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POLICY ANALYSIS FOR A DEVELOPING COUNTRY IN A FINANCIAL CGE MODEL: CASE OF TUNISIA AFTER THE 2011'S REVOLUTION

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Abstract

The macroeconomic fundamentals of the Tunisian economy deteriorated seriously after the 2011's revolution. The objective of this paper is to assess to which extent it was possible for Tunisia to realize better macroeconomic performance through alternative economic policy choices taking into account the domestic and external shocks. To that end, the paper employs a financial dynamic general equilibrium model calibrated using six flow-of-funds accounts representing the Tunisian economy in 2010. In a first stage, I reproduce the main macroeconomic variables observed for the Tunisian economy during the period 2011-2018. In a second stage, the model is used to compare the Tunisian macroeconomic performance during that period with counterfactual scenarios. The results show that the economy would have performed much better, in relation to a battery of macroeconomic indicators (economic growth, unemployment, public external and domestic debts, current account, fiscal balance) under alternative economic policies, given the same conditions of internal and external shocks. The most impactful results are obtained under the scenario a total factor productivity's growth at its average level during 2001-2010. Indeed, the average yearly gain in terms of GDP growth would have been of 3.45 percentage points and the average unemployment rate reduced by 7 percentage points to reach 9%. The domestic and external domestic debt stock would have been much lower than the actual average, by reaching respectively 16.3% and 18% of the GDP.

Keywords: Financial CGE model, counterfactual scenarios, Tunisia, revolution, macroeconomic performance.
JEL Classification: E12, E16, E17, E47, E63.

I. INTRODUCTION

Tunisia is a lower-middle income country with a small open economy. Since the 2011's revolution its economic performance is weakening due to the various internal and external shocks. The average economic growth declined from 4.6% during the period 2001-2010 to 1.5% over 2011-2019. This evolution is accompanied with the decline of investment and total factor productivity (TFP). While the contribution of the capital/labour to GDP growth potential declined from 0.7 to 0.2, the contribution of TFP decreased from 1.5 to 1 (OCDE,2018). Meanwhile, the successive governments since 2011 increased social spending and massively hired in the public sector to cope with the rising social unrest and youth unemployment. Conversely, there was no clear progress in undertaking most of the structural reforms related to reforming the State owned enterprises (SOEs), restructuring the pension system, lowering the huge subsidy budget via efficient targeting of the poor, and establishing an appropriate fiscal policy (Nabi, 2019).

From 2011 to 2017 the monetary policy was accommodating using various instruments including the policy rate, the injection of liquidity (to cope with the structural deficit of the commercial banks via an increasing volume of refinancing) and the easing the collateral policy. Meanwhile, the net foreign assets (NFA) of the central bank declined, while its net domestic assets (NDA) increased and fuelled the expansion of its balance sheet. This resulted in a negative real interest rates, an inflation peak of 7.7 percent in June 2018 and a continuous depreciation of the Tunisian Dinar. The monetary policy tightening began in 2018 in order to slow the demand for credit and constrain its supply (End et al., 2020). The increased public deficit (from 1% of the GDP in 2010 to -5.3% in average over 2011-2018) generated the expansion of the public debt from 40.7% of the GDP in 2010 to 77.9% in 2018 with more than 2/3 constituted from external debt. During the same period, the external imbalances of the Tunisian economy deteriorated. The current account deficit increased from 4.8% of the GDP in 2010 to -11.1% in 2018 with a huge contribution of the energy balance deficit (due to high oil prices and the decline of domestic supply of phosphate and oil). The current political instability, and the recent crisis triggered by the COVID-19 pandemic are exacerbating the structural weaknesses of the country's macroeconomic fundamentals.

In our knowledge, there are only few papers that analysed the macroeconomic performance of the Tunisian economy after the 2011 and the economic cost of the so called Arab Spring. Matta et al. (2016) shows the output loss in Tunisia, as a result of the "Arab Spring", amounts to 5.5%, 5.1% and 6.4% of the GDP in 2011, 2012, and 2013 respectively. Their paper uses the Synthetic Control Methodology and considers a weighted average of countries resembling to the pre-shock features of the Tunisian economy, to estimate what would have happened to the latter in the absence of the Arab Spring. The main channel of impact that was identified by that paper is the decline of investment. Sy et al. (2017) estimates the economic impacts of the Libyan crisis on the Tunisian economy, through a computable general equilibrium (CGE) model. The simulations show that it contributed by 24% to the deceleration of the economic growth in Tunisia during 2011–2015, which is equivalent to about 2% of 2015 GDP per year. In addition, the study shows that the main channel of this loss was the decline of the private investment (60%) and tourism (36%).

The present paper considers a more exhaustive and policy oriented perspective by delving to which extent it was possible for Tunisia to realize better macroeconomic performance during the period 2011-2018, through alternative economic policy choices scenarios, while taking into account the domestic and external shocks. To that end, the paper updates and extends the financial dynamic general equilibrium model of de Melo et al. (1989) that was used during the structural economic program undertaken by Tunisia in 1986 under the auspice of the IMF and World Bank. In addition to its calibration using six flow-of-funds accounts representing the Tunisian economy in 2010, a new version of the model is suggested to reflect the evolution of the economic structure during the recent period. The extension is made from several perspectives. First the calibration is made so that the model

reproduces the main macroeconomic fundamentals of the Tunisian economy during the period 2011-2018. By considering this calibration approach, this paper has commonality with Lovo et al. (2018) which develops a regional dynamic general equilibrium model for the Italian region Valle D'Aosta, using historical calibration over 40 years' period. As they noted, the CGE model with this calibration approach provides a powerful tool for historical counterfactual analysis not available using standard dynamic general equilibrium models. Lovo et al. (2018) compares the growth path followed by the region with a counterfactual scenario to evaluate how the region would have performed in the case of a contraction of the transfers from the national government to the regional government and the families.

In the present context, I consider the Tunisian economy over 2011-2018 and take into account the economic policy choices that were adopted during that period as well as the alternative options. In addition, contrarily to the de Melo et al (1989) I do not consider the neoclassical closure according to which the non-government investment is saving-driven, given that it is far from reflecting the Tunisian case. Besides, I consider a second different closure relatively to de Melo et al (1989) where the increase in the base money matches partially the government deficit. I also consider the subsidies and transfers in the state budget as independent policy variables, given their continuous increase after 2010 and their higher share in the State budget.

Beyond the original theme of this paper and its calibration approach in the Tunisian context, it also contributes to the existing literature using financial CGE models to analyse the impact of various economic policies in a developing country. These models incorporate financial markets and enable the interactions between the financial mechanisms and the real side of the economy (Robinson, 1991). Despite their usefulness for policy makers, there are only few financial CGE models, given the difficulty to construct a Financial Social Accounting Matrix (FSAM). Among the first models, one can cite Bourguignon et al. (1992) which combines the real side of a CGE model with asset portfolio behaviour of macroeconomic models in Tobin's tradition, in order to analyse the impacts of policy changes on the distribution of income and wealth. Yeldan (1997) constructs a CGE model with financial markets to analyse the effects of the external financial liberalization in Turkey on the real economy. The model is used to generate counterfactual and comparative static simulations experiments covering the following issues: (1) the impact of the mode of financing of the fiscal deficit through debt instruments or monetization; (2) the effects of deregulating the rules of issuing the public debt instrument on the financial markets; and (3) the implications of the exchange rate devaluations and external debt servicing. Bennour and Abdessalem (2010) proposes a general framework of a recursive dynamic general equilibrium model, with real and financial parts. It analyses how various modalities of public deficit financing (bonds; seignorage) affect the real economy and income distribution. While the real part of the model generates the saving of each agent, the allocation of saving among the financial assets (modalities) determines the money market equilibrium. In this model, investment does not automatically adjust to savings, and is financed by domestic and foreign borrowing (determined by the financial part of the model). Haqiqi and Mirian (2015) constructs a generic real-financial CGE model incorporating multi-investors, multi-assets, and multi-sectors for policy analysis of a small open economy with imperfect capital mobility. The financial side includes a central bank, commercial banks, deposits, loans, equities, bonds, and foreign currency.

The present paper also contributes to the rich literature (e.g. Bchir et al., 2005; Bchir et al., 2010; Chemingui and Thabet, 2007; Konan and Maskus, 2006; Marouani, 2008) having developed CGE models to analyse the impact of various economic policies (trade, agriculture and services liberalization; fiscal reforms) on unemployment, wages and poverty in Tunisia. However, the CGE models developed in the above cited papers do not consider explicitly the financial flows while taking into account the central bank's role (through the money creation and the policy rate) and its interaction with the financial intermediaries' role in financing the government and the non-government sector.

The remaining of the paper contains four main sections. In section II we present the main characteristics of the Tunisian economy. In section III, we present the model specification. Section IV presents the main results of the simulations. Finally, some policy recommendations are presented in the conclusion.

II. THE MODEL

II.1. The static specification

As discussed in the introduction, the model is a modified version of de Melo et al (1989). The economy is composed of a government, a central bank, a representative financial intermediary, the non-government sector (public enterprises and the private sector); and the rest of the world. There is one activity (gross output at factor price) and four commodities: (i) domestically produced goods for domestic use which is produced by using two factors of production: capital and labor, (ii) imports, (iii) exports, and (iv) a composite good as an aggregation of the first two.

II.1.1. Production technology

The output of the non-government sector (X) is produced with capital (K) and labor (L_{NG}) as inputs according to a constant elasticity of substitution (CES) production function with a constant returns to scale:

$$X = \bar{A}[\alpha(L_{NG})^{-\rho} + (1-\alpha)(K)^{-\rho}]^{\frac{-1}{\rho}} \quad (1)$$

The intermediate good demand (W) is given by:

$$W = \bar{a}X \quad (2)$$

Where $(\bar{a})$ represents the input-output coefficient. The price of the gross output (P_X) is a weighted average of its domestic and export prices respectively (P_D) and (P_E):

$$P_X = \left(\frac{D^S}{X}\right)P_D + \left(\frac{E}{X}\right)P_E \quad (3)$$

Using the price of the composite good (P_Q) (see equation (10)), the net price (P_N) (used as numeraire) of the value added is given by:

$$P_N = P_X - \bar{a}P_Q \quad (4)$$

II.1.2. Factors

The government labor demand $(\bar{L}_G)$ is set exogenously by the government policy and the government wage is exogenous $(\bar{W}_G)$. The non-government wage $(\bar{W}_{NG})$ increases at an exogenous growth rate as will be mentioned in the dynamic specification subsection. The profit maximizing behavior ensures that the value added $P_N X$ is distributed to remunerate capital and labor:

$$P_N X = W_{NG}L_{NG} + rK \quad (5)$$

Where (r) represents the average return on capital. The demand for non-government labor (L_{NG}) is obtained through the equalization of the wage and the value of the marginal product of labor:

$$L_{NG} = \bar{A}^{\frac{-\rho}{1+\rho}}\left[\frac{\alpha P_N}{W_{NG}}\right]^{\frac{1}{1+\rho}}X \quad (6)$$

II.1.3. Domestic product market

The demand for domestically produced goods for the domestic market, (D^d), is derived from the demand for the composite good, (Q), which aggregates imports (M) and (D^d) under the Armington assumption of imperfect substitutability. It is the first order condition of the CES function for (Q) :

$$D^d = \bar{B}^{(\sigma-1)}(1-\beta)^{\sigma}\left[\frac{P_Q}{P_D(1+\bar{t})}\right]^{\sigma} Q \tag{7}$$

Where (σ) represents the elasticity of substitution between domestic and foreign products. The supply of domestically produced goods (D^s) goods for domestic use satisfies the first order condition of a constant elasticity of transformation CET function for (X), reflecting imperfect substitution in production for the domestic and export markets :

$$D^s = \bar{H}^{(\Omega-1)}\gamma^{-\Omega}\left[\frac{P_D}{P_X}\right]^{\Omega} X \tag{8}$$

Where (Ω) represents the elasticity of transformation between domestic sales and exports. The price (P_D) of domestically produced goods for domestic use is determined through the market clearing for supply and demand:

$$D^s = D^d \tag{9}$$

The price (P_Q) of the composite good, (Q), is a weighted average of its two component prices (P_D) and (P_M) :

$$P_Q = [(1+\bar{t})P_D]\frac{D^d}{Q} + P_M\frac{M}{Q} \tag{10}$$

The volume of the demand for the composite good (Q) equals the demand in terms of government and non-government consumption, investment, and intermediate good demand:

$$P_Q Q = P_Q G + C_{NGV} + \bar{I} + P_Q W \tag{11}$$

II.1.4. Foreign trade and current account

The Tunisian economy is exposed to the exogenous world market prices. Hence, the domestic price of imports (P_M) and the domestic price of exports (P_E) depend on the foreign prices ($\bar{P}_{M\$}$) and ($\bar{P}_{E\$}$) adjusted by the import tariff ($\bar{t}_m$) and by the endogenous exchange rate :

$$P_M = (1+\bar{t}_m)E_R\bar{P}_{M\$} \tag{12}$$

$$P_E = E_R\bar{P}_{E\$} \tag{13}$$

The prices of exports and imports on the international markets ($\bar{P}_{M\$}$ and $\bar{P}_{E\$}$) are considered exogenous reflecting that Tunisia is a price-taker on the international markets. The exchange rate (E_R) represents the value of 1 USD in Tunisian Dinar. Likewise the domestic demand for domestic produced goods given by equation (7), imports (M) are modelled using the Armington hypothesis according to which domestic products and foreign products are imperfect substitutable according to the CES function of the demand for (Q):

$$M = \bar{B}^{(\sigma-1)}\beta^{\sigma}\left[\frac{P_Q}{P_M}\right]^{\sigma} Q \tag{14}$$

Likewise the supply of domestically produced goods for domestic use given by equation (8), exports (E) are modelled using the CET function according to which the quality of goods that are sold in the domestic market has a different quality relatively to that of the exported goods:

$$E = \overline{H}^{(\Omega-1)}(1-\gamma)^{-\Omega}\left[\frac{P_E}{P_X}\right]^{\Omega} X \tag{15}$$

The current account deficit $(F_{\$})$ in foreign currency, verifies the following equation :

$$F_{\$} = \bar{P}_{M\$}M - \bar{P}_{E\$}E + NF_{G\$} + \overline{NF}_{NG\$} - \overline{NF}_{T\$} - \overline{NF}_{CB\$} \tag{16}$$

The international interest payments by the government and the non-government, respectively $(\overline{NF}_{G\$})$ and $(\overline{NF}_{NG\$})$, as well as the receipts $(\overline{NF}_{CB\$})$ and the net current receipts/transfers $(\overline{NF}_{T\$})$, are entered in the model exogenously.

II.1.5. Roles of the central bank and the financial institutions

There is an indirect monetization of the deficit through central bank credit (C_{CB}) to the financial institutions which need to be refinanced to cope with their reduced liquidity:

$$\Delta C_{CB} = \theta\overline{\Delta DB_G} \tag{17}$$

Where $\theta \in [0,1]$ represents the share of the banks' holding of new issued government bonds (ΔDB_G) which is refinancing by the central bank. The profit of the central bank (PCB) is the sum of the interest receipts on credits to the financial institutions (NC_{CB}) and the net foreign interest $(\overline{NF}_{CB\$})$:

$$PCB = NC_{CB} + E_R\overline{NF}_{CB\$} \tag{18}$$

Using the financial institutions' flow of funds equilibrium, it is straightforward to show that the credit to the non-government by the financial institutions (ΔDB_{NG}) is given by :

$$\Delta DB_{NG} = [\Delta C_{CB} + \overline{\Delta DEP} + ND_G - NC_{CB}] - \overline{\Delta DB_G} \tag{19}$$

Equation (19) shows that there is a one-for-one tradeoff between the credit to government (ΔDB_G) and the credit to non-government (ΔDB_{NG}). The interest receipts by the central bank on credit to financial institution (NC_{CB}) depends on the nominal interest rate $(\overline{\iota_{CB}^{d}})$ and the considered period average stock of the central bank's credit to the financial institutions:

$$NC_{CB} = \overline{\iota_{CB}^{d}}[2C_{CB}(-1) + \Delta C_{CB}]/2 \tag{20}$$

Similarly, the domestic interest payments by the government on credit to financial institution (ND_G) depends on the nominal interest rate $(\overline{\iota_G^d})$ and the considered period average stock of the government domestic debt:

$$ND_G = \overline{\iota_G^d}[2\overline{DB_G}(-1) + \overline{\Delta DB_G}]/2 \tag{21}$$

II.1.6. Income and consumption

The gross domestic product at market prices (Y) is defined as the sum of the value added by the non-government sector $(P_N X)$, the value added of the government (represented by the government wage payments) $(W_G \bar{L}_G)$; and the net indirect taxes $(ITAX)$:

$$Y = P_N X + W_G \bar{L}_G + ITAX \tag{22}$$

The income of the non-government (Y_{NG}) is defined as the total value added, plus non-government net factor service income from abroad and current transfers, valued in domestic currency:

$$Y_{NG} = P_N X + W_G \bar{L}_G + E_R(\overline{NF}_{T\$} + \overline{NF}_{CB\$} - \overline{NF}_{NG\$}) \tag{23}$$

The non-government disposable income (Y_D) is obtained from the income of the non-government (Y_{NG}) after deducing the direct taxes, adding the social transfers and the subsidies $(\overline{Tr})$, domestic interest payment by the government (ND_G) and clearing the other government revenues $(\overline{OR})$ and the profit of the central bank (PCB):

$$Y_D = (1 - \bar{t}_d) Y_{NG} + \overline{Tr} + ND_G - \overline{OR} - PCB \tag{24}$$

The value of non-government consumption (C_{NGV}) is the remaining part of the disposable income after saving (S_{NGV}) :

$$C_{NGV} = Y_D - S_{NGV} \tag{25}$$

The value of government consumption (C_{GV}) is equal to the government payments for wages $(\bar{W}_G \bar{L}_G)$ and goods and services $(\bar{P}_Q \bar{G})$:

$$\bar{C}_{GV} = \bar{W}_G \bar{L}_G + \bar{P}_Q \bar{G} \tag{26}$$

II.1.7. Government deficit and foreign borrowing

The government deficit (D) is defined as the difference between the government investment $(\bar{I}_G)$ and other capital expenditure $(\overline{EKO})$, and the government saving (S_G) (total revenues minus consumption and interest payments):

$$D = \bar{I}_G + \overline{EKO} - S_G \tag{27}$$

Contrarily to de Melo (1989) the government does not set a fixed level of foreign borrowing. The budget deficit which is not covered by the government bonds placed with the financial institutions $(\overline{\Delta DB_G})$, is financed by foreign borrowing $(E_R \Delta FB_{G\$})$:

$$E_R \Delta FB_{G\$} = D - \overline{\Delta DB_G} \tag{28}$$

The foreign interest payments by the government $(NF_{G\$})$ depend on the nominal interest rate $(\bar{\iota}_G^{\bar{F}})$ and the considered period average stock of the government foreign debt:

$$NF_{G\$} = \bar{\iota}_G^{\bar{F}} [2FB_{G\$}(-1) + \Delta FB_{G\$}]/2 \tag{29}$$

II.1.8. Savings, investment and macro-closure

The non-government savings (S_{NG}) is assumed to be a constant fraction ($\bar{s}$) of the disposable income:

$$S_{NG} = \bar{s} Y_D \tag{30}$$

The government budgetary saving (S_G) is obtained as the sum of the direct and indirect revenues minus transfers and subsidies, consumption and the net domestic and foreign interest payments:

$$S_G = DTAX + ITAX + \overline{OR} + PCB - \overline{Tr} - \bar{C}_{GV} - ND_G - E_R NF_{G\$} \tag{31}$$

Where (ITAX) and (DTAX) represent respectively the indirect and direct taxes given by the following expressions:

$ITAX = \bar{t}_m (E_R \bar{P}_{M\$} M) + \bar{t}(P_D D^d)$

$DTAX = \bar{t}_d Y_{NG}$

Contrarily to de Melo et al. (1989) I do not consider the neoclassical closure according to which the non-government investment is saving-driven. I consider the Keynesian closure according to which the non-government investment is fixed at an exogenous level $\bar{I}_{NG}$. The level of the aggregate investment is given by:

$$\bar{I} = \bar{I}_{NG} + \bar{I}_G \tag{32}$$

where $\bar{I}_G$ represents the exogenous level of the public investment. The following equilibrium condition between the aggregate investment and the national and foreign resources is given by:

$$\bar{I} = S_{NG} + S_G + E_R F_\$ \tag{33}$$

Therefore, the foreign resource gap $E_R F_\$$ in domestic currency is adjusted residually and verifies (33). However, contrarily to de Melo et al (1989), the nominal exchange rate (E_R) and the current account deficit $(F_\$)$ adjust to verify also equation (16) in which both exports (E) and imports (M) depend on (E_R). This second particular closure in this model, generates multiple equilibria which needs carful treatment during the simulations. Besides, as mentioned above, I consider another different closure relatively to de Melo et al (1989) where the net external borrowing by the government ($\Delta FB_{G\$}$) is not fixed in dollars but is endogenously determined (see equation, 29).

II.2. The dynamic specification

The reference year is 2010 and the model is solved forward for the period 2011-2018 in a dynamically recursive way. The evolution of the stock of capital depends on the capital depreciation rate (δ) and the aggregate investment $(\bar{I}_t)$ deflated by the composite good price $(P_{Q,t})$:

$$K_t = (1 - \delta) K_{t-1} + \frac{\bar{I}_t}{P_{Q,t}} \tag{34}$$

The non-government wage (W_{NG}) increases with an exogenous rate φ :

$$\overline{W}_{NG,t} = \overline{W}_{NG,t-1}(1+\varphi) \quad (35)$$

The domestic and the foreign government debt stock evolve according to the following equations respectively:

$$\overline{DB}_{G,t} = (1+\overline{\iota_G^d})\overline{DB}_{G,t-1} + \overline{\Delta DB_G} \quad (36)$$

$$FB_{G\$,t} = (1+\overline{\iota_G^F})FB_{G\$,t-1} + \Delta FB_{G\$,t} \quad (37)$$

All the exogenous variables (See table 2 – Appendix 1) are yearly updated in order to capture their effective evolution during the period 2011-2018.

II.3. Data and calibration

The following flow-of-funds accounts reflecting the state of the economy in 2010 are used: the national accounts, the consolidated central government budget, the central bank accounts; the financial institutions accounts, the balance of rest of the world, and the non-government (public enterprises) non-financial sector. For each account, the budget constraint (sources = uses of funds) is satisfied and the corresponding variables in the model are matched. Each variable appears twice, as a "source" in one table and as a "use" in another one. In addition, the aggregated social accounting matrix (SAM) for the year 2010 (table 4 – appendix 2) was constructed from budgetary and national accounts data in line with the model's specification. The model's parameters and the elasticities of substitution and transformation (given in table 3– appendix 1) take into account plausible cross-country evidence and the model is calibrating so that it replicates the evolution of the main macroeconomic fundamental during the period 2011-2018. As highlighted by Lovo et al. (2018), there are few studies in the economic literature which attempt to carry out an historical calibration procedure for dynamic general equilibrium models.

III. Simulations

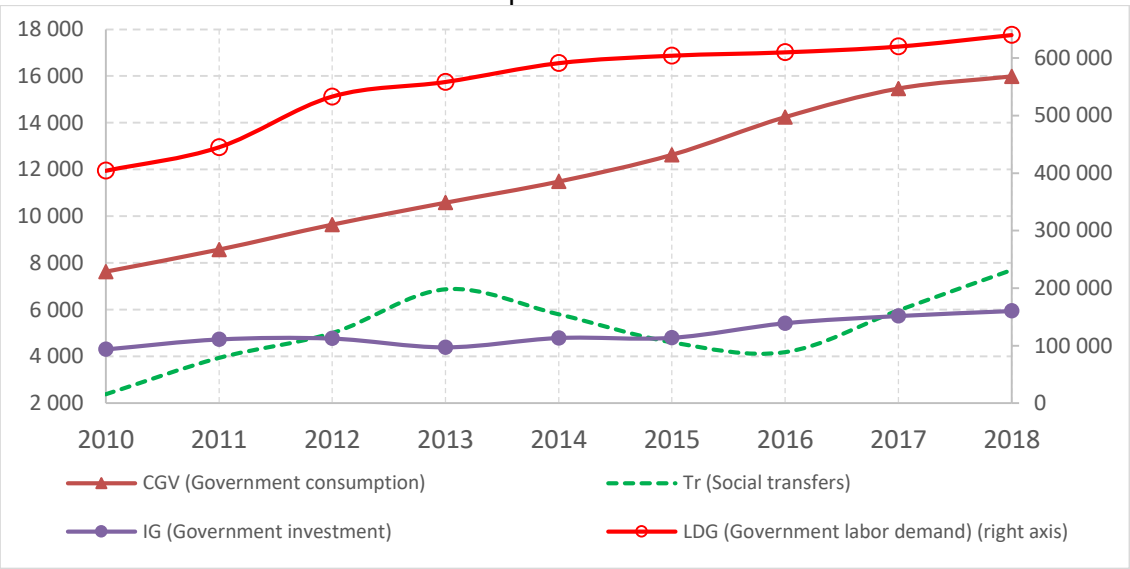
III.1. Replication of the macroeconomic fundamentals evolution

The model is calibrated to simulate the evolution of the macroeconomic fundamentals (GDP, unemployment, external debt, public deficit and current account deficit, among others) during the period 2010-2018.

III.2. Counterfactual analysis

The number of civil servants ($\bar{L}_G$) in Tunisia passed from 404 thousands in 2010 to 640 thousands in 2018 (figure 1). This evolution was accompanied by a growth of the public wage bill at an average rate of 10.2%. Hence, the share of the government wage bill in its total expenditures passed from 47,4% in 2010 to almost 50% in 2019. Given the weak economic growth during the same period (1.8% in average), the ratio of the public wage bill to GDP increased from 10.8% in 2010 to 14% in 2018. Meanwhile, the social transfers ($\overline{Tr}$) grew at an average growth rate of 15.8% leading to an increase of its share in the government expenditures from 16.6% in 2010 to 26% in 2018. At the opposite, the growth of the public investment was just of 4.1% during the same period. As consequence, the share of public investment ($\bar{I}_G$) in the government total expenditure passed from 5.9% in 2010 to 4.1% in 2018.

Figure 1 – Evolution (real) of the main components of the government expenditures over the period 2010-2018



Source: The author. Data retrieved from the Ministry of finance and the National Institute of Statistics

I simulate a counterfactual analysis (policy experiment 1) by delving the impacts of different policy choices in relation to the government consumption ($\bar{C}_{GV}$), the government wage bill ($\bar{W}_G\bar{L}_G$), the government investment ($\bar{I}_G$), and the social transfers ($\overline{Tr}$). More precisely, I analyze the impacts on economic growth, unemployment and public debt, of a different combination of government expenditures, rebalanced towards more public investment and lower government labor demand and social transfers. This is done by simulating the scenario of keeping the same structure of government expenditure during the period 2011-2018 as that of the reference year 2010 (see table 1). Hence, the public wage salaries increase in the policy experiment at a rate of 9.5% instead of 10.2%. This will have an impact on the evolution of the wage bill to GDP which would reach 13.3% in 2018 instead of 14%. The social transfers also increase at the rate of 9.5% instead of 15.8%. Conversely, the government investment increase at 9.5% instead of 4.1%. This policy experiment is done while keeping unchanged the total government expenditures as the real ones.

Table 1 – Evolution of the main components of the government expenditures over the period 2010-2018: the real path and the policy experiment I

Evolution of the main government expenditures over the period 2010-2018

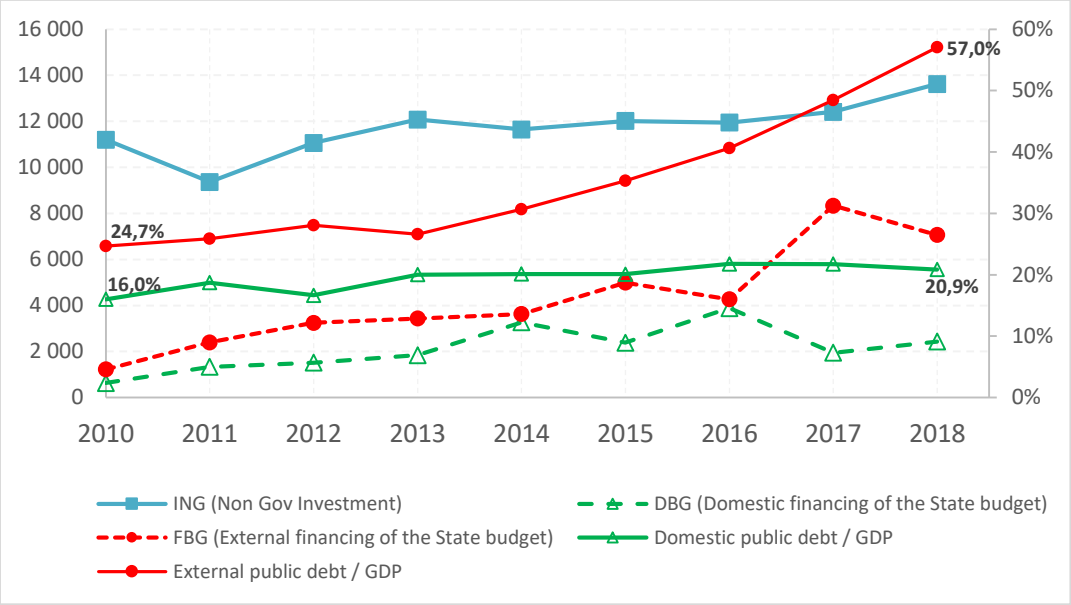
	2010	2011	2012	2013	2014	2015	2016	2017	2018	Avreage growth rate 10-18
CGV (Government consumption)	7626,2	8571,2	9638,9	10577,8	11483,4	12627,6	14241,8	15465,0	15986,0	9,7%
Public Wage Salaries	6785,2	7679,4	8655,5	9608,0	10540,7	11581,4	13163,9	14352,0	14776,0	10,2%
Wage bill/GDP (ratio)	10,8%	11,9%	12,3%	12,8%	13,0%	13,7%	14,7%	14,9%	14,0%	
Government consumption (G)	841,0	891,8	983,4	969,8	942,7	1046,2	1077,9	1113,0	1210,0	4,7%
Tr (Social transfers)	2374,8	3931,4	4997,1	6869,9	5801,3	4600,1	4178,6	5967,0	7694,0	15,8%
IG (Government investment)	4302,2	4729,4	4765,9	4392,6	4791,7	4798,9	5421,6	5729,7	5944,5	4,1%
Total	**14303,2**	**17232,0**	**19401,9**	**21840,3**	**22076,4**	**22026,6**	**23842,0**	**27161,7**	**29624,5**	**9,5%**

Policy experiment I : Evolution according to the same structure of the government expenditures as in 2010

	2010	2011	2012	2013	2014	2015	2016	2017	2018	Avreage growth rate 10-18
CGV (Government consumption)	7626,2	9187,8	10344,7	11644,8	11770,7	11744,2	12712,1	14482,1	15795,2	9,5%
Public Wage Salaries	6785,2	8174,6	9203,9	10360,7	10472,7	10449,1	11310,2	12885,1	14053,4	9,5%
Wage bill/GDP (ratio)	10,8%	12,7%	13,1%	13,8%	13,0%	12,3%	12,6%	13,4%	13,3%	
Government consumption (G)	841,0	1013,2	1140,8	1284,2	1298,0	1295,1	1401,9	1597,1	1741,9	9,5%
Tr (Social transfers)	2374,8	2861,1	3221,4	3626,2	3665,4	3657,1	3958,6	4509,7	4918,6	9,5%
IG (Government investment)	4302,2	5183,1	5835,8	6569,3	6640,3	6625,3	7171,3	8169,9	8910,6	9,5%
Total	**14303,2**	**17232,0**	**19401,9**	**21840,3**	**22076,4**	**22026,6**	**23842,0**	**27161,7**	**29624,5**	**9,5%**

The second policy experiment that I consider, is to delve the impacts of different mix between the domestic and external sources of financing the public deficit. As shown in figure 2, the external financing of the State Budget (in domestic currency $E_R FB_{G\$}$) dominated the domestic financing (DB_G) over the entire period with an accelerated gap in 2017 and 2018. This policy choice, has contributed to the acceleration of the public external debt which passed from 24.7% of the GDP in 2010 to 57% of the GDP in 2018. Meanwhile, the ratio of the public domestic debt to GDP increased at a slower pace from 16% in 2010 to 20.9% in 2018.

Figure 2 – Evolution of the non-government investment, the public debt stock and the change in the external and domestic financing of the State budget over the period 2010-2018

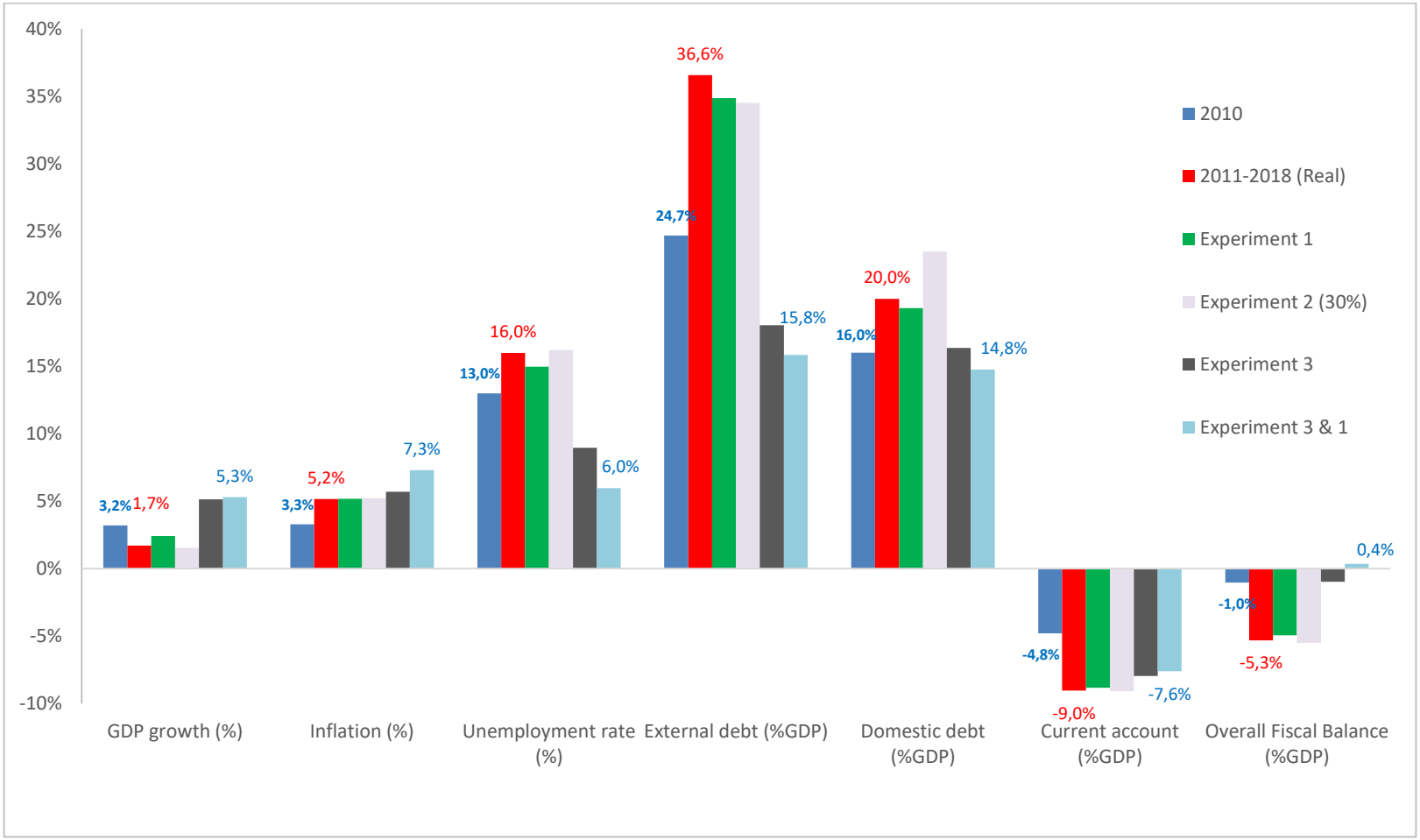


Source: The author. Data retrieved from the Ministry of finance and the National Institute of Statistics

The policy experiment II, consists in analyzing the impacts of higher recourse to the domestic borrowing in financing the public deficit through domestic debt ($\overline{\Delta DB_G}$). Hence, we increase the yearly domestic financing of the budget ($\overline{\Delta DB_G}$) by 30%. This will reduce the recourse to the external financing. Among the impacts, one can expect a change in the composition (domestic versus external) of the public debt stock. But what will be the impacts on GDP growth, unemployment and the CPI index (inflation), and the current account deficit?

The final policy experiment III consists in increasing the growth rate of the Total Factor Productivity ($\Delta A/A$) from its estimated level of around -1% during the period 2011-2018 to 1.7% its estimated level over the period 2001-2010.

Figure 3 – Evolution of the macroeconomic fundamentals during 2010-2018 under the real and experimental scenarios



Source: The author using the simulations of the proposed financial CGE model.

III.3. Simulations results

The main results of the simulations are summarized in figure 3. First, let's present the impacts of the first policy experiment which consisted in keeping the same structure of government expenditure during the period 2011-2018 as that of the reference year 2010, without changing the effective yearly total public expenditure. The results show that the average year-to-year GDP growth would have been of about 2.4% which means around 0.7% yearly percentage growth gain. The unemployment rate would have been lower by around 1% point at 15%. The external debt to GDP would have been slightly lower by 2% points, while the domestic debt to GDP lower by 0.7% point. The current account deficit would have been reduced by 0.2% and the public deficit lower by 0.4% point.

The second policy experiment consisted in increasing the yearly domestic financing of the budget ($\overline{\Delta DB_G}$) by 30%. The impact was slightly negative on the economic growth, unemployment, current account and the public deficit. However, there was naturally a rebalancing of the public debt composition with a decline by 2% of the GDP of the external debt, compensated by an increase of the domestic public debt by 3.5% points. The impacts on the exchange rate and inflation are also worthy to mention. The average exchange rate USD/TND and inflation rate would have passed respectively from 1.93 to 2.00 (depreciation of the Tunisian Dinar), and from 5.15% to 5.70% under this policy experiment. Let's note that our model does not include a complete bloc of the money market, and therefore, the results in relation to the exchange rate and inflation are not reflective of the all mechanisms in play in reality.

The third policy experiment consisted in increasing the growth rate of the Total Factor Productivity ($\Delta A/A$) from its estimated level of around -1 % during the period 2011-2018 to 1.7% its estimated level over the period 2001-2010. This had a higher impact on the averages of the economic growth and unemployment rates which pass respectively to 5.1% (from 1.7%) and 9% (from 16%). In addition, there would have been a clear decline in the stock of the external and domestic debt which would have reached respectively 18% and 16.3% of the GDP respectively. Finally, the average current account deficit would have been of about 7.6% (the effective average deficit is 9%) and the average fiscal deficit just around -1% (the effective deficit is -5.3%).

Finally, the combination of an improvement in the quality of the public expenditure (experiment 1) and higher level of the total factor productivity growth as 2001-2010 (experiment 3) has naturally bigger impacts on the economic growth (would have reached 5.3%) and unemployment (with its rate reduced to 6%), the stock of the external and domestic debt (respectively reduced to around 16% and 15%), the current account deficit (would have declined to -7.6%), and the fiscal balance (a surplus of 0.4%). However, the average inflation rate would have increased to 7.3% (that would have called for an intervention of the monetary policy, which is not explicitly modeled here).

IV. Conclusion

This paper contributes to the existing literature using financial CGE models to analyse the impacts of various economic policies in developing countries. It updates and extends the financial dynamic general equilibrium model of de Melo et al. (1989). In addition to its calibration using six flow-of-funds accounts representing the Tunisian economy in 2010, the structure of the model is adjusted to reflect the evolution of the Tunisian economic structure during the period 2011-2018. The historical calibration is made so that the model reproduces the main macroeconomic fundamentals of the Tunisian economy during the period 2011-2018.

The constructed model enabled the implementation of counterfactual analysis by comparing the path actually followed by the Tunisian economy with alternative policy scenarios under four policy experiments. The results show that the Tunisian economy would have performed much better, in relation to a battery of macroeconomic indicators (economic growth, unemployment, public external and domestic debts, current account, fiscal balance) under alternative economic policies, given the same conditions of internal and external shocks. In particular, higher economic growth, lower unemployment, reduced domestic and external public debt, lower current account deficit and improved overall fiscal balance are obtained for the following policy experiments: 1) a sustained growth of the total factor productivity at the same average level of 2001-2010; and 2) a stabilized structure of the public expenditures.

Therefore, the results confirm that the short-term foresight of the macroeconomic management of the Tunisian economy during the period 2011-2018, prevented the country from important opportunities in terms of reduced unemployment, higher growth, and much lower public debt. Consequently, it is extremely urgent for the policy makers to accelerate the implementation of the macroeconomic reforms, and catalyse the adhesion to a comprehensive development plan favouring the investment (public and private), the entrepreneurship, and improving the total factor productivity (by-but not limited to-incentivizing the digital transformation of the private sector, implementing the e-administration, and developing an integrated ecosystem for innovation and R&D connecting universities, private firms, the public sector and the financial institutions).

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The data that support the findings of this study are available from the corresponding author upon reasonable request.

Appendix 1

TABLE 2.a. - LIST OF ENDOGENOUS VARIABLES (35)

QUANTITIES		*PRICES*		*VALUES*	
X	Non-government product supply	P_X	Producer price of gross output	Y	Gross Domestic Product (GDP)
W	Intermediate demand	P_N	Net price	Y_{NG}	Income of non-government sector
Q	Composite good or gross expenditure volume	P_Q	Composite good price	Y_D	Disposable income of non-government sector
E	Export supply	P_E	Domestic price for exports	C_{NGV}	Non-government consumption
M	Import demand	P_M	Domestic price for imports	S_G	National saving of government
K	Capital stock	P_D	Price of domestically produced goods for domestic use	S_{NG}	National saving of non-government
D^S	Supply of non-traded goods	r	Average return on capital	C_{CB}	Central bank credit to financial institutions (stock)
D^d	Demand of non-traded goods	E_R	Nominal exchange rate	D	Deficit of consolidated government budget
L_{NG}	Demand for non-government labor			$F_\$$	Current account deficit (foreign saving) in dollars
$\bar{G}$	Government purchases of non-labor goods and services			ΔDB_{NG}	Change in Domestic Credit to Non-Gov
				$\Delta FB_{G\$}$	Change in government foreign debt in dollars
				PCB	Profits of the Central Bank
				NC_{CB}	Interest receipts by the Central Bank on credit to financial institutions
				ND_G	Domestic interest payments by the government
				$NF_{G\$}$	Foreign interest payments by the government
				ΔMB	Change in Money Base

TABLE 2.b. - LIST OF EXOGENOUS VARIABLES (24)

QUANTITIES		*PRICES*		*VALUES*	
$\bar{L}_G$	Demand for government labor	$\overline{W_G}$	Average wage of governmental workers	$\bar{C}_{GV}$	Government consumption
$\bar{L}_F$	Active population	$\bar{P}_{E\$}$	World price for exports	$\overline{Tr}$	Transfers and subsidies
		$\bar{P}_{M\$}$	World price for imports	$\bar{I}_{NG}$	Non-government investment
		$\overline{\iota_G^d}$	Nominal interest rate on government domestic debt	$\bar{I}_G$	Government investment
		$\overline{\iota_G^F}$	Nominal interest rate on government foreign debt	$\overline{\Delta DB_G}$	Change in Gov. Net Dom Borrowing
		$\overline{\iota_{CB}^d}$	Nominal interest rate on Central Bank credit to financial institutions	$\Delta\overline{FB_{NG\$}}$	Change in non-government foreign debt in dollars
		$\overline{W}_{NG}$	Average wage of non-governmental workers	$\overline{\Delta DEP}$	Change in Demand & Time Deposits
				$\overline{OR}$	Other budgetary revenues net of other current transfers
				$\Delta\overline{NF}_{A\$}$	Change in Net foreign assets of the Central Bank in dollars
				$\overline{NF}_{NG\$}$	Foreign interest payments by the non-government in dollars
				$\overline{NF}_{T\$}$	Other net current receipts in dollars, including workers remittances, and other current services and transfers in the balance of payments
				$\overline{NF}_{CB\$}$	Net foreign interest receipts by the Central bank in dollars
				$\overline{EKO}$	Other capital expenditures of government budget
				$\overline{\Delta OTHCB}$	Change of other items of central bank
				$\overline{\Delta OTHFI}$	Change in other items of Financial Institutions
				$\overline{DFIO}$	Direct foreign investment, grant & others

TABLE 3 - LIST AND VALUES OF THE EXOGENOUS STRUCTURAL PARAMETERS

$\bar{A}$=49.9 (base year 2010)	Shift parameter for the CES production function	$\rho = 1.5$	CES production function exponent	$\delta = 4\%$	Depreciation rate for capital stock
$\bar{a} = 0.48$	I-O coefficient	$\sigma = 1.7$	CES Armington import function exponent	$\varphi = 5\%$	Annual growth rate of wages of the non-government sector
$\bar{B} = 2$	Shift parameter for the CET demand function	$\Omega = 1.3$	CET export function exponent	$\bar{t} = 9.5\%$	Net indirect tax rate on domestic goods
$\bar{H} = 2.6$	Shift parameter for the CET supply function	$\theta = 0.48$	Share of the central bank new credit to the financial institutions, related to the refinancing of the new government domestic debt	$\bar{t}_m = 1.7\%$	Import tariff rate
$\alpha = 0.57$ $\beta = 0.36$ $\gamma = 0.29$	Distribution parameters for the CES and CET functions	$\bar{s} = 0.22$	Saving rate of the non-government	$\bar{t}_d = 8.1\%$	Direct tax rate

Appendix 2 – TABLE 4 - AGGREGATED SOCIAL ACCOUNTING MATRIX FOR TUNISIA ((in Millions of Dinars) - 2010.

		FACTOR OF PRODUCTION		INST. CUR. ACC.		NET INDIRECT TAXES		CAPITAL ACCOUNT			ACTIVITES	PRODUCTION ACCOUNT - COMMODITIES				REST OF THE WORLD	TOTAL REVENUES
		LABOR	CAPITAL	Gov.	Non-Gov.	Trade Taxes	Oth. Taxes	Gov. Savings	N. Gov Inv. BC	N.Gov Inv. Ac		Domestic	Imports	Exports	Composite		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
1	**LABOR**			6785,2							16 276,5						23 061,7
2	**CAPITAL**										34 701,9						34 701,9
	INST. CUR. ACC.																
3	Government				6 630,0	563,9	4 727,3										11 921,2
4	Non-Government	23 061,7	34 701,9	-258,0												4 451,0	61 956,6
	NET IND. TAXES																
5	Trade Taxes												563,9				563,9
6	Oth. Taxes											4 727,3					4 727,3
	CAPITAL ACCOUNT																
7	Gov. Savings			3 958,0					344,1								4 302,2
8	N. Gov Inv. BC				12 551,8											5 263,6	17 815,3
9	N.Gov Inv. Ac								17 471,2								17 471,2
10	**ACTIVITIES**											74 980,3		23 519			98 499,3
	COMMODITIES																
11	Domestic														79 707,6		79 707,6
12	Imports														32 944,5		32 944,5
13	Exports															23 519,0	23 519,0
14	Composite			841,0	42 516,8			4 302,2		17 471,2	47 520,9						112 652,1
15	**REST OF THE WORLD**			595,0	258,0								32 380,6				33 233,6
16	**TOTAL EXPENDITURE**	23 061,7	34 701,9	11 921,2	61 956,6	563,9	4 727,3	4 302,2	17 815,3	17 471,2	98 499,3	79 707,6	32 944,5	23 519,0	112 652,1	33 233,6	