What Drives Tunisian Business Cycles?

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Abstract: In this paper, we try to shed light on the following question «Can the New Neoclassical Synthesis presuppositions be validated on the Tunisian business cycle?" To do this, we adopt structural VAR model for a small open economy after describing the stylized facts. The study examines five types of shocks: external shock, financial shock, inflation shock, monetary shock, and supply shock. According to the dynamic impulse responses function, supply shock, monetary shock, and external shock have an effect on the Tunisian business cycle. We also note that the effects of the first two shocks are transitory and deeper compared to the external shock. The latter shock shows a persistent effect on the Tunisian economic fluctuations in the long term. This result is also confirmed by the variance decomposition results. Firstly, the paper finds compatibility between stylized facts and the structural VAR model estimations. Secondly, the estimations highlight in particular the importance of monetary shock on the real sphere of the Tunisian economy. The results allow us to confirm the assumptions of the New Neoclassical Synthesis on a small open economy such as Tunisia.

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1. Introduction:

Since the free trade agreement signature between Tunisia and the European Union in 1995, the Tunisian economic situation became vulnerable to international fluctuations. However, due to its small size on the world and the unavailability of quarterly data, the Tunisian business cycle has rarely been the subject of economic analysis (Fathi 2007a & b; Fathi 2009; Baccouche et al., 1997).

This paper proposes to identify the sources (internal and external) of Tunisian business cycle fluctuations. In terms of literature, a debate is largely developed on the nature of shocks sources since the glorious years. The Keynesian theory attributes the cause of economic fluctuations to an endogenous source, demand aggregates. Contrary to Milton Friedman, leader of monetarism, which considers that Keynesian theory failed to limit the negative impact of inflation during the 1970s in several countries. As a result, targeting inflation through a restrictive monetary policy has returned to the agenda policymakers.

According to the monetarist theory, money supply is exogenous because it depends on the decisions taken by the Central Banks, which are the basis of the variation in the general level of prices and economic fluctuations.

The monetarist explanation of the causes of economic cycles was strongly supported and confirmed by the empirical work of the Saint-Louis school with the two founders articles (Andersen & Carlson 1970; Andersen & Jordan 1968).

From the 1980s, a new literature has developed: the Real Business Cycle theory (Kydland & Prescott 1982, 1990; Prescott 1986; Plosser 1989; Long & Plosser 1983; Backus et al., 1992). In contrast to the quantitative theory of money and Keynesian theory, the (RBC) model attributes the cause of economic fluctuations to supply shocks. The starting point of this theory consists of the dynamic general equilibrium model recommended by (Lucas 1977). This approach was reinforced later with the New Neoclassical Synthesis (NNS) or the neo-Keynesian theory founded by (Goodfriend and King, 1997). The New Neo-Classical Synthesis criticized the rejection of the role of monetary or fiscal policies in model simulations by RBC theory. Indeed, the NNS constitutes a combination of the quantitative money theory, the Keynesian theory, and the RBC theory. It focuses on the role of monetary, fiscal and supply shocks in the business cycles analyses (Gali 1996; Galí & Gertler 2007; Galí 2015; Blanchard & Galí 2007, 2010).

Referring to this recent theory, the present work attempts to study the following issue: «Can the New Neoclassical Synthesis presuppositions be validated on the Tunisian business cycle?" To do this, we adopt a structure VAR model for an open small economy. The paper focus on the study of five socks: an external shock and four domestic shocks (financial shock, inflation shock, monetary shock, and supply shock). According to (Sims 1980), the structural VAR model has several advantages. Among these advantages, the author cites the importance of its interaction with the results of the stylized facts.

This paper is organized as follows. The second section presents the stylized facts results. The third section tends to test the New Neoclassical Synthesis presumptions on the Tunisian economy by using the structural VAR model. The last section is a conclusion.

2. Stylized Facts:

In this section, we measure the volatility of the different countries business cycles through the standard deviation, and then we identify the nature of internal and external shocks and detect the stabilizing (countercyclical) and amplifier variables (pro-cyclical).

To do this, we adopt a method of moments (the cross-correlation and the temporal correlation). For stylized facts, the choice of variables is based on the new neoclassical synthesis. Is the Tunisian business cycles caused by monetary, real, financial or external shocks?

To realize this evaluation, all series are transformed into a log and seasonally adjusted using the Census X11 method. The first two moments (standard deviation and cross-correlation) are estimated using the GMM method, using the program written by Hevia (2008) on MATLAB. This method has been used by several studies due to its robustness (Aguiar & Gopinath, 2007; Ambler et al., 2004; Backus et al., 1992; Neumeyer & Perri 2005) etc. The moments are applied to the cyclic components of the variables extracted by the filter of Hodrick and Prescott (1997). Series data are extracted from Tunisian Central Bank, National Institute of Statistics (INS), and INSEE.

The business cycles volatility is carried out by comparing its level by decades since the 1960s. According to the results reported in Table 1, the Tunisian business cycles show certain stability during the years 2000, compared to the previous decades. The standard deviation is one-fifth of that recorded during the 1960s, 1970s, and 1980s. From 1995, the Tunisian business cycles show a level of volatility around 2%, which is between 2000 and 2010 around 1%. The progressive decrease in the volatility of the Tunisian business cycle is configured by the dynamic standard deviation shown in figure 1.

Table 2 summarizes the volatility and the cross-correlation of the real GDP fluctuations with different macroeconomics variables by referring to the NNS theory. The study period is between 2000T1 and 2011T1.

According to the results reported in this table, rainfall (rain.) represents the highest level of volatility with a standard deviation equal to 16%. High volatility is also recorded with exports (X) and imports (M) but at a lower level 8%.

For the monetary variables presented by M1, M2 and domestic credits (D.C), the volatility of their cyclical components is about twice as high as that of the Tunisian business cycles (GDP). Among the financial variables, remittances (Remi) and foreign debt (FD) volatile four times more than the Tunisian business cycles, while foreign direct investment (FDI) has the same level of volatility equal to 1.15%.

To identify the procyclical or countercyclical variables and to determine the nature of impulses sources, we examine the degree of co-movement of these variables with reference cycle. To do this, we compute the coefficients of cross-correlation order (0) and temporal correlation.

According to (Agenor, McDermott, and Prasad 2000) yt is pro-cyclical, cyclical, or countercyclical variable if the cross-correlation is respectively positive zero, or negative. Moreover, the series y_t is strongly correlated if the correlation coefficient, in absolute value is between 0.26 and 1, is weakly correlated if the correlation coefficient is between 0.13 and 0.26, there is no correlation when the correlation coefficient in absolute value is between 0.13 and 0.

In addition, by measuring the temporal cross-correlation denoted ρ (j), with j Є {± 1, ± 2, ± 3, ± 4, ...}, shown in Table 3, it is possible to know the number of quarters during which the peaks (or troughs) of a given variable lead or lag real GDP. (Agénor et al., 2000; Kydland & Prescott 1982; Mendoza 1995) affirm that the cyclical component of a variable leads the reference cycle of j periods if the absolute value of ρ(j) was at maximum for j> 0. On the other hand, if the | ρ(j) | was at maximum for j <0, the cycle of the variable examined lags the reference cycle (cycle of GDP) by j periods, which suggests that this variable produces a change in real GDP fluctuations.

Following this classification of the degrees of correlations, we will start with the domestic variables. The cross and temporal correlations are reported in Tables 2 and 3. The variables are classified into three categories: real variables, financial variables, and monetary variables.

It is essential in the business cycles analysis to examine the level of autocorrelations, order (1) of the reference cycle. According to several studies, particularly those of (Kose & Riezman 2001; Kouparitsas 1997) etc. this statistic measures the persistence of the business cycles. It allows us to know the duration of the expansion or contraction phase by which the economy can go over. According to table 3, the cyclical component of GDP shows a strong persistence with an autocorrelation order (1) equal to 0.7.

For real variables, cross-correlation shows independence between the phases of private and public consumption, and those of GDP with a coefficient equal to 0.1. For contemporaneous correlation, the results presented in Table 3 shows a counter-cyclical effect of these two variables on GDP, with 4 quarters lags. This indicates the stabilizing role of these two variables on the Tunisian business cycles.

Turning to monetary variables, the results summarized in Table 3 show a strong positive correlation (greater than 0.26) of GDP with M1 and a low correlation with M2. On the side of the temporal correlation, the results show that peaks of both M1 and M2 cycles manifest after two and three quarters compared to the GDP. For domestic loans, contemporaneous correlation exhibits the contra-cyclical (negative correlation) of this variable vis-à-vis the reference cycle variable. Moreover, on the basis of the temporal correlation calculations (Table 3), the credit cycle phases lag the real activity cycle by three quarters. Consumer price index is associated with a low correlation coefficient showing independence between price levels fluctuations and real activity.

Concerning the correlation coefficient associated to this rainfall (Table 3), there is a significant countercyclical behavior of this variable vis-à-vis GDP.

And finally, the work focused on the roles of the oil price index (PPI) fluctuations on the Tunisian real activity. A strong positive correlation between this variable and Tunisian business cycles is shown (Table 3), indicating their correlation and considerable effect on the Tunisian business cycle.

The stylized facts results allow us to say that the Tunisian business cycle is sensitive to three categories of variables studied - real, monetary and financial - which tend to confirm the New Neoclassical Synthesis theory.

This leads us to examine: Can the New Neoclassical Synthesis assumptions corroborate on the Tunisian economy? Section III will aim to answer this question, trying to confirm the stylized facts by adopting the structural VAR model.

3. Econometric Validation:

In this section, we begin by presenting the model. Then we proceed to an identification of the model restrictions based on the literature. And finally, we present a discussion of the results.

3.1.Model Presentation:

Initiated by Sims (1980) and developed later by (Blanchard & Quah, 1993) the structural VAR model allows testing the interactions between variables on multivariate time series. It allows to estimate the general dynamics system and to describe its behavior in relation to a shock on the terms of error.

According to (Stock & Watson 2001, 2016), the VAR model is a model with n equations, a linear model with n variables, in which each variable is explained by its own lag values and by the present and past values of the remaining n - 1 variables. The estimation of this model needs the construction of reduced and recursive form time series vector.

Formally, Blanchard & Watson (1986), Bruneau (1998) and Gimet (2007) represent the canonical VAR model as follows:

$$X_t = \sum_{j=1}^{p} A_j X_{t-j} + \varepsilon_t \qquad (1)$$

Ou X_t is a vector of n time series, A is a matrix $(n \times n)$with 1 on the main diagonal and $\varepsilon_t = (\varepsilon_t^1, \dots, \varepsilon_t^n)'$ is an iid $\rightarrow N(0,\ \Sigma)$ error term vector where Σ is a dimensional diagonal matrix. The matrix A represents the relations of simultaneity between the variables of $X_t\ vector.$

At each time t, innovations are simply estimated as the regression residuals corresponding to the estimation equation by the equation of the VAR model.

$$\hat{\varepsilon} = X_{it} - \sum_{h=1}^{p} \widehat{A_{ij}}\ X_{j,t-h}, \quad 1 \leq i \leq n$$

At each time t, the canonical innovations t are expressed as a linear combination of structural shocks ω_t :

$$\varepsilon_t = P\omega_t$$

Consequently, the identification of the structural impulses is obtained as soon as the passage matrix P is estimated since it is possible to write:

$$\hat{\omega} = \widehat{P^{-1}}\hat{\varepsilon}$$

For Bruneau (1998), the process of these hypotheses becomes clearer when we consider the two equivalent representations of the VAR model, namely moving average and structural VAR.

The moving average is derived from an intermediate step which consists in "inverting" the canonical VAR model in order to obtain it as a moving average:

$$X_t = \sum_{j=1}^{\infty} C_h \varepsilon_{t-h} = C(L)\varepsilon_t \qquad (2)$$
$$C(L) = \sum_{h \geq 0} C_h L^h$$

Where $\boldsymbol{C}(0) = \boldsymbol{I_n}$ and ε_t is the vector of canonical innovations.

The second writing from the VAR model is the writing of the structural VAR model. It takes the following form:

$$X_t = \sum_{h=0}^{\infty} B_h X_{t-h} + \omega_t \qquad (3)$$

Where the matrices B_h and the residuals variance of the Var (ω_t) are estimated by multiplying the two members of the estimated VAR (1) by$\widehat{P^{-1}}$:

$$\mathrm{Id} - \widehat{B_0} = \widehat{P^{-1}}$$
$$\hat{B}_h = \widehat{P^{-1}}\hat{A}_h\ , 1 \leq h \leq p$$
$$\mathrm{var}(\hat{\omega}_t) = \hat{P}^{-1}\Sigma(\hat{P}^{-1})'$$

The aim of the representations (2) and (3) is to analyze the impulses by the response function and the variance decompositions of the estimated term error.

3.2 Restriction Identification: Literature Review:

The structural VAR model estimation goes through a necessary step, the identification of restrictions. For a number of variables equal to n, we must make n (n + 1) / 2 restrictions. To do this, there are two ways.

The first one is a-theoretic and uses the Cholesky decomposition to identify the short-term constraints that the structural VAR model needs.

According to Guillaumin (2008), the disadvantage of this decomposition is that the results depend on the order of the time series. The modeler must order the equations of his system from the most exogenous variable to the most endogenous variable.

The second way of restriction identification is by referring to the economic theory. This method, initiated by Blanchard and Quah (1988), was adopted and developed by several other authors based on the IS-LM model Blanchard and Quah (1988), on the aggregate supply – aggregate demand (AS-AD model) (Bayoumi & Eichengreen, 1992), On the model of Mundell-Fleming for a small open economy (Huh, 1999; Dungey and Pagan, 2000; Dungey and Pagan, 2000) on stochastic general equilibrium models based on the new neoclassical synthesis (Gali, 1996 ; Aguiar & Gopinath, 2004).

The work of Blanchard and Quah (1988) assumes that there are two types of shocks, presented as constraints, affecting unemployment and GDP. By reference to the Keynesian model IS-LM, the first has no long-term effect on either unemployment or GDP. The latter has no long-term effect on unemployment but may have a long-term effect on output. The first refers to a demand shock and the second refers to a supply shock. These two shocks are uncorrelated.

The authors concluded that the effect of the demand shock takes the form of a bum on GDP and unemployment. This effect disappears after two to three years. The supply shock has an effect that accumulates over time and then stabilizes after five years. The authors also concluded that demand shocks make a significant contribution to output fluctuations over short and medium-term horizons.

By adopting the structural VAR approach developed by Blanchard and Quah (1988), the study of Bayoumi & Eichengreen (1992) analyzes data on real GDP and price level of eleven nations of the European Commission. The economic interpretation of demand and supply shocks is based on the AS-AD model, which is an extension of the IS-LM model by integrating the labor market, wages and prices. This model makes it possible to study the equilibrium in the short and the long term.

The restrictions adopted in Bayoumi and Eichengreen (1992) to identify the structural VAR model are four. Similarly to Blanchard and Quah (1988), both of these restrictions are simple normalization, which defines the variance of shocks. A third restriction comes from the assumption that the demand shock and the supply shock are orthogonal. The last restriction is that the demand shock has only short-term effects on production.

Because of the problem of over-identification, the authors did not impose the restriction resulting from the AS-AD model, which implies that demand shocks should increase prices in the short and long-term, while supply shocks should decrease the prices.

In order to characterize the joint behavior of a higher number of variables, namely the nominal interest rate, real GDP, exchange rate, price level and money supply, Huh (1999) attempts to validate the Mundell-Fleming model on the Australian economy after the abolition of the Bretton Woods system.

The economic interpretation given to structural shocks in the VAR model is based on the Mundell-Fleming model. This model is a version of the IS-LM model but for a small open economy with the integration of the mobility of capital flows as a key component of the model. The five structural shocks in the VAR model are the world interest rate shocks, aggregate supply shocks, IS shocks, money supply shock, and money demand shock.

The identification of the structural VAR model is given in Huh (1999) by imposing short and long-term restrictions. The world interest rate shock is identified by assuming that for a small open economy, the long-term domestic interest rate cannot diverge from the world interest rate which is also an exogenous variable (the Australian economy has no influence on the external variables). No other shock in the model has an effect on the domestic interest rate.

The supply shock is identified by assuming that the demand shock has no long-run effect on real GDP (the same restriction proposed by Blanchard and Quah, 1988), and Huh (1999) has decomposed the demand shock into IS shocks, money demand shocks, and money supply shocks, so none of these shocks has a long-term effect on real GDP.

Similarly, in Blanchard and Quah (1988) and Bayoumi and Eichengreen (1992), and in the most of empirical studies, the five error terms representing the five structural shocks is iid→ $N(0,\ \Sigma)$ error term, where Σ is an identity variance-covariance matrix.

In order to distinguish IS shocks and two money supply and money demand shocks, the author follows Gali (1992) assuming that neither has a short-run effect on real GDP. The author assumes that aggregate demand for goods and services is not directly influenced by monetary shocks but is rather affected by changes in interest and/or exchange rate levels. A final restriction is imposed by following Blanchard & Watson (1986) which in the short run, price shocks have no effect on money demand.

(Wen 2001) attempts to identify and estimate the change in productivity and employment associated with supply shocks and demand shocks. This decomposition of two shocks is approved using a structural VAR model, identified by long-term restrictions that satisfy a set of dynamic stochastic general equilibrium model including real business cycles and nominal rigidity model (the New Neoclassical Synthesis).

The main restriction of Gali (1996) is in line with that of Blanchard and Quah (1988) where only technological shocks have a long-term effect on the level of labor productivity. The variation observed in productivity and employment is interpreted by Gali (1996) as the source of two types of exogenous shocks, namely technological shock, and demand shock. These two shocks are orthogonal and their impacts spread over time to employment and GDP. The assumption of orthogonality combined with the normality of error terms implies that the variance-covariance matrix is diagonal and identity. These assumptions imply, in other words, that the matrix of long-run multipliers is a lower triangular matrix.

Leu (2011) presents a structural VAR model for the Australian economy where identifications are based on a New Neoclassical Synthesis of a small open economy that specifies the interactions between exogenous structural shocks and expected behavior of economic agents.

The structural VAR model used is to estimate the dynamic response of GDP, inflation, exchange rate and interest rate to four structural shocks: aggregate supply shock, aggregate demand shock, risk premium shock and monetary policy shock.

For the identification of the restrictions, this article adopts the program of identification of the rational expectations of Keating (1990) for a new Keynesian open economy. The identification system is based on the conversion of the contemporary structure system into a residual representation which consists of structural shocks and residuals of the reduced VAR, subtracting from each variable the expectation at time t-1 of this variable. It is similar to the method of (Stock & Watson 2001) which used the Taylor rule equation to estimate the structural VAR model.

4. Results and Discussion:

In this paragraph, empirical work consists in estimating a structural VAR model of a small open economy in order to investigate how the new neoclassical synthesis can be confirmed in Tunisian economy? According to Sims (1980), the structural VAR model has several advantages, including the possibility to evaluate the compatibility between stylized facts results and model estimation.

For Stock & Watson (2001), the standard practice in VAR analysis is to see the results of Granger's causality tests, the reaction function (impulse-response) and The variance decomposition.

Granger causality Statistic examines whether the lagged values of a variable predict another variable. The impulse-response function traces the response of the present and future values of each of the variables following an increase of one unit of the current value of one term error of the VAR (a positive shock), assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The variance decomposition forecast is the percentage of the predicted variable variance following a specific shock at a given horizon.

In our analysis, the series vector X_t (equation (3)) with a dimension(5×1), are oil price index, consumer prices index, FDI, the Tunisian money market rate and GDP at constant prices. The vector X_t is denoted (cycipp, cycipc, cycide, cyctmmt, cyct). The choice of variables used in the structural VAR model is based on the results of the stylized facts. Of course, the oil price index, the consumer price index, FDI, showed strong correlations with Tunisian real GDP.

The Tunisian money market rate was not included in the stylized facts but we include it in the model because the interest rate is considered the main instrument of monetary policy for the New Neoclassical Synthesis. Indeed, the stylized facts showed a strong correlation between the monetary variables with the real GDP through the two variables M1 and the domestic credit.

The series was transformed into a log and adjusted for seasonal variations using the X11 Census method (except for the Tunisian money market rate which is seasonally adjusted using the X12 Census method). We also consider five structural shocks formed in the system of equations (3) by the vector $\omega_t = (\omega_t^{ipp}\omega_t^{ipc}\omega_t^{ide}\omega_t^{tmmt}\omega_t^{pibt})'$ which denote respectively the external shock (the oil price index shock), the inflation shock, the financial shock, The monetary shock and supply shock. The estimation is made from 2000T1 to 2011T1.

In order to identify the structural VAR model, we adopt the necessary long-term restrictions. First, by following Gali (1996), we will decompose the model into a technological shock and a non-technological shock, i.e. the monetary shock (ω_t^{tmmt}), the inflation shock(ω_t^{ipc}), the financial shock (ω_t^{ide}) . Second, the non-technological shock or the demand shock has no long-term effect on GDP. Third, the shocks are orthogonal two by two which implies that the vector follows the normal distribution. The latter two restrictions are those adopted by Blanchard and Quah (1988).

Fourth, following Dungey and Pagan (2000) and Dungey and Pagan (2009), we consider Tunisia to be a small open economy. This last restriction allows us to consider that the external variable (oil price index) is exogenous and the domestic variables have no influence on this external variable.

Fifth, the last restriction refers to the New Neoclassical Synthesis, which suppose that the interest rate affects economic activity only in the short term, so that the money market rate has a zero long-term effect on other variables of the variable X_t.

Before presenting the results of the reaction function and the variance decomposition, we present the results of the diagnostic tests. The first test consists of selecting the optimal number of lags. There is usually used information criteria. Table 4 summarizes the results of these criteria showing the number of an optimal number of lags equal to two. The second test examines the characteristics of the AR polynomial. It tests the stability condition of the VAR model. The results of the unit roots showed that the model satisfies the stability condition. All roots are within the unit circle (see Appendix 1 for test results). For the Granger causality test, the results presented in Appendix 1 indicate that (cyctmmt) helps to explain (cyct) at 5% significance level (p-value equal to 0.03) but (cycipp), (cycipc) and (cycide) do not explain (cyct). Under the null hypothesis that the residuals follow the normal distribution, the p-value (Jarque-Bera statistic) for three equations is greater than 10%, which implies the null hypothesis is not rejected.

Figure 2 shows the impulse responses function with one standard deviation shocks. A positive oil price shock causes a small decrease in the level of the Tunisian economic fluctuations during the first two quarters. Then GDP fluctuations tend to increase. The reaction of the Tunisian business cycles to the oil price shock takes the form of a bump during the first year. In the second year, the fluctuations decrease. The response comes down to zero on the horizon of eighteenth quarters.

For the consumer price index shock, the reaction of GDP shows only a weak response over the first twelve quarters and thus a minor role in the Tunisian business cycle. This corroborates Fathi (2007a), which finds an insignificant impact of the consumer price index close to zero. It should be noted, however, that consumer prices are the only component of the demand shock in Fathi (2007a), contrary to our work, where the demand shock is also reflected by financial shock (cycide), and a monetary shock (cytmmt).

Similarly, it appears that the reaction of Tunisian business cycles to FDI shock is weak during ten quarters. Concerning the money market rate shock, the impulse-response function shows an immediate reaction of the GDP cyclical component behavior. From the sixth quarter, the response function begins to decline and to be closer to zero at about the tenth quarter.

Finally, figure 11 shows a supply shock leads to lower levels of economic fluctuations which run until the eighth quarter with a significant effect on the first quarter. This decrease spread out the eighth quarter with a significant effect from the first quarter. We show that this effect is reduced over twelve quarters and become null in the third quarter of the second year. This result for the supply shock confirms Fathi (2007a) findings, even though the supply shock is measured by the industrial production index and not by GDP, like in our case.

In summary, from the reaction function results, three shocks among the five studied have an important effect on the Tunisian business cycle. These shocks are the supply shock, the monetary shock (one of the three components of demand shocks) and the external shock. We also note that for the first two shocks their effects are transitory although they are deeper than the external shock. The external shock shows a persistent effect on the Tunisian economic fluctuations at the horizon of 19 quarters. Some of these results corroborate with those found by Fathi (2007a) concerning the amplitude of the supply shock and the external shock on GDP fluctuations and the weak role of the consumer price index shock.

Now, we turn to the variance decomposition to measure the contribution of each shock to GDP fluctuations.

The relative importance of the five structural shocks studied, captured by examining the proportion of the Tunisian GDP variance, is shown in Table 4.

The results show that the supply shock is the main contributor to the GDP variance. At the horizon of one quarter, 60% of the variance of the Tunisian cycle is attributed to the supply shock. This contribution remains virtually unchanged up to 25 quarters. On the horizon of one quarter, 60% of the variance of the Tunisian business cycle is attributed to the supply shock. This contribution remains almost unchanged up to 25 quarters.

For demand shocks, the monetary shock, the financial shock, and the consumer price shock contribute respectively to the GDP variance 34%, 2%, and 0.12%, over one quarter. The consumer price index shows a contribution close to zero; contrary to Fathi (2007a) results where 35% of the industrial production index variance is explained by the consumer price shock in Tunisia. This difference is due to the introduction of the monetary shock measured by the interest rate which in our work imposes itself as the dominant effect. The results show a low contribution of external shock (shock index of oil prices) on the horizon of one quarter. But unlike the monetary shock, which is decreasing over 25 quarters, the oil price index shock is rising over time to climb from 2% in the first quarter to about 10% on the horizon of 25 quarters, corresponding to the persistent effect of this shock on the GDP which is the same result found with the reaction function. We also find that the share of the oil price index shock exceeds the consumer price index and FDI shocks.

In summary, as the impulse response function results, three shocks among the five studied contribute the most to the GDP variance: the supply shock at about 60%, the monetary shock for 34% in the short term and 23% in the long term and the external shock (the oil price index) for about 10% on the horizon of 25 quarters.

The importance of the monetary shock on the real sphere confirms the results of the stylized facts of the second section. This allows us to conclude also that the structural VAR model estimation for a small open economy such as Tunisia confirms the presuppositions of the New Neoclassical Synthesis.

5. Conclusion:

The objective of this work is to seek how much the assumptions of the new neoclassical synthesis can be validated on the Tunisian economy? For this purpose, the SVAR methodology was used by decomposing five types of shock: an external shock and four domestic shocks. We find that the monetary shock (one of the three components of demand shocks) and the external shock have shown a considerable effect on the Tunisian business cycle. It is also observed that the effects of the first two shocks are transient although they are deeper than the impact of the external shock. The latter showed a persistent effect on GDP fluctuations over 19 quarters. Concerning the decomposition of the variance results, the supply shock is the main contributor to the variance of the GDP. Our findings exhibit that 60% of the variance of the Tunisian business cycle is attributed to the supply shock. This level of contribution remains almost unchanged over 25 quarters. For the demand shock composed of a monetary shock, financial shock and consumer price shock, each quarter contributes to the GDP variance respectively 34%, 2%, and 0.12%, showing the significant contribution of the monetary shock. For the external shock (oil price index shock), within a quarter, the result shows a small contribution of this shock to GDP, but unlike the shares of the monetary shock, on the horizon of 25 Quarters, the participation of the oil price index shock has increased significantly to climb from 2% in the quarter to about 10% showing the persistent impact of this shock on the GDP variance. These results corroborate with those of impulse response function.

First, this paper show an econometric validation of stylized facts results by adopting structure VAR model. Secondly, the estimation highlights the importance of the monetary shock on the real sphere of Tunisian economic activity. This allows us to confirm the presuppositions of the New Neoclassical Synthesis on a small open economy such as Tunisia.

The work requires other areas of improvement. The period studied is relatively short for a deep business cycles analysis. From a methodological point of view, the use of the factor-augmented VAR model (Forni, Gambetti, and Sala, 2014) seems particularly appropriate in the study of the monetary policy impulse. It has the advantage of combining the standard VAR model and common factor models. On the other hand, the persistent and gradual effect of external shock in explaining the variance of GDP opens the horizon to future work on the international fluctuations transmission channels on the Tunisian business cycles.

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ANNEX 1

Diagnostics tests

Roots of Characteristic Polynomial
Endogenous variables: CYCIPP CYCIPCT CYCIDE CYCTMMT CYCT
Exogenous variables: C
Lag specification: 1 2

Root	Modulus
0.737488 - 0.314443i	0.801725
0.737488 + 0.314443i	0.801725
0.551883 - 0.544022i	0.774941
0.551883 + 0.544022i	0.774941
0.620658 - 0.450709i	0.767043
0.620658 + 0.450709i	0.767043
0.668727	0.668727
-0.360115	0.360115
-0.094077 - 0.342292i	0.354985
-0.094077 + 0.342292i	0.354985

No root lies outside the unit circle.
VAR satisfies the stability condition.

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 08/27/14 Time: 16:49
Sample: 2000Q1 2012Q4
Included observations: 43

Dependent variable: CYCIPP

Excluded	Chi-sq.	df	Prob.
CYCIPCT	0.069052	2	0.9661
CYCIDE	0.706294	2	0.7025
CYCTMMT	0.159410	2	0.9234
CYCT	2.411735	2	0.2994
All	3.642342	8	0.8879

Dépendent variable: CYCIPCT

Excluded	Chi-sq.	df	Prob.
CYCIPP	0.313024	2	0.8551
CYCIDE	5.080486	2	0.0788
CYCTMMT	7.560957	2	0.0228
CYCT	5.197614	2	0.0744
All	16.97216	8	0.0304

Dependent variable: CYCIDE

Excluded	Chi-sq.	df	Prob.
CYCIPP	1.213956	2	0.5450
CYCIPCT	3.511297	2	0.1728
CYCTMMT	2.270661	2	0.3213
CYCT	0.091803	2	0.9551
All	7.417363	8	0.4923

Dependent variable: CYCTMMT

Excluded	Chi-sq.	df	Prob.
CYCIPP	11.37823	2	0.0034
CYCIPCT	0.123213	2	0.9403
CYCIDE	2.494982	2	0.2872
CYCT	1.962703	2	0.3748
All	16.18428	8	0.0398

Dependent variable: CYCT

Excluded	Chi-sq.	df	Prob.
CYCIPP	2.463749	2	0.2917
CYCIPCT	1.377971	2	0.5021
CYCIDE	3.882330	2	0.1435
CYCTMMT	6.835693	2	0.0328
All	9.287438	8	0.3186

VAR Residual Normality Tests
Orthogonalization: Estimated from Structural VAR
Null Hypothesis: residuals are multivariate normal
Date: 08/27/14 Time: 19:09
Sample: 2000Q1 2012Q4
Included observations: 43

Component	Skewness	Chi-sq	df	Prob.
1	-1.123582	9.047469	1	0.0026
2	-0.155635	0.173592	1	0.6769
3	1.108644	8.808492	1	0.0030
4	-0.057613	0.023788	1	0.8774
5	0.339695	0.826979	1	0.3631
Joint		18.88032	5	0.0020

Component	Kurtosis	Chi-sq	df	Prob.
1	4.951366	6.822358	1	0.0090
2	1.518221	3.933906	1	0.0473
3	4.710618	5.242800	1	0.0220
4	2.232417	1.055622	1	0.3042
5	1.862939	2.316460	1	0.1280
Joint		19.37114	5	0.0016

Component	Jarque-Bera	df	Prob.
1	15.86983	2	0.0004
2	4.107498	2	0.1283
3	14.05129	2	0.0009
4	1.079409	2	0.5829
5	3.143439	2	0.2077
Joint	38.25146	10	0.0000

Table 1: *Standard deviation of the Tunisian business cycles*

	1961/1969	1970/1979	1980/1989	1990/1999	2000/2010
Tunisia	5,18 (0.00)	5,18 (0.00)	3.8 (0.00)	1.98(0.00)	1.15(0.00)

Business cycles are measured by applying the H-P filter on GDP. The series is transformed into a log and seasonally adjusted using the Census X11 method.

Table 2 : *cyclical proprieties of Tunisian economy*

	Real GDP	PV. C	Pb. D	Ivt.	X.	M.	M_1	M_2	CPI	FDI	FD	D.C	Remi.	Rain	D.Dde
Volât	1.15 (0.00)	2.01 (0.00)	2.9 (0.00)	3,5 (0.00)	8.23 (0.00)	7.7 (0.00)	2,3 (0,0)	2,5 (0,00)	0.6 (0.00)	1,15 (0.04)	2.9 (0.00)	3.35 (0.00)	4.35 (0.00)	16.15 (0.01)	2.21 (0.00)
Corr	1 (0)	0,07 (0.14)	-0.1 (0.13)	0, 37 (0.11)	0.45 (0.1)	0.4 (0.12)	0,26 (0.1)	0,06 (0.1)	0,1 (0,16)	0,06 (0,1)	0.37 (0.13)	-0,35 (0.12)	-0,07 (0,12)	-0,61 (0.1)	0. 31 (0.12)

PV.C: private consumption; Pb.D: public expenditure, Ivt: investment; X: exports; M: imports; CPI: commerce price index; FD: foreign debt; FDI: foreign direct investment; D.C: domestic credit; Remi: remittances; Rain: rainfall; D.Dde: domestic demand. All series transformed into logarithms and filtered by the Hodrick-Prescott method. Volatility measured by standard deviation. Cross-correlations and standard deviations are calculated using the GMM method. Series data are extracted from Tunisian Central Bank, National Institute of Statistics (INS), and INSEE.

Table 3: *the contemporaneous cross-correlations of the Tunisian business cycles*

	-8	**-7**	**-6**	**-5**	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
GDP										0.7	0.45	0.22	0.044				
PV. C	-0.02	-0.24	-0.41	-0.60	-0.68	-0.64	-0.50	-0.21	0.07 (0)	0.29	0.41	0.40	0.33	0.24	0.15	0.12	0.11
Pb.D	0.14	-0.09	-0.28	-0.51	-0.65	-0.7	-0.61	-0.36	-0.10 (0.13)	0.11	0.24	0.27	0.26	0.22	0.17	0.14	0.11
Ivt.	-0.41	-0.40	-0.39	-0.33	-0.21	-0.07	0.06	0.22	0, 37 (0.11)	0.51	0.59	0.61	0.57	0.49	0.40	0.31	0.24
X.	-0.17	-0.23	-0.14	-0.11	-0.07	0.06	0.15	0.26	0.45 (0.1)	0.49	0.46	0.34	0.22	0.11	0.07	0.02	0.01
M.	-0.09	-0.08	0.00	-0.00	0.01	0.12	0.12	0.22	0.39 (0.12)	0.38	0.33	0.22	0.08	-0.04	-0.06	-0.07	-0.05
M_1	-0.32	-0.32	-0.35	-0.29	-0.23	-0.09	0.04	0.14	0.26 (0.1)	0.35	0.39	0.33	0.27	th	0.16	0.11	0.09
M_2	-0.34	-0.36	-0.37	-0.35	-0.33	-0.27	-0.11	0.07	0.06 (0.1)	0.29	0.36	0.40	0. 39	0.37	0.32	0.25	0.2
CPI	-0.06	-0.00	-0.11	-0.14	-0.09	-0.05	0.02	0.05	0.10 (0,16)	0.27	0.22	0.10	-0.01	-0.11	-0.14	-0.10	-0.03
FDI	-0.02	0.06	0.14	0.21	0.16	0.14	0.09	0.02	0.06 (0,1)	0.15	0.14	0.16	0.24	0.23	0.16	0.27	0.17
FD	-0.09	-0.14	-0.26	-0.34	-0.32	-0.30	-0.05	0.27	0.37 (0.13)	0.34	0.14	0.16	0.14	0.03	-0.10	-0.17	-0.2
DC	-0.1	-0.12	-0.16	-0.27	-0.38	-0.38	-0.37	-0.38	-0.35 (0.12)	-0.29	-0.02	0.03	0.09	0.14	0.19	0.21	0.19
Remi.	0.03	-0.04	-0.08	-0.16	-0.2	-0.23	-0.20	-0.14	-0.07 (0,12)	-0.00	-0.02	-0.09	-0.23	-0.33	-0.34	-0.30	-0.1939
Rain.	0.30	0.38	0.39	0.29	0.08	-0.18	-0.42	-0.61	0,61 (0.1)	-0.74	-0.68	-0.49	-0.23	0.01	0.20	0.31	0.3689
PPI	-0.12	-0.03	0.01	0.12	0.18	0.32	0.36	0.41	0.46 (0.08)	0.42	0.22	0.08	0.01	-0.01	-0.04	-0.07	-0.07

PV.C: private consumption; Pb.D: public expenditure, Ivt: investment; X: exports; M: imports; CPI: commerce price index; FD: foreign debt; FDI: foreign direct investment; D.C: domestic credit; Remi: remittances; Rain: rainfall; D. Dde: domestic demand; PPI: petrol prices index. All series transformed into logarithms and filtered by the Hodrick-Prescott method.

Table 4: *information criteria for the optimal number of lags*

Number of Lag	LogL	LR	FPE	AIC	SC	HQ
0	339.4698	NA	8.33e-14	-15.92713	-15.72027	-15.85131
1	410.2329	121.3082	9.52e-15	-18.10633	-16.86514*	-17.65138
2	451.7122	61.23131*	4.58e-15*	-18.89106*	-16.61554	-18.05699*
3	471.9675	25.07799	6.60e-15	-18.66512	-15.35527	-17.45193

Table 5: *the variance decomposition*

Quarters	Petrol prices index shock	Consumer prices index shock	FDI shock	Monetary shock	Supply Shock
1	2.663007	0.123653	2.329630	34.44120	60.44251
2	2.199571	0.445509	3.298786	28.86683	65.18931
3	1.909470	0.380223	4.351626	24.81315	68.54553
4	1.999867	0.455728	3.863857	23.92601	69.75454
5	2.339253	0.449322	4.020740	24.82750	68.36318
6	3.412848	0.438643	4.511821	25.57425	66.06243
7	5.253201	0.506297	4.835798	25.42938	63.97533
8	7.155400	0.605605	4.889533	24.79108	62.55838
9	8.333727	0.666358	4.818938	24.25616	61.92481
10	8.665187	0.679094	4.757874	24.04353	61.85431
11	8.624902	0.675521	4.729287	24.01956	61.95073
12	8.717163	0.676760	4.711746	23.99147	61.90286
13	9.061953	0.683111	4.694175	23.89775	61.66301
14	9.466084	0.688942	4.679398	23.78733	61.37825
15	9.734606	0.692221	4.670444	23.71395	61.18878
16	9.835871	0.693698	4.666287	23.68509	61.11906
17	9.848380	0.694257	4.664843	23.67912	61.11340
18	9.848555	0.694312	4.664823	23.67644	61.11587
19	9.862312	0.694150	4.665389	23.67093	61.10722
20	9.882090	0.694038	4.665849	23.66464	61.09338
21	9.896779	0.694101	4.665917	23.66026	61.08294
22	9.903692	0.694282	4.665757	23.65828	61.07799
23	9.905662	0.694454	4.665643	23.65776	61.07648
24	9.905846	0.694543	4.665673	23.65770	61.07624
25	9.905797	0.694562	4.665774	23.65761	61.07626

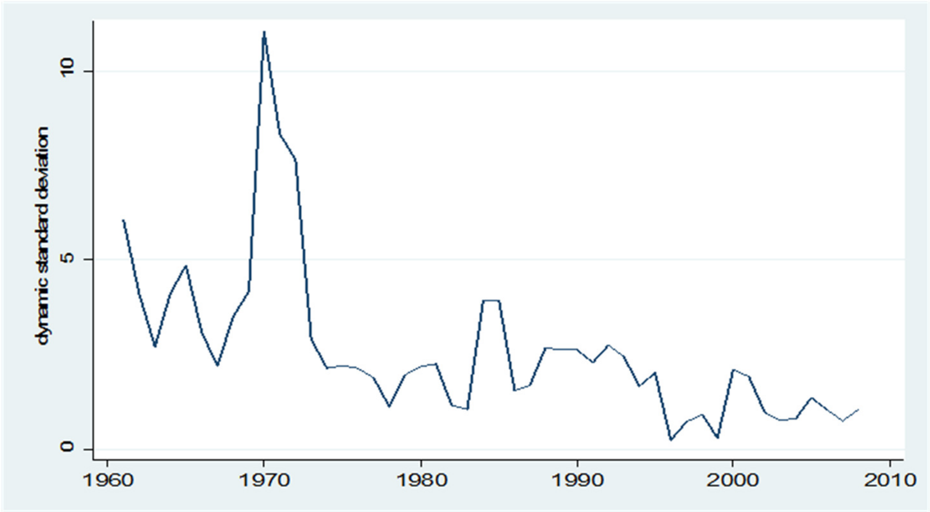

Figure 1. Dynamic standards deviation of Tunisian GDP

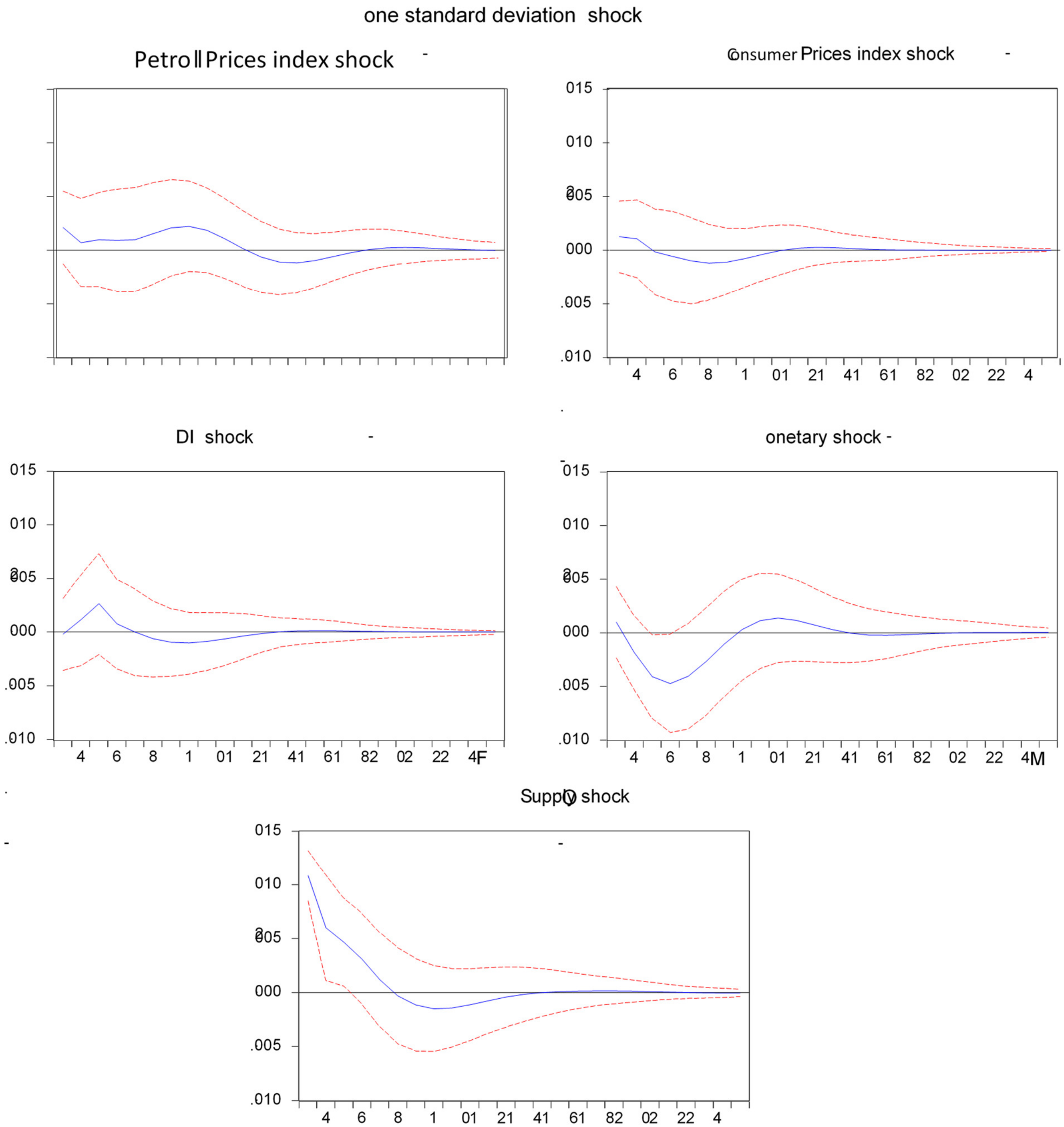

Figure 2. Impulse-response function