of different closure rules, and their effects respect to supply and demand shocks.	They apply the usual four closures in a floating exchange rate regime.	They derive different magnitudes in the effects of the closure choice if they suppose a supply disturbance (increase in the capital stock) or a demand disturbance (increase in exports).

(table 1 continues)

Author	Framework	Problem	Closure	Result
Taylor (1990, 1991)	Literature Survey	Presentation of the concept of the problem, what the closure choice means.	He concentrates on the Kaldorian closures in comparison with the Neoclassical. The Kaldorian closures contain the main element of the Keynesian one (the aggregate demand effect) so that it is a comparison among the three models. Moreover he describes closures for heterodox models (Loanable funds closure, and the Pigou or Real Balance effect closure).	Theoretical presentation and analysis of the macroeconomics behind an adopted closure rule.
Abdelkhalek, and Martens (1996)	Open Economy	How to choose the appropriate closure rule when there is no prior information.	Neoclassical, Keynesian, Johansen.	The solution of the problem is testing the significance of the simulation imposing upper and lower bounds for each closure.
Thissen (1998)	Literature Survey	Analysis of the likely closures for a generic CGE model	He describes the four closures but he splits the Kaldorian closure into four different closures: the Neo-Keynesian that is the Kaldorian in a strict sense, the Kaleckian or Structuralist, the Loanable funds closure, and the Pigou or Real Balance effect closure.	A taxonomy of the different closures and a classification of empirical CGE models.
Decaluwé, Martens, and Savard (2000)	Open Economy	Effects of the alternative closures of the Neoclassical approach.	Keynesian, Kaldorian, Johansen.	There are different relations at the basis of each assumption. Mainly, they recognize a different mechanism for income generation and distribution.
Robinson (2003)	Closed and Open Economy	Analysis of the different closure rules in a closed and an open economy.	The four closure of Sen both in the closed economy and the open economy version.	He stresses the role of foreign savings in closing the saving-investment gap.
Gibson (2008)	Closed Economy	The closure problem may be overcome.	Keynesian vs Neoclassical closures.	The need of a choice in the closure rule may be overcome when we introduce multi-agents and dynamic.

I. The original Sen's dilemma

As previously cited, the closure rule problem arises through two distinct avenues. In mathematical terms this choice has to solve the problem of a system where the number of equations is not equal to the number of endogenous variables. In practice, the modeller decides which variables are endogenous and which ones are exogenous. Furthermore, the modeller's decision is a personal belief about the economic structure when deciding a plausible adjustment process. This statement was formally carried out by Sen in his 1963 paper.

Here, he demonstrates the simplest case of a closed economy without Government where the closure choice still matters[30]. As Rattsø (1982) presented, the framework is composed of 7 equations. In this model one product is produced with constant returns to scale (CRTS) technology, and factors are paid according to the value of their marginal productivity (equations 1 and 2). Then, only capital and labour are employed and they are fixed in supply (equations 6 and 7). Because of the exhaustion theorem, the total income is divided between profits and a wage bill (equation 3). In the model, there are two classes of agents, wage earners and rentiers, and each of them has a specific saving propensity. Moreover, investments are fixed in real terms. To reach equilibrium in the system, savings and investments must be equal.

Table 2: The original Sen's Model

$$X = f(N,K) \tag{1}$$

$$PF_N = w \tag{2}$$

$$PX = rK + wN \tag{3}$$

$$PI = s_R rK + s_W wN \tag{4}$$

$$I = \bar{I} \tag{5}$$

$$N = \overline{N} \tag{6}$$

$$K = \overline{K} \tag{7}$$

Source: ***Rattsø (1982)***

However if we count for the endogenous variables, there are only six: X, N, K, I, w/P, r/P. This means the system is over-determined. In order to be solved, it must have as many equations as unknowns.

According to Sen we must drop one assumption, but this choice is not trivial. There are a minimum of four possible choices, although as Robinson (2003) stresses, "*the different macroclosure models range along a continuum*". However, in terms of reference we mainly focus on the *Neoclassical*, *Keynesian*, *Kaldorian* and *Johansen* model closures. In a concise form, this choice may be reduced to dropping one specific equation. In the *Neoclassical closure*

[30] To have a quantitative exposition of the Sen's model and an empirical application in an archetype economy see section II. For the simulation we have employed, see the MPSGE/GAMS software.

we drop equation 5 so investments are not exogenously determined but endogenous, and consequently their amount is equal to savings. The *Keynesian closure* allows for unemployment which eliminates equation 6. In this case labour supply is not fixed, but endogenized. The *Johansen closure* is a mid- point between the Neoclassical and the Keynesian. It maintains the neoclassical setup on the production side but there is also an exogenous level of investments (as in Keynes). In this case, the fundamental mechanism works through an endogenous fiscal policy instrument[31]. Finally, there is the *Neo-Keynesian closure* (in Sen's terminology, otherwise also defined *Kaldorian*), where an income distribution mechanism acts.

These four models may be classified on the basis of the factor market and the laws it follows. From this perspective, the *Neoclassical* and the *Johansen* closures may be compared. Both of them assume that the production side has full utilisation of available resources so that real wage and the rate of return to capital are determined[32]. Therefore, the production side is completely separated from the demand side where the two models differ. There is no room for an interaction between the two sides.

Neoclassicals suppose there is a level of investments that equals the total amount of savings that are fixed in the economy. The Johansen closure assumes exogenous investments and endogenous consumption, whose volume adjusts to liberate sufficient savings.

The other two options consider more complicated interactions. The *Keynesian* possibility supposes that a supply- demand interaction determines employment level, output, and relative prices. The *Kaldorian* closure supposes that employment and output are fixed but income redistribution takes place and frees the necessary savings.

In the table below, we present schematically how the different closures model the assumptions on the factor market, and the assumptions on the *ex- ante* identity between savings and investments.

In the summary below, we highlight which variables in the core model are fixed and which ones are not. Thus, the final step is to describe which adjusting mechanism acts and the interactions inside the model itself. As Taylor (1991) points out: "*prescribing closure boils down to stating which variables are endogenous or exogenous in an equation system largely based upon macroeconomic accounting identities, and figuring out how they influence one another. When one is setting up a model for any economy, the closure question becomes more*

[31] This means an endogenous consumption.

[32] Real wage is determined by the solution of the first- order condition in the maximization problem the producers face. And the return to capital is interpreted as the residual.

interesting, transforming itself to one of empirically plausible signs of "effects" and, more important, a perception of what are the driving macroeconomic forces in the system".

Table 3: A summary of the four macroclosures sssumptions

	Neoclassical	Keynesian	Johansen	Kaldorian
Equilibrium in the factor market	Full-Employment	Unemployment	Full- Employment	Full-employment
Ex- ante equilibrium in savings-investments	Saving- driven	Exogenous investment	Exogenous investment	Exogenous investment
Variables				
P	Numeraire	Numeraire	Numeraire	Numeraire
N	Fixed		Fixed	
K	Fixed	Fixed	Fixed	Fixed
I		Fixed	Fixed	Fixed
w		Fixed		Fixed
s_R, s_W	Fixed	Fixed		Fixed

II. The closure rule problem in a closed economy without Government

To follow with our simulations on detecting how the closures work and the peculiarities of each model, we use a numerical representation of an archetype economy. The numerical values are as follows: total output, $X = 100$, is divided among consumption out of wages, $C_w = 45$, consumption out of profits, $C_r = 20$, and investments, $I = 35$. All prices are set equal to one in the base level. Total output is produced employing labour, $L = 60$, and capital, $K = 40$.

The saving propensities are assumed to be $s_w = 0.25$ and $s_r = 0.5$ for workers and capitalists, respectively. For the sake of simplicity we assume that we have a Cobb- Douglas production function.

Then, to summarize the values, we adopt an MCM (Micro- Consistency Matrix) which is the starting point for the building of the MPSGE code.

Box 10: An illustrative MCM for a closed economy without government

	ACT	WORK	RENT	INV
PX	100	-45	-20	-35
w	-60	60		
r	-40		40	
SAV		-15	-20	35

Source: ***Author's own model***

a)The Neoclassical closure for a closed economy

In the *Neoclassical closure* there are no fixed investments (the real investment target is abandoned). This implies the existence of a mechanism that causes investments to be equal to savings at the full employment level. Simply, whatever is saved is invested. The adjusting mechanism, not explicitly modelled, is an interest rate effect like in the Solow growth model

(1956)[33]. The total effect on production is nil. There is no GDP effect. In this way the only effect is compositional on total demand. This means that when investments move to equal savings, there is a contemporary opposite movement in the other demand components (namely consumption). In order to increase the GDP level, we have to increase the available inputs so that firms may move towards a north-eastern isoquant[34].

To better explain these mechanisms we refer to box 11, where a simple closed economy model is presented in MCP format (Mixed Complementarity Format[35]). Then, we will assume two different shocks: a demand side shock with a 10% increase in real investments, and a supply side shock with a 10% increase in capital supply.

Box 11: The MCP format for a Neoclassical closed economy model without government

$$w^{\beta} \cdot r^{(1-\beta)} = G = PX \tag{1}$$

$$GDP = G = ((WORK + RENT)/PX) + INV \tag{2}$$

$$LS = G = GDP \cdot \beta \cdot \left(\frac{r}{w}\right)^{(1-\beta)} \tag{3}$$

$$KS = G = GDP \cdot (1-\beta) \cdot \left(\frac{w}{r}\right)^{\beta} \tag{4}$$

$$WORK = E = w \cdot LS - alphaz \cdot (PX \cdot INV) \tag{5}$$

$$RENT = E = r \cdot KS - (1 - alphaz) \cdot (PX \cdot INV) \tag{6}$$

$$WORK = L = (1 - s_w) \cdot w \cdot LS \tag{7}$$

$$RENT = L = (1 - s_r) \cdot r \cdot KS \tag{8}$$

GDP= total domestic production, *PX*= output price, w= wage rate, *r*= rental rate of capital, *WORK*= nominal workers' consumption, *RENT*= nominal rentiers' consumption, *INV*= real investment, *LS*= labour supply, *KS*= capital supply, *alphaz*= workers' saving share on total private saving, s_w= saving rate for workers, s_r= saving rate for rentiers.
= *G* = means greater than, = *E* = means strictly equal, and = *L* = means lower than.

Source: *Authors' own model*

In the box above, we summarize the fundamental relations that describe the model. Equation (1) is the dual representation of the production function. Firms employ labour and capital (*LS* and *KS*) paid *w* and *r*, respectively. Theoretically speaking, this equation represents the "*zero profit condition*" for sector *X*: production costs are greater or equal to final sale prices when firms act in perfect competition. The production function is a CD function with an elasticity of substitution between inputs equal to β. Then, equations (3) and (4) follow

[33] This closure, although correct in macroeconomic terms, partly contradicts the macro nature of the CGE model where it is employed. In the CGE there is no money or financial market. However, the mechanism is based on a monetary variable (the interest rate) which is not directly described by the model. This issue is part of the debate on Neoclassical CGE models (see Robinson (2003)).

[34] For a diagrammatical representation of isoquants in the plane see Varian (1992).

[35] For a description of the MCP format in describing CGE models, see Rutherford T. F. (1987, 2005), Markusen J.R. (2002), Mathiesen L. (1985a, 1985b).

as the *Shepard's lemma*: the first derivative of the production function with respect to an input equals the ratio of the input itself with respect to total production[36]. Equation (2) represents a "*market clearing condition*". It simply states that in real terms production is fully exhausted by consumption (in this case of two classes, workers and rentiers, *WORK* and *RENT* respectively) and investments (*INV*). Equations (5) and (6) are the "*income balance*" equations: total income is devoted to consumption and savings. Since here we are in a Neoclassical context, savings are equal to investments. A difference from the original Sen's model is the utilization of parameter *alphaz*. It represents the share of workers' savings with respect to the total private savings.

This means each consumer participates in totalling investments according to this share. Finally, equations (7) and (8) are "*constraint conditions*" which define consumption as the residual income after decisions about saving.

If we count for the variables of the model, we have 4 parameters, β, *alphaz*, s_w, and s_r; and we have 9 variables, *GDP*, *LS*, *KS*, *INV*, *w*, *r, WORK, RENT, PX.* To solve the system we need an equal number of unknowns and relations so we have to fix one variable exogenously. Since we want to build a Neoclassical model, we suppose that *LS* is fixed and the identity between savings and investments holds.

Let us describe the first possible shock: a demand side shock due to a 10% increase in real investments[37]. As we have previously assumed, this kind of shock leads to a simple reallocation of the available output. Firms face the same production function since they have the same amount of input. If the input combination is the same, the firm is on the same isoquant so that total output doesn't change (from relations (1), (3) and (4)). However, investments increase by assumption and this means that private consumption (in this case a combination of workers' and rentiers' consumptions) has to decline (to satisfy relation (2)) .

From relations (5) and (6) we derive the negative relationship between private consumption and investments. From relations (7) and (8) we derive the consequence of a negative relationship between consumption and savings.

Quantitative results are presented in table 5. Real and nominal GDP are stable at the benchmark level, as are labour and capital employment. A change occurs in the private consumption levels. Workers diminish their consumption by more than 3% while rentiers diminish theirs by 10%. The increase in investments (by assumption, 10%) is satisfied by a

[36] For the mathematical proof, see Varian (1992).

[37] Formally, when we follow a Neoclassical model, we should use another expression to define this shock: a 10% increase in total savings. In this way we capture the causality inside the model: a change in savings stimulates a change in investments and not the other way round.

contemporaneous increase in workers' and rentiers' savings (both increased by 10%). It is valuable to highlight that the two social classes' free available savings depend upon the *ex-ante alphaz* share.

More properly, the change in available savings allows investments to increase. The causal chain goes from savings to investments as the fundamental element in the Neoclassical framework.

When we move to a supply side shock (namely a 10% increase in capital supply) a bit more complicated mechanism takes place. The production function does not change, and so the ratio *r/w* is stable. However, in the new situation labour is the scarce factor and its remuneration increases, and as a consequence the profit rate increases. Since both factor prices are raised, the final price *PX* increases as well according to relation (1). In real terms there is the same output level and redistribution is all that takes place between capitalists and workers. The former faces a higher income so that they allocate this increase between consumption and savings, while workers reduce their consumption in favour of savings.

This effect is a price effect: now good *X* is more expensive causing workers to decide to consume less because their real income is lower while capitalists increase their consumption because of the increase in their real income.

As before, numerical results of the simulation are presented in table 6. The supply side shock affects nominal variables, the general price level, and the profit rate-wage ratio. As a consequence, the changes in real variables are driven from a price effect. It is worth noting that real investments are not affected. Also in this case the *alphaz* parameter is fixed at its benchmark level as in the case of the demand side shock.

b) The Keynesian closure for a closed economy

In the *Keynesian closure* labour market equilibrium does not necessarily exist. Each activity employs labour according to an increasing function of production and decreasing in real wages. In this way, households' income is determined and savings are adjusted in order to bring savings and investments into equilibrium. This may be different from those at the full employment level. Here the multiplier effect takes action. When investments increase, there is a higher demand for production so that firms have to hire extra workers up to the full-employment level. With this kind of closure, this simple CGE model becomes a textbook case of a multiplier model with expansionary effects on output and employment as Keynes predicts.

As Robinson (2003) describes, we may have different models which satisfy Keynes' prescriptions. Specifically, he discusses two different Keynesian closures. Both of them are coherent with Keynesian macroeconomics although they suppose an economic system that works rather differently. The fundamental assumptions adopted are both a multiplier mechanism and an exogenous investment level. But the labour demand may be modelled differently. In the first case (Robinson calls it the "*Keynesian 1 closure*"), labour supply is supposed to be endogenous so the adjusting mechanism works through adjustments in the real wage. But this model assumes firms are on they labour demand curve, so that wages decline to give firms an incentive to hire extra- workers.

A different story is for "*Keynesian 2 closure*". In this case wages are fixed and the labour supply is assumed to be free. Firms are not on their labour demand curve and there is a distortion between effective wages and the marginal productivity.

Although the original debate did not consider these peculiarities, in our work we want to apply what we call "*Bastard Keynesian closure*" (using the terminology of von Arnim and Taylor (2006, 2007a, 2007b)). It is nothing else than what Robinson defines as "*Keynes 1 closure*". The multiplier still works but the labour market is Neoclassical in fashion: firms are on their labour demand curve and pay labour according to its marginal productivity. It is likely to have unemployment but it could be eliminated through a reduction in wages.

The "Bastard Keynesian" closure is presented formally in box 12 in the MCP format.

Box 12: The MCP format for a "Bastard Keynesian" closed economy model without government

$$w^{\beta} \cdot r^{(1-\beta)} = G = PX \tag{1}$$

$$GDP = G = ((WORK + RENT)/PX) + INV \tag{2}$$

$$m \cdot LS = G = GDP \cdot \beta \cdot \left(\frac{r}{w}\right)^{(1-\beta)} \tag{3}$$

$$KS = G = GDP \cdot (1-\beta) \cdot \left(\frac{w}{r}\right)^{\beta} \tag{4}$$

$$WORK = E = w \cdot m \cdot LS - alphaz \cdot (PX \cdot INV) \tag{5}$$

$$RENT = E = r \cdot KS - (1-alphaz) \cdot (PX \cdot INV) \tag{6}$$

$$WORK = L = (1-s_w) \cdot w \cdot m \cdot LS \tag{7}$$

$$RENT = L = (1-s_r) \cdot r \cdot KS \tag{8}$$

GDP= total domestic production, *PX*= output price, *w*= wage rate, *r*= rental rate of capital, *WORK*= nominal workers' consumption, *RENT*= nominal rentiers' consumption, *INV*= real investment, *LS*= labour supply, *KS*= capital supply, *alphaz*= workers' saving share on total private saving, s_w= saving rate for workers, s_r= saving rate for rentiers, *m*= endogenous labour supply multiplier.
= *G* = means greater than, = *E* = means strictly equal, and = *L* = means lower than.

Source: *Authors' own model*

Essentially, the model is similar to the Neoclassical version. The main difference is the introduction of *m*, the endogenous labour supply multiplier. It answers the question of how many workers want to be employed. This is a way to model unemployment or under-employment. In this way any change in *m* has to be interpreted as a change in labour supply. Fundamentally, the model works like the previous one. In this case, however, there are 8 equations in the model, 4 parameters, β, *alphaz*, s_w, and s_r, and 10 unknowns, *w*, *r*, *PX*, *GDP*, *WORK*, *RENT*, *INV*, *m*, *LS*, and *KS*. So, we have to fix 2 variables: the first one is *INV*, according to Keynes' ideas on exogenous investment level, and the second is the choice of w as the numeraire of the model.

Also in this case, we suppose that in our economy the two shocks occur. The interesting aspect is to compare the results with the ones of the Neoclassical closure.

Firstly we suppose a 10% increase in real investments occurs. The mechanism is the one described above, that is, a textbook case of multiplier effect. An increase in investments is an increase in a final demand component. To satisfy it, firms have to hire extra workers at the full employment level. This choice affects the level of m, which increases. Labour becomes the abundant factor so that profit rate increases as well.

Both social classes face higher income and they allocate a higher portion to consumption. Savings also increase in order to balance the higher investments.

Numerically, it is interesting to note that a 10% increase in investments stimulates a more than proportional increase in employment (17%) while both the other demand component in real terms and savings in real terms increase by 10% as did the initial stimulus. We have a fixed wage rate as the numeraire. The profit rate moves up since capital becomes the scarce factor, and therefore the general price level, depending on production costs, increases.

An opposite effect comes from a 10% increase in capital supply. In this case, an increase in capital supply reduces the profit rate while wages are fixed since their level is the numeraire of the model. The change in the ratio r/w causes the isocost to become smoother so that the tangency condition holds with a higher isoquant (or in other words, a north-eastern isoquant). In nominal terms production increases, but higher production cost means higher final price of output. In real terms GDP is lower than in the benchmark. By assumption, rentiers' income as well as their real consumption is higher.

The rotation of the isocost has another implication: the new productive technique employs a different combination of inputs with higher capital and lower labour. Therefore m declines, creating more unemployment and reducing workers' income.

A lower workers' income reduces consumption as a consequence of the higher final prices. Our simulation quantifies these changes. An increase in capital supply reduces real output by more than 1.5 percentage points and employment can decline by up to 3 points.

Comparing the consequences of the two shocks, we may assert that a Keynesian model (or in this case "Bastard Keynesian") is a demand- driven system. This result is particularly clear if we analyse the effects on GDP under different shocks. When a demand component (i.e. investments) increases, GDP moves in the same direction, both in real and in nominal terms. A supply side shock (i.e. a capital supply increase) causes an increase of merely nominal GDP while even real GDP declines. This effect is due solely to a price increase.

c) The Neo-Keynesian (Structuralist) closure for a closed economy

In the *Neo- Keynesian* (*Kaldorian*) *closure* factors of production are not remunerated according to their marginal productivity. The adjusting mechanism is based on the forced savings model of Kaldor (1956). Practically, this means that the nominal wage rate is fixed while production is a function of labour and capital supplies as usual.

As the wage is fixed and the price level endogenous, the equality between savings and investments still holds only if there is a change in income distribution. This transfer takes place from households with a weaker saving propensity to households with a higher saving propensity. This reallocation of income means a reallocation of demand. If income moves from weaker saving propensity households (namely wage earners) to higher propensity households (capitalists), this leads to a reduction in consumption. The compositional effect on demand is coherent with the total production determined by initial endowments in factors of production.

In this paper we analyse one of the possible closures, the Structuralist closure, with a formal presentation given in box 3.

In this framework we assume that there is only one factor of production, labour, while capital is considered to be a stable mark-up over variable costs. The production function is a Leontief where labour is employed proportionally to the output (according to the output/labour coefficient *b*), coherently with relation (3). The output price is formed through a mark- up rule where a fixed mark- up rate (*tau*) is considered over variable production costs[38] (relation 1). From this mark- up rate we derive the profit rate (*r* is a function of *tau* and the output/capital ratio *u*). In this way remunerations of capital and labour are not equal to their marginal productivity but instead are fixed in the short run since they depend on "history" (relations (3) and (4)). Simply, they depend on the production techniques available in a specific time and the mark-up decisions carried out by the producers. Income distribution becomes a social phenomenon.

The system is demand driven so a multiplier effect still holds. The material balance works as usual (relation 2), and workers and rentiers have to satisfy their income budget constraints (relationships (5) and (6)).

[38] In this simplest case variable production costs are assumed to be only the labour costs but when we extend the model to an open economy we will also have costs for imported intermediates and related tariffs.

Box 13: The MCP format model for a Structuralist/ Post Keynesian closed economy model without government

$$(1+tau)\cdot w\cdot b = G = PX \quad (1)$$

$$GDP = G = ((WORK + RENT)/PX) + INV \quad (2)$$

$$m\cdot LS = G = b\cdot GDP \quad (3)$$

$$KS = G = tau\cdot w\cdot b\cdot GDP \quad (4)$$

$$WORK = E = w\cdot m\cdot LS - alphaz\cdot(PX\cdot INV) \quad (5)$$

$$RENT = E = r\cdot KS - (1-alphaz)\cdot(PX\cdot INV) \quad (6)$$

$$WORK = L = (1-s_w)\cdot w\cdot m\cdot LS \quad (7)$$

$$RENT = L = (1-s_r)\cdot r\cdot KS \quad (8)$$

GDP= total domestic production, *PX*= output price, *w*= wage rate, *b*= output/ labour ratio, *WORK*= nominal workers' consumption, *RENT*= nominal rentiers' consumption, *INV*= real investment, *LS*= labour supply, *KS*= capital supply, *tau*= mark up rate, *alphaz*= workers' saving share on total private saving, s_w= saving rate for workers, s_r= saving rate for rentiers, *m*= endogenous labour supply multiplier.
= *G* = means greater than, = *E* = means strictly equal, and = *L* = means lower than.

Source: *Authors' own model*

To clarify the causal chain in this class of models, we will refer to the simulation whose results are summarized in tables 5 and 6. A fundamental assumption to be stated is that capacity constraint does not exist in this economy, therefore employment may go to a full employment level.

Supposing an exogenous investment level exists, we increase it by 10%. Because of the multiplier effect, an increase in a demand component means an increase in total production.

But, since labour is employed in a fixed proportion with total production (the so- called labour- output coefficient), employment also increases with the same proportion. Moreover, profits are derived as a mark-up over variable costs.

In this simplest framework labour is all that enters into the variable costs so that if employment increases, the mark-up income follows in the same direction. It is evident that from this causal chain output, employment and mark-up income all increase by the same percentage (10%).

As usual, we have two social classes, wage earners and rentiers. The wage bill has increased and a fixed share is saved. The same happens for the rentiers. The main difference is in their saving propensities: wage earners save a lower fraction of their income with respect to rentiers. This is coherent with the macroeconomic balance of the model. An increase in investments requires more available savings. Obviously this extra savings comes mainly from rentiers rather than from workers because of the higher saving propensity.

In this case we do not have a direct reference to capital. We call the capital income "mark-up income" referring to its nature. If we want to implement a supply side shock, we must change the parameter *tau* which modifies the total mark-up income. Namely we assume a 10 percent increase (results are in table 6). Simulation results are quite similar to the ones of the

"Bastard Keynesian" model. Also in this case real production declines, as does employment, although in the structuralist case this decline is less evident (1.6 per cent against 2.8 percent). Because of the increase in mark- up, there is income redistribution in favour of rentiers. Despite the 10% increase in *tau*, rentiers' income increases less than proportionally because of the interaction with *w*. Rentiers consume and save higher fractions in nominal terms. For workers the story is the contrary: their nominal consumption decreases and their nominal savings slightly increase. However, this increase is derived only from a price effect: savings in real terms are not affected and remain stable at their benchmark level.

Although both the "Bastard Keynesian" closure and the Structuralist/ Post Keynesian closure work through a multiplier effect, their results are very different. This is due to an element already cited: the pricing rule.

In the "Bastard Keynesian" case, labour income and capital income are distinguished so that when employment increases, only wage earners gain. In the structuralist closure the mark- up pricing rule ensures that the same effects occur for both social classes.

Table 4: Results of a 10% increase in real investments

	Benchmark	***Neoclassical***	***"Bastard Keynesian"***	***Structuralist/ Post Keynesian***
Volumes				
GDP	100	100	117.2	110
Labour	60	60	70.3	66
Capital	40	40	46.9	44
Investments	35	38.5	41	38.5
Workers' consumption	45	43.5	52.7	49.5
Rentiers' consumption	20	18	23.5	22
Private total consumption	65	61.5	76.2	71.5
Values				
GDP	100	100	110	110
Investments	35	38.5	38.5	38.5
Workers' savings	15	16.5	16.5	16.5
Rentiers' savings	20	22	22	22
Private total savings	35	38.5	38.5	38.5
Price				
Wage	1	1	1	1
Rental rate of capital	1	1	1.1722	1
Output price	1	1	1.0656	1

Source: ***Author's own calculations***

Table 5: Results of a 10% increase in capital supply

	Benchmark	***Neoclassical***	***"Bastard Keynesian"***	***Structuralist/ Post Keynesian***[39]
Volumes				
GDP	100	104	101.1	102.3
Labour	60	60	58.33	59
Capital	40	44	42.77	43.3
Investments	35	36.4	36	36.4
Workers' consumption	45	44.4	42.9	43.4
Rentiers' consumption	20	23.2	22.2	22.5
Private total consumption	65	67.6	65.1	65.9
Values				
GDP	100	100	98.4	98.4
Investments	35	35	34.6	35
Workers' savings	15	15	14.8	15
Rentiers' savings	20	20	19.8	20
Private total savings	35	35	34.6	35
Price				
Wage	1	1	1	1
Rental rate of capital	1	1	0.9721	0.984
Output price	1	1.04	1.0276	1.04

Source: ***Author's own calculations***

[39] In this case we simulate a 10% increase in *tau*.

III. The closure rule problem in a closed economy with government

Starting from the core version of the CGE discussed by Sen, when we introduce the government as a new agent, we adopt a similar framework to quantify the effects of both supply side and demand side shocks. It is a source of savings as well. In this simple model there is still only one productive sector which produces one good employing capital and labour. There are two classes of households (workers, and capitalists) and the government. Households differ due to their propensity to save: workers have a weaker propensity than capitalists and for their tax rate on income (they pay a higher tax rate). This is an "archetype economy" used to study the effects of the closure choice combined with different shocks on the supply and the demand side. The numerical representation of this economy is a revised closed version of the model presented in Taylor and Lisy (1979) and Rattsø (1982).

The introduction of the government as a new actor complicates the analysis. In this case, a new basic macro- balance is introduced: the government deficit. In the previous model we dealt with only the saving- investments balance which was reduced at its basic form where investments where only balanced by private savings. Now savings include the government's (or deficit) but at the same time we have to set a rule for their determination. Specifically, this means deciding which behavioural target the government pursues. Mainly two rules are commonly adopted in CGE building: fixed government savings (with endogenous real spending) or fixed government expenditures (and endogenous government deficit).

This choice greatly affects the model results not only from a quantitative perspective but also from a theoretical point of view. This decision assumes a modeller's interpretation of the causal chain which directly affects the interpretation of fiscal revenue.

Here we will describe firstly the theory at the basis of this choice and then we will return to our original model to study the impact of the different closures.

Let us suppose we have a more simplified framework with respect to our original model where there is only a consumer and only direct tax revenue for the government's fiscal receipt. The two fundamental macroeconomic balances are:

$$PX \cdot I = PX \cdot (S^P + S^G)$$

$$PX \cdot S^G = Y^G - PX \cdot GZ$$

The first one is the revised version of the saving- investments balance, where investments in equilibrium should be equal to the available savings from the different agents in the economy. In this case there are both households and government. The second relation describes how government savings are produced, and their links with the other government macro- aggregates.

When government deficit is fixed the relations appear in this way:

$$PX \cdot I = PX \cdot S^{P} + PX \cdot S^{G}$$
$$PX \cdot \overline{S^{G}} = Y^{G} - PX \cdot GZ$$

where the bar means "*its level is fixed*". To clearly understand this mechanism we suppose there is a change in the real public expenditure level. In this case *GZ* increases but we have assumed fixed savings so the only way to satisfy the second equation is an increase in fiscal revenue. Since taxes are defined as a fraction of income, endogenous taxes mean income redistribution, lower savings and a likely crowding out of private investments.

The second option is mathematically summed up in this way:

$$PX \cdot I = PX \cdot S^{P} + PX \cdot S^{G}$$
$$PX \cdot S^{G} = Y^{G} - PX \cdot \overline{GZ}$$

In this case government deficit adjusts when the total tax revenue changes and its expenditures are considered irrepressible, as if there is a minimum level of spending that is optimal for the economy. Therefore, savings follow the revenue receipts trend.

Now we turn to our simulation. The numerical values are as follows: total output, $X = 100$, is divided among private consumption of the two household groups, $C_w = 40$ and $C_r = 15$, investments, I =30, and public expenditures, $G = 15$. All prices are set equal to one at the base level. Total output is produced employing labour, L =60, and capital, K=40. The savings propensities are assumed to be $s_r = 0.571$ (or 20/35) for capitalists, and $s_w = 0.11$ (or 5/45) for workers. Tax rates on personal income are $t_r = 0.125$ (or 5/40) and $t_w = 0.25$ or (15/60). For sake of simplicity we assume that our production function is a Cobb- Douglas production function and at this point we suppose that consumption is simply as a residual of tax payments and savings decisions. A concise representation of the economy is given in the MCM in table 7.

Box 14: An illustrative MCM for a closed economy with government

	ACT	WORK	RENT	GOVT	INV
PX	100	-40	-15	-15	-30
w	-60	60			
r	-40		40		
SAV		-5	-20	-5	30
dtax		-15	-5	20	

Source: ***Author's own model***

We are interested in studying the mechanisms at the basis of each closure rule and in the magnitudes of the effects. Moreover we want to analyse whether or not the same closure reacts in the same way if the shock is on the supply or the demand side. Hence, we model two shocks of the same magnitude: a 10% increase in investments and a 10% increase in capital supply.

a) The Neoclassical closure with government

The dataset of this model has already been presented above. Here we start with the description of the model, variables, and equations. In box 4 we list all the equations building the model, and then we describe them in detail.

Box 15: The MCP format for the Neoclassical closed model with government

$$w^{\beta} \cdot r^{(1-\beta)} = G = PX \quad (1)$$

$$GDP = G = ((WORK + RENT + GOVT) / PX) + INV \quad (2)$$

$$LS = G = GDP \cdot \beta \cdot \left(\frac{r}{w}\right)^{(1-\beta)} \quad (3)$$

$$KS = G = GDP \cdot (1-\beta) \cdot \left(\frac{w}{r}\right)^{\beta} \quad (4)$$

$$WORK = E = w \cdot LS \cdot (1-t_w) - alphaz \cdot (PX \cdot INV - PX \cdot GSAV) \quad (5)$$

$$RENT = E = r \cdot KS \cdot (1-t_r) - (1-alphaz) \cdot (PX \cdot INV - PX \cdot GSAV) \quad (6)$$

$$GOVT = E = t_w \cdot w \cdot LS + t_r \cdot r \cdot KS - PX \cdot GSAV \quad (7)$$

$$WORK = L = (1-s_w) \cdot (1-t_w) \cdot w \cdot LS \quad (8)$$

$$RENT = L = (1-s_r) \cdot (1-t_r) \cdot r \cdot KS \quad (9)$$

GDP= total domestic production, *PX*= output price, w= wage rate, *r*= rental rate of capital, *WORK*= nominal workers' consumption, *RENT*= nominal rentiers' consumption, *INV*= real investment, *LS*= labour supply, *KS*= capital supply, *alphaz*= workers' saving share on total private saving, s_w= saving rate for workers, s_r= saving rate for rentiers, *GOVT*= government nominal expenditures, *GSAV*= real Government saving.
= *G* = means greater than, = *E* = means strictly equal, and = *L* = means lower than.

Source: ***Author's own model***

In this economy, output is produced using capital and labour (eq. (1)), both of which are paid a fraction of total production (eq. (2) and (3)) therefore the amount depends on their marginal productivity. This representation is formally known as *Shepard's lemma*: the share of wages (or profits) with respect to total production is equal to the partial derivative of the production function itself with respect to the related factor (labour or capital) The productive factors are fully employed (eq. (4) and (5)). Labour income is accrued to workers who decide to pay taxes according to a marginal rate t_W, and save a fraction s_W (eq. (7) and (8)). The same happens for rentiers whose tax rate and savings rate are respectively t_R and s_R (eq. (8) and (9)). Therefore, we identify two aggregates defined as total private savings (S^P) and total tax revenue (Y^G) which are simply the sums of households' savings and direct taxes, respectively. Then, government itself has an income constraint to satisfy. It is the relationship between deficit, tax receipts, and government spending (eq.12). Finally, two accounting identities must be fulfilled: the saving- investments balance and the material balance. Investments adjust and are totalled according to the total saving supply in the economy. This amount is decided both by the government and the households. The material balance ensures that the total supplied production is completely devoted to the demand components (consumption of both social classes, government spending, and investments).

In this context we analyse two scenarios: one is a 10 percent increase in investments and the other is a 10 percent increase in capital supply. Both must be studied with fixed government savings or fixed government expenditures.

The effects of a 10 percent increase in investments are exactly the same in both closures. From the production perspective there are no changes: total GDP is stable, and labour and capital fixed in their demands. The investments' increase is absorbed by an increase in total private savings: both wage earners and rentiers increase their savings in the same proportion (a 12% increase).

Since input demand (and consequently income) does not change, both closures have a fixed real amount of public savings and expenditures. Tax revenue is linked to income levels because the government fixes a tax rate. But if income is fixed there is no change in tax revenue and consequently the other macro-aggregates: government consumption and deficit remain unchanged.

When we suppose a supply side shock occurs, the story goes differently. Here, the closure rule matters. A common feature is the productive side: with more capital there is movement of the productive frontier toward the north-eastern corner and this means an increase in total production by 4 percent. This increase, however, is only the effect of the higher output price: real production is unchanged. Finally, there is income redistribution towards the earners of the abundant factor: rentiers.

But how the demand side responds is different. Workers maintain their income since labour has not increased. This means that total nominal taxes are at their benchmark level.

We defined savings as a fraction (by definition fixed) of disposable income (income minus tax payments). Therefore savings in real terms is unchanged in this case. Nonetheless, it increases because of a price effect (a 4 percent increase). Plus, consumption declines both in real and nominal terms. The decline is more evident in real terms because it declines more than 4 percentage points while in nominal terms the reduction is limited to half a percentage point (in this case we also count the effect of higher price).

Rentiers' income increases by assumption. This means higher income taxes as the tax base broads (tax increases proportionally to the tax base). Savings increase in nominal terms (price effect) but they are fixed in real terms at their benchmark level as it is for wage earners as well. But consumption for this social class increases in both nominal and real terms (13 and 18 percentage points respectively).

Government obtains higher nominal tax revenue (a 2.5 percent increase). The constraint is the real level of savings which is fixed at 5, although in nominal terms it increases. To close the identity, nominal public expenditure grows because of a price effect while its real value is lower. Thus, the Government behavioral rule is a kind of "*fiscal responsibility*": higher nominal expenditures are allowed only if there are more nominal tax receipts.

Finally, we have to highlight a peculiarity of the saving- investment balance: changes take place only in nominal terms because of the increase in output price, but in real terms the balance does not differ from the benchmark situation. The main effects of this closure, supposing there is a change in capital supply, are mainly nominal effects. The only real effects are compositional effects on real demand components: private expenditures grow against a reduction in real public consumption.

The demand side works differently when we suppose fixed government expenditures. From a productive point of view, there is no change from the case of fixed public savings. As before, a higher capital supply means a higher rentiers' income, so they increase their nominal tax payments and what remains is divided between savings and consumption. The workers' situation is unchanged: they continue to be paid with the same wage bill and they pay the same income tax. Because of a higher output price, they reduce consumption in favour of savings. Therefore, real savings increase by 2 percent while real consumption declines by 4.5 percentage points. Investments increase only in nominal terms because of the increase in output price.

A different situation presents itself for the government. Here, real expenditures are fixed so that only nominal value increases (a 4 percent increase). Although in nominal terms total fiscal receipts increase, in real terms they decline. This means that to satisfy the saving-investments balance private savings have to increase while the public participation declines. In fact, in this simulation we show that in absolute values the decline in real government savings is completely fulfilled by the increase in aggregate real private savings. From a demand point of view we have only price effects since each demand component in real terms is at its benchmark level.

b) The "Bastard Keynesian" closure with government

We immediately start to present the main differences between this closure, the neoclassical example we have just shown and the closed version without government of the "Bastard Keynesian" (henceforth BK) closure. With respect to the model presented in box 2, here there is a new actor: the government. This affects both the demand side and the saving-investment balance. In fact, it is a component of the aggregate demand (*GOVT*) but is at the same time, a source of savings (*GSAV*). Furthermore, as we have analysed in the previous section, the introduction of the government requires a new constraint which explicitly defines the relationship between fiscal revenue, expenditures and public deficit (in box 5 it is represented by relation (7)). Except for these differences, the system acts as any Keynesian system would: with the same macroeconomic causality discussed in section 2b.

In respect to the Neoclassical version of the model, here the main introduction is *m*, the endogenous labour supply multiplier. Its role was already discussed when the BK closure in its simplest version was introduced. In this context it is worthy to point out that now tax revenue is also a function of *m*. In fact, nominal income depends on the share of supplied work (expressed by *m*), and tax revenues are counted as a fixed proportion of this income.

Tax rates enter the Keynesian constraint as relations (8) and (9) shown below.

Box 16: The MCP format for the "Bastard Keynesian" closed economy with government

$$w^{\beta} \cdot r^{(1-\beta)} = G = PX \quad (1)$$

$$GDP = G = ((WORK + RENT + GOVT)/PX) + INV \quad (2)$$

$$m \cdot LS = G = GDP \cdot \beta \cdot \left(\frac{r}{w}\right)^{(1-\beta)} \quad (3)$$

$$KS = G = GDP \cdot (1-\beta) \cdot \left(\frac{w}{r}\right)^{\beta} \quad (4)$$

$$WORK = E = w \cdot m \cdot LS \cdot (1-tw) - alphaz \cdot (PX \cdot INV - PX \cdot GSAV) \quad (5)$$

$$RENT = E = r \cdot KS \cdot (1-t_r) - (1-alphaz) \cdot (PX \cdot INV - PX \cdot GSAV) \quad (6)$$

$$GOVT = E = t_w \cdot w \cdot m \cdot LS + t_r \cdot r \cdot KS - PX \cdot GSAV \quad (7)$$

$$WORK = L = (1-s_w) \cdot (1-t_w) \cdot w \cdot m \cdot LS \quad (8)$$

$$RENT = L = (1-s_r) \cdot (1-t_r) \cdot r \cdot KS \quad (9)$$

GDP= total domestic production, *PX*= output price, w= wage rate, *r*= rental rate of capital, *WORK*= nominal workers' consumption, *RENT*= nominal rentiers' consumption, *INV*= real investment, *LS*= labour supply, *KS*= capital supply, *alphaz*= workers' saving share on total private saving, s_w= saving rate for workers, s_r= saving rate for rentiers, *GOVT*= government nominal expenditures, *GSAV*= real Government saving, *m*= labour supply multiplier.
= *G* = means greater than, = *E* = means strictly equal, and = *L* = means lower than.

Source: *Author's own model*

In this case we also simulate the usual two shocks used to evaluate how the model acts.

First, we suppose a 10% increase in investments. Both government closures ensure expansionary results: real, not solely nominal, GDP increases. However, the magnitude of this change is different: when government savings are fixed, GDP increases more than when public expenditures are fixed (20.8 percent against 11.3 percent). The reason is apparent: a change in investments stimulates a higher production level. This extra production may be absorbed by private consumption or public expenditures. When we suppose a fixed deficit, public expenditures are allowed to increase and absorb a share of the extra production. In real terms, private consumption is allowed to increase by 12 percent and at the same time government consumption increases by 16 percent.

Otherwise, when expenditures are fixed, only private consumption may increase (by 11.2 percent) and therefore the increase in production must be lowered so as to be absorbed.

Clearly, labour supply withstands the same effect which increases more in the fixed government savings case than in the fixed government expenditure case (more than 20 percent against 11 percent). Higher production means higher output prices because of the higher quantity of employed labour (due to the increase in *m*, while *w* is the numeraire) and the higher rental rate of capital (because the real quantity of employed capital is fixed).

Another interesting aspect to be detected is the savings- investments account. When government savings are fixed, the increase in investments is totally absorbed by private savings that increase by 12 percent, which is the same percentage increase in real GDP. In the other case, both sources of savings work: private savings increase only by 7.2 percent while public deficit increases by 24 percent. In absolute terms, private savings continue to absorb more than half of the investments shock.

Next, we analyse the effects of an increase in capital supply. Here, the results are a bit surprising at first glance. In the case of fixed government expenditures, as predicted, expansionary effects on GDP are evident only in nominal variables as a result of the increase of final prices. In fact the increase in capital supply stimulates the capital costs and therefore final prices increase because of the higher production costs. An interesting aspect to detect and analyse are the different results in the case of fixed government savings. This is a comparison of the effects on prices. In this case shifts in final prices and rental rates of capital are symmetric. Both variables move by 3 percent in different directions: the increase in final prices is counterbalanced by a decrease of the same amount in *r*. The mechanism is the same as the other shock. Because government saving is free to move, it decreases and the necessary extra savings is supplied by the two households according to the *alphaz* share. The private consumption component increases because of the higher nominal incomes accruing to the two classes. The total tax revenue declines in real terms but nominal tax receipts are unchanged from the benchmark. The fall is different between the two consumers: workers diminish their real tax payments because of the lower employment level. Rentiers slightly increase their fiscal payments. Because of our assumption of fixed government expenditures in real terms, the consequence is a real decline in public savings. This is further proof of the relationship between the public sector's variables.

In the fixed government savings case, the numerical results are surprising. Because of the closure rule and stable real investments, the saving - investment balance is unchanged from the benchmark.

As usual, a supply side shock reduces real GDP but this time nominal GDP decreases as well. This effect is due to the response of prices. In the previous case we described a symmetrical movement of output price and capital rental rate. Here it no longer appears. Final commodity price increases by 1.1 per cent (a higher increase than the one in the previous case) but the fall in r is greater too (6.3 percent). It offsets the expansionary effect of the final price and reduces the nominal magnitude.

With respect to the fixed government expenditure case, employment levels are lower (m is now 0.93 against 0.97). This means a lower income for workers and a reduction in their nominal fiscal payments. Because of fixed government saving, this reduction causes a decline in government spending. The effects on rentiers' income have an opposite sign: their income increases and therefore so do their tax payments. However, this is not enough to contain the decline in total fiscal revenue because the fall in workers' income is higher than the increase in rentiers' income (6.3 per cent against 3 per cent).

Finally, the closure rule affects the consumption of the agents. Declines in income are not counterbalanced by reductions in savings in order to avoid worsening the consumption behaviour by much. Taking into account the case of workers, a 6.3 percent reduction in income means a tax payment constant according to a fixed tax rate; there is now a lower disposable income. The savings decision is made prior to the consumption one and the total amount of real savings must be constant because of the closure rule. This means a slight increase in nominal terms. Therefore, as a residual, consumption declines. Numerically, although the income reduction is 6.3 percent (in nominal terms), consumption falls more (7.25 percent in nominal terms). This already considerable value worsens if we consider it in real terms. In fact it becomes 8.25 because there is not the 1.1 percent increase in prices.

c) The Johansen closure with government

The *Johansen closure*, in its original exposition, expands the model of Sen by introducing the government as an important source of savings. In this context government consumption or the tax rate become endogenous. Supposing, as did Johansen (1960, 1974), that personal tax rates are endogenous breaks the link between production and demand. Without this element the Johansen model is not far from the Neoclassical one in its working system. But, when introducing endogenous tax rates on income, the net remuneration of the factors of production and the net disposable income are no longer equal. Therefore there is a distinction between the production stage and demand.

Savings depend on the tax rate and so when we adjust the variable, we may free enough savings to close the saving- investment gap. The total effect is solely a reallocation of demand because we assume output at the full- employment level.

Nowadays, supposing endogenous tax rates is one of the hallmarks of one of the most worldwide used CGE model: the World Bank LINKAGE model. Quoting the technical notes of the model "*Government collects income taxes,* […] . *Aggregate government expenditures are linked to changes in real GDP. The real government deficit is exogenous. Closure therefore implies that some fiscal instrument is endogenous in order to achieve a given government deficit. The standard fiscal closure rule is that the marginal income tax rate adjusts to maintain a given government fiscal stance*" (van der Mensbrugghe, 2005).

Although widely adopted, we reject the hypothesis of endogenous tax rate, both in the idea of personal taxation and indirect taxes. Macroeconomics and political economics have always defined taxes as a governmental instrument used to pursue a certain goal. However, the imposition of a tax is also a political process with its own timing and procedures. Supposing, as in the LINKAGE model, that tax rates are endogenous contradicts the idea of taxes as a policy instrument. It is not likely to suppose that tax rates move instantaneously in order to reach the equilibrium in the model.

This critique is supported by many scholars. For instance von Arnim and Taylor (2006) suggest "*there is neither an economic theory nor actual country experience that supports this kind of adjustment. Governments cannot spontaneously increase taxes to balance the budget* […]".

d) The Structuralist/ Post Keynesian closure with government

Fundamentally, the Structuralist model presented in its MCP format in box 6, is not far from the "Bastard Keynesian" model already discussed. The only difference is the production side which determines the pricing rule and the inputs demand (relations (1), (3), and (4)). Government does not enter these relationships. Therefore, they are exactly the same as we described in detail when we spoke about a closed economy without government.

Results from our simulations are very close to the "Bastard Keynesian" outcomes: the system is still demand driven and employment is endogenous. However, main differences stem from the magnitudes of endogenous variables' variations. In this case, in the investments' disturbance, prices are fixed at their benchmark level and are unchanged because we have supposed the wage rate to be the numeraire of the model. In fact, when we allow *tau* to move, we demonstrate that the output price level also changes (from relation (1) in the MCP format of the model in box 6).

Fundamentally, the only slight difference between the "Bastard Keynesian" results and the Structuralist model is in absolute terms in the saving- investments balance. As in the former closure, the role of public and private savings is maintained. The main difference is a sort of forced savings mechanisms taking place between consumers, especially in the case of fixed government expenditures.

Results mainly differ in nominal terms, as we have already discussed, because of the different pricing rule. Only in the cases of supply side shocks is the output price different from the unit.

Box 17: The MCP format for the Structuralist/ Post Keynesian closed economy with government

$$(1+tau)\cdot w\cdot b = G = PX \qquad (1)$$

$$GDP = G = ((WORK + RENT + GOVT)/PX) + INV \qquad (2)$$

$$m\cdot LS = G = b\cdot GDP \qquad (3)$$

$$KS = G = tau\cdot w\cdot b\cdot GDP \qquad (4)$$

$$WORK = E = w\cdot m\cdot LS\cdot(1-tw) - alphaz\cdot(PX\cdot INV - PX\cdot GSAV) \qquad (5)$$

$$RENT = E = r\cdot KS\cdot(1-t_r) - (1-alphaz)\cdot(PX\cdot INV - PX\cdot GSAV) \qquad (6)$$

$$GOVT = E = t_w\cdot w\cdot m\cdot LS + t_r\cdot r\cdot KS - PX\cdot GSAV \qquad (7)$$

$$WORK = L = (1-s_w)\cdot(1-t_w)\cdot w\cdot m\cdot LS \qquad (8)$$

$$RENT = L = (1-s_r)\cdot(1-t_r)\cdot r\cdot KS \qquad (9)$$

GDP= total domestic production, *PX*= output price, w= wage rate, *r*= rental rate of capital, *WORK*= nominal workers' consumption, *RENT*= nominal rentiers' consumption, *INV*= real investment, *LS*= labour supply, *KS*= capital supply, *tau*= mark up rate, *alphaz*= workers' saving share on total private saving, s_w= saving rate for workers, s_r= saving rate for rentiers, *GOVT*= government nominal expenditures, *GSAV*= real Government saving, *m*= labour supply multiplier, *b*= output/labour ratio,
= *G* = means greater than, = *E* = means strictly equal, and = *L* = means lower than.

Source: ***Author's own model***

Table 6 : Results of a 10% increase in real investments with fixed government expenditures

	Benchmark	***Neoclassical***	***"Bastard Keynesian"***	***Structuralist/ Post Keynesian***
Volumes				
GDP	100	100	111.4	106.7
Labour	60	60	66.8	64
Capital	40	40	44.6	42.7
Investments	30	33	34.5	33
Workers' consumption	40	39.4	44.5	42.7
Rentiers' consumption	15	12.6	16.7	16
Total private consumption	55	52	61.2	58.7
Government consumption	15	15	15.7	15
Values				
GDP	100	100	106.7	106.7
Investments	30	33	33	33
Workers' savings	5	5.6	5.4	5.3
Rentiers' savings	20	22.4	21.4	21.4
Total private savings	25	28	26.8	26.7
Government savings	5	5	6.2	6.3
Price				
Wage	1	1	1	1
Rental rate of capital	1	1	1.1136	1
Output price	1	1	1.044	1

Source: ***Author's own calculations***

Table 7: Results of a 10% increase in real investments with fixed government savings

	Benchmark	***Neoclassical***	***"Bastard Keynesian"***	***Structuralist/ Post Keynesian***
Volumes				
GDP	100	100	120.8	112
Labour	60	60	72.5	67.2
Capital	40	40	48.3	44.8
Investments	30	33	35.6	33
Workers' consumption	40	39.4	48.3	44.8
Rentiers' consumption	15	12.6	18.1	16.8
Total private consumption	55	52	66.4	61.6
Government consumption	15	15	18.8	17.4
Values				
GDP	100	100	112	112
Investments	30	33	33	33
Workers' savings	5	5.6	5.6	5.6
Rentiers' savings	20	22.4	22.4	22.4
Total private savings	25	28	28	28
Government savings	5	5	5	5
Price				
Wage	1	1	1	1
Rental rate of capital	1	1	1.2079	1.12
Output price	1	1	1.0785	1

Source: ***Author's own calculations***

Table 8 : Results of a 10% increase in capital supply with fixed government expenditures

	Benchmark	***Neoclassical***	***"Bastard Keynesian"***	***Structuralist/ Post Keynesian*** [40]
Volumes				
GDP	100	104	101.4	102.5
Labour	60	60	58.5	59.1
Capital	40	44	42.9	43.4
Investments	30	31.2	30.9	31.2
Workers' consumption	40	39.7	38.6	39.4
Rentiers' consumption	15	17.5	16.5	16.3
Total private consumption	55	57.2	55.1	55.7
Government consumption	15	15.6	15.4	15.6
Values				
GDP	100	100	98.5	98.5
Investments	30	30	30	30
Workers' savings	5	5.1	5.1	4.8
Rentiers' savings	20	20.2	20.4	20.8
Total private savings	25	25.3	25.5	25.6
Government savings	5	4.7	4.5	4.4
Price				
Wage	1	1	1	1
Rental rate of capital	1	1	0.97	0.98
Output price	1	1.04	1.03	1.04

Source: ***Author's own calculations***

Table 9: Results of a 10% increase in capital supply with fixed government savings

	Benchmark	***Neoclassical***	***"Bastard Keynesian"***	***Structuralist / Post Keynesian*** [41]
Volumes				
GDP	100	104	97.4	100.1
Labour	60	60	56.2	57.7
Capital	40	44	41.2	42.4
Investments	30	31.2	30.4	31.2
Workers' consumption	40	39.8	37.1	38.5
Rentiers' consumption	15	17.7	15.8	15.9
Total private consumption	55	57.5	52.9	54.4
Government consumption	15	15.3	14.1	14.5
Values				
GDP	100	100	96.3	96.3
Investments	30	30	30	30
Workers' savings	5	5	5	4.6
Rentiers' savings	20	20	20	20.4
Total private savings	25	25	25	25
Government savings	5	5	5	5
Price				
Wage	1	1	1	1
Rental rate of capital	1	1	0.94	0.97
Output price	1	1.04	1.01	1.04

Source: ***Author's own calculations***

[40] In this case the 10% increase is in *tau*.

[41] In this case the 10% increase is in *tau*.

IV. The closure rule problem in an open economy

As already presented, the model becomes more complex with the introduction of new agents while the closure rule problem becomes more rigid and complex. This has been evident passing from the closed economy without government to the closed version with government. Here, we introduce a new agent we call the "foreigners". It represents the opening up of our economy towards the rest of the World.

Therefore we must now introduce new features to our basic CGE and analyse new relationships among the macro aggregates of these new agents. New possible choices then arise.

First of all we have to describe the basic relationships within this new aspect. In this way we derive the fundamental accounting values and how they are linked together. Namely, we have to consider the concepts of net exports, foreign savings, and then the concepts of export and import functions.

In any standard textbook on international trade we derive these fundamental identities:

$$NEXP = EXP - IMP$$

$$NEXP = FSAV$$

We may say that the first identity is the trade balance. To simply define that, a variable called "net exports" is the difference between exports of final goods and relative imports. Supposing no financial variables, its value equals the foreign savings, that is, the amount of money to be lent to the rest of the World. By definition *NEXP* should be equal to or greater than zero.

The relationship between foreign savings and net exports is clear and understandable. When foreigners sell imports they receive monetary payments which they use partly to buy other goods (exports) and partly to lend to the rest of the World. Supposing they want to demand more exports, they should make a decision and reduce their disposable savings for the rest of the World.

Analysing the issue in this way we implicitly assume that *NEXP* are strictly positive but this is not true. However, in this way we may model shocks on net exports and foreign savings in a proper way and obtain reasonable results.

The model is presented in its MCP format in box 7 where we assume a model similar to the one of the closed economy with only two exceptions. The first exception (which is absolutely apparent) is when we introduce a new agent called *ROW*, which is the foreign sector. The second is that we assume that the productive sector employs primary factors as well as imported intermediates in fixed proportion. In this example we assume a Neoclassical system for the sake of simplicity.

We should take a moment to describe the fundamental and innovative aspects of the models described up until now. The introduction of imported intermediates complicates the production function that is now a "*nested production function*". This means that there are more steps to aggregate before obtaining the final production. In this example we have assumed that the final product is a Leontief function of value added and intermediates[42], according to a parameter *b*. This is defined as "*value added share on total production*" so that value added and intermediates, with respect to (1-*b*), are both proportional to GDP. In this case, value added is the aggregation of labour and capital through a Cobb- Douglas function. Its formulation, however, is a bit different because there is a new coefficient, the inverse of *b*, an efficiency parameter.

Box 18: The MCP format for an open economy model (option 1)

$$\left[GDP \cdot b \cdot \left(r^{\alpha} \cdot w^{(1-\alpha)}\right)\right] + \left(a0 \cdot PWM \cdot e \cdot (1+tm) \cdot GDP\right) = G = PX \quad (1)$$

$$GDP = G = ((WORK + RENT + GOVT + ROW)\ /\ PX) + INV \quad (2)$$

$$LS = G = \left(\frac{GDP}{a}\right) \cdot \left[\left(1-\alpha\right) \cdot w^{\alpha} \cdot r^{(1-\alpha)}\ /\ r\right] \quad (3)$$

$$KS = G = \frac{GDP}{a}\left[\alpha \cdot w^{\alpha} \cdot \left(r^{(1-\alpha)}\ /\ w\right)\right] \quad (4)$$

$$WORK = E = wLS \cdot (1-t_w) - alphaz \cdot \left[\left(PX\left(INV - GSAV\right)\right) - \left(e \cdot FSAV\right)\right] \quad (5)$$

$$RENT = E = rKS \cdot (1-t_r) - (1-alphaz) \cdot \left[\left(PX\left(INV - GSAV\right)\right) - \left(e \cdot FSAV\right)\right] \quad (6)$$

$$GOVT = E = t_w \cdot w \cdot LS + t_r \cdot r \cdot KS + tmi \cdot e \cdot IMP - PX \cdot GSAV \quad (7)$$

$$ROW = E = e \cdot a0 \cdot PWM \cdot GDP - e \cdot FSAV \quad (8)$$

$$WORK = E = \left(1-s_w\right) \cdot (1-t_w) \cdot w \cdot LS \quad (9)$$

$$RENT = E = \left(1-s_r\right) \cdot (1-t_r) \cdot r \cdot KS \quad (10)$$

GDP= real production, *LS*= labour supply, *KS*= capital supply, α=capital share in value added, *e*= exchange rate, *tm*= tariff rate, *a0*= input-output coefficient for intermediates, *PWM*= World price for imports, *b*= value added share in total GDP, *a*= efficiency parameter in nested-production function, *r*= rental rate of capital, *w*=wage rate, *WORK*= nominal workers' consumption, *RENT*= nominal capitalists' consumption, *ROW*= foreigners' consumption, s_w= saving propensity for workers, s_r= saving propensity for capitalists, *INV*= real investments, *PX*= output price, *GOVT*= nominal government consumption, t_w= direct tax rate on workers, t_r= direct tax rate on capitalists, *GSAV*= nominal government saving.
=*G*= means greater than or equal to, =*E*= means equal to, =*L*= means lower than or equal to.

Source: *Author's own model*

Although this model is formally correct, it is limited by the assumption of strictly positive net exports. The assumption appears too strong, such that it may be contradicted. We have to find a solution and we must find modelling exports and imports separately. In this way both

[42] In this example intermediates are completely imported but the reasoning is the same if we assume domestic intermediates, or if we assume an Armington approach.

aggregates may be assumed positive but we do not make such an assumption on net exports. Practically, this aim may be obtained by creating two fictitious productive sectors: one for exports and one for imports. The former works as follows: it employs as input domestic exports at domestic currency and “produces” a new good which is the “foreign demand for exports” whose price is now in foreign currency. The latter acts in the same manner: it employs foreign goods that are imports at foreign price, and it is changed into the “domestic demand for imports” which has a domestic price. A fundamental aspect is how we treat prices, especially foreign prices. They depend on the exchange rate and on World prices according to the assumption of the small open economy. We suppose that the economy is small enough not to have market power and determine the World price.

In this way we have solved the previous model and we have a great advantage. In adding international prices, we may analyse a new class of shocks. A typical exercise of this kind is the modelling of an oil shock where the oil price increases. We are interested in detecting which will be the impact on the productive sectors when employing them as input.

Obviously, this different approach is formalized differently from box 7 because now we have two more productive sectors and two more markets to be cleared.

A likely application of this idea is the Armington assumption. In his renowned 1963 paper, Paul Armington built a coherent framework to formally represent the cross- hauling phenomenon. Looking at statistical data, it is easy to detect both exports and imports of the same commodity because they were imperfect substitutes. His idea was exactly this: goods from different countries may be imperfect substitutes. Practically, this means that domestic productive sectors may decide to produce for the inner market or for the foreign markets in order to have maximized revenues. At the same time, imports are decided in order to minimize costs so domestic agents may decide the origin of their imports.

Mathematically, this leads to the formulation of new aggregates. Firstly, exports and imports are now CET (Constant Elasticity of Transformation) and CES (Constant Elasticity of Substitution) functions.

The former exhibits fixed elasticities of transformation between domestic products sold both domestically and abroad. The idea is that a producer makes these choices according to the comparison of internal and external prices. If external prices are higher, the producer decides to export more; the opposite happens when the domestic price are higher. The latter aggregates a composite supply, composed of imports and domestic products. As in the previous case, the choice is made based on prices. If imports are more competitive than domestic commodities, this aggregate supply will mainly be composed of imports and a lower fraction will be domestic products.

Box 19: The MCP format for an open economy model (option 2)
In this case we have assumed an Armington framework.

$$\left[GDP \cdot b \cdot \left(r^{\alpha} \cdot w^{(1-\alpha)}\right)\right] + \left(a0 \cdot P \cdot GDP\right) = G = Q \quad (1)$$

$$Q \cdot (GDP - ROW) + e \cdot PWM \cdot M \cdot (1+tm) = G = P \quad (2)$$

$$GDP = G = (SUP \cdot P - (e \cdot PWM \cdot M \cdot (1+tm)) + ROW) / Q \quad (3)$$

$$SUP = G = (WORK + RENT + GOVT) / P + (a0 \cdot GDP) + INV \quad (4)$$

$$LS = G = \left(\frac{GDP}{a}\right) \cdot \left[(1-\alpha) \cdot w^{\alpha} \cdot r^{(1-\alpha)} / r\right] \quad (5)$$

$$KS = G = \frac{GDP}{a}\left[\alpha \cdot w^{\alpha} \cdot \left(r^{(1-\alpha)} / w\right)\right] \quad (6)$$

$$WORK = E = wLS \cdot (1-t_w) - alphaz \cdot \left[\left(PX\left(INV - GSAV\right)\right) - \left(e \cdot FSAV\right)\right] \quad (7)$$

$$RENT = E = rKS \cdot (1-t_r) - (1-alphaz) \cdot \left[\left(PX\left(INV - GSAV\right)\right) - \left(e \cdot FSAV\right)\right] \quad (8)$$

$$GOVT = E = t_w \cdot w \cdot LS + t_r \cdot r \cdot KS + tmi \cdot e \cdot IMP - PX \cdot GSAV \quad (9)$$

$$ROW = E = e \cdot a0 \cdot PWM \cdot GDP - e \cdot FSAV \quad (10)$$

$$WORK = E = \left(1-s_w\right) \cdot (1-t_w) \cdot w \cdot LS \quad (11)$$

$$RENT = E = \left(1-s_r\right) \cdot (1-t_r) \cdot r \cdot KS \quad (12)$$

GDP= real domesticproduction, *LS*= labour supply, *KS*= capital supply, *α*=capital share in value added, *e*= exchange rate, *a0*= input-output coefficient for intermediates, *PWM*= World price for imports, *b*= value added share in total GDP, *tm*= tariff rate, *a*= efficiency parameter in nested-production function, *r*= rental rate of capital, *w*=wage rate, *SUP*= real composite supply, *P*= price index for composite supply, *Q* =price index for domestic production, *WORK*= nominal workers' consumption, *RENT*= nominal capitalists' consumption, *ROW*= foreigners' consumption, s_w= saving propensity for workers, s_r= saving propensity for capitalists, *INV*= real investments, *GOVT*= nominal government consumption, t_w= direct tax rate on workers, t_r= direct tax rate on capitalists, *GSAV*= nominal government saving.
=*G*= means greater than or equal to, =*E*= means equal to, =*L*= means lower than or equal to.

Source: ***Author's own model***

A third option allows the modelling of other shocks. This may be obtained through the explicit formulation of export and import functions. These functions are built according to traditional textbook international economics. Real exports are modelled through a function combining two components, exogenous components, *EZ*, and a part which is a function of relative prices and exchange rate according to a certain export elasticity with respect to the exchange rate. Formally, the relation is:

$$RX = EZ \cdot \left(e \cdot \frac{\overline{p}}{p}\right)^{\sigma}$$

Final imports are modelled similarly:

$$IMP = MZ \cdot \left(e \cdot \frac{P_w}{p}\right)^{\gamma}$$

These assumptions are very schematic and many other features may be inserted to make the functions more complete. However, assuming these simple functions we are already able to model other new shocks on international trade moving the autonomous components of these functions or setting different elasticities.

Box 20: The MCP format for an open economy (option 3)
In this case we have made explicit the export function

$$\left[GDP \cdot b \cdot \left(r^{\alpha} \cdot w^{(1-\alpha)}\right)\right] + \left(a0 \cdot P \cdot GDP\right) = G = Q \qquad (1)$$

$$\mathrm{Q} \times (\mathrm{GDP - ROW}) + \mathrm{e} \times \mathrm{PWM} \times \mathrm{M} \times (1+\mathrm{tm}) = \mathrm{G} = \mathrm{P} \qquad (2)$$

$$GDP = G = (SUP \cdot P - (e \cdot PWM \cdot M \cdot (1+tm)) + ROW) / Q \qquad (3)$$

$$SUP = G = (WORK + RENT + GOVT) / P + (a0 \cdot GDP) + INV \qquad (4)$$

$$LS = G = \left(\frac{GDP}{a}\right) \cdot \left[(1-\alpha) \cdot w^{\alpha} \cdot r^{(1-\alpha)} / r\right] \qquad (5)$$

$$KS = G = \frac{GDP}{a}\left[\alpha \cdot w^{\alpha} \cdot \left(r^{(1-\alpha)} / w\right)\right] \qquad (6)$$

$$WORK = E = wLS \cdot (1-t_w) - alphaz \cdot \left[\left(PX\left(INV - GSAV\right)\right) - \left(e \cdot FSAV\right)\right] \qquad (7)$$

$$RENT = E = rKS \cdot (1-t_r) - (1-alphaz) \cdot \left[\left(PX\left(INV - GSAV\right)\right) - \left(e \cdot FSAV\right)\right] \qquad (8)$$

$$GOVT = E = t_w \cdot w \cdot LS + t_r \cdot r \cdot KS + tmi \cdot e \cdot IMP - PX \cdot GSAV \qquad (9)$$

$$ROW = E = e \cdot a0 \cdot PWM \cdot GDP - e \cdot FSAV \qquad (10)$$

$$WORK = E = \left(1-s_w\right) \cdot (1-t_w) \cdot w \cdot LS \qquad (11)$$

$$RENT = E = \left(1-s_r\right) \cdot (1-t_r) \cdot r \cdot KS \qquad (12)$$

$$ROW / P = E = EZ \cdot \left(\frac{PWE}{P} \cdot e\right)^{sigma}$$

GDP= real domesticproduction, *LS*= labour supply, *KS*= capital supply, *α*=capital share in value added, *e*= exchange rate, *a0*= input-output coefficient for intermediates, *PWM*= World price for imports, *b*= value added share in total GDP, *tm*= tariff rate, *a*= efficiency parameter in nested-production function, *r*= rental rate of capital, *w*=wage rate, *SUP*= real composite supply, *P*= price index for composite supply, *Q* =price index for domestic production, *WORK*= nominal workers' consumption, *RENT*= nominal capitalists' consumption, *ROW*= foreigners' consumption, s_w= saving propensity for workers, s_r= saving propensity for capitalists, *INV*= real investments, *GOVT*= nominal government consumption, t_w= direct tax rate on workers, t_r= direct tax rate on capitalists, *GSAV*= nominal government saving, *EZ*= exogenous component of export demand, *PWE*= world price for exports, Sigma0= elasticity of exports respect to exchange rate.
=*G*= means greater than or equal to, =*E*= means equal to, =*L*= means lower than or equal to.

Source: ***Author's own model***

After the modelling of foreign trade, we must consider another relation that is fundamental to establishing equilibrium: the saving- investment balance. As compared to the other models, this relation includes one more saving source. It is the foreign saving, *FSAV*. Therefore the balance condition becomes:

$$PX \cdot I = PX \cdot S^{P} + PX \cdot S^{G} + e \cdot FSAV$$

From a mathematical point of view we may set *FSAV* both exogenous and endogenous without any problem because the aim is making the system square. So, we may treat the variable as we wish if the system has an equal number of variables and equations. But our assumption is based on mainstream applications. Most of the empirical applications assume that foreigners' decisions are made without being affected by domestic resident behaviour. In other words, foreign residents decide how much they want to save; in this case, they look merely at their own interests. Moreover, for developing countries donors, international institutons and foreign agencies decide how much aid to allocate to a country. Practically, residents have only to accept a decision taken outside the country.

Although this is the mainstream position, a criticism has been made by Taylor (2004). From an accounting point of view, he suggests that modellers usually call "foreign savings" an aggregate that is the "net external position". If it is so, it contains not only savings from foreigners but also a bowl of assets at foreign currency owning by domestic residents. Even if we are thinking of a developing country there is a small fraction of population wealth enough to have finanacial assets. They may decide by themselves to sell these foreign assets. Thay are accounting as foreign savings in the SAM although they are detained by domestic households. In such a situation, foreign savings are no longer exogenous but they become endogenously determined because the decision is taken by domestic actors and not only foreign donors.

In our model we have decided to expose both import and export functions. In this economy there is only one productive sector whose production is X= 100, employing primary factors, L= 50 and K= 35, and intermediate inputs that are fully imported ($INTMZ$= 12). A 25 percent import duty is levied on them (tmi= 0.25). There are two agents: workers, owning labour, and capitalists owning capital. Furthermore, workers pay a tax rate t_w= 0.2 on income and save according to a s_w= 0.125 saving propensity. The residual income is spent (C_w= 35). Rentiers pay a tax rate t_r= (5/35) on their income and save half of their disposable income (s_r= 0.5). The residual part is totally spent (C_r= 15). Government collects taxes on income and imports, saves a fraction ($GSAV$= 3) and spends the rest (GZ= 15). Foreigners ask for exports according to a specific export function (EX= 10) and obtain income from intermediate imports (note that there is no import of final goods). Part of their income is saved as foreign saving ($FSAV$= 2). Finally, all disposable saving is employed to buy investment goods (INV= 25).

These data may be summarized into an MCM like the one below.

Box 21: An illustrative MCM for an open economy

	ACT	WORK	RENT	GOT	ROW	INV
Q	100	-35	-15	-15	-10	-25
w	-50	50				
r	-35		35			
e	-12				-12	
taxM	-3			3		
dtax		-10	-5	15		
SAV		-5	-15	-3	-2	25

Source: ***Author's own model***

a) The neoclassical closure in an open economy[43]

As in previous models, in this case we will analyse both a demand side and a supply side shock for each closure in order to trace differences. In this neoclassical closure we firstly suppose a demand side shock which we model as a 10 percent increase in the autonomous component of the export function. The modeller chooses the exchange rate as numeraire. As any supply driven system, the effect of an increase in exports is only a compositional effect on final demand. In the foreign sector, imports are fixed because they are intermediates according to a fixed fraction with respect to domestic production (in our case production is not affected by the shock), and exports increase by 10 percent. This reduces the foreign savings (now it is 1 and not 2). Income of the two classes is unchanged as are their tax payments. This leads to constant revenue for government. Its spending is fixed and consequently the same happens for its savings. Therefore the reduction in foreign savings should be compensated by an increase in private domestic savings in order to maintain the saving-investment balance. Therefore, workers' and rentiers' consumptions decline (by 0.7 percent and 5 percent, respectively) so that they free available savings to restore the equilibrium. The demand side shock does not affect any price.

As usual the supply side shock is a 10 percent increase in capital supply. After the shock, capital is the more abundant factor so its rental rate declines. The same happens to the wage rate. Both of them lessen by nearly 4 percent (3.95 percent). This means that total costs for primary factors is unchanged and the same happens for imported intermediates. Exchange rate is the numeraire so that imports are as costly as before the shock. Therefore, total production is fixed at the benchmark level.

However, income distribution has now become opposite the initial situation: labour income is lower than capital income. This means that workers have a lower income, their tax payment declines (by 4 percent) like their consumption but their savings remain unchanged. Rentiers'

[43] Formally the model is the one presented in box 9 with only one exception. In this case intermediates are only imported and they are not a composite of domestic and imported goods.

income increases by 5.7 percent. Their income tax increases as well because of the higher tax base and consumption also increases by 10.6 percent. However, in absolute terms, the increase in income (which is 2) is mainly devoted to consumption (1.6). Only a small fraction is devoted to income tax (0.3) and the residual 0.1 is the increase in savings.

As a consequence, to restore the saving- investment balance, government saving should decline to a 2.9 level. This may be explained by looking at the situation of the public sector. Total tax revenue slightly declines because, although import tariffs are unaffected, the fall in workers' tax payment offsets the increase in rentiers' payment. By assumption government expenditures are at their benchmark level so that only public saving may move and in this situation it should decline.

b) The "Bastard Keynesian" closure in an open economy

An increase in exports[44] is a stimulus to the aggregate demand. This means that real production increases. This causes an increase in labour demand to get to a higher production level. Labour increases by 1.6 percentage points. Since now labour is relatively abundant with respect to capital, the rental rate of capital is higher. In the production sphere an increase in total final products means an increase in imported intermediates. In fact, intermediates are in fixed proportion to production (Leontief production function). The increase in imports is lower than the initial shock on exports (note the difference with the Neoclassical case). Therefore, foreign saving declines. Now from a distributive point of view, workers own a higher nominal income. Because of the broader tax base, income taxes increase in the same proportion. But there are also higher saving and consumption levels (+1.14% and +3.4% respectively). In absolute terms, the 0.8 increase in income is allocated in this way: a 0.2 goes to income tax, a 0.4 to consumption, and 0.2 to savings.

Although these calculations are on a nominative basis, the same trend is shown in real variables. In this case quantities are a bit lower because we have eliminated the price effect.

Rentiers have a higher income level because of the higher remuneration of the same amount of capital. This leads to higher taxes and savings (+1.6% and +4%) while consumption lowers (-1.3%). In absolute terms, the 0.5 increase is devoted to tax (+0.1), savings (+0.6), and consumption (-0.2).

[44] Our shock is on the exogenous component of the export function. However, the increase in exports is higher than the initial stimulus (+10% increase in the foreign component of exports, and 9.7% increase in final real exports).

This is caused by the iteration of the two components. When the exogenous component increases, the general price level increases as well so that the fraction (*PEW*/*Q*) declines.

Government has fixed spending (by assumption) but its fiscal revenue is higher. This means that government savings has to increase as well (+9.3%).

Disposable nominal savings are now at a higher level as are nominal investments. However, in real terms the saving- investment balance is unchanged. The loss in foreign savings is counterbalanced by all the domestic saving sources.

Since the system is demand driven, an increase in capital supply stimulates only an increase in nominal terms because of the higher general price level as a consequence of higher price of inputs. Specifically, labour declines (-0.6%). At the same time there is an increase in capital remuneration (+9.1%). Because of the functional form of intermediates, they slightly decline (-0.4%). Workers have a reduced income (-0.6%) so tax payments and consumption are lower (-0.6% and -1.5%). Savings increase by 2.4 % in real terms. Conversely, rentiers increase their income, which is devoted to taxes (+ 9%), savings (+ 5.3%), and consumption (+ 12.6%).

Government expenditures increase only in nominal terms while real expenditures are fixed by assumption. Tax revenue increases in nominal terms while they decline in real terms. Then, public saving declines.

In the foreign sector, imports are lower while exports increase only in nominal terms. Real exports have declined because of the reduction in the term (PEW/Q). As a consequence, foreign savings shrink by 15%.

The saving- investment balance changes only in nominal terms with a slight increase in investment and consequently in nominal total savings. But in real terms investment is unaffected and the reduction in public and foreign sectors' savings is counterbalanced by an increase in real private saving.

c) The Structuralist/ Post- Keynesian closure for an open economy

This closure is very similar to the "Bastard Keynesian" model just described both in its achievements and in its logical construction. The main difference is the pricing rule which affects the quantitative results of the simulations. The effects of the export shock are quite simple because they are proportional to the initial shock. Therefore, a 10 percent increase in the autonomous component of exports leads to a 1 percent increase in GDP. Because the nested production function is a two- stage Leontief function, labour and mark- up (what we have called capital income up to this point) increase by the same percentage (+1%). Intermediates are aggregated according to *a0* and therefore also imported intermediates increase by the same percentage.

There are no nominal effects because final price is a function of wage rate (for the labour costs) and exchange rate (for non-labour costs). In our model both these variables are assumed to be numeraires of the model. Both workers' and rentiers' incomes increase. For workers, the increase in income means a proportional increase in taxes. Then consumption and savings increase as well (+0.64% and +3.5% respectively). In absolute terms, the income increase is 0.5 and it is allocated in 0.225 for consumption, 0.1 in taxes, and 0.175 for saving. For rentiers the situation is quite similar. However, in this case savings and taxes increase while consumption declines. The extra saving is necessary to maintain the saving- investment balance. Government tax revenue gets higher while, for the chosen closure rule, government spending is fixed. This means an increase in public saving.

In the external sector both exports and imports increase but in absolute terms the export increase is higher so that foreign saving declines as in "Bastard Keynesian". It is worth noting that the decline is lower than in the "Bastard Keynesian" case because now we have no price effect.

The supply side shock is an increase in *tau*. The effect on real GDP is negative: it declines by 0.38%. This makes labour employment diminish while mark- up income increases because of the shock. The imported intermediates decline too. Because we have increased *tau*, final price increases as well. This fact has a direct implication about the foreign sector. In fact, real exports decline because of the increase in final price. This leads foreign savings to decline from the initial benchmark level. The effects on workers' and rentiers' income are very similar to the ones in the "Bastard Keynesian" model. Trends are exactly the same but nominal variables are different because in the Structuralist model price increases more than in the "Bastard Keynesian" model.

Table 10: Results of a 10% increase in exports

	Benchmark	***Neoclassical***	***"Bastard Keynesian"***	***Structuralist/ Post Keynesian***
Volumes				
GDP	100	100	101.53	101
Labour	50	50	50.82	50.5
Capital	35	35	35.57	35.35[a)]
Imported intermediates	12	12	12.12	12.12
Workers' consumption	35	34.75	35.43	35.225
Rentiers' consumption	15	14.25	14.81	14.775
Total private consumption	50	50	50.24	50
Government consumption	15	15	15.11	15
Exports	10	10	11.04	11
Investments	25	25	25.14	25
Values				
GDP	100	100	100,96	101
Investments	25	25	25	25
Workers' saving	5	5	5.19	5.175
Rentiers' saving	15	15	15.59	15.525
Total private saving	20	20	20.78	20.7
Government saving	3	3	3.14	3.18
Foreign saving	2	1	1.08	1.12
Prices				
Output price	1	1	1.0057	1
Wage rate	1	1	1	1
Rental rate of capital	1	1	1.0164	1
Exchange rate	1	1	1	1

Source: ***Author's own calculations***

Table 11: Results of a 10% increase in capital supply

	Benchmark	***Neoclassical***	***"Bastard Keynesian"***	***Structuralist/ Post Keynesian***
Volumes				
GDP	100	100	102.87	103.11
Labour	50	48	49.68	49.81
Capital	35	37	38.25	38.36[a)]
Imported intermediates	12	12	11.95	11.95
Workers' consumption	35	33.4	34.46	34.54
Rentiers' consumption	15	16.6	16.93	16.96
Total private consumption	50	50	51.39	51.50
Government consumption	15	15	15.48	15.525
Exports	10	10	10.19	10.21
Investments	25	25	25.81	25.875
Values				
GDP	100	100	99.64	99.62
Investments	25	25	25	25
Workers' saving	5	5	5.12	5.13
Rentiers' saving	15	15.1	15.35	15.31
Total private saving	20	20.1	20.47	20.44
Government saving	3	2.9	2.82	2.81
Foreign saving	2	2	1.73	1.75
Prices				
Output price	1	1	1.0325	1.035
Wage rate	1	0.9605	1	1
Rental rate of capital	1	0.9605	0.9936	1
Exchange rate	1	1	1	1

Source:***Author's own calculations***

[a)] In this case income from capital is defined as mark-up income to remember its nature.

PART 2

An Analysis of the Mozambican Case

3. The Mozambican Economy and the SADC Agreement

As the 1992 Treaty of Abuja states, the African continent must take part in the world economic integration through the existence of regional economic communities. During the 1990s, Mozambique underwent a series of liberalizing reforms after the end of the Civil War. It has demonstrated a commitment to regional integration by participating in the SADC and has been invited to join SACU. Both possibilities appear profitable because of the presence of South Africa among the Member States, which is its "*largest, most diversified and most consistent trade and investment partner*" (Alfieri, Cirera, Rawlinson, 2006). Given this fact, Mozambique has decided to create a Free Trade Area among SADC countries. This implies a further liberalization and the removal of all trade barriers. That ultimately means a change in the trade policies pursued up to today. Given the classification of Mozambique as a least developed country, this liberalization process is particularly crucial since it involves not only economic variables but also political and technical capabilities. This is the element that threatens the International Community: the possibility that the Protocol on Trade may result as simply an unsuccessful attempt.

This chapter hopes to present a comprehensive description of the SADC Agreement, paying particular attention to the Trade Protocol. The emphasis on Trade Protocol will lead to an understanding of the key elements and the timing of each phase from its beginning to FTA implementation. On the other hand, the paper constitutes a brief review of the trade pattern and policies in Mozambique in order to evaluate what the SADC-FTA adhesion and implementation has meant for this country. Moreover, the goal is to highlight the features of the SADC that make it appear as a North-North agreement and at the same time the weaknesses derived from the collocation of the agreement in the African context.

II. The SADC Agreement

a. Historical Overview

In April 1980 the Governments of nine Southern African countries[45] established the Southern African Development Co-ordination Conference (SADCC). This was the result of the independence obtained in the 1970s in most of these countries. Since the SADCC was a result of political struggles, it had four political objectives: to reduce Member States' dependence and apartheid in South Africa, to implement both programmes and projects at a regional level, to mobilize Member States' resources and to secure international support.

This experiment first demonstrated the tangible benefits of working together and created a climate of trust and confidence among States in the African Continent, that ultimately established a tradition of consultation among people and governments of the Region. Therefore under the SADC Programme of Action, a number of infrastructural projects were undertaken. On the other hand, the lack of financial independence, the inadequacy of all institutions and their decision- making processes pushed for a reform of the system. This was done in 1992 with the meeting of Windhoek.

The Windhoek Treaty established the SADC (the Community), an international body whose objectives were to promote and sustain regional economic growth, and to maximise productive employment and a rational utilization of natural resources. In order to achieve these goals, the SADC Member States agreed on a wide variety of topics including trade, whose protocol (PC-SADC) was signed on 24 August 1996 and became active on 25 January 2000. However, this document was amended on 7 August 2000 with a series of three new annexes that provided a quota system in the clothing, textile and sugar markets for Malawi, Mozambique, Tanzania and Zambia, (MMTZ)[46] the Least Developed countries in SADC.

This cooperation led to the creation of a Free Trade Area (FTA) in 2008 as "*a step towards a deeper integration*[47]", as box 22 demonstrates.

[45] The founding fathers were Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, Zimbabwe.

[46] See paragraph b.

[47] This is the slogan the SADC itself uses to define the FTA (SADC (2008))

Box 22: The economic integration in the Southern Africa Development Community

1992: Southern Africa Development Community (SADC)
1996: SADC Protocol on Trade
2008: Establishment of the SADC Free Trade Area (FTA)
2010: Establishment of the SADC Custom Union (CU)
2015: Completion of a Common Market
2016: Creation of the SADC Monetary Union and SADC Central Bank
2018: Implementation of a regional currency

SADC is not the only regional agreement established here; it has some overlapping memeberships mainly with the Common Market for Eastern and Southern Africa (COMESA) and the South Africa Custom Union (SACU). Now, there are fourteen SADC Members: five are SACU members (two of which are also COMESA members) seven are COMESA Members, and only Mozambique has a single commitment with SADC. This overlapping membership has created problems, especially in the negotiations with the SADC-EU EPAs since each RTA has a different external tariff without the possibility of harmonization at a continental level[48].

Box 23: Overlapping Membership in the Southern African Region

	Individual Country "commitment" Index [a)]	**SADC**	**SACU**	**COMESA**
Angola	0.50	•		•
Botswana	0.50	•	•	
Congo, Democratic Republic of	0.50	•		•
Lesotho	0.50	•	•	
Madagascar	0.25	•		•
Malawi	0.33	•		•
Mauritius	0.25	•		•
Mozambique	1.00	•		
Namibia	0.33	•	•	•
South Africa	0.33	•	•	
Swaziland	0.33	•	•	•
Tanzania	0.33	•		
Zambia	0.33	•		•
Zimbabwe	0.33	•		•

a) This index derives from Lledó V., Peiris S.J., Kvintradze E. (2007)

b. SADC Provisions for a Free Trade Area

The creation of an FTA among SADC Member States was established by the treaty constituting the Community and the Regional Indicative Strategic Development Plan (RISDP). In this document, Member States were divided into three categories in order to organize the liberalization process on the basis of "asymmetry". This concept states that the trade barriers' removal should take place on the basis of each country's development level.

[48] This problem will be discussed more precisely in section II paragraph c.

That means "*developed countries should accelerate their tariff phasing out more than developing countries and least developed ones* (LDCs)".

There are only twelve participants in the FTA since Congo and Angola are set to join at a later date.

1) Least Developed Countries (LDCs): this group is comprised of Malawi, Mozambique, Tanzania and Zambia (elsewhere defined as the MMTZ countries) Angola, DRC, and Madagascar. They are the members with the lowest economic indicators for whom special treatment is provided. According to the phase down schedule they are defined as *Back loading group* since they reduced tariffs for products by equal installments from year 6 to year 8 (i.e. from 2006 to 2008).

2) Developing countries: Mauritius, Zimbabwe. In SADC terminology they are the *Mid loading group* that reduced tariffs from year 4 to year 8 (i.e. 2004-2008).

3) Members both of SADC and SACU: these are considered the most developed countries in the area as well as the most beneficial for regional trade integration. They are Botswana, Lesotho, Namibia, South Africa, and Swaziland. Also defined as *Front loading group*, they started trade barriers' removal immediately in year 1 and continued to year 8 (i.e. 2001-2008), since they have stronger economies and may face the tariff revenue loss in a more proper way.

At the basis of the Protocol there are four principles:

1) Free assent. Each country decides for itself about participation in SADC on the basis of a cost-opportunity analysis looking at its own benefits. The abstention of the DRC and Angola to the implementation of the SADC may be interpreted by the basis of this principle.

2) "Win/win" principle. No country member should have a loss at the end of the liberalization process.

3) Globality. There should be unanimity on each decision SADC wants to make.

4) Asymmetry.

To establish an FTA the participants should remove all barriers from the intra- regional trade. As literature clarifies, a free trade area is characterized by the elimination of barriers, both tariff and non- tariff, from the intra- region trade and each member maintains its own tariff for third countries (i.e. there is no Common External Tariff (CET)). The establishment of the SADC- FTA, started in 2000, was complex and based on three main kinds of elimination: first, regarding tariffs and a reorganization of the tariff's structure for each country; second, concerning non- tariff barriers; and the last, rules of origin that are managed at the regional level with the principle of harmonization.

1. *Tariff Barriers*

To reduce tariffs, the Member States had to divide their production into categories (namely A, B, C, E) in order to define a timetable for liberalization. Category A is formed by products that countries want to liberalize as soon as the PC- SADC implements them. They are mainly capital goods and count for around 47 percent of total traded goods. Category B is formed by sub- categories (i.e. B1, B2) and defines products that are subject to different tariff phase out schedules. The objective is the liberalization of at least 85 percent of traded goods. Category C responds to individual countries' interests since it is formed by products of special importance for each country. In the SADC project, the number of items should be limited but special interests have increased the group to the limit imposed by the PC- SADC (15 per cent of the total intra- SADC trade). Finally, category E is the smallest one where there are products that international treaties declare as excluded goods for international trade[49] and it is mainly formed by commodities collected in HS Chapter 93 (arms and ammunitions).

The phasing out schedule is complicated by the heterogeneity of the Member States' economies[50]. For this reason, import duties diminish on the basis of a base tariff offer and a differentiated tariff offer. The former is applied for all the SADC members, SACU members[51] included, while the latter is expressed only for trade with South Africa[52].

2. *Non- tariff Barriers* (NTBs)

A non- tariff barrier to trade is complex to define. It comprises, for example, import or export quotas, policies to preserve public health or security, and so called "technical barriers" (TBs). The problem of NTBs in the region has been identified mainly by the private sector and

[49] In the protocol the reasons for an exclusion are summarized in article 9. To sum up, it declares exceptions not only on the basis of international agreements but also to protect public morals, public order, human, animal and plant life, health, intellectual property rights, natural resources and environment. Then gold, silver, precious and semi-precious stones are excluded together with national treasures.

[50] Since it is a LCD country according to the UN terminology, and it has been involved in a civil war till the 1990s, Mozambique has obtained a delay in its liberalization that should be concluded by 2012 and 2015 for SADC Members and South Africa, respectively.

[51]"*SACU is a functional Custom Union with a Common External Tariff*" (WTO/Committee on Regional Trade Agreements- WT/REG176/5).

[52] "*The size of the South African economy in relation to the other economies necessitated the application of asymmetry in the scheduling of tariff reductions by the non-SACU Members*" (WTO/Committee on Regional Trade Agreements- WT/REG176/5)

other stakeholders who state that difficulties at borders are the key barriers to doing business. Goods must cross several borders as many SADC Member States are landlocked.

Generally, PC- SADC suggests to Member countries not to raise new quantitative restrictions unless necessary. This is in order to mitigate short- term production instability (in the case of export quotas) or to preserve public health (article 7, and 8). However, these measures should be temporary and only used in the face of a serious threat.

The only quota systems directly established by the Protocol[53] are applied to the sugar market (Protocol on Trade, Annex VII) and for products of HS chapter 50 to 63. But in the Protocol itself these systems are defined as "*ad interim measures*" (Protocol on Trade, Annex 1, Appendix V).

In the first case, the one of the sugar market, market access on a non- reciprocal basis for SADC and a preferential sugar exported on a quota basis into the SACU market are established. If total exports are higher, the excess is subject to MFN tariffs. But the long-term objective for this market is a full liberalization of intra- SADC trade after 2012 depending on the conditions of the world sugar market.

The second case is again applied to LDCs (also known as MMTZ group) for textiles and clothing. In this case the temporary deadline was July 2006 but later moved to December 2009. This preferential treatment according to MMTZ is linked to a special set of rules of origin[54]:

1) Items (clothing and textile categories) should be the result of a single- stage transformation;

2) Derogation for double- stage transformation of manufactured products in HS Chapters 50 and 63 is established.

[53] These provisions are not included in the first version of the Protocol on Trade of 1996 but in the 2000 amended version.

[54] For the other Rules of Origin see subsection c.

Table 12: Annual Quotas granted to MMTZ by SACU

	HS Ch. 52	HS Ch. 55	HS Ch. 60	HS Ch. 61-62	HS Ch. 63
	(cotton)	*(man-made staple fibers)*	*(knitted or crocheted fabrics)*	*(articles of apparel and clothing accessories knitted/crocheted and not)*	*(other made up textile articles)*
Malawi	1.110.000	43.000	200.000	8.565.000	565.000
Mozambique	3.600.000	-	-	4.200.000	170.000
Tanzania	1.200.000	-	-	500.000	300.000
Zambia	1.700.000	390.000	60.000	500.000	300.000

Source: ***SADC Trade Protocol, Annex I, Appendix V***
Note: these features are kilos.
Note: Preferences shall only be extended: in the case of HS Ch. 52, to products of HS headings 5204 to 5212;
in the case of HS Ch. 55, to products of HS headings 5508 to 5516;
in the case of HS Ch. 60, to products of HS headings 6001 and 6002;
in the case of HS Ch 61, to products of HS headings 6010 to 6117;
in the case of HS Ch. 62, to products of HS heading 6201 to 6217;
in the case of HS Ch. 63, to products of HS headings 63012 to 6308
(and 6301.4000 for Zambia).

The other group of NTBs, and probably the broadest, is not composed directly of economic measures, but policies or procedures that usually represent a waste of time for traders. These are divided according to frequency in their application and their impact on trade in box 24.

In making this distinction, SADC decides on an immediate elimination of practices in group 1. Then, for the ones in group 2, there are two possibilities: one is their elimination within 1- 2 years and the other, harmonization. Practices in group 3 will be eliminated within 2- 5 years after the creation of the SADC- FTA.

Box 24: Non- Tariff Barriers in the SADC Member Countries

Highly frequent NTBs with high impact on trade

→ Customs and Administrative entry procedure
→ Customs that are not import or export licenses
→ Customs valuation

Frequent NTBs with medium impact on trade

→ Government monopoly practices
→ Import licensing
→ Restrictive practices for export licences
→ Consular formalities and documentation

Less frequent NTBs with low impact on trade

→ Not necessary quantitative import restrictions
→ Pre- shipment inspection
→ Technical regulations and standards for food (for public security purposes)

Within this group of barriers, one could also include Technical Barriers (TBTs)[55] such as technical regulations and standards. There could be testing or certification and other conformity assessments, but the way for their elimination passes through the establishment of the SADC Cooperation Standardization, Quality Assurance, Accreditation and Metrology (SADC- SQAM). This road is the one of harmonization and standardization (included in Annex III).

3. *Rules of Origin* (RO)

This group of regulations is included in the NTBs, but has a unique status inside the SADC framework. These should represent the rules to define a "country[56]" product that may be met a preferential treatment. In other words, rules of origin decide for a minimum in terms of economic activity.

The Protocol on Trade defines two main rules:

1) Wholly produced/ obtained rule: a commodity may meet a preferential treatment within the SADC region if it is fully produced in and of itself. This rule is used particularly for agricultural products.

2) Sufficiently worked/ processed rule: this is a broader rule as a lot of different provisions enter it. With this definition PC-SADC defines two sub- rules:

Value addition criteria: a commodity should contain 35 percent of its value added, produced in the SADC region.

Import content (MC): imported intermediates should not be more than 60 percent of total value of intermediates. This is typical in textiles, some metals and the special treatment applied to MMTZ is based on this rule.

Although the final objective is an FTA, the Protocol recognizes that the Parts are at different stages of development and that they can face transition burdens as a new element of instability. This can result in a worsening of the economic environment. For these reasons, it sets up a series of temporary protectionist rules, briefly defined as safeguards (PC- SADC, article no. 20), infant industry protection (PC- SADC, article no. 21), and anti-dumping measures (PC- SADC, article no.18).

The first set of provisions is constrained by a situation in which "*a product is imported in large quantities a price that causes or threatens to cause serious injury to the domestic*

[55] Technical standards and regulations are not TBTs when they are based on internationally agreed standards.

[56] "Country" in this case means the whole SADC region.

industry" (SADC, 2007). This definition respects the idea of temporary measures and these trade restrictions in the SADC- FTA may last between 4 and 8 years to give domestic industry time to adjust. This treatment cannot discriminate among countries and so the rule should be applied to all imports.

Infant industry protection allows the imposition of duties that may be removed when the industry becomes competitive, respecting imports, after having demonstrated that the only strategy for industry development is trade protection.

Anti- dumping measures in SADC are exactly the same as those internationally enforced.

c. Negotiations with the EPAs

The history of the cooperation between the European Union and the developing countries started in 1977 with the Lomè Conventions. These established that 77 countries, defined ACP[57], would have a preferential treatment, since they were recipients of unilateral preferences in the EU market.

This agreement gave important market access mainly to agricultural products and then other minor exports.

In 2000 these provisions were revised and the new Cotonou Partnership Agreement (CPA) entered into action. The reason for this revision was the incoherence of the Lomè conventions within the GATT framework. In fact, one of the main elements of the GATT treaty is the Enabling Clause rule[58] that prohibits unilateral preferences that discriminate between groups of developing countries. The 1977 Agreements were exactly these kind of provisions and so inconsistent with the international economic organization. The key principle of CPA was reciprocity, differentiation, deeper regional integration, coordination of trade and aid.

To revise the system, but not to nullify it, the EU invited (Cotonou Agreement article 37.4) ACP countries to negotiate new WTO-compatible EPAs by 2007.

This new system guaranteed reciprocal market access with a possible transition period of 10- 12 years for phasing out tariff barriers. The final stage was a Free Trade Area (FTA)[59] with special arrangements for sensitive products. To reach this objective, two phases had to be undertaken; after an *interim* period, started with the signing on 23 June 2000. The first phase was launched on 27 September 2002. It had to be concluded with the identification of the

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[57] This group included all members of COMESA and SADC except Egypt and South Africa.

[58] It is included in article XXIV.

[59] In order to be GATT consistent, an FTA should be recognized by the elimination of restrictions on "*substantially all the trade*". The quantitative qualification is a requirement of 80- 90 percent of bilateral trade liberalized.

RECs in order to start the negotiations. The second phase with a regional perspective was launched in 2004 for East and Southern Africa[60].

As the previous version of the agreements, the EPAs maintained their developmental focus since they were interpreted as help for the ACPs to enlarge their markets and as a stimulus to South-South integration. Formally, the EPAs had three pillars:

1) Regionalism;

2) Market access;

3) Integrated trade and development support.

ACPs, however, continued to focus more on the development dimension of the EPAs rather than the EU focus on trade aspects.

Negotiations for the SADC- UE agreement[61] were launched in Brussels in 2002. Given table 8, the objective of the SADC economies is clear. All the countries have a strategic economic partner in the EU since it is the first, or one of the first, commercial partners. The average export share of SADC to the EU is slightly above 33 percent, while the regional import share reaches nearly 25 percent.

Table 13: European-Union Share in Trade for SADC Members

	Exports to EU %	Imports from EU %
Angola	13.7	52.2
Democratic Republic of Congo	66.8	41.6
Malawi	31.3	9.8
Mauritius	71.3	41.5
Madagascar	51.5	52.3
Mozambique	63.7	14.6
SACU	-	-
Botswana	59.6	45.2
Lesotho	-	-
Namibia	-	-
South Africa	38.9	44.9
Swaziland	-	-
Tanzania	32.0	23.6
Zambia	16.6	10.0
Zimbabwe	18.0	10.1

Source: ***Khandelwal (2004)***

Note: -: not available data

60 In the African context, there are four negotiating forums with SADC, ESA- COMESA, CEMAC, ECOWAS- UEMOA.

61 An important aspect to note is that four countries, Malawi, Mauritius, Zambia and Zimbabwe, negotiate in the COMESA- EU Forum. This is another example of the partial commitment these countries have with SADC.

The EPA is based on regional integration initiatives of the SADC countries. It involves, as a consequence, SADC member states except for RSA, who had already signed a TDCA (Trade, Development Cooperation Agreement). The objectives in establishing such an agreement were to complement and support the regional integration process and programmes, to harmonize regional rules and to consolidate the SADC regional market.

For these reasons, both parties agreed to establish a SADC- EU Regional Preparatory Task Force (RPTF). This focused on finding ways to cooperate and on addressing SPS and TBT problems affecting both intra- and extra- SADC trade. This goal is reached through three preliminary stages: the setting of priorities and preparation, substantive negotiations and finalization.

The main concerns are involved in the first stage; after a general agreement among the African countries on the main modalities of the negotiation issues, difficulties arise because of the BLNS group. It is formed by four countries (i.e. Botswana, Lesotho, Namibia, and Swaziland) that have difficulties finalizing their lists of sensitive products.

Currently, the process is ongoing. Both parties have agreed on at least three main concerns:

1) Overlapping membership. Since in Southern Africa there is an overlapping membership between COMESA and SADC with different tariff structures, this problem occurs in Angola, Congo, Malawi, Mauritius, Swaziland, Zambia, and Zimbabwe, all of which are COMESA and SADC members. Moreover, it arises for South Africa, which is not an ACP country but a member of SACU (a custom union) Consequently, RSA is a constraint for SACU-Members. And there is the case of Tanzania, a member of SADC and EAC (a custom union).

A likely solution is harmonization between COMESA and SADC tariff structures in order to establish a comprehensive custom union. Otherwise, these countries may choose a single membership in only one RTA.

2) Different economic structures. The SADC members are not uniform in terms of development and economic structure. This is clear when taking into account the contemporaneous presence of a developing country such as Swaziland and a LDC such as Mozambique.

3) No diversification in the economies and supply- side constraints.

Despite these difficulties, the parties agreed that the SADC- EU EPA would become a *quasi* free trade area[62] in the years following 2008. It would liberalize imports of industrial and

[62] It should be similar to the EBA strategy that grants 48 LDCs duty free access to EU markets for all goods except weapons and armaments. As UN- ECA ATPC (2005) states. "*the critical difference between*

processed agricultural products and would provide special market access under "commodity protocols" for a few products (i.e. bananas, rum, beef and veal, and sugar). These categories of sensitive products would be traded duty- freely only in quotas (as it happens in the SADC market for sugar). This has been a strong claim of the African countries. They have pushed for the exclusion of a greater number of items since their economies are subject to international shocks.

Although these exclusions exist, UN- ECA and the ATPC (2005) demonstrated that the SADC- EU EPA should have had a negative impact on a wide range of industrial products, both in terms of losses in revenue exports and of private consumption for the poorest categories. In particular, these vulnerable products should have been in HS Chapters 11 (products of milling industry), 19 (preparation of cereals, flour), 21 (miscellaneous edible preparations), 22 (beverages), 32 (tanning/ dyeing extract), 33 (essential oils, perfume), 40 (rubber), 73 (iron and steel products), 84 (nuclear machinery), 85 (electrical machinery), 87 (vehicles other than railway and tramway), 94 (furniture).

III. The Mozambican Trade Sector

a. Mozambique Trade Patterns

Analyzing the trade performances of Mozambique in recent years, we may outline a relatively stable trade deficit. As depicted in the table below, Mozambique is a net importer of goods and services despite its sensible export increase since 2001 with an average annual growth rate of nearly 39 percent. On the other hand, in the same period, there was a marked increase, on average 17 percent, in imports. It is worthy of note that the growth rate of exports is lower than the one of imports despite the liberalization process that Mozambique pursued according to its international commitments. Notwithstanding a constantly negative trade balance, the worst year was 1999; this trade deterioration was the result of the construction of the Mega Aluminium Smelter Project MOZAL and it was mainly due to an increased import of machinery and capital goods.

Another interesting part of this is the composition of exports and imports and how they changed during this period. In fact, the changes in value depended not only on the quantity but also on world prices. Because Mozambique is an exporter mainly of primary and agricultural goods, it is subject to international shocks. For example, there were lower cashew nut prices in 2006, and more markedly in 2007 (AfDB/ OECD,2008), or the higher oil prices

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the EBA initiative and the EPAs in terms of trade is that the EBA initiative is non-discriminatory amongst least developed countries while the EPAs are just for ACP countries".

that raised imports and spending of consumer durables and capital goods. In fact, imports mainly consist of these classes of commodities.

Table 14: Mozambique's Trade Balance, 1996-2006

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Merchandising Trade											
Export	217	222	230	263	364	703	810	1045	1504	1745	2398
%change		***+2.3***	***+3.6***	***+14.3***	***+38.4***	***+93.1***	***+15.2***	***+29.0***	***+43.9***	***+16.0***	***+37.4***
Import	759	739	790	1139	1158	1063	1543	1753	1927	2408	2807
%change		***-2.6***	***+6.9***	***+44.2***	***+1.7***	***-8.2***	***+45.1***	***+13.6***	***+9.9***	***+25.0***	***+16.6***
Balance	**-542**	**-517**	**-560**	**-876**	**-794**	**-360**	**-733**	**-708**	**-423**	**-663**	**-409**
Commercial Services											
Export	253	279	286	295	325	249	336	300	246	316	355
%change		***+10.3***	***+2.5***	***+3.1***	***+10.2***	***-23.4***	***+35.0***	***-10.7***	***-18.0***	***+28.4***	***+12.3***
Import	319	329	396	392	439	607	559	553	512	627	729
%change		***+3.1***	***+20.4***	***-1.0***	***+12.0***	***+38.3***	***-8.0***	***-1.1***	***-7.4***	***+22.5***	***+16.3***
Balance	**-66**	**-50**	**-110**	**-97**	**-114**	**-358**	**-223**	**-253**	**-266**	**-311**	**-374**

Source: ***author's computation on the basis of WTO International Trade Statistic 2007***
Note: the features are billion dollars

In the table below, we analyze the trends in imports and exports according to goods in order to better define the relative importance of different sectors. As we have previously cited, agricultural products, especially food products, fisheries and fresh and dried nuts account for a strong percentage of total exports while in the last three years exports have extended to minerals and electricity. This is due to the beginning of MOZAL production and new investments in the energy and mining sectors. In recent years there were two other mega-projects: the Sasol natural gas pipeline and the Cahora Bassa hydro-electric facility. As a result of their reaching maturity, there was an exponential increase in the export of these sectors and even the natural gas export started from nothing and became one of the leading export products. In the following years, new mega projects should begin building and production; this regards mainly coal- production and the mining sector as a whole. The most interesting projects that should positively affect the trade balance are the MOMA titanium smelter, and the KENMARE smelter for the production of ilmenite, rutile and zircon.

Table 15: Principal exported products, 1996-2006

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Raw Cashew	3964	20011	23182	7864	8399	2104	1114	1499	8015	5514	13010
Cotton	12746	22160	10916	19991	25495	18271	15925	32442	35791	56267	45691
Wood	7983	10067	5208	9186	14601	12559	17977	20434	29967	32353	35593
Lobsters	1868	1630	22	642	269	307	855	455	756	841	1172
Tobacco	820	6333	5016	2501	7803	9099	24446	21463	40794	43245	110337
Maize	2125	12521	6156	1322	1621	1647	7090	1369	2944	3185	5017
Sugar	12868	12815	2898	5349	4323	8036	17069	16094	26523	37700	71351
Cashew	39038	5848	13547	25150	11946	10895	16201	7438	21209	17588	23678
Crayfish	79871	75364	58178	65564	91458	92448	114241	75822	91752	70888	86676
Electric. energy	-	-	36993	62862	66979	57346	107378	113268	102252	141800	177820
Nat.Gas	-	-	-	-	-	-	-	-	31273	100158	109606
Alumin. Bars	-	-	-	-	60160	383100	361100	567600	915011	1020547	1401315

Source: INE Mozambique

Imports have a different composition. Since agricultural performance is erratic and vulnerable to climatic shocks, cereals' and other foodstuffs' imports reflect these natural events. For instance, the imports in the period between 2002- 2005 which are the highest of the last decade, reflect a severe drought affecting the South of the Country. Talking about the agricultural sector, it is worthy to note that Mozambique has become a net exporter of sugar in recent years proving the industrial protectionist policies adopted by the Government have worked. The prediction for the future is a consolidation of this trend.

In the manufacturing sector, however, the increasing trend in capital goods' and machinery's imports is accelerating as a response to the new mega- projects the Government announces. (see Table 5).

Table 16: Principal imported goods, 1996-2006

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Automobile	66891	82216	48830	154065	114384	67304	160859	108082	118054	150295	208113
Cereals	74409	84433	88369	68168	52978	73094	113130	108963	144536	172581	1795
Medicines	19413	7040	4875	5366	9036	14411	22460	16621	29996	26780	39265
Sugar	19823	30503	24346	14185	9055	6378	4661	7397	19542	9888	4773
Machinery	150081	139051	147617	109852	259098	142452	148816	227145	304887	344520	397681
Gasoline	49488	45991	28629	39453	84759	76806	59492	114237	144752	171389	233767
Electric Energy	13261	15026	8405	1412	14526	28456	30744	48770	75478	79774	83718
Petrol	9768	9053	10835	10493	15172	23497	16374	26058	36073	41629	54922

Source: ***INE Mozambique***

In 2006, the most recent available year, exports were divided into three categories and we may find the same patterns we have previously described in relation to the last decade. Agricultural sector exports accounted for nearly 16 percent (i.e. 15.8 percent), while the mining and fuels sector was five times higher (74.7 percent) and finally the manufacturing exports reached 7.2 percent. These imports present a different composition. The highest value is for manufacturing (49.6 percent), followed by agriculture (15.4 percent) and only 2 percent of the fuel and mining sector is imported.

Another interesting aspect to evaluate is the destination of exports and the origin of imports. Mozambique's export destinations are mainly the EU, South Africa and secondly Zimbabwe and Switzerland. More than 66 percent of total exported goods are bound for the EU with a closer relation to the Mediterranean Countries and limited economic relations with the new EU- Member States. Imports come mainly from South Africa.

In order to state the reasons Mozambique wants to become a member of a regional FTA it is useful to analyze the regional trade and highlight the improvements and the advantages.

As depicted in the table below, the main trade partner is South Africa and consequently a regional agreement should include this country. Imports are mainly derived from Malawi, Swaziland and Zimbabwe, a group of neighbouring countries, while exports are destined for the same countries plus Tanzania and Zambia. Consequently, a regional agreement seems to be profitable even if the share of regional trade is not very significant. In particular, in 2005, Mozambican imports from the Region were 48 percent of the total while export reached only 22 percent.

Table 17: Mozambican imports and exports within the SADC region

	Imports						
	2006	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**
Angola	31.78	42.28	94.54	117.86	14.00	70.72	47.81
Botswana	51.78	116.54	110.70	208.84	79.09	2017.30	1645.95
Congo	20.46	0.00	0.00	0.00	0.00	0.00	0.00
Lesotho	0.07	8.44	3.31	1.70	0.00	0.00	0.00
Madagascar	0.00	0.0	0.00	0.00	0.00	0.00	0.00
Malawi	17809.21	11713.80	10016.52	18321.53	5043.70	3713.52	3827.12
Mauritius	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Namibia	1.14	0.00	0.00	0.00	0.00	677.22	0.00
RSA	94793643	91049242	84194595	58771995	49922995	42944536	51495272
Swaziland	15936.85	15570.83	11403.09	4156.98	4456.71	9103.51	10003.50
Tanzania	6315.32	4361.80	3452.59	1605.04	1201.29	787.18	1935.09
Zambia	1264.29	2983.42	687.29	72.69	135.68	60.33	379.84
Zimbabwe	24123.06	16963.68	9354.32	9472.48	16992.41	9035.05	7424.29
	Exports						
	2006	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**
Angola	1540.43	821.20	631.69	858.89	482.87	501.23	537.54
Botswana	531.90	55.84	750.88	1.754.35	296.54	7.24	2.32
Congo	544.19	326.37	736.62	299.08	132.11	99.08	71.62
Lesotho	778.09	128.37	129.03	0.61	50.45	0.00	0.00
Madagascar	147.67	0.00	0.66	47.03	0.00	17.21	168.64
Malawi	24738.39	48811.46	49861.3	32836.91	40578.85	10274.05	10974.61
Mauritius	916.78	576.75	195.43	612.66	159.06	77.17	16.88
Namibia	50.79	8.86	177.43	53.06	15.60	3.06	27.44
RSA	36170719	28286537	19399435	16963351	12496303	10761879	5333250
Swaziland	8228.60	3881.28	2683.67	17454.36	1039.33	686.34	636.18
Tanzania	4522.48	452.29	2230.79	1264.58	1582.55	180.80	0.00
Zambia	2116.03	1340.02	1036.55	808.94	2107.28	107.07	77.30
Zimbabwe	76128.17	51197.28	35025.61	29467.99	54659.57	37145.95	64525.46

Source: ***INE Mozambique***
Note: Features are in thousands of US$

b. Mozambique Trade Policy Regime

The trade sector has been reformed multiple times since 1987, although the main reforms have happened in the last few years. The result is the creation of a significantly liberalized regime based on tariffs. Moreover, foreign exchange controls have been abolished and most export restrictions have been eliminated or simplified in their procedures. As the Government itself states: "*Mozambique's external trade policies are designed to create an environment conducive to promoting its products in international markets, especially those of the developed countries of Europe, America, and Asia without prejudice to the promotion of intra-African trade*". These policies may be divided into two categories: those that improve external competitiveness and those that enhance its market access. The former includes both control over the exchange rate, which government abandoned at the beginning of the reform, and distorted policies such as subsidies. The latter is formed by tariff and non- tariff measures that affect the ability to sell outside the domestic market.

Tariff simplification has been decided upon in order to fulfill the WTO commitment. Now the tariff rates range from 0 to 30 percent and the system has a modestly escalatory structure. The average applied MFN tariff in 2000 was 13.8% with a decreasing trend as the 2006 value (i.e. 12.1 percent) shows. It is a lower rate in respect to the majority of the neighbouring countries. This is, in fact, a delight for the other countries in the Region since they believe this measure distorts regional trade.

Then, like others WTO participants, Mozambique has a 100 percent ceiling rate for agricultural products[63] and a tariff for non- agricultural products which ranges from 5 and 15 percent[64]. More specifically, in 2006 the average rate applied to agricultural products and non-agricultural products was 16.4 and 11.4 percent respectively.

At the beginning of 1997 the Mozambican Government opted for acceleration in customs reform. Crown Agents, a private British agency, was contacted to implement this reform. In order to increase Government revenue from customs, in 1999 they introduced a 17% value-added tax (VAT)[65]. The Government expected to improve public revenue with this measure and hopes to reduce the maximum tariff to 20 percent in the following years.

[63] This provision was negotiated under the Uruguay Round.

[64] See table 7.

[65] The exceptions are medical services and drugs, non- profit activities, banking, finance, insurance, housing rent, gambling, funeral services, wheat flour, rice, bread, tomatoes, agriculture and fishing. For imported goods it is calculated as a percentage of the c.i.f. plus duties plus excise.

Box 25: MFN tariff rates, 2000

	Ranges of MFN tariffs applied					
	0-5	**5-10**	**10-15**	**15-20**	**20-25**	**25-30**
Live animals/ products						•
Vegetables products				•		
Animal/ vegetable oils & fat			•			
Prepared foodstuff/beverage					•	
Mineral products	•					
Products of chemical ind.	•					
Plastics/ rubber			•			
Raw hides/ skins			•			
Wood/ articles of wood		•				
Pulp of wood		•				
Textile/ articles of textile					•	
Footwear/ headgear/ umbrella					•	
Stone/ plaster cement			•			
Precious stones				•		
Base metals		•				
Machineries		•				
Transport equipment			•			
Precision instruments					•	
Arms/ ammunitions						•
Misc. manufactured articles						•
Works of art						•

Source: WTO Secretariat

1. *Trade measures affecting imports*

The reform of NTBs took place in 1998 and it was directed towards a simplification in procedures and the elimination of prior licenses. At present, an importer has to be registered annually by completing a Single Administrative Document that is similar to the one used in the EU. Another simplified measure is the pre-shipment inspection that has been replaced by a pre- declaration before goods are shipped. In this context a 25 percent deposit against possible duty must be paid. Eventually, if exempted products are traded, there is a US$ 50 administrative charge. To conclude, customs fix the exchange rate for the transaction.

As mentioned above, the main pillar in the tax system is the imposition of tariffs, duties, and charges. Since 1989 duties are *ad valorem* and Mozambique does not apply any seasonal duties, tariff quotas or variable levies. In 2000, in the system there were 133 duty- free items and the tariff structure for the others was escalatory in nature. This means that at different stages of processing there was a different tariff rate, in particular, imported primary goods have a 12.8 percent duty, semi- processed a 9.5 percent duty, while finished goods have a 16.6 percent duty.

This demonstrates that processed goods face a higher effective rate of protection (ERP) while there is a modest degree of protection for higher level processing activities which ultimately means higher costs for consumers.

Another measure is the import surcharge that is applied in three cases. The first one is sugar imports. It is not fixed but depends on the world price[66]. The objective is to attract investments to revive sugar production as all sugar plants were destroyed in civil war. Investors in this sector negotiate a price policy to assure profitability[67] since there is the surcharge over a minimum import price equal to the world minimum price. It is known as "Sugar price policy". The second one is a surcharge on cement with the intent to build a foundation for a domestic cement industry. It was introduced in 1997 and was fixed at 12.5 percent although the Government envisions a gradual phasing out. Lastly, a surcharge on steel sheets and tubes was introduced because of dumping attitude of RSA and Zimbabwe. These countries actually sold their steel products below market prices in the Mozambican economy. Indeed, in 1997 a surcharge of a certain percentage [68] was imposed on this import from all countries, not only these two.

The ones described above are the main provisions for imports. Some minor measures are:

1) Import restrictions. They are applied only for reasons of health, morals or counterfeiting (i.e. pornography, narcotic drugs, select used automobiles older than five years).

2) Import regulations and licensing. This regards certain medications, arms, explosives, certain used clothes, gold, silver, platinum, certain foreign and domestic currency, certain used tyres.

3) Reference prices. This is limited to imports of second- hand automobiles.

4) Minimum import prices. This represents an effort to eliminate undervaluing by small importers at land borders, and on the basis of these prices duties are collected. They are limited to agricultural products and in particular to fresh produce and condensed milk. In the latter case, it is a reaction to the entry of small quantities of products by small traders taking advantage of the price differences between RSA and Mozambique.

5) Excise taxes. This is limited to alcoholic beverages, tobacco, luxury goods and automobiles. For luxury products, it ranges from 15 to 65 percent and it is calculated as a percentage of the c.i.f. plus duties.

6) User fees. These are for goods exempt from duties. Importers should pay a fee of US$ 50 for each importation.

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[66] In 2004 this tariff surcharge was structured in this way: for raw cane sugar and raw beetroot sugar there was a 77 percent surcharge, and for white sugar with flavourings/ colourings and other white sugars it was 54 percent. (Alfieri A., Cirera X., Rawlison A.(2006))

[67] It implies a nominal protection of about 60 percent.

[68] This surcharge is structured as follows: a 20 percent surcharge on corrugated iron/steel sheets, a 10.5 percent surcharge on both round tubes of iron/steel and others.

There is no regulation for antidumping, or safeguards in the Mozambican legislation. As a consequence, this kind of rule is directly implemented by SADC regulations. Rules of origin, then, are not often implemented and the law defines them as "*the country of origin of a product where it underwent its last relevant transformation*". Practically, this means that the addition of value added respect the final value of the good should be at least 35 percent.

2.*Trade measures affecting exports*

The reforms in the 1980s and 1990s were implemented to create a liberalized system that could attract foreign investments. As a consequence, foreign exchange control was abolished and the external sector was opened to external forces of supply and demand. Non- tariff barriers, such as export registrations and export licenses have been abolished to make export processes shorter, easier, faster and less cumbersome.

In the Mozambican system there are no export subsidies and no export taxes with the exception of an 18 percent surcharge on raw cashews. It grants protection to the domestic cashew processing industry increasing the price for poor small farmers and improving the incentives to revitalize cashew orchards.

At the end of 1999 the National Assembly passed a bill, known as "Cashew Nut Overvaluation Tax", raising the tax on exports of raw nuts from 14 percent to the current 18-22 percent.

Other minor measures include the following:

1) Export prohibitions. They are limited to foods that do not meet domestic standards, certain metal containers, counterfeit goods, ivory and ivory products, currency above a certain limit, art and cultural patrimony.

2) Measures restricting exports. They are decided by specified authorities for certain commodities. This is the case for animals and animal products, items of historical importance, gold and silver, poisonous and toxic substances, and narcotics that should be checked directly by the Veterinary Services, the Ministry of Culture, the Bank of Mozambique, and the Ministry of Health, respectively.

3) Duty and tax concessions. This measure is directed only to the special category of the companies in Export Processing Zones (EPZ). These were established in 1999 and the first one was the Beluluane Industrial Park followed by the MOZAL aluminium smelter in 2001. In order for an enterprise to be eligible to apply for EPZ status, it must satisfy two pre-requisites: it should export at least 85 percent of its annual production and employ at least 20 Mozambican workers (as long as there are at least 500 permanent jobs for Mozambicans in the EPZ). So, for customs purposes, an EPZ is treated as if it were offshore.

IV. Maputo's Offer to SADC

In December 1999 Mozambique submitted its first offer to SADC for its tariff phase- out and only in 2001 its implementation began. This offer comprised all the provisions established in the Protocol on Trade. This means it was differentiated between SADC Members and RSA. Each of them was presented in terms of product categories and the phasing out process would last until 2012 for SADC and SACU Members and until 2015 for RSA according to the special treatment reserved for Mozambique.

In the tables below (table 8 and 9) this offer is briefly depicted in terms of variations of import duties.

As previously cited, the first table shows that products of category A (immediate liberalization) faced an immediate zero percent import tariff starting in 2001. Products in category B (gradual liberalization) are divided into three subsections with different tariff rates (i.e. B1 presents the highest tariff while B22 the lowest) and their liberalization started only from year 6 to year 8 (i.e. 2006/ 2008) as the protocol grants to back loading member states. For category C (sensitive products) reductions start only after year 8 but a complete liberalization if maintained until 2012.

The purpose for RSA, as depicted in the second table, is similar. The only difference is the deadline for products in category C which will be liberalized until 2015.

An important facet to highlight is that the same product coming from a third country enters another category. More distinctively, goods in category A may enter categories B or C if they are produced in a third state. For category B, goods may enter either group B if they are Member States' products or group C if they are products from another African State.

Table 18: The Mozambican phase- out for SADC and SACU members

Cat. SADC	*Cat.Int.*	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
A	***A***	-	-	-	-	-	-	-	-				
B1	***B1***	30	30	25	25	25	20	10	-				
B2	***B21***	7.5	7.5	7.5	7.5	7.5	7.5	4	-				
B2	***B22***	5	5	5	5	5	5	3	-				
C1	***C1***	30	30	25	25	25	20	20	20	15	10	5	-
C2	***C21***	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	5	-
C2	***C22***	5	5	5	5	5	5	5	5	5	5	3	-
C2	***C23***	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	1	-
E	***E***												

Table 19: The Mozambican phase- out for RSA

Cat.SADC	*Cat.Int.*	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
A	***A***	-	-	-	-	-	-	-	-							
B1	***B1***	30	30	25	25	25	20	10	-							
B2	***B21***	7.5	7.5	7.5	7.5	7.5	7.5	4	-							
B2	***B22***	5	5	5	5	5	5	3	-							
C1	***C1***	30	30	25	25	25	20	20	20	15	15	15	10	10	10	-
C2	***C21***	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	5	5	3	3	-
C2	***C22***	5	5	5	5	5	5	5	5	5	5	4	3	2	1	-
C2	***C23***	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	1	-
E	***E***															

Source: ***MIC Mozambique***
Note: the features are import duties

From a different perspective, the liberalization program may be seen and analyzed in terms of categories of products according to the HS system. In the table below, we present a timetable for liberalization respecting twenty- one merchandising groups. In more detail, we can divide them into three categories:

1) Agriculture. This includes animals, vegetables and products from them.

2) Mining. This is formed by mineral products.

3) Manufacturing. This is the widest and least homogeneous category. It comprises, for example, textiles, the chemical sector, paper, wood, food manufacturing, machinery and equipment.

Table 20: The Mozambican offer to SADC, SACU members and RSA

	SADC (exc. RSA)				RSA			
	Duty free in				*Duty free in*			
	2001	**2008**	**2012**	***Excl.***	**2001**	**2008**	**2012**	***Excl.***
totals	***1578***	***3351***	***298***	***19***	***1475***	***3382***	***370***	***19***
Live animals/products	44	125	42	2	31	133	47	2
Vegetables products	133	142	29	-	120	145	39	-
Animal/ vegetable oils & fat	14	19	15	-	13	19	16	-
Prepared foodstuff/ beverage	36	145	16	-	9	146	42	-
Mineral products	118	41	3	-	115	41	6	-
Products of chemical ind.	642	139	7	-	638	143	7	-
Plastics/ rubber	104	100	8	-	100	97	15	-
Raw hides/ skins	15	59	-	-	14	60	-	-
Wood/ articles of wood	16	67	-	-	15	67	1	-
Pulp of wood	37	110	1	-	36	110	2	-
Textile/ articles of textile	98	616	111	-	78	635	112	-
Footwear/ headgear /umbrella	4	53	-	-	2	55	-	-
Stone/ plaster cement	8	134	5	-	7	135	5	-
Natural/ cultured pearls	-	-	-	-	-	52	-	-
Base metals	154	389	34	-	151	381	45	-
Machineries/ mech. appliance	142	658	14	-	138	662	14	-
Vehicles/ aircraft/vessel	-	138	11	-	-	135	14	-
Optical/ photogr. equipment	2	235	-	-	2	235	-	-
Arms/ ammunitions	-	-	-	17	5	-	-	17
Misc. manufactured articles	10	122	2	-	1	124	5	-
Works of art	1	7	-	-	-	7	-	-

Source: ***WTO Secretariat***
Note: the features are the number of liberalized tariff lines

This table demonstrates how liberalization is faster for raw materials than for the manufacturing sector with a negative record for the textile and clothing sector. With respect to RSA the same thing happens and it demonstrates that the manufacturing sector has a higher degree of protection.

According to the SADC terminology and division into categories, we can easily determine the impact of each category on the total number of liberalized tariff lines and on the share of free trade. As we can see, 30 percent of goods in category A have no import duties when they are exported to SADC Members in 2001. In 2008, around 94 percent of tariff lines should be liberalized since in that year there is a contemporaneous liberalization of categories A and B.

Finally, by 2012, around 99.57 per cent of tariff lines will be liberalized with the exception being tariffs on the exclusion list (category E). Those count for only 0.43 percent.

Table 21: Relative shares of each category in the number of liberalized tariff lines for Mozambique (except RSA)

Category	*No. tariff lines*	*% total*
A	1613	30.04%
B1	1542	28.72%
B21	1350	25.14%
B22	541	10.07%
C1	233	4.34%
C21	55	1.02%
C22	7	0.13%
C23	6	0.11%
E	23	0.43%
totals	***5370***	***100%***

Source: ***MIC Mozambique***

The same reasoning may be applied to the liberalization towards RSA. In this case, the first is the liberalization of around 28 percent of tariff lines while at the end of 2008 the liberalized share was higher than 92 percent. This was caused by two categories (A, B) which were then fully liberalized. Then, the results were reached in the last two steps and increase the share of only 7 percentage points (from around 92.5 per cent to 99.48 percent). This small change in respect to a seven- year period is derived from the possibility of liberalizing trade for commodities of categories C in two steps instead of the unique implementation period decided for their trade within the SADC- SACU region.

Table 22: Relative shares of each category in the number of liberalized tariff lines for Mozambique (RSA)

Category	*No. tariff lines*	*% total*
A	1509	28.10%
B1	1568	29.20%
B21	1348	25.10%
B22	547	10.19%
C1	269	5.01%
C21	89	1.66%
C22	7	0.13%
C23	10	0.19%
E	23	0.43%
Totals	***5370***	***100%***

Source*: MIC Mozambique*

The purpose of this chapter was to examine the contents of the SADC Protocol on Trade and the effect that the creation of a Free Trade Area in the region may have, with an emphasis on Mozambique. It shows that this process is likely to be an opportunity for the region to grow through the expansions of small domestic markets. It is important since it represents both an increase on demand, namely an increase in the number of consumers, and a benefit on supply if SADC- FTA will be able to attract foreign direct investments and stimulate the full implementation of trans- borders and regional mega- projects.

The forecasts are positive in relation to the Mozambican experience. As previously described, there is a number of already accomplished projects and new opportunities to explore. These involve not only intra- SADC resources but also extra- African ones, namely from the United States, Switzerland, the United Kingdom, China, Portugal, Spain, and Canada. The manufacturing and the mining sectors seem to be the key elements for FTA's success since the agricultural sector is exceptionally protected as a response to the national special interests.

The agricultural example raises new concerns about the effective level of commitment of Member States and their true willingness to create a common market. In fact, this region presents an overlapping membership to many different regional agreements creating an environment of non- commitment to any of them.

Mozambique, as demonstrated, is the only Country belonging to a single REC. This choice may be critical. This may obligate them to accept provisions that are not the optimal ones but are the result of a compromise between special interests.

From an international perspective, SADC is an interesting experiment to follow as it develops. Since South- South integration is considered to be the best way to enter the globalized world economy for developing countries, it is sustained by all international organizations, especially in technical and capacity building. This is one of the objects of the established SADC- EU EPA besides the enlarging of markets.

4. The Accounting Framework: A 2003 Social Accounting Matrix

At this stage, we want to explore the Mozambican economy in order to capture its essential elements for utilisation in building CGE models. Then, we want to exploit the comprehensive framework of a SAM to address our empirical issue. In this way, we will easily be able to sum up the basic features of the economy and the relationships among different economic agents. In a SAM framework, we may study the liberalization process by locating its effects on income distribution and production pattern changes. As Round (2003a) states: "[a SAM] *connects the following aspects: the levels and distributions of incomes available to institutions (in particular households); the private and public spending of these incomes on goods and services (which are part of the determination of individual's living standards); transfer payments and savings by institutions; the production of goods and services, and the generation of factor incomes*".

First, a macro SAM is built to generally quantify the size of the economy and the overall changes after the policy. Then, we profoundly study the economy and highlight its structural features. To briefly sum up the fundamental nature of this, we quote Tarp et al. (2002): "*this SAM confirms the critical importance of high marketing costs, the sizeable share of agricultural production consumed on-farm, and the severe capital constraint, which inhibits marketed agricultural production particularly*". The disaggregated, or micro, SAM exploits information from the National Household Survey (*2002/ 03 IAF*), and permits us to divide the household account into two categories according to location (i.e. rural or urban). Furthermore, both from the *IAF 2002/ 03* and from Labour Force statistics (*2004/ 05 IFTRAB*), we divide labour into three categories according to workers' skills. Naturally, skilled, unskilled, or semiskilled workers should earn different wages and should be employed in different proportions in the activity sectors. For instance in the agricultural sector there should be more unskilled labour than in the service sector.

II. The Mozambican economic performance in 2003

Since the 1980s, the Mozambican government has withdrawn its direct participation in production, processing, and marketing activities in the agricultural sector. As a consequence, it has liberalized input prices, removed subsidies and the monopolistic positions of cooperatives. and suppressed marketing boards.

The primary sector is one of the leading forces in the development of the country. Although it counts only for 16 percent of the total GDP, it employs more than 80 percent of the total workforce. Its results, however, are affected by the country's proneness to natural disasters, such as droughts and floods[69], and the remnants of the Civil War which left a trail of land mines in a large part of rural areas. The main sectors are food grains, sugar production, tobacco/ tea production, and cashew/ cotton production. Among these sectors only the one of cashews is stagnant even though it was recovered after the war's end. Cashew nuts production is one of low quality and the exported crops do not result in high prices. An important consequence is poverty in rural areas. Rural farmers consider cashew nuts to be the most profitable crop. Generally, this is largely due to the small-scale farmers' concerns about food self-sustainability for the coming year. Food grain cultivation has been expanded in terms of land cultivation because of an increasing cross-border trade of maize with Malawi. The tobacco and tea production has attracted Zimbabwean companies' and farmers' investments. The tea sector was seriously damaged by the Civil War which destroyed the highest producing region, Zambesia province. However, since the privatization of the tea growing and processing units, the sector has started growing again. Nevertheless, sugar production leads development since it is attractive for foreign investors. These investments are mainly due to the special protection policy they are subject to: this sector benefits from an exemption from sales taxes and a surcharge on sugar imports that reached 90 percent in 2003. Moreover, preferential quotas are offered in the U.S. market.

This sector features two main innovations: the former is the market integration inside the Country while the latter is the technological progress. The market integration involves the Northern, Central and Southern regions that until now have been self- sufficient due to high transportation costs[70] and poor communication.

As a result, prices in agricultural products converge across sub-regions and the percentage of smallholders selling food crops (maize and cassava) increases, especially in the maize segment. The final results of the *2002/03 IAF* show that 66 percent of the agricultural products are self- consumed at the national level, although it reaches 69 percent in rural areas and only 52 percent in urban zones.

[69] For these reasons, the production changes. There is the prioritisation of short cycles especially in the Gaza province in order to maximize production in a situation of rainfall uncertainty.

[70] However, in 2003 the circulation of agricultural products has worsened as a consequence of the deterioration of infrastructures and damages mainly caused by the lowering atmospheric pressure (*Delfina*) and the *Japhet* cyclone.

The technological progress is not clear. Calculated in terms of employed fertilizers and chemical products, this progress has not given a unique result. The paradox has been represented by the cash crop segment (beans and potatoes) that remains underdeveloped despite use of fertilizers'. Because of the suppression of subsidized fertilizers, their employment has decreased[71].

In the same period the depreciation of the Metical in the international context has raised their costs. Therefore the Government encourages the domestic fertilizer production and seeks international investments in this area.

One of the most significant features of the agricultural sector is the coexistence of a family and a business sector. The *2002/03 IAF* demonstrates that nearly 87 percent of household are self- employed with only 16.4 percent working in the agricultural private sector. This affirmation restates what we have previously cited about own- consumption. For 95 percent of family workers there is no money remuneration but an in- kind transfer, mainly a part of their crop production.

The business sector contributes to the global sector's production around 90 percent and in the marketed production 75 percent. Moreover, this sector employs only 10 percent of total capital value added and, supposing the rate of return of capital is equal across the sub- sectors, this means that agriculture in Mozambique is relatively low capital intensive.

Table 23: The agricultural production

	Unit of measure	Quantity
Basic food crops		
Maize	Ton	1,178,792
Sorghum	Ton	190,820
Mafurra	Ton	21,609
Unshelled rice	Ton	117,483
Beans	Ton	112,578
Batata	Ton	877,165
Peanuts	Ton	87,463
Cassava	Ton	6,547,298
Cash crops		
Cotton	Ton	54,144
Raw cashew	Ton	63,818
Sugarcane	Ton	1,940,799
Leaf tea	Ton	12,690
Citrus fruits	Ton	30,000
Coconut husk	Ton	47,600
Tobacco	Ton	37,051
Sunflowers	Ton	6,400

Source: ***MADER Mozambique, 2003 TIA (INE website, 2009)***

[71] A simple way to demonstrate this proposition is an analysis of the IO table, where the intermediate consumption of each sector is shown. From these data we derive that pesticides and fertilizers are mainly used in the forestry sector (nearly 40 percent of the total used pesticides), while for crops production they are not employed for crops other than maize, and only a small fraction (0.1 and 0.6 percent, respectively) is dedicated to beans and other basic vegetables (namely fruit and vegetables, and bulbs and roots).

The mining sector has rapidly developed and is sustained by the increasing extraction of products such as limestone, sand for construction, clay, riolite, and tantalite, which are used in the electronics and steel industry. At the same time, however, there has been a decrease in coal extraction and in raw bentonite because of old extraction equipment and the bad weather in the area of Cuamba, where the main mines are located. The projections for this sector demonstrate an increasing trend in production when the Pande- Temane Gas pipeline project starts operating. This will mean an increase in the production and a change in the internal composition since natural gas extraction will become a major division.

Nowadays, this sector employs less than one percentage point of the total national workforce and it is mainly composed of private companies (6 percent of them are involved in this activity). However Mozambique is rich in other mineral deposits: ilimenite, graphite, fluorine, gold, marble, granite, precious or semi- precious stones, asbestos, diamonds, apatilite, and beilite. Many of these have yet to be exploited.

Table 24: Mineral resources' production

	Unit of measure	Quantity
Coal	Ton	36,742
Bentonite	Ton	24,627
Sand for construction	Ton	1,372,032
Clay	Ton	100,176
Bauxite	Ton	10,250
Natual gas	Gj	2,522,897

Source: ***INE website, 2009***

The overall impact of the manufacturing and industrial production is positive but this trend is mainly led by the aluminium production that significantly increased after the beginning of the MOZAL project (along the Maputo- Johannesburg corridor) and more considerably after MOZAL phase II. This does not mean solely an increase in this segment, but it has positive spill-over on the overall transformation industry. This has been especially true for the metallic product industry, machineries and equipment. In fact, without counting aluminium production, these activities would have had a very negative trend. An example is the indicator of base metallurgy, where aluminium counts for 99.89 percent of the total production.

Furthermore, the positive trend is sustained by the food, beverage and tobacco segments that represent a large share in the total industrial production (more than 47 percentage points) structure but that has also benefited from the encouraging performance in the agricultural sector.

Bad performances have been in the textile and paper activities. In the former, the problem is that half of the productive complex is not operative while the ones that are still operational are reducing their production levels. As in the mining sector, the manufacturing activities employ only one percent of the total active population. However, the employment levels differ across regions. In fact, industries are concentrated in the South of the Country where there is half of the total sectoral employment and especially in Maputo city (3.9 percent of the sector employment).

The service sector has not had a unique trend. In fact, the overall sector presented a positive trend in 2003. However, when disaggregating data, we can note some opposing performances. First of all the transportation compartment has had a positive result. Led by the road construction[72] that offsets the negative trend recorded in the railway and pipeline segments, they all are still affected by the Zimbabwean crisis. The notably good performance of the construction sector is not only a result of political commitment in building infrastructure but is led by private sector construction with a high level of urbanization in the country as well.

Then, led by the positive results of the agricultural, fishery, transformation, and the extractive industries, the commerce sector has grown since there has been an increase in marketable products. The communication sector growth should be more robust than constant with an increase of only 0.3 percent over the previous year, especially taking into account the full privatization of the sub- sector.

This sector employs 14 percent of the workforce, mainly in the commerce activity, which counts for 7 percent. In the primary sector, there are 1.3 female workers for each male, conversely the service sector is mainly dominated by male workers (28.3 percent against 9.9 for female workers). Moreover, particularly in the commerce segment there is a concentration of workers in Maputo province and City where nearly 40 percent of the total sector workforce is employed.

Public utilities, electricity, and water are quite a different matter. Potentially, Mozambique could be the main supplier to the region thanks to its hydroelectric prospects. Nonetheless, the activity has recorded a downfall, mainly caused by modernization works at the “Hydroelectric de Cahora Bassa”. This decrease affects the export performance more than the production for domestic demand[73]. Furthermore, this component has increased as a result of the economic growth and the rural electrification efforts. Despite the natural endowment of electricity, Mozambique imports part of its power need. This is caused by the localization of the Cahora Bassa plant that is too far from the Southern provinces and especially from Maputo City

[72] Road construction and maintenance are two pillars of the Mozambican developmental strategy included in the PARPA.

[73] Although in 2003 Mozambique started exporting to Zambia.

whose higher electric requirement is satisfied by South African imports. As previously cited, there is a huge amount of Mozambican electrical exports. Their destination is South Africa. For a long period this trade was unbalanced: Mozambique exported electricity and imported it at double the price.

After this brief introduction on the Mozambican economy, we must focus on two peculiarities that are fundamental for the SAM building: own consumption and marketing margins. These two phenomena are largely correlated and one explains the other. One of the startling features of the Mozambican economy is the presence of high marketing margins that change the farm gate price from the final purchaser's price[74] sensibly.

This wedge changes across sectors and may reflect a wide variety of arguments: a certain degree of imperfect competition, poor infrastructure level and therefore difficulties in trading, or a high cost of capital[75] (Arndt and Tarp, 2000). As Arndt *et al.* (1998) showed, these margins are connected both to domestic transactions and international exchanges. Domestic transaction, as previously mentioned, does not mean solely the whole output produced domestically but it takes into account another important feature of the economy: own consumption[76].

This means producers consume part of their production, especially in the agriculture, livestock and fisheries sectors and in the food processing sector. The motives are to maintain food security. To strengthen this concept we may take into account the cassava productive sector. It is composed both of a formal sector and an informal one, both of which contribute to

[74] This characteristic has an historic grounding. High marketing margins were introduced during the Portuguese colonialism when prices of a wide variety of commodities were set by Government according to commodity types, processing stages and final uses. After the independence this centralized price system was maintained with the establishment of a series of state- owned marketing boards, each one for a different kind of commodity, that acted as wholesalers. For instance, in the 1960s the Mozambican government funded a state marketing board for cereals. Although, the presence of marketing boards in Africa is quite common, the Mozambican ones were characterized by a price control not only on the exported goods, but also on domestic transactions.

[75] Gohin A. (2000) highlighted "*four main types of marketing services*" that we may classify as: "*transport activities, storage activities, wholesale trade and retail trade*". Moreover in the last sector (i.e. retail trade), Betancourt et Gautschi (1992) said "*accessibility of location, assortment, assurance of production delivery in the desired form and at the desired time, information, and ambiance*" are collected.

[76] As the *2002/03 IAF* (INE, 2003d) demonstrates, home consumption is mainly a widespread rural phenomenon.

total production for less than 1 percent and 99 percent, respectively. Additionally, the total own consumption counts for 73 percent while the marketed production is only a quarter of the total production. Only in this small fraction may marketing margins be applied since, by definition, own consumption avoids marketing margins. At this stage we may briefly describe the trade service sector, how it acts, and its weight in the economy. Trade services are produced by two different activities that reflect the various nature of the marketing margins. Together with a pure marketing margin that counts for the highest amount (nearly 97.40 percent), a part of these margins is caused by transportation costs[77]. This sector provides 12 percent of the total domestic production, nearly 20 percent of total capital value added and 11 percent of labour value added. This is a demonstration of Arndt and Tarp's (2000) affirmation "*the commerce activity, which provides marketing services, is capital intensive.* […] *Due to the capital intensity of the commerce sector, returns to capital have a strong impact on marketing services prices*". From many sources, we derive that marketing margins are particularly high for the agricultural sector and for the food processing sector, while by definition, they are zero for services.

For the year 2003, we deduce that the general features in the margins' distribution still held. In fact, if we consider the agricultural sector and the food processing we had nearly half of the total marketing margins in the economy while the manufacturing sector, as a whole, had a lower margin rate. Moreover, it is worth noting that basic food crops, grains and cassava counted for more than 12 percent, nearly as much as the fuels and chemical sector which produced more output and included a wider range of goods. Under deeper scrutiny, the higher margins in the agricultural sector appear higher if we consider that in this sector there was a high level of own consumption. In other words, more than half of total domestic production (considered both in the formal and the informal sectors) was consumed inside the productive units[78] and the total margins could be applied to a smaller output volume since own consumption avoids marketing margins.

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[77] This transportation costs are not associated with transport in general but with goods transported by road. This means that it is mainly part of the domestic margins since it is well- known that the infrastructure level inside the country is very low. As Tarp F. *et al.* (2002) shows, the only developed road system is the so called east- west corridor linking Maputo, Beira, and Nacala to the landlocked African countries, South Africa, Zimbabwe, and Malawi. Infrastructure in the north- south direction is poor, rail links are lacking and permanent roads minimal. It makes agricultural goods' trade more expensive and food shortages in the South more frequent.

[78] In this case with the definition "productive units" we mainly define small- size family farms where family components work and earn no monetary wages but an in- kind transfer, as the final results of the *2002/03 IAF* (INE, 2003d) show.

This means that the margin per unit of output is higher. Tarp F. *et al.* (2002) demonstrated that in these sectors margins a wedge of at least 50 percent from the farm gate price and the final consumer's price could be created.

III. The analytical framework

The pioneer in the SAM development was Sir Richard Stone, who in the early 1960s participated in preparing a SAM for the U.K. According to many scholars, "*a social accounting matrix (SAM) is a particular representation of the macroeconomic and mesoeconomic accounts of a socioeconomic system*" (Pyatt and Round, 1985; Round, 2007).

Although used in a different context and for a different analysis (fixed- price multipliers, flex- price multipliers, or as the benchmark for calibrating a CGE), SAMs share some common features in their construction. Three main aspects are usually emphasised (Round, 2003, 2007). The first is that the SAM is a *square matrix* where each economic transaction is inserted into a cell so that the matrix displays explicitly the connections between institutions. The second is rows and columns have different meanings. Since the SAM captures the circular flow of income inside the economy, rows represent incomings and columns outgoings for each institution. The third is each column's sum is equal to the corresponding institution's row sum. This directly derives from the circular idea of income where a receipt for an institution is a payment for another one at the same time. No transfer goes outside of this flow, so in the SAM we will find all the transactions between agents.

There are two different entries. First, there are entries which describe flows across markets, typically payments moving in one direction (from column to row) and commodities moving in the opposite one. Second, there are "*nominal flows without a counterpart*". This definition means this class of transaction does not involve productive activity or real exchange. In this group we may insert all the financial transactions and the so- called transfers, that include other non- market nominal flows and pure transfers, such as welfare payments and tax payments. As Robinsons (1989) recognised: "*while financial flows and transfers have no real counterparts, they nonetheless represent important economic transactions, reflecting the institutional structure of the economy and assumptions about the behaviour of various actors. These flows largely define the macroeconomic structure of the economy and must be capture in any model that is concerned with distributional issues or macro adjustment*".

Then, the SAM is *comprehensive,* describing all the economic activities inside the system. Although for analysis purposes the compiler may prefer to stress certain elements instead of others. In these peculiarities we recognise the *flexibility* of the system. Although a basic representation, a SAM may be disaggregated in different ways or more attention may be put on particular relationships in the system.

The effectiveness of SAM is based mainly on three motivations. Its construction helps to combine statistical data from different sources, such as national accounts, surveys on enterprises or households, or sector specific statistics. Then, it is easy to pass from the macro- to the meso- level of the economy, or in other words "*a macroeconomic SAM evolves naturally into a mesoeconomic framework*" (Round, 2007), showing "*in a clear way the linkages between the generation of income, and the distribution to and redistribution between institutions*" (Round, 2007). Finally, this is the analytical framework for modelling. As previously cited, the SAM is the benchmark for calibrating a whole CGE model, and it gives some fundamental relations between the strutures of the economic system.

A basic SAM is composed of a "*use matrix*" (otherwise defined as input-output matrix) where intermediate consumption is shown. Then, there is the "*make matrix*" where activities sell their products to the market. Finally, the "*institutional matrix*" captures the transactions between the activities' and the commodities' accounts and the institutions we introduce in the SAM.

The role and the importance of the accounts change according to the issues we address. For instance, as Robinson (1989) described, the commodity account is particularly important when the SAM is the basis for an analysis on international trade. It is also true that if the focus is on distributional issues the household decomposition becomes crucial. Finally, a tax incidence analysis needs a disaggregation among different taxes instead of a generic government account.

In table 25 below we present a basic SAM in order to capture the essential relationships and practically describe how to interpret the entries.

Table 25: A basic macro- SAM

		1	2	3	4	5	6	7	8	9	10	11
		ACTIVITY	**COMMODITY**	**LABOR**	**CAPITAL**	**HHDS**	**ENTERPRISE**	**GOVT**	**PRIVATE INV.**	**GOVT INV.**	**ROW**	**TOTALS**
A	**ACTIVITY**		Domestic marketed sales									Total domestic production
B	**COMMODITY**	Intermediate consumption				Final household consumption		Final government consumption	Private invest.'s	Govt invest.'s	Exports (FOB)	Total marketed supply
C	**LABOR**	Labour										Labour income
D	**CAPITAL**	Capital										Capital income
E	**HHDS**			Labour income			Distributed profits	Welfare transfers			Remittances from abroad	Total household income
F	**ENTERPRISE**				Capital income			Subsidies				Total enterprise income
G	**GOVT**	Activity subsidies and indirect tax	Import duties and taxes on final goods (Excises, import duties)			Individual income taxation	Corporate taxation					Total government income
H	**PRIVATE INV**					Household savings	Enterprise savings				Net private capital inflows	Total private savings
I	**GOVT INV**							Government savings			Aid in govt budget	Total govt savings
L	**ROW**		Imports (CIF)									Total foreign exchange outlays
M	**TOTALS**	Total cost of production	Total absorption	Labour income	Capital income	Total household expenditure	Total enterprise expenditure	Total government expenditure	Total private investment	Total govt investment	Total foreign exchange earnings	

Source: ***Own modifications of Arndt et al. (1998)***

To analyse a SAM, it is useful to start from column 1 which is the cost decomposition column. It states that the total output (cell M- 1) is exhausted by intermediate consumption (B- 1), the payments to factors of production (C- 1, D- 1), and tax payments on output or subsidies (G- 1). Note that if we have a multi- sector model the intermediate consumption is not a single entry but a sub- matrix called an "input-output" table. Then, the activity sells its commodity in the market (A- 2) where imports (L- 2) also build up the total supply (M- 2). Imports enter the internal market gross of import tariff, while on the domestic sales there are other sales taxes (G- 2). Labour and capital incomes go to the institutions, households and enterprises. The former earns labour income (E- 3), distributed profits from enterprises (E- 6), remittances from foreign workers (E- 10) and welfare payments from the government (E- 7); the latter gets gross profits (F- 4) and subsidies (F- 7). These incomes are used according to columns 5 and 6. Households pay part of their income in consumption of commodity (B- 5), a share is devoted to personal direct taxation (G- 5) and a fraction is saved (H- 5). Enterprises pay distributed profits (E- 6) and direct tax (G- 6) while they save a part (H- 6). Government income derives from tax payments so the total revenue (G-11) is equal to the sum of indirect taxes on activity and commodity (G- 1, G- 2) and the direct taxes (G- 5, G- 6). Its expenditures are consumption of goods (B- 7), welfare and subsidy payments (E- 7, F, 7) while it saves (I- 7). Both the private sector (households and enterprises) and the government invest (B- 8, B- 9). Total private investment should equal the total private savings (H- 11, M- 8), and the same happens in the public sector account (I- 11, M- 9). If these identities are not satisfied, there are foreign capital inflows that may occur both in the private sector (H- 10) and in the public one (I- 10).

As Robinson (1989) points out, "*the definition of the SAM should be tailored to the problem being analyzed, and there is no standard SAM that can serve all purposes*". We could add: there is no world- wide SAM but it should be tailored to address a country's peculiarities since each country has distinct characteristics. For this reason the SAM presented above is a good starting point to build up a SAM for Mozambique but it does not take into account some specificities of the Mozambican economy. We perform our analysis in two steps. First, we build a macro SAM where only some characteristics are shown, and then we make a micro SAM where all the peculiarities are shown and directly observable.

a. A 2003 macro SAM for Mozambique

This macro SAM is based upon an unpublished SAM used in Arndt et al. (2008). It follows the traditional format employed in the IFPRI SAMs. It does not differ greatly from the example presented in table 25. We only introduce a new element in cell A- 5 that we call "own consumption." We explicitly count for marketing margins and we disaggregate the government revenue accounts according to the tax nature. In this way, we take into account the specificities of the Mozambican economy with the first two elements, and the third one becomes useful when we run our policy simulation and we want to evaluate changes in government revenues due to trade liberalization (i.e. a reduction in import duties and VAT collected at borders).

As briefly summarized in the introduction, the macro SAM presents two sectors: one is specifically the trade margins sector while the other is the productive one (an aggregation of agricultural, mining and quarrying, manufacturing, and service sectors).

As many scholars suggest, one of the main advantages of the SAM framework is to reconcile data from different institutions and sources. As Round (2003b) states: "*the construction of a SAM helps to bring together data from many disparate sources that help to describe the structural characteristics of an economy*". However, this is also a great problem in its construction since data are often not matching and so the compiler has to decide how to handle them with personal criteria. In the construction of this SAM the data sources are more than one.

The construction of the macro SAM starts from National Accounts data. We re- compile them in an income - expenditure balance sheet format and present them in table 5. Moreover, as Round (2003b) clearly expresses: "*an aggregate SAM is a particular way of representing the national accounts within a matrix framework*".

Table 26: National income statistic balance sheets (in Billion MT)

GDP	Income		Expenditure
Compensation to employees	61,824	Government final consumption	14,745
Gross operating surplus	39,500	Private final consumption	92,205
Net indirect taxes	10,555	Gross fixed capital formation	24,373
		Increase in stock	2,660
		Exports	30,527
		Less Imports	-52,631
Total GDP (market price)	**111,879**	**Total GDP (market price)**	**111,879**
National Disposable Income	**Income**		**Expenditure**
Compensation to employees	61,824	Government final consumption	14,745
Gross operating surplus	39,500	Private final consumption	92,205
Net indirect taxes	10,555	Savings	2,439
Compensation of employees from ROW	1,343		
Property and entrepreneurial income to ROW	-3,833		
Current transfers from ROW	12,505		
Total	**109,389**	**Total**	**109,389**
Capital Accounts	**Income**		**Expenditure**
Gross savings	2,439	Gross fixed capital formation	24,373
Current account deficit	24,594	Increase in stock	2,660
Total	**27,033**	**Total**	**27,033**
Rest of World	**Income**		**Expenditure**
Imports of goods and services	52,631	Exports of goods and services	30,527
Compensation of employees to ROW	n.a.	Compensation of employees from ROW	1,343
Property and entrepreneurial income to ROW	3,833		
Other current transfers to ROW	n.a.		
Surplus on current account to ROW	-24,594		
Total	**31,870**	**Total**	**31,870**

Source: ***Constructed from National Accounts (INE, 2003, 2009 and BM, 2009)***
Note: n.a. means "not available"

In this framework we record changes in stock of assets and liabilities held by institutions, and each flow account represents a particular economic activity, such as production, generation, distribution, redistribution or use of income. Usually, accounts are recorded by transactor of origin, or resource, and destination, or use. In our case, we use the terms income and expenditure.

As Round (2003b) expresses: "*it can be viewed as a system whereby income "cascades" from one account to another*". In the first account, value added is the balancing item which cascades in the national disposable income account through the process of redistribution of income. Then, the uses of the income itself are shown distinguishing between capital account and a connecting account for the rest of the World.

In the table below we summarize the macro labels and the different data sources employed. Then, the final macro SAM is presented.

Box 26: Label definitions and data sources in the 2003 macro SAM

ROW	COLUMN	LABEL DEFINITION	DATA SOURCE
Activity	**Commodity**	Marketed domestic supply	National Accounts- Produto Interno Bruto, Óptica Da Produção (INE website, 2009), SU table (INE, 2003a)
Activity	**Household**	Own consumption	Household Survey (*2002/03 IAF*, INE 2003d) and SU table (INE, 2003a)
Commodity	**Activity**	Intermediate consumption	RESIDUAL
Commodity	**Household**	Private final consumption	Household Survey (2002/03 IAF, INE 2003d) and SU table (INE, 2003a)
Commodity	**Trd**	Marketing margins for domestic transactions	Unpublished MACROSAM 2003 Arndt et al. (2008)
Commodity	**Tre**	Marketing margins for exports	Unpublished MACROSAM 2003 Arndt et al. (2008)
Commodity	**Trm**	Marketing margins for imports	Unpublished MACROSAM 2003 Arndt et al. (2008)
Commodity	**Govt**	Government recurrent expenditures	Orçamento Geral do Estado-Despesas, Défice e Produção Total (BM website, 2009), IMF (2005) and SU table (INE, 2003a)
Commodity	**Capital**	Private investments	National Accounts- Produto Interno Bruto, Óptica de Despesas (INE website, 2009) and SU table (INE, 2003a)
Commodity	**Govt capital**	Government capital expenditures	Orçamento Geral do Estado- Despesas, Défice e Produção Total (BM website, 2009), IMF (2005) and SU table (INE, 2003a)
Commodity	**Dstk**	Private change in stocks	National Accounts- Produto Interno Bruto, Óptica de Despesas (INE website, 2009) and SU table (INE, 2003a)
Commodity	**Row**	Exports (FOB)	Balance of Payments- current account (BM website, 2009) and SU table (INE, 2003a)
Labour	**Activity**	Labour component of value added	National Accounts- Produto Interno Bruto, Óptica de Rendimento (INE website, 2009) and GDP table (INE, 2003b)
Capital	**Activity**	Capital component of value added	National Accounts- Produto Interno Bruto, Óptica de Rendimento (INE website, 2009) and GDP table (INE, 2003b)
Household	**Labour**	Labour income and mixed income	National Accounts- Produto Interno Bruto, Óptica de Rendimento (INE website, 2009) and GDP table (INE, 2003b)
Household	**Capital**	Capital income	National Accounts- Produto Interno Bruto, Óptica de Rendimento (INE website, 2009) and GDP table (INE, 2003b)
Household	**Enterprise**	Distributed profits	RESIDUAL
Household	**Govt**	Welfare transfers	Orçamento Geral do Estado- Despesas, Défice e Produção Total (BM website, 2009) and IMF(2005)
Household	**Row**	Remittances	Balance of Payments- capital account (BM website, 2009)

(Box 26 continues)

ROW	COLUMN	LABEL DEFINITION	DATA SOURCE
Enterprise	**Capital**	Gross profits	National Accounts- Produto Interno Bruto, Óptica de Rendimento (INE website, 2009) and GDP table (INE, 2003b)
Enterprise	**Govt**	Subsidies to enterprises	Orçamento Geral do Estado- Despesas, Défice e Produção Total (BM website, 2009) and IMF (2005)
Govt	**Enterprise**	Profit payment for state-owned enterprises	Orçamento Geral do Estado- Receitas (BM website, 2009) and IMF (2005)
Ytax	**Household**	Personal income tax	Orçamento Geral do Estado- Receitas (BM website, 2009) and IMF (2005)
Ytax	**Enterprise**	Company income tax	Orçamento Geral do Estado- Receitas (BM website, 2009) and IMF (2005)
Vatb	**Commodity**	VAT tax collected at borders	Orçamento Geral do Estado- Receitas (BM website, 2009), IMF (2005) and SU table (INE, 2003a)
Vatd	**Commodity**	VAT tax domestically collected	Orçamento Geral do Estado- Receitas (BM website, 2009), IMF (2005) and SU table (INE, 2003a)
Reb	**Activity**	VAT rebate	RESIDUAL
Atax	**Activity**	Activity tax (or subsidy to activities)	Orçamento Geral do Estado- Receitas (BM website, 2009) and GDP table (INE, 2003b)
Stax	**Commodity**	Sale tax (or excises)	Orçamento Geral do Estado- Receitas (BM website, 2009), IMF (2005) and SU table (INE, 2003a)
Mtax	**Commodity**	Import duties	Orçamento Geral do Estado- Receitas (BM website, 2009), IMF (2005) and SU table (INE, 2003a)
Capital	**Household**	Private savings	Household Survey (*2002/03 IAF*, INE 2003d)
Capital	**Enterprise**	Enterprise savings	National accounts (INE website, 2009) and IMF (2005)
Capital	**Govt**	Government savings (or dissavings)	Orçamento Geral do Estado- Despesas, Défice e Produção Total (BM website, 2009) and IMF (2005)
Govt capital	**Govt capital**	Government savings (or dissavings) for investments	Orçamento Geral do Estado- Despesas, Défice e Produção Total (BM website, 2009) and IMF (2005)
Capital	**Row**	Capital inflows	Balance of Payments- capital account (BM website, 2009)
Row	**Commodity**	Imports (CIF)	Balance of Payments- current account (BM website, 2009)
Row	**Enterprise**	Enterprise payments to foreigners	Balance of Payments- capital account (BM website, 2009)

Table 27: A 2003 macro- SAM for Mozambique

		1	2	3	4	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		Activity	**Commodity**	**Lab.**	**Cap.**	**Hhds**	**Enter.**	**Trd**	**Tre**	**Trm**	**Govt**	**Ytax**	**VATb**	**VATd**	**REB**	**Stax**	**Atax**	**Mtax**	**Priv Capital**	**Govt capital**	**Dstk**	**Foreign**	**TOTAL**
A	**Activity**		148,354			26,225																	174,579
B	**Commodity**	76,622				65,980		15,783	1,172	4,078	14,745								12,284	12,089	2,660	4,964	235,940
C	**Labour**	61,824																					61,824
D	**Capital**	39,500																					32,281
F	**Hhds**			61,824			33,113				411											1,343	96,691
G	**Enterpr.**				39,500						147												39,647
H	**Trd**		15,783																				15,783
I	**Tre**		1,172																				1,172
J	**Trm**		4,078																				4,078
K	**Govt**						102					3,129	5,289	4,027	- 3,177	2,468	-190	2,138					13,786
L	**Ytax**					2,204	925																3,129
M	**VATb**		5,289																				5,289
N	**VATd**		4,027																				4,027
O	**REB**	-3,177																					-3,177
P	**Atax**	-190																					-190
Q	**Stax**		2,468																				2,468
R	**Mtax**		2,138																				2,138
S	**Private Capital**					2,282	1,674				-1,517											12,505	14,944
T	**Govt capital**																					12,089	12,089
U	**Dstk**																		2,660				2,660
V	**Foreign**		52,631				3,833																56,464
Z	**TOTAL**	174,579	235,940	61,824	32,281	96,691	39,647	15,783	1,172	4,078	13,786	3,129	5,289	4,027	- 3,177	2,468	-190	2,138	14,944	12,089	2,660	56,464	

Source: ***Unpublished 2003 SAM and own calculation***

The notation for the macro SAM cell entries is **[row account, column account]**. Here we briefly describe them. All values are in 2003 Billion of MT, unless otherwise specified.

1. **Intermediate consumption [Commodity, Activity]**: 76,622. Total intermediate demand includes imported intermediate inputs, tariffs and marketing margins.
2. **Labour value added [Labour, Activity]**: 61,824. This account includes compensation to employees and part of the mixed income account. Mixed income is the expression used to define the income from small family enterprises mainly devoted to agricultural activity. Specifically, 75 per cent of this income accrues the labour account. It is a reasonable assumption if we consider the particular nature of the activity: family enterprises mainly employ household workers in traditional labour intensive activities (i.e. agricultural activities).
3. **Capital value added [Capital, Activity]**: 39,500. This account includes operating surplus of the formal sector and the remaining 25 per cent of income from family firms. Finally, land remuneration enters into this account.
4. **VAT rebate [Reb, Activity]**: 3,177. This account shows the so- called VAT rebate. Activities pay VAT for the intermediate consumption but VAT, for its own nature, should be imposed only on final transactions so activities are entitled to obtain a refund for this expenditure. It is coherent with the 1998 law establishing VAT that recognises four categories: normal, simplified, exempted, and "zero rate" regimes. In the last case, enterprises are enabled to ask the VAT for reimbursement for inputs.
5. **Activity subsidies [Atax, Activity]**: 190. This is a negative entry and it counts for subsidies given to activities according to their production. As compared to 2001, this value has more than doubled although it has changed in its composition. There are no subsidies for agricultural activities but they mainly concentrate on the service sector.
6. **Domestic sales [Activity, Commodity]**: 148,354. Marketed supply is residual when we subtract own consumption from total costs of production. Domestic sales are subject to marketing margins and include exports at producer prices.
7. **Trade margins [Tr, Commodity]**: 21,033. This is the sum of trade and transport margins for domestic, imported, and exported goods and services. However, in our macro SAM we already decompose the three components.
8. **VAT [VAT, Commodity]**: 9,316. This account is composed of a vector. VA tax has a unified rate of 17 percent collected both on domestic transactions and imported goods by DNIA and DNA, respectively. Exemptions were introduced by decree in 2001, 2002 and finally in 2004. They may be classified in three groups: full exemptions cover both imported and

domestically-produced items, simple exemptions apply only for domestic products while exemption for imports, as the definition suggests, are limited to imported goods.

9. Sales taxes [Stax, Commodity]: 2,468. With this label we count for special taxes on particular kinds of goods. In 1998 the excise system was introduced through the creation and enforcement of the Excise Taxes Code, later amended by decree. The initial provisions established a tariff rate of 20-75 percent that has been lowered to 15-65% since. The items subject to excises are the same as before: mostly luxury, superfluous and unhealthy goods, with some expansions to cover musical instruments, games and sports equipment. The collectors for excises are different according to the goods the taxation is imposed upon. In fact, where the excises' collection should be due to the DNIA, for excises on alcoholic beverages, beer, wine and tobacco, the collector is actually the DGI. Besides the excise taxes (ICE), there is a different taxation on all fuels sold in Mozambique, known as *Taxa sobre Combustiveis*. Its revenues are dedicated to the transport sector. While excises have been lowered, in 2003 fuel taxes increased as a consequence of internal inflation and the international price of petroleum products to partially offset the real erosion accumulated.

10. Import duties [Mtax, commodity]: 2,138. Import tariffs are applied only on goods, while services are exempted.

11. Imports [Foreign, Commodity]: 52,631. This account is composed of imports at c.i.f. prices.

12. Own consumption [Activity, Households]: 26,225. The household own consumption is derived from the Household Survey *2002/03 IAF*. It is recorded in farm gate price therefore to obtain this value we must multiply it by the consumer price index (CPI) for 2003.

13. Final private consumption [Commodity, Households]: 65,980. Final private consumption is valued at final prices so it includes marketing margins.

14. Individual income tax [Ytax, Households]: 2,204. With regard to the personal income tax (also called IRPS) established in 2002 and applied for the first time in 2003, it may be defined as a single, progressive tax on the total amount of the income of natural persons. The tax base includes employment income, pensions, and annuities; it includes business income and income from professions practiced on a self- employed basis; it includes income from capital and capital gains, and income from real estate; and finally it includes gains from lotteries and gambling. The system is progressive. This means there are classes of income with a different tax rate, increasing as the income level increases. Moreover, each group has a lump sum detraction besides the family quotient. Indeed, the system recognizes the following categories: incomes up to 28 Mill Mts have a 10 percent rate; incomes between 28 and 112 Mill Mts have a 15 percent rate and are entitled to a 1.4 Mill Mts subtraction; incomes between 112 and 336 Mill Mts have a 20 percent rate and 7 Mill Mts subtraction; incomes between 336 and 1,008 Mill Mts have a 25 percent rate and 23.8 Mill Mts subtraction; incomes above 1,008

Mill Mts have a 32 percent rate and are entitled to a 94.36 Mill Mts subtraction. Households earning less than 24 Mill Mts are exempted from the IRPS payment. Exemptions from this progressive tax system are for incomes of non- residents and most of the income from capital and gaming gains. In these cases the final tax rate is 20 percent for stock dividends and other incomes of non- residents and 10 percent for residents. Another special treatment is determined by agricultural income which is taxed with a marginal rate of only 10 percent. Since, when possible, incomes are taxed at source with a 20 percent marginal rate for all incomes and a 10 percent rate for ones from capital, these payments at the source should be subtracted from the annual income.

15. Household savings [Private Capital, Households]: 2,282. National Accounts data figure out only "total (gross) savings" so it includes both household and enterprise savings. To derive this item we use it as the balancing item equilibrating the household income (row) and expenditures (column).

16. Distributed profits [Household, Enterprises]: 33,113. Distributed profits are computed as enterprise income (gross operating surplus plus government subsidies to enterprises) minus other enterprise payments (corporate tax, money payment to ROW, and accumulated savings.)

17. Nonfinancial enterprise profits [Government, Enterprises]: 102.

18. Corporate tax [Ytax, Enterprises]: 925. The corporate taxation, also named IRPC, is levied on the overall profits of all Mozambican companies (and enterprises) and all Mozambican- sourced income of foreigner ones. However, the State, the local governments, law enforcement and social security institutions are exempt. Its general rate is proportional and it is 32 percent, although special rates are accorded for incomes from particular sources. For example, for agricultural income the rate is 10 percent; for large mining companies there is a 24 percent tax in the first five years; operators in tax free zones pay 12.8 percent in the first ten years and, agriculture, handicrafts, and cultural cooperatives have a 16 percent rate.

19. Enterprise savings [Private Capital, Enterprises]: 1,674. This is a residual feature balancing enterprise income and expenditures.

20. Enterprise factor payments to ROW [Foreign, Enterprises]: 3,833.

21. Government final consumption [Commodity, Government]: 14,745. From data in the Budget Execution we see that the sum of the final consumption, welfare payments and enterprise subsidies exhaust the total current expenditures.

22. Welfare payments [Household, Government]: 411. This item includes pensions, transfers and social security.

23. Subsidies to enterprises [Enterprises, Government]: 147.

24. Government savings [Private Capital, Government]: 1,517. They are computed as residual such that the sum of private savings, enterprise savings, and government savings equal the total domestic gross savings value in the National Accounts.

25. Cross fixed capital formation [Commodity, Private Capital]: 12,284. The official data show total private investment without distinguishing changes in stock.

26. Public investments [Commodity, Government Capital]: 12,089. This figure is slightly underestimated as compared to official data. It is approximately 1 percentage point lower.

27. Change in stock [Commodity, Dstk]: 2,660. The change in stock value is obtained from the SU table but there is no other information to check this feature.

28. Exports [Commodity, Foreign]: 30,527. Exports are calculated at f.o.b. prices. In their price the marketing margins are included.

29. Remittances [Household, Foreign]: 1,343. This feature represents labour income from abroad. It is mainly due to the Mozambican workers employed as miners and farmers in South Africa.

30. Private foreign capital inflows [Private Capital, Foreign]: 12,505. There is only a feature in National Accounts on capital inflow. We calculate it as the balancing residual in the saving- investment account. It balances capital expenditures (private and public gross fixed capital formation, and changes in stock) and capital income (the sum of private savings, and current account deficit).

31. Foreign capital inflows in the government budget [Government Capital, Foreign]: 12,089. This is the balancing item in the public account. It guarantees the necessary capital to balance capital expenditure (investments) and current account deficit.

b. The micro SAM for Mozambique

As Round (2007) states: "*a macroeconomic SAM evolves naturally into a mesoeconomic framework*". In this way the SAM is truly "social" since we disaggregate the macro accounts capturing the essential features of the economy. But, to obtain such a disaggregation, "*their construction requires a significant degree of detailed estimation and use of data sets that have not hitherto formed part of standard national accounting practice*" (Round, 2003b). Our micro SAM, proposed by IFPRI, has five sectors: the agricultural one is comprised of 14 agricultural activities; the mining sector has 1 mining and quarrying activity; the manufacturing sector oversees two related food and beverage processing activities and 3 other manufacturing activities; the marketing sector, although been part of the service sector we treat it separately; finally, the services sector figures out 11 service activities. In this way we have a clear and effective general outlook on all the important economic sectors and the agricultural sectors. The population in Mozambique in 2003 was more than 70 percent rural with a vast majority employed in agricultural activities and dependent on agriculture for their livelihood. Although this model does not want to specifically address the agricultural development issue, it is worth noting that any policy which affects poverty and living conditions inside the country must consider this sector. Moreover, trade liberalization concerns agricultural products and this means different behaviours of farmers in the production choice. There will be a change in relative prices affecting the choice between producing food crops and export crops, or cash crops and food crops.

In the table below we summarize the codes for the activity and commodity accounts.

Box 27: The activity and commodity accounts' codes

ACTIVITY and ACTIVITY COMPOSITION	ACTIVITY CODE	COMMODITY CODE
AGRICULTURAL ACTIVITY	**A-AGRI**	**C-AGRI**
0. Wheat	awhea	cwhea
1. Maize	amaiz	cmaiz
2. Unshelled rice	arice	crice
3. Other grains	aogrn	cogrn
4. Cotton	acott	ccott
5. Other crops (Peanuts, tea, etc)	aocrp	cocrp
6. Other export crops (Citrus fruits, sugarcane, etc)	aoexp	coexp
7. Cassava	acass	ccass
8. Other basic food crops (Vegetables, fresh fruit, etc)	aobfc	cobfc
9. Beans	abean	cbean
10.Raw cashew	acash	ccash
11.Livestock	alive	clive
12.Forestry	afrst	cfrst
13.Fisheries	afish	cfish
MINERAL RESOURCE ACTIVITY	**A-MINE**	**C-MINE**
14.Mining	amine	cmine
MANUFACTURING ACTIVITY	**A-MAN**	**C-MAN**
15.Food processing	afood	cfood
16.Beverages and tobacco	abevt	cbevt
17.Light manufacturing (textile, garments, wood, paper, and furniture)	alman	clman
18.Heavy manufacturing	ahman	chman
19.Metal products	ameti	cmeti
TRADE ACTIVITY	**A-TRADE**	**C-TRADE**
20.Trade	atrad	tr
SERVICES	**A-SERV**	**C-SERV**
21.Energy	aengy	cengy
22.Construction	acons	ccons
23.Repairs	arepa	crepa
24.Hotels and restaurant	are_h	cre_h
25.Transports (Rail, pipelines, marine, other)	atran	ctran
26.Road transport	aroad	croad
27.Air transport	aaero	caero
28.Other services (financial, real estate, etc)	aosrv	cosrv
29.Public administration and social security	apadm	cpadm
30.Private services (education, health)	apsrv	cpsrv

In the activity account we distinguish among different type of labour according to skills: unskilled, semiskilled, and skilled labour. Thus, we may distinguish "traditional" sectors, where unskilled workers are mainly employed and "modern" sectors with a high share of skilled labour. After our simulation, we should be able to say something about the connection between trade liberalization and labour characteristics. If, for instance, trade liberalization positively affects "modern" sector, a policy prescription could be an improvement in the educational system to have more skilled workers. Obviously, we will set different wage rate for each group according to its skills.

Once, again land is not included as a separate factor, supposing, according to Arndt *et al.* (1998) that "*supply of arable land vastly exceeds demand*". Moreover, as already said, this analysis has a trade- focused aim so we are not concerned of agricultural issues where land availability, productivity, and employment are crucial variables. In the final SAM we count for land as a part of capital, and it is completely owned by rural households.

Other feature to explain is the treatment of marketing margins. Since there is no direct information on how they are allocated among commodities and how they are divided between domestic, imported, and exported commodities, we follow the judgement applied in Arndt *et al.* (1998): "*margins are split between exports, imports, and domestics according to shares in total commodity supply*".

The foreign sector in the disaggregated SAM needs a special treatment since we build a specific "trade matrix" to detail our analysis. As we have introduced above, our aim is to detect the effects of the Mozambican participation into the SADC free trade area from 2008[79].

A peculiarity of this agreement is the principle of asymmetry in the tariff phase out process among member states. Indeed, we have to clearly identified how Mozambique has to reduce its tariffs respect to each participant. As the SADC Trade protocol establishes: "*developed countries should accelerate their tariff phasing out more than developing countries and least developing ones*". Moreover, the WTO recognizes that "*the size of the South African economy in relation to the other economies necessitated the application of asymmetry in the scheduling of tariff reductions by the non- SACU Members*". So following these judgements, we build a trade matrix with three foreign regions: South African Republic (RSA), the rest of the SADC- FTA members (RoSADC), and, finally the rest of the World (RoW).

To decompose the trade data, we have to base on another source that is the *SADCtrade database*. In fact, the National Institute of Statistics's (INE) data are incomplete. They present only either data on trade with the main trading partners, or the aggregate value of total imports and exports. So we integrate it with this new database, which, on the contrary, shows three kinds of data according to trading partners for the year 2003: RSA, SADC as a whole, and the World.

Although we have solved one question, another problem arises. These data are expressed in HS classification of commodity, so we have to translate them into our classification. Firstly, however, the *SADCtrade database* gives us the total import and export for each trading

[79] A detailed presentation of the provisions, schedule, and legal framework of the SADC Trade Protocol has been presented in chapter 3.

partners. Exports to South Africa are 18.8 per cent, 7.2 to the rest of the SADC members and the remaining 74 percent to the rest of the World. Imports from South Africa, instead, are 25.1 per cent, 2.8 per cent from the rest of the SADC, and 72. 1 per cent from the rest of the World. Then, according to each commodity section we decompose these flows.

It is worth noting that this is a database for commodity trade. Here there are no data on trade in service, which will be derived from a different source, the *Africa GTAP Database*. Here, after having aggregated services into a unique bowl and defined the three trading partners, we obtain the percentage composition of service trade according to region. Let us start with imports; 4.5% of total service imports derives from RSA, 0.3% from RoSADC, and 95.2% from ROW. Exports, instead, are equally distributed towards RSA and the rest of the World (43.8% and 41.9% respectively) while the RoSADC region is destination of 14.2% of the total Mozambican service exports.

Up to this stage we have solved the problems of the trade flows, however trade decomposition requires other information we have to collect from different sources. In fact, there are other economic quantities depending on regional decomposition, namely taxes imposed on imports. They are the import duties, and consequently the tariff rate and the VAT at borders, and its rate. These two categories have been treated differently. For import duties we consider the Custom Code (in Portuguese Pauta Aduaneira), the best source in terms of data accuracy. It collects 5370 tariff lines, each of them presents a general import duty applied for imports from RoW, and the two offers to SADC and SACU Members, and to RSA. However, the one at our disposal is the for 2008 and, as a consequence, we have to underline some basic facts. Firstly, the general import duty for RoW is the one for 2008 and we have to change them. Basically, we should consider that in 2003 the maximum rate was 25 percent and it was applied each time in 2008 we see a 20 percent rate. Secondly, we have to derive the RSA and the RoSADC Mozambican proposals as they were in 2003, since in 2008 the liberalization process has gone further. Moreover, we have to aggregate the HS chapters according to our commodity classification.

Respect to imports from RoW, the average tariff rate goes from 25 percent for arms and jewellery, and some primary products (i.e. agricultural products and foodstuffs) to only 2.5 percent for plastics, wood and raw cotton. The situation for the SADC area reflects exactly the SADC trade protocol provisions. Imports from RSA pay a higher tariff rate up to five percentage points more than imports from other SADC Member States. This differential treatment is particularly evident for agricultural products (fisheries) and the foodstuff industry while there is no evident gap, for instance, for machineries and equipment.

To distinguish tariffs in terms of imports' country of origin and good, we may have at least two procedures. The first one, which is the simplest, is to divide proportionately tariffs on a specific good among countries according to the imports' percentage from that country. Supposing agricultural imports from RSA are 10% we give 10% of the total tariffs on agricultural products to that origin. However, this means an equal tariff rate among countries and differentiated according to commodity, a quite unreasonable assumption. The second procedure is the one adopted here, assuming the Custom Code as the reference source. In this way, tariff rates are differentiated both among commodities and countries of origin. Moreover, the final tariff matrix is likely to well interpret the reality. Tariff rates of imports from ROW are higher than the other origins respect to all goods, as in the Custom Code, while the best treatment is reserved to imports from RSA. Moreover, industrial products have a higher tariff rate respect to agricultural and mining products because of the higher incidence of final products while agricultural products are mainly raw products with lower rates. In the table below we sum up the tariff matrix.

Table28: The tariff matrix

	Agricultural goods	Mining goods	Industrial goods
Republic of South Africa-RSA	7	-	619
Rest of SADC- RoSADC	1	-	84
Rest of World- RoW	40	5	1381

Source: ***Author's own calculations***
Note: Features are billion MT

A different approach is followed for VAT collected at borders. We have used no specific source or criterion but we simply obtain these values as residuals in order to maintain the total balance. In other words, VAT values are derived considering the commodity columns and interpreting them as residuals. VA payments are summarized according to sectors and origins in the table below:

Table29: VAT collected at borders

	Agricultural goods	Mining goods	Industrial goods	Services
Republic of South Africa- RSA	22	4	1110	65
Rest of SADC- RoSADC	3	-	151	4
Rest of World- RoW	59	16	2481	1374

Source: ***Author's own calculations***
Note: Features are billion MT

Now all the fundamental values are derived and here we presents the codes for the factors' and the institutions' accounts.

Box 28: The factors' and institutions' account codes

	Definition	Elements in the Set	Code
FACTORS	Labour	Unskilled labour	**USK-LAB**
		Semiskilled labour	**SSK-LAB**
		Skilled labour	**SK-LAB**
	Capital	Capital	**CAP**
DOMESTIC INSTITUTIONS	Households	Rural households	**R-HHDS**
		Urban households	**U-HHDS**
	Enterprises	Enterprises	**ENTR**
	Government	Local government	**GOVT**
EXTERNAL INSTITUTIONS	Republic of South Africa	Republic of South Africa	**RSA**
	Rest of SADC	Rest of SADC	**RoSADC**
	Rest of World	Rest of World	**RoW**
SAVING-INVESTMENT	Saving-investment	Saving-investment	**S-I**

Source: ***Author's own modifications from the 2003 unpublished SAM***

In appendix A the micro 2003 SAM is presented. It is broken down in its constitutive sub-matrices: the input- output table (commodity x activities), the institutional part of the activity columns (institutions x activities), the make matrix (activities x commodities), the institutional part of the activity rows (activities x institutions), the institutional part of the commodity rows (commodities x institutions), the institutional part of the commodity columns (institutions x commodities), and the institutional diagonal matrix (institutions x institutions).

5. The SADC Trade Liberalisation in a Neoclassical System: the IFPRI Model

The initial point for building this Neoclassical in spirit model is the standard IFPRI model presented in Lofgren, Lee Harris, and Robinson (2002) which ultimately is the Computable General Equilibrium model applied at the Macroeconomic and Trade Division (TMD) at the IFPRI itself. It follows the neoclassical- structuralist modelling tradition referable to Dervis *et al.* (1982). However, because these models are mainly applied for developing countries, the IFPRI researchers have added many features that characterize these economies, i.e. the presence of a fraction of total production which not enter the market but is self- (home) consumed and an explicit treatment of marketing and transportation costs (transaction margins) both in the inner and in the foreign markets.

To implement it a SAM is required. It should have the format of the one presented in appendix A. In this way the IFPRI model may summarize and explain each accounting relation. More generally, as Pyatt (1988) states: "*A SAM is not a model*" however "*SAMs and models are intimately related and that making this relationship explicit is potentially useful for model construction and analysis"*.

Here, we consider a country- specific case of this model's application and we describe in details the Mozambican CGE with its main features, and then we present its implementation in GAMS/MPSGE. In fact, this class of models is mainly applied as Non- Linear problems but in this context we present it as a Mixed Complementarity problem. Although we follow the standard framework, the application in MPSGE and some values restrictions modify the formal presentation of the model itself.

I. The features of the Mozambican CGE

As already cited, the departure point of this model is the one presented in Dervis *et al.* (1982), which ultimately derives from the Neoclassical CGE model which assumes: perfect competition, profit and utility maximizing activities and households, respectively; no transactions costs; and perfect mobility of factor of production (with the exception of land). However, to better fit the country experience, we have to consider many other aspects which are not sufficiently detected in the Neoclassical model.

First of all, statistical data demonstrate the presence of cross- hauling trade with the rest of the World. This means that at the same time a commodity is both imported and exported. To represent this phenomenon, the 1-2-3 model appears more adequate. Moreover, there is imperfect substitutability both between imports and domestic products, according to a fixed elasticity of substitution, and between products sold domestically and abroad, according to a fixed elasticity of transformation. To capture theses features of international trade the Armington assumption, already a key element of the 1-2-3 model, is the right tool.

In our model two points of departure stand out: the home consumption and the presence of transactions costs (otherwise defined as marketing margins). But, as Tarp *et al.* (2002) recognize, a Mozambican model should contain two other salient features: a distinction between agricultural and non- agricultural labour, and the agricultural household behaviour[80]. Our model focuses on trade issues so that we do not consider these two aspects which are particularly relevant for analysis concentrating on agricultural issues.

a) Marketing margins

Marketing margins are associated with storage, transportation costs, and risks related to trading activities[81]. For their nature, these margins affect both domestic transactions and foreign trade flows. In the former case, they mainly represents lack in infrastructure (i.e. roads, railways), while in the latter they are associated also with procedures for trading. For instance, marketing margins for imports count for custom procedures and the so- called non-tariff barriers.

They are assumed to be fixed in the medium run, so that the marketing technology is stable in this time period (as in Tarp *et al.* (2002)). Because the model treats separately products entering the domestic markets, imports and exports, we suppose three distinctive technology, one for each kind of product according to their market place.

Because of the trade oriented analysis it could be a useful exercise to cut both tariffs and marketing margins for imports and exports toward SADC member states to reproduce the reduction in tariff and non- tariff trade barriers. Our simulation, however, takes into account solely the tariff cut.

Transactions costs vary from zero, for services (by definition), to even high values for agricultural goods[82].

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[80] To investigate these two aspects, see Tarp *et al.* (2002).

[81] Tarp *et al.* (2002) suggests that the amount of marketing margins depends on returns to capital because the marketing activity is capital intensive.

[82] See the explanation in chapter 4.

In our model specification, they have a precise productive sector, which sells the total amount of margins to three wholesale actors (on the basis of domestically sold, imported, and exported goods). Then they sell to the formal market. This process clarify the scope of the marketing margins' introduction: they create a wedge between producer's price and market price (for domestic produced goods), or between border price and domestic market price (for exports and imports). It finally affects another element of the model which is the home consumption discussed in details below.

b) The home consumption

The presence itself of marketing margins justifies the existence of home consumption. With this definition they are usually referred to an activity- based consumption. To better clarify the concept, let us firstly describe the Mozambican reality and then we will return to theory. Almost all Mozambicans own an income which is not only composed of factors remuneration or social transfers. Many are paid with in- kind transfers mainly if they are employed in secondary activities or in informal sectors. They directly receive a fraction of their production as payment. The reason of this behaviour is quite intuitive: it has subsistence purposes. Looking at empirical data, we argue that this kind of transfer is limited to agricultural and food processing activities, strengthening our idea on their motivations. Moreover, the beneficiaries are rural households, who are the poorest group. This practice is widely adopted because it guarantees a certain level of food without buying it in the formal market where prices are higher due to the marketing margins wedge.

To model this phenomenon, IFPRI assumes there is a production function for each activity which has a combined output, a part is sold in the market and a part is self- consumed. But, to follow this procedure we have to know the elasticity of transformation between home-consumption and marketed output. we apply a different procedure based both on practical necessity and theoretical considerations. Firstly, the elasticity value is not public available and it should be estimated through an econometric procedure. However, to obtain robust results we need at least 30 observations to use in our regression. But the National Statistical Institute does not produce data on home consumption, or they are not published[83]. As a consequence we cannot adopt a CET functional form to describe how output is allocated between them.

After having analysed Lofgren, Lee Harris, and Robinson (2002), we may assume that home consumption may be interpreted as a fixed fraction over total produced output. This assumption is not trivial and it is based on some theoretical considerations. Supposing that there is a certain elasticity of transformation between home consumption and marketed

[83] Values are available only for 2003 thanks to the *2002/ 03 IAF*.

output, it determines the existence of a transformation function in the prices' space. The optimal production decision is assumed according to the usual tangency condition so that what ultimately matters is the relative price between the two products. However, looking at the SAM (appendix A), both marketed output and home consumption are in the same row and, for accounting rules, elements on the same row are valued at the same price. Consequently the relative price is fixed and also the two outputs are produced in fixed proportions. The idea of a fixed coefficient is restated if we consider another issue. As we can see from the data of the *2002/ 03 IAF*, home consumption is a phenomenon involving mainly the poorest households in the country, that we assume living in the rural areas. Therefore we may imagine a certain degree in home consumption preference respect to the income level: the poorer is the household, the higher fraction of final products he consume without buying in the formal market.

The existence of home consumption is fundamental in poverty analysis and developmental issues but it becomes an interest aspect to detect in trade focused analysis too. The reason is clearly explained in Tarp *et al.* (2002) and Sadoulet and de Janvry (1995). They argue that if part of the consumption basket is composed of own consumption a policy affecting market prices has a different impact, probably lower, on households' consumption. At least a tariff removal may have no effect.

Other features of this Mozambican CGE model are quite standard. There are two private institutions: enterprises and households. The former uses capital, and social transfers, to produce profits which are divided among households and government. The latter, instead, are divided into two groups, rural and urban households. This distinction is useful to catch the fundamental differences between the two socio- economic groups both in terms of income receipts and in terms of current expenditures. In fact, rural households have a lower income level mainly composed of labour income and social transfers, and they spend it in consumption (both home- and marketed consumption), pay direct taxes and save. Urban households have a higher income level out of labour, distributed profits, social transfers and remittances from abroad. Respect to the other group, social transfers are a minor component of the overall income and, according to our classification, labour income for urban households comprehends mainly payments for skilled and semiskilled labour. Their expenditures are quite similar to the rural group although there is a change in their internal composition: savings are a higher fraction and direct tax payments are higher.

There is a government actor, whose income is composed mainly of tax payments, which spends it for recurrent expenditures and save a fraction.

The external sector is modelled according to the Armington approach. Export and import decisions are taken on the basis of a cost or benefit comparison. Specifically, deciding to produce for the internal or the external market depends on the relative price of the commodity: if the export price exceeds the domestic price, then producers devoted a higher fraction of their production to the foreign markets. Importing from abroad depends on the relative price of the foreigner and the domestic commodity: if the import price is lower than the domestic one, then a higher fraction will be imported. The former is a benefit analysis: the producer tries to maximize his profits with a higher purchaser's price[84]; the latter is a cost minimizing decision: producers import if it is more convenient than buying the inner production[85]. According to this scheme, the model captures many shocks on the international markets "*allowing producers and consumers to shift between domestic and foreign markets depending on changes in the relative prices of imports, exports and domestic goods*" (Arndt *et al*. (2008)).

Capital is accumulated inside the country through the savings of the private, public institutions and from abroad, i.e. the foreign savings. There are many different ways to model them; they may be divided between households and government or it may accrue to a single institution. The logic is different. In the first case, foreign savings are devoted both to public and private investments as if both actors need them to ensure their saving- investment balance. In the second case instead foreign savings are devoted only to one agent. The latter is the case of this Mozambican CGE. Here, foreign savings accrue only to the government. The reason is suggested by statistical data. Foreign savings in the country are mainly transfers to the Central Government[86] allocated among grants for programmes (from the E.U., the U.S. and other single European Countries), grants in- kind (mainly for food), and other grants for medicine and special programmes (BM, 2003). Therefore in our CGE foreign capitals are totally accrued to the Central Administration.

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[84] "*Under a constant elasticity of transformation (CET) function, profit maximization drives producers to sell in markets where they achieve the highest returns based on domestic and export prices (where the latter is determined by the world price times the exchange rate adjusted for internal transaction costs)*" (Arndt *et al.* (2008)).

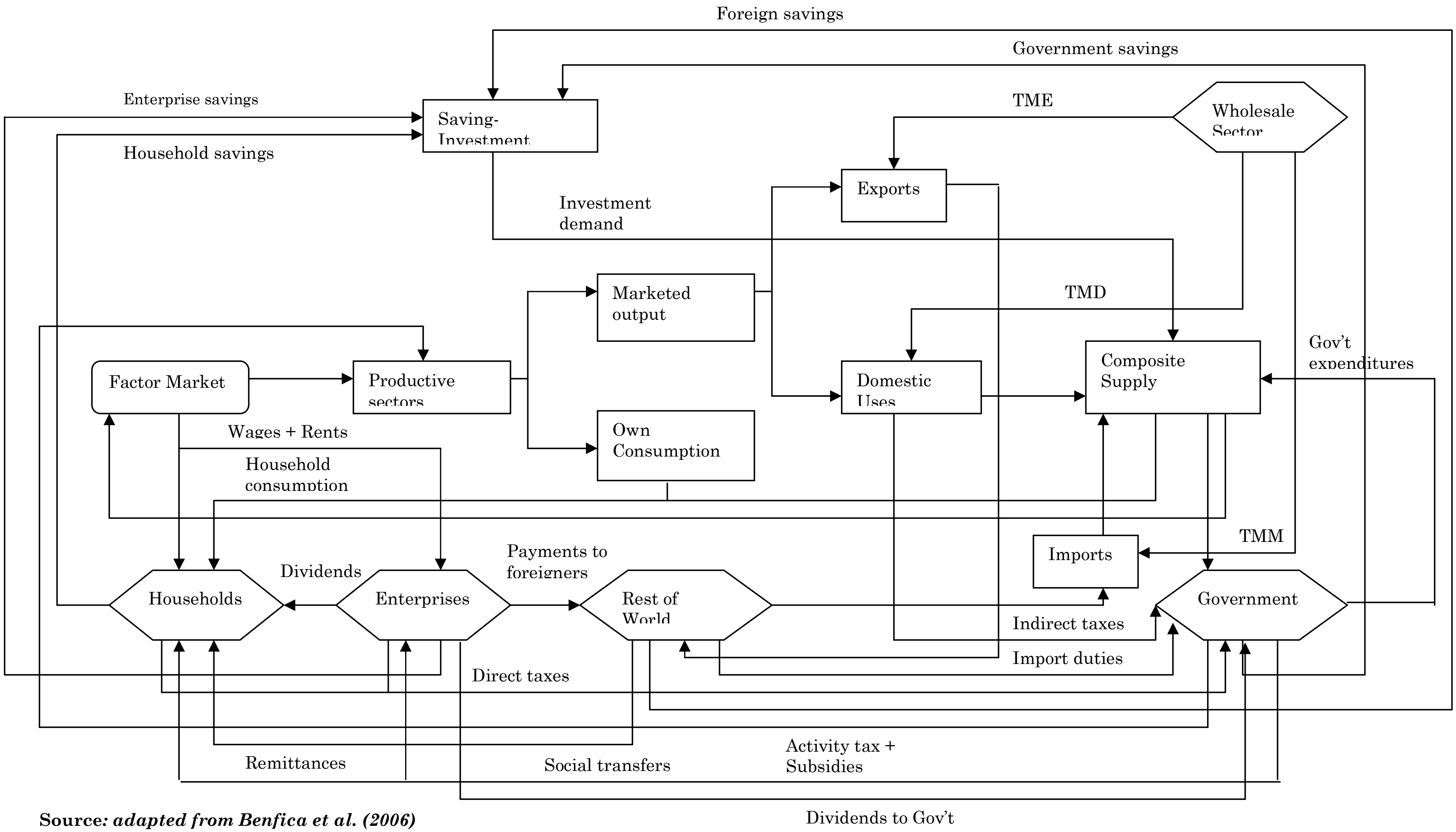
[85] "*Under a CES Armington function, cost minimization determines final and intermediate demand for imported and domestic goods based on relative prices (both of which include relevant taxes)*" (Arndt *et al.* (2008)).

[86] According to Bank of Mozambique (2003) nearly 92 percent of total transfers were devoted to the Central administration in 2003.

In the graph below a structural representation of the Mozambican economy is given. Here, there are the institutions and the productive activities. The latter are especially well designed to present the multistage path to arrive from production to supply in the market.

Precisely, at the first stage the productive units decide how much is self- consumed and how much should be sold; in the following stage, the marketed output is divided between domestic uses and exports (this decision is taken according to a CET function); finally domestic uses are combined with imports to obtain the final supply in the inner market (the CES function).

Figure 2: A diagrammatical representation of the Mozambican economic system



Source*: adapted from Benfica et al. (2006)*

II. The MCP format for the Mozambican CGE

In order to specify how the economy works, the modeller has to choose a functional form for each relation, so that each fundamental block is characterized in its preferences and/or technologies. Although this step is fundamental in a theoretical perspective it becomes absolutely irrelevant when we develop the model in MPSGE which is autonomously able to reconstruct the functional forms given only reference prices, elasticities, and quantities.

As noted, each domestic productive sector *Y*(*s*) produces two kinds of output, domestic uses and exports[87] (*D*(*s*) and *E*(*s*), respectively). These are assumed to be imperfect substitutes according to a constant elasticity of transformation. To produce each sector employs intermediates (*A*(*g*, *s*) a part of the aggregate Armington supply), labour (*L*(*l*, *s*) according to different labour types *l*), capital (*K*(*s*)) and eventually taxes on inputs or activity subsidies should be considered. As such, the sectoral production becomes:

$$Y(s) = g(D(s), E(s)) = f(K(s), L(l,s), A(g,s))$$

where *g* is the output transformation function and *f* is the input transformation function. In particular function *g* is the CET function:

$$g(D(s), E(s)) = CET(D(s), E(s))$$

The input combination function has two stages: capital and labour enter a Cobb-Douglas value added aggregate. Then, intermediates are added through a Leontief function to obtain a bowl of intermediates. Finally, at the top level a Leontief function aggregates value added and intermediates:

$$f(K(s), L(l,s), A(g,s)) = LF[CD(K(s), L(l,s)), LF(A(1,s), A(2,s), ...A(g,s))]$$

where *LF* means Leontief aggregation, and *CD* is the Cobb- Douglas aggregation. The same input combination function is applied in the informal sectors (*is*) which produce own-consumption.

[87] In this example and in the following MCP formulation we suppose there is only one foreign region. In the final model and in the code of Appendix C there are three foreign trading partners.

In the market final users ask for an aggregate good, $A(g)$ which is a composite bowl of imports and domestic commodities. These goods are imperfect substitutes assuming a constant elasticity of substitution:

$$A(s) = CES(D(s), M(s))$$

Armington aggregate is used for private consumption, government expenditures, investment, and intermediate inputs for production.

Formally, both investments and public consumption are Leontief aggregates across Armington composite of these kinds:

$$I = LF(A(s))$$
$$G = LF(A(s))$$

Households' private consumption is a Leontief aggregation of home- consumption and a fraction of the Armington aggregate:

$$C = LF(HC(s), C(A(s)))$$

Up to this point in our model there is no reference about economic agents' behaviour. In the standard Arrow- Debreu economic model, there are usually two agents: consumers and firms but here we introduce a government too.

Consumers have an initial endowment of factors of production, they earn income from their sales and from dividend payments. Then consumers engage in buying goods to maximize their satisfaction (or utility). Producers, instead, use inputs (either from initial endowments of consumers or intermediates) and turn them into goods. Producers get outputs subject to the available technological knowledge. Their goal is to maximize profits, which in turn are distributed to shareholders.

Both agents assume prices as given so that each of them believe that his actions do not affect the general price level.

Here, the third economic agent, the government, collects tax revenues to maximize social welfare function. The role of taxes is income redistribution, recurrent expenditures financing, altering the agents' behaviour, and economic stabilization.

It has been already discussed that a CGE may be interpreted as a Complementarity problem (chapter 1) where three classes of equations define the equilibrium: market clearance, zero profit, and income balance.

Zero profit conditions (hereto ZPCs) are derived for all production sectors. They describe the relationship between costs of production (gross of taxes) and value of output. For our model ZPCs for eight productive sectors should be satisfied: final production for both formal and informal sectors, Armington aggregation, private goods, investment goods, margins, exports, and import. ZPCs are associated with levels of production.

Final production for formal sectors $Y(s)$:

$$\begin{aligned}&\left[sum(g,ca(g,s)\cdot pa0(g,s))\right]+\left[pf("l")^{va(s)}\cdot pf("k")^{(1-va(s))}\right]=\\&(1+atx(s))\cdot(pd(s)\cdot dm(s)+px(s)\cdot x0(s))\end{aligned} \tag{1}$$

Final production for informal sectors $Y(is)$:

$$\left[sum(g,ca(g,is)\cdot pa(g))\right]+\left[pf("l")^{va(is)}\cdot pf("k")^{(1-va(is))}\right]=pn(is)\cdot ch(is) \tag{2}$$

Between the two equation above there are many similarities. The productive techniques are the same but the former presents taxes while the latter is tax free. In fact, formal activities benefit of the VAT rebate on intermediate inputs (included into the reference price $pa0(g, s)$ and a subsidy on total production whose rate is $atx(s)$.

Armington aggregation $A(s)$:

$$\begin{aligned}&\left[dm(s)+pt\cdot mrd(s)\right]+\\&+\left[(pm0(s)\cdot m0(s))\cdot((1-thetam(s))\cdot pd(s)^{(1-dm)}+(thetam(s))\cdot pm(s)^{(1-dm)}\right]^{(1/(1-dm))}+pt\cdot mrm(s)=\\&=(1-vtx(s)-itx(s))\cdot pa(s)\cdot a0(s)\end{aligned} \tag{3}$$

The left hand- side of the equation above shows that costs for the Armington aggregation depend upon two components, the domestic uses and imports (both evaluated gross of marketing and transportation margins). They enter the cost function according to a constant elasticity of substitution, dm, and in a fixed share ($thetam$).

The right hand- side, that is the price of the Armington aggregate, comprehends also taxes on goods, both VA tax (tax rate $vtx(s)$) and other indirect taxes (here generally defined with a tax rate $itx(s)$).

Private goods $C(h)$:

$$sum(s, pa(s) \cdot ch(s,h)) + sum(is, pn(is) \cdot ha(is,h)) = pc(h) \cdot c0(h) \tag{4}$$

For each household h there is a specific aggregation function which sums up the marketed consumption and home- consumption (these two components have different prices). Then, the final demand for consumption is a composite good, $c0(h)$, whose price is an average of the prices of both types of consumption.

Investments goods *INV*:

$$sum(s, id0(s) \cdot pa(s)) = pinv \cdot i0(s) \tag{5}$$

This function is intuitive and very close in meaning with the previous one. It sums the investment demand components to bowl down a new pool of investments with its own price.

Margins *MRG*:

$$sum(s, trd(s) \cdot pa(s)) + sum(s, trm(s) \cdot pa(s)) + sum(s, tre(s) \cdot pa(s)) = pt \cdot (trd(s) + trm(s) + tre(s)) \tag{6}$$

Exports $X(s)$:

$$px(s) \cdot x0(s) + pt \cdot tre(s) = pfx \cdot x0(s) \tag{7}$$

The exports costs are composed of exports evaluated in domestic currency at producer price and the transportation and margin component; the total is transformed into the export price evaluated at final price through the exchange rate (foreign currency).

Imports $M(s)$:

$$m0(s) \cdot pm0(s) \cdot pfx = pm(s) \cdot m0(s) \tag{8}$$

Imports' costs are expressed in foreign currency (left hand- side) and they are gross of import tariffs because of the term $pm0(s)$ which is the reference price $(1+tm0(s))$. The final price in the right hand- side is in domestic currency.

Market clearing conditions (hereto MCCs) represent the fact that output and initial endowment of each commodity equals intermediate plus final demand[88]. Because this relation

[88] In other words the MMCs represent the supply- demand law.

must hold for each good and factor of production, in our model there are thirteen MCCs: for final goods produced in formal and informal sectors, Armington supply, private goods, investment goods, margins, export, import, foreign exchange, capital, labour, distributed profits, and lump- sum transfers . Here the associated variable is the price level for each good or factor of production.

Final goods produced in formal sectors (s):

$$dm(s)\cdot\left(\frac{pd(s)}{\left(thetad(s)\cdot pd(s)^{(1+eta)}+(1-thetad(s))\cdot px(s)^{(1+eta)}\right)^{\frac{1}{1+eta}}}\right)^{eta}=$$

$$=A(s)\cdot dm(s)\cdot\left(\frac{\left(\left(1-thetam(s)\cdot pd(s)\right)^{1-dm}+\left(thetam(s)\cdot pm(s)\right)^{1-dm}\right)^{\frac{1}{1-dm}}}{pd(s)}\right)^{dm} \tag{9}$$

Exports:

$$Y(s)\cdot x0(s)\cdot\left(\frac{px(s)}{\left(thetad(s)\cdot pd(s)^{(1+eta)}+(1-thetad(s))\cdot px(s)^{1+eta}\right)^{\frac{1}{1+eta}}}\right)^{eta}=x0(s)\cdot X(s) \tag{10}$$

Imports:

$$\left(m0(s)\cdot pm0(s)\right)\cdot M(s)=$$

$$=A(s)\cdot pm0(s)\cdot m0(s)\cdot\left(\frac{\left(\left((1-thetam(s)\cdot pd(s)\right)^{1-dm}+\left(thetam(s)\cdot pm(s)\right)^{1-dm}\right)^{\frac{1}{1-dm}}}{pm(s)}\right)^{dm} \tag{11}$$

Foreign exchange:

$$fsv0+(sum(s,x0(s)\cdot X(s))+(sum(h,hx(h)))=sum(s,m0(s)\cdot M(s))+ex \tag{12}$$

Armington aggregate:

$$a0(s)\cdot A(s)=sum(g,ca(g,s)\cdot Y(g))+sum\left(h,\frac{cd0(h,s)}{pa(s)}\cdot C(h)\right)+\frac{gd0(s)}{pa(s)}\cdot GOV+id0(s)\cdot INV \tag{13}$$

Labour:

$$Ls0 = sum\left(s, va(s) \cdot \left(\frac{pf("k")}{pf("l")} \right)^{(1-va(s))} \cdot Y(s) \right) + sum\left(is, va(is) \cdot \left(\frac{pf("k")}{pf("l")} \right)^{(1-va(is))} \cdot Y(is) \right) \tag{14}$$

Capital:

$$Ks0 = sum\left(s, (1-va(s)) \cdot \left(\frac{pf("l")}{pf("k")} \right)^{va(s)} \right) + sum\left(is, (1-va(is)) \cdot \left(\frac{pf("l")}{pf("k")} \right)^{va(is)} \right) \tag{15}$$

Distributed profits:

$$ENT \cdot (sum(h, he(h)) + ge) = sum\left(h, \frac{he(h)}{pe} \right) + \frac{ge}{pe} \tag{16}$$

Production in informal sectors:

$$ha0(is) \cdot Y(is) = sum\left(h, \frac{ch0(h,is)}{pn(is)} \right) \tag{17}$$

Margins:

$$sum(s,(trd(s)+trm(s)+tre(s))) \cdot MRG = \frac{sum(s,(trd(s)+trm(s)+tre(s)))}{pt} \tag{18}$$

Private goods:

$$C(h) \cdot c0(h) = \frac{RA(h)}{pc(h)} \tag{19}$$

Investment goods:

$$INV \cdot i0 = \frac{i0}{pinv} \tag{20}$$

Finally, the income balance conditions state that the level of expenditure equals the value of income accruing from sale of factors' endowments, dividends' payment, or tax receipts. More precisely in our model there are three agents whose income budget must be fulfilled: households, enterprises, and government. Households (*h*) receive an income equals to factor remuneration, plus social payments, remittances and dividends. Enterprises earns capital income, and social transfers. Government, instead, collects tax receipts from other agents.

Income balance conditions for household(h):

$$RA(h) = pf("l") \cdot hl(h) + pe \cdot he(h) + ptran \cdot SOCTRANSF(h) + pfx \cdot hx(h) - DTAX(h) - pinv \cdot hs(h) \tag{21}$$

Income balance condition for enterprises:

$$ENT = pf("k") \cdot Ks0 + ptran \cdot SOCTRS - pfx \cdot ex - pinv \cdot es - DETAX \tag{22}$$

Income balance condition for government:

$$\begin{aligned} &GOV = DTAX + DETAX - \left(sum(h, ptran \cdot SOCTRANSF(h))\right) - ptran \cdot SOCTRS + \\ &\left(sum(s, tm(s) \cdot pfx \cdot m0(s) \cdot M(s)\right) + \left(sum(s, itx(s) \cdot pa(s) \cdot a0(s) \cdot A(s))\right) + \\ &\left(sum(s, vtx(s) \cdot pa(s) \cdot a0(s) \cdot A(s))\right) - \left(sum(s, atx(s) \cdot (pd(s) \cdot dm(s) + px(s) \cdot x0(s))\right) \\ &-\left(sum(s, rebt(s) \cdot pa(s) \cdot sum(g, ca(g,s)))\right) - gsv0 \cdot pinv \end{aligned} \tag{23}$$

However, as already described, MPSGE automatically generates these equilibrium condition as the code, reported in appendix C, shows.

III. The elasticity issue

As the MCP formulation shows, the functional forms heavily rely on elasticities. The utilization of CES and CET functions is based on elasticity of transformation and substitution whose values affect the model outcomes. To better clarify this issue we quote a consideration of Arndt *et al.* (2001) that clearly states the main problems and limits we face in our work. They assert that "*despite their popularity, CGE models are frequently criticized for resting on weak empirical foundations, particularly for estimates of behavioural parameters*. […] *For developing countries, the lack of an empirical basis for behavioural parameters is even more severe.* […] *The dearth of estimates of behavioural parameters has generally led analysts to specify functional relationships that require relatively few behavioural parameters. Hence, the ubiquity of the constant elasticity of substitution (CES) functional form in applied general equilibrium analysis*".

We are working on a least developed country whose statistical office was funded after the Civil War's end in 1992. Therefore, we have not enough data to econometrically estimate the parameters[89]. If econometric determination of parameters is not likely, there is another

[89] This procedure is feasible if we have at least 30 observation to obtain a consistent solution according to the law of large number.

possible solution that is to assume the values applied in published papers. In this context we have at least two sources of great renown.

Firstly, this country has been part of a large project sponsored by IFPRI called MERRISA[90] under which they construct country- specific CGE for many South-Eastern African countries. Secondly, Mozambique is one of the countries inserted in the *GTAP database* which collects economic features all over the World. In the table below we sum up the required elasticities, their symbols, and the available sources.

Table 30: The CGE parameters

Elasticity symbol	Definition	Sources
va(s)	Substitution parameter among primary factors in sector *s*[91]	Thurlow(2008), GTAPAfrica
sigmaQ(s)	Elasticity of substitution between domestic uses and imports	Thurlow(2008), GTAPAfrica
sigmaT(s)	Elasticity of transformation between domestic uses and exports	Thurlow(2008), GTAPAfrica
relasarm(s)	Elasticity of substitution among imports from different origins	GTAPAfrica and a previous version of GTAP presented in Thurlow (2008)
relacet(s)	Elasticity of transformation among exports to different destinations	GTAPAfrica and a previous version of GTAP presented in Thurlow (2008)

In table 3 we summarize the value of each parameter according to the different sources. In this way we may compare them and decide if there are discrepancies in values and how to choice which ones to apply in our model.

[90] It stands for Macroeconomic Reforms and Regional Integration in Southern Africa.

[91] Because of the model construction the same parameter is applied also for the corresponding informal sector. As already said, we assume that both formal and informal sectors face the same technology.

Table 31: The parameters' values according to sources

Elasticity		Value from Turlow(2008)[92]	Value from GTAPAfrica[93]
va(s)			
	va("AGRI"*)*	0.5	0.3
	va("MIN"*)*	0.5	0.2
	va("IND"*)*	0.5	1.2
	va("TRADE"*)*	0.5	1.7
	va("SERV"*)*	0.5	1.3
sigmaQ(s)			
	sigmaQ("AGRI")	2.1	2.4
	sigmaQ("MIN")	3.1	5.9
	sigmaQ("IND")	2.6	3.3
	sigmaQ("TRADE")	1.9	1.9
	sigmaQ("SERV")	2.1	1.9
sigmaT(s)			
	sigmaT("AGRI")	2.1	2.4
	sigmaT("MIN")	3.1	5.9
	sigmaT("IND")	2.6	3.3
	sigmaT("TRADE")	1.9	1.9
	sigmaT("SERV")	2.1	1.9
relasarm(s)[94]			
	relasarm("AGRI")	5.8	4.9
	relasarm("MIN")	13.2	13.4
	relasarm("IND")	6.7	7.1
	relasarm("TRADE")	3.8	3.8
	relasarm("SERV")	3.9	3.9
relacet(s)[95]			
	relacet("AGRI")	5.8	4.9
	relacet("MIN")	13.2	13.4
	relacet("IND")	6.7	7.1
	relacet("TRADE")	3.8	3.8
	relacet("SERV")	3.9	3.9

Source: ***Author's own calculations on Thurlow (2008) and GTAP.***

[92] This is the last available dataset for an IFPRI Mozambican CGE. It has been adopted in Arndt *et al.* (2008b). It sums up the elasticities for 55 commodities. The author, however, has adapted the dataset through an average value for each sector employed in the final CGE.

[93] The GTAP Database for Africa is part of the GTAP dataset version 6 and it is freely available at the GTAP website.

[94] These values in Thurlow (2008) are obtain from an unspecified older version of the GTAP database.

[95] These values in Thurlow (2008) are obtain from an unspecified older version of the GTAP database.

Clearly the two datasets differ in their final results, however there are many features to highlight. First, the IFPRI team deliberately assume a uniform primary factors' substitution elasticity according to their own consideration: "*fixed rigid production technologies are relatively fixed over the medium- term, we assume low and uniform factor substitution elasticities (0.5)*" (Arndt *et al.* (2008)). *GTAP database*, instead, presumes different substitution elasticities among primary factors in different sectors. Although it may be a likely assumption, we have to focus on the aggregation scheme. To obtain these values we have aggregated capital, land and natural resources under the label "capital". We are sure that in our benchmark data capital and land are aggregated but we have no information on natural resources, therefore we assume the IFPRI criterion for substitution among primary factors.

Second, the trade parameters differ although there is a common general trend. For instance, from both sources the highest values for *sigmaQ*(*s*) and *sigmaT*(*s*) are in the extraction sector (*MIN*), and the overall ordering according to sectors is maintained in both datasets (the highest value for *MIN*, then, decreasing, *IND*, *AGRI*, *SERV*, and *TRADE*). The same considerations may be applied for the parameter *relasarm*(*s*): they different solely in absolute terms probably because of the different version of the *GTAP database* they refer to. This means there is a quite common agreement on these values and no one contradicts the other.

Therefore the author chooses values according solely to a personal belief of her. In the final CGE we will assume the values in Thurlow (2008). The reasoning is mainly based on considerations on the aggregation scheme. As already cited, the IFPRI values are available for 55 commodities while the GTAP values are obtained respect ten HS Chapters. Since we have to get values for our five representative sectors an aggregation should be done. Respect to the IFPRI elasticities the author is more confident on a right matching between original values and final sectoral destination, while respect to GTAP values there are more chances to have matched sectors not appropriately.

Up to this point we have described only the elasticities associated to CES and CET functions, but there are other two values to consider: the elasticity of substitution among intermediates, and the elasticity of substitution between intermediate inputs (as a bowl) and value added. Both values are assumed nil because of Leontief functions[96].

[96] Especially respect to the elasticity of substitution among intermediates this CGE model differs from the latest IFPRI models for Mozambique. This difference depends on the nature of the model itself. Many of these papers focus on biofuels so they are more interested in analysing a productive system where "*factors are then combined with fixed- share intermediates using a Leontief specification which captures the varying fuel- intensity of sector*" (Arndt *et al.* (2008)).

After having described the values assumed by the parameters, we outline a theoretical critique and exposition on how much important the trade elasticities are considering a foreign trade *à la* Armington[97]. There at least three reasons to consider the parameter choice as crucial for the model outcomes. First, the elasticities are fundamental to the conceptual framework of the Armington assumption which relies on them. Second, assuming "adequate" trade elasticity it is possible to "maximize the positive effects of the trade liberalization". Finally, they affects the performance of the public sector trough their "fiscal effect".

We try to illustrate these aspects in order to demonstrate that the trade parameter choice is not only an empirical issue to run the model and perform the simulation but it is, before all, an element which affects both qualitatively and quantitatively the model outcomes. This approach follows von Arnim and Taylor (2006, 2007a, 2007b). As they recognized most of AGEs does not consider the interaction of trade elasticities on final results and especially in the consumption component, because of the complexity of the models themselves.

Supposing a standard closure with exogenous government deficit, a tariff reduction has three immediate consequences. First, an increase in the other tax instruments to restore the initial level of tax revenue[98]. Second, a price effect which modifies the price ratio between domestic and Armington composite goods. And finally, the third effect is a stimulus on consumption because now the consumption basket is cheaper.

The second and the last effects affect private consumption which becomes the crucial variable in this reasoning. *A priori* we can't evaluate which of the two effects is stronger. Moreover, the little triangle welfare calculation[99] may become meaningless. There is a contrast between an income and a substitution effect, caused respectively by the tax change and lower final prices.

The crucial element is that in the Armington structure there is a less than 100% pass-through of tariffs into supply prices. If it was not, the two effects offset one another. Consequently, there will be a lower switch toward imports and the little triangle calculation will have sense.

To clarify these consequences and to evaluate their impacts we refer to a simple one-country Armington economy, where production depends only on value added, households do

[97] It is possible to compare this description of foreign trade with the one in the Structuralist/ Post-Keynesian model of chapter 7.

[98] Supposing the government has only two fiscal instruments, tariffs on imports and direct taxation, a reduction in tariff rates induces an increase in income tax.

[99] As already explained in chapter 1, the little triangle calculation is the basis of Partial Equilibrium theory and it is based only on the supply side. In fact, it assumes that a trade liberalization process leads to benefits both for government and consumers only because of a change in prices.

not save, investments are nil, and foreign savings assure the government savings to be balanced ($ZT+etZ'E'+e\Delta'=S_G$). the whole equations are listed in table 32.

Table 32: The One- Country Armington model

$Q=\left(\alpha w^{1-\sigma}+\beta r^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$	(1)
$PX=QV$	(2)
$Z=\left(\chi P^{1-\theta}+\delta\left[e(1+t)Z'\right]^{1-\theta}\right)^{\frac{1}{1-\theta}}$	(3)
$\frac{\partial Z}{\partial P}=\frac{X}{A}=\chi\left(\frac{Z}{P}\right)^{\theta}$	(4)
$\frac{\partial Z}{\partial\left[e(1+t)Z'\right]}=\frac{E'}{A}=\delta\left(\frac{Z}{e(1+t)Z'}\right)^{\theta}$	(5)
$ZC=PX-ZT$	(6)
$etZ'E'+ZT=Z\overline{G}+\overline{S_G}$	(7)
$ZT+etZ'E'+e\Delta'=S_G$	
$ZI=0$	(8)
$ZA=ZC+ZG+ZE$	(9)
$\frac{\partial Q}{\partial w}=\frac{L}{V}=\alpha\left(\frac{Q}{w}\right)^{\sigma}$	(10)
$\frac{\partial Q}{\partial r}=\frac{K}{V}=\beta\left(\frac{Q}{r}\right)^{\sigma}$	(11)

Q = value added price, α= labour share on value added, w= wage rate, β= capital share on value added, r= rental rate of capital, σ= elasticity of substitution between capital and labour, P= price of domestic output, X= total domestic output, V= total value added, Z= price of the Armington supply, χ= share of domestic output in total Armington supply, δ= share of imports in total Armington supply, e= exchange rate, t= import tariff rate, Z'= foreign price of imports, θ= elasticity of substitution between domestic and imported goods, A= total Armington supply, E'= imports, C= real consumption, T= real income tax, G= government expenditures, S_G= government deficit, Δ'= foreign savings, I= real investment, E= real exports, L= labour demand, K= capital demand

Source: ***von Arnim and Taylor*** **(2007a)**

Considering the consumption function, we derive real consumption as:

$$C=\frac{P}{Z}X-T$$

so that real consumption depends positively on the ratio (P/Z) and negatively on income tax (T). This means that a reduction in aggregate Armington price Z acts as a stimulus to consume and an increase in tax reduces it. Supposing that government is able to control its deficit handling some sort of fiscal instrument, in this case the tariff shortfall will be offset by an increase in direct taxes. Formally:

$$teZ'E'+ZT=ZG+S_G$$

where in the left hand- side there are the fiscal revenue from import duties (first element) and income tax (second element), in the right hand- side there are the uses of this revenue: partly is spent and partly saved. Differentiating respect to t we obtain how much T should change to counterbalance the fall in t:

$$\frac{\partial T}{\partial t} = -\frac{eZ'E'}{Z}$$

This is the quantification of the income effect. However, there is to evaluate the effects of *Z* reduction. Differentiating it respect to *t*, we get:

$$\frac{\partial Z}{\partial t} = -\frac{\delta eZ'}{Z^2}\left[\frac{Z}{e(1+t)Z'}\right]^{\theta}$$

Taylor and von Arnim derive that the absolute value of the former effect is greater than the second one:

$$\left|\frac{eZ'E'}{Z}\right| > \frac{\delta eZ'}{Z^2}\left[\frac{Z}{e(1+t)Z'}\right]^{\theta} \cdot PX$$

The right hand-side, which is the positive effects of the price reduction on consumption, depends on the choice of the parameter value θ: the higher θ is, the lower the shortfall in consumption is. Rearranging the inequality above, we have:

$$E' > \frac{PX}{ZA} \cdot E'$$

which presents the story in another way. *E*' is our import considered from the other country's point of view and it is a function of θ. A high parameter value means a higher export demand and domestic supply price changes. The negative tax effect is outweighed.

To sum up, the Armington assumption is built on the interaction between liberalization and fiscal policies, and the strongly positive correlation between trade parameters and the welfare gains.

Now the benchmark for the model calibration is complete. We have initial equilibrium points (quantities and prices) derived from the SAM, the functional forms to describe how the system works, and finally the parameters to develop the model itself. The final step is to define "the rules of the game" through he definition of the closure rules, that will be the subject of the following section.

IV. The closure rule choice

As demonstrated on a theoretical basis in chapter 2, the closure rule choice affects the model outcomes, because it imposes a different causality inside the economy and, as a consequence, the system works according to different adjusting mechanisms.

Using the words of Tarp *et al.* (2002): "*Since the model is a closed system, it must satisfy Walras' law. Walras' law states that if all but one equation in a closed system are satisfied, the final equation must be satisfied as well. In addition, basic macroeconomic balances imply that private savings + government savings + foreign savings = aggregate investment. One of these* *elements must be allowed to adjust, unencumbered by any behavioral equation, if the model is to simultaneously satisfy this identity and Walras' law.*" The closure rule issue is to assign to each saving source and to aggregate investment an endogenous or an exogenous value.

To discuss which options are available we refer to three papers: Robinson (2003), Tarp *et al.* (2002), and Taylor and von Arnim (2006), which, although it directly addresses the issue in the context of "Bastard Keynesian" models, surveys closures for Neoclassical models too. The former is a paper on the general closure issue without any reference to a specific country with only theoretical purposes, the latter, instead, is a research paper focusing on Mozambique where trade issues are analysed according to two different closures.

Because Robinson (2003) is interested in analyzing the role of aggregate investments and foreign savings in a Neoclassical and a Keynesian context, it recognizes two Neoclassical closures. Both characterized by full employment and flexible exchange rate, one is a "*truly Neoclassical closure*" where all saving sources are assumed fixed so that "*the model will behave very much like the closed- economy model*", and the other is called "*foreign closure*" where foreign saving is endogenous and moves to reach the saving- investment equilibrium. Moreover, the former assumes saving- driven investment while the latter supposes a fixed investment level.

In Tarp *et al.* (2002) simulations on trade issues are pursued under two macro- closures. The first one combines an external closure, with fixed foreign savings, flexible exchange rate, and saving- driven investments. It is close to the "*truly Neoclassical*" version described before. The second, instead, assumes investment and government recurrent expenditures in fixed shares to total absorption. Because of fixed foreign savings as well, the adjusting mechanism is allowing private saving propensities to save free to move. They call it a "*balanced closure*".

Taylor and von Arnim (2006), instead, focus mainly on the government closure and the foreign balance[100]. They compare a constant and an adjusting deficit. In the first case, the adjusting mechanism is through endogenous tax rate, in the second case, instead, "*governments across the globe use automatic stabilizers and public works programmes to counter negative effects of economic downturns – meaning the deficit (and not tax revenue) is endogenous*" (Taylor and von Arnim (2006)). Two opposite interpretations of foreign balance are given. In the first assumption exchange rate adjusts to hold current account at its benchmark level. They point out that "*a constant current account corresponds to the idea of balanced trade: an exchange rate change combined with the "right" elasticities ensures that an*

[100] We will discuss this class of models in chapter 6 where we clarify why the government role becomes so crucial.

increase in the value of imports is met by an equivalent increase in the value of exports". Conversely, supposing a fixed exchange rate and an adjusting current account allows trade flows income to accommodate price changes due to trade liberalization.

In our analysis we combine these papers. We simulate the same trade experiment (i.e. the trade liberalization inside the SADC area) through four Neoclassical closures. The first one is called *benchmark closure* and it is the most Neoclassical closure. It assumes saving- driven investment, full employment, fixed government deficit, fixed foreign savings and flexible exchange rate. Then, *Closure 1* is very close to the previous one but it investigates the effects of a different assumption on government behaviour. *Closure 2*, instead, examines how the outcomes of *Closure 1* are affected by endogenous foreign savings. Finally, in *Closure 3* we investigate the effects of the simultaneous introduction of endogenous foreign savings and fixed government expenditures[101]. The table below clearly depicts how main variables are treated in the different closures.

Table 33: The closure rules

	Neoclassical Benchmark	**NEO Closure 1**	**NEO Closure 2**	**NEO Closure 3**
Potential macro closure variables				
Exchange rate				
Investment				
Foreign savings	Fixed	Fixed		
Labour supply	Fixed	Fixed	Fixed	Fixed
Capital supply	Fixed	Fixed	Fixed	Fixed
Government demand		Fixed		Fixed
Saving rate	Fixed	Fixed	Fixed	Fixed
Tax rate	Fixed	Fixed	Fixed	Fixed
Wage rate				

Source: ***Author's own model***

VI. Simulations

The analysis we want to pursue is a comparative static exercise. We are not only interested in investigated the final effects of the tariff cut but we want to analyse the effects of each step in the gradual tariff reduction. For this reason, according to the SADC trade protocol provisions, we set up three stages. The first one lasts 3 years (2003-2005), the second and the third one year respectively (2006, 2007), and finally the fourth stage in 2008 when intra-SADC trade is fully liberalized.

Although this timetable is quite a good approximation of the real tariff phase- out, there are some limits we want to highlight. Firstly, because of our commodity aggregation we do not

[101] How empirically the different savings sources may be endogenized is clearly described in chapter 6 section IV.

capture the differentiated treatment properly. In fact, according to our scheme presented in table 33 we suppose for instance that agricultural commodities are liberalized as a B1 category. However under this assumption we cannot capture the coexistence of many goods (especially raw products) which are immediately liberalized as goods A and other goods having a longer phasing out process. Moreover, our scheme assume the same tariff reduction for RSA and RoSADC imports in each phase. This is a limit due to the aggregation. We loose the differentiated treatment among trading partners. For instance, we cannot highlight that commodities entering HS chapter 8 are liberalized as C1 goods respect RSA and as B1 goods respect RoSADC.

Table 34: The simulation scenarios

		Imports from RSA						
		First step			Second step	Third step	Fourth step
		2003	2004	2005	2006	2007	2008
Agricultural goods	B1	-0%	-0%	-0%	-20%	-50%	-100%
Manufacturing goods	B22	-0%	-0%	-0%	-0%	-40%	-100%
		Imports from RoSADC					
		First step			Second step	Third step	Fourth step
		2003	2004	2005	2006	2007	2008
Agricultural goods	B1	-0%	-0%	-0%	-20%	-50%	-100%
Manufacturing goods	B22	-0%	-0%	-0%	-0%	-40%	-100%

Source: ***Author's own calculations***

Although the limits already described, this tariff phase- out schedule is quite realistic. As illustrated in chapter 3, liberalized tariff lines were 93.97 percent in 2008. The remaining 6.03 percent is not modelled in our simulations. The fact that the majority of the tariff lines has been liberalized by 2008 is an empirical evidence that our model fit the real trade liberalization process in a good manner.

VI. Simulations' results

a) The "benchmark closure"

Here we present the outcomes of the IFPRI model imposing selected closure rules. Firstly we present the *benchmark closure* which is the world- wide adopted Neoclassical closure (see World Bank LINKAGE model). It consists of imposing both government and foreign savings fixed, a saving- driven investment function, and full employment. It directly derives that investments depend on private savings which is the only component to move in the saving-investment balance.

In the first step of the liberalization process, where only tariffs on imported agricultural commodities from South Africa are reduced, the effects are very limited in their values. We may observe a slightly increase in real production, both formal and informal, in the agricultural, manufacturing and trade sectors while an opposite trend is evident for services and the mining and quarrying segment is not affected (see table 36).

At the aggregate level total domestic supply declines. Disaggregating data we may show that this trend is explained by a more robust decline in service supply offsetting the contemporaneous increase in the other sectors. This explains why with a declining supply margins increase. Typically, margins production and Armington supply has the same sign. The increase in trade margins is mainly led by the good performance of the primary sector. As already analysed, agricultural goods final prices comprehend an higher fraction of marketing margins.

There is no movement in the exchange rate respect to any region. As predictable, imports from South Africa increases while imports from the other regions are stable at the benchmark level. Exports, instead, are lower for the rest of the World and slightly increase respect RSA (table 37). This is mainly due to the tariff phase- out schedule. At this stage it affects a commodity (agricultural goods) which is a low fraction of total imports and moreover the tariff reduction is very small (only 20 percent).

Households have a smaller consumption price index which means that to consume is now cheaper so that they increase their consumption level. The increase in consumption level is not equal for each social class. Rural households increase their consumption less than urban households. This may be explained analysing the consumption basket of each group. Urban consumption price decreases more since only marketed commodities enter it. As already said their prices lower thanks to the tariff cut. Rural consumers, instead, do not spend only in marketed commodity but a higher fraction is devoted to informal domestic production whose price is fixed at the benchmark level.

This closure affects the government performance. It faces a reduction in tariffs (the direct effect of the liberalization process), and a reduction in VAT collected at borders, whose tax base is imports at c.i.f. prices gross of tariffs (-0.0017 10^3 Billion Mts). Because of the government closure (fixed government savings) the adjusting variable is public consumption which may only fall (- 0.01 percent).

Enterprises have not any gain in the first phase of the tariff cut. This is due to the stability of both wage and profit rates at the benchmark level.

Investments, in this closure, are driven by savings, and more precisely by private savings. Supposing, as we have done, that savings are a fixed fraction of disposable income, in this situation there is no change in them as a consequence of income stability. Investments are fixed at their initial level.

In the second and the third steps in the tariff phase- out, the same trends are more evident as the tariffs lower up to be nil. Once more domestic production increases, but this time it happens also in the mining sector. This may be explained by the fact that now the liberalization process regards manufacturing commodities too. The mining sector does not use agricultural products as intermediates (see SAM appendix A), therefore it is not affected by step 1. As before, production is displaced against the service sector, whose domestic production continue falling. An exception is the informal service sector. This is a consequence of the fact that informal production depends on total households' consumption, so when households consume more they increase their demand also for the informal output.

Lowering tariff rates cause changes in trade flows. Looking at total flows, imports from South Africa and the other SADC members increase while trade with the ROW gets down. However, disaggregating across sectors, we may observe an interesting and quite surprising behaviour. There is a reduction in service imports from each trading partner, but for ROW this decline offsets the contemporaneous increase in imports of other products.

The effects of the tariff reduction are like the ones predicted in the standard trade theory. Lowering tariff rates, RSA and RoSADC become more competitive (because of the lower prices) and this stimulates imports from those regions. At the same time trade is created in this area and diverted from the rest of the World.

Exports increase at the producer price level because of the higher domestic production levels and this causes and increase in exports to ROW and RSA, while exports to RoSADC falls.

The foreign exchange rate declines to maintain at the benchmark level foreign savings (in foreign currency).

The local total supply (the composite of domestic output and imports) increases for each sector except services whose sector is affected both by a reduction in imports and a reduction in domestic uses. Among sectors it is interesting to note that the highest increase is recorded in the trade sector. It is led by the contemporaneous increase in domestic transactions (given the highest production), exports, and imports as well.

In this process real employment is not affected (because of the assumption of full employment and fixed supply) but it is mobile across sectors. There is a constant deterioration of wages for skilled and unskilled labour while unskilled labourers face a higher wage. This may be cause by the good performance in the agricultural sector, which is the productive activity with the highest growth rate, and an unskilled labour intensive sector.

As a consequence, rural households, who mainly hold unskilled and semiskilled labour, increase their consumption level more than urban households. However, the latter have a higher saving propensity and a higher tax rate. These two elements affect the saving-investment balance. Indeed, nominal investments decline too[102]. Enterprises have a lower income too, because of the declining profit rate. This enforces the negative effects of the loss of income out of wages for urban household who also earn from distributed profits.

As already analysed, because of the closure rule for government, public expenditures fall down as a consequence of the minor tax revenue. In the second and third steps in the liberalization process tax revenues declines by 0.3247 and 0.8060 10^3 Million MT. Real government consumption shortfall is evident and it is evaluated as 0.04 percentage points.

The tables below show statistics for selected indicators to quantify the effects of the *benchmark closure*. It is worthy to note that this closure has effects not only on nominal variables but also on real ones. Considering the economic system as a whole, the tariff reduction causes a decrease in nominal GDP. We may explain this phenomenon considering that the tariff reduction positively affects the liberalized sectors[103] while the domestic production is displaced against the service sector, which has no new advantages both from the reduction in tariff (to stimulate production for foreign markets) both from lower costs of production because the sector employ a high quantity of services as intermediates.

Table 35: Factors' prices, costs of living and exchange rate in the "benchmark closure"

	Percentage change respect the base run			
	Base run	**1 step**	**2 step**	**3 step**
Consumer price index (CPI)	1	-	-0.2	-0.6
Factors' prices				
Skilled labour wage rate	1	+6e^{-5}	+0.124	+0.307
Semi- skilled wage rate	1	+2e^{-4}	+0.139	+0.342
Unskilled wage rate	1	+0.003	+0.453	+1.126
Profit rate	1	+0.001	+0.191	+0.473
Costs of living indices				
Rural	1	+6e^{-4}	+0.095	+0.235
Urban	1	-5e^{-4}	-0.086	-0.213
Exchange rate				
ROW	1	3e^{-4}	+0.093	+0.231
RSA	1	6e^{-4}	+0.089	+0.221
RoSADC	1	7e^{-4}	+0.105	+0.260

Note: changes are evaluated respect the CPI
Source: ***Static CGE model results***

[102] Note that it is fixed in real terms.

[103] Here we intend not only the agricultural and the manufacturing sectors which are liberalized but also the mining and quarrying sector which employs a higher fraction of liberalized goods as intermediates.

Table 36: Short- run benchmark Neoclassical CGE model results on real production

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production
Agriculture	10.0430	11.6010	-	-	+0.14	+0.30	+0.35	+0.75
Mining	0.7680	-	-	-	+0.06	-	+0.14	-
Manufacturing	37.6390	9.7380	-	-	+0.05	+0.30	+0.12	+0.75
Trade	21.0340	-	-	-	+0.12	-	+0.30	-
Services	78.8700	4.8850	-	-	-0.21	+0.30	-0.51	+0.75

Table 37: Short-run benchmark Neoclassical CGE model results on real foreign trade

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Rest of world- ROW	19.5420	41.2920	-	-	-0.03	-0.2	-0.09	-0.04
Republic of South Africa- RSA	8.1200	10.2310	-	-	0.09	0.07	+0.23	+0.18
Rest of the SADC area- RoSADC	2.8640	1.1090	-	-	0.03	0.08	+0.08	+0.21

Source: ***Static CGE model results***

Note: features in the base run are 10^3 Billion MT

b) Closure 1

Closure 1 analyzes the impact of a different government behaviour. In fact, supposing that foreign savings remain fixed in foreign currency, now public deficit is allowed to move while its expenditures in real terms are fixed at the benchmark level.

When only tariffs on agricultural products from South Africa are lowered, there is a decline in real terms of formal production in the manufacturing and service sectors, while informal production behaves oppositely. Respect to foreign trade, there is no real effects on trade between Mozambique, South Africa, and other SADC members, while there is a decline in real trade flows respect to the rest of the World. Precisely, the decline in imports is caused by a negative change in manufacturing, and it is completely offsets by a decrease in exports of the same commodity class.

Households increase their consumption: urban households' consumption by 0.002 percent while rural households by only 0.0016 percent, as in the previous closure. This means a decline also in private savings. Because of the closure rule the reduction in tariffs is not absorbed by a change in recurrent expenditures but it causes the deficit to enlarge (more than 12 percent). Combining a decline in public and private savings, total aggregate investments decline not only in nominal but also in real terms (-0.006 percent).

When tariffs lower, the effects on the domestic market remain with the same sign although they worsen in absolute values. In fact, aggregate domestic production declines since only agricultural sector faces a better performance and the opposite trend of informal sectors persists[104]. Meanwhile, real imports and exports change their patterns. Imports increase respect to all trading partners only in agricultural products, imports of other commodities decline. This leads regional imports to decline respect to each trading partner. Exports, instead, are differentiated in their behaviour among partners. Exports to the rest of the World and South Africa increase and contemporaneously they decline respect to RoSADC. This is reflected in the foreign exchange rate behaviour. Foreign exchange rates decline in the same proportion for ROW and SADC (- 0.13 percent), while a marked decline is obtained respect the rest of the SADC area (- 0.17 percent). The markedly decline in margins reflects the reduction in trade flows with RoSADC and, mainly, in the aggregate domestic supply, because of the reduction in both domestic uses and imports.

Under this closure, private agents have a lower consumption price that stimulates their consumption (- 0.22 and - 0.35 percent for rural and urban households respectively). The percentage change in urban households' consumption is higher than in rural since their

[104] Negative effects are not only in real but also in nominal terms.

consumption basket is composed of only composite goods, whose prices decline, while rural agents spend a higher fraction in informal production which faces an increase in their prices.

At the same time profit rate declines reducing enterprises income. This contracts their savings. At the end of the liberalization path total private savings (enterprise plus households) are reduced.

Effects on public performance are very negative. In the first phase of the liberalization process public deficit worsens by 11 percent, it increase up to 22.49 percent, and finally at the end of the tariff phase- out process it is increased by 55.92 percent. As a consequence, saving-driven investments dramatically reduce both in nominal and real terms (3.14 and 3.1 percent respectively).

An interesting aspect to highlight is the composition of savings, which are used to finance investments. Respect to the *benchmark closure* investments are driven both by private and public savings. This means that burdens should not be paid only by households. This is evident looking at the consumption level. In the previous closure, urban households, who have a higher saving propensity, increase their consumption less than in this closure (in real terms 0.83 and 0.86 percent respectively[105]). Now, instead, also government has a role in investment financing. In the benchmark government has a negative deficit so that a diminishing private savings worsens the public position allowing deficit to increase, as a consequence investment level is deteriorated at the end of the tariff cut.

Table 38: Factors' prices, costs of living, and exchange rate in "*closure 1*"

	Percentage change respect the base run			
	Base run	**1 step**	**2 step**	**3 step**
Consumer price index (CPI)	1	-	-0.2	-0.6
Factors' prices				
Skilled labour wage rate	1	$+8e^{-4}$	+0.124	+0.307
Semi- skilled wage rate	1	$+9e^{-4}$	+0.139	+0.342
Unskilled wage rate	1	+0.003	+0.453	+1.126
Profit rate	1	+0.001	+0.191	+0.473
Costs of living indices				
Rural	1	$+6e^{-4}$	+0.095	+0.235
Urban	1	$-5e^{-4}$	-0.086	-0.213
Exchange rates				
ROW	1	$+3e^{-4}$	+0.093	+0.231
RSA	1	$+6e^{-4}$	+0.089	+0.221
RoSADC	1	$+7e^{-4}$	+0.105	+0.260

Note: changes are evaluated respect the CPI
Source: ***Static CGE model results***

[105] In nominal terms the percentage increase because of the summation of a quantity and a price effect.

Table 39: Short- run Neoclassical CGE "*closure 1*" model results on real production

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production
Agriculture	10.0430	11.6010	-	-	+0.07	+0.29	+0.16	+0.71
Mining	0.7680	-	-	-	-0.12	-	-0.27	-
Manufacturing	37.6390	9.7380	-	-	-0.12	+0.29	-0.29	+0.71
Trade	21.0340	-	-	-	-0.03	-	-0.08	-
Services	78.8700	4.8850	-	-	-0.08	+0.29	-0.20	+0.71

Table 40: Short-run Neoclassical CGE "*closure 1*" model results on real foreign trade

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Rest of world- ROW	19.5420	41.2920	-	-	-0.17	-0.08	-0.42	-0.20
Republic of South Africa- RSA	8.1200	10.2310	-	-	-0.10	-0.08	-0.25	--0.20
Rest of the SADC area- ROSADC	2.8640	1.1090	-	-	-0.03	-0.07	-0.08	-0.21

Source: *Static CGE model results*

Note: features in the base run are 10^3 Billion MT

c) Closure 2

This new closure supposes endogenous foreign savings, which adjusts to reach the saving-investment balance. According to this closure, investments depend on private savings and foreign capital inflows while government does not erode its deficit. We may compare these results with the outcomes of the *benchmark closure* detecting which is the impact of endogenous foreign savings, the effects on real and nominal variables, and on private agents.

At a first sight, it is interesting noting that changes affect solely nominal variables. Activity levels are at their benchmark levels both in step 1 and step 2. Here, only prices move. In fact the change in foreign savings, which increase, is caused by a movement in the foreign exchange rate. It increases for each region, mainly for South Africa and SADC countries. Nominal increases take place in rural households' consumption, because now informal production price is at the benchmark level, and the government expenditures that are free to move.

In the second stage this trend persists. However, there is a differentiated behaviour of foreign savings. Capital inflows from the rest of the World decline (- 0.1%) while they increase from RoSADC (+ 0.57%) and mainly from South Africa (+ 0.68%). This phenomenon is led by the advantages of these trading partners after the tariff cut.

In this period domestic internal prices do not stay at their benchmark level but they get higher (especially for informal production), so that nominal consumption for urban consumers reduces because of a higher price index (+0.27%). Urban households do not suffer from the increase in prices and their nominal consumption remains at the benchmark level.

Both investment and public expenditures increase in nominal terms although their real values are stable.

The majority of the effects in this closure is left to the last step when the total tariff removal takes place. Here, effects are not solely in nominal terms but also in real terms. Formal production gets higher for all sectors except the trade sector which faces a slightly decline (- 0.006%). This positive trend is evident also for the informal production.

A quite surprising result is the one for the domestic total supply; it increases only in nominal terms but dramatically declines in real ones, led by a reduction in real supply of agricultural goods and marketing services.

Households face a decline in real consumption for urbans and an increase for rurals, while also public expenditure modestly increases in real terms. The diminishing investments are also an effect of the reduction in enterprise savings because of a lower rental rate of capital.

The aggregate saving increases mainly because of the foreign source. Looking at outcomes, the leading force is the increase in capital inflows from South Africa. In fact, respect to the rest of the World Mozambique increases its exports more than imports because of stable import tariffs. This reduces foreign savings available for the Country (- 0.15%). For the rest of the SADC member states, the situation is opposite: the tariff reduction makes imports cheaper so that they increase more than exports. But, at the benchmark level foreign saving from this region has a negative value; when in our results we obtain an increase of 1.68 percentage points, it means that now its level is lower and this means lower saving sources. Up to this point there should be a decline in investments, since they are saving- driven. However, capital inflows from South Africa increase by 1.98 percent that more than offset the decline in the two just mentioned components.

Combining external saving and the higher private savings, from urban households, investments increase both in nominal and in real terms (10.6 percent). Allowing movements in foreign savings permits a better performance of public finance with a smaller deterioration of deficit.

As in *Closure 1*, the burdens are divided between many agents but the two closures' results greatly differ in their achievements. In the first case, government savings are diminished, as in this closure, but private savings are not sufficient to maintain a stable investment level both in nominal and in real terms. When, instead, they are mainly driven by foreign savings, the final investment performance is better. This kind of closure, with endogenous foreign savings, reflects the causality investigated many times by IFPRI: investments mainly relies on foreign sources of savings.

Table 41: Factors' prices, costs of living, and exchange rate in "*closure 2*"

	Percentage change respect the base run			
	Base run	**1 step**	**2 step**	**3 step**
Consumer price index (CPI)	1	-	+0.001	+0.004
Factors' prices				
Skilled labour wage rate	1	$9e^{-4}$	+0.211	+0.512
Semi- skilled wage rate	1	$9e^{-4}$	+0.211	+0.512
Unskilled wage rate	1	$9e^{-4}$	+0.211	+0.514
Profit rate	1	$9e^{-4}$	+0.211	+0.512
Costs of living indices				
Rural	1	$6e^{-4}$	+0.137	+0.318
Urban	1	$-5e^{-4}$	-0.124	-0.288
Exchange rates				
ROW	1	+0.01	+2.520	+6.531
RSA	1	+0.02	+3.313	+8.806
ROSADC	1	+0.018	+3.204	+8.486

Note: changes are evaluated respect the CPI
Source: *Static CGE model results*

Table 42: Short- run Neoclassical CGE "*closure 2*" model results on real production

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production
Agriculture	10.0430	11.6010	-	-	-	-	$1e^{-4}$	+0.002
Mining	0.7680	-	-	-	-	-	+0.01	-
Manufacturing	37.6390	9.7380	-	-	-	-	+0.001	+0.002
Trade	21.0340	-	-	-	-	-	-0.06	-
Services	78.8700	4.8850	-	-	-	-	0.001	+0.002

Table 43: Short-run Neoclassical CGE "*closure 2*" model results on real foreign trade

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Rest of world- ROW	19.5420	41.2920	-	-	-	-	+0.001	-
Republic of South Africa- RSA	8.1200	10.2310	-	-	-	-	-	+0.001
Rest of the SADC area- ROSADC	2.8640	1.1090	-	-	-	-	-	-

Source: ***Static CGE model results***

Note: features in the base run are 10^3 Billion MT

d) Closure 3

This closure stems from a series of considerations respect to the other implemented closures and their results. Here we suppose both endogenous government and foreign savings. There are at least two reasons for this closure. Firstly, looking at the real world, as already discussed, assuming endogenous government deficit is more likely than assuming it as fixed. Government expenditures have a minimum level to ensure services to people. On the other side we have demonstrated in *closure 2* that investments are mainly driven by foreign savings, so we allow them to change and we want to investigate if private households may increase their consumption since we presuppose their participation in saving- investment balancing is replaced by foreign or public savings.

This closure has negative effects on real domestic production from step 1 in the liberalization process, solely the agricultural sector gains while mainly the manufacturing and mining sectors loose. The same trend is evident in the Armington supply. Private consumption increases by 0.0018 percent for rural households and 0.002 percent for urban ones. Because of the construction of the model, this leads to an increase in informal production. In fact, as rural household consumption increases, informal sectors produce more.

In this step, investment declines both because the increase in nominal private consumption and because of the increase in government dissavings (+0.12%). This effect on aggregate investments depends upon the benchmark situation which shows a negative public saving level. So its increase means a deterioration of public finance.

In phase 2 both public and foreign savings change. The former increases by 22.74 percent while the latter by 0.22 percent from ROW, 0.23 form South Africa, and 0.26 from RoSADC. The foreign exchange rate declines but the tariff cut stimulates imports more than proportional respect to exports. In fact, the bad performance of RoSADC saving depends on the fact that imports form this region are now cheaper only for a small fraction of its imports while exports increase more.

Domestically, although the agricultural sector gains, the production in the manufacturing sector dramatically declines.

Households spend more: rural household has a 0.29 percent increase in consumption, while urban one is 0.31 percent. This different performance is explained by the contemporaneous decline in general price level for marketed commodities. Since only marketed commodities enter the urban consumption basket, they gains more from their price decrease.

Investments continue to fall. Respect to their benchmark level they decline by 1.06 percent. This negative performance is explained by a contemporaneous increase in public deficit, a decline in private savings (although enterprises have a higher income and therefore higher savings), and a deterioration of trade account respect to ROSADC.

When tariffs are completely liberalized, the situation worsens. Investments fall by 2.64 percent and domestic production declines. There is an increase in foreign capital inflows from RSA and ROW by 0.58 and 0.56 percent respectively, but they positive effects are balanced by the bad performance respect to RoSADC (Mozambican foreign outflows increase by 0.66%).

Although the drop in production and the diminishing level of total supply, households increase their consumption. As in the other phases of the tariff phasing out, this is more markedly for urban households than for rural ones.

Table 44: Factors' prices, costs of living, and exchange rate in "*closure 3*"

		Percentage change respect the base run		
	Base run	**1 step**	**2 step**	**3 step**
Consumer price index (CPI)	1	-	-0.2	-0.6
Factors' prices				
Skilled labour wage rate	1	$9e^{-4}$	+0.124	+0.307
Semi- skilled wage rate	1	$1e^{-3}$	+0.139	+0.342
Unskilled wage rate	1	+0.003	+0.453	+1.126
Profit rate	1	+0.001	+0.191	+0.473
Costs of living indices				
Rural	1	$6e^{-4}$	0.095	+0.235
Urban	1	$-5e^{-4}$	-0.086	-0.213
Exchange rates				
ROW	1	$3e^{-4}$	+0.093	+0.231
RSA	1	$7e^{-4}$	+0.089	+0.221
ROSADC	1	$7e^{-4}$	+0.105	+0.260

Note: changes are evaluated respect the CPI
Source: ***Static CGE model results***

Table 45: Short- run Neoclassical CGE "*closure 3*" model results on real production

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production
Agriculture	10.0430	11.6010	-	-	+0.07	+0.29	+0.16	+0.71
Mining	0.7680	-	-	-	-0.12	-	-0.27	-
Manufacturing	37.6390	9.7380	-	-	-0.12	+0.29	-0.29	+0.71
Trade	21.0340	-	-	-	-0.03	-	-0.08	-
Services	78.8700	4.8850	-	-	-0.08	+0.29	-0.20	+0.71

Table 46: Short-run Neoclassical CGE "*closure 3*" model results on real foreign trade

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Rest of world- ROW	19.5420	41.2920	-	-	-	-0.08	-	-0.20
Republic of South Africa- RSA	8.1200	10.2310	-	-	-	-0.08	-	-0.20
Rest of the SADC area- ROSADC	2.8640	1.1090	-	-	-	-0.07	-	-0.21

Source: ***Static CGE model results***

Note: features in the base run are 10^3 Billion MT

VII. Concluding remarks

This chapter has dealt with a likely model to evaluate a trade liberalization process. This is the Neoclassical model where the fundamental element is the full employment assumption. Here, we present its basic structure, the parameters and the other information. Then, after having built it, we run our simulation which follows the real trade liberalization process within SADC members. The focus is on the possibility to have different closures affecting model outcomes. In fact, although in the same paradigm and considering the same shock, we have radically different results as depicted in table 47 below where, at the macro level, GDP components are shown according to each closure rule.

Table 47: GDP components according to closure rules of the Neoclassical model

		Base	Benchmark closure	Closure 1	Closure 2	Closure 3
		10^3 Million MT	Percentage variation respect the base			
A= b+c+d	**Total Absorption**	**133.981**	**-0.50%**	**0.06%**	**0.6%**	**-0.44%**
b	Private consumption	92.203	0.26%	0.19%	0.34%	0.19%
c	Investments	27.033	-0.80%	-2.62%	0.11%	-2.62%
d	Government consumption	14.745	-4,71%	-0.35%	3.09%	-0.35%
e	Exports	30.526	-0.13%	-0.67%	1.11%	-0.32%
f	Imports	52.632	-0.15%	-0.53%	-0.16%	-0.66%
G=e-f	**Trade balance**	**-22.106**	**-0.17%**	**-0.33%**	**7,0%**	**-1.12%**
H=A+G	**GDP at market prices**	**111.875**	**-0.57%**	**-0.46%**	**-0.70%**	**-0.30%**

Source: ***Static CGE model results***

Usually, when an import tariff cut is evaluated through a Neoclassical model, what we have called the *benchmark closure* is the model closure usually applied when a simulation will be performed in a Neoclassical framework. It replicates the good performance of a PE analysis. The reason is straightforward to understand: there may not be effects on employment (by assumption), the price effect of the Armington approach prevails and both public and foreign position is unchanged respect the benchmark (by the closure rules).

The limits of the Mozambican economic system are evident analyzing the results in the table above. The existence of consistent trade and government deficit reduce drastically the positive effects of the trade liberalization. The *benchmark closure* and *closure 1* differ respect to government behaviour supposing that foreign savings are exogenous. Both of them has negative effects on investments, although *closure 1* worsens the situation because making the public saving endogenous means a likely reduction of the available savings which, in this case, is not counterbalanced, for instance, by higher foreign savings. *Closure 2* shows positive effects on total absorption because of the dependence of Mozambique on foreign aid that in this closure are free to move. However, total GDP at market prices decline because now foreign trade balance is deteriorated. *Closure 3* is a medium point between *closure 2* and *closure 1*, since we allow foreign and public savings to move partially offsetting each other.

6. The SADC Trade Liberalisation in a Demand- driven System: the "Bastard Keynesian" Model

The label "*Bastard Keynesian model*" combines two features that derives from two different theories: the marginal productivity as labour remuneration and the relation between aggregate demand and labour market. As Keynes (1936) himself explained in its *General Theory*: "*For we shall maintain the first postulate* [the wage is equal to the marginal product of labour] *as heretofore* […]". Moreover, he introduced a new relationship between the output market and the labour market to explain unemployment. For the Neoclassicals unemployment is due to rigidities in the labour market itself while for Keynes the labour demand is free to change its position according to changes in the aggregate demand. In this way he links unemployment to a shortfall in the output demand. Supposing the aggregate demand depends only on the investment level, in the simplest case without government and foreign trade, we may say changes in investments affects the aggregate demand with the same sign. Supposing the starting point is equal to a level of investment INV_1, this means an aggregate demand Y_1 could be produced with the employment of L_1 paid w_1. Supposing investment demand increases, also Y_1 increases up to Y_2. Then, the demanded labour gets higher to allow output to raise. So, as the economy faces a demand shock, the labour market absorbs workers. But, this process is not infinite, there should be an "*upper bound*". New workers may be employed only up to the existence of unemployment. When a condition of full employment is reached, any change in the aggregate demand could not affect the employment level. An increasing demand will lead to increasing prices, that in a dynamic perspective will lower the demand and create new unemployment to be exploited in the future.

The term "Bastard Keynesian", firstly adopted by Joan Robbins, is currently used by Lance Taylor and Rudiger von Arnim as a term of comparison respect to mainstream Neoclassical models, and especially the World Bank LINKAGE model. In the following section we will describe their critique to present the potential advantages of this model.

I. The critique of mainstream CGEs

Trade liberalization for Neoclassical modellers means solely gains, but Taylor and von Arnim assert that final results of those models are affected mainly by two problems. The former is the “*Armington effect*” that comprehends an effect on real consumption and a fiscal effect, the latter, instead, is the closure rule. Here, we present their positions and briefly describe their reasoning.

What they define as the “*Armington effect*” is the interaction between external trade and the other macro-aggregates, mainly private consumption and government revenue through changes in prices. When we study a trade liberalization process, supposing the simplest model with only tariffs and a lump-sum tax on income, a reduction in tariffs means a higher income tax that stimulates a reduction in consumption. However, consumption itself is part of the “*Armington composite good*”, so it is affected by the tariff removal too. Thus, there is an income and a substitution effect, each of them has a different magnitude and they could not offset each other[106].

Moreover Taylor and von Arnim (2006) stated “*the negative direct impact of a higher tax on aggregate real consumption is greater than the positive indirect effect of a tariff reduction via a lower price*.”

This is not the only weakness of the Armington assumption. They recognize at least other two theoretical problems to detect.

Firstly, the model speaks in terms of composite goods. This means there is a composite good resulting from the imperfect substitutability between imports and domestically produced commodities and this choice reflects the national perspective. This analysis is not at the individual agent level. Another failure is the idea of spatial differentiation. Quoting von Arnim and Taylor (2007a), “*National product differentiation ignores the fact that characteristics of products are mostly determined by firms, not countries*” and to enforce this concept they present an example “*A Toyota manufactured in Japan is identical to the same model made in the US, and the Toyota Group itself decides how much international trade to undertake*”.

The other problem, the closure rule, is particular evident if we briefly illustrate the World Bank closure. Its assumptions are a saving-driven investment function, balanced trade, fixed employment (not necessarily full employment), and a balanced government budget. The last assumption is particularly strong if we follow the previous example of the simplest model. When tariffs lower the income tax should be adjusted, or better, increased. Using von Arnim and Taylor’s words “*LINKAGE limits macroeconomic risks of trade liberalization by holding employment, current account and the public fiscal deficit constant*”.

[106] The mathematical demonstration is provided in chapter 5.

They highlight two different closures inside their “Bastard Keynesian” model, imposing either fixed government savings (or deficit) or fixed government expenditures.

Government revenue comes from taxation, both direct and indirect, while the expenditures are for consumption and investment. The latter is set exogenous as the government saving (or deficit), while its consumption expenditures are endogenous. Due to a trade liberalization process tariff revenue diminishes, it should be balanced by a change of the same sign of government expenditures. The government has no possibility of financing expenditures through increasing borrowing. Foreign capital inflows depend mainly on trade flows and not on government saving although this inflow is used to finance public deficit.

This kind of closure is very close to the World Bank view of the public sector. In fact, we may read “*Government collects income taxes, indirect taxes on intermediate and final consumption, production taxes, tariffs, and export taxes/ subsidies. Aggregate government expenditures are linked to changes in real GDP. The real government deficit is exogenous. Closure therefore implies that some fiscal instrument is endogenous in order to achieve a given government fiscal deficit*” (van der Mensbrugghe, 2005).

It is possible to derive the same closure rule in the “Bastard Keynesian” model too. When a link between private sector savings and foreign capital inflows is set, savings are decided after the tax payment so that income tax rate becomes indirectly the equilibrating variable.

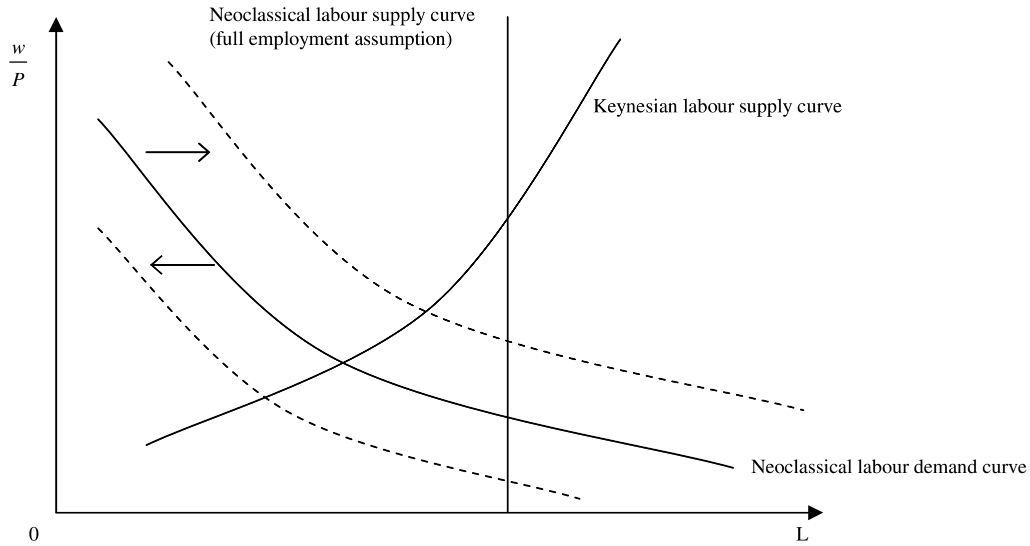
On the other side, there is the endogenous government saving with exogenous expenditures, a truly Keynesian perspective, which they define as “*absorption closure*”.

In this case government deficit is able to change and absorb each kind of shock, as a reduction in the tariff revenue. This means that government saving derives from government expenditure level. A fixed exchange rate, that in the short run is a plausible assumption, leaves the current account deficit to move and to be an adjusting variable. In this way as von Arnim and Taylor (2007a) have defined “*it permits macroeconomic absorption of shifting import and export quantities, instead of an elastic adjustment of trade flows to international prices*”.

II. A graphical interpretation of the “Bastard Keynesian” elements in the model

We have already argued about the structure of the “Bastard Keynesian” model in chapter 2 when we have described its fundamental relations and we will consider it in the next section. Here we want to describe using a diagrammatical representation the main concepts which underlie the BK model. As already cited in the introduction of this chapter, the term “Bastard Keynesian” derives from the contemporaneous existence of a Keynesian term (the well known Keynesian multiplier) and a Neoclassical demand labour function.

Figure 3: A diagrammatical representation of the labour market



The graph above shows the labour market in both a Neoclassical and a “Bastard Keynesian” model. Both of them have the same labour demand curve with diminishing returns to scale. It is a traditional Neoclassical interpretation of how labour is demanded by firms: the higher the real wage is, the lower is the employment level. The curve has two features that characterize it: its slope and its position in the $(\frac{w}{P}, L)$ plane.

In both cases, the slope is determined by the Shephard’s lemma but the curve position and its movements (the arrows in the figure above) are explained by different elements: the Keynesian multiplier, in the BK case, and the price of final output in the Neoclassical case. The former assumes that firms hire workers according to the final output demand. If one of the demand component (government consumption, for instance) declines, they produce less to satisfy the market demand level. As a consequence they have to employ less workers. In this case the curve moves leftwards. If the demand expands for the same real wage level a higher employment level is reached (a rightward movement).

The latter, instead, states that labour is demand up to when its marginal productivity equals the real wage rate. It may be straightforward to demonstrate assuming a Cobb-Douglas production function.

The production function takes this form: $Y = L^{\alpha} \cdot K^{1-\alpha}$

In this case the labour marginal productivity becomes:

$mpl = \alpha \cdot L^{\alpha-1} \cdot K^{1-\alpha}$

and rearranging: $mpl = \alpha \cdot \frac{Y}{L}$

As already said labour demand is determined by the equality between marginal productivity and real wage:

$$w = P \cdot \alpha \cdot \frac{Y}{L}$$

or $w = P \cdot \alpha \cdot \frac{Y}{L}$

Since the second element in the right hand- side is diminishing, the wage rate depends on the general output price level. From the relation above we can demonstrate what we have said about the BK interpretation of the closure. The Keynesian multiplier makes the output (or production) level endogenous because now *Y* is endogenous.

To complete the description of the labour market we add the supply curve which differs according to the theory under investigation. In the Neoclassical theory it is vertical, because of the assumption of full employment. Although an increase in the real wage, labour is wholly employed and there is no room for a change in its level. The story goes differently in the BK case. Here, the supply curve has a negative slope to show that the supply may be modified and it answers to changes in real wages: the higher is its level, the more the workers claim to be employed.

III. The Mozambican “Bastard Keynesian” CGE.

Fundamentally, the “Bastard Keynesian” model does not differ from the Neoclassical model in its essential elements. The only remarkable difference it the treatment of labour market. In chapter 5, speaking about the IFPRI model, we have supposed that labour supply is equal to labour demand. Here to switch the model into a “Keynesian” model we have not to maintain this equality. This is the idea of Lofgren, Lee, and Robinson (2002), who assert that “*It is also feasible […] to specify a Keynesian. closure in which aggregate employment is linked to macro variables through a Keynesian multiplier process. In the labour market (in one of the labour markets if labour is disaggregated), it is assumed that the real wage is flexible in a setting with unemployment. Adjustment in the real wage induces firms to change their labour demand and employment sufficiently to generate incomes and savings that are needed to finance the fixed quantity of real investment*”. Our model, however, is a bit different. We do not suppose under-employment only in one of the labour markets but we consider a general unemployment. This assumption is coherent with Mozambican labour statistics. Here a widespread underemployment is demonstrated respect to both localization and educational level. Presupposing that the educational level is a proxy of skilled, semiskilled, and unskilled labour, we may say that the unemployment rate is higher than 15 percent in each class, but the higher is the educational level the higher the rate becomes. Workers with secondary (or more) education have an unemployment rate more than double respect to workers with no education (*2004/ 05 IAF*).

To model this fact, we suppose that unemployment is a phenomenon at the “aggregate labour” level. So we suppose there are only two productive factors, capital and labour, while the former is fully employed the latter is supplied in the market according to an households’ decision. The idea is that workforce is not fully supplied in the market so that its level may change according to the productive needs. Activities, in fact, may face a demand increase which may be satisfied only by more inputs to produce more. In this way households supply extra labour. Its remuneration is a decreasing function so that to employ more workers firms diminish their wage rate.

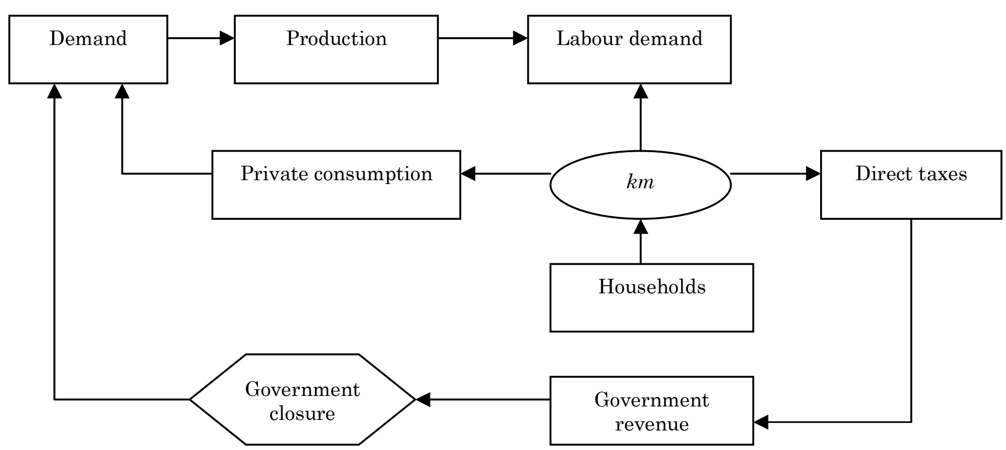
This mechanism has two effects on income and indirectly on personal taxation. The former is evident: higher employed work means higher income for labour owners. The latter instead is the effects of income changes on taxation. Direct taxes from labour depend on how much labour households decide to supply.

Although this mechanism is quite easily to explain, its implementation in MPSGE requires the introduction of a new element we call *km* (or Keynesian multiplier). It is the parameter which represents how much labour to supply. It may move from zero, when total labour is unemployed, to an upper bound representing when labour is fully employed. Formally it is known as “scaling parameter” and it is associated in the MCP format to a complementarity condition. To derive which is the constraint in this case, we refer to the simplest case of a closed economy without government already presented in chapter 2 box 12. As already said *km* represents an household’s decision on labour and consequently on income. The constraint should reflect these peculiarities but also guarantee the stability of the system itself. As a consequence it must satisfy the market clearing condition, which states that total supply in the market has to be cleared by the summation of the different demand components. Because the scaling parameter acts at the household level, the demand component it may affect is private consumption. An aspect should be underlined. The related constraint is binding for the economy as a whole so it affects aggregate private consumption. This means that if there are many private consumers we have to consider the summation of their consumption, simply evaluated as the residual after tax payment and saving decisions. Therefore, *km* scales aggregate consumption so that demand is consistent with total supply.

It is straightforward to derive how much the closure rule choice is crucial for this class of models. We have said that *km* affects consumption, via changes in disposable income, but it causes government tax revenue changes via variations in direct taxes. In this case government closure is crucial. If a reduction in government revenue is counterbalanced by a fixed government expenditure level, only private consumption and investments in our small example may change. If we assume fixed public deficit, instead, a direct tax change reflects a change in recurrent expenditures.

In figure below we reconstruct the fundamental relations between *km*, private and public consumption, and total demand.

Figure 4: The role of *km* in a demand- driven system



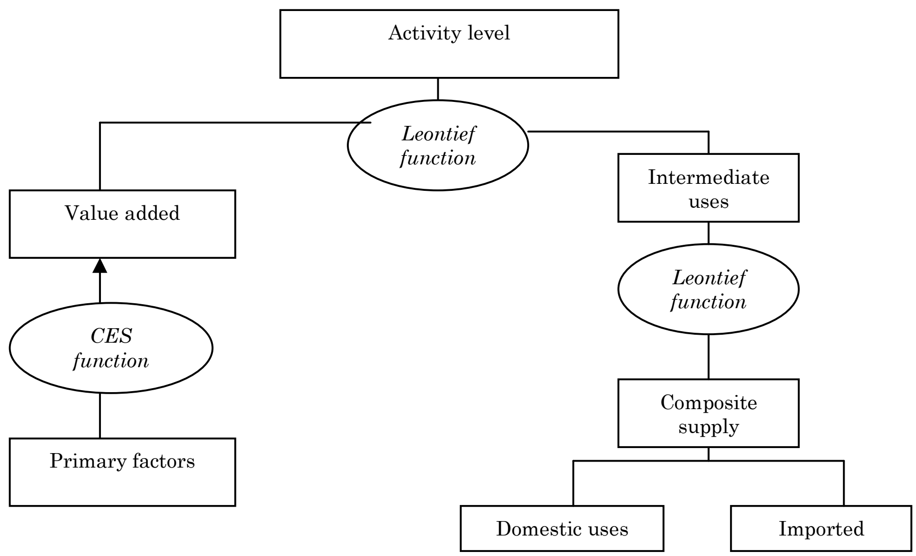
The rest of the model is business as usual. As in the Neoclassical model presented in chapter 5, each producer is a maximizing agent, who has the objective of maximizing profits given the production technology. In our case there is a multi- stage production technology (depicted in figure 5). Firstly, there is the aggregation of domestic produced and imported goods into a composite, a part of which is used as intermediate inputs. On the other side, primary factors are aggregated into the value added component. Finally, in the last step value added and intermediates are used to obtain the final production. At each stage, the aggregating function is a CES function: there is a certain elasticity of substitution between inputs. In our case we suppose at the top level a Leontief function (a particular CES with elasticity equal zero), then a CES function with elasticity equal 0.5 in value added composition[107].

In profit maximization, producers decide to use primary factors up to when their wages equal their marginal productivity. As previously described, the “Bastard Keynesian” model does not differ in the productive side respect to the Neoclassical model. As Lofgren, Harris and

[107] The parameter choice is exhaustively treated in chapter 5.

Robinson (2002) state: “*it is possible to assume that a factor is unemployed […]the supply variable is flexed (or endogenized)*”.

Figure 5: The production technology



Source: ***Lofgren, Harris, Robinson (2002)***

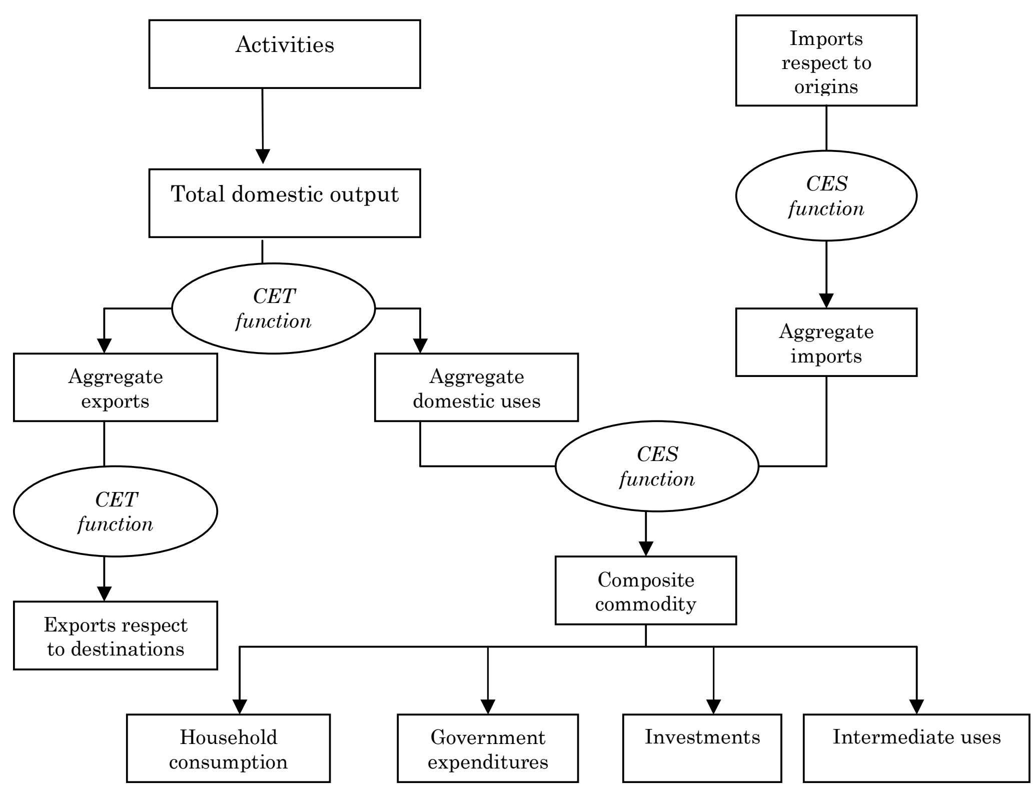
In the previous paragraph we have referred to a composite supply, here we clarify this concept. In the figure above there is the last step where domestic uses and imported goods boil down to create the composite supply. Figure 6 shows the physical flow of commodities in the market. Domestic output may be sold in the formal market or self- consumed[108]. Supposing it is marketed, producers have to allocate it between exports and domestic uses. The underlying assumption is that suppliers want to maximize sales revenue subject to the imperfect transformability between the two uses. Mathematically this is captured by a CET function. Unitary export prices are expressed in domestic currency and gross of unitary transaction costs (at the border, eventually, but this is not our case, the price is adjusted for export taxes). If the commodity, instead, is domestically sold, its unitary price is equal to the domestic purchaser price less transactions costs. On the basis of these two prices producers decide where to sell their production.

Final demand may be satisfied solely by domestic production, but, in an open economy, it is more likely to assume that the country imports some goods. So, when final consumers take decisions on their spending they think in terms of a composite bowl made up by domestic and

[108] In the implementation of the model we assume two distinct productive activities for home-consumption and marketed commodities according to the assumptions and observations described and analysed in chapter 5.

imported goods. However, the composition of the bowl is based on the concept of imperfect substitutability between domestic and imported goods. It is captured by a CES function and the decision is taken respect to relative prices. The import prices paid by domestic demanders includes both import taxes (and indirect taxes whose tax base is total imports) and the costs of transaction services per import unit (to move commodities from borders to the final demanders). Domestic suppliers, instead, receive a price net of transaction costs which are, however, paid by domestic consumers (they pay to move commodities from suppliers to them).

Figure 6: Flows of commodities in the markets



In this CGE model, institutions are represented by households, enterprises, the government, and the rest of the World.

Households (disaggregated into rural and urban households as in the SAM) receive income from factors of production. Income from labour is subject to the choice of *km* and it is directly given, capital income, instead, is indirectly received via the enterprises[109]. Then, their income is composed also of transfers from other institutions, i.e. from government, and the rest of the World. Income is used to pay direct taxes, save, and consume. In this model direct tax rate is

[109] We have to remember that a part of what enter the capital account is land. It is directly given to rural households while capital, in a strict sense, is received by households via the enterprises.

assumed to be fixed for each household[110] and we suppose a fixed share of private savings respect to total private savings. Consumption is a residual after taxes and savings. It covers marketed, purchased at market prices (i.e. gross of commodity taxes, and transaction costs) and home commodities evaluated at producer price. Household consumption is allocated across different commodities (both marketed and home commodities).

Private enterprises receive, as already described, capital income besides transfers from other institutions (i.e. the government). Their income is allocated to direct taxes (with a fixed tax rate), savings (in fixed proportion respect total private savings), and transfers to other institutions (i.e. the government, and the rest of the World). They do not consume.

The government collects taxes, and receives transfers from other institutions. Its income is used to purchase commodities for its consumption and for transfers to other institutions. The behaviour of government consumption and savings depends upon the choice of closure rule.

The final institution is the rest of the World. As noted, transfers from this institution to the others are fixed in foreign currency. Foreign savings is the difference between foreign currency spending and receipts. However, also in this case the closure rule choice affects its behaviour.

IV. The MCP format of the “Bastard Keynesian”

The MCP format of this model does not greatly differ from the one presented for the Neoclassical model. Here, we will only focus on the different relationships.

As pointed out, differences arises in the specification of the labour market, so only the labour market clearing condition, the income balance condition for households, and government revenue from direct taxes changes.

For the first relation there is no change in the demand for labour (once again it is derived from the Sheperd’s lemma) but this time the labour supply depends upon *km*. *Ls0* is not fixed but, as already described, it may change as a response in aggregate demand.

Formally equation (14) in the previous chapter becomes:

$$km \cdot Ls0 = sum\left(s, va(s) \cdot \left(\frac{pf("k")}{pf("l")} \right)^{(1-va(s))} \cdot Y(s) \right) + sum\left(is, va(is) \cdot \left(\frac{pf("k")}{pf("l")} \right)^{(1-va(is))} \cdot Y(is) \right) \qquad (14BK)$$

The income balance condition for household (*h*) takes into account the fact that labour supply is now endogenized and that its amount may vary. Formally, we highlight the amount

[110] With this assumption, we suppose the government has not the power to change instantaneously tax rates as a policy instrument to compensate declines in indirect taxation.

of direct taxes paid for each income receipt. In this way we make evident the relationships between labour supply and tax payments:

$$\begin{aligned}RA(h) = (1 - th(h)) \cdot ((pf("l") \cdot hl(h) \cdot km) + pe \cdot he(h) + ptran \cdot SOCTRANSF(h) + pfx \cdot hx(h) \\ - alphaz(h) \cdot pinv \cdot INV)\end{aligned} \tag{21BK}$$

Government balance becomes:

$$\begin{aligned}&GOV = sum(h,(th(h) \cdot (pf("l") \cdot hl(h) \cdot km) + pe \cdot he(h) + ptran \cdot SOCTRANSF(h) + pfx \cdot hx(h)) \\ &+ DETAX - \left(sum(h, ptran \cdot SOCTRANSF(h))\right) - ptran \cdot SOCTRS + \\ &\left(sum(s,tm(s) \cdot pfx \cdot m0(s) \cdot M(s)\right) + \left(sum(s,itx(s) \cdot pa(s) \cdot a0(s) \cdot A(s))\right) \\ &+ \left(sum(s,vtx(s) \cdot pa(s) \cdot a0(s) \cdot A(s))\right) - \left(sum(s,atx(s) \cdot (pd(s) \cdot dm(s) + px(s) \cdot x0(s))\right) \\ &- \left(sum(s,rebt(s) \cdot pa(s) \cdot sum(g,ca(g,s)))\right) - pinv \cdot gsv0\end{aligned} \tag{23BK}$$

where the first element in the right hand- side is households direct tax out of labour income.

Finally, as already said, to switch from the Neoclassical to the “Bastard Keynesian” model we need the introduction of a scaling parameter, *km*, and its associated condition. We have already detected why this constraint binds aggregate private consumption and its role in the stability of the system. Here we solely write it down in a formal way:

$$\begin{aligned}sum(h,RA(h)) = sum(h,(1 - sr(h)) \cdot (1 - th(h)) \cdot (pf("l") \cdot hl(h) \cdot km + pe \cdot he(h) + \\ + ptran \cdot SOCTRANSF(h) + pfx \cdot hx(h))\end{aligned} \tag{BK CONSTRAINT}$$

It is worthy noting that if we fix *km* at unity our model returns to be a Neoclassical model exactly as the one presented in chapter 5. According to this statement, a question arises: may the Neoclassical model be interpreted as a special case of the “Bastard Keynesian” model? In our opinion yes. Supposing that the scaling parameter value is fixed equal to one is a special case because in the BK model it may have each value. We may represent the relationship between them assuming that the Neoclassical class of model is a subset of the broader and more generally set of “Bastard Keynesian” models, which in turns are a subset of the larger Keynesian family.

V. The closure rules

Similarly to what has been done in chapter 5, here we summarize the closure options we implement in our model. When we have described how *km* works, we have briefly explained the role of government spending and how it is a likely demand injection which could stimulate activities to hire extra workers. So, its role is different respect to the Neoclassical model and we suppose that the government closure affects both the saving- investment balance (as in the Neoclassical model) and the employment level. Similarly, foreign savings may be a source of new demand. Therefore its treatment is fundamental. In the table below we sum up the different closures. All of them present endogenous labour supply (because of *km*) and fixed investment level. Moreover, tax and savings rates are fixed as capital supply.

Literature reference for this class of model is Taylor, von Arnim (2006) and subsequents. What we call here “Bastard Keynesian” benchmark is exactly the BK closure in their papers.

They call it “*absorption closure*” and the reason is evident analysing causality assumptions. Taxes on household are held fixed, so that a tariff cut causes a revenue reduction and government deficit adjusts to finance expenditures. As they state: “*Government borrowing moves up and down in any functioning economy, even when it is hypothetically constrained by IMF conditionalities or Maastricht accords. Letting it play its proper role in a model simulation is simple common sense*”. Leaving the current account (foreign savings) to move “*permits macroeconomic absorption of shifting import and export quantities, instead of an “elastic” adjustment of trade flows to international prices*”.

Table 48: The closure rules

	“Bastard Keynesian” benchmark	**BK Closure 1**	**BK Closure 2**	**BK Closure 3**
Potential macro closure variables				
Exchange rate				
Investment	Fixed	Fixed	Fixed	Fixed
Foreign savings			Fixed	Fixed
Labour supply				
Capital supply	Fixed	Fixed	Fixed	Fixed
Government demand	Fixed		Fixed	
Saving rate	Fixed	Fixed	Fixed	Fixed
Tax rate	Fixed	Fixed	Fixed	Fixed
Wage rate				

The other closures want to analyze the effects of changing one specific assumption each time. We want to detect if the outcomes in a demand driven system are of the same sign independently of the closure rule or if a specific hypothesis on government or foreign savings may reverse the effects of the policy shock. Therefore, we will maintain endogenous foreign savings but we suppose a fixed government savings (*BK closure 1*), or suppose exogenous foreign exchange rate related to either with fixed public expenditures or fixed government deficit (*BK closure 2* and *BK closure 3*, respectively).

After having summed up the different closures and having clarified our aims, we should describe how these closures may be implemented. Similarly to what has been done with the

Keynesian multiplier, adopted to endogenize labour supply, there are other two scaling parameters to consider: *fsav*, and *gsav*. Both of them should be applied when foreign savings and government savings, respectively, want to be endogenized. Let us start investigate the parameter on foreign savings, *fsav*[111]. It represents an activity level for this variable. In the benchmark its value is one. Then it changes according to the associated variable. It shows the percentage increase (or decrease) in foreign savings. The associated complementarity condition is built as the difference between current account and capital account according to the accounting definition of the scaled variable[112]. Formally:

$$fsav \cdot fsv0 \cdot pfx = pfx \cdot (sum(s, m0(s) \cdot M(s)) - (sum(s, xo(s) \cdot X(s))) + (ex - sum(h, hx(h)))) \tag{FSAV}$$

Because of the construction of the model (see section III) the capital account is fixed in foreign currency so that changes in total available foreign savings reflect only changes in the trade balance. In fact, as Taylor and von Arnim point out foreign savings are mainly a consequence of commodity trade.

A similar reasoning may be applied for the scaling parameter *gsav*. Also in this case it is a level and directly shows the percentage change in government savings. This time the related complementarity condition has at least two different functional forms. The first is as the one for *fsav* and expresses public deficit as the residual between total tax revenue and commodity consumption, according to the accounting rule. We can otherwise write the constraint in terms of government consumption. Deciding a closure rule for government means deciding which of the two variables, saving and consumption, is exogenous. Obviously supposing endogenous savings means assuming fixed government expenditures and the other way round. So we may say that endogenous government savings adjusts such that the institution's real consumption is at its benchmark level. Formally:

[111] Here we limit our analysis in the simplest case when the rest of the world is identified into a unique region. In our finale model, however, we present three distinct regions. In that case the issue becomes a bit more complex. We have not only one auxiliary variable *fsav* but as many as the foreign areas (in our case three). The reason is intuitive: each trading partners presents a different quantity of imports and exports and therefore a different current account. On this basis they free different quantities of savings and a trade liberalization process like the one here studied, with differentiated treatments, has different effect on each region.

[112] However it is likely another formal presentation of the condition. Similarly to what happens for *gsav*, we may express the constraint in terms of real consumption and real demand. Foreigners' real demand equals real exports at final prices: $FOREIGN / pfx = sum(s, (x0(s) \cdot X(s)))$

$$govt / pg = sum(s, gd0(s)) \qquad \text{(GSAV)}$$

Fixing one of the scaling parameters (or all of them) at unity means assuming either one variable or both of them as exogenous.

VI. Our simulations' results

Our analysis focuses on the short- run effects of this tariff phase- out process, so we concentrate on immediate effects we perform an analysis through the different steps in the tariff cut. We may say how macro- aggregates act immediately step by step.

a) The benchmark BK closure

In this closure we suppose endogenous government and foreign savings. In the first step, when only agricultural products from RSA are liberalized, there is no change in the employment level (table 50). Since labour demand is strictly connected to production, also total production does not change. The reduction in tariffs displaced imports against the ones from the rest of the World while there is no evident advantage in tariff cut which stimulate imports from RSA that are fixed at the benchmark level, as shown in table 51.

The reduction in tax revenue, due to a tariff cut, affects only the government account. Because of the closure rule, government saving adjusts to close the gap between tax revenue and the fixed expenditures. Gains are mainly for households whose consumer price index declines because now agricultural products are cheaper. This stimulate private consumption which increases both for urban and rural households.

Because of the contemporaneous decline in private savings (because of higher consumption levels) and the broader government deficit nominal and real investments decline.

In step 2 we may observe the first effects on labour employment, which declines by 0.02 percentage points. This means that the tariff cut has a contractionary effects on total employment and production. At least if we consider formal production. Generally, informal production increases in each sector by the same percentage (+ 0.22 percent) because of the positive effects of the increase in labour remuneration. Formal production, instead, has not a unique trend across activities. The primary sector increases its production level, while the other sectors worsen their production. Similarly, labour employment in informal sectors increases but it is more than offset by the decline in formal employment.

In the external sector both imports and exports decline. The former diminish more than the latter. The only except is the trade with the other SADC member states whose imports decline more than exports. Because of the reduction in domestic production and imported goods, total internal Armington supply declines (-0.06 percent). By sector, in this stage only the agricultural sector gains from the tariff liberalization. The reason is quite intuitive considering the tariff phase- out. Up to this point, Mozambique has reduced drastically only tariffs on agricultural products.

The lower supply level combined with the increase in labour remuneration (+ 0.04 percent), because now labour is the scarce productive factors, leads to higher real private consumption and lower real investments (-1.06 percent). An interesting aspect to detect is that the decline in employment level is completely offset by the increase in wages which ultimately allows households to earn a higher total income.

The effects on the macro aggregates are negative. Government savings worsen and increase by 22.37 percent. We can immediately declare that it is a negative phenomenon because at the benchmark level government has negative savings, this means it worsens its financial position. This time also foreign savings move. They change between 0.21 and 0.23 percent respect to the region. It is worthy to note that foreign savings from RoSADC, already negative in the benchmark, worsen. All these data are shown in table 52.

When the tariff cut is completed, the effects are the same already explained the only difference is in numbers. Final employment is declined by 0.04 percent and formal production declines from 0.08 percent, in the trade sector, to 0.30 percent, in the mining sector. Tariff reduction has positive spillovers only on the agricultural sector and the informal activities (but here the reason is the stimulus to consumption because of the reduction in consumer prices). Government savings diminishes by more than a half (- 55.64 percent) and increases in foreign savings have the same magnitudes.

Table 49: Short- run benchmark BK CGE model results on real production

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production
Agriculture	10.0430	11.6010	-	-	+0.07	+0.22	+0.17	+0.54
Mining	0.7680	-	-	-	-0.12	-	-0.30	-
Manufacturing	37.6390	9.7380	-	-	-0.11	+0.22	-0.28	+0.54
Trade	21.0340	-	-	-	-0.03	-	-0.08	-
Services	78.8700	4.8850	-	-	-0.08	+0.22	-0.19	+0.54

Table 50: Short- run benchmark BK CGE model results on employment

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment
Agriculture	6.4690	7.4270	-	-	+0.11	+0.20	+0.14	+0.50
Mining	0.0730	-	-	-	-0.14	-	-0.41	-
Manufacturing	7.5290	1.8860	-	-	-0.15	+0.18	-0.36	+0.46
Trade	6.1750	-	-	-	-0.07	-	-0.16	-
Services	27.3780	4.8850	-	-	-0.10	+0.22	-0.25	+0.54

Source: ***Static CGE model results***

Note: features in the base run are 10^3 Billion MT

Table 51: Short-run benchmark BK CGE model results on real foreign trade

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Rest of world- ROW	19.5420	41.2920	-1e[3]	-5e[4]	-0.16	-0.08	-0.40	-0.19
Republic of South Africa- RSA	8.1200	10.2310	-	-	-0.10	-0.08	-0.25	-0.20
Rest of the SADC area- ROSADC	2.8640	1.1090	-	-	-0.03	-0.08	-0.08	-0.20

Table 52: Short- run effects of the BK benchmark CGE model on macro- aggregates

	Base run	Percentage change respect the base run		
		1st step	2nd step	3rd step
km	1	-	-0.02	-0.04
gsav	1	+0.12	+22.37	+55.64
fsav- ROW	1	-	+0.21	+0.53
fsav- RSA	1	-	+0.23	+0.55
fsav- ROSADC	1	-	+0.23	+0.59

Source: ***Static CGE model results***

Note: features in the base run are 10^3 Billion MT

b) The BK closure 1

Respect to the previous closure, here we suppose fixed government savings. In this way we want to detect whether there is the same behaviour in key elements such as production, employment and foreign trade in the short- run. Moreover, we are interested in looking at the relationship between saving sources (especially we want to see if government and foreign savings are interchangeable) and investment demand. In other words, we investigate if this closure allows to maintain at least the same investment demand level of the *BK benchmark* so that we may say that a change in one institution’s savings may be completely offset by a change in another institutions’ saving source.

As in *BK benchmark*, the first stage in tariff liberalization has no remarkable effects on production and employment levels. This is evident if we think of the phase- out: there is a 20 percent reduction in agricultural products from RSA and RoSADC. It represents near 1 percent of total imports. The only immediate effect is a reduction in the aggregate supply price for this class of products, that stimulates private consumption. Although we are considering minimal changes in quantities, there is a decline in imports from ROW which causes a decline in Armington supply. Because the consumption component increases, both government expenditures and investments slightly declines.

In this phase our macro- aggregates are fixed at the benchmark level.

When tariffs are partially cut on agricultural and manufacturing commodities, effects on the Mozambican economy becomes more robust. Formal total production declines led by the marked decline in services (-0.22 percent). In fact, the other sectors show positive performances (more evident in the agricultural and trade sectors with increases of 0.17 and 0.16 percent, respectively). Labour employment follows the same trend so that the decline in employment in the service sector counterbalances the higher employment level of the other sectors. This makes aggregate *km* to fall by 0.02 percentage points.

Because now labour is the relative scarce factor its wage increases (+ 0.01 percent) while profit rate declines (-0.05 percent). The declines in capital remuneration pushes downward the distributed profit rents which however do not decline by the same percentage (only -0.02 percent).

Respect to foreign trade, there is an increase in capital inflows from abroad, mainly from RSA since the tariff cut affects mostly imports from this country which is the major trading partner within SADC. Imports and exports from the rest of the World in this step are unaffected by the policy, while evidently it affects intra- SADC trade. There is a more pronounced effect on imports (directly affected by the policy) than on exports which however increase. Higher imports cause total domestic supply to increase lowering the related price.

This stimulates private consumption. Rural and urban households present different patterns: the former consume only 0.2 percent more and the latter 0.35. This difference may be explained by the composition of the consumption basket. Rural households buy both composite and informal goods, while urban households buy only in the formal market. Composite formal prices decline more than the informal sector producer prices. This leads to different consumption prices which fall by 0.21 and 0.35 percent for rural and urban households, respectively. Since urban consumption basket is composed only by market- commodities the price fall is not counterbalanced by the informal component.

As in the first step government consumption declines, because of the public sector’s closure rule, by 2.2 percent. On the contrary, investments slightly increase (+ 0.22 percent).

When intra- SADC trade is completely liberalized, the trend already analysed in the second stage is reinforced. Labour employment lowers again (-0.04 percent) and, because of the closure rule with fixed government savings, foreign capital inflows grow too, especially respect to South Africa (table 56). Demand components are divided between increased and decreased ones; namely both rural and urban private consumption get higher (+ 0.50 and + 0.86 percent respectively), government expenditures drastically decline (-5.4 percent) while real investments increase by 0.56 percent.

Table 53: Short- run "*BK closure 1*" CGE model results on real production

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production
Agriculture	10.0430	11.6010	$9e^5$	$2e^3$	0.17	0.20	0.42	0.50
Mining	0.7680	-	-	-	0.09	-	0.23	-
Manufacturing	37.6390	9.7380	$3e^4$	$1e^3$	0.09	0.20	0.23	0.50
Trade	21.0340	-	$9e^4$	-	0.16	-	0.41	-
Services	78.8700	4.8850	$-1e^3$	$2e^3$	-0.22	0.20	-0.55	0.50

Table 54: Short- run "*BK closure 1*" CGE model results on employment

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment
Agriculture	6.4690	7.4270	$1e^3$	$1e^3$	0.16	0.19	0.41	0.48
Mining	0.0730	-	-	-	0.13	-	0.13	-
Manufacturing	7.5290	1.8860	-	-	0.08	0.18	0.20	0.47
Trade	6.1750	-	-	-	0.15	-	0.38	-
Services	27.3780	4.8850	$-1e^3$	$2e^3$	-0.23	0.20	-0.58	0.50

Source: *Static CGE model results*

Note: features in the base run are 10^3 Billion MT

Table 55: Short-run “*BK closure 1*” CGE model results on real foreign trade

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Rest of world- ROW	19.5420	41.2920	-	$-2e^{4}$	$9e^{3}$	$4e^{3}$	0.02	0.01
Republic of South Africa- RSA	8.1200	10.2310	$1e^{3}$	-	0.14	0.11	0.35	0.28
Rest of the SADC area- ROSADC	2.8640	1.1090	-	-	0.02	0.13	0.12	0.31

Table 56: Short- run effects of the “*BK closure 1*” model on macro- aggregates

	Base run	Percentage change respect the base run		
		1st step	2nd step	3rd step
km	1	-	-0.02	-0.04
gsav	1	-	-	-
fsav- ROW	1	-	0.23	0.59
fsav- RSA	1	-	0.30	0.70
fsav- ROSADC	1	-	0.28	0.76

Source: ***Static CGE model results***

Note: features in the base run are 10^3 Billion MT

c) The BK closure 2

In this closure we suppose that foreign savings are fixed while public deficit is allowed to move and balances the saving- investment account. In the short- run, trade liberalization has a negative impact on labour employment which reduces by 0.02 percent in the second phase and 0.04 percent in the third one. Government savings deteriorate too. At the end of the process it has increased by 56.14 percent.

Analysing data in table 57, we note that domestic production gradually increases only in the agricultural sector, while it severely falls in the service and manufacturing ones. The same trend is evident in the employment data. Only in the primary sector labour is more employed while all the other sectors face declines. Informal production, instead, increases independently of the sector because it is stimulated by the higher rural incomes and consequently the higher demand.

Respect to foreign trade, we have supposed fixed capital inflows. This means that changes in imports and exports counterbalance each other in order to maintain stable the current account. According to this closure, the SADC free trade area diverts trade for the Mozambican economy. This means that because of the lower tariff rates respect to South Africa and the rest of SADC, imports from these regions have a comparative advantages because of their lower prices. However, according to simulation results, imports from these regions decline as well. In details, while imports from the rest of the World fall for each sector, within SADC members there is an increase in agricultural goods trade. The worst performance is in the manufacturing commodities trade which looses positions respect all trading partners. Relatively, the fall down inside the SADC region is partially mitigated by the good performance in the agricultural sector.

The same situation may be observed in the total Armington supply which increases only in the primary sector. The marketed prices declines and this fact particularly stimulates private consumption for urban households who consume a higher fraction of these goods respect to rural families. Urban living costs fall by 0.84 percent while in the rural area only by 0.5 percent.

Because of fixed government expenditures and the increasing consumption components, investments dramatically fall. They reduce by 3.15 percent.

As already said, labour becomes the scarcer factor, so that its remuneration increases more than proportionally, so that at the end of the liberalization process it is 0.10 percent higher. Although profit rate gets higher, the price of distributed profits decline and this partly offsets the increase in labour income for households. This mainly affects urban households (who only hold distributed profits). However they have a higher percentage increase in their consumption respect to rural households.

Table 57: Short- run “*BK closure 2*” CGE model results on real production

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production
Agriculture	10.0430	11.6010	-	$2e^{3}$	0.12	0.21	0.31	0.51
Mining	0.7680	-	-	-	-0.08	-	-0.18	-
Manufacturing	37.6390	9.7380	$-8e^{4}$	$1e^{3}$	-0.06	0.21	-0.16	0.51
Trade	21.0340	-	-	-	-0.05	-	-0.13	-
Services	78.8700	4.8850	$-4e^{4}$	$2e^{3}$	-0.09	0.21	-0.23	0.51

Table 58: Short- run “*BK closure 2*” CGE model results on employment

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment
Agriculture	6.4690	7.4270	-	$1e^{3}$	0.11	0.19	0.27	0.48
Mining	0.0730	-	-	-	-0.14	-	-0.27	-
Manufacturing	7.5290	1.8860	$-1e^{3}$	-	-0.1	0.17	-0.24	0.43
Trade	6.1750	-	-	-	-0.08	-	-0.21	-
Services	27.3780	4.8850	$-4e^{4}$	$2e^{3}$	-0.12	0.21	-0.29	0.51

Table 59: Short-run “*BK closure 2*” CGE model results on real foreign trade

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Rest of world- ROW	19.5420	41.2920	$-1e^{3}$	$-2e^{4}$	0.05	-0.11	0.14	-0.28
Republic of South Africa- RSA	8.1200	10.2310	-	-	$-1e^{3}$	-0.11	$-1e^{3}$	-0.29
Rest of the SADC area- ROSADC	2.8640	1.1090	-	-	-0.18	-0.11	-0.45	-0.30

Table 60: Short- run effects of “*BK closure 2*” on macro- aggregates

	Base run	Percentage change respect the base run		
		1st step	2nd step	3rd step
km	1	-	-0.02	-0.04
gsav	1	0.12	22.58	56.14
fsav- ROW	1	-	-	-
fsav- RSA	1	-	-	-
fsav- ROSADC	1	-	-	-

Source: *Static CGE model results*

Note: features in the base run are 10^3 Billion MT

d) The BK closure 3

Under this closure both government deficit and foreign savings are fixed at their benchmark level. By construction households and enterprises devote a fixed share of savings respect total investments. It is likely to suppose that in this case real investment level should be stable at the benchmark level. In fact, looking at data, investments are not effected by the policy shock.

However, a labour multiplier acts and reduces labour supply by 0.03 percent. The model works as a textbook BK model when a supply side shock occurs, as the ones described in chapter 2. Throughout the whole liberalization process, benefits, in terms of domestic production, are widespread across sectors with the only exception of the service sector which drastically reduces its formal production (table 61). The general employment level, as already observed, declines due to the service sector performance. Its decline counterbalances the positive effects on employment in all the other sectors.

Foreign trade is affected by the shock. As predictable, imports from SADC countries are preferred so that they increase both from South Africa and the rest of the SADC members. Meanwhile Mozambique reduces its imports from the rest of the World. This behaviour is coherent with the traditional interpretation of a tariff cut: now RSA and RoSADC have competitive advantages, therefore Mozambique imports more from those origins. Exports, instead, do not follow the same trend. They increases respect to South Africa but surprisingly also respect to the rest of the World. Exports to other SADC member states declines[113]. For the first time this closure causes a different behaviour in foreign exchange rate. Under the other closures they diminish respect to each trading partner. Here, foreign exchange rate respect the rest of the World and South Africa increases while only for the rest of the SADC members it declines.

As usual, households have advantages from the tariff cut because of the lower market prices. For this reason, rural households, spending a smaller fraction in marketed commodities have a lower increase in consumption demand respect to urban households.

[113] We have to clarify a concept both in this closure and in the previous one. Here we assume fixed foreign savings. By default, this is the option in MPSGE but it does not consider foreign savings from different countries. So in these simulations it is assumed that foreign savings is fixed in aggregate terms.

Table 61: Short- run “*BK closure 3*” CGE model results on production

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production	Formal production	Informal production
Agriculture	10.0430	11.6010	$9e^{4}$	$2e^{3}$	0.23	0.19	0.58	0.46
Mining	0.7680	-	-	-	0.14	-	0.36	-
Manufacturing	37.6390	9.7380	$2e^{4}$	$1e^{3}$	0.15	0.19	0.38	0.46
Trade	21.0340	-	$9e^{4}$	-	0.14	-	0.36	-
Services	78.8700	4.8850	$-1e^{3}$	$2e^{3}$	-0.24	0.19	-0.60	0.46

Table 62: Short- run “*BK closure 3*” CGE model results on employment

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment	Formal labour employment	Informal labour employment
Agriculture	6.4690	7.4270	$1e^{3}$	$1e^{3}$	0.23	0.18	0.56	0.45
Mining	0.0730	-	-	-	0.14	-	0.27	-
Manufacturing	7.5290	1.8860	-	-	0.14	0.17	0.35	0.43
Trade	6.1750	-	-	-	0.13	-	0.33	-
Services	27.3780	4.8850	$-1e^{3}$	$2e^{3}$	-0.25	0.19	-0.62	0.46

Source: *Static CGE model results*

Note: features in the base run are 10^3 Billion MT

Table 63: Short-run "*BK closure 3*" CGE model results on foreign trade

	Base run		Percentage change respect the base run					
			1st step		2nd step		3rd step	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Rest of world- ROW	19.5420	41.2920	$-5e^{4}$	-	0.25	-0.03	0.62	-0.08
Republic of South Africa- RSA	8.1200	10.2310	$1e^{3}$	$9e^{4}$	0.29	0.07	0.73	0.19
Rest of the SADC area- ROSADC	2.8640	1.1090	-	-	-0.12	0.09	-0.32	0.20

Table 64: Short- run effects of "*BK closure 3*" on macro- aggregates

	Base run	Percentage change respect the base run		
		1st step	2nd step	3rd step
km	1	-	-0.01	-0.04
gsav	1	-	-	-
fsav- ROW	1	-	-	-
fsav- RSA	1	-	-	-
fsav- ROSADC	1	-	-	-

Source: *Static CGE model results*

Note: features in the base run are 10^3 Billion MT

VII. Concluding remarks

This chapter has presented a different framework to analyse the impact of a trade liberalization process. Conversely to chapter 5, this is a demand- driven model where labour supply is endogenized. This elements allows to study the employment effects of the policy shock. In the Neoclassical case, as already explained, the CGE illustrates only the "usual" consequences of a price reduction (led by lower tariffs) in the supply side. Predictably, the process has positive effects since we consider that a reduction in final prices stimulates an increase in consumption without affecting both capital and labour employment, because of the full employment assumption. In this BK model, instead, we may answer other questions that usually arise during a liberalization process such as: supposing the country loses its comparative advantages in the production of one good, is there not only a change between sectoral employment levels but also a change in the general employment level?

According to the IFPRI model the answer is no. A change in labour employment levels may occurs only at the sectoral level. Considering the whole economy, total labour employment is fixed at its benchmark level. Obviously, this supposition enforces the concept of "a liberalization process without loses but only gains" where people always have a work and they may benefit from the price reduction.

Here instead this is not true. We have definitely demonstrated that, although changes in the model closures, the SADC trade liberalization will reduce employment levels (-0.04 percent). However this analysis regards only short- run effects. In the medium- to long- run according to a steady state model, employment will increase (between 0.03 and 0.04 percent), coherently with mainstream macroeconomics.

The "Bastard Keynesian" model allows to capture many salient features in the liberalization process, i.e. direct effects of the price reduction, immediate effects on the public budget, and the innovative element of the effects on labour employment.

7. The SADC Trade Liberalisation in a Demand- driven System: The Post- Keynesian/ Structuralist Model

An alternative approach to study the Mozambican participation into SADC is a structuralist CGE model. Starting from some Keynesian propositions, they move further to analyze the structure of the economic system as Baghirathan R. et al. (2004) states: “[…]*concentrated on structure in the sense of analyzing economic issues within a framework of institutions and agents interacting with each other through mechanisms that themselves complete and make the society a sustainable system*”. Traces of this theory may be seen trough out the whole 20th century. Its evolution passes through at least two main phases: early Structuralism and late Structuralism. The former focused on “r*igidities and frictions in local economies*”; the latter, instead, accounts “*for macro-foundations of behavior*” and “*global foundations that is the constraints the evolution of the global system itself imposes on the players*” (Gibson, 2002).

Early Structuralism was divided between Latin American, with a more economic perspective, and European Early Structuralism, which provided for philosophical and methodological bases. In other words, it was mainly a philosophical, sociological, and anthropological phenomenon, whose main representatives were Foucalt, Levi-Strauss, and Godelier. They stressed the role of empirical research in science and they formalized three concepts at the basis of the philosophical construction of the movement.

From an economic point of view, the seedbed of late Structuralism was the ECLA in Santiago, Chile under the guidance of Raoul Prebisch. These pioneers observed “*the nature of the problems facing small, low-income countries were fundamentally different from those of the larger, industrialized countries*” (Gibson, 2002). Nowadays, Structuralism is referred to the works of Lance Taylor and his followers who continues the research line of Prebisch and the pioneers.

In this context we introduce our empirical problem that is an in- depth study of the trade liberalization process in Mozambique. Already applied in the construction of a Neoclassical and a “Bastard Keynesian” model, we continue in our aim to find the better model to answer our question on the possibility of gains, losses, and their quantification. This time, we will apply a typical Structuralist/ Post- Keynesian model for open economies.

II. The structuralist theory

As previously cited, economic Structuralism grounded in the ECLA and its pioneers were Lewis, Prebisch, Singer, and Myrdal among the others. They developed a theory called "the Southern Cone". It was an approach that studied trade and its advantages in a global system, where he US and Europe were already industrialized and they attempted to block the efforts of Latin American countries to gain in the manufactured goods' trade. The strategy should be increasing returns to scale in capital and wage goods.

But, this has several implications: firstly, a non-competitive position in the majority of markets, then, the erection of trade barriers in the industrialized countries, and finally, a large dependence on imported capital goods. The interactions of these three elements caused the slow industrialization process in the post-war Third World. Formally this leads to "dual economy two gaps models", which capture the essential structure both of the domestic market (i.e. the presence of a dual economic structure) and of the international markets (i.e. a centre-periphery system of the World economy[114]).

The French pedagogue Piaget identified three major themes in the structuralist method that are nowadays translated in an economic perspective. The first concept is "wholeness[115]". It is referred both to the scope and to the method of investigation. Traditionally, Structuralism debates on social and political institutions, and their dynamics. Undoubtedly, this analysis may not be focused on a system isolated from he whole World system. In other words, context is a main ingredient. From an economic point of view, this concept justifies the "North- South models" where growth and distribution in the two World's poles are affected by each other. Wholeness is also applied in the investigation on agents and institutions: there is no assumption of "sharing a common preference ordering" among agents, which are uniform, small, or price-takers. Instead, there is a wide variety of social classes with different behaviors.

[114] In a Neoclassical model there is a different modelling of internal and external economy. The central variable is the endowment of capital per unit of labour, and therefore labour productivity. Income per capita in each country increases by the same means and independently. The external context, instead, is the extrapolation of the mechanisms ruling perfect competition. This means each country, advanced and developing ones, pursues its own interest exploiting its comparative advantages.

[115] Wholeness is a common feature of Ricardo and Marx's works. For instance, Ricardo's analysis of distributive conflicts between landlords and peasants, industrialists and workers may be interpreted as phenomenon affecting the entire economy (Baghirathan R. *et al.*, 2004).

Another concept is "transformation". Gibson (2002) tries to explain this concept using the example of a Markov chain. In each time a system *X* depends on a transformational matrix *M* according to the rule:

$$X_t = MX_{t-1}$$

where (*t*-1) is the immediately previous period.

From a Structuralist perspective, *M* is inadequate since it is not time dependent and it is a matrix. This system could generate steady states if *X* is an eigenvector of *M*. In this way the system becomes non-transformational. This kind of analysis is irrelevant for Structuralist purposes, since long- run steady- state dynamic models are static in nature and not interested in capturing changes over time. Instability, instead, may be more interesting. It means some "givens", such as institutional parameters, change due to an economic phenomenon. For this reason, Structuralist models have a medium- run horizon (3- 10 years) to capture transformation and not to contradict the wholeness principle[116].

Moreover, transformation could be applied in studying the concept of technology. Along Schumpeterian lines technology is by definition a continuous transformation process through time. To stress this point, Schumpeter himself recognized in the "institutionalization of innovative process" the cause of the slowdown of technological advance.

Finally, the last principle is "self- regulation", that may be summed up in this way "*no external forces drive the system along a determinate path*".

Structuralist models are based on some Keynesian lines. Firstly, they accept the idea that effective demand affects output determination: "*The reconciliation of the identity between saving and investment with the apparent "free- will" of the individual to save what he chooses irrespective of what he or others may be investing, essentially depends on saving being, like spending, a two- sided affair. For although the amount of his own saving is unlikely to have any significant influence on his own income, the reactions of his consumption on the incomes of others makes it impossible for all individuals simultaneously to save any given sums. Every such attempt to save more by reducing consumption will so affect incomes that the attempt necessarily defeats itself*[117]" (the so- called "paradox of thrift") (Keynes, 1936). Moreover, they accept the saving- investments relation which goes from exogenous real investment to savings

[116] In this case it is not a spatial wholeness but a kind of "wholeness over time".

[117] This quotation is an example of the heterodox idea on how macro level economic behaviour derives from micro interactions.

and the inefficacy of wage cutting in stimulating income growth. The link between macro aggregates and the aggregate demand level is a crucial variable: u. It is defined as "capacity utilization level" and, formally speaking, it is the ratio between the sectoral output X and the total sectoral capital stock K. This concept implies two theories: one of the production function and one of aggregate demand effects. The former is the exploitation of the Leontief production function in the Structuralist theory. This means the factors of production (capital in this specific context, but the same reasoning could be applied for labor) is employed in fixed proportions respect to the level of output. It is an accommodating variable which changes in response to movements in aggregate demand.

The Structuralist economic theory differs from the Neoclassical one at least in five aspects: the production function and technique, the monetary phenomena, like inflation, distributive patterns, international trade and the macro causality among variables.

The production function, as previously described, is a Leontief production function where there is no possibility of substitutability between factors. In fact, labor and capital are employed in fixed proportions for each sectoral output level. Moreover, as cited above, production is tightly linked to the concept of technological innovation along Schumpeterian lines. So, the production function in each time is nothing else than the "state of the art" in that time. In a dynamic perspective it may change and reaches new frontiers with different combinations of capital and labor. Neoclassical functions, instead, exploit a certain degree of substitutability (the isoquant curve) as it is likely to have the same level of output choosing a labor/ capital combination instead of another (see Varian, 1984).

Although for Neoclassicals money and monetary phenomena have no implication on the real side of the economy, Structuralist macroeconomics interprets these events as strongly dependent on the real side of the economy (i.e. inflation). Both the doctrines recognize the role of social conflicts on inflation but in two different contexts. The orthodox theory of inflation interprets conflict claims as a pressure element through the political process on fiscal and monetary policies. Monetary policy, mainly, affects inflation and then, in an indirect way, conflict claims affect inflation. Structuralist point of view suppose a passive monetary policy, and directly conflicts affect inflation through different market powers that ultimately result on price formation and income distribution (Ros, 1989). Formally, the mechanism is the lagged wage indexation. Nominal wages are set in bargainings for the whole economy and they change at discrete time length. However, in that period inflation may change and erodes part of the purchasing power of workers. In this situation, obviously, workers claim for higher wages. This puts pressure on the price level since prices are formed as a mark- up rate over variable costs. And ultimately inflation speeds up. Moreover, Structuralists have two views of steady inflation: the inertial view and the conflict view. In the former distributional conflicts have no role in perpetuating inflation but the adaptive mechanism is the determination of the target real wage, or the desired real wage that guarantees a certain purchasing power. Aspirations are the elements that accelerate the inflation process. This theory explains better low and medium inflation processes.

Instead the latter gives a fundamental role to distributional conflicts not only as original inflationary pressure but also as factor of perpetuating it. The mechanism is an adaptation gap (between target and average real wage) that is usually present when workers' aspirations are not fully met.

According to Ros (1989), we may have a taxonomy of inflation models based on the market where there is disequilibrium (i.e. the commodity or the labor market), on which kind of adjustment mechanism (i.e. quantity or price adjustment) is employed, and on the dynamic of the disequilibrium (i.e. transitionary or permanent).

He recognizes four situation. The two extremes are the inertial inflation, where expectations and indexation play a role, the disequilibrium is only temporary, and the conflict inflation with its permanent disequilibrium. Then, he discusses two other intermediate situations, defined as Joan Robinson's "inflation barrier" and the Keynesian one. The former is characterized by a disequilibrium condition in the commodity market in a price-adjustment model, while the latter presents a persistent disequilibrium in the labor market. The two dynamics differ greatly. In the first case, workers defend their real wages and so profits and savings decrease. Investment could not be balanced and finally there is an excess investment demand. In the other one, instead, output is at full employment level, then increasing profit margins get savings higher. Obviously consumption declines. In this model inflation is driven by a disequilibrium between workers' aspirations and the real wage implied by firms' profit margins.

As described above, income distribution plays a crucial role in the economy and it is the mechanism through which the system changes. Although in the Neoclassical theory there is a well defined rule for distribution, since factors are paid according to their marginal productivity, in Structuralism nominal wages are set fixed institutionally across the economy. Functional distribution and effective demand jointly determine economic activity level. Moreover, according to the role of profits and wages inside the economy, we have two different regimes: a profit- or a wage- led system. This means the economy has a different reaction to a distribution change. Following Barbosa-Filho and Taylor (2003), the growth regime is evident if we study the effective demand schedule in a capacity utilization- wage share plane. A positive slope means it is a wage- led system. In this case, along to Keynesian ideas the originary force is the increase in the wage share. Since this class of models supposes higher workers' consumption than rentiers' one, this means an increase in demand and a higher level of capacity utilization. Assuming an investment function depending on an accelerator term (function of the capacity utilization level) and a profitability term (function of the actual profit share or profit rate) as in Marglin- Bhaduri (1989), the wage-led system faces a stronger accelerator response respect to the negative one on profitability. If the effective demand has a negative slope the system is profit- led. A higher profit share due to a redistribution towards rentiers stimulate the investment function in the profitability term more than the decrease in the accelerator term.

Describing a system as profit- or wage- led is a fundamental step in a Structuralist framework since it affects the outcomes of different policy choices. For instance, if a country faces an increase in its exports, the effects in the two systems will differ greatly. More exports due to an increased competitiveness in the international arena mean lower labor costs and a higher profit share. In a profit- led system this will stimulate growth. In the case of a wage-led system, instead, the same increase in exports means lower labor costs and a devaluation. But, this means real wages will be cut and the result will be an output contraction.

Since our aim is to study a liberalization process through a Structuralist model, it is useful to deeply discuss the international trade context. There is not a unique model to study it but a wide variety of models addressing different issues. We may look at employment and poverty issues through a "tradable/ non-tradable" model, or we may compare different countries and their interactions using a "North/South" model, or finally, we may analyze the relation between trade and growth in a Keleckian multi-sector model.

Instead of a Heckscher- Ohlin or a Ricardo- Viner trade model, most of the Structuralist scholars present international trade in terms of a "fix- price/ flex- price" model[118], although it is not implemented in CGE models[119].

They exploit a variety of market imperfections and rigidities as the context of imperfect competition in the productive sectors and the introduction of fixed capital and labor in the short run. It is worth consider the assumptions of this model. There are two kind of goods:

[118] The "fix- price/flex- price" model is employed in different context. Inside a country, it well depicts the dichotomy between agriculture and industry, then between sectors it is nothing else than the model we discuss in the text, and finally between nations in the World grouped into economic blocks it becomes a "North/ South" model.

[119] See Gunter et al. (2005), Taylor (1983, 1991b, 2001).

traded goods and non- traded goods. The former is mainly produced using skilled labor and capital while the latter with unskilled labor and capital.

Both of them acts as a monopolist and they decide a mark- up rate over variable costs (interpreted as imported intermediates and productivity level of unskilled labor). Then, traded goods price level is stable due to the stable mark- up and the relative output level is determined by effective demand. The non- traded goods market, instead, exhibits decreasing returns to labor. A higher output level is the result of a greater unskilled employment. However, firms decide to employ more workers only at a lower wage. In this way, the fundamental variable in the sector is the price- wage ratio that is free to move.

In this context it is possible to evaluate changes in the employment level in the two sectors and the poverty impact of trade liberalization. Typically, this model contradicts the traditional trade models: they focus on an increasing inequality between skilled and unskilled workers as a consequence of the workplace reorganization inside the traded- goods sector that after a current account liberalization competes with more convenient imports.

Another recurrent theme since the Latin scholars is the North- South trade model. The basic hypothesis is e differentiation among countries in the World system. The simplest textbook version, extensively and algebraically discussed in Taylor (1983), presents a three countries model: North, South, and a third country, whose behavior differs greatly from the other two. It sells intermediates to the North choosing the price at it own will. Then, the North presents a Keynesian growth where output level depends upon the aggregate demand[120]. Investment demand and saving supply are function of the local rate of profit. Obviously, the macroeconomic balance is obtained through the identity between savings and investments. But in this context the growth rate, the profit rate and the output level are determined only by domestic conditions. Moreover, the Engel elasticity of the North respect to the Southern exports is less than one.

A different situation characterized the South. Here, output is constrained by supply. In the labor market there is a labor surplus[121] that in the model is translated in a fixed real wage. Then, investments and growth are function of the available savings that is composed of both domestic saving and fixed capital inflows form the North in the short- run. Finally, the South is dependent on the Northern supply of capital goods.

The consequences of these assumptions are quite strong. Firstly, the system recognizes "*there are no enough degrees of freedom in the international system to allow the South to choose*

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[120] Moreover, in a Keynesian economy firms are on their labour demand curve and labour could be hired at the current nominal wage as it is necessary.

[121] In other words there is an infinitely elastic labour supply.

its own growth rate or terms of trade" (Taylor, 1983). This means that the Southern growth rate depends on the Northern conditions. Macroeconomic equilibrium depends on investments in the North and capital inflows. Then, changes in productivity reduce the demand in the North that faces a slower growth rate and consequently worse Southern terms of trade. To restore the aggregate demand, nominal wages should rise. As we have previously discussed, increases in nominal wages speed up inflation. Any inflationary process is beneficial to the South. Moreover, faster capital inflows are a great advantage for the Southern growth. This is the consequence of the basic assumptions of the Keynesian growth in the North while in the South there is a labor surplus and, therefore, capital inflows are necessary to shape saving supply in the South. Finally, a greater productivity in the South is negative for its own growth and its terms of trade depending on the hypothesis of a Northern Engel elasticity for consumption of Southern exports lower than one.

The last model we want to consider is a Kaleckian model where using Taylor's words: "*trade and industrial strategy should be designed to fit the structure and institutions of the economy at hand*" (Taylor, 1990b). This kind of model considers three markets, one for the home goods, one for exports, and the last one is the intermediates' sector. Each of them has fixed capital stock and has an independent investment demand. Then there are many differences among them. The home goods' sector acts with excess capacity utilization and a mark- up pricing rule while the export sector uses all the available sectoral capital stock acting at full capacity. Intermediates, instead, are a composite (formally a CES function) of domestic intermediates and tariff- ridden imported intermediates. As usual, consumption patterns differ among social classes and in the simplest case all wage income is devoted to consumption purposes while from profit income a fraction is saved. This consumption good is domestically produced.

Given these assumptions, growth induced by trade depends in the short run on changes in the sectoral profit rates that influence the investment functions and shifts in sectoral investments.

Macro causality means how variables inside a model are interrelated, which is the starting sector and how they interact. To focus on this aspect we may follow Taylor (1983,1991b). Causality is "*influenced by microeconomic detail*" (Taylor, 1991b). He defines "injections", that are elements which increases the aggregate demand and are predetermined variables (i.e. investments, exports, fiscal demand), and "leakages", that create savings supply (i.e. income, import, and output flows). So we can move from the former to the latter group through a change in income and wealth distribution. These macro adjustment processes are nothing else than the historical processes of capital accumulation, technical process, or the effect of exogenous shocks.

From a methodological aspect, a Structuralist model is based on the country's reality of a base year. So, National Accounts are boiled down into a SAM, which captures the primary distribution. What really matters is income distribution which, in turns, is affected by social conflicts among classes. Moreover, another startling feature is the presence of a financial sector inside the SAM itself.

Baghirathan R. et al. (2004) state "*Structuralism uses a mode of inference similar to that of abduction or retroduction. It starts with observed phenomenon, what is out there, and then works backward to a theory. The focus is not on prediction but description and explanation*". This means the SAM is the starting point but it is only numbers, then the modeler looks at the reality and translate it into economic relations that are country- specific and time- dependent. This is tightly connected to the concept of closure rules of the model. As we have analyzed in our previous models, the choice of closure rules is crucial in identifying the causal chain. In this class of models we have two options: a so- called "artificial" or a "temporal" rule. As we have declared before, the idea of Structuralism is an adherence to the country reality in an exact period of time. So, the idea is a temporal closure rule, since the causal chain relies on how the country- specific and time- dependent model is closed.

Surely, as Foley and Taylor (2004) stated Structuralist or "heterodox" models share a common characteristic: "*the avoidance of model closures that imply full employment of a given labor force*".

In conclusion we may cite two quotations which sum up the Heterodox methodology. Following Baghirathan R. et al. (2004): "*the methodological framework of Structuralist economics remains a tool and not and end chosen for the sake of generating esthetically pleasing formal solutions to theoretically complex problems. Structuralist methodology is often criticized as being ad hoc*[122]*. We accept that criticism by replying that indeed, our methodology is in many instances tailored to serve best the final purpose of economic analysis, which is the understanding of economic processes that are the engines of change of the capitalist system*". Instead, using Palma's words: "*Structuralism is basically a method of enquiry which challenges the assumptions of empiricism and positivism. The principal characteristic of structuralism is that it takes as its object of investigation a "system," that is, the reciprocal relations among parts of a whole, rather than the study of the different parts in isolation*".

[122] Precisely the critique is motivated on the basis that the Structuralist models do not exploit optimization procedures and transversality conditions in a dynamic perspective.

III. A Structuralist/ Post- Keynesian model vs. a Neoclassical model

A Structuralist/ Post- Keynesian model differs respect to mainstream Neoclassical models at least in two aspects: the former is about the nature of the model itself and the latter is the treatment and modelling of foreign trade. Here we will discuss both aspects before presenting the relations constituting the Mozambican model.

Firstly, a Structuralist/ Post- Keynesian model (here to SPK) has a macroeconomic perspective. As already explained, it emphasizes the role of the effective demand. It influences at the macro level the economy performance so that an SPK is a macroeconomic model in spirit. There is another aspect to detect. When a policy shock, and in this specific case a trade liberalization, has been studied according to the Neoclassical paradigm the objective of the simulation is the quantitative evaluation of effects that are already supposed *a priori*. For instance, a tariff cut is supposed to have a positive effect via the price fall on private consumption. However, we have already demonstrated there are other effects not considered from mainstream AGEs. Probably the most important one is the fiscal effect which reduces public expenditures. Neoclassical exercises assume that consumption gains are bigger. They only want to know how much. A Structuralist analysis, instead, recognizes these double effects on the different demand components and, moreover, it assumes the existence of a labour supply multiplier. Already described in chapter 6, it is the balancing item in a demand- driven system, both Keynesian and Post- Keynesian. We have argued its role both in labour supply determination and its effect on fiscal revenue (i.e. direct taxation) in the previous chapter.

Although a Neoclassical model is more a "computational" exercise, where we know *a priori* that, supposing the usual closure rule of fixed saving sources, the positive price effect on consumption is predominant and that the only objective is to quantify the gain, a SPK model is a "true" exercises where not only quantitative changes has to be evaluated but also which effect is predominant. There is nothing *a priori* in a SPK model.

Secondly, international trade is modelled differently. Both the Neoclassical and the "Bastard Keynesian" models adopt an Armington specification of foreign trade. Structuralist/ Post- Keynesian macroeconomics, instead, avoids that representation preferring establishing explicit functions for imports and exports like the ones presented in chapter 2. Moreover, they are particularly interested in decomposing production costs in order to highlight imported intermediates' role in the determination of prices. For this reason in this SPK model we have to model three functions: one for exports, one for final imports and the last one for intermediate imports.

This different interpretation of foreign trade has consequences not only on the model structure but also on the accounting framework. Precisely, the SAM presented in Appendix A is intrinsically based on the Armington assumption. Here, we need a macro- SAM, where only the sectoral decomposition is useful for the structuralist analysis (Taylor, 2011) which follows the prescriptions above.

IV. The accounting framework

As already described, the accounting framework for a truly Structuralist/ Post- Keynesian model is a SAM comprehending both the real and the financial side. The idea is that one affects the other; a new concept respect to mainstream macroeconomics where money and monetary events are totally independent of the real side of the economy. Here, we consider only the real side of the economy although we know that an SPK analysis should contain both elements.

To build this structuralist SAM we start from the same data of the traditional SAM. However, we have to correct them and make some assumptions to break down data especially for imports. We must abandon the Armington assumption so that we can't speak in terms of "aggregate commodity" or an "aggregate supply". We have to consider separately imports for intermediate and final uses, domestic output and exports. We have data on intermediate consumption respect to a bowl of imported and domestic goods but no criterion on how to break it down. This is only one example; there is another problem when we have to define how much is imported for final uses and how much is domestically produced, how to allocate taxes on imports. Only a personal criterion may be applied.

Coherently to what is the Armington assumption, we assume that in the composite good the two components are proportional to imports and domestic output in the total supply. This criterion will be abandoned only if we have specific information from statistical data. The same idea is applied to give taxes to the different import uses.

In the following page there is the macro- structuralist SAM for Mozambique, the symbolic SAM, and then we will present each entry, how we derive the values, if they differ from the macro- IFPRI SAM, and the criterion adopted for their calculation.

Table 65: The macro- Structuralist SAM for Mozambique, 2003 (real side)

		Production costs	Domestic Market	Transaction margins	Firms' income uses	Current spending by income type			Foreign income uses	Capital formation	Totals
						Rural hhds	Urban hhds	Government			
		1	2	3	4	5	6	7	8	9	10
A	Sales		148,354			26,224					**174,578**
B	Domestic sales	57,120		21,034		9,165	25,154	14,745	30,526	14,061	**171,805**
C	Wages	69,041									**69,041**
D	Profits	32,281									**32,281**
E	Atax	-190									**-190**
F	VAT-reb	-3,178									**-3,178**
G	Mtax	650				282	773			432	**2,137**
H	VATBorder	1,608				697	1,914			1,070	**5,289**
I	Stax		2,468								**2,468**
J	VATDomestic		4,027								**4,027**
K	Direct taxes				925	133	2,071				**3,129**
L	TMD		15,783								**15,783**
M	TMM	1,240				538	1,475			825	**4,078**
N	TME		1,173								**1,173**
O	Foreign income	16,006			3,833	6,938	19,043			10,645	**56,465**
P	Rural hhds income	44,422									**44,422**
Q	Urban hhds income	52,267									**52,267**
R	Government income	13,784									**13,784**
S	Firms income	32,427									**32,427**
T	Savings				1,673	445	1,837	-1,518	24,596		**27,033**
U	Social transfers							557			**557**
V	Remittances								1,343		**1,343**
W	Distributed profits				25,996						**25,996**
X	Totals	**174,578**	**171,805**	**21,034**	**32,427**	**44,422**	**52,267**	**13,784**	**56,465**	**27,033**	

Source: ***Author's own calculation, based on Taylor (1990a)***

Table 66: The symbolic macro- Structuralist SAM for Mozambique (real side)

		Production costs	Domestic Market	Margin	Firms' income uses	Current spending by income type			Foreign income uses	Capital formation	Totals
						Rural hhds	Urban hhds	Gov't			
		1	2	3	4	5	6	7	8	9	10
A	Sales		$P_y \cdot dm0$			$P_y \cdot hc_{rh}$					$P_y Y$
B	Domestic sales	$a_0 PY$		$P \cdot MRG$		$P \cdot ch0_{rh}$	$P \cdot ch0_{uh}$	$P \cdot G0$	$P \cdot X0$	$P \cdot \beta_0 I$	$P \cdot A$
C	Wages	wbY									Y_w
D	Profits	$rP_k K$									$rP_k K$
E	Activity tax	$atx0 \cdot P_y dm0$									$Atax$
F	VAT-reb	$vtreb0 \cdot \left[a_0 P + a_1 Pim\right] \cdot Y$									$VATreb$
G	Mtax	$tm0 \cdot a_1 eP^* Y$				$tm0 \cdot \left(eP^* fch0_{rh}\right)$	$tm0 \cdot \left(eP^* fch0_{uh}\right)$			$tm0 \cdot \beta_1 eP_i^* I$	Tar
H	VATBorder	$vtb0 \cdot \left[\left(1+tm0\right) \cdot \left(a_1 eP^* Y\right)\right]$				$vtb0 \cdot \left[(1+tm0) \cdot \left(eP^* fch0_{rh}\right)\right]$	$vtb0 \cdot \left[(1+tm0) \cdot \left(eP^* fch0_{uh}\right)\right]$			$vtb0 \cdot \left[(1+tm0) \cdot \left(eP_i^* \beta_1 I\right)\right]$	$VATb$
I	Sales tax		$stx0 \cdot PA$								$Stax$
J	VATDomestic		$vtd0 \cdot dm0$								$VATd$
K	Direct taxes				$dtx0_e \cdot Y_e$	$dtx0_{rh} \cdot Y_{rh}$	$Y_f \quad dtx0_{uh} \cdot Y_{uh}$				Dir
L	TMD		$P_t \cdot TMD$								$P_t \cdot TMD$
M	TMM	$P_t \cdot mrm \cdot a_1 eP^* Y$				$P_t \cdot mrm \cdot \left(eP^* fch0_{rh}\right)$	$P_t \cdot mrm \cdot eP^* fch0_{uh}$			$P_t \cdot mrm \cdot eP_i^* \beta_1 I$	$P_t \cdot TMM$
N	TME		$P_t \cdot TME$								$P_t \cdot TME$
O	Remittances								eR		eR
P	Social transfers							$Tran$			$Tran$
Q	Savings				S_e	S_{rh}	S_{uh}	S_g	S_f		S_{tot}

(Table 66 continues)

		Production costs	Domestic Market	Transaction margins	Firms' income uses	Current spending by income type			Foreign income uses	Capital formation	Totals
						Rural hhds	Urban hhds	Gov't			
		1	2	3	4	5	6	7	8	9	10
R	Foreign income	$a_1 eP^* Y$			eF	$eP^* fch0_{rh}$	$eP^* fch0_{uh}$			$eP_i^* \beta_1 I$	Y_f
S	Rural hhds income	Y_{rh}									Y_{rh}
T	Urban hhds income	Y_{uh}									Y_{uh}
U	Gov't income	Y_g									Y_g
V	Firms income	Y_e									Y_e
W	Totals	$P_y Y$	$P \cdot A$	$P \cdot MRG$	Y_e	Y_{rh}	Y_{uh}	Y_g	Y_f	$P_{inv} I$	

Definitions:

$Pim = e \cdot (1 + tm) \cdot (1 + vtb0)$ $\quad P_{inv} = \beta_0 eP_i^* + \beta_1 P$

Source: ***author's own SAM based on Taylor (1990a)***

The notation for the macro- Structuralist SAM cell entries is **[row account, column account]**. Here we briefly describe them. All values are in 2003 Billion of MT, unless otherwise specified.

1. Domestic intermediate consumption [domestic sales, production costs]: 557,120. This feature is the value of intermediate consumption of domestic goods gross of indirect taxes and transaction margins. In the original SAM we have only the value of the composite (domestic + imported) intermediate. We have to decompose it into the two components. The reasoning applied is simple and realistically fit the Armington assumption at the basis of the IFPRI SAM building. We suppose that each demand component of the composite good is composed partly of domestic and partly of imported goods. The two shares are fixed and represent how much of domestic and imported commodities enter the Armington supply. Practically, in the original dataset gross imports and total supply were 60,058 Billion MT and 235,941 Billion MT respectively, we suppose that each demand component has a [1-(60,058/ 235,941)] percentage of gross domestic intermediates.

2. Labour value added [wages, production costs]: 69,041. This feature comprehends labour and land, which in the IFPRI model was aggregated to capital.

3. Capital value added [profits, production costs]:32,281. As in the IFPRI SAM of chapter 4.

4. Activity subsidies [Activity tax, production costs]: -190. As the original SAM.

5. VAT rebate [VAT-reb, production costs]: -3,178. This value does not change; however, in the model implementation we should break it down into two components: the VAT rebate for domestic intermediates and for imported intermediates. These two values are 2,369 and 809 respectively.

6. Import tax on imported intermediates [Mtax, production costs]: 650. We have decomposed import duties respect to final and intermediate imports. After having derived the value of net imported intermediates we apply the same import tax rate of the original dataset.

7. VAT collected at borders on intermediate imports [VATBorder, production costs]: 1,608. The reasoning is straightforward and very close to the one of the import tax. Given the values of net imported intermediates and related import taxes, VAT collected at borders is obtained as the starting rate by imports gross of tariffs.

8. Margins applied on intermediate imports [TMM, production costs]: 1,240. The value is derived as in the case above.

9. Net intermediate imports [foreign income, production costs]: 16,006. The gross value of imported intermediates is given as (60,058/ 235,941) percentage of composite intermediate in the original SAM.

Then to obtain net values we apply tax rates, and transport margin per unit of import as in the dataset and we use the formula:

$$M0net = \frac{M0gross}{mrm0 + \left[(1+vtb0)\cdot(1+tm0\right]}$$

It ultimately states that net value is a positive function of gross value of imports and a negative function of *mrm0*, unitary transportation margin (which is applied on net imports), *vtb0*, rate of the VAT collected at borders (which is applied on imports gross of import tariffs), and *tm0*, import tariff rate (applied on net imports).

10. Domestic sales [sales, domestic market]: 148,354. As in the SAM in chapter 4.

11. Margins on domestic commodities [TMD, domestic market]: 15,783. As in the IFPRI SAM.

12. Margins on exports [TME, domestic market]: 1,173. As in the SAM in chapter 4.

13. Sales tax [Sales tax, domestic market]: 2,468. As in the IFPRI SAM.

14. VAT domestically collected [VATDomestic, domestic market]: 4,027. As in the SAM in chapter 4.

15. Total marketing margins demand [domestic sales, margin]: 21,034. As in the SAM in chapter 4.

16. Corporate income tax [direct taxes, firm's uses of income]: 925. As in the IFPRI SAM.

17. Firm's payments to foreigners [foreign income, firm's uses of income]: 3,833. As in the original SAM.

18. Corporate savings [savings, firm's uses of income]: 1,673. As in the IFPRI SAM in chapter 4.

19. Total distributed profits [distributed profits, firm's uses of income]: 25,996. This is the total value of distributed profits. In the SAM in chapter 4 it is broken down in its two components: distributed profits accruing to households, and distributed profits accruing to government.

20. Home consumption [sales, current spending by income type]. It is a vector with only one entry for rural households, 26,224, as in the IFPRI SAM.

21. Foreign final consumption [foreign income, current spending by income type]. It is a vector whose entries are 6,938, and 19,043 for rural and urban households respectively. The element corresponding to government consumption is nil, according to the SU table.

The distinction of the final uses of imports depends on a modeller assumption. Firstly, we have the total net final imports (the value in the dataset minus net imported intermediates), then we allocate it across final uses (households consumption and capital formation) according to the composite good allocation. For instance, in the original SAM rural household consumption is 17,620 while the sum of the three components (composed both of domestic and imported goods) is 93,012. Therefore, we suppose that (17,620/ 93,012) percent of final imports is devoted to rural household consumption. The same reasoning is applied for urban household consumption and capital formation since we have no other information from the SU table.

22. Domestic final consumption [domestic sales, current spending by income type]. It is a vector composed of 9,165, 25,154, and 14,745 for rural household consumption, urban household consumption, and government expenditures, respectively. The decomposition for private consumption is derived as the difference between the original composite values and imported final consumption (gross of taxes and margins). Government expenditures are totally counted as domestic goods according to the SU table.

23. Import tax on foreign final consumption [Mtax, current spending by income type]. It is a vector with two entries 282, 773 respectively for rural and urban import final consumption. having the net values, we apply the import tax rate of the original SAM.

24. VAT collected at borders on foreign final consumption [VATBorder, current spending by income type]. It is a two- entry vector: 697 and 1,914. The decomposition follows the criterion applied for import taxes on foreign final consumption.

25. Margins applied on foreign final uses [TMM, current spending by income type]. It is the vector 538, 1,475. The reasoning is close to the one applied for taxes on final import uses.

26. Personal direct taxes [Direct taxes, current spending by income type]. The vector's entries are 133, and 2,071 for rural and urban households, respectively. Data are the same of the SAM in chapter 4.

27. Rural household saving [savings, rural hhds]: 445. As the value in the IFPRI SAM.

28. Urban household saving [savings, urban hhds]: 1,837. As the feature in the original SAM.

29. Public deficit [savings, gov't]: -1,518. As in the SAM of chapter 4.

30. Social transfers [social transfers, gov't]: 557. This value collects social contributions to households and enterprises. In the IFPRI SAM they are disaggregated across receivers. However, the total value is unchanged.

31. Exports [domestic sales, foreign income uses]: 30,526. As in the IFPRI SAM.

32. Foreign savings [savings, foreign income uses]: 24,596. As in the SAM in chapter 4.

33. Remittances from abroad [remittances, foreign income uses]: 1,343. As in the IFPRI SAM.

34. Foreign capital formation [foreign income, capital formation]: 10,645. Residually after having distributed final imports to all the other demand components.

35. Domestic capital formation [domestic sales, capital formation]: 14,061. Residually after having distributed domestic sales to all the other demand components of domestic commodities.

36. Import tax on foreign capital formation [Mtax, capital formation]: 432. Residually after having distributed import duties to all the other components of intermediate and final imports.

37. VAT collected at borders on foreign capital formation [VATBorder, capital formation]: 10,70. Residually after having distributed VAT collected at borders to all the other components of intermediate and final imports.

38. Margins applied on foreign capital formation [TMM, capital formation]: 825. Residually after having distributed import margins to all the other components of intermediate and final imports.

39. Rural household income [rural hhds income, production costs]: 44,422. This entry is a summary of total income for rural households. It comprehends income out of labour, distributed profits, and social transfers.

40. Urban household income [urban hhds income, production costs]: 52,267. This entry is a summary of total income for urban households. It comprehends income out of labour, distributed profits, social transfers, and remittances from abroad.

41. Government income [gov't income, production costs]: 13,784. This entry sums up the total government fiscal revenue from both direct and indirect taxes.

42. Firm's income [firm's income, production costs]: 32,427. This cell shows total firm's income which is solely out of capital.

V. The SPK model specifications

In this section we describe the fundamental relationships building the Structuralist/ Post-Keynesian model. As already done for the other models, we will present the MCP format. As usual, there are three groups of relations: zero profit conditions, market clearing conditions and income balances. The model differs in the functional forms of these relations. The SPK model has the same Keynesian multiplier, *km*, of the BK model, since both of them are demand- driven system where output is endogenized through an endogenous labour supply. Although this similarity, the SPK model greatly differs in two aspects: the production function and the treatment of foreign trade. We have already outlined the essential features of the Structuralist production function, here we briefly sum up the basic notions to present it formally. Firstly, this formulation of the production technique is contextualized in a time period through the employment of the technical coefficient b, a_0, and a_1. It is assumed that these coefficients show a particular combination of inputs given the technique available at time t. If the analysis considers time t+1, they are likely to be changed. Secondly, the combination of a mark- up rule for price determination and the rejection of marginal productivity remuneration leads to a different income distribution theory. Now, income is allocated not according to marginal product but as the result of class conflicts and bargaining power of the different social classes. Both the mark- up rate (which the profit income comes from) and the wage rate are set after struggling between rentiers and wage earners. Once more, income distribution has an historic perspective: it is determined by previous bargainings so that at time t it is determined by class conflicts.

These specifications leads to the determination of the *numeraire* of the model. In the previous models we have assume no specific *numeraire*[123]. Here it is not likely. In the short-run we must assume that wages are fixed. They are set by previous workers' struggles and they do not change instantaneously to adjust. Here, wages are indexed and rigid in the short-run.

Formally, the production function is a Leontief function with fixed coefficients (the technical coefficients), determining the shares of input respect to total production.

The second difference is the treatment of international trade. In Neoclassical (and BK) model we have assumed the Armington assumption holds. This means there is an imperfect substitutability between domestic and imported goods and between domestic production and exports. Typically Structuralists reject this hypothesis. They prefer consider explicit functions for exports and imports. Moreover, they are interested in analysing the role of foreign intermediates into production costs, and consequently their effect on final price level. Therefore, there are three functions that illustrate foreign relations: an export function, an intermediate import function and a final import function.

This representation clearly avoids any degree of substitutability between domestic and foreign commodities.

In this functional description of the SPK model we refer to the previous macro- SAM so that in our model there is only one sector, one good, and two households, indexed by h. The first class of relations is the zero profit conditions whose associated variable is the activity level.

[123] The reader may see Appendixes C and E where the codes for the Neoclassical and the "Bastard Keynesian" model are shown. There is any reference to a *numeraire* of the model because GAMS/MPSGE automatically computes the results assuming normalization respect the higher agent's income. This means that, in those cases, it considers urban household income as the term of reference.

As already discussed, the zero profit condition for the productive sector satisfies the conditions on the production function listed above.

Production in sector *Y*:

$$PY0\cdot(1+atax0)=(1+\tau 0)\left[b0w0+\left(a_0P+a_1P^{*}pim\right)\cdot(1+vtreb0)\right]\cdot Y0 \qquad (1)$$

Where *PY* is the nominal GDP, τ is the profit mark- up rate over variable costs, *b0*, a_0, and a_1 are the technical coefficients of the Leontief function respect labour, domestic, and imported intermediates. Usually, variable costs comprehend only labour costs and imported intermediates, here there are also domestic intermediates. We suppose that the productive sector can't use directly its own intermediates without selling them to the formal market. This hypothesis is *ad hoc* in order not to have different tax rates and unitary margin on transactions. In equation (1) *w0* is the wage rate in the benchmark, *P* the domestic general price level (gross of tariffs and margins), P^{*} is the foreign price. Then, *atax0* and *vtreb0* are the tax rate for activity subsidy and VAT rebate respectively[124]. $P^{*}\cdot pim$ represents the costs of imported intermediate in domestic currency gross of taxes and margins, since *pim* is defined as: $pim = pfx\cdot(1+tm0)\cdot(1+vtb0)+pt\cdot mgm$.

The second zero profit condition is related to the domestic market, where we aggregate domestic uses, margins, and indirect taxes.

Domestic supply, *A*:

$$(1+stx0)P\cdot a0 = Py\cdot dm0\cdot(1+vtd0)+pt\cdot Trd+pt\cdot Tre \qquad (2)$$

Where *PA* is the nominal total domestic supply, *dm0* is the marketed production, *pt* is the price of margins, and *Trd* and *Tre* the two margins' quantities. *Stx0* and *vtd0* are the tax rates for sales tax (on total supply) and VAT collected on domestic uses.

Consumption for households is an aggregation of imported and domestic goods, *C*(*h*):

$$Py\cdot ha(h)+P\cdot ch0(h)+P^{*}\cdot pim\cdot fch0(h)=c0(h)\cdot pc(h) \qquad (3)$$

[124] If this relation should describe the production function for an informal sector it would not have either activity subsidies or VAT rebate.

For government expenditures the reasoning is close, although in this case they are referred only to domestic commodities.

Government consumption, *GOVT*:

$$P \cdot gd0 = GOVT \cdot pg \tag{4}$$

Investment production sector, *INV*:

$$P \cdot \beta_0 I + pim \cdot P^* \beta_1 I = pinv \cdot i0 \tag{5}$$

In this case investments are composed of domestic capital goods (a share β_0 of total investments) and imported commodities, so that $\beta_0 + \beta_1 = 1$.

Transactions margins, *MRG*:

$$P \cdot (Trd + Trm + Tre) = pt \cdot Trm + \cdot pt \cdot Trd + pt \cdot Tre \tag{6}$$

Exports, *EX*:

$$py \cdot x0 + pt \cdot Tre = pfx \cdot x0 \cdot \overline{P} \tag{7}$$

Overall imports, *IMP*:

$$a_1 Y \cdot pmi + pmi \cdot \left[sum(h, fch(h)) + \beta_1 I \right] = P^* \cdot a_1 Y + P^* sum(h, fch(h)) + P_i^* \beta_1 I \tag{8}$$

Market clearing conditions represent the supply- demand law. It states that the supplied quantity of each good is demanded either as final or intermediate uses. Because this relation must hold for each good and factor of production, in our model there are twelve MCCs: for productive sector's output, domestic sales, private consumption goods, investment goods, margins, export, import, foreign exchange, capital, labour, distributed profits, and lump- sum transfers . Here the associated variable is the price level for each good or factor of production.

Productive sector's output:

$$Py \cdot Y0 \cdot Y = Py \cdot dm0 + sum(h, Py \cdot ah(h)) \tag{9}$$

Domestic sales:

$$a0 \cdot A = \frac{a_0}{P} Y + \frac{(Trd + Tre + Trm)}{P} MRG + \left(sum(h, \frac{cd(h)}{P} C(h) \right) + \frac{gd0}{P} GOVT + \frac{\beta_0}{P} INV \tag{10}$$

Foreign exchange:

$$
\begin{aligned}
&P \cdot x0 \cdot \overline{P} \cdot EX + pfx \cdot R + pfx \cdot S_f = \\
&a_1 \cdot pfx \cdot P^* \cdot y0 \cdot Y + pfx \cdot F + (sum(h, pfx \cdot P^* \cdot fch0(h)) + pfx \cdot P_i^* \beta_1 I
\end{aligned} \tag{11}
$$

Exports:

$$
x0 \cdot EX = x0 \cdot \left(\frac{pfx \cdot \overline{P}}{P} \right)^{\delta} \tag{12}
$$

Imports:

$$
m0 \cdot IMP = m0 \cdot \left(\frac{pfx \cdot P^*}{P} \right)^{\alpha} \cdot \left(y0 \cdot Y \right)^{\beta} + a_1 \cdot P^* \cdot pim \cdot y0 \cdot Y \tag{13}
$$

Labour:

$$
km \cdot LS = b \cdot w \cdot y0 \cdot Y \tag{14}
$$

Capital:

$$
KS = \tau \left[b \cdot w + \left(a_0 \cdot P + a_1 \cdot P^* \cdot pim \right) \cdot (1 - vatreb0) \right] \cdot y0 \cdot Y \tag{15}
$$

Distributed profits:

$$
ENT \cdot (sum(h, he(h)) + ge) = sum\left(h, \frac{he(h)}{pe} \right) + \frac{ge}{pe} \tag{16}
$$

Margins:

$$
(Trd + Tre + Trm) \cdot MRG = \frac{Trd + Tre + Trm}{pt} \tag{17}
$$

Private goods:

$$
C(h) \cdot c0(h) = \frac{RA(h)}{pc(h)} \tag{18}
$$

Investment goods:

$$
INV \cdot i0 = \frac{i0}{pinv} \tag{19}
$$

Lump- sum transfers:

$$TRAN = \frac{sum(h,Tranh(h)) + Trane}{ptran} \quad TRAN = \frac{sum(h,htran(h)) + etran}{ptran} \tag{20}$$

Finally, the income balance conditions state that the level of expenditure equals the value of income accruing from sale of factors' endowments, dividends' payment, or tax receipts, given the assumption of non- satiation. In our model there are four agents whose income balance condition has to be fulfilled: two household groups, enterprises, the government, and the foreigners.

Income balance conditions for household(h):

$$RA(h) = (1 - dtx(h)) \cdot \left[Yw(h) + pe \cdot he(h) + ptran \cdot Tranh(h) + pfx \cdot R(h) \right] - pinv \cdot S_h(h) \tag{21}$$

Income balance condition for enterprises:

$$ENT = (1 - dtxe) \cdot (rP_k KS + ptran \cdot Trane) - pfx \cdot F - pinv \cdot S_e \tag{22}$$

Government income balance condition:

$$\begin{aligned} &GOVT = Dir + (Atax + VATreb + VATb + VATd + Tar + Stax) - \\ &ptran \cdot (Trane + sum(h,tranh(h))) - pinv \cdot S_g \end{aligned} \tag{23}$$

Foreigners income balance condition:

$$\begin{aligned} &FOREIGN = pfx \cdot (a_1 P^* \cdot y0 \cdot Y) + pfx \cdot \left[sum(h, fch(h)) + \beta_1 I \right] + pfx \cdot F \\ &- pfx \cdot R - pinv \cdot S_f \end{aligned} \tag{24}$$

VI. The elasticity issue

As in the Neoclassical and "Bastard Keynesian" models, also the SPK model heavily relies on the modeller's choice on elasticity estimation. All the considerations explained in chapter 5 are still valid. However, here the issue is a bit more complicated. As the Neoclassical (and BK) model assumes the Armington assumption holds, we have the opportunity to adopt elasticity from the *GTAP database* whose statistics are derived according to this economic theory. But as clarified in the above section, SPK models reject the existence of a substitutability between imports and domestically produced goods[125] and they adopt explicit import functions. Equation (13) shows the total imports demand highlighting the two components of intermediate and final imports. The former is a Leontief function respect to total production, according to the input-output coefficient[126], a_1. The latter, instead, presents two elasticity parameters we have to estimate: a price elasticity, α, and an income elasticity, β.

The final import demand function is as follows:

$$finIMP = m0 \cdot \left(\frac{pfx \cdot P^*}{P} \right)^{-\alpha} \cdot \left(y0 \cdot Y \right)^{\beta}$$

The elasticities are calculated using a Ordinary Least Squares (OLS) method[127] as in von Arnim (2010). Taking the logarithmic expression of the function above, our regression becomes:

$$\ln finIMP = \ln M0 - \alpha \ln \left(\frac{pfx \cdot P^*}{P} \right) + \beta \ln GDP$$

denoting the real exchange rate as $\rho = pfx \cdot P^* / P$, the regression simply becomes:

$$\ln finIMP = \ln M0 - \alpha \ln \rho + \beta \ln GDP$$

so that we regress the logarithm of the value of imports on the logarithm of both domestic GDP and the relative price of imports respect domestic prices.

We need the import and GDP values, the price of imports and the domestic price. To provide continuity and for ease of comparison each variable should be indexed to a year value.

Firstly, we have to set which period we consider, and which kind of statistical variables are adopted.

As already stated, according to the law of the large numbers, a regression to estimate parameters is robust if there are at least 30 observations[128]. Respect to *UNCTADStat database*

[125] Another issue they rebut is the property of the CES function itself, and especially the income elasticity equals one. They assert that it is unlikely that a change in income stimulate an equal percentage change in demand for both domestic and imported commodities.

[126] The input- output elasticity values both for domestic and imported intermediates are calibrated on the benchmark data.

[127] The regression is performed using E-Views software version 5.

we have 30 annual observation from 1980 to 2010. However, we decide to restrict the time series to the period 1992- 2010. There are at least three reasons for this choice. Firstly, we assume there is an impossibility to compare data of the periods 1980-1991 and 1992-2010 because of the different economic systems in Mozambique. In the former time period there was a socialist economic system where Government had a strong role in price determinacy, in the latter there is a market economy with a lower level of State participation. Secondly, before 1992 the Country was involved in a Civil War which takes it to the economic collapse. We assume, according to Arndt *et al.* (2001), that in the Civil War period data collection and estimates were of poor quality. Moreover, in 1991 a new National Statistics Institute, INE, was created and it started its work.

Because of all these considerations, we justify a shorter period obtaining short- run elasticities.

After having defined the time period we have to find the useful data. For all our calculations, data are taken from the International Monetary Fund's International Financial Statistics (IFS), other IMF publications (IMF, 2009a, b, c, 2008a, b, 2007, 2005, 2004, 2002, 2001), and the *UNCTAD's volume series*. For each calculation *import volume* was used as the measure of imports, *Gross Domestic Product* (GDP) *volume* is used as the measure for GDP. Both of these variables are indexed to 2005 (according to the IMF data). For the price elasticity, the relative price may be calculated in cases where both import price and GDP deflator are available. Since we haven't information on the former we use the Real Effective Exchange Rate (REER). Both GDP deflator and REER are re- indexed to 2005 to provide continuity by the author.

In table 67 we sum up the values employed for the regression.

[128] In chapter 5 when we have faced the same problem for the first time, we have chosen to adopt the GTAP values, commonly adopted in literature. Here we haven't either a 30- observation series or literature values.

Table 67: GDP and import volumes, GDP deflator and REER (1992- 2007)

Year	GDP volume	Import volume*	GDP deflator	Real Effective Exchange Rate**
		values are indexed to 2005 (2005= 100)		
1992	35.36	45.41	9.42	99.30
1993	38.47	51.77	13.73	96.27
1994	40.83	65.34	21.50	93.09
1995	41.75	39.38	32.65	88.99
1996	47.92	40.31	50.36	102.18
1997	53.23	38.48	54.46	111.28
1998	59.53	43.27	56.86	114.77
1999	64.51	62.39	59.22	108.09
2000	65.50	60.89	66.05	103.70
2001	73.52	57.16	75.64	93.99
2002	80.31	82.58	81.65	87.93
2003	85.52	87.57	85.34	85.51
2004	92.26	94.04	91.93	106.73
2005	100	100	100	100
2006	108.68	112.13	109.32	101.80
2007	116.71	109.79	118.41	108.41

Source: ***IFS and author's own calculations***

Notes: * Values from the *UNCTAD's volume series* and re-indexed to 2005 by the author.

** Values taken from *IMF Country Staff Reports* (various years) and re- indexed to 2005 by the author.

Then, the results of the regression are shown in table 68.

Table 68: Regression results

Dependent Variable: LOG(M0)

Method: Least Squares

Sample: 1992 2007

Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.584154	1.270734	-2.033592	0.0629
-LOG(ρ)	-0.418352	0.149403	-2.800160	0.0150
LOG(GDP)	1.553539	0.283784	5.474375	0.0001

R-squared	0.820881	Mean dependent var	4.154454
Adjusted R-squared	0.793324	S.D. dependent var	0.379175
S.E. of regression	0.172379	Akaike info criterion	-0.510880
Sum squared resid	0.386289	Schwarz criterion	-0.366020
Log likelihood	7.087040	F-statistic	29.78868
Durbin-Watson stat	1.378548	Prob(F-statistic)	0.000014

Source: ***Author's own calculations***

V. Simulations

The analysis of the SPK model is performed under the usual closure rules already applied in the previous models. This time we call *SPK benchmark* the closure where both public and foreign savings are allowed to move endogenously. Then, *closure 1* explores the effects of exogenously fixed public savings. We want to analyse if, modifying the model structure, the role of foreign savings remains unchanged. *Closure 2* and *3*, respectively, assume fixed foreign savings but different government behaviour: fixed government savings and fixed government expenditures. Table 69, as usual, shows the assumptions on the main economic variables and macro- aggregates in each closure. Formally, it does not greatly differ from the respective BK version (table 48). But, we have clearly demonstrated in section III that at least three issues are opposite: the production side, the consequent income distribution and the international trade. At a first sight the main difference is the introduction of a fixed wage rate that we have already justified as the *numeraire* choice.

There is a last aspect to detect: how to perform simulation. In the other models we have had a simulation involving different goods and different trading partners as well. Here, instead, the analysis is performed at the macro- level without distinguishing either commodities or foreign regions. If we set a reduction to zero in tariffs we are supposing a multilateral trade liberalization respect to the whole World. So, it is not likely. The better way is assuming a partial reduction in tariffs as if only the intra- SADC trade would be liberalized. Therefore, we simulate that tariff rate falls to 0.027.

Table 69: The closure rules

	SPK benchmark	SPK Closure 1	SPK Closure 2	SPK Closure 3
Potential macro closure variables				
Exchange rate				
Investment	Fixed	Fixed	Fixed	Fixed
Foreign savings			Fixed	Fixed
Labour supply				
Capital supply	Fixed	Fixed	Fixed	Fixed
Government demand	Fixed			Fixed
Saving rate	Fixed	Fixed	Fixed	Fixed
Tax rate	Fixed	Fixed	Fixed	Fixed
Wage rate	Numeraire	Numeraire	Numeraire	Numeraire

VI. Simulation's results

As already mentioned, this model is a demand- driven system, so we suppose that the effects on employment should be close to the BK ones. In fact, looking at data shown in table 70, whatever the closure rule is, there is a fall down in labour employment by 0.8 percent. This result is in line with the other demand- driven systems and with the theoretical outcomes of the SPK adopted in chapter2. More precisely, this simulation demonstrates close outcomes respect the simulation of a supply- side shock in an SPK environment of chapter 2.

An interesting aspect to detect is the behaviour of the demand side which appears not to be affected by the closure rule. The same happens for the household consumption.

The causal chain may goes from the reduction of intermediates costs to a change in demand components. Let us present what happens in the production side. A drop down into tariff rates makes imported intermediates cheaper. This leads to a reduction in final production because intermediates (gross of taxes and margins) are proportional to total production through a Leontief production function. It is worthy noting (table 70) that in the formal sector the decline in production, employment and intermediate uses are all proportional (-0.91 percent). In the informal sector, instead, the outcomes are different. There is an increase in labour employment while intermediate uses are reduced by 0.30 percent (on average). This opposite trend may be explained by the role of this sectoral production. Since it is used for food-security purposes by poorer households, it probably has to outweigh the reduction in formal consumption. Indeed, as the formal production declines, domestic supply diminishes in the same proportion.

The drop in labour employment causes a reduction in wage income for households. This makes consumption to decline. At the same time also distributed profits reduce because now with a lower level of variable costs the mark- up rule assigns a lower amount of profits to enterprises. Private consumption declines differently across social groups. Rural households consume less than urban households. This depends on the change in consumption basket price. For rural consumers marketed (domestic and imported) and non- marketed commodities enter it. However, while marketed goods face a price reduction (imports because of the tariff cut and domestic goods because lower production prices), home consumption price is higher. It depends on the fact that the informal sector has no fiscal advantages in its production (no activity subsidies or VAT rebate, see Appendix F). Because of that the consumption price for rural household declines by 0.5 percentage points respect to the 1 percentage point decline in urban consumption price.

The behaviour of the other demand components (government expenditures, exports, and investments) and of the final import demand heavily relies on the closure rule choice.

Table 70: Simulation results for the SPK model (real values)

		Base run	Percentage change respect the base run Benchmark SPK closure	SPK closure 1	SPK closure 2	SPK closure 3
Real Production						
	Formal	148.354	-0.91	-0.91	-0.91	-0.91
	Informal	26.224	-0.28	-0.28	-0.28	-0.28
Labour employment						
	Formal	53.185	-0.91	-0.91	-0.91	-0.91
	Informal	15.586	+1.44	+1.44	+1.44	+1.44
Real imported intermediates						
	Formal	14.397	-0.91	-0.91	-0.91	-0.91
	Informal	1.609	-0.31	-0.31	-0.31	-0.31
Real domestic intermediates						
	Formal	51.377	-0.91	-0.91	0.91	0.91
	Informal	5.743	-0.28	-0.28	-0.28	0.28
Real consumption						
-Domestic						
	Rural households	9.165	-0.28	-0.28	-0.28	-0.28
	Urban households	25.154	-0.04	-0.04	-0.04	-0.04
-Imported*						
	Rural households	8.455	-0.28	-0.28	-0.28	-0.28
	Urban households	23.205	-0.04	-0.04	-0.04	-0.04
Real government expenditures		14.745	-	-5.76	-5.82	-
Real investments						
	*Imported investment goods**	12.972	-2.79	+0.54	-	-3.36
	Domestic investment goods	14.061	-2.79	+0.54	-	-3.36
Real expenditures		30.526	-1.5	-0.35	-0.06	-1.23
Real final imports		36.626	-0.89	+0.08	-0.07	-1.05
km		1	-0.8	-0.8	-0.8	-0.8
fsav		1	+0.6	+0.6	-	-
gsav		1	+59.3	-	-	+59.3

Source: *Static CGE model results*

Note: * Denotes import demand components at final prices (gross of taxes and margins)

Features in the base run are 10^3 Billion MT

In the closure with fixed government savings, because of the contemporaneous reduction in tariffs, indirect taxes on imported goods, and direct taxes on mark- up income, government expenditures have to decline to balance its income constraint. However, the reduction depends on the foreign sector closure rule. Whenever foreign savings is set exogenous too (*SPK closure 2*), investment component is fixed. This has a positive effect on exports which slightly declines (only -0.06 percent). At the same time investments are at the base run level because no saving source is allowed to move (private savings by construction, public and foreign savings by closure rule). Because of the assumption on foreign savings final imports have to decline to maintain stable the capital inflows. The percentage change completely offsets the decline in final exports.

In this case because the total domestic production has declined, the demand components have to adjust to clear the market and therefore they diminish too. Firstly, private consumption has been satisfied, then government expenditures that should decline by closure assumption. At a second stage investments and net exports. Since investments have to be balanced by available savings, in this closure they cannot move. As already said this depends on the impossibility to move of the saving sources. Finally, because of the foreign closure net exports are fixed too.

Whenever fixed government savings are combined with endogenous foreign savings (*SPK closure 1*), we have the only case when real investments and final imports increase. Here, government expenditures fall (only by 5.76 respect 5.82 of *SPK closure 2*), consumption is immediately allocated, then, the final elements to consider are investments and net exports (exports minus imports). Both of them may move. As usual, foreign savings are a positive stimulus to investments. In this case they get higher. To clear the domestic market, the last element, net exports, must diminish. Therefore, while final imports increase exports decline. The final aggregated effect on foreign trade has a negative sign. Exports decrease but it is outweighed by the shortfall in imports (where the decline in intermediate imports counterbalances the increase in final import demand).

As a consequence foreign capital inflows increase and this stimulate the capital accumulation.

Comparing these two closures where government savings are fixed, we highlight the prominent positive role of foreign savings in the Mozambican economy. These closures allow investment not to fall under the base run value.

Now we turn to the closures with endogenous government savings (namely the *SPK benchmark closure* and *SPK closure 3*). The *SPK benchmark closure* is compared in its effects with *SPK closure 1*. Since government expenditures are fixed now, the reduction in total production has to be cleared by other demand components, namely investments and net exports. The effects on net exports are evidently negative; they decline more than in *SPK closure 1*. The *SPK closure 1* 5.76% government expenditure reduction is allocated to investments too. It reverses the sign: while in *closure 1* investments grow, in the *SPK benchmark closure* they decline.

Although foreign savings may move, this closure has no the positive effects *of SPK closure 1*. The reason is the presence of endogenous government savings. This is the great limit of the Mozambican system. Because of a public dis- saving (or negative saving) in the base run, each closure involving a tax revenue reduction and moving expenditures leads to a worsening public saving. Because it is already negative in the base run it becomes more negative.

In *SPK closure 3* the only demand component allows to move is the investment demand. Here, in fact, endogenous government savings is combined with fixed foreign savings. The outcomes may be compared with *SPK closure 2*. In both cases the production reduction is satisfied by the change of only one demand element. Since investments decline, as demand component, to clear the market, it is coherent with an increasing public negative saving level.

Prices' levels are not affected by the closure rule choice. Domestic production prices declines differently if they are formal on informal goods. The former declines by 0.4 percentage points while the latter only by 0.2 percent. This different behaviour depends on the presence of activity subsidies. The price of domestic supply declines in the same proportion of formal goods since only they enter the supply. Foreign exchange rate declines, while the final price of final imports declines more because of the accumulated effects of both the exchange rate reduction and the tariff cut.

VII. Concluding remarks

In this chapter we have surveyed the Structuralist point of view on macroeconomics and causality inside a CGE model. This has been the basis to outline the differences between this theory and the others presented in previous chapters. After having presented them theoretically we move further and apply them to the Mozambican reality. This leads to the formulation of a new SAM which better reflects the fundamental relations building a SPK model and then to a CGE model to evaluate the Mozambican participation into the SADC-FTA.

Theoretically, this chapter has demonstrated the macro- causality inside the SPK model and how the closure rule choice affects it. Outcomes are summarized in box 29, where we show the behaviour of macro- aggregates for each closure.

Box 29: Schematic representation of the causality in the SPK model according to closure rules

Closure rule	Macroeconomic balance
SPK benchmark closure	$\downarrow Y = C\downarrow + I\downarrow + \bar{G} + \left[\left(X\downarrow - M\downarrow\downarrow\right)\right]\downarrow$
SPK closure 1	$\downarrow Y = C\downarrow + I\uparrow + G\downarrow + \left[\left(X\downarrow - M\downarrow\downarrow\right)\right]\downarrow$
SPK closure 2	$\downarrow Y = C\downarrow + \bar{I} + G\downarrow\downarrow + \overline{(X-M)}$
SPK closure 3	$\downarrow Y = C\downarrow + I\downarrow\downarrow + \bar{G} + \overline{(X-M)}$

Source: ***Results of the static CGE model***

Note: $\bar{}$ means fixed by closure rule; ↓ means "decline"; ↓↓ means a "bigger decline"

Respect to the empirical analysis, this analysis has clarified two aspects that we recognize as fundamental in the analysis of the Mozambican trade reform. Firstly, this model shows an increase in unemployment as a result of the liberalization process, according to the BK model outcomes. Here, however, workers loose more. Because of the production function the negative effects on employment are reinforced. Secondly, this model has demonstrated the fundamental role of foreign savings too. Assuming endogenous foreign savings mitigates partly the negative effects while the weakness of the Mozambican system is the high public deficit which leads to worsening performances when it is supposed endogenous.

8. Lessons Learned

This thesis sought to respond to a fundamental question in CGE modelling: is the closure rule choice a salient feature of the modelling process? According to literature the answer is yes. However, current AGE models mainly adopt Neoclassical frameworks to pursue policy analysis. It seems to us a limit which does not capture interesting aspects and limit the outcomes of the models.

To stress the importance of the closure rule, from a theoretical point of view, in chapter 2 we present a series of stylized examples where the main features of each kind of model are described. Here, the macroeconomic aspects and relations among variables are clearly depicted. The models, however, are exactly only “stylized examples” whose role is to demonstrate the basic causal relationships inside the model, without considering how much they are close to real world. Although this is a starting point to assess that the closure choice matters and that it characterizes not only the quantitative outcomes but also the qualitative aspects of the model itself, we are conscious that assuming *maquettes* is not a definitive demonstration of closure rule impact. We decide to move into the real world analysing a policy through different closures.

Precisely, we implement a study on trade liberalization using three different theoretical approaches: a Neoclassical, a “Bastard Keynesian” and a “Structuralist/Post- Keynesian” model. The choice of these three closures is quite simple. We move from mainstream approach to more heterodox ones. In the first case (chapter 5) we assume full employment and saving-driven investment function, as the main pillars of the Neoclassical world. Then, the “Bastard Keynesian” model (chapter 6) assumes a similar general framework (i.e. the Armington assumption for international trade, the same production functions) but it introduces both endogenous labour supply – and consequently unemployment – and fixed investment. Respect to chapter 5, this model should be able to capture effects on employment level which are not evaluated in the Neoclassical model.

However, also this model assumes strong theoretical notions such as the remuneration of factors according to their marginal productivity. So a step further is the introduction of a

different distributive rule, as the mark-up rule introduced in the Structuralist/ Post-Keynesian model. But it is not the only change. Another major difference is not to consider international trade *à la* Armington. Here, exports and imports are modelled through explicit demand functions, according to the truly Structuralist perspective.

The closure choice means deciding the relations in the macroeconomic equilibrium between savings and investments and which variable affects the other.

Moreover, in each model we set different closures on how available savings are determined. Namely, we consider if public and foreign savings are determined as exogenous or endogenous. This is not a trivial issue, and the thesis shows it especially respect to foreign savings determination.

Therefore, we have demonstrated from a theoretical point of view that the closure rule choice affects the logical structure of model and the final outcomes. Closing the model is not only a mathematical requirement to make the system solvable but it involves personal beliefs of the modeller on how the system works. Choosing a theory instead of another should be sustained both by the country case and the modeller's beliefs. This leads to different results which can lead to different policy prescriptions.

CGE modelling, in fact, is an instrument to give hints and suggestions on which policies should be pursued but at the same time this judgement is prone to personal decision on how to close the model.

In chapter 2 we have demonstrated that closure rules affect the outcomes of a series of simple models which already show what happens in chapter from 5 through 7 where the same closures are applied to Mozambique.

One of the traditional field in CGE modelling is the analysis of trade agreements. We follow this line and analyse the impact of the Mozambican participation into the SADC- FTA. Mozambique is one of the poorest countries in the world. It has experienced a civil war and only in the past two decades it starts a process of economic development. Regional integration is a country strategy to stimulate economic growth, as stated in chapter 3.

Analysing the same policy using three different models allows us to present not only theoretical conclusions but also policy prescriptions.

The three models have three common results: the role of foreign savings in domestic capital formation, the role of the service sector, and the role of the primary sector.

Assumptions made on foreign savings behaviour is fundamental in the Mozambican case study. They are the prominent resource of savings in the country so that they are the driving force in capital accumulation. Each closure with endogenous foreign savings leads to lower negative impact on capital and welfare improvements in the households' position. In fact, because of the negative public savings, assuming endogenous foreign savings means freeing the households to consume more. For the same reasoning, the inverse happens respect to public savings. If it is free to vary, it irremediably worsens its position and it is likely to create problems for public finance in the future.

The second issue is the role of the service sector. Services are not object of the tariff cut. Each closure demonstrates that this is the weak point in the liberalization process. Services are not liberalized and this causes a lack of benefits. Their prices remain unchanged and this does not stimulate their employment in the productive sectors. Moreover, the domestic service sector is high intensive in services so it produces less. Higher prices reduces also final consumption of services. Even when we assume models with endogenous labour supply, the negative performance is mainly driven by this sector which drastically reduces its labour employment level.

Finally, the agricultural sector is commonly represented as the sector with the highest benefits. In fact, intra- SADC trade is mainly composed of this kind of products whose price lowers. This stimulates on one hand their employment in the productive sphere and, on the other hand, it has positive impacts on poverty alleviation reducing the costs of living for households.

If this study should be used to give suggestions to policy makers at least one recommendation appears crucial: to speed up the service trade liberalization. Without its implementation trade liberalization is quite inefficient.

Then, there are other policy prescriptions that depend on the closure rule.

The Neoclassical model shows that trade liberalization is a winning decision. Because of its assumption of full employment of resources, it concentrates mainly on the price effects: joining the SADC- FTA permits to the general price level to diminish so that final uses are stimulated, both in terms of private final consumption and intermediate uses for productive activities.

In the “Bastard Keynesian” model, where labour supply is endogenized, we may have information on the employment effects of the trade liberalization. Unequivocally, in the short-run there are negative effects: many labourers may loose their jobs. So a valuable advice is to create a kind of social security system so that ex- workers may have an income source for the transitional period. In fact in the medium- to long- run the simulation demonstrates an increase in the employment level which gets higher than in the benchmark. It should be a transitional policy which may be refunded by the future increase in direct taxes payments (because of the higher labour level).

The Structuralist/ Post- Keynesian model agrees with the BK model in its prescription on labour employment, although because of the different production function its quantitative results are higher. These results are partly caused by the link among mark- up income, intermediate uses, and direct taxes.

Moreover, because of its nature as a macro- economic model, it shows the role of foreign savings as a positive element in the Mozambican system and the negative effects of public savings. Practically, the model prescription is a better performance of the government saving because it is a strong weakness in the system. More generally, whenever government saving is been allowed to move in each model, the system has had its worst performances.

Therefore, it is a structural weak of the Mozambican economic system itself and it does not depend on either the closure rule or the model choice.

To sum up, this thesis demonstrates that in CGE model building the closure rule choice is a crucial element. It has not only the role of making the system square but it reflects an idea of how an economic system works. In this way a certain causality inside the system is assumed. Through the causality the final outcomes are different for each closure rule choice.

Appendix A: The 2003 Social Accounting Matrix

The Input- Output Table

	A.AGRI	A.MINE	A.MAN	A.TRADE	A.SERV	INF-A.AGRI	INF-A.MINE	INF-A.MAN	INF-A.TRADE	INF-A.SERV
C.AGRI	19	1	4757		13	22		1192		
C.MINE	27	1	3942		416	30		987		
C.MAN	825	44	7691	73	17860	947		1927		
C.TRADE										
C.SERV	779	285	6806	7381	18000	894		1705		
INF-C.AGRI										
INF-C.MINE										
INF.C.MAN										
INF-C.TRADE										
INF-C.SERV										

Note: features are in Billion MT

Source: ***Author's own calculations based on Thurlow (2008)***

Appendix A

The Institutional Part of the Activity Columns

	A.AGRI	A.MINE	A.MAN	A.TRADE	A.SERV	INF-A.AGRI	INF-A.MINE	INF-A.MAN	INF-A.TRADE	INF-A.SERV
SK-LAB	193	6	1033	1271	7202	222		259		
SSK-LAB	402	9	1526	2036	9784	461		382		
USK-LAB	5874	58	4970	2868	10392	6744		1245		4885
CAP	1985	380	8144	7405	17264	2281		2041		
ENTR										
R-HHDS										
U-HHDS										
TRD										
TRE										
TRM										
GOVT										
YTAX										
VATB-RSA										
VATB-RoSADC										
VATB-ROW										
VATD										
REB	-61	-15	-1230		-1872					
STAX										
ATAX		-1			-189					
MTAX-RSA										
MTAX-RoSADC										
MTAX-ROW										
S-I										
RSA										
RoSADC										
ROW										
TOTALS	**10043**	**768**	**37639**	**21034**	**78870**	**11601**	**0**	**9738**	**0**	**4885**

Note: features are in Billion MT

Source: ***Author's own calculations based on Thurlow (2008)***

Appendix A

The Make Matrix

	C.AGRI	C.MINE	C.MAN	C.TRADE	C.SERV	INF-C.AGRI	INF-C.MINE	INF-C.MAN	INF-C.TRADE	INF-C.SERV
A.AGRI	10043	0	0	0	0					
A.MINE	0	768	0	0	0					
A.MAN	0	0	37639	0	0					
A.TRADE	0	0	0	21034	0					
A.SERV	0	0	0	0	78870					
INF-A.AGRI										
INF-A.MINE										
INF.A.MAN										
INF-A.TRADE										
INF-A.SERV										

Note: features are in Billion MT

Source: ***Author's own calculations based on Thurlow (2008)***

Appendix A

The Institutional Part of the Activity Rows

	SK-LSB	SSK-LAB	USK-LAB	CAP	ENTER	R-HHDS	U-HHDS	TRD	TRE	TRM	GOVT	YTAX	VATB-RSA	VATB-RoSADC	VATB-ROW
A.AGRI															
A.MINE															
A.MAN															
A.TRADE															
A.SERV															
INF-A.AGRI						11601									
INF-A.MINE						0									
INF.A.MAN						9738									
INF-A.TRADE						0									
INF-A.SERV						4885									

	VATD	REB	STAX	ATAX	MTAX-RSA	MTAX-RoSADC	MTAX-ROW	S-I	RSA	RoSADC	ROW	TOTALS
A.AGRI												**10043**
A.MINE												**768**
A.MAN												**37639**
A.TRADE												**21034**
A.SERV												**78870**
INF-A.AGRI												**11601**
INF-A.MINE												**0**
INF.A.MAN												**9738**
INF-A.TRADE												**0**
INF-A.SERV												**4885**

Note: features are in Billion MT

Source: ***Author's own calculations based on Thurlow (2008)***

Appendix A

The Institutional Part of the Commodity Rows

	SK-LSB	SSK-LAB	USK-LAB	CAP	ENTER	R-HHDS	U-HHDS	TRD	TRE	TRM	GOVT	YTAX	VATB-RSA	VATB-RoSADC	VATB-ROW
C.AGRI						2114	6152								
C.MINE						154	77								
C.MAN						10180	22383								
C.TRADE								15783	1173	4078					
C.SERV						5172	19747				14745				
INF-C.AGRI															
INF-C.MINE															
INF-C.MAN															
INF-C.TRADE															
INF-C.SERV															

	VATD	REB	STAX	ATAX	MTAX-RSA	MTAX-RoSADC	MTAX-ROW	S-I	RSA	RoSADC	ROW	TOTALS
C.AGRI								66	706	270	2777	**18089**
C.MINE								476	32	12	127	**6281**
C.MAN								14708	3214	1231	12652	**93735**
C.TRADE									0	0	0	**21034**
C.SERV								11783	4168	1351	3986	**96802**
INF-C.AGRI												**0**
INF-C.MINE												**0**
INF-C.MAN												**0**
INF-C.TRADE												**0**
INF-C.SERV												**0**

Note: features are in Billion MT

Source: ***Author's own calculations based on Thurlow (2008)***

Appendix A

The Institutional Part of the Commodity Columns

	C.AGRI	C.MINE	C.MAN	C.TRADE	C.SERV	INF-C.AGRI	INF-C.MINE	INF-C.MAN	INF-C.TRADE	INF-C.SERV
SK-LAB										
SSK-LAB										
USK-LAB										
CAP										
ENTR										
R-HHDS										
U-HHDS										
TRD	4814	353	11189		-573					
TRE	743	11	419							
TRM	472	10	3596							
GOVT										
YTAX										
VATB-RSA	22	4	1110		65					
VATB-RoSADC	3		151		4					
VATB-ROW	59	16	2481		1374					
VATD		39	1409		2579					
REB										
STAX			2468							
ATAX										
MTAX-RSA	7		619							
MTAX-RoSADC	1		84							
MTAX-ROW	40	5	1381							
S-I										
RSA	473	1274	7828		656					
RoSADC	53	142	873		41					
ROW	1359	3659	22488		13786					
TOTALS	**18089**	**6281**	**93735**	**21034**	**96802**	**0**	**0**	**0**	**0**	**0**

Note: features are in Billion MT

Source: ***Author's own calculations based on Thurlow (2008)***

Appendix A

The Institutional Diagonal Matrix

	SK-LSB	SSK-LAB	USK-LAB	CAP	ENTER	R-HHDS	U-HHDS	TRD	TRE	TRM	GOVT	YTAX	VATB-RSA	VATB-RoSADC	VATB-ROW
SK-LAB															
SSK-LAB															
USK-LAB															
CAP															
ENTR	0	0	0	32281							146				
R-HHDS	272	1899	31533	7219	3382						117				
U-HHDS	9914	12701	5503	0	22512						294				
TRD															
TRE															
TRM															
GOVT					102							3129	1201	158	3930
YTAX					925	133	2071								
VATB-RSA															
VATB-RoSADC															
VATB-ROW															
VATD															
REB															
STAX															
ATAX															
MTAX-RSA															
MTAX-RoSADC															
MTAX-ROW															
S-I					1673	445	1837				-1518				
RSA					3833										
RoSADC															
ROW															
TOTALS	**10186**	**14600**	**37036**	**39500**	**32427**	**44422**	**52267**	**15783**	**1173**	**4078**	**13784**	**3129**	**1201**	**158**	**3930**

(The Institutional Diagonal Matrix continues)

	VATD	REB	STAX	ATAX	MTAX-RSA	MTAX-RoSADC	MTAX-ROW	S-I	RSA	RoSADC	ROW	TOTALS
SK-LAB												**10186**
SSK-LAB												**14600**
USK-LAB												**37036**
CAP												**39500**
ENTR												**32427**
R-HHDS												**44422**
U-HHDS									1343			**52267**
TRD												**15783**
TRE												**1173**
TRM												**4078**
GOVT	4027	-3178	2468	-190	626	85	1426					**13784**
YTAX												**3129**
VATB-RSA												**1201**
VATB-RoSADC												**158**
VATB-ROW												**3930**
VATD												**4027**
REB												**-3178**
STAX												**2468**
ATAX												**-190**
MTAX-RSA												**626**
MTAX-RoSADC												**85**
MTAX-ROW												**1426**
S-I									4601	-1755	21750	**27033**
RSA												**14064**
RoSADC												**1109**
ROW												**41292**
TOTALS	**4027**	**-3178**	**2468**	**-190**	**626**	**85**	**1426**	**27033**	**14064**	**1109**	**41292**	

Note: features are in Billion MT

Source: ***Author's own calculations based on Thurlow (2008).***

Appendix B: The IFPRI CGE Model Specifications

Indices

Index	Variable definition
s	Formal activities
	Aliases of s: g
	Elements of s:
	agri,
	min,
	man,
	trade,
	serv;
is	Informal activities
	Aliases of is: ig
	Elements of is:
	agri,
	min,
	man,
	trade,
	serv;
f	Factors of production
	Elements of f:
	skl-lab,
	sskl-lab,
	uskl-lab,
	cap;
h	Households
	Elements of h:
	r-hhds,
	u-hhds;
r	Regions
	Elements of r:
	rsa,
	rosadc,
	row;

Parameters

Parameter	Symbol	Definition
va (s)		Elasticity of substitution among primary factors in the production function of sector *s*
sigmaT (s)	σ^T_s	Elasticity of transformation between domestic uses and exports in sector *s*
relacet (s)		Elasticity of transformation among exports to different destinations
sigmaQ (s)	σ^Q_s	Elasticity of substitution between domestic uses and imports of sector *s*
relasarm (s)		Elasticity of substitution among imports from different origins
at0 (s)		Activity tax rate for sector *s*
rebt0 (s)		VAT rebate tax rate for sector *s*
st0 (g)		Sales tax rate on commodity *g*
vtd0 (g)		VAT collected domestically tax rate on commodity *g*
th0 (h)		Household *h* income tax rate
te0		Enterprise income tax rate
mrge0 (g, r)		Share of export margins by commodity *g* and country of destination *r*
tm0 (g, r)		Import tax rate on good *g* from region *r*
vtb0 (g, r)		VAT collected at borders tax rate on good *g* imported from region *r*

Prices

Variable	Definition
PY (g)	Price index for domestic formal production *s*
PIY (is)	Domestic price for home- consumed commodity good *g*
PD (g)	Domestic price for marketed commodity good *g*
PX (r, g)	Producer price index for exports of commodity *g* to region *r*
PA (g)	Price index for aggregate Armington supply for good *g*
PC (h)	Consumption price for composite good *g* consumed by household *h*
PT	Price for transportation and marketing margins
PG	Price index for government expenditures
PTRAN	Price for social transfers
PE	Price for distributed profits
PINV	Investment price for composite good *g*
PFX (r)	Exchange rate respect region *r*
PY0(s)	Reference price for formal sector *s* production gross of activity tax
PA0(g,s)	Reference price for intermediate composite good *g* employed in sector *s* gross of VAT rebate

Production

Variable	Definition
X(s)	Domestic production of exports in sector *s*
Y(s)	Domestic total production (exports + domestic uses) in sector *s*
IY(s)	Home- consumption of commodity of sector *s*
ES(r)	Exports according to destination *r*
A(s)	Domestic output of composite activity *s*
MG	Domestic output of composite margins
C(h)	Household *h* total consumption
G	Government total consumption
INVEST	Domestic output of composite investment good

Factors

Variable	Definition
PF (f)	Price for factor *f*
FA0 (f, s)	Factor *f* demand in activity *s*
FIA0 (f, is)	Factor *f* demand in activity *is*
HF0 (h)	Factor *f* income for household *h*
EF0	Factor demand *f* income for enterprises

Income and expenditures

Variable	Definition
CA0 (g,s)	Intermediate demand of composite good *g* in sector *s*
CIA0 (g, is)	Intermediate demand of composite good *g* in sector *is*
CH0 (g,h)	Final demand of household *h* for marketed good *g*
IAH0 (s, h)	Final demand of household *h* for home consumed products of sector *is*
C0 (h)	Aggregate household *h* consumption
HR0 (r,h)	Remittances of household *h* from region *r*
HSV0 (h,)	Household *h* savings
HE0 (h)	Household *h* distributed profits
HG0 (h)	Household *h* social transfers
TP0 (“YTAX”, h)	Household *h* income tax

Variable	Definition
XE0 (r)	Enterprise payments to region *r*
ESV0	Enterprise savings
EG0	Enterprise social transfers
TE0 (“YTAX”, h)	Enterprise income tax
GD0 (g)	Final government demand for composite good *g*
FSV0 (r)	Foreign savings from region *r*
GSV0	Government savings
GE0	Government distributed profits
MTX0 (r, g)	Import duties on good *g* from region *r*
VTX0 (r, g)	VAT on imports of good *g* from region *r*
CS (g)	Final investment demand for good *g*
TA0 (“ATAX”, s)	Activity tax in sector *s*
TA0 (“REB”, s)	VAT rebate in sector *s*
TC0 (“VTD”, g)	Domestic VAT on good *g*
TC0 (“STAX”, g)	Sales tax on good *g*

Scaling parameters

Parameter	Definition
fsav (r)	Scaling parameter on foreign savings from region *r*
gsav	Scaling parameter on government savings

Appendix C: The GAMS/MPSGE Code for the IFPRI Model

In this appendix we present the GAMS/MPSGE code to perform and evaluate our simulations. This code is mainly compose of 3 parts:

1) The SAM, presented in Appendix A, is called and imported into the GAMS code. Then, we check for SAM consistency imposing that rows sums equal columns sums (the notion of double- book keeping). Finally, we report if there are negative values or empty rows or columns.

2) The SAM is manipulated and we move from a square matrix with numeric indices to model-relevant subtraces with meaningful text labels. This relies on the concept of "*tuples*". According to Rutherford (2003) "*these are multidimensional sets which can associated a numeric index with a text index*". In our case the SAM has 37 rows and columns and in this part of the code it is broken down into 11 logical subsets, whose dimension is indicated in brackets:

```
Production activities              A(5)
Production informal activities     IA(5)
Commodities                        C(5)
Trade margins                      M(3)
Primary factors                    F(4)
Enterprises                        E(1)
Private households                 H(2)
Government                         G(1)
Types of taxes                     T(7)
Rest of world                      X(3)
Investment- savings                I(1)
```

This allows us to divide the SAM into sub- matrices as in the map below. Note that the same labels are employed later in the code. All cells with no labels are empty.

	A	IA	C	M	F	E	H	G	T	X	I
A			ac								
IA							iah				
C	ca	cia		cm			ch	gd		er	cs
M			mc								
F	fa										
E					ef			eg			
H					hf	he		hg		hr	
G						ge			tr		
T	ta	tc				te	tp				
X		rc				xe					
I						esv	hsv	gsv		fsv	

3)The model itself is constructed. Using the MPSGE solver, we need zero profit conditions (block $sectors:), market clearing conditions (block $commodities:), and income balance (block $consumers:).

```
$TITLE An IFPRI CGE Model for Mozambique

$ontext
This model was developed to assess the impact of the Mozambican participation into the
Southern Africa Development Community (SADC). This code is part of the Ph.D. thesis "The
Mozambican Participation in SADC- A Liberalization Process trough Different Models and
Different Closures".
The study was conducted by Elisa Delpiazzo, under the supervision of Prof. Marco
Missaglia, University of Pavia. The analysis uses a GAMS/MPSGE CGE model based on the
2003 Mozambique SAM. The focus of the study is on examining the impact of a tariff
reduction as the one scheduled in the SADC Trade Protocol.
$offtext

set colorder /chk/;

set i SAM rows and column indices   /1*37/;

*SAM rows and columns are the same set:

alias (i,j);

table sam(i,j)  Base year social accounts

*Call the SAM from the worksheet in Excel format and import it in GAMS:

$call=xls2gms  i=sam5sectors2hhds3reg.xls   o=sam5sectors2hhds3reg.inc
$include sam5sectors2hhds3reg.inc
;

*Computation works best when features are around unit, so we scale the SAM values:

sam(i,j)        = sam(i,j)/1000;

display sam;

*Check the consistency of the SAM and report negative values and empty rows or columns:

parameter       samchk  Check of SAM consistency;
samchk(i) = (sum(j, sam(i,j)-sam(j,i)));
display samchk;
```

```
set  negval(i,j)   flag for negative elements;
negval(i,j) = yes$(sam(i,j)<0);
display negval;

set  empty(i,*)     flag for empty rows and columns;
empty(i, "row")= 1$(sum(j,sam(i,j))=0);
empty(j,"col")= 1$(sum(i,sam(i,j))=0);

display empty;

*Declare sets with which the SAM should be relabelled:

set     s    List of formal activities and commodities/
                AGRI    agriculture fishing forestry and breeding activities,
                MIN     mining,
                MAN     industry (food processing and beverages light and heavy
                       manufacturing metal products),
                TRADE   wholesales and retail trade,
                SERV    services/,

        is   List of informal activities and commodities/
                INF-AGRI    agriculture fishing forestry and breeding activities,
                INF-MIN     mining,
                INF-MAN     industry (food processing and beverages light and heavy
                             manufacturing metal products),
                INF-TRADE   wholesales and retail trade,
                INF-SERV    services/,

        m    Margins/
                TMD     domestic sales transactions costs,
                TMM     import transactions costs,
                TME     export transactions costs/,

        f    Factors of production/
                L1      unskilled labour,
                L2      semi-skilled labour,
                L3      skilled labour,
                K       capital/,

        h    Household /
                R-HHDS  rural households,
                U-HHDS  urban households /,

        e    Enterprise /ENTR/,

        t    Taxes/
```

```
                ATAX   Activity tax (subsidy),
                REB    Vat rebate (on intermediate uses),
                YTAX   Income tax (for households and private firms),
                VATB   VAT tax collected at borders (on imports gross of tariffs),
                VATD   VAT tax collected on domestic sales,
                STAX   Sales tax,
                MTAX   Import tax/,

        r    Regions/
                RSA      Republic of South Africa,
                ROSADC   Rest of SADC,
                ROW      Rest of World/

alias  (i,j), (s,g), (is,ig), (m,mm);

*Mapping the activities:

Set     mapa(i,s) Mapping from SAM to formal activities/
                1.AGRI,
                2.MIN,
                3.MAN,
                4.TRADE,
                5.SERV /,

        mapia(i,is) Mapping from SAM to informal activities/
                6.INF-AGRI,
                7.INF-MIN,
                8.INF-MAN,
                9.INF-TRADE,
                10.INF-SERV /,

        mapc(i,g) Mapping from SAM to commodities/
                11.AGRI,
                12.MIN,
                13.MAN,
                14.TRADE,
                15.SERV /,

        mapf(i,f) Mapping from SAM to factors of production /
                16.L1,
                17.L2,
                18.L3,
                19.K /,

        mapm(i,m) Mapping from SAM to marketing margins /
               20.TMD,
               21.TMM,
```

```
        22.TME /,

maph(i,h) Mapping from SAM to households /
        23.R-HHDS,
        24.U-HHDS /,

mape(i) Mapping from SAM to enterprise account /25/,

mapg(i)   Identifying government row           /26/,

mapt(i,t) Mapping from SAM to source of taxes /
         27.REB,
         28.ATAX,
         29.VATD,
         30.VATB,
         31.MTAX,
         32.STAX,
         33.YTAX /,

 mapi(i)   Identifying the investment and saving row /34/,

 mapx(i,r) Identifying the rest of the world /
         35.RSA,
         36.ROSADC,
         37.ROW /;

set     ss/a, ia, c, m, f, e, h, g, t, x, i/

*Generate a report of submatrix totals:

parameter     totals(*,*)        SAM totals for reporting;
totals("a","c") = sum((mapa(i,s), mapc(j,g)), sam(i,j));
totals("ia","h") = sum((mapia(i,is), maph(j,h)), sam(i,j));
totals("c","a") = sum((mapc(i,g), mapa(j,s)), sam(i,j));
totals("c","ia") = sum((mapc(i,g), mapia(j,is)), sam(i,j));
totals("c","m") = sum((mapc(i,g), mapm(j,m)), sam(i,j));
totals("c","h") = sum((mapc(i,g), maph(j,h)), sam(i,j));
totals("c","g") = sum((mapc(i,g), mapg(j)), sam(i,j));
totals("c","x") = sum((mapc(i,g), mapx(j,r)), sam(i,j));
totals("c","i") = sum((mapc(i,g), mapi(j)), sam(i,j));
totals("m","c") = sum((mapm(i,m), mapc(j,g)), sam(i,j));
totals("f","a") = sum((mapf(i,f), mapa(j,s)), sam(i,j));
totals("f", "ia") = sum((mapf(i,f), mapia(j,is)), sam(i,j));
totals("e","f") = sum((mape(i),   mapf(j,f)), sam(i,j));
totals("e","g") = sum((mape(i),   mapg(j)), sam(i,j));
totals("h","f") = sum((maph(i,h), mapf(j,f)), sam(i,j));
totals("h","e") = sum((maph(i,h), mape(j)), sam(i,j));
```

```
totals("h","g") = sum((maph(i,h), mapg(j)), sam(i,j));
totals("h","x") = sum((maph(i,h), mapx(j,r)), sam(i,j));
totals("g","e") = sum((mapg(i),   mape(j)), sam(i,j));
totals("g","t") = sum((mapg(i),   mapt(j,t)), sam(i,j));
totals("t","a") = sum((mapt(i,t), mapa(j,s)), sam(i,j));
totals("t","c") = sum((mapt(i,t), mapc(j,g)), sam(i,j));
totals("t","e") = sum((mapt(i,t), mape(j)), sam(i,j));
totals("t","h") = sum((mapt(i,t), maph(j,h)), sam(i,j));
totals("x","c") = sum((mapx(i,r),   mapc(j,g)), sam(i,j));
totals("x","e") = sum((mapx(i,r),   mape(j)), sam(i,j));
totals("i","e") = sum((mapi(i),   mape(j)), sam(i,j));
totals("i","h") = sum((mapi(i),   maph(j,h)), sam(i,j));
totals("i","g") = sum((mapi(i),   mapg(j)), sam(i,j));
totals("i","x") = sum((mapi(i),   mapx(j,r)), sam(i,j));

alias (ss,sss);

totals(ss,"total") = sum(sss, totals(ss,sss));
totals("total",ss) = sum(sss, totals(sss,ss));

option totals:1;
display totals;

*Extract sub- matrices from the SAM. When a sub- matrix is extracted the associated
*values in the original SAM are set equal to zero.

*Extraction of domestic production- related data from SAM:

Parameter
        ca0(g,s)     Intermediate inputs demand for formal sectors,
        cia0(g,is)   Intermediate input demand for informal sectors,
        fa0(f,s)     Factor demand (or value added) for formal sectors,
        fia0(f,is)   Factor demand (or value added) for informal sectors,
        ta0(t,s)     Tax collection,
        iah0(is,h)   Household consumption of own production,
        ac0(s,g)     Marketed output,
        iac0(is)     production of informal sectors;

loop((mapc(i,g), mapa(j,s)),      ca0(g,s) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapia(j,is)),    cia0(g,is) = sam(i,j); sam(i,j)=0;);
loop((mapf(i,f), mapa(j,s)),      fa0(f,s) = sam(i,j); sam(i,j)=0;);
loop((mapf(i,f), mapia(j,is)),    fia0(f,is) = sam(i,j); sam(i,j)=0;);
loop((mapt(i,t), mapa(j,s)),      ta0(t,s) = sam(i,j); sam(i,j)=0;);
loop((mapia(i,is), maph(j,h)),    iah0(is,h) = sam(i,j); sam(i,j)=0;);
loop((mapa(i,s), mapc(j,g)),      ac0(s,g) = sam(i,j); sam(i,j)=0;);

iac0(is) = sum(h,iah0(is,h));
```

```
*Extraction of commodity demand components from SAM:

Parameter
        mc0(m,g)        Marketing and transportation costs,
        tc0(t,g)        Indirect taxes,
        rc0(r,g)        Value of imports at cif price,
        cm0(g,m)        Sales to wholesale and retail margins,
        gd0(g)          Government demand,
        er0(g,r)        Export (fob),
        cs0(g)          Investment demand,
        ch0(g,h)        Private consumption;

loop((mapm(i,m), mapc(j,g)),    mc0(m,g) = sam(i,j); sam(i,j)=0;);
loop((mapt(i,t), mapc(j,g)),    tc0(t,g) = sam(i,j); sam(i,j)=0;);
loop((mapx(i,r), mapc(j,g)),    rc0(r,g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapm(j,m)),    cm0(g,m) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapg(j)),      gd0(g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapx(j,r)),    er0(g,r) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapi(j)),      cs0(g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), maph(j,h)),    ch0(g,h) = sam(i,j); sam(i,j)=0;);

*Extraction of factor- related data from SAM:

parameter
        hf0(h,f)    Factors income to households,
        ef0(f)      Factors income to enterprises;

loop((maph(i,h), mapf(j,f)),      hf0(h,f) = sam(i,j); sam(i,j)=0;);
loop((mape(i), mapf(j,f)),        ef0(f) = sam(i,j); sam(i,j)=0;);

*Extraction of household- related data from SAM:

parameter
        tp0(t,h)       Income tax payment by households
        he0(h)         Enterprise payment to households
        hg0(h)         Government transfer to households
        hr0(h,r)       Household income from abroad
        hsv0(h)        Household savings;

loop((mapt(i,t), maph(j,h)),     tp0(t,h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mape(j)),       he0(h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mapg(j)),       hg0(h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mapx(j,r)),     hr0(h,r) = sam(i,j); sam(i,j)=0;);
loop((mapi(i), maph(j,h)),       hsv0(h) = sam(i,j); sam(i,j)=0;);

*Extraction of enterprise- related data from SAM:
```

```
parameter
        te0(t)          Enterprise direct taxes
        ge0             Enterprise dividends paid to Government
        xe0(r)          Enterprise payments to foreigners
        esv0            Enterprise savings
        eg0             Government transfers to enterprise;

loop((mapt(i,t), mape(j)),      te0(t) = sam(i,j); sam(i,j)=0;);
loop((mapg(i), mape(j)),        ge0 = sam(i,j); sam(i,j)=0;);
loop((mapx(i,r), mape(j)),      xe0(r) = sam(i,j); sam(i,j)=0;);
loop((mapi(i), mape(j)),        esv0 = sam(i,j); sam(i,j)=0;);
loop((mape(i), mapg(j)),        eg0 = sam(i,j); sam(i,j)=0;);

*Extraction of other saving- related data from SAM:

parameter
        gsv0       Government saving
        fsv0(r)    Foreign saving;

loop((mapi(i), mapg(j)),     gsv0 = sam(i,j); sam(i,j)=0;);
loop((mapi(i), mapx(j,r)),   fsv0(r) = sam(i,j); sam(i,j)=0;);

*Extraction of other tax- related data from SAM:

parameter
        tr0(t)     Tax revenue;

loop((mapg(i), mapt(j,t)),     tr0(t) = sam(i,j); sam(i,j)=0;);

*Check if all values have been extracted from SAM:

display "All values should be zero if all data has been read:", sam;

display ca0,fa0,ta0,iah0,ac0,iac0,
        mc0,tc0,rc0,cm0,gd0,er0,cs0,ch0,
        hf0,ef0,
        tp0,he0,hg0,hr0,hsv0,
        te0,ge0,xe0,esv0,eg0,
        gsv0,fsv0,
        tr0;

*Introduction of tax and trade- related data:

table regtm(r,g) tariff revenue by country of origin and good
```

```
                    AGRI         MIN       MAN
RSA                 0.007       0.001    0.618
ROSADC              0.001           0    0.084
ROW                 0.040       0.004    1.382
;

table regvatb(r,g)   vat collected at borders by country of origin and good

                     AGRI         MIN         MAN         SERV
RSA                 0.022       0.004       1.110        0.065
ROSADC              0.003           0       0.151        0.004
ROW                 0.059       0.016       2.481        1.374
;

parameter
    mtx0(r,g)    total import duties on imports of good g from region r,
    tm0(g,r)     import tariff rate,
    vtx0(r,g)    total vat collected at borders on good g from region r,
    vtb0(g,r)    vat rate collected at borders on imports entering Armington supply;

mtx0(r,g) = regtm(r,g);
vtx0(r,g) = regvatb(r,g);
tm0(g,r)$rc0(r,g) = mtx0(r,g)/rc0(r,g);
vtb0(g,r)$rc0(r,g) = vtx0(r,g)/((1+tm0(g,r))*rc0(r,g));

display
mtx0, vtx0, tm0, vtb0;

*Manipulation of extracted values from SAM:

parameter
    at0(s)       activity tax (subsidies),
    rebt0(s)     vat rebate (on intermediate uses),
    st0(g)       sales tax,
    vtd0(g)      vat collected on domestic sold commodities entering Armington supply,
    th0(h)       household tax rate (on income from wages capital dividends and
                 transfers),
    et0          enterprise tax rate (on income from capital and transfers),
    as0(g)       total Armington supply,
    ex0(r,g)     exports of good G at producer price for region R,
    dm0(g)       domestic uses,
    ya0(g)       aggregate output from all sectors,
    c0(h)        total household consumption (own + marketed),
    ter0(g)      total exports of good G,
    tex0(r)      total exports to region R,
    mrge0(g,r)   export margin by country of destination and good
;
```

```
ter0(g) = sum(r, er0(g,r));
mrge0(g,r)$er0(g,r) = mc0("TME",g)*(er0(g,r)/ter0(g));
ex0(r,g) = er0(g,r) - mrge0(g,r);
tex0(r) = sum(g, ex0(r,g));
ya0(g) = max(sum(s, ac0(s,g)), ter0(g));
dm0(g) = ya0(g) - (sum(r, ex0(r,g)));
at0(s)$(not sum(g,ac0(s,g))=0) = ta0("ATAX",s)/sum(g,ac0(s,g));
rebt0(s)$(not(sum(g,ca0(g,s))=0)) = ta0("REB",s)/sum(g,ca0(g,s));
vtd0(g)$dm0(g) = tc0("VATD",g)/dm0(g);
th0(h) = tp0("YTAX",h)/(sum(f,hf0(h,f)) + he0(h) + hg0(h) + (sum(r,hr0(h,r))));
et0 = te0("YTAX")/(sum(f,ef0(f)) + eg0);
as0(g) = sum(r,rc0(r,g)) + sum(t,tc0(t,g)) + mc0("TMD",g) + mc0("TMM",g) + dm0(g);
st0(g)$as0(g) = tc0("STAX",g)/as0(g);
c0(h) = sum(g, ch0(g,h)) + sum(is, iah0(is,h));

display at0, rebt0, vtd0, th0, et0, as0, st0, ex0, ya0, dm0, ter0, tex0, mrge0;

parameter
py0(s)         Reference price of final activity products gross of activity tax,
pa0(g,s)       reference price of intermediate uses gross of VAT rebate;

py0(s)          = 1-at0(s);
pa0(g,s)        = 1+rebt0(s);

*Introduction of trade elasticities:

table elasticity(*,*) elasticities in CES and CET functions

                   sigmaQ     sigmaT      RELASARM    RELACET
AGRI                2.1         2.1          5.8         5.8
MIN                 3.1         3.1         13.2        13.2
MAN                 2.6         2.6          6.7         6.7
TRADE               1.9         1.9          3.8         3.8
SERV                2.1         2.1          3.9         3.9
;

parameter

sigmaQ(s)     Elasticity of substitution between imports and domestic uses,
sigmaT(s)     Elasticity of transformation between exports and domestic uses,
relasarm(s)   Elasticity of substitution among imports from different origins,
relacet(s)    Elasticity of transformation among exports to different destinations;

sigmaQ(s) = elasticity(s,"sigmaQ");
sigmaT(s) = elasticity(s,"sigmaT");
relasarm(s) = elasticity(s,"relasarm");
```

```
relacet(s) = elasticity(s, "relacet");


$ontext
$model:moz

$sectors:
x(s)                    !allocation of output to domestic and export markets
y(s)                    !sectoral output (domestic production) for formal sectors
iy(is)$iac0(is)         !sectoral output (domestic production) for informal sectors
es(r)$tex0(r)           !export activity (applies margins) per destination
a(s)                    !aggregate supply (armington aggregate)
mg                      !transport margins
c(h)                    !household consumption
gd                      !government consumption
invest                  !aggregate investment

$commodities:
py(g)                   !output price for formal sectors
piy(is)$iac0(is)        !output price for informal sectors
pd(g)$dm0(g)            !domestic sales price
px(r,g)$ex0(r,g)        !export price
pa(g)                   !composite demand price for marketed output
pc(h)                   !household consumption price
pt                      !trade and transportation margins
pf(f)                   !factor prices
pg                      !government consumption price
pe                      !enterprise rents
pfx(r)                  !price of foreign exchange
pinv                    !price of investments
ptran                   !price of social transfers

$consumers:
ra(h)                   !private households
entr                    !private firms
govt                    !government
foreign(r)              !foreigners

$auxiliary:
fsav(r)     !scaling parameter for foreign savings from region r
gsav        !scaling parameter for government savings

*Sectoral production combines primary factors and intermediates. the first sector
*produces market output and pays taxes, the second produces non- market output.

$prod:y(s)      s:0  va:0.5
o:py(g)         q:ac0(s,g)          a:govt    t:(at0(s))    p:py0(s)
```

```
i:pa(g)         q:ca0(g,s)             a:govt    t:(rebt0(s))  p:pa0(g,s)
i:pf(f)         q:fa0(f,s)    va:

$prod:iy(is)$iac0(is)      s:0  va:0.5
o:piy(is)         q:iac0(is)
i:pa(g)           q:cia0(g,is)
i:pf(f)           q:fia0(f,is)    va:

*Commodity supply to domestic and export markets is modelled as a constant
*elasticity of transformation function:

$prod:x(g)      td:relacet(g)  t(td):sigmaT(g)
o:pd(g)         q:dm0(g)
o:px(r,g)       q:ex0(r,g)
i:py(g)         q:ya0(g)

*Domestic production for export markets (at producer price) is decomposed into
*exports for different destinations (at final prices applying margins):

$prod:es(r)$tex0(r)
o:pfx(r)        q:(sum(g,er0(g,r)))
i:px(r,g)       q:ex0(r,g)
i:pt            q:(sum(g,mrge0(g,r)))

*Production of marketing and transportation services:

$prod:mg  s:0
o:pt            q:(sum((m,g),mc0(m,g)))
i:pa(g)         q:(sum(m, cm0(g,m)))

*Supply of Armington composite supply involves collection of import duties and
*other indirect taxes, the application of distribution margins:

$prod:a(g)      ddm:relasarm(g)  dm(ddm):sigmaQ(g)   d:0   m(dm):0
o:pa(g)         q:as0(g)               a:govt   t:st0(g)
i:pd(g)         q:dm0(g)          d:   a:govt   t:vtd0(g)
i:pt            q:mc0("TMD",g)    d:
i:pfx(r)        q:rc0(r,g)        m:   a:govt   t:(vtb0(g,r)+(tm0(g,r)*(1+vtb0(g,r))))
i:pt            q:mc0("TMM",g)    m:

*Investment demand:

$prod:invest
o:pinv          q:(sum(g,cs0(g)))
i:pa(g)         q:cs0(g)

*Household demand for market and non- market goods and services:
```

```
$prod:c(h)
o:pc(h)         q:(sum(g,ch0(g,h)) + sum(is,iah0(is,h)))
i:pa(g)         q:ch0(g,h)
i:piy(is)       q:iah0(is,h)

*Government demand:
$prod:gd
o:pg            q:(sum(g,gd0(g)))
i:pa(g)         q:gd0(g)

*Household income and expenditures:

$demand:ra(h)
d:pc(h)         q:c0(h)
e:pf(“l”)       q:(hf0(h,”l”)*(1-th(h)))          !labour income net of tax
e:pf(“k”)       q:(hf0(h,”k”) *(1-th(h)))         !capital income net of tax
e:pfx(r)        q:(hr0(h,r) *(1-th(h)))           !remittances net of tax
e:pinv          q:(-hsv0(h))                      !private savings
e:pe            q:(he0(h) *(1-th(h)))             !distributed profits net of tax
e:ptran         q:(hg0(h) *(1-th(h)))             !social transfers net of tax

*Enterprise income and expenditures:

$demand:entr
d:pe            q:(sum(h,he0(h)) + ge0)
e:pf("k")       q:(ef0("k")*(1-et0))                    !capital income net of tax
e:pfx(r)        q:(-xe0(r))                             !payments to foreigners
e:ptran         q:(eg0*(1-et0))                         !social transfers net of tax
e:pinv          q:(-(betaz)*(sum(g,cs0(g))))            !enterprise savings

*Government income and expenditures:

$demand:govt
d:pg            q:(sum(g,gd0(g)))
e:pinv          q:(-gsv0)                   r:gsav       !government savings
e:ptran         q:(-(eg0+sum(h,hg0(h))))                 !social trasnfers
e:pe            q:ge0                                    !distributed profits
e:pf("k")       q:(sum(h,(hf0("k",h)*(th0(h)))))         !tax on household capital
e:pf("l")       q:(sum(h,(hf0("L",h)*(th0(h)))))         !tax on household labour
e:pfx(r)        q:(sum(h,(hr0(h,r)*(th0(h)))))           !tax on household
                                                          remittances
e:pe            q:(sum(h,(he0(h)*(th0(h)))))             !tax on household
                                                          distributed profits
e:ptran         q:(sum(h,hg0(h)*(th0(h))))               !tax on household social
                                                          transfers
e:pf("k")       q:(ef0("k")*(et0))                       !tax on enterprise capital
```

```
e:ptran        q:(eg0*(et0))                                !tax on enterprise social
                                                             transfers

*Foreigners' income and expenditures:

$demand:foreign(r)
d:pfx(r)       q:(sum(g,er0(g,r)))
e:pinv         q:(-fsv0(r))                r:fsav(r)        !foreign savings
e:pfx(r)       q:(xe0(r))                                   !enterprise payments to
                                                             foreigners
e:pfx(r)       q:(-sum(h,hr0(h,r)))                         !household remittances
e:pfx(r)       q:(sum(g,rc0(r,g)))                          !imports

*Complementarity condition for the scaling parameter fsav:

$constraint:fsav(r)

 fsav(r)*fsv0(r)*pinv =e= pfx(r)*((sum(g,rc0(r,g)))-(sum(g,er0(g,r)))+ (xe0(r))-
                          sum(h,hr0(h,r))) ;

*Complementarity condition for the scaling parameter gsav:

$constraint:gsav

 govt/pg =e= (sum(g,gd0(g)));

$report:
v:formprod(s,g) o:py(g)       prod:y(s)
v:inforprod(is) o:piy(is)     prod:iy(is)
v:import(r,g)   i:pfx(r)      prod:a(g)
v:export(r,g)   o:px(r,g)     prod:x(g)
v:exportfp(r)   o:pfx(r)      prod:es(r)
v:domuses(g)    o:pd(g)       prod:x(g)
v:margins       o:pt          prod:mg
v:intermed(g,s) i:pa(g)       prod:y(s)
v:factdeminf(f,is)  i:pf(f)   prod:iy(is)
v:factdem(f,s)  i:pf(f)       prod:y(s)
v:armington(g)  o:pa(g)       prod:a(g)
v:rinvest       o:pinv        prod:invest
v:rcons(h)      o:pc(h)       prod:c(h)
v:rgovt         o:pg          prod:gd
v:renter        d:pe          demand:entr

$offtext
$sysinclude mpsgeset  moz

*Initialization of the scaling parameters and choice of the appropriate closure rule.
```

```
km.L=1;

*If the closure rule is EXOGENOUS foreign savings put an asterix before these commands:
fsav.L(r)=1;
fsav.LO(r)= -inf;
**If the closure rule is ENDOGENOUS foreign savings put an asterix before the command:
fsav.FX(r)=1;
*If the closure rule is EXOGENOUS governmemnt savings put an asterix before these commands:
gsav.L=1;
gsav.LO=-inf;
*If the closure rule is ENDOGENOUS government savings put an asterix before the command:
gsav.FX=1;

$include moz.gen
solve moz using mcp;

*Counterfactual: trade liberalization in the SADC area:

tm0(g,"rsa") = 0;
tm0(g,"rosadc") =0;

$include moz.gen
solve moz using mcp;
```

Appendix D: The "Bastard Keynesian" CGE Model Specifications

Indices

Index	Variable definition
s	Formal activities
	Aliases of *s*: *g*
	Elements of *s*:
	agri,
	min,
	man,
	trade,
	serv;
is	Informal activities
	Aliases of *is*: *ig*
	Elements of *is*:
	agri,
	min,
	man,
	trade,
	serv;
f	Factors of production
	Elements of *f*:
	lab,
	cap;
h	Households
	Elements of *h*:
	r-hhds,
	u-hhds;
r	Regions
	Elements of *r*:
	rsa,
	rosadc,
	row;

Appendix D

Parameters

Parameter	Symbol	Definition
va (s)		Elasticity of substitution among primary factors in the production function of sector *s*
sigmaT (s)	σ^T_s	Elasticity of transformation between domestic uses and exports in sector *s*
relacet (s)		Elasticity of transformation among exports to different destinations
sigmaQ (s)	σ^Q_s	Elasticity of substitution between domestic uses and imports of sector *s*
relasarm (s)		Elasticity of substitution among imports from different origins
at0 (s)		Activity tax rate for sector *s*
rebt0 (s)		VAT rebate tax rate for sector *s*
st0 (g)		Sales tax rate on commodity *g*
vtd0 (g)		VAT collected domestically tax rate on commodity *g*
th0 (h)		Household *h* income tax rate
te0		Enterprise income tax rate
mrge0 (g, r)		Share of export margins by commodity *g* and country of destination *r*
tm0 (g, r)		Import tax rate on good *g* from region *r*
vtb0 (g, r)		VAT collected at borders tax rate on good *g* imported from region *r*
alphaz(h)		Share of household *h* savings on total investments
betaz		Share of enterprise savings on total investments

Prices

Variable	Definition
PY (g)	Price index for domestic formal production *s*
PIY (is)	Domestic price for home- consumed commodity good *g*
PD (g)	Domestic price for marketed commodity good *g*
PX (r, g)	Producer price index for exports of commodity *g* to region *r*
PA (g)	Price index for aggregate Armington supply for good *g*
PC (h)	Consumption price for composite good *g* consumed by household *h*
PT	Price for transportation and marketing margins
PG	Price index for government expenditures
PTRAN	Price for social transfers
PE	Price for distributed profits
PINV	Investment price for composite good *g*
PFX (r)	Exchange rate respect region *r*
PY0(s)	Reference price for formal sector *s* production gross of activity tax
PA0(g,s)	Reference price for intermediate composite good *g* employed in sector *s* gross of VAT rebate

Production

Variable	Definition
X(s)	Domestic production of exports in sector *s*
Y(s)	Domestic total production (exports + domestic uses) in sector *s*
IY(s)	Home- consumption of commodity of sector *s*
ES(r)	Exports according to destination *r*
A(s)	Domestic output of composite activity *s*
MG	Domestic output of composite margins
C(h)	Household *h* total consumption
G	Government total consumption
INVEST	Domestic output of composite investment good

Factors

Variable	Definition
PF (f)	Price for factor *f*
FA0 (f, s)	Factor *f* demand in activity *s*
FIA0 (f, is)	Factor *f* demand in activity *is*
HF0 (h)	Factor *f* income for household *h*
EF0	Factor demand *f* income for enterprises

Income and expenditures

Variable	Definition
CA0 (g,s)	Intermediate demand of composite good *g* in sector *s*
CIA0 (g, is)	Intermediate demand of composite good *g* in sector *is*
CH0 (g,h)	Final demand of household *h* for marketed good *g*
IAH0 (s, h)	Final demand of household *h* for home consumed products of sector *is*
C0 (h)	Aggregate household *h* consumption
HR0 (r,h)	Remittances of household *h* from region *r*
HSV0 (h,)	Household *h* savings
HE0 (h)	Household *h* distributed profits
HG0 (h)	Household *h* social transfers
TP0 (“YTAX”, h)	Household *h* income tax

Variable	**Definition**
XE0 (r)	Enterprise payments to region *r*
ESV0	Enterprise savings
EG0	Enterprise social transfers
TE0 (“YTAX”, h)	Enterprise income tax
GD0 (g)	Final government demand for composite good *g*
FSV0 (r)	Foreign savings from region *r*
GSV0	Government savings
GE0	Government distributed profits
MTX0 (r, g)	Import duties on good *g* from region *r*
VTX0 (r, g)	VAT on imports of good *g* from region *r*
CS (g)	Final investment demand for good *g*
TA0 (“ATAX”, s)	Activity tax in sector *s*
TA0 (“REB”, s)	VAT rebate in sector *s*
TC0 (“VTD”, g)	Domestic VAT on good *g*
TC0 (“STAX”, g)	Sales tax on good *g*

Scaling parameters

Parameter	**Definition**
km	Scaling parameter on labour supply
fsav (r)	Scaling parameter on foreign savings from region *r*
gsav	Scaling parameter on government savings

Appendix E: The GAMS/MPSGE Code for the "Bastard Keynesian" Model

```
$TITLE A "Bastard Keynesian" CGE model for Mozambique

$ontext
This model was developed to assess the impact of the Mozambican participation into the
Southern Africa Development Community (SADC). This code is part of the Ph.D. thesis "The
Mozambican Participation in SADC- A Liberalization Process trough Different Models and
Different Closures".
The study was conducted by Elisa Delpiazzo, under the supervision of Prof. Marco
Missaglia, University of Pavia. The analysis uses a GAMS/MPSGE CGE model based on the
2003 Mozambique SAM. The focus of the study is on examining the impact of a tariff
reduction as the one scheduled in the SADC Trade Protocol.
$offtext

set colorder /chk/;

set i SAM rows and column indices   /1*35/;

*SAM rows and columns are the same set:

alias (i,j);

table sam(i,j)  Base year social accounts

*Call the SAM from the worksheet in Excel format and import it in GAMS:

$call=xls2gms  i=bksam.xls   o=bksam.inc
$include bksam.inc
;

*Computation works best when features are around unit, so we scale the SAM values:

sam(i,j)        = sam(i,j)/1000;

display sam;

*Check the consistency of the SAM and report negative values and empty rows or columns:
parameter       samchk  Check of SAM consistency;
samchk(i) = (sum(j, sam(i,j)-sam(j,i)));
display samchk;

set  negval(i,j)   flag for negative elements;
negval(i,j) = yes$(sam(i,j)<0);
```

```
display negval;

set  empty(i,*)     flag for empty rows and columns;
empty(i, "row")= 1$(sum(j,sam(i,j))=0);
empty(j,"col")= 1$(sum(i,sam(i,j))=0);

display empty;

*Declare sets  with which the SAM should be relabbeled:

set     s    List of formal activities and commodities/
                AGRI    agriculture fishing forestry and breeding activitities,
                MIN     mining,
                MAN     industry  (food  processing  and  beverages  light  and  heavy
                       manufacturing metal products),
                TRADE   wholesales and retail trade,
                SERV    services/,

        is   List of informal activities and commodities/
                INF-AGRI   agriculture fishing forestry and breeding activitities,
                INF-MIN    mining,
                INF-MAN    industry  (food  processing  and  beverages  light  and  heavy
                          manufacturing metal products),
                INF-TRADE  wholesales and retail trade,
                INF-SERV   services/,

        m    Margins/
                TMD     domestic sales transactions costs,
                TMM     import transactions costs,
                TME     export transactions costs/,

        f    Factors of production/
                L       labour,
                K       capital/,

        h    Household /
                RHHDS   rural households
                UHHDS   urban households/,

        e    Enterprise /ENTR/,

        t    Taxes/
                ATAX   Activity tax (subsidy),
                REB    Vat rebate (on intermediate uses),
                YTAX   Income tax (for households and private firms),
                VATB   VAT tax collected at borders (on imports gross of tariffs),
```

```
            VATD   VAT tax collected on domestic sales,
            STAX   Sales tax,
            MTAX   Import tax/,

        r    Regions/
            RSA      Republic of South Africa,
            ROSADC   Rest of SADC,
            ROW      Rest of World/

alias  (i,j), (s,g), (is,ig), (m,mm);

*Mapping the activities:

Set     mapa(i,s) Mapping from SAM to formal activities/
            1.AGRI,
            2.MIN,
            3.MAN,
            4.TRADE,
            5.SERV /,

        mapia(i,is) Mapping from SAM to informal activities/
            6.INF-AGRI,
            7.INF-MIN,
            8.INF-MAN,
            9.INF-TRADE,
            10.INF-SERV /,

        mapc(i,g) Mapping from SAM to commodities/
            11.AGRI,
            12.MIN,
            13.MAN,
            14.TRADE,
            15.SERV /,

        mapf(i,f) Mapping from SAM to factors of production /
            16.L,
            17.K /,

        mapm(i,m) Mapping from SAM to marketing margins /
           18.TMD,
           19.TMM,
           20.TME /,

        maph(i,h) Mapping from SAM to households /
           21.RHHDS,
           22.UHHDS/,
```

```
        mape(i) Mapping from SAM to enterprise account /23/,

        mapg(i) Identifying government row          /24/,

        mapt(i,t) Mapping from SAM to source of taxes /
                 25.REB,
                 26.ATAX,
                 27.VATD,
                 28.VATB,
                 29.MTAX,
                 30.STAX,
                 31.YTAX /,

         mapi(i) Identifying the investment and saving row /32/,

         mapx(i,r) Mapping from SAM to the rest of the world /
                 33.RSA,
                 34.ROSADC,
                 35.ROW /;

set     ss/a, ia, c, m, f, e, h, g, t, x, i/

*Generate a report of submatrix totals:

parameter     totals(*,*)        SAM totals for reporting;
totals("a","c") = sum((mapa(i,s), mapc(j,g)), sam(i,j));
totals("ia","h") = sum((mapia(i,is), maph(j,h)), sam(i,j));
totals("c","a") = sum((mapc(i,g), mapa(j,s)), sam(i,j));
totals("c","ia") = sum((mapc(i,g), mapia(j,is)), sam(i,j));
totals("c","m") = sum((mapc(i,g), mapm(j,m)), sam(i,j));
totals("c","h") = sum((mapc(i,g), maph(j,h)), sam(i,j));
totals("c","g") = sum((mapc(i,g), mapg(j)), sam(i,j));
totals("c","x") = sum((mapc(i,g), mapx(j,r)), sam(i,j));
totals("c","i") = sum((mapc(i,g), mapi(j)), sam(i,j));
totals("m","c") = sum((mapm(i,m), mapc(j,g)), sam(i,j));
totals("f","a") = sum((mapf(i,f), mapa(j,s)), sam(i,j));
totals("f", "ia") = sum((mapf(i,f), mapia(j,is)), sam(i,j));
totals("e","f") = sum((mape(i),   mapf(j,f)), sam(i,j));
totals("e","g") = sum((mape(i),   mapg(j)), sam(i,j));
totals("h","f") = sum((maph(i,h), mapf(j,f)), sam(i,j));
totals("h","e") = sum((maph(i,h), mape(j)), sam(i,j));
totals("h","g") = sum((maph(i,h), mapg(j)), sam(i,j));
totals("h","x") = sum((maph(i,h), mapx(j,r)), sam(i,j));
totals("g","e") = sum((mapg(i),   mape(j)), sam(i,j));
totals("g","t") = sum((mapg(i),   mapt(j,t)), sam(i,j));
totals("t","a") = sum((mapt(i,t), mapa(j,s)), sam(i,j));
totals("t","c") = sum((mapt(i,t), mapc(j,g)), sam(i,j));
```

```
totals("t","e") = sum((mapt(i,t), mape(j)), sam(i,j));
totals("t","h") = sum((mapt(i,t), maph(j,h)), sam(i,j));
totals("x","c") = sum((mapx(i,r),   mapc(j,g)), sam(i,j));
totals("x","e") = sum((mapx(i,r),   mape(j)), sam(i,j));
totals("i","e") = sum((mapi(i),   mape(j)), sam(i,j));
totals("i","h") = sum((mapi(i),   maph(j,h)), sam(i,j));
totals("i","g") = sum((mapi(i),   mapg(j)), sam(i,j));
totals("i","x") = sum((mapi(i),   mapx(j,r)), sam(i,j));

alias (ss,sss);

totals(ss,"total") = sum(sss, totals(ss,sss));
totals("total",ss) = sum(sss, totals(sss,ss));

option totals:1;
display totals;

*Extract sub- matrices from the SAM. When a sub- matrix is extracted the associated
*values in the original SAM are set equal to zero.

*Extraction of domestic production- related data from SAM:

Parameter
        ca0(g,s)    Intermediate inputs demand for formal sectors,
        cia0(g,is)  Intermediate input demand for informal sectors,
        fa0(f,s)    Factor demand (or value added) for formal sectors,
        fia0(f,is)  Factor demand (or value added) for informal sectors,
        ta0(t,s)    Tax collection,
        iah0(is,h)  Household consumption of own production,
        ac0(s,g)    Marketed output,
        iac0(is)    production of informal sectors;

loop((mapc(i,g), mapa(j,s)),     ca0(g,s) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapia(j,is)),   cia0(g,is) = sam(i,j); sam(i,j)=0;);
loop((mapf(i,f), mapa(j,s)),     fa0(f,s) = sam(i,j); sam(i,j)=0;);
loop((mapf(i,f), mapia(j,is)),   fia0(f,is) = sam(i,j); sam(i,j)=0;);
loop((mapt(i,t), mapa(j,s)),     ta0(t,s) = sam(i,j); sam(i,j)=0;);
loop((mapia(i,is), maph(j,h)),   iah0(is,h) = sam(i,j); sam(i,j)=0;);
loop((mapa(i,s), mapc(j,g)),     ac0(s,g) = sam(i,j); sam(i,j)=0;);

iac0(is) = sum(h,iah0(is,h));

*Extraction of commodity demand components from SAM:

Parameter
        mc0(m,g)        Marketing and transportation costs,
        tc0(t,g)        Indirect taxes,
```

```
        rc0(r,g)        Value of imports at cif price,
        cm0(g,m)        Sales to wholesale and retail margins,
        gd0(g)          Government demand,
        er0(g,r)        Export (fob),
        cs0(g)          Investment demand,
        ch0(g,h)        Private consumption;

loop((mapm(i,m), mapc(j,g)),    mc0(m,g) = sam(i,j); sam(i,j)=0;);
loop((mapt(i,t), mapc(j,g)),    tc0(t,g) = sam(i,j); sam(i,j)=0;);
loop((mapx(i,r), mapc(j,g)),    rc0(r,g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapm(j,m)),    cm0(g,m) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapg(j)),      gd0(g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapx(j,r)),    er0(g,r) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapi(j)),      cs0(g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), maph(j,h)),    ch0(g,h) = sam(i,j); sam(i,j)=0;);

*Extraction of factor- related data from SAM:

parameter
        hf0(f,h)    Factors income to households,
        ef0(f)      Factors income to enterprises;

loop((maph(i,h), mapf(j,f)),      hf0(f,h) = sam(i,j); sam(i,j)=0;);
loop((mape(i), mapf(j,f)),        ef0(f) = sam(i,j); sam(i,j)=0;);

*Extraction of household- related data from SAM:

parameter
        tp0(t,h)         Income tax payment by households
        he0(h)           Enterprise payment to households
        hg0(h)           Government transfer to households
        hr0(h,r)         Household income from abroad
        hsv0(h)          Household savings;

loop((mapt(i,t), maph(j,h)),     tp0(t,h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mape(j)),       he0(h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mapg(j)),       hg0(h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mapx(j,r)),     hr0(h,r) = sam(i,j); sam(i,j)=0;);
loop((mapi(i), maph(j,h)),       hsv0(h) = sam(i,j); sam(i,j)=0;);

*Extraction of enterprise- related data from SAM:
parameter
        te0(t)          Enterprise direct taxes
        ge0             Enterprise dividends paid to Government
        xe0(r)          Enterprise payments to foreigners
        esv0            Enterprise savings
        eg0             Government transfers to enterprise;
```

```
loop((mapt(i,t), mape(j)),      te0(t) = sam(i,j); sam(i,j)=0;);
loop((mapg(i), mape(j)),        ge0 = sam(i,j); sam(i,j)=0;);
loop((mapx(i,r), mape(j)),      xe0(r) = sam(i,j); sam(i,j)=0;);
loop((mapi(i), mape(j)),        esv0 = sam(i,j); sam(i,j)=0;);
loop((mape(i), mapg(j)),        eg0 = sam(i,j); sam(i,j)=0;);

*Extraction of other saving- related data from SAM:

parameter
        gsv0       Government saving
        fsv0(r)    Foreign saving;

loop((mapi(i), mapg(j)),     gsv0 = sam(i,j); sam(i,j)=0;);
loop((mapi(i), mapx(j,r)),   fsv0(r) = sam(i,j); sam(i,j)=0;);

*Extraction of other tax- related data from SAM:

parameter
        tr0(t)     Tax revenue;

loop((mapg(i), mapt(j,t)),     tr0(t) = sam(i,j); sam(i,j)=0;);

*Check if all values have been extracted from SAM:

display "All values should be zero if all data has been read:", sam;

display ca0,fa0,ta0,iah0,ac0,iac0,
        mc0,tc0,rc0,cm0,gd0,er0,cs0,ch0,
        hf0,ef0,
        tp0,he0,hg0,hr0,hsv0,
        te0,ge0,xe0,esv0,eg0,
        gsv0,fsv0,
        tr0;

*Introduction of tax- and trade- related data:

table regtm(r,g) tariff revenue by country of origin and good

                  AGRI         MIN      MAN
RSA               0.007          0    0.619
ROSADC            0.001          0    0.084
ROW               0.040      0.005    1.381
;

table regvatb(r,g)   vat collected at borders by country of origin and good
```

```
                    AGRI        MIN         MAN         SERV
RSA                 0.022       0.004       1.110       0.065
ROSADC              0.003           0       0.151       0.004
ROW                 0.059       0.016       2.481       1.374
;

parameter
    mtx0(r,g)    total import duties on imports of good g from region r,
    tm0(g,r)     import tariff rate,
    vtx0(r,g)    total vat collected at borders on good g from region r,
    vtb0(g,r)    vat rate collected at borders on imports entering Armington supply;

mtx0(r,g) = regtm(r,g);
vtx0(r,g) = regvatb(r,g);
tm0(g,r)$rc0(r,g) = mtx0(r,g)/rc0(r,g);
vtb0(g,r)$rc0(r,g) = vtx0(r,g)/((1+tm0(g,r))*rc0(r,g));

display
mtx0, vtx0, tm0, vtb0;

*Manipulation of extracted vlues from SAM:

parameter
    at0(s)       activity tax (subsidies),
    rebt0(s)     vat rebate (on intermediate uses),
    st0(g)       sales tax,
    vtd0(g)      vat collected on domestic saled commodities entering Armington supply,
    th0(h)       household tax rate (on income from wages capital dividends and
                 transfers),
    et0          enterprise tax rate (on income from capital and transfers),
    as0(g)       total Armington supply,
    ex0(r,g)     exports of good G at producer price for region R,
    dm0(g)       domestic uses,
    ya0(g)       aggregate output from all sectors,
    c0(h)        total household consumtpion (own + marketed),
    ter0(g)      total exports of good G,
    tex0(r)      total exports to region R,
    mrge0(g,r)   export margin by contry of destination and good,
    alphaz(h)    household h share on total investments,
    betaz        enterprise share in total investments,
    sr(h)        saving propensity for household h
;

ter0(g) = sum(r, er0(g,r));
mrge0(g,r)$er0(g,r) = mc0("TME",g)*(er0(g,r)/ter0(g));
ex0(r,g) = er0(g,r) - mrge0(g,r);
tex0(r) = sum(g, ex0(r,g));
```

```
ya0(g) = max(sum(s, ac0(s,g)), ter0(g));
dm0(g) = ya0(g) - (sum(r, ex0(r,g)));
at0(s)$(not sum(g,ac0(s,g))=0) = ta0("ATAX",s)/sum(g,ac0(s,g));
rebt0(s)$(not(sum(g,ca0(g,s))=0)) = ta0("REB",s)/sum(g,ca0(g,s));
vtd0(g)$dm0(g) = tc0("VATD",g)/dm0(g);
th0(h) = tp0("YTAX",h)/(sum(f,hf0(f,h)) + he0(h) + hg0(h) + (sum(r,hr0(h,r))));
et0 = te0("YTAX")/(sum(f,ef0(f)) + eg0);
as0(g) = sum(r,rc0(r,g)) + sum(t,tc0(t,g)) + mc0("TMD",g) + mc0("TMM",g) + dm0(g);
st0(g)$as0(g) = tc0("STAX",g)/as0(g);
c0(h) = sum(g, ch0(g,h)) + sum(is, iah0(is,h));
alphaz(h) = hsv0(h)/sum(g, cs0(g));
betaz = esv0/sum(g,cs0(g));
sr(h) = hsv0(h)/((1-th0(h))*(sum(f,hf0(f,h)) + he0(h) + hg0(h) + (sum(r,hr0(h,r)))));

display at0, rebt0, vtd0, th0, et0, as0, st0, ex0, ya0, dm0, ter0, tex0, mrge0, c0,
alphaz, betaz, sr;

parameter
py0(s)        Reference price for final activity products gross of activity tax,
pa0(g,s)      Reference price of intermediate uses gross of VAT rebate;

py0(s)          = 1-at0(s);
pa0(g,s)        = 1+rebt0(s);

*Introduction of trade elasticities:

table elasticity(*,*) elasticities in CES and CET functions

                   sigmaQ     sigmaT      RELASARM    RELACET
AGRI                2.1        2.1          5.8         5.8
MIN                 3.1        3.1         13.2        13.2
MAN                 2.6        2.6          6.7         6.7
TRADE               1.9        1.9          3.8         3.8
SERV                2.1        2.1          3.9         3.9
;

parameter

sigmaQ(s)    Elasticity of substitution between imports and domestic uses,
sigmaT(s)    Elasticity of transformation between exports and domestic uses,
relasarm(s)  Elasticity of substitution among imports from different origins,
relacet(s)   Elasticity of transformation among exports to different destinations
;

sigmaQ(s) = elasticity(s,"sigmaQ");
sigmaT(s) = elasticity(s,"sigmaT");
relasarm(s) = elasticity(s,"relasarm");
```

```
relacet(s) = elasticity(s, "relacet");

$ontext
$model:moz

$sectors:
x(s)                          !allocation of output to domestic and export markets
y(s)                          !sectoral output (domestic production) for formal sectors
iy(is)$iac0(is)               !sectoral output (domestic production) for informal sectors
es(r)$tex0(r)                 !export activity (applies margins) per destination
a(s)                          !aggregate supply (armington aggregate)
mg                            !transport margins
c(h)                          !household consumption
gd                            !government consumption
invest                        !aggregate investments

$commodities:
py(g)               !output price for formal sectors
piy(is)$iac0(is)    !output price for informal sectors
pd(g)$dm0(g)        !domestic sales price
px(r,g)$ex0(r,g)    !export price
pa(g)               !composite demand price for marketed output
pc(h)               !household consumption price
pt                  !trade and transportation margins
pf(f)               !factor prices
pg                  !government consumption price
pe                  !enterprise rents
pfx(r)              !price of foreign exchange
pinv                !price of investments
ptran               !price of social transfers

$consumers:
ra(h)       !private households
entr        !private firms
govt        !government
foreign(r)  !foreigners

$auxiliary:
Km           !Keynesian multiplier
fsav(r)      !scaling parameter for foreign savings from region r
gsav         !scaling parameter for government savings

*Sectoral production combines primary factors and intermediates. The first sector
*produces market output ad pays taxes, the second produces non- market output.

$prod:y(s)      s:0  va:0.5
o:py(g)         q:ac0(s,g)          a:govt    t:(at0(s))    p:py0(s)
```

```
i:pa(g)         q:ca0(g,s)            a:govt    t:(rebt0(s))  p:pa0(g,s)
i:pf(f)         q:fa0(f,s)    va:

$prod:iy(is)$iac0(is)      s:0  va:0.5
o:piy(is)         q:iac0(is)
i:pa(g)           q:cia0(g,is)
i:pf(f)           q:fia0(f,is)    va:

*Commodity supply to domestic and export markets is modelled as a constant
*elasticity of transformation function:

$prod:x(g)      t:sigmaT(g)   tt(t):relacet(g)
o:pd(g)         q:dm0(g)
o:px(r,g)       q:ex0(r,g)    tt:
i:py(g)         q:ya0(g)

*Domestic production for export markets (at producer price) is decomposed
*into exports for different destinations (at final prices applying margins):

$prod:es(r)$tex0(r)
o:pfx(r)        q:(sum(g,er0(g,r)))
i:px(r,g)       q:ex0(r,g)
i:pt            q:(sum(g,mrge0(g,r)))

*Production of marketing and transportation services:

$prod:mg  s:0
o:pt            q:(sum((m,g),mc0(m,g)))
i:pa(g)         q:(sum(m, cm0(g,m)))

*Supply of Armington composite supply involves collection of import dulie and
*other indirect taxes, the application of distribution margins:

$prod:a(g)      ddm:relasarm(g)  dm(ddm):sigmaQ(g)   d:0   m(dm):0
o:pa(g)    q:as0(g)                   a:govt       t:st0(g)
i:pd(g)    q:dm0(g)          d:         a:govt       t:vtd0(g)
i:pt       q:mc0("TMD",g)   d:
i:pfx(r)   q:rc0(r,g)        m:       a:govt       t:(vtb0(g,r)+(tm0(g,r)*(1+vtb0(g,r))))
i:pt       q:mc0("TMM",g)   m:

*Household demand for market and non- market goods and services:

$prod:c(h)
o:pc(h)         q:c0(h)
i:pa(g)         q:ch0(g,h)
i:piy(is)       q:iah0(is,h)
```

```
*Government demand:

$prod:gd
o:pg            q:(sum(g,gd0(g)))
i:pa(g)         q:gd0(g)

*Investment demand:

$prod:invest
o:pinv          q:(sum(g,cs0(g)))
i:pa(g)         q:cs0(g)

*Household income and expenditures:

$demand:ra(h)
d:pc(h)        q:c0(h)
e:pf("k")      q:(hf0("k",h)*(1-th0(h)))                  !capital income net of tax
e:pf("l")      q:(hf0("L",h)*(1-th0(h)))      r:km        !labour income net of tax
e:pfx(r)       q:(hr0(h,r)*(1-th0(h)))                    !remittances net of tax
e:pe           q:(he0(h)*(1-th0(h)))                      !distributed  profits  net  of
                                                          tax
e:ptran        q:(hg0(h)*(1-th0(h)))                      !social transfers net of tax
e:pinv         q:(-alphaz(h)*(sum(g,cs0(g))))             !private savings

*Enterprise income and expenditures:

$demand:entr
d:pe           q:(sum(h,he0(h)) + ge0)
e:pf("k")      q:(ef0("k")*(1-et0))                        !capital income net of tax
e:pfx(r)       q:(-xe0(r))                                 !payments to foreigners
e:ptran        q:(eg0*(1-et0))                             !social transfers net of tax
e:pinv         q:(-(betaz)*(sum(g,cs0(g))))                !enterprise savings

*Government income and expenditures:

$demand:govt
d:pg           q:(sum(g,gd0(g)))
e:pinv         q:(-gsv0)                         r:gsav     !government savings
e:ptran        q:(-(eg0+sum(h,hg0(h))))                     !social trasnfers
e:pe           q:ge0                                        !distributed profits
e:pf("k")      q:(sum(h,(hf0("k",h)*(th0(h)))))             !tax on household capital
e:pf("l")      q:(sum(h,(hf0("L",h)*(th0(h)))))  r:km       !tax on household labour
e:pfx(r)       q:(sum(h,(hr0(h,r)*(th0(h)))))               !tax on household
                                                             remittances
e:pe           q:(sum(h,(he0(h)*(th0(h)))))                 !tax on household
                                                             distributed profits
```

```
e:ptran         q:(sum(h,hg0(h)*(th0(h))))                      !tax on household social
                                                                 transfers
e:pf("k")       q:(ef0("k")*(et0))                              !tax on enterprise capital
e:ptran         q:(eg0*(et0))                                   !tax on enterprise social
                                                                 transfers

*Foreigners' income and expenditures:

$demand:foreign(r)
d:pfx(r)        q:(sum(g,er0(g,r)))
e:pinv          q:(-fsv0(r))                  r:fsav(r)         !foreign savings
e:pfx(r)        q:(xe0(r))                                      !enterprise payments to
                                                                 foreigners
e:pfx(r)        q:(-sum(h,hr0(h,r)))                            !household remittances
e:pfx(r)        q:(sum(g,rc0(r,g)))                             !imports

*Complementarity condition for the scaling parameter km:

$constraint:km

 sum(h,ra(h)) =e= sum(h,((1-sr(h))*(1-th0(h))*(hf0("l",h)*pf("l")+hf0("k",h)*pf("k") +
                  he0(h) *pe+ hg0(h)*pg + (sum(r,hr0(h,r)*pfx(r))))));

*Complementarity condition for the scaling parameter fsav:

$constraint:fsav(r)

 fsav(r)*fsv0(r)*pinv =e= pfx(r)*((sum(g,rc0(r,g)))-(sum(g,er0(g,r)))+ (xe0(r))-
                          sum(h,hr0(h,r))) ;

*Complementarity condition for the scaling parameter gsav:

$constraint:gsav

 govt/pg =e= (sum(g,gd0(g)));

$report:
v:formprod(s,g) o:py(g)       prod:y(s)
v:inforprod(is) o:piy(is)     prod:iy(is)
v:import(r,g)   i:pfx(r)      prod:a(g)
v:export(r,g)   o:px(r,g)     prod:x(g)
v:exportfp(r)   o:pfx(r)      prod:es(r)
v:domuses(g)    o:pd(g)       prod:x(g)
v:margins       o:pt          prod:mg
v:intermed(g,s) i:pa(g)       prod:y(s)
v:factdeminf(f,is)  i:pf(f)   prod:iy(is)
v:factdem(f,s)  i:pf(f)       prod:y(s)
```

```
v:armington(g)  o:pa(g)       prod:a(g)
v:rinvest       o:pinv        prod:invest
v:rcons(h)      o:pc(h)       prod:c(h)
v:rgovt         o:pg          prod:gd
v:renter        d:pe          demand:entr

$offtext
$sysinclude mpsgeset  moz

*Initialization of the scaling parameters and choice of the appropriate closure rule.

km.L=1;

*If the closure rule is EXOGENOUS foreign savings put an asterix before these commands:
fsav.L(r)=1;
fsav.LO(r)= -inf;
**If the closure rule is ENDOGENOUS foreign savings put an asterix before the command:
fsav.FX(r)=1;
*If the closure rule is EXOGENOUS governmemnt savings put an asterix before these
commands:
gsav.L=1;
gsav.LO=-inf;
*If the closure rule is ENDOGENOUS government savings put an asterix before the command:
gsav.FX=1;

$include moz.gen
solve moz using mcp;

*Counterfactual: trade liberalization in the SADC area:

tm0(g,"rsa") = 0;
tm0(g,"rosadc") =0;

$include moz.gen
solve moz using mcp;
```

Appendix F: The 2003 Structuralist/ Post- Keynesian SAM

	Y	IY	Supply	Marg	Enter	Rhhds	Uhhds	Govt	Row	Invest
Y	148,354		-148,354							
IY		26,224				-26,224				
Supply	-51,377	-5,743	171,805	-21,034		-9165	-25,154	-14,745	-30,526	-14,061
w	-53,185	-15,856				40,923	28,118			
r	-29,617	-2,664			32,281					
Atax	190							-190		
VATreb	3,178							-3,178		
VATb	-1,446	-162				-697	-1,914	5,289		-1,070
Mtax	-585	-65				-282	-773	2,137		-432
VATd			-4,027					4,027		
Stax			-2,468					2,468		
Dtax					-925	-133	-2,071	3,129		
TMD			-15,783	15,783						
TMM	-1,115	-125		4,078		-538	-1,475			-825
TME			-1,173	1,173						
Row	-14,397	-1,609			-3,833	-6,938	-19,043		56,465	-10,645
SAV					-1,673	-445	-1,837	-1,518	-24,596	27033
Transf					146	117	294	-577		
Rem							1,343		-1,343	
Dprof					25,996	3,382	22,512	102		

Source: ***Author's own calculations***

Note: features are Billion MTs

The SAM above is expressed in its MCM format (see chapter 1 for an explanation of MCMs)

Appendix G: The Structuralist/ Post- Keynesian CGE Model Specifications

Indices

Index	Variable definition
s	Formal activities
	Informal activities
	Aliases of *s*: *g*
h	Households
	Elements of *h*:
	r-hhds,
	u-hhds;

Parameters

Parameter	Symbol	Definition
b(s)		Input- Output coefficient for labour in sector *s*
shvaz (s)		Share of value added in sector *s*
tau (s)		Mark- up rate in sector *s*
a0 (s)		Input- Output coefficient for domestic intermediates used in sector *s*
a1 (s)		Input- Output coefficient for imported intermediates (net of taxes and margins) in sector *s*
at0 (s)		Activity tax rate for sector *s*
rebt0 (s)		VAT rebate tax rate for sector *s*
st0 (g)		Sales tax rate on commodity *g*
vtd0 (g)		VAT collected domestically tax rate on commodity *g*
th0 (h)		Household *h* income tax rate
te0		Enterprise income tax rate
mgm0		Share of margins per unitary imports
tm0 (g, r)		Import tax rate on good *g* from region *r*
vtb0 (g, r)		VAT collected at borders tax rate on good *g* imported from region *r*
rho	ρ	Price elasticity in the final import demand function
sigma	σ	Income elasticty in the final import demand function
beta1		Share of imports in total capital formation
beta2		Share of domestic goods in total capital formation

Prices

Variable	Definition
PY (g)	Price index for domestic formal production *s*
PA	Final price for domestic products
PC (h)	Consumption price for composite good *g* consumed by household *h*
PT	Price for transportation and marketing margins
PG	Price index for government expenditures
PTRAN	Price for social transfers
PE	Price for distributed profits
PINV	Investment price for composite good *g*
PFX (r)	Exchange rate respect region *r*
PIM	Price of imports in domestic currency
PY0(s)	Reference price for formal sector *s* production gross of activity tax
RPL(s)	Reference price for labour employed in sector *s*
RPI(s)	Reference price for domestic intermediates
RPII(s)	Reference preice for imported intermediates
Pstar	Price of imports in foreign currency
Pbar	Price of exports in foreign currency

Production

Variable	Definition
Y(s)	Domestic total production in sector *s*
FINIMP	Final imports
X	Exports
COMMX	Domestic supply
MG	Domestic output of composite margins
C(h)	Household *h* total consumption
GD	Government total consumption
INVEST	Domestic output of composite investment good

Factors

Variable	Definition
W(s)	Wage rate for labour employed in sector *s*
FA0 (f, s)	Factor *f* demand in activity *s*
WAGEINC (h)	Factor *f* income for household *h*

Income and expenditures

Variable	Definition
DCH0 (h)	Final demand of household *h* for domestic good
CH0ME (s, h)	Final demand of household *h* for home consumed products of sector *is*
C0 (h)	Aggregate household *h* consumption
HR0 (h)	Remittances of household *h* from abroad
HSV0 (h,)	Household *h* savings
HE0 (h)	Household *h* distributed profits
HG0 (h)	Household *h* social transfers
XE0	Enterprise payments to foreigners
ESV0	Enterprise savings
EG0	Enterprise social transfers
GD0	Final government demand
DGD0	Final government demand for domestic goods
FSV0	Foreign savings
GSV0	Government savings
GE0	Government distributed profits
MTAX	Import duties on good *g* from region *r*
VATB	VAT on imports of good *g* from region *r*
DCS	Final investment demand for domestic good
INV	Aggregate total investments
ATAX (s)	Activity tax in sector *s*
VATREB (s)	VAT rebate in sector *s*
VATD	Domestic VAT on good *g*
STAX	Sales tax on good *g*

Foreign sector

NMINT(s)	Net Imported intermediate used in sector *s*
MINT(s)	Imported intermediates used in sector *s* (gross of taxes and margins)
NMC0(h)	Net household *h* consumption of imported goods
MC0(h)	Housheold *h* consumption of imported goods (gross of taxes and margins)
NMCS	Net imported goods in capital formation
MCS	Imported goods in capital formation (gross of taxes and margins)

Scaling parameters

Parameter	Definition
km	Scaling parameter on labour supply (Keynesian multiplier)
fsav	Scaling parameter on foreign savings
gsav	Scaling parameter on government savings

Appendix H: The GAMS/ MPSGE Code for the Structuralist/ Post-Keynesian Model

```
$TITLE A Structuralist/ Post- Keynesian CGE Model for Mozambique

$ontext
This model was developed to assess the impact of the Mozambican participation into the
Southern Africa Development Community (SADC).
This code is part of the Ph.D. thesis "The Mozambican Participation in SADC- A
Liberalization Process trough Different Models and Different Closures".
The study was conducted by Elisa Delpiazzo, under the supervision of Prof. Marco
Missaglia, University of Pavia.
The analysis uses a GAMS/MPSGE CGE model based on the 2003 Mozambique SAM.
The focus of the study is on examining the impact of a tariff reduction as the one
scheduled in the SADC Trade Protocol.
$offtext

*Define the sets of the model, to use them in the vectorial language of the model:

sets  s  /Y  formal production sector,
          IY informal production sector/,

      h  /RHHDS rural households,
          UHHDS urban households/
alias(s,g)
;

*Data are inserted in a SAM (in MCM format:
)
table sam(*,*)

                   Y        IY    SUPPLY      MARG     ENTER     RHHDS     UHHDS      GOVT       ROW    INVEST
Y            148.354             -148.354
IY                      26.224                                 -26.224
SUPPLY       -51.377    -5.743   171.805   -21.034              -9.165   -25.154   -14.745   -30.526   -14.061
W            -53.185   -15.856                                  40.923    28.118
R            -29.617    -2.664                        32.281
ATAX           0.190                                                                -0.190
VATREB         3.178                                                                -3.178
VATB          -1.446    -0.162                                  -0.697    -1.914     5.289              -1.070
MTAX          -0.585    -0.065                                  -0.282    -0.773     2.137              -0.432
VATD                              -4.027                                             4.027
STAX                              -2.468                                             2.468
DIRTAX                                                -0.925    -0.133    -2.071     3.129
TMD                              -15.783    15.783
TMM           -1.115    -0.125               4.078              -0.538    -1.475                        -0.825
TME                               -1.173     1.173
ROW          -14.397    -1.609                        -3.833    -6.938   -19.043              56.465   -10.645
SAV                                                   -1.673    -0.445    -1.837     1.518   -24.596
TRANSF                                                 0.146     0.117     0.294    -0.557
REM                                                                        1.343              -1.343
PROF                                                 -25.996     3.382    22.512     0.102
;

*Declare parameters:

parameters
rho             Price elasticity in final import function /-0.418/
sigma           Income elasticity in final import function /1.553/
Pstar           foreign price of imports /1/
Pbar            foreign price of exports /1/
wz(s)           Sector s wage rate in the benchmark
mx(s)           Marketed production of sector s
nmx(s)          Non- marketed production of sector s
gdpz(s)         Total production of sector s
wbill(s)        Wage bill in sector s
b(s)            Input- Output coefficient for labour of sector s
shvaz(s)        Share of value added on GDP in sector s
mrk(s)          Mark- up income in sector s
tau(s)          mark- up rate in sector s
mint(s)         Imported intermediates (gross of taxes and margins) used in sector s
dint(s)         Domestic intermediate (gross of taxes and margins) used in sector s
```

```
a0(s)           Domestic intermediate input- output coefficient in sector s
a1(s)           Imported intermediate (net of taxes and margins) input- output
                 coefficient in sector s
atax(s)         Activity tax (subsidy) in sector s
at0(s)          Activity tax rate in sector s
vatreb(s)       VAT rebate on intermediates used in sector s
rebt0(s)        VAT rebate rate on intermediates used in sector s
nmint(s)        Net imported intermediates used in sector s
vatb            Total VAT collected at borders
vtb0            Tax rate of VAT collected at borders
mtax            Total import duties
tm0             Tax rate on imports
fimp            Final imports (gross of taxes and margins)
nfimp           Net final imports (cif prices)
mrgm            Total margins on imports
imrgm(s)        Total margins on intermediate imports (cif) used in sector s
mgm0            Margins per unit of imports
dm(s)           Ttal domestic uses
exdp            Exports gross of margins
vatd            Total VAT on domestic commodity
vtd0            VAT rate on domestic commodities
stax            Total sales tax
st0             Sales tax rate
mrgd            Total margins on domestic produced goods
ts              Total supply of domestic final goods
exp             exports net of margins
mrge            Total margins on exports
wageinc(h)      Wage income for housheold h
hr0(h)          Remittances from abroad of household h
mc0(h)          Consumption of imports of household h (gross)
nmc0(h)         Net consumption of imports of household h
c0(h)           Total consumption of household h
dtax(h)         Total direct tax of household h
th0(h)          Direct tax rate of household h
hsv0(h)         Total savings of household h
sh0(h)          Saving rate of household h
hg0(h)          Total social transfers to household h
he0(h)          Total distributed profits to household h
dch0(h)         Total consumption of domestic good of household h
chome(s,h)      Home consumption of goods of sector s of household h
mkincome        Total mark- up income
xe0             Total payments to foreigners
dtaxe           Total direct tax for enterprises
te0             Direct tax rate for enterprises
esv0            Total savings enterprise
se0             Saving rate for enterprise
eg0             Total social transfers to enterprises
gsv0            Government savings
ge0             Total distributed profits to government
dgd0            Total government expenditures in domestic goods
gd0             Aggregate total government expenditures
mcs             Total investments in imported goods (gross of taxes and margins)
nmcs            Net total investments in imported goods
inv             Total aggregate investments
dcs             Total investments in domestic goods
fsv0            Foreign savings
py0(s)          Reference price for final production of sector s
rpl(s)          Reference price for labour
rpi(s)          Reference price intermediate domestic
rpii(s)         Reference price intermediate imported
beta1           Share of imports in total capital formation
beta2           Share of domestic goods in total capital formation
;

*Extraction of data from the SAM.

wz(s)=1;
mx(s)= -sam(s,"supply");
nmx(s)= -sam(s,"rhhds");
wbill(s)= -sam("w",s);
```

```
mrk(s)= -sam("r",s);
nmint(s)= -sam("row",s);
dint(s)= -sam("supply",s);
atax(s)= sam("atax",s);
vatreb(s)= sam("vatreb",s);
vatb= sam("vatb","govt");
mtax= sam("mtax","govt");
imrgm(s) = -sam("tmm",s);
mrgm= sam("tmm","marg");
dm(s)= -sam(s,"supply");
exdp= -sam("supply","row");
vatd= sam("vatd","govt");
stax= sam("stax","govt");
mrgd= sam("tmd","marg");
ts= sam("supply","supply");
mrge= sam("tme","marg");
wageinc(h)= sam("w",h);
hr0(h)= sam("rem",h);
nmc0(h)= -sam("row",h);
dtax(h)= -sam("dirtax",h);
hsv0(h)= -sam("sav",h);
hg0(h)= sam("transf",h);
he0(h)= sam("prof",h);
dch0(h)= -sam("supply",h);
chome(s,h)= -sam(s,h);
mkincome= sam("r","enter");
xe0= -sam("row","enter");
dtaxe= -sam("dirtax","enter");
esv0= -sam("sav","enter");
eg0= sam("transf","enter");
gsv0= -sam("sav","govt");
ge0= sam("prof","govt");
dgd0= -sam("supply","govt");
nmcs= -sam("row","invest");
dcs= -sam("supply","invest");
fsv0= -sam("sav","row");

*Manipulation of data:

gdpz(s)= mx(s)+nmx(s);
mint(s)= nmint(s)- sam("mtax",s)- sam("vatb",s)- sam("tmm",s);
nfimp= nmcs+(sum(h,nmc0(h)));
fimp= nfimp-sum(h,sam("mtax",h))-sum(h,sam("vatb",h))-sum(h,sam("tmm",h))-
           sam("mtax","invest")-sam("vatb","invest")-sam("tmm","invest");
mgm0= mrgm/(nfimp+sum(s,nmint(s)));
exp= exdp-mrge;
mc0(h)=nmc0(h)+(-sam("vatb",h))+(-sam("mtax",h))+(-sam("tmm",h));
mcs= nmcs+(-sam("mtax","invest"))+(-sam("vatb","invest"))+(-sam("tmm","invest"));
c0(h)= dch0(h)+mc0(h)+(sum(s,chome(s,h)));
inv= mcs+dcs;

*Alternative definitions of tau:

*tau(s) =((gdpz(s)+atax(s))/(gdpz(s)+atax(s)-mrk(s)))-1;
tau(s)= mrk(s)/(wbill(s)+mint(s)+dint(s)-vatreb(s));
*tau(s)=   (gdpz(s)+atax(s)-wbill(s)-mint(s)-dint(s)+vatreb(s))/(wbill(s)+mint(s)+dint(s)-
*vatreb(s));

*Manipulation of tax rates:

at0(s)$mx(s)= atax(s)/mx(s);
rebt0(s)= vatreb(s)/(mint(s)+dint(s));
tm0= mtax/(nfimp+(sum(s,nmint(s))));
vtd0$(not sum(s,dm(s))=0)= vatd/(sum(s,dm(s)));
vtb0= vatb/(sum(s,nmint(s))+nfimp+mtax);
st0= stax/ts;
th0(h)= dtax(h)/(wageinc(h)+hr0(h)+hg0(h)+he0(h));
te0= dtaxe/(mkincome+eg0);

*Definition of reference prices:
```

```
py0(s) = 1-at0(s);
rpl(s)= 1+tau(s);
rpi(s)= 1-rebt0(s);
rpii(s)= ((1+tm0)-rebt0(s));

*Parameters calibrated on the benchmark:

b(s)= wbill(s)/(wz(s)*gdpz(s));
shvaz(s)= (wbill(s)+mrk(s))/gdpz(s);
a0(s)= dint(s)/gdpz(s);
a1(s)= nmint(s)/gdpz(s);
sh0(h)= hsv0(h)/(wageinc(h)+hr0(h)+hg0(h)+he0(h)-dtax(h));
se0= esv0/(mkincome+eg0-dtaxe);
beta1=mcs/inv;
beta2=(1-beta1);

*Show values for parameters:

Display
wz,mx,nmx,wbill,mrk,nmint,dint,atax,vatreb,vatb,mtax,imrgm,mrgm,dm,
exdp,vatd,stax,mrgd,ts,mrge,wageinc,hr0,nmc0,dtax,hsv0,hg0,he0,dch0,
chome,mkincome,xe0,dtaxe,esv0,eg0,gsv0,ge0,dgd0,nmcs,dcs,fsv0,
gdpz,mint,nfimp,fimp,mgm0,exp,mc0,mcs,c0,inv,tau,at0,rebt0,tm0,
vtd0,vtb0,st0,th0,te0,py0,rpl,rpi,rpii,b,shvaz,a0,a1,sh0,se0,beta1,beta2;

$ontext
$model:moz

$sectors:
y(s)            !domestic productive sectors (formal and informal)
finimp          !production of final imports
commx           !supply of domestic goods
x               !production of exports at final prices
mg              !production of wholesale and retail margins
invest          !aggregate investment
c(h)            !household consumption
gd              !government consumption

$commodities:
py(s)           !output price for domestic production (formal and informal)
w               !wage rate
pfx             !exchange rate
pim             !import price (in domestic currency)
pt              !margin price
pinv            !price of investments
pg              !price of government consumption
pe              !price of distributed profits
pa              !price of marketed domestic production (gross of taxes and margins)
pc(h)           !price of household consumption
ptran           !price of social transfers

$consumers:
ra(h)           !households
entre           !enterprises
govt            !government
foreign         !foreigners

$auxiliary:
km              !keynesian multiplier
gsav            !scaling parameter for government savings
fsav            !scaling parameter foreign savings
FINALIMPORT     !final imports (to insert the demand function)
INTIMP          !intermediate imports (to insert the demand function)


*Sectoral   production   combines   variable   costs   (labour,   imported   and   domestic
*intermediates) and a profit mark- up.
*Formal sector earns activity subsidies as Activity tax and VAT rebate.
```

```
$prod:y(s)      d:0  va:0
o:py(s) q:gdpz(s)          p:py0(s)   a:govt    t:(-at0(s))
i:w     q:wbill(s)         p:rpl(s)   a:entre   t:((1-te0)*tau(s))
                                       a:govt   t:(te0*tau(s))
i:pa    q:dint(s)          p:rpi(s)   a:entre   t:((1-te0)*tau(s)*(1-rebt0(s)))
                                       a:govt   t:((te0*tau(s)*(1-rebt0(s)))-rebt0(s))
i:pfx   q:(nmint(s)*pstar)  p:rpii(s)   d:0
                           a:entre  t:((1-te0)*tau(s)*((1+tm0)*(1+vtb0)+mgm0)*(1-rebt0(s)))
                            a:govt   t:((te0*tau(s)*((1+tm0)*(1+vtb0)+mgm0)*(1-
                            rebt0(s)))+((1-rebt0(s))*(tm0*(1+vtb0)+vtb0)-rebt0(s)*(1+mgm0)))
i:pt    q:imrgm(s)    d:0

*Final imports is the aggregation of final uses of imports and transaction margins.
*It involves the collection of a part of import duties and other indirect taxes:

$prod:finimp
o:pim    q:fimp
i:pfx    q:(nfimp*pstar)            a:govt   t:(tm0*(1+vtb0)+vtb0)
i:pt     q:(mrgm-(sum(s,imrgm(s))))

*Commodity supply of domestic products involves collection of indirect taxes and
*the application of distribution margins:

$prod:commx
o:pa     q:ts                     a:govt t:st0
i:py(s)  q:dm(s)                  a:govt t:vtd0
i:pt     q:mrgd
i:pt     q:mrge

*Export transformation into foreign currency:

$prod:x
o:pfx    q:(Pbar*exdp)
i:pa     q:exdp

*Production of marketing and transportation margins:

$prod:mg    s:0
o:pt     q:(mrgd+mrge+mrgm)
i:pa     q:(mrgd+mrge+mrgm)

*Investment demand:

$prod:invest  s:0
o:pinv   q:inv
i:pim    q:(beta1*inv)
i:pa     q:(beta2*inv)

*Household demand for non-marketed, domestic and imported goods and services:

$prod:c(h)
o:pc(h)  q:c0(h)
i:pim    q:mc0(h)
i:pa     q:dch0(h)
i:py(s)  q:chome(s,h)

*Government demand for goods and services:

$prod:gd
o:pg     q:gd0
i:pa     q:dgd0

*Household income and expenditures:

$demand:ra(h)
d:pc(h)  q:c0(h)
e:w      q:((1-th0(h))*wageinc(h))       r:km    !net income out of wages
e:ptran  q:((1-th0(h))*hg0(h))                   !net income out of social transfers
e:pe     q:((1-th0(h))*he0(h))                   !net income out of distributed profits
e:pfx    q:((1-th0(h))*hr0(h))                   !net income out of remittances
```

```
e:pinv   q:(-hsv0(h))                              !private savings

*Enterprises' income and expenditures:

$demand:entre
d:pe     q:(sum(h,he0(h))+ge0)
e:pfx    q:(-xe0)                                  !payments to foreigners
e:pinv   q:(-esv0)                                 !enterprises savings
e:ptran  q:(eg0*(1-te0))                           !net income out of social transfers

*Government income and expenditures:

$demand:govt
d:pg     q:gd0
e:ptran  q:(-eg0-sum(h,hg0(h)))                          !social payments
e:pe     q:ge0                                           !distributed profits
e:pinv   q:(-gsv0)                        r:gsav         !governmemnt savings
e:w      q:(sum(h,(th0(h)*wageinc(h))))   r:km           !direct taxes out of wage income of
                                                          households
e:ptran  q:(sum(h,th0(h)*hg0(h)))                        !direct taxes out of social
                                                          transfers of households
e:pe     q:(sum(h,(th0(h)*he0(h))))                      !direct taxes out of distributed
                                                          profits of households
e:pfx    q:(sum(h,(th0(h)*hr0(h))))                      !direct taxes out of remittances of
                                                          households
e:ptran  q:(te0*eg0)                                     !direct taxes out of social
                                                          transfers of enterprises

*Foreigners' income and expenditures:

$demand:foreign
d:pfx    q:(Pbar*exdp)
e:pfx    q:xe0                                       !enterprise payments to foreigners
e:pfx    q:(-sum(h,hr0(h)))                          !remittances
e:pfx    q:(1)              r:FINALIMPORT            !final imports
e:pfx    q:(1)              r:INTIMP                 !intermediate imports
e:pinv   q:(-fsv0)          r:fsav                   !foreign savings

*Complementarity condition for the scaling parameter km:

$constraint:km
sum(h,ra(h)) =e= sum(h,((1-sh0(h))*(1-
th0(h))*(w*km*wageinc(h)+ptran*hg0(h)+pe*he0(h)+pfx*hr0(h))));

*Complementarity condition for the scaling parameter gsav:

$constraint:gsav
govt/pg =e= gd0;

*Complementarity condition for the scaling parameter fsav:

$constraint:fsav

fsav*fsavz*pinv =e= pfx*((nfimp*Pstar)+(sum(s,nmint(s)*Pstar))-(Pbar*exdp))+pfx*(xe0-
sum(h,hr0(h)));

*Constraint to define the functional form of the intermediate import demand:

$constraint:INTIMP
INTIMP =e= sum(s,(a1(s)*Pstar*gdpz(s)*y(s)));

*Constraint to define the functional form of the intermediate import demand:

$constraint: FINALIMPORT
FINALIMPORT =e=
(nfimp/(sum(s,gdpz(s)*y(s)))**sigma)*(pfx*Pstar/pa)**rho*(sum(s,gdpz(s)*y(s)))**sigma;

$report:
v:rgdp(s)    o:py(s)    prod:y(s)
v:rlab(s)    i:w        prod:y(s)
```

```
v:realint(s) i:pfx      prod:y(s)
v:rfinimp    i:pfx      prod:finimp
v:rexp       o:pfx      prod:x
v:totmrg     o:pt       prod:mg
v:rinv       o:pinv     prod:invest
v:rcons(h)   o:pc(h)    prod:c(h)
v:rgovt      o:pg       prod:gd
v:prof       d:pe       demand:entre

$offtext
$sysinclude mpsgeset moz

*Initialization of the scaling parameters and choice of the appropriate closure rule.

km.L = 1;

*Inizialization of the value of INTIMP.

INTIMP.L=sum(s,nmint(s));

*Initialization of the value of FINALIMPORT.

FINALIMPORT.L=nfimp;

*If the closure rule is EXOGENOUS foreign savings put an asterix before these commands:
fsav.L = 1;
fsav.LO = -inf;
*If the closure rule is ENDOGENOUS foreign savings put an asterix before the command:
fsav.FX = 1;
*If the closure rule is EXOGENOUS governmemnt savings put an asterix before these
commands:
gsav.L = 1;
gsav.LO = -inf;
*If the closure rule is ENDOGENOUS government savings put an asterix before the command:
gsav.FX = 1;

*Numeraire of the model:
w.FX = 1;

$include moz.gen
solve moz using mcp;

*Counterfactual: Trade liberalization in the SADC area.

mtx= 0.027;
$include moz.gen
Solve moz using MCP;
```

Acronyms and abbreviations

ACP	African, Caribbean and Pacific group of States
AGE	Applied General Equilibrium model
ATPC	African Trade Policy Centre
BK	Bastard Keynesian
BLNS	Botswana, Lesotho, Namibia, and Swaziland group
BM	Mozambique's Central Bank
CD	Cobb- Douglas function
CEMAC	Economic Community of Central African States
CES	Constant Elasticity of Substitution function
CET	Common External Tariff
CET	Constant Elasticity of Transformation function
CGE	Computable General Equilibrium model
C.i.f.	Cost, Insurance and Freight
COMESA	Common Market for Eastern and Southern Africa
CPA	Cotonou Partnership Agreement
CPI	Consumer Price Index
CRTS	Constant Returns To Scale technology
CU	Custom Union
DGI	General Directorate of Tax Administration
DNA	National Directorate of Customs
DNIA	National Directorate of Taxes and Audit
DRC	Democratic Republic of Congo
EAC	East African Community
EBA	Everything but the Arms strategy
ECLA	UN Economic Commission for Latin America
ECOWAS	Economic Community of West African States
EPA	European Partnership Agreement
EPZ	Export Processing Zone
ERP	Effective Rate of Protection

ESA	Trade in the Eastern and Southern Africa
EU	European Union
F.o.b.	Free of Board
FTA	Free Trade Area
GAMS	General Algebraic Modelling System
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GE	General Equilibrium analysis
GTAP	Global Trade Analysis Project
HS	Harmonized System
IAF	Household Survey
ICE	Excise Tax
IFPRI	International Food Policy and Research Institute
IFTRAB	Integrated Labour Workforce Survey
IFS	IMF International Financial Statistics
IMF	International Monetary Fund
INE	National Institute of Statistics
IO	Input- Output
IRPC	Corporate Income Tax
IRPS	Individual Income Tax
KKT	Karush- Kuhn- Tucker conditions
LDC	Least Developed Country
LINKAGE	LINKAGE model of the World Bank
LP	Linear Programming
MC	Import Content criterion
MCCs	Market Clearing Conditions
MADER	Ministry of Agriculture and Rural Development
MCM	Micro- Consistency Matrix
MCP	Mixed Complementarity Problem
MERRISA	Macroeconomic Reforms and Regional Integration in Southern Africa
MFN	Most Favoured Nation treatment
MIC	Ministry of Industry and Trade
MMTZ	Malawi, Mozambique, Tanzania, and Zambia group
MOMA	Kenmare Resources plc titanium smelter

MOZAL	Mozambique Mega Aluminium smelter
MPSGE	Mathematical Programming System for General Equilibrium
MTs	Meticais (Mozambique's currency)
NLCP	Non- Linear Complementarity Problem
NTB	Non- Technical Barriers to trade
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares method
PARPA	Mozambique's Action Plan for the Reduction of Absolute Poverty
PC- SADC	Trade protocol- SADC
PE	Partial Equilibrium analysis
RECs	Regional Economic Communities
REER	Real Effective Exchange Rate
RISPD-SADC	Regional Indicative Strategic Development Plan- SADC
RO	Rules of Origin
RoSADC	Rest of SADC Member States
ROW	Rest of the World
RPTF	Regional Preparatory Task Force
RSA	Republic of South Africa
RTA	Regional Trade Agreement
SACU	Southern Africa Custom Union
SADC	Southern Africa Development Community
SADCC	Souther Africa Development Co-ordination Conference
SADC- FTA	Free Trade Area in SADC
SAM	Social Accounting Matrix
SLCP	Sequence of Linear Complementarity Problem
SPK	Structuralist/ Post- Keynesian
SU	Supply- Use table
TBT	Technical Barriers to Trade
TDCA	Trade, Development Cooperation Agreement
TIA	Survey on Agricultural Activities
TMD	Trade and Macroeconomic Division at IFPRI
UEMOA	West African Economic and Monetary Union
UN	United Nations
UN- ECA	UN Economic Commission for Africa
US	United States
VAT	Value Added Tax

WTO	World Trade Organization
ZPCs	Zero Profit Conditions

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