Economic Alternatives, 2018, Issue 2, pp. 213-227

An Analysis of Tunisian Monetary Policy in a Post-Keynesian Stock-Flow Consistent Macroeconomic Growth Model

Amine MAROUANE*

Summary

The purpose of this paper is to build a post-Keynesian macroeconomic model most compatible with the Tunisian economy, which allows us to understand the dynamics of the economy not only in their scale flows, but also stock, which is too often neglected by economists. This allows us to better understand the role and conduct of monetary policy during an economic crisis.

Key words: SFC model, simulation, monetary policy, development, Tunisia

JEL Classification: E12, E52, O11, O55

Introduction

This paper is an attempt to model the Tunisian economy in a post-Keynesian Stock Flow Consistent (SFC) approach, which allows us to identify the transmission mechanism of monetary policy, i.e. how changes in the central bank policy rate are transmitted through the economy. In fact, this type of modeling has become fashionable again especially in the work of Post Keynesians who analyse the effects of economic policies (Le Heron (2007) ; Dos Santos and Zezza (2005); Godley and Lavoie (2007)). The SFC macroeconomic models developed in recent years are the modern version of the research carried out at the department of applied economics from the University of Cambridge in the 1970s under the direction of W. Godley. The SFC approach is relevant because it takes into account the movements of these stocks through time, unlike most neo-Keynesian economic theory which concentrates on flows and prices rather than stocks. In fact, the omission of these stocks from a model may therefore lead to false predictions regarding the consequences of policy changes or exogenous shocks to the system. Therefore, the SFC model was created to prevent this kind of problem.

The macroeconomic SFC approach is such that the balance-sheet dynamics of all institutional sectors are explicitly and rigorously modeled. Taking into account stock-flow relations allows describing an economy that is closer to reality. Accordingly this model aims to achieve realism and to approximate through modeling the actual functioning of the economy.

This model can be useful in developing post-Keynesian monetary analysis. In fact, Post-Keynesian theorists attribute great importance to the fact that Keynes wished to deal with a monetized economy of production and considered the money supply variable both as a flow and stock: money-flow allows for financing of production and investment, money stock allows for hedging against uncertainty. Therefore, the SFC model can “make the connection between money flows, which appears at the beginning

* University of Picardie Jules Verne, CRIISEA.

of the period when the production is made by bank advances, and the money stock, which appears at the end of the period and resulting from portfolio choice." Lavoie (2003, p 144).

However, most researchers who have used the SFC model have been interested in developed countries (Le Heron (2007), Jean- Vincent Accoce and Tarik Mouakil (2005), Dos Santos and Zezza (2004; 2005). In fact, little research is available in the literature where the stock-flow model is applied in developing countries. Another originality of this model is to examine a small economy where the rest of the world weighs very heavily.

In the first part of the paper, we try to propose a stock-flow model the most appropriate to Tunisian economy. The second part describes experiments in which we explore the role and channels of transmisssion of monetary policy.

1. Presentation of stock-flow model applied to the Tunisian economy

Building a SFC model requires three steps: writing the matrices; a balance sheet matrix (stock) and a transaction matrix (flows)[1], then counting the variables and the accounting identities issued from the matrices[2], and lastly defining each unknown variable with an equation (accounting identity or behavioral equation).

Six sectors form our open economy: government, firms, central bank, private banks, households and rest of the world. We consider the European Union (EU) as the rest of the world given the strong dependence of the Tunisian economy on Europe. In fact, the growth rate of the Tunisian economy seems to be correlated with the annual growth rate of Europe (0,7515 from 2005 to 2010) illustrated in Figure 1.

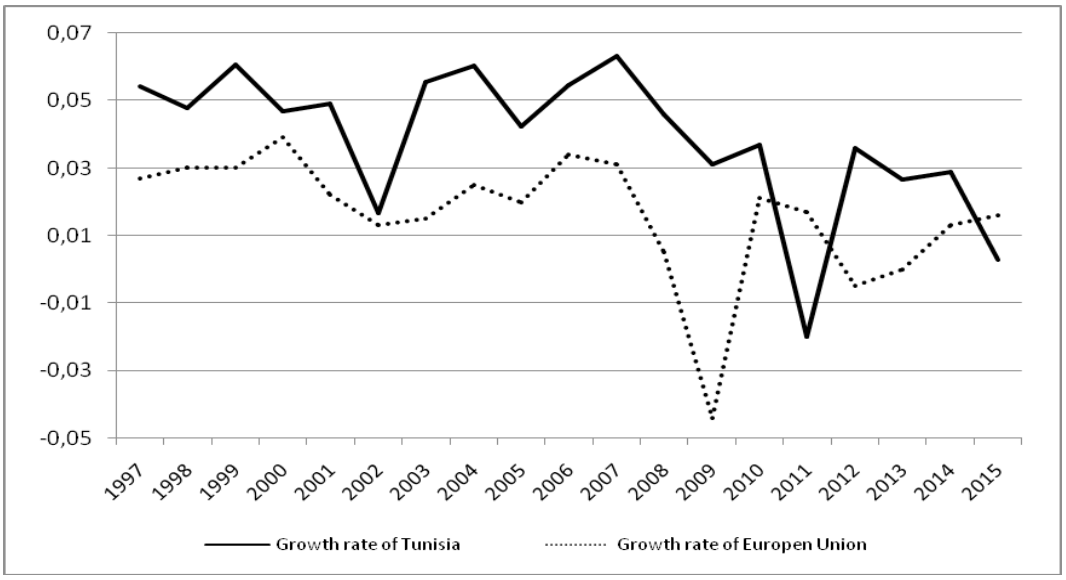


Figure 1: *Growth rate of Tunisia and the European Union*

[1] Appendix 1 et 2

[2] When we use an accounting identity, we add a Roman numeral.

Now we have to define every variable relative to the six sectors of the economy using an accounting identity or a behavioral equation. The variables of this model are in real terms in order to study the possible effects of wealth. The Gross Domestic Product (*Y*) is equal to real GDP multiplied by the domestic prices (*pd*). The real Gross Domestic Product (*YR*) adds real household consumption (*CR*), business investment (*IR*), real government expenditure (*GR*) the actual exports (*XR*) and eliminating the real import (*IMR*). (*GrYR*) defines the growth rate.

(1) $Y = YR \,.\, pd$
(2) $YR = CR+IR+GR+XR–IMR$
(3) $GrYR = \Delta YR/YR_{-1}$

1.1. Rest of the world

Few studies have been carried out using the stock-flow model in an open economy, but we can follow the same approach used by Tarik Mouakil (2005) and Godley Lavoie (2003). The domestic prices (*Pd*) are set as a mark-up (ρ) on unit direct cost (*UDC*), where unit direct cost is the ratio of direct costs (wages and imports) on sales. Wages are determined by unit wage (w), productivity (σ_2) and real purchase (QR).

(4) $Pd = (1+\rho)\ UDC$
(5) $UDC = (W + IMR\ )/QR$
(6) $QR=CR+IR+GR+XR$
(7) $W = w / \sigma_2.\ QR$

Equations (4) and (5) restate the kaleckian rule of mark-up used in the model Godley Lavoie (2003) and also often used in post-Keynesian macroeconomic models. This rule reflects the principle of pricing of leader firms. Furthermore, the follower firms must then adopt similar prices if they want to be able to maintain their market share and their ability to meet any increased demand. However, and with regard to the Tunisian export firms, they are not the leader firms in international markets. Therefore, they are going to fix the prices of their exports (*px*) on the basis of foreign prices (*pd€)* and they tend to play on their margin to absorb increases in domestic costs and effects of changes in exchange rates. The following equation used by Godley and Lavoie (2003) and repeated by Tarik Mouakil assumes such a procedure for fixing prices (in domestic currency).

(8) $\ln px = \chi 0 - \chi 1.\ \ln xr + (1 - \chi 1).\ \ln pd + \chi 1.\ln pd€$ avec χi : constants ·

(9) $\ln pm = \nu 0 – \nu 1\ \ln xr + (1 – \nu 1).\ln pd + \nu 1.\ \ln pd€$

Where pm is import prices, px is export prices, pd is the domestic prices.

If there were a simultaneous addition of some given amount to domestic inflation in both countries with no change in the exchange rate, then there would be an equivalent addition to export and (therefore) import prices in each country – hence the constraint that the coefficients on domestic and foreign inflation sum to unity.

If currency depreciation (a negative change in xr) were accompanied by a simultaneous and equal addition to domestic inflation, it is reasonable to expect that import prices and (therefore) export prices would rise by the full amount of the depreciation - hence the sum of the (absolute values) of the coefficient on the exchange rate and domestic inflation should also sum unity.

(10) $LnXR=\kappa_0–\kappa_1.(lnpm€_{-1} –lnpd_{-1}€)+\kappa_2 lnYR€$
(11) $LnIMR=ə_0 –ə_1.(lnpm_{-1} –lnpd_{-1})+ə_2\ lnYR$
(12) $pm€ =px.xr$
(13) $YR€= YR\text{-}1€.\ (1 + GRYR€)$

The equation (10) shows that the volume of Tunisia exports (*XR*) responds to an elasticity of κ_1 with respect to European import prices (*pm€*) relative to domestic

European prices *(pd$_{-1}$€)* , and κ_2 with respect to real domestic European output (*YR€*).

Equation (11) shows that Tunisian imports (*IMR*) respond with an elasticity $\ni_1$ with respect to Tunisian import prices (*pm*) relative to Tunisian domestic prices (*pd*), and $\ni_2$ with respect to real domestic output (*YR*).

Since it is so often assumed that the sum of the elasticities with respect to relative prices must sum to at least one if the trade balance is to improve following devaluation (the Marshall-Lerner condition), it is worth noting that in effect the sum of these elasticities need to be no greater than the elasticity of terms of trade with regard to devaluation. For instance, if the deterioration in the terms of trade were 20% of the devaluation, then the sum of the price elasticities need be no more than 0.2. If there were no change at all in the terms of trade following devaluation – not an impossible outcome – the sum of the elasticities need be no greater than positive for the balance of trade to improve (Godley Lavoie 2003). The value of trade flows is equal:

(14) $IM = IMR \cdot pm$

(15) $X = XR \cdot px$

The exports of one country are the imports of the other.

(16) $IM€ = X \,.\, xr$

(17) $X€ = IM \,.\, xr$

1.2. Government

We notice that the government collects taxes mainly from households (T_H) and firms (T_E). Taxes on households are direct taxes on wages ($\lambda_1 W_{-1}$) and deposits ($\lambda_2 D$). Taxes on firms are direct taxes on profits ($\lambda_3 P_E$) and indirect taxes on domestic sales ($\lambda_4 QR_d$).

(18) $T_H = \lambda_1 \cdot W_{-1} + \lambda_2 \cdot D$

(19) $T_E = \lambda_3 \cdot P_E + \lambda_4 \cdot QR_D$

(20) $QR_D = CR + IR + GR$

The government finances any deficit (*DG*) by issuing bills, so that the supply of treasury bills (*B*) in the economy is identical to the stock of government debt. We assume that the interest rate on Treasury bills (i_b) is the central bank's key rate (i_{cb}). We assume that public expenditures (*G*) are growing at the same rate (gr_Y) as the national income (*Y*). In addition to taxes, the government receives part of the profits of the central bank (P_{Acb}) and the nationalized banks (P_{Ab}).

(21) $\Delta B = DG$

(22-i) $DG = G + (i_{b-1} \cdot B_{-1}) - T - P_{Acb} - P_{Ab}$

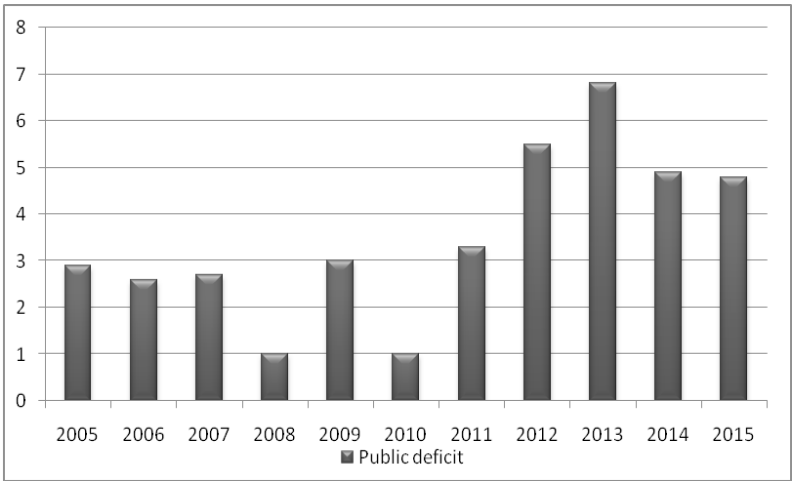


Figure 2: *Public deficit*

1.3 Firms

The stock of capital increases with the flow of net investment that is financed by the external funds from commercial banks (L_E), and by profit of firms (P_E). To simplify, we assume that there is no financing by the financial market given its weakness in Tunisia. Indeed, the contribution of the financial market to the financing of the GFCF of the private sector remains low, about 5% during the period 2005-2016.

(23) $\Delta KR = IR$
(24) $K = KR \cdot pd$
(25) $IR = gr_{KR} \cdot KR_{-1}$
(26) $I = IR \cdot pd$
(27) $\Delta L_E = I - P_E$

The investment function is the most important function in our model. The accumulation rate depends positively on the profitability measured by the cash flow ratio for the previous period (r_{cf-1}) that means the ratio of profit firms (P_E) to capital (K), the rate of capacity utilization defined as the ratio of real sales to full capacity real sales (QR_{fc}). These two variables refer to the real economy and link flow and stock. Unlike the New Keynesians, there is no predetermined long-term equilibrium, therefore no potential growth or natural unemployment. The output gap is measured by comparing output with full capacity output corresponding to the maximum use of physical capital. Finally, investment also depends on financial constraints representing the risk of the borrower. This risk is an increasing function of the leverage (*lev*) and the interest rate paid by entrepreneurs (i_L).

(28) $gr_{KR} = \gamma_0 + \gamma_1 \cdot r_{cf-1} + \gamma_2 \cdot U_{-1} - \gamma_3 \cdot lev_{-1} \cdot i_L$
(29) $r_{Cf} = P_E / K$
(30) $U = QR / QR_{fc}$
(31) $YR_{fc} = KR_{-1} / \sigma$
(32) $lev = L_E / K$

Total profits (P_E) of firms are the difference between their sales and their expenditures.

(33–ii) $P_E = C + I + G_E + X - M - W - T_E - i_{L-1} \cdot L_{E-1}$

1.4. Households

We assume that households determine their real consumption expenditure (*CR*) on the basis of expected disposable income real (*YRwa*), their wealth from the previous period (consisting entirely of bank deposits) (DR_{-1}), their real expected financial income (YR^{-}_{va}) and loans (L_H). Each (a_i) corresponds to a marginal propensity to consume. Recalling Kalecki's (1971) approach, wage incomes are more consumed than financial incomes and the stock of real wealth. The expected value of a variable for the current period depends on its value of the previous period plus an error correction mechanism, according to the principle of adaptive expectations.

(34) $CR = \alpha_1 \cdot YR_w^a + \alpha_2 \cdot DR_{-1} + \alpha_3 \cdot YR_v^a + \alpha_4 \cdot L_{H-1}$
(35) $C = CR \cdot pd$

The disposable income of workers (Y_W) is essentially the wages paid by firms (W), wages and social benefits as well as current transfers paid by the government (G_H) minus taxes (T_H). Household financial income (Y_V) is the interest on bank deposits ($i_{d-1} D_{-1}$) less interest paid on loans ($i_{L-1} L_{H-1}$). We consider that the rate of agreement by the banks on loans to households is the same as that towards Firms.

(36) $YR_w^a = Y_w^a / pd$
(37) $Y_w^a = Y_{W-1} + \theta_h \cdot (Y_{W-1} - Y_{W-1}^a)$
(38) $Y_w = W + G_H - T_H$
(39) $YR_v^a = Y_v^a / pd$
(40) $Y_v^a = Y_{v-1} + \theta_h \cdot (Y_{v-1} - Y_{v-1}^a)$
(41) $Y_v = i_{d-1} \cdot D_{-1} - i_{L-1} L_{H-1}$
(42) $L_H = \xi \cdot L$

1.5. Private Banks

Unlike Le Heron (2008; 2011), bank behavior and lender risk are not integrated into the model. The banks will satisfy only the demand for solvent credit, without the analysis of this solvency being explained.

Banks set long rates according to the central bank's interest rate, considered as exogenous, plus a margin rate. The rate on deposits is equal to the rate of central bank less a rate of margin, which allows the banks to make a profit. The profit of banks (P_b) is paid in part to the government (public banks: P_{Ab}) and to households (private banks: P_{Hb}).

$$(43\text{-v})\ P_b = i_{B-1} \cdot B_{-1} + i_{L-1} \cdot L_{-1} - i_{cb-1} \cdot REF_{-1} - i_{d-1} \cdot D_{-1}$$

1.6. Central Bank

It is assumed that banks are forced by the government to hold reserve requirements (*H*) in high-powered money that does not generate interest payments and which must always be a fixed share (the compulsory ratio h) of deposits:

$$(44)\ H = \eta \cdot D$$

The central bank's profit (P_{cb}) is equal to the interest received during the refinancing of the banks minus the interest payments on foreign credits in foreign currency used to finance Tunisia's current account deficit. The profit realized by the central bank is paid in part to the government (P_{Abc}) and partly conserved as a reserve.

$$(45\text{-vii})\ P_{cb} = i_{cb-1} \cdot REF_{-1} - i_L^{€} \cdot L^{€} / xr$$

$$(46\text{-vi})\ \Delta REF \equiv \Delta H + \Delta B + \Delta L - P_b - \Delta D$$

The model is completed with 65 equations and 65 variables (Appendix 3). The model is solved with 64 equations to find a general equilibrium which respects the stylized facts of Tunisia in normal period. An identity relative to the central bank has been left out and must always be checked so that the model is consistent in stock and in flows on the accounting level.

$$(47\text{-viii})\ \Delta H(\text{théorique}) = \Delta REF - L^{€} / xr - P_{cbr}$$

2. Experiments of economic shocks on Tunisian economy

Given the complexity of the 65-equation model, it would be difficult to solve it analytically. We therefore make simulation expermients using the Eviews software and we follow the methodology used by Gogley and Lavoie « *First we assigned values to the various parameters using reasonable stylized facts. Then we solved the model, and found a steady-state solution through a process of successive approximations. Having found a steady state, we conducted experiments by modifying one of the exogenous variables or one of the economically significant parameters of the model at a time"* Lavoie and Godley (2001, p.296).

However, the choice of the parameters was based on values of the Tunisian economy, so that the steady state is in accordance with the current functioning of the Tunisian economy. Therefore, finding the steady state of a 65-equation model, consistent with the evolution of different economic indicators in terms of ratio, appears a priori to be extremely difficult, but necessary to carry out the various simulations. Appendix 4 shows that the steady state of key variables in our model corresponds to the economic variables of the Tunisian economy (Table 1).

Table 1. *Main economic indicators of Tunisia*

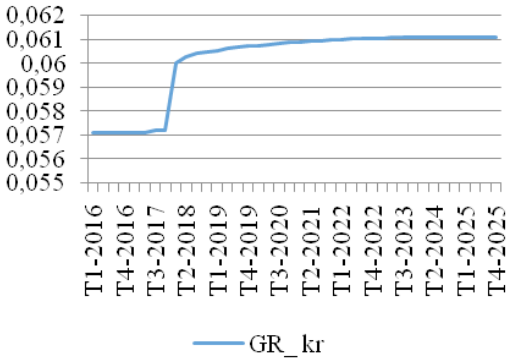
	2010	2011	2012	2013	2014	2015	2016
Consumption / GDP (%)	61.2	61.7	62.5	65.5	66.2	64.5	63.8
Public expenditure / GDP (%)	18	16	17	17	19	20	20
Investment / GDP (%)	29.5	30	29.4	27.5	27.9	27.9	28.2
Export / GDP (%)	43	33.2	37.1	38.4	37.3	35.2	34.4
Import / GDP (%)	51.7	41.5	47.3	48.7	50.5	47.9	46.8

Source : National Institute of statistics (INS)

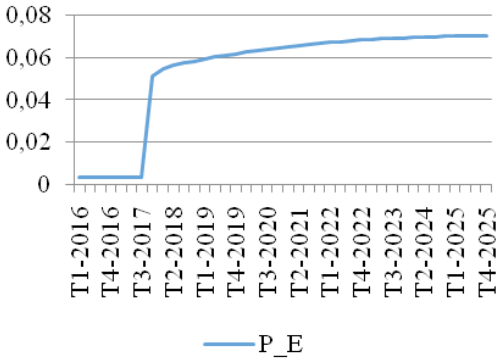
2.1 Experiments about monetary policy shocks

Following the Post-Keynesian 'horizontalist view', pioneered by Kaldor (1970; 1982; 1985), Lavoie (1984; 1996) and Moore (1988; 1989), we consider the rate of interest to be the exogenous variable in our model mainly determined by the interest rate policies of the central bank. The volume of credit (as a flow) and the quantity of money (as a stock), however, are therefore endogenous to the income generation and accumulation process.

In the second semester of 2017, we changed the value of the central bank key interest rate (i_{cb}) from 5 per cent to 4 per cent to provoke a monetary policy shock. The simulations helped understand how the interest rate affects economic activity through several channels, which are known collectively as the "transmission mechanism" of monetary policy.



Effects on growth rate accumulation



Effects on profits of firms

Figure 3. *Lower central bank key interest rate*

Monetary policy will have a stronger impact on expenditure by smaller firms that rely heavily on bank loans than it will on large firms that can directly access the credit markets without going through banks.

2.1.1. Firms channel

In fact, the interest rate may affect investment by firms channel in acting either on the profits of firms (*P_E*). In fact, when interest rates rise, banks charge more for business loans. This means businesses must use more of their earnings to pay interest on their loans. That decreases profits. Some business owners may decide not to start new projects or expansions during periods of high interest rates. This hampers the growth of the company, which in turn leads to a fall in the accumulation rate.

On the contrary, when interest rate remains low, businesses may borrow more readily. Low-interest loans can fund business growth and increase profitability because businesses can earn enough off of new ventures to pay for the loan interest and have money left over for profits.

2.1.2 Banks channel

Low interest rates make it cheaper for firms to borrow money to finance their operations, payroll and purchases. So, low interest rates tend to make it easy for firms to obtain external finance, which stimulate economic activity

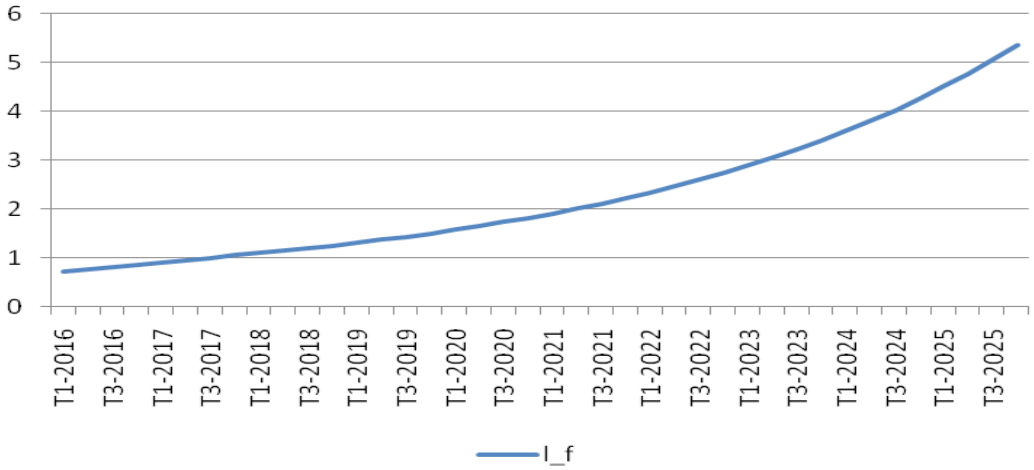


Figure 4. *Lower central bank key interest rate : effects on external finance*

Another mechanism refers to adverse selection through which expansionary monetary policy that lowers interest can stimulate production involves the credit rationing phenomenon. As shown by Stiglitz and Weiss (1981), credit rationing occurs in cases where borrowers are denied loans even when they are willing to pay a higher interest rate. This is due to the fact that households and firms with the riskiest investment projects are those who agree to pay the highest rates because, if their investment proves profitable, they will be the main ones beneficiaries. Consequently, higher interest rates increase the problem of adverse selection and lower interest rate exerts the opposite effect. When an expansionary monetary policy favors a decline in interest rates, less risk-prone borrowers are a higher fraction of those demanding loans and thus lenders are more willing to lend, leading to an increase in investment and production.

2.1.3 Household channel (paradox of thrift)

This channel takes into account consumer spending, particularly on consumer durables and housing. A reduction in bank lending induced by a monetary policy contraction should lead to a decrease in durables and housing purchases by households who do not have access to other sources of credit. Similarly, a rise in interest rates leads to a deterioration in the wealth situation of households because the value of fixed-income assets is negatively affected.

In our model, any change in the interest rate will cause a change in the rate structure. Indeed, the decline in the key interest rate and thus the interest rate on Treasury bills also leads to a fall in the interest rate on bank deposits and the interest rate on loans. This has two opposite effects on household consumption: a direct effect resulting in a fall in consumption following the fall in household financial income (Y_v) and an indirect effect resulting in an increase in household income (Y_w) as a result of the increase in investment due to lower financing costs.

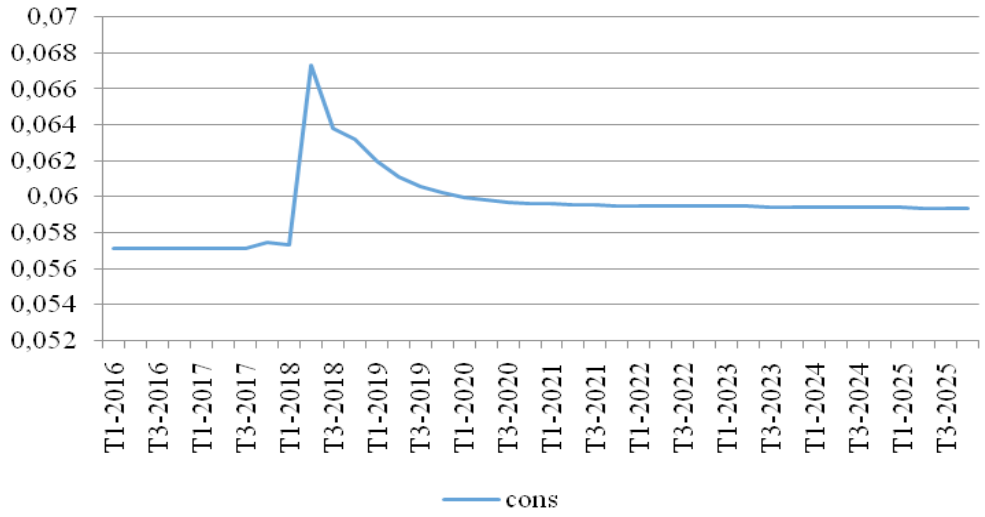


Figure 5. *Lower central bank key interest rate: effects on consumption*

Since the marginal propensity to consume on labor income is higher than that on financial income, the fall in the interest rate will have a positive effect on the growth of consumption. Indeed, it will encourage investment, hence an increase in demand and thus an increase in the rate of growth of economy and incomes. The model shows that some traditional results of Keynesian Theory as the "paradox of thrift" and the demand-led nature of economic growth still hold in a SFC framework.

2.2 The role of monetary policy in the economic crisis

Afer the subprime financial crisis that first appeared in the United States in 2007 and then to Europe in 2008, Tunisia's growth rate declined to 3% in 2009. In fact, Tunisia was relatively insulated from international financial contagion but is exposed to a slowdown in economic activity in its partner countries. Highly dependent on Europe for its external demand and FDI, Tunisia saw its exports falling in 2009. The drop in exports affected most sectors, particularly mining and phosphates (-50% in 2009 vs + 130% in 2008), energy (-35.3% vs. + 30%), Agriculture and agri-food industries (-14.2% versus 14.2%), textile, apparel and leather (-8.9% vs. + 0.4%) and mechanical and electrical industries (-3.7% vs. + 18.3%).

The Central Bank of Tunisia (BCT) reacted to the economic slowdown by loosening its monetary policy in 2009. The BCT reduced its key policy rate from 5¼ percent to 4½ percent in February 2009, its first such policy change in thirty months.

The decline in the interest rate by the BCT and the current account deficit led to the depreciation of the national currency, which caused ceteris paribus to increase exports and lower imports, thus boosting production and the demand

The EU's growth rates (YR €) and Tunisian monetary policy (interest rate and exchange rate) are considered as exogenous variables in our model. So, we can integrate in our model the true values (from the first quarter of 2008 to the fourth quarter of 2010) of growth rate in Europe, exchange rate and interest rate in order to study the impact of financial crisis and the role of monetary policy.

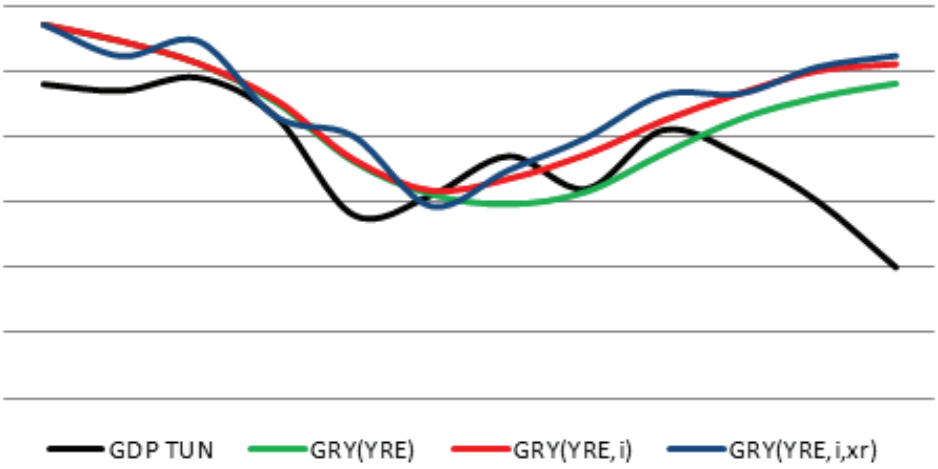


Figure 6: *Crisis of 2008, monetary policy and Tunisian growth rate*

Figure 6 shows that the real GDP growth (the black curve) has slowed reaching 3% in 2009 against 4.5% in 2008, which is mainly due to a decline in growth rate in Europe (the green curve). Given the decline in external demand, the Tunisian government has increased spending for public support aggregate demand causing an increase in budget deficit in 2009 (see figure 2).

The results show that decreasing interest rates by 75% reduces the effect of the crisis (the red curve). Given the increasing internationalization of the Tunisian economy and the transition to flexible exchange rates, the change in interest rate affects the exchange rate. In fact, when domestic interest rates decrease, domestic dinar deposits become less attractive to deposits denominated in foreign currencies. This would decrease the demand for domestic currency leading to the depreciation of value of the home currency. Depreciation of home currency makes the domestic goods less expensive compared to the foreign goods. It will lead to a fall in net exports and hence in output (the blue curve). Furthermore, the lower interest rates make loans cheaper and this encourages entrepreneurs to seek more funds and to finance new productive projects. This new situation marked by optimism stimulates economic activity.

Conclusion

Although Tunisia was not hit directly by the financial crisis, the steep recession in European countries affected significantly Tunisian exports as well as the manufacturing sector in 2009. So, our attempt to model the Tunisian economy from a post-Keynesian approach has established a framework with reference to studying the impact of various economic shocks on economic activity. Along with this attempt, we showed that growth shocks in Tunisia's major EU partners have relatively large effects on economic growth in Tunisia. These shocks are transmitted primarily through the export channel.

The results indicate that the recession of 2008 in the European Union presents significant risks for Tunisia. Faced with this crisis, Tunisia is acting through monetary policy by its interest rate (down 75%), which allows for the recovery of economic growth by acting on bank channel, firms channel and household channel. In this respect we

noted the importance of the credit channel in explaining the variability of production. In fact, the importance of the credit channel reflects certain characteristics of the Tunisian economy, such as the relevance of SMEs largely dependent on bank loans, the limit of direct financing, the existence of automatic lines of credit especially to priority sectors.

Furthemore, the authorities adopted in December 2008 several temporary measures to support exporting firms affected by the crisis, including partial exemption of social security contributions, fiscal incentives, and credit guarantees. An allocation of TD 730 million (1.4 percent of GDP) is provided in the supplementary budget adopted in July 2009 for additional expenditures in 2009 relative to 2008, including for accelerated public investment projects and expanded direct support measures.

Following the measures adopted by the Tunisian government, an economic rebound began in 2010, with a GDP growth estimate of 3.7%. This led many to believe Tunisia was, by-and-large, a sustainable good practice development model.

However, the Tunisian economy is characterized by structural weaknesses such as high external indebtedness, high unemployment among young graduates and a high level of corruption in the "ruling family". What prevents the country from optimizing its growth potential and culminated in January 2011 in the outbreak of the Tunisian revolution, which somewhat destabilized the economic situation.

References

Accoce, J-V. and Mouakil, T.,2005. The monetary circuit approach: a stock-flow consistent model, 9th workshop of the RNAMP, Berlin, Germany, 28-29, Octobre.

Dos Santos, C. and Zezza, G., 2004. A Post-Keynesian Stock-Flow Consistent Macroeconomic Growth model: preliminary results, WP No. 402, The Levy Economics Institute, February.

Dos Santos, C. and Zezza, G., 2005. The role of Monetary Policy in Post-Keynesian stock- flow Consistent Macroeconomic Growth models, in M. Lavoie M. and M. Seccareccia, Central Banking in the modern world: alternative perspectives, Cheltenham, UK and Northampton, MA, US, Edward Elgar, Aldershot.

Godley, W. and Lavoie, M., 2003, Two-country stock-flow consistent macroeconomics using a closed model within a dollar exchange regime, WP No 10, *CERF*, University of Cambridge.

Godley, W. and Lavoie, M., 2007, Monetary Economics: An Integrated Approach to Credit, Money, Income, Production and Wealth, Macmillan, London.

Kaldor, N., 1970, The new monetarism, *Lloyds Bank Review*, 97, p.1-17.

Kaldor, N., 1982, The Scourge of Monetarism, Oxford: Oxford University Press.

Kaldor, N., 1985, How Monetarism failed, *Challenge*, 28(2), p.4-13.

Kalecki, M., 1971, Selected Essays on the Dynamics of the Capitalist Economy, Cambridge: Cambridge University Press.

Lavoie, M., 1984, The endogenous flow of credit and the post Keynesian theory of money, *Journal of Economic Issues,* 18, pp.771-797.

Lavoie, M., 1996, Horizontalism, structuralism, liquidity preference and the principle of increasing risk, *Scottish Journal of Political Economy*, 43, pp.275-300.

Lavoie, M., 003, La monnaie endogène dans un cadre théorique et comptable cohérent, in P. Piegay and L.P. Rochon (ed), pp.141-161.

Le Héron, E.,2007, Dynamic Analysis of Monetary Policy Shock on Banking Behavior, in Institutions, Public Policy and Governance, McCombie (ed), Londres, 2007.

Le Héron, E. and Mouakil, T., 2008, A post-keynesian stock-flow consistent model for dynamic analysis of monetary policy shock on banking behaviour, *Metroeconomica*, 59 (3), pp. 405-440.

Mouakil, T., 2006, Instabilité financière et méthode stock-flux : analyse de l'hypothèse de Minsky, thesis at university of Bordeaux , November.

Moore, B.J., 1988, Horizontalists and Verticalists: The Macroeconomics of Credit Money, Cambridge: Cambridge University Press.

Moore, B.J., 1989, The endogeneity of credit money, *Review of Political Economy*, 1, pp.65-93.

Stiglitz, J.E. and Weiss, A., 1981, Credit rationing in markets with imperfect information, *The American Economic Review*, 71 (3), pp.393-410.

APPENDIX 1: BALANCE SHEET MATRIX

	Government	Firms	households	Private Banks	Central Bank	Rest of the world	∑
Capital		+K					K
HPM High powerd money				+H	-H		
Treasury Bills	-B			+B			
Loans		$-L_E$	$-L_H$	+L			
Foreign loans					$-L^€$	$+L^€$	
Bank deposits			+D	-D			
CB advances				-REF	+REF		
Net wealth	-B	$+V_E$	$+V_H$	$+V_B$	+RES	$+L^€$	+K

APPENDIX 2: TRANSACTION MATRIX

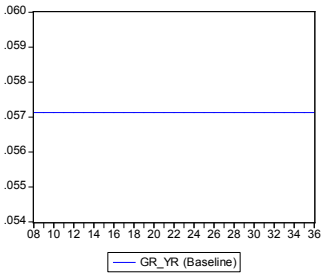
	government	firms		houshold	Private Bank		Central bank		∑		Rest of the world	∑∑
Consumption		$+C$		$-C$					0			0
Government expenditures	$-G$	$+G_E$		$+G_H$					0			0
Investment		$+I$	$-I$						0			0
Wages		$-W$		$+W$					0			0
Taxes	$+T$	$-T_E$		$-T_H$					0			0
Interest on tresaury bills	$-i_{b-1} B_{-1}$				$+i_{B-1} B_{-1}$				0			0
Interest on loans		$-i_{L-1} L_{-1}$			$+i_{L-1} L_{-1}$				0			0
Interest on bank deposits				$+I_{d-1} D_{-1}$	$-I_{d-1} D_{-1}$				0			0
Interest on CB advances					$-i_{cb-1}$ REF		$+i_{c-b}$ REF		0			0
Interest on foreign loan							$-i^{€}_{L-1} L^{€}_{-1}/xr$		0	xr	$+i^{€}_{l-1} . L^{€}_{-}$	0
Profit of firms		$-P_E$	$+P_E$						0			0
Profit of banks	$+P_{Ab}$			$+P_{Mb}$	$-P_b$	$+P_{Bb}$			0			0
Profit of CB	$+P_{Acb}$						$-P_{cb}$	$+P_{cbr}$	0			0
Δ HPM (High-powered money)						$-\Delta H$		$+\Delta H$	0			0
Δ treasaury bills	$+\Delta B$					$-\Delta B$			0			0
Δ loans			$+\Delta L_E$	$+\Delta L_H$		$-\Delta L$			0			0
Δ deposits				$-\Delta D$		$+\Delta D$			0			0
Δ CB advances						$+\Delta$REF		$-\Delta$REF	0			0
Δ foreign loans								$+\Delta L^{€}/xr$	0	xr	$-\Delta L^{€}$	0
Import		-IM							0	xr	$+ X^{€}$	0
Export		$+X$							0	xr	$- M^{€}$	0
∑	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 3: SFC MODEL

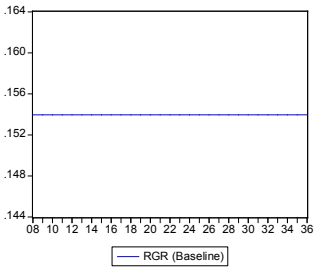
(1)	$Y = YR \cdot pd$	National income
(2)	$YR = CR + IR + GR + XR - IMR$	Real national ncome
(3)	$Gr_{YR} = \Delta YR/YR_{-1}$	Real growth rate
(4)	$pd = (1+\rho) \cdot UDC$	Domestic prices
(5)	$UDC = (W + IM)/QR$	Direct unit cost
(6)	$QR = CR + IR + GR + XR$	Real sales
(7)	$W = (w / \sigma_2) \cdot QR$	Wages
(8)	$\ln px = \chi_0 - \chi_1 . \ln xr + (1 - \chi_1). \ln pd + \chi_1 . \ln pd^{\epsilon}$	Export prices
(9)	$\ln pm = v_0 - v_1 . \ln xr + (1 - v_1). \ln pd + v_1 . \ln pd^{\epsilon}$	Import prices
(10)	$Ln XR = \kappa_0 - \kappa_1 . (\ln pm^{\epsilon}_{-1} - \ln pd_{-1}^{\epsilon}) + \kappa_2 \ln YR^{\epsilon}$	Real exports
(11)	$pm^{\epsilon}_{-1} = px . xr$	Import prices of europe
(12)	$Ln IMR = \theta_0 - \theta_1 . (\ln pm_{-1} - \ln pd_{-1}) + \theta_2 \ln YR$	Real imports
(13)	$YR^{\epsilon} = YR_{-1}^{\epsilon} . (1 + gr_{Y\epsilon})$	Real income of europe
(14)	$IM = IMR \cdot pm$	Imports
(15)	$X = XR \cdot px$	Exports
(16)	$IM^{\epsilon} = X . xr$	Imports of Europe
(17)	$X^{\epsilon} = IM . xr$	Exports of Europe
(18-xi)	$T \equiv T_H + T_E$	Taxes
(19)	$T_H = \lambda_1 W_{-1} + \lambda_2 D$	Taxes paid by households
(20)	$T_E = \lambda_3 P_f + \lambda_4 QR_d$	Taxes paid by firms
(21)	$QR_d = CR + IR + GR$	Domestic real sales
(22)	$\Delta B = DG$	Treasury Bills (BT)
(23)	$i_b = i_{cb}$	Interest rate in treasury bills
(24-i)	$DG \equiv G + (i_{b-1} . B_{-1}) - T - P_{cbt} - P_{Tb}$	Government defecit
(25)	$GR = GR_{-1} . (1+gr_{yr-1})$	Real government expenditure
(26)	$G = GR . pd$	
(27-x)	$G_E \equiv G - G_{HR} - G_{HP}$	Government expenditure
(28)	$G_H = z_1 . G$	
(29)	$KR = KR_{-1} + IR$	Public expenditure for firms
(30)	$K = KR . pd$	
(31)	$IR = gr_{KR} . KR_{-1}$	Public expenditure for houshold
(32)	$I = IR . pd$	
(33-iii)	$\Delta L_E \equiv I - P_E$	stock of real capital
(34-ix)	$\Delta L^{\epsilon} \equiv IM . xr + i_L^{\epsilon} . L^{\epsilon}_{-1} - X . xr$	
(35)	$gr_{KR} = \gamma_0 + \gamma_1 r_{cf-1} + \gamma_2 U_{-1} - \gamma_3 lev\ i_L$	Stock of capital
(36)	$r_{cf} = P_E / K_{-1}$	
(37)	$U = QR/ QR_{fc}$	Real net investment
(38)	$QR_{fc} = KR_{-1}/\sigma$	
(39)	$lev = L_E / K$	Net investment
(40-ii)	$P_E \equiv C + I + G_E + X - M - W - T_E - i_{L-1} . L_{E-1}$	
(41-xiii)	$L \equiv L_H + L_E$	Loans of firms
(42)	$L_H = \xi . L$	Foreign loans
(43)	$C = CR . pd$	Growth rate in the stock of capital
(44)	$CR = \alpha_1 . YR_w^a + \alpha_2 DR_{-1} + \alpha_3 YR_v^a + \alpha_4 L_{H-1}$	Ratio of cash-flow
(45)	$YR_v^a = Y_v^a / pd$	Capacity utilization rate
		Production capacity
(46)	$Y_v^a = Y_{v-1} + \theta_h (Y_{v-1} - Y_{v-1}^a)$	Leverage ratio
(47)	$Y_v = i_{d-1} . D_{-1} - i_{L-1} L_{H-1}$	Firms profits
(48)	$YR_w^a = Y_w^a / pd$	Loans
(49)	$Y_w^a = Y_{W-1} + \theta_h (Y_{W-1} - Y_{W-1}^a)$	Loans of households
(50)	$Y_w = W + G_H - T_H$	Consumption
(51-iv)	$\Delta D \equiv Y_W + Y_v - C + P_{Mb} + \Delta L_H$	Real consumption
(52)	$DR = D / pd$	Real expected disposable financial income
(53)	$i_L = i_{cb} + \mathfrak{z}_1$	Expected disposable financial income
(54)	$i_d = i_{cb} - \mathfrak{z}_2$	Diposable financial income
(55-v)	$P_b \equiv i_{B-1} B_{-1} + i_{L-1} L_{-1} - i_{cb-1} REF_{-1} - i_{d-1} D_{-1}$	Real expected disposable income
(56-xv)	$i_{L-1} L_{-1} \equiv i_{L-1} . L_{E-1} + i_{L-1} . L_{H-1}$	Expected disposable income
(57)	$P_{Tb} = \beta_1 . P_b$	Disposable income of workers
(58)	$P_{Mb} = \beta_2 . P_b$	Bank deposit
(59-xii)	$P_{bb} \equiv P_b - P_{Mb} - P_{Tb}$	Real bank depoits
(60)	$H = \eta \cdot D$	Interest rate on loans
(61-vii)	$P_{cb} \equiv i_{cb-1} . REF_{-1} - i_L^{\epsilon} \cdot L^{\epsilon} / xr$	Interest rate on deposits
(62-vi)	$\Delta REF \equiv \Delta H + \Delta B + \Delta L - P_{bb} - \Delta D$	Banks profits
(63-xvi)	$P_{cbr} \equiv P_{cb} - P_{cbt}$	Interest on loans
(64)	$P_{cbt} = \xi . P_{cb}$	Profit of banks paid to the government
		Profit of banks paid to households
(65-viii)	$Hthq \equiv REF - L^{\epsilon} / xr - P_{cbr}$	Undistributed Bank Profit
		High-powered money
		Central bank profits
		Reserve requirements
		Profit of the central bank not distributed
		Profit of the central bank distributed to the government
		Theoretical high powered money

APPENDIX 4: STEADY STATE OF KEY VARIABLES

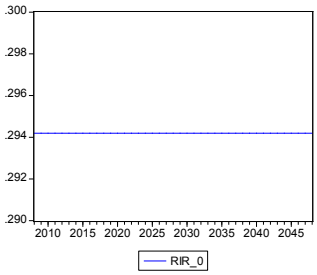
Real growth rate



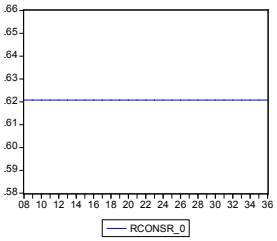
Public expenditure / GDP



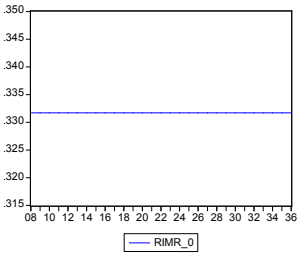
Investment/ GDP



Consumption / GDP



Import / GDP



Export / GDP