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Rzigui, Lotfi

URDEE FSEG Sfax

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External shocks and economic fluctuations: evidence from Tunisia

Lotfi RZIGUI *
(URDEE)

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Abstract

In this paper, we investigate the role of openness and external shock transmission affecting Tunisian economy. The paper proposes a new econometric methodology of fluctuations analysis in the objective to evaluate the effect of external shock based on trade on the dynamics of the GDP. The estimated common trend model reveals the role of external shock as well as technological shock in variation of economic activity. Our results are added to criticisms addressed to RBC model of first generation and show the role of external shock, ignored a long time in the business cycle literature.

Key words: External shocks, technological shocks, common trend representation, variances decomposition.

JEL classification: C32; E32; F41

I. Introduction

Since the seminal papers by Kydland and Prescott (1982), Long and Plosser (1983) and King Plosser and Rebelo (1988), stochastic neoclassical models have been used to study source of economic fluctuations in closed economy. The well-known shortcoming of these calibrated models is to confront simulation with the data. There are many criticisms associated to this procedure concerning the validation methods, inability to reproduce labor market futures and the identification of the source of economic fluctuation.

* URDEE Faculté des Sciences économique et de Gestion de Sfax route de l'aéodrome km 4 Sfax 3029, Tunisie.
rzigui_lotfi@yahoo.fr

The world economy has become increasingly integrated in recent years, characterized by a rapid increase of trade and higher openness degrees. Extensions in business cycle theory to account international co-movement and external shock propagation come from Backus et al (1992) and Zimmermann (1994, 1995). IRBC model analyze the role of international trade in the transmission of business cycle across countries. Many empirical literatures on international transmission exist. One stand of studies use Vector autoregression (VAR) and structural VAR to analyze impulse and propagation mechanisms, other approach use stationarity and cointegration tests to study short and long run dynamics.

In this paper, we attempt to investigate the role of openness and external shock transmission affecting Tunisian economy through a new empirical approach suggested by Warne (1993) characteristic of economic fluctuation analysis. Tunisia, as an open economy, has to profit from opportunities of its trade and international liberalization process. However, trade and liberalization may contribute to international transmission of external shocks. Section II reviews Tunisian trade liberalization; section III discusses recent empirical framework of shocks propagations; section IV summarizes empirical estimation and results and section V concludes.

II. Trade liberalization process

International liberalization policies in Tunisia generally started at the second half of the 1980's and they are perused as part of broader structural adjustment programs that included trade and exchange rate policies. The aim of these policies is integration into the world market.

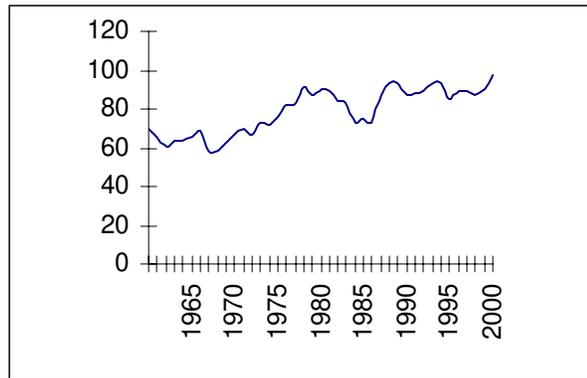
1. Trade liberalization

The political change in November 1987 allowed Tunisian authorities to accept conditions imposed by the World Bank on exchange and trade liberalization. The SAP period (1987-1994) of trade liberalization was characterized by a lower protection of the economy. General agreement in term of trade adhesion in 1989, Uruguay round agreement signature and participation in 1993 and adhesion to the world trade organization in 1994 are the principal measures taken to liberalize trade.

Since 1995, trade liberalization has been dominated by the free trade agreement with the European Union. The agreement suggests removing tariffs on industrial imports from Europe over a 13 years period started in 1996. These events influence degree of openness of Tunisian

economy, measured through current transaction to GDP. The computed ratio (see figure1) reveals increases in the integration of Tunisian economy into the world economy. Indeed, the ratio, interpreted as integration indicator, was climbed from 69.79% in 1961 to 97.83% in 2001.

Graph 1: Tunisia openness degree



2. Exchange rate policy

Tunisia, like many countries in the region, pursued a stabilization policy and exchange rate policy until the second half of 1980s. The aim of these policies is to attract foreign direct investment and total convertibility of Tunisian Dinar forecasted in 2010. In 1970s, Tunisian dinar was related to the FF and it was unstable. In the first of the 1980s, the dinar was linked to the German mark; US dollar was added to the FF and the DM in a new basket. In the second half of 1980s, four other currencies were added to the basket and the weights were revised to stabilize exchange rate.

Due to international liberalization process, Tunisian economy is assumed to be affected by external shocks at the level of trade, and exchange rate. The considered economy has been also affected by the value of foreign currencies, especially the European currencies. We note that contagion effects on the Tunisian economy are limited because financial markets are less open to international exchange.

III. Empirical fluctuation analysis: common trend model

1. Theoretical model

Analysis of sources of fluctuation and impulses mechanisms has been well researched in the business cycle literature. This theory assumes that economic fluctuations are determined by supply shocks, especially productivity and technological shocks. Inability of the canonical model of business cycle to reproduce some features in labor market is the well-known shortcoming of these models. Recent studies by Hairault (1999), Collard (1999) and Benassy (1995) have attempted to introduce monetary and demand shocks in the canonic RBC model. Other studies introduce external shocks to analyze international transmission of business cycle¹.

In a world characterized by free trade, it is important to take external shocks into account to analyze business cycle. The notion that external shocks may affect business cycle fluctuations has been researched in international business cycle literature. IRBC models by Bakus, Kehoe and Kydland (1992, 1994) and Zimmermann (1995) extend the canonical RBC model from single closed to many open economies. The starting point is that foreign technological shocks may affect domestic real activity. The shortcoming of these studies is that they do not reproduce some characteristic features. Indeed, it is important to introduce others kinds of external shocks.

Zimmermann (1996) develops an IRBC model who takes into account external shocks. The prediction of these models can reproduce many stylized facts. Cunat and Maffezzoli (2004) introduce comparative advantage into an international real business cycle model and study the international transmission of country specific productivity shocks through trade in good. These models give an important role to external shocks transmissions in business cycle analysis on the theoretical as well as empirical levels.

Several works studies the role of external shocks using calibrated models of international business cycle for industrialized countries. In the Tunisian case, this technique is difficult to be used due to unavailability of statistical data on specific micro and macro variables to calibrate and simulate RBC models. As in previous empirical studies we will use an alternative approach to analyze the role of external shocks in Tunisian real activity dynamics: the common trend representation, variance decomposition and impulse response functions.

¹ These include studies by Ahmed et al (1993), Hairault (2002), Jacobson et al (2002), Filosa (2004)...

2. Common trend representation

To account various shocks transmission and to quantify their effect on economic activity we need to consider appropriate framework. Several studies exist since Sims (1980): the VAR methodology, considered as the most appropriate to analyze fluctuations, can work only with a limited number of variables². The standard structural VAR method was criticized by Chari, Kehoe and McGrattan (2005); indeed, SVAR can't account the long and the short run impact on real activity dynamics. In the present paper, we use a common trend model as appropriate to analyze economic fluctuation³. This representation, started by King et al (1987), can account both short and long run dynamics and can distinguish permanent and transitory component of variables.

Consider X_t a $N \times 1$ vector containing the variables of interest all integrated [I (1)] and cointegrated (1, 1) [as suggested by King et al (1987) and Warne (1993)]. β is $(N \times r)$ matrix of cointegrating vectors such that $\beta'X_t$ are stationary linear combinations and α is $(N \times r)$ loading matrix. Following cointegrated VAR representation for X_t :

$$\Delta X_t = A(L)\Delta X_{t-1} + \alpha\beta'X_{t-1} + \varepsilon_t \quad (1)$$

Where $A(L)$ is a polynomial in the lag operator and ε_t is vector of white noise of mean zero. Using Wold representation for X_t , (1) can be written as follow:

$$\Delta X_t = C(L)\varepsilon_t \quad (2)$$

Where $C(L) = I_N + \sum_{j=1}^{\infty} C_j L^j$ with $\sum_{j=0}^{\infty} j|C_j| < \infty$

From Wold representation in (2) we can follow expression of levels of the variables:

$$X_t = X_0 + C(1) \sum_{j=0}^{t-1} \varepsilon_{t-j} + \tilde{C}(L)\varepsilon_t \quad (3)$$

Where $\tilde{C}(L) = \frac{C(L) - C(1)}{1-L}$, X_0 is the initial observation and $C(1)$ captures the long run effect of ε_t on X_t .

² According to Zikky and Mansouri (2003), VAR model generally can work with a maximum of five variables.

³ Common trend representation, as called by Warne (1993), is interpreted as characteristic to economic fluctuations analysis.

Equation (3) is the multivariate version of Beveridge-Nelson decomposition. King et al (1987, 1991) and Warne derived this representation to obtain the called "Common Trend representation"⁴:

$$\begin{aligned} X_t &= X_0 + A\tau_t + \tilde{C}(L)\varepsilon_t \\ \tau_t &= \mu + \tau_{t-1} + \varphi_t \end{aligned} \tag{4}$$

To identify common trend model, we need to estimate the matrix A . Indeed, King et al (1991) and Warne (1993) note that matrix A estimation require some theoretical restrictions on the long run matrix $A0$ ⁵.

3. Data and shocks specification

We use two blocks of variables: domestic and external variables. Concerning domestic variables, we select real GDP and GDP deflator. GDP is used to measure real activity and GDP deflator is used to capture policies shocks, especially monetary policy. About variables that should measure openness degree, we select openness ratio measured as a ratio of current transaction to GDP. All data are provided from world development indicator 2003 and cover the period (1961-2001)⁶. In definitive, the CT model to be estimated includes the following variables: real GDP (y), GDP deflator (p) and openness ratio (ouv).

The fundamentals of Warne algorithm is stationarity and cointegration tests. Standard ADF unit root test show that all variables are treated as an integrated process. The cointegration analysis has been carried out using Johansen likelihood test. Three lags of each variable are included on the basic of diagnostic tests show that residual are serially uncorrelated. Table 1 below synthesizes Johansen test and suggests the existence of one cointegrating vector at 1% and 5% level of significance.

⁴ Warne (1993) make algorithm to estimate the called representation and give a Gauss code to estimate CT model.

⁵ King et al (1991) identify the long run matrix as: $A = A_0\Pi$, where A_0 is $(N \times k)$ matrix and Π is $(k \times k)$ matrix. We impose restrictions on A_0 matrix

⁶ Data are annual in million US dollar at price 1995 and expressed in natural logarithm.

Table 1: Johansen cointegration test

H_0	Eigen value	Trace statistics	Critical value at 5%
$r=0$	0.438997	30.87574	24.31
$r \leq 1$	0.176557	8.910628	12.53
$r \leq 2$	0.039431	1.528734	3.84

In the CT frame work as outlined by King et al (1987-1991) and Warne (1993), the existence of one cointegrating vector among three variables implies the presence of two permanent shocks affecting some of variables interpreted as supply shock and external shock we specify supply shocks (productivity shocks) as having an effect on domestic variables and don't affect external variable. By contrast, external shock is assumed to affect domestic and external variables. These assumptions are made to account the fact that Tunisian economy is a small open economy. A transitory shock is specified as policy shock.

IV. Empirical results and variance decomposition

1. Empirical results

CT estimation necessitates restrictions on long run matrix $A0$, some of these restrictions are cointegration restrictions. Other restrictions are imposed according to economic theory. In our case we assume that restrictions are imposed to reflect the fact that Tunisia is a small open economy. These assumptions imply $a4 = 0, a5 = 0$ and $\beta'A0 = 0$, the long run matrix is written as follow:

$$A0 = \begin{pmatrix} a1 & a2 \\ a3 & 0 \\ 0 & a6 \end{pmatrix} \quad (5)$$

Consider X_t the vector containing all three variables. The cointegrating vector presented in the order (y_t, p_t, ouv_t) is given by:

$$\hat{\beta} = \begin{pmatrix} 1.0000 \\ -1.1916 \\ -0.7712 \end{pmatrix}$$

Using A0 specification and Johansen cointegrating vector we can write the common trend representation⁷ as presented bellow. The estimated coefficient of matrix A are positive and statically significant expect of response of openness ratio to supply shock. Some features can be noticed from the estimated model. Supply shock $\hat{\tau}_s$ has a permanent effect on domestic variables. External shock $\hat{\tau}_{ext}$ has also a permanent and positive effect on domestic and external variables. Contribution of supply shock on openness is negative but not significant.

$$X_t = \begin{pmatrix} y_0 \\ p_0 \\ ouv_0 \end{pmatrix} + \begin{pmatrix} 0.017882 & 0.011255 \\ (0.006255) & (0.002450) \\ 0.033065 & 0.000000 \\ (0.008573) & - \\ -0.015232 & 0.022510 \\ (0.08269) & (0.004900) \end{pmatrix} \begin{pmatrix} \hat{\tau}_s \\ \hat{\tau}_{ext} \end{pmatrix} + \tilde{C}(L)\hat{\varepsilon}_t \quad (6)$$

$$\begin{pmatrix} \hat{\tau}_{st} \\ \hat{\tau}_{ext} \end{pmatrix} = \begin{pmatrix} 1.277532 \\ 1.565325 \end{pmatrix} + \begin{pmatrix} \hat{\tau}_{st-1} \\ \hat{\tau}_{ext-1} \end{pmatrix} + \hat{\varphi}_t$$

2. Variances decompositions results

The relative importance of macroeconomic shocks for variation in economic activity is checked by computing the forecast error variance decomposition from the CT representation. Table 2 presents the variance decomposition from the common trend representation at different time horizon for the change in GDP.

Variance decompositions of real GDP reveal the predominance of supply and external shocks in explaining economic activity. This result is also confirmed by responses functions to shocks. Table 2 shows that contribution of supply shocks is higher than those of external shocks. Indeed, supply shock contributes from 64.1% first horizon to 71.62% for the infinite horizons to GDP fluctuation. Concerning external shock, its contribution to GDP fluctuation is as important, this contribution always remains lower than the one of the supply shocks. In particular, around 28.374% of the long run variability in real GDP is attributable to external shocks.

⁷ Estimation has been carried out using the CT Rats package of Warne and Hansen. Data and model estimation are available from the authors.

Table 2: Shocks contribution on real GDP dynamics

<i>horizon</i>	<i>Supply shock</i>	<i>External shock</i>
1 st	64.1	25.1
2 nd	57.7	21.5
5 th	47.5	19.0
10 th	58.7	25.3
∞	71.625	28.374

As shown by table 3 reported in appendixes, GDP deflator dynamics is dominated by the transitory shock for short horizon. This shock is interpreted as a monetary policy shocks. The contribution of supply shock is less than 1% during the five first horizons to attend 46.2%. Contribution of external shocks is about 10% over long forecast horizons. Table 4 shows that openness degree dynamics is dominated by external and supply shocks for both short and long horizons. This dynamics is predominated in the short run by supply shock; the external shocks have a negligible effect and their effects increase in the long run. This report can be justified by the fact that Tunisia is a small open economy; it is a price taker country. The exchange of this country is constrained by the law of supply and demand.

In conclusion, our results reveal the predominance of supply shocks to economic activity fluctuations. This can be interpreted by the strong correlation of GDP to agricultural production. External shocks contribution is less than supply shock, this can be interpreted by the fact that Tunisia is a small open economy and its openness degree is relatively weak in comparison with many emergent economies.

V. Conclusion

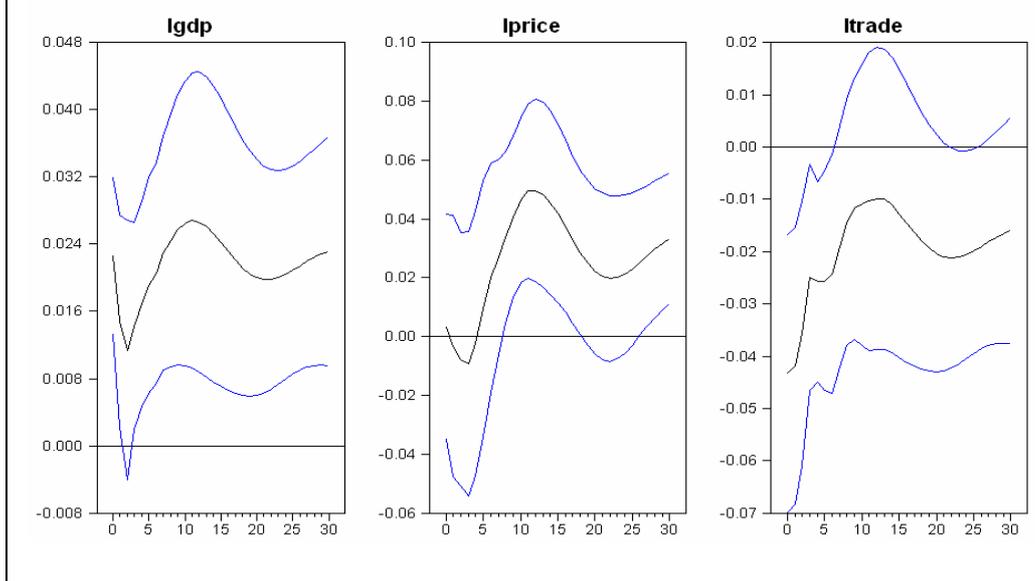
In this paper, we provided new evidence on the relationship between international trade and business cycle. I constructed a common trend model that was used to characterize supply and external shocks dynamics and calculate quantitative contribution of these shocks in variation of real economic activity in Tunisia. Our results show that external shocks propagate into Tunisian economic activity and play an important role to its variations. I conclude that economic fluctuations are predominated by supply shock. External shock contribution is important but it is less than supply shock.

In general, the empirical analyses have shown that external shock has an important impact on real economic activity. Indeed, this shock propagates into Tunisian economy through trade.

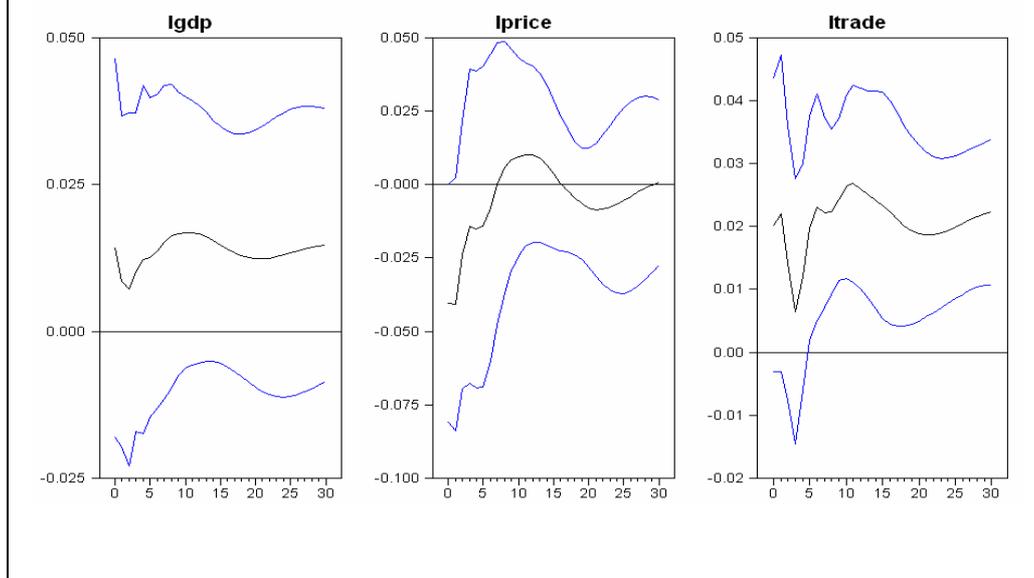
We assume that this shock comes from European economies. The significant role played by external shocks in explaining economic fluctuations can be justified by the effort of Tunisia to be integrated in the world economy. The transmission of the external shocks can be done through several channels. The channel of technology is most significant as suggested by Coe and Helpman (1995). Another channel of importance is that of commercial liberalizations. Our study shows as well as the international transmission of the shocks, a long time ignored in the business cycle theory, present in our case a significant framework to explain the fluctuation.

Appendix

Graph 1: Impulses responses functions of supply shocks



Graph 2: Impulses responses functions of external shocks



Graph 3: Impulses responses functions of transitory shocks

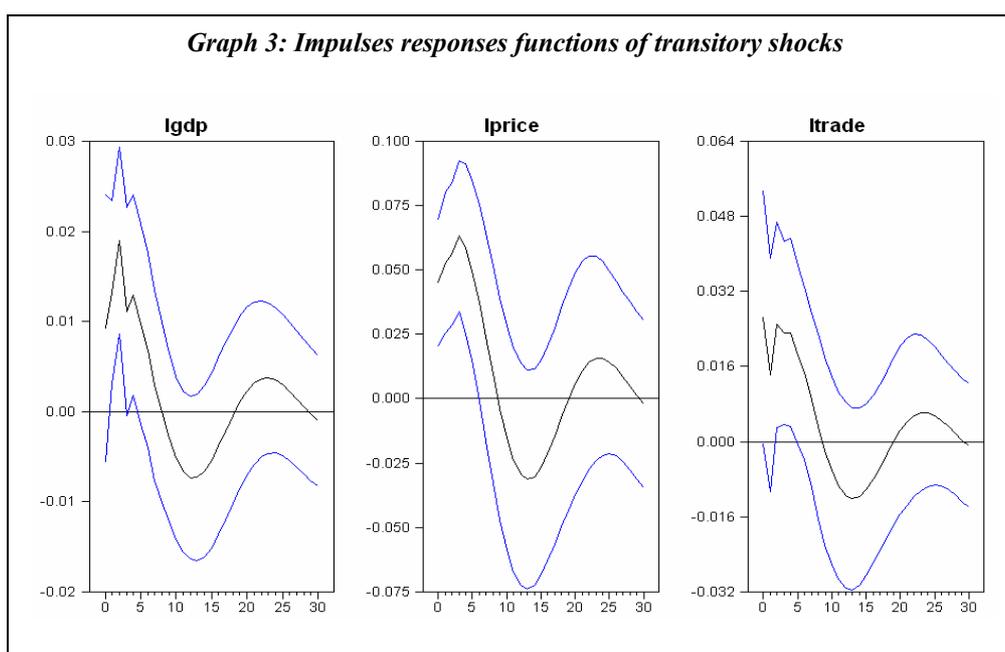


Table 3: shocks contribution on GDP deflator dynamics

<i>horizon</i>	<i>Supply shock</i>	<i>External shock</i>
1st	0.3	44.4
2nd	0.3	40.4
5th	0.9	21.6
10th	14.5	16.2
∞	46.2	9.4

Table 4: Shocks contribution on openness degree dynamics

<i>horizon</i>	<i>Supply shock</i>	<i>External shock</i>
1st	62.8	13.8
2nd	66.8	16.5
5th	61.5	12.8
10th	51.6	28.0
∞	31.4065	68.5935

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