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[1]. 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[2]. 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[3].

[1] To investigate these two aspects, see Tarp *et al.* (2002).

[2] Tarp *et al.* (2002) suggests that the amount of marketing margins depends on returns to capital because the marketing activity is capital intensive.

[3] 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[4]. 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

[4] 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[5]; the latter is a cost minimizing decision: producers import if it is more convenient than buying the inner production[6]. 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[7] 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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[5] "*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)).

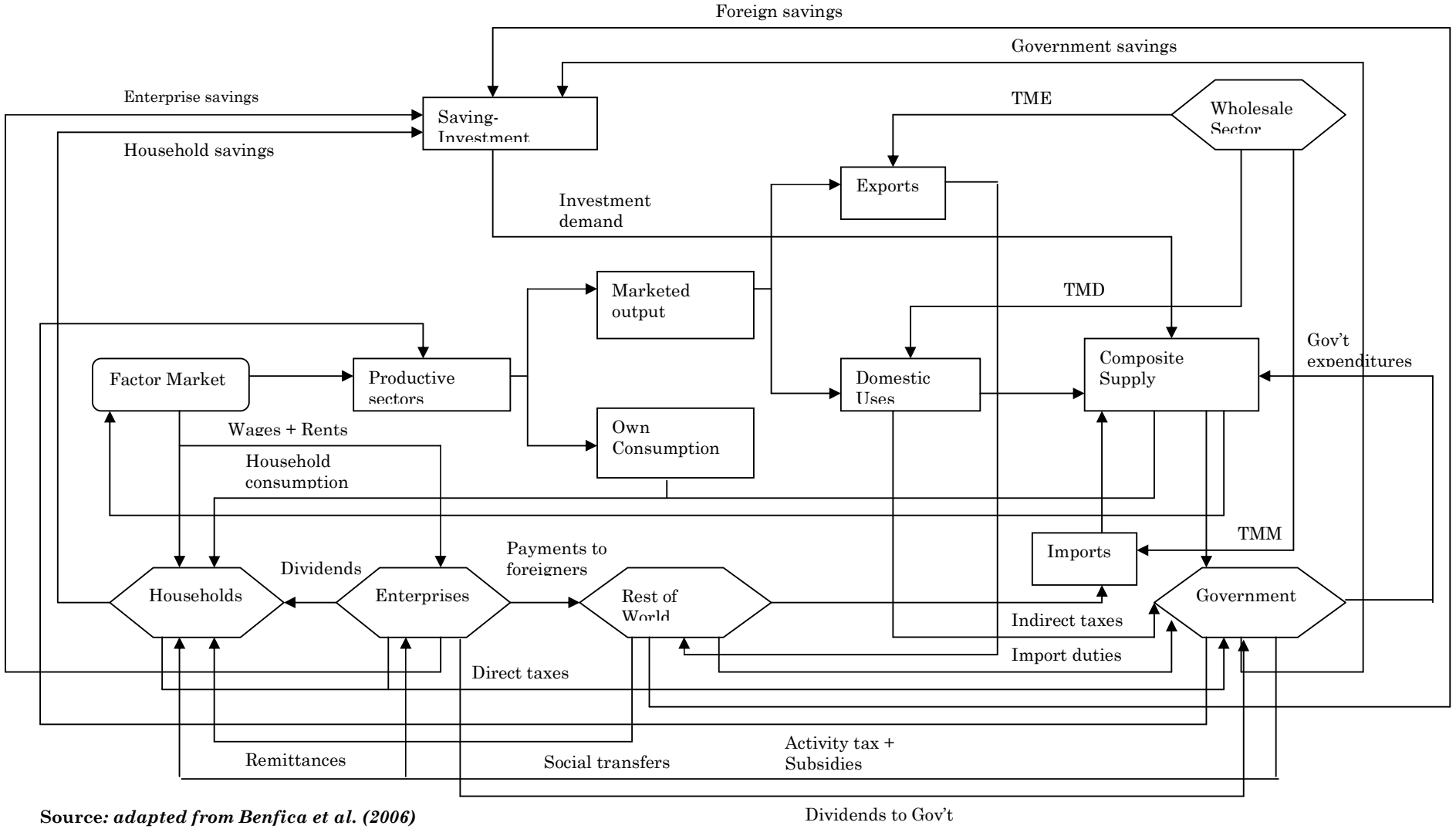
[6] "*Under a CES Armington function, cost minimization determines final and intermediate demand for imported and domestic goods based on relative prices (both of which include relevant taxes)*" (Arndt *et al.* (2008)).

[7] 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[8] ($D(s)$ 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.

[8] 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 $Y(s)$:

$$\left[sum(g,ca(g,s)\cdot pa0(g,s))\right]+\left[pf("l")^{va(s)}\cdot pf("k")^{(1-va(s))}\right]= \\ (1+atx(s))\cdot(pd(s)\cdot dm(s)+px(s)\cdot x0(s)) \tag{1}$$

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 $A(s)$:

$$\left[dm(s)+pt\cdot mrd(s)\right]+ \\ +\left[(pm0(s)\cdot m0(s))\cdot((1-thetam(s))\cdot pd(s)^{(1-dm)}+(thetam(s))\cdot pm(s)^{(1-dm)}\right]^{(1/(1-dm))}+pt\cdot mrm(s)= \\ =(1-vtx(s)-itx(s))\cdot pa(s)\cdot a0(s) \tag{3}$$

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 $C(h)$:

$$sum(s, pa(s) \cdot ch(s,h)) + sum(is, pn(is) \cdot ha(is,h)) = pc(h) \cdot c0(h) \quad (4)$$

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:

$$sum(s, id0(s) \cdot pa(s)) = pinv \cdot i0(s) \quad (5)$$

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:

$$sum(s, trd(s) \cdot pa(s)) + sum(s, trm(s) \cdot pa(s)) + sum(s, tre(s) \cdot pa(s)) = pt \cdot (trd(s) + trm(s) + tre(s)) \quad (6)$$

Exports $X(s)$:

$$px(s) \cdot x0(s) + pt \cdot tre(s) = pfx \cdot x0(s) \quad (7)$$

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 $M(s)$:

$$m0(s) \cdot pm0(s) \cdot pfx = pm(s) \cdot m0(s) \quad (8)$$

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[9]. Because this relation

[9] 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:

$$Ls0 = sum\left(s, va(s)\cdot\left(\frac{pf("k")}{pf("l")}\right)^{(1-va(s))}\cdot Y(s)\right) + sum\left(is, va(is)\cdot\left(\frac{pf("k")}{pf("l")}\right)^{(1-va(is))}\cdot Y(is)\right) \quad (14)$$

Capital:

$$Ks0 = sum\left(s, (1-va(s))\cdot\left(\frac{pf("l")}{pf("k")}\right)^{va(s)}\right) + sum\left(is, (1-va(is))\cdot\left(\frac{pf("l")}{pf("k")}\right)^{va(is)}\right) \quad (15)$$

Distributed profits:

$$ENT\cdot(sum(h, he(h)) + ge) = sum\left(h, \frac{he(h)}{pe}\right) + \frac{ge}{pe} \quad (16)$$

Production in informal sectors:

$$ha0(is)\cdot Y(is) = sum\left(h, \frac{ch0(h,is)}{pn(is)}\right) \quad (17)$$

Margins:

$$sum(s, (trd(s) + trm(s) + tre(s)))\cdot MRG = \frac{sum(s, (trd(s) + trm(s) + tre(s)))}{pt} \quad (18)$$

Private goods:

$$C(h)\cdot c0(h) = \frac{RA(h)}{pc(h)} \quad (19)$$

Investment goods:

$$INV\cdot i0 = \frac{i0}{pinv} \quad (20)$$

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*):

$$RA(h) = pf("l") \cdot hl(h) + pe \cdot he(h) + ptran \cdot SOCTRANSF(h) + pfx \cdot hx(h) - DTAX(h) - pinv \cdot hs(h) \quad (21)$$

Income balance condition for enterprises:

$$ENT = pf("k") \cdot Ks0 + ptran \cdot SOCTRS - pfx \cdot ex - pinv \cdot es - DETAX \quad (22)$$

Income balance condition for government:

$$\begin{aligned} GOV = {} & DTAX + DETAX - \left(sum(h, ptran \cdot SOCTRANSF(h))\right) - ptran \cdot SOCTRS + \\ & \left(sum(s, tm(s) \cdot pfx \cdot m0(s) \cdot M(s)\right) + \left(sum(s, itx(s) \cdot pa(s) \cdot a0(s) \cdot A(s))\right) + \\ & \left(sum(s, vtx(s) \cdot pa(s) \cdot a0(s) \cdot A(s))\right) - \left(sum(s, atx(s) \cdot (pd(s) \cdot dm(s) + px(s) \cdot x0(s))\right) \\ & - \left(sum(s, rebt(s) \cdot pa(s) \cdot sum(g, ca(g, s)))\right) - gsv0 \cdot pinv \end{aligned} \quad (23)$$

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[10]. If econometric determination of parameters is not likely, there is another

[10] 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[11] 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*[12]	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.

[11] It stands for Macroeconomic Reforms and Regional Integration in Southern Africa.

[12] 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)[13]	Value from GTAPAfrica[14]
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)[15]			
	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)[16]			
	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.***

[13] 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.

[14] The GTAP Database for Africa is part of the GTAP dataset version 6 and it is freely available at the GTAP website.

[15] These values in Thurlow (2008) are obtain from an unspecified older version of the GTAP database.

[16] 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[17].

[17] 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[18]. 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[19]. 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[20] 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

[18] It is possible to compare this description of foreign trade with the one in the Structuralist/ Post-Keynesian model of chapter 7.

[19] 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.

[20] 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)
$etZ'E'+ZT=Z\overline{G}+\overline{S_G}$ $ZT+etZ'E'+e\Delta'=S_G$	(7)
$ZI=0$	(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, a= labour share on value added, w= wage rate, β= capital share on value added, r= rental rate of capital, o= 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[21]. 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*

[21] 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[22]. 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

[22] 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[23]. 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[24] 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***

[23] Note that it is fixed in real terms.

[24] 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[25]. 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

[25] 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[26]). 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*

[26] 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.