Does the J-Curve Hypothesis Hold for Tunisia? Evidence from a Kalman Filter Analysis

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Abstract

This paper examines how the Tunisian trade balance reacts to exchange rate changes during the post liberalization period, 1993:01 to 2014:03. To determine this, a state space specification technique is employed to estimate the trade balance model of Tunisia. Our findings suggest that the effective real exchange rate has a significant impact on the trade balance of Tunisia, showing oscillating effects that can be best described as a "W-curve."

Keywords: Effective real exchange rate, J- curve, Kalman Filter, Trade balance, W-curve
Jel Classification: C32, F14, F31, F32.

1. Introduction

Growing trade deficit has been one of the major problems of Tunisia despite the government's strong willingness to enforce exports and facilitate trade. In fact, Tunisia is a small open economy whose growth is highly dependent on export revenues. Like many developing economies, Tunisia relies much on exchange rate policies that help improving trade balance and enhance competitiveness in the international market. Thus, determining the relationship between the trade balance and the real exchange rate for such a small open economy can undoubtedly provide policymakers with an excellent tool to evaluate and assess the effect of central bank intervention.

Between the early 1990's and 2000, the exchange rate policy in Tunisia was characterized by being stable. The central aim was to stabilize the real effective exchange rate through the adjustment of the nominal effective exchange rate. Between the early 2000's and 2008, the real exchange rate was allowed to depreciate in hopes to preserve or even raise the competitiveness of the Tunisian exports. However, during 2008 the depreciation policy was abandoned to put back a stable exchange rate policy that was supported until 2012. By 2012, a more flexible exchange rate policy was put into place in order to cope with the increases in the current account deficit. The monetary authorities changed the way of intervening in the foreign exchange market. The intervention was no longer dictated by the reference rate calculated based on the basket of foreign currencies, but on the interbank rate.

It is widely believed that the impact of the exchange rate changes on the trade balance follows a J-curve. According to this phenomenon, depreciation or devaluation worsens the trade balance in the short-run and improves it in the long-run, Magee (1973). However, for the depreciation or devaluation to be balance improving, the Marshall-Lerner condition should be satisfied. That is, sum of absolute values of export and import demand elasticities must be greater than unity.

A large number of studies have attempted to test this phenomenon using different techniques and different model specifications. Bahmani-Oskooee and Ratha (2004a) and Bahmani-Oskooee and Hegerty (2010) went over the literature, examined and reviewed several methodologies used to test whether currency depreciation worsens the trade balance first

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before improving it. The main finding is that the short-run response of the trade balance to currency devaluation does not follow any specific pattern and the results are country specific.

Rafiq (2013) argued that the correlation between the trade balance and real exchange rate has historically been highly conditional on the temporal dimension of the macroeconomic shock (transitory or permanent). Moreover, Grier and Ye (2009) showed that fixed coefficient models explaining the relation between trade balance and exchange rate lead to spurious results. In order to overcome this bias, we propose a novel approach to evaluate the impact of exchange rate depreciation on the trade balance. Our methodology is based on state space specifications which allow the trade balance elasticity with respect to the exchange rate to vary over time. From our point of view, this approach is not only more appropriate to figure out the timing of the trade balance response following depreciation, but can also help in sketching the shape of the trade balance response to each depreciation or devaluation as a J-, W- or U-curve.

To the best of our knowledge few studies dealt with the case of Tunisia separately. Moreover, the most relevant period for the Tunisian case is the post 90's, during which a progressive trade liberalization process supported by several reform programs has been undertaken in order to integrate Tunisia to the global market. Hence, we employ the Kalman filter technique to estimate the trade balance model for Tunisia for the period 1993:01 to 2014:03. The contribution of this study are twofold : Not only does it examine the response of the trade balance to currency devaluation but also describes the shape of this response as a W-curve.

This paper is organized as follows. Section 2 presents the literature review. Section 3 provides data and the methodology used. Sections 4 illustrates the results and discussion and Section 6 concludes.

2. Literature Review

The theoretical and empirical literature examining the relationship between the trade balance and the exchange rate is very abundant and rich. The existing literature can be classified into three broad categories depending on the type of trade data used: The earlier studies employing aggregate trade data, the recent ones employing bilateral trade data between a given country and its major trading partners and the more recent ones employing disaggregated data at the industry/commodity level (see Bahmani-Oskooee and Ratha (2004), and Bahmani-Oskooee and Hegerty (2010) for a comprehensive literature review).

The first category of studies employed aggregate trade data between one country and the rest of the world to examine the overall relation between a country's trade balance and the exchange rate. Few studies dealt with the case of Tunisia separately and some ones included it in the sample of countries examined.

Rose (1990) used a nonstructural model which explains trade balance as a function of the real exchange rate, measures of domestic and foreign incomes to investigate the impact of the real exchange rate changes and the sign of the cumulative effect of this change over the trade balances of 30 developing countries including Tunisia, during the period 1970-1988. He found that for Tunisia, the trade balance is significantly affected by the real exchange rate changes but the cumulative effect is not different from zero.

Bahmani-Oskooee and Alse (1994) used the cointegration and error-correction modeling techniques to examine the long-run and the short-run relation between the trade balance and the exchange rate for 19 developed and 22 less developed countries including Tunisia over the period 1971:1-1990:3. They found that for only 6 out of 20 countries for which the cointegration technique could be applied, the trade balance and the real effective exchange rate are cointegrated providing evidence for the J-curve phenomenon. For Tunisia the real trade balance and the real effective exchange rate were found to be not integrated of the same order. Hence, the cointegration technique could not be applied and no conclusion on the effect of devaluations on the trade balance was reached.

Bahmani-Oskooee (2001) argued that since a currency could depreciate against one currency and appreciate against another, a more comprehensive measure that assesses better the international competitiveness of a given country should be used. Based on a weighted bilateral rate which is the effective exchange rate, he constructed indices of real and nominal effective exchange rates for 11 middle eastern countries, including Tunisia. He then employed Engle and Granger and Johansen and Juselius cointegration techniques and produced results showing that real depreciation has favorable long-run effect on the trade balance of most nonoil exporting middle eastern countries including Tunisia, over the period 1971:1 to 1994:4.

The studies carried out at the aggregate level, generally employed the cointegration technique, the error correction model, and the impulse response function and conveyed mixed results. Among the studies where evidence for a J-curve pattern is found we can state, Yusoff (2007) for Malaysia over the period 1977:1-1998:3, Lal and Lowinger (2002) for some East Asian countries (Indonesia, Korea, Malaysia, Philippines, Singapore and Thailand but not Japan) covering the period from 1980:1 to 1998:4 and Hacker and Hatemi-J (2003) for five North European Countries (Belgium, 1976:1 to 1999:12; Denmark, 1976:1 to 1999:12; the Netherlands, 1977:1 to 2000:3, Norway, 1978:1 to 2000:3 and Sweden, 1975:1 to 2000:3).

Whereas, among the studies that employed aggregate trade data and failed to find evidence in support of the J-curve hypothesis we can state Akbostanci (2004), for Turkey over the period 1987 to 2000, Singh (2004) for India over the period 1975:02 to 1996:03 and Rahman and Islam (2006) for Bangladesh over the period 1972:01 to 2003:04.

The results of the previously mentioned category of studies could suffer from the aggregation bias of data as argued by Bahmani-Oskooee and Brooks (1999). First, it can be the case that the effective exchange rate won't necessarily reflect that a country's currency could appreciate against one currency and at the same time depreciate against another currency. Second, a country's trade balance could improve with one trading partner and at the same time deteriorate with another.

In order to overcome this aggregation bias a second category of studies emerged and examined the impact of the exchange rate on the trade balance by employing bilateral trade data between a specific country and its major trading partners. The studies falling within this category also conveyed mixed results and did not provide much support for the J-curve phenomenon. In fact, most of them found that the exact J-curve is observed for a limited number of countries, corresponding generally to a small portion of the trading partner countries included in the study. Rose and Yellen (1989) found almost no evidence in support of the J-curve for the bilateral trade balance between the G-7 countries, that is, the US and each of its six largest trading partners over the period 1960 to 1985. However, Marwah and

Klein (1996) showed mixed results and found evidence of an S-curve for both Canada and its five largest trading partners as well as for the US and its five trading partners for the period 1977 to 1992. Bahmani-Oskooee and Ratha (2004b) found no short-run pattern of a J-curve when they expanded the list of US trading partners to include its 18 industrial trading partners.

In fact, most of the studies found little support of the J-curve phenomenon : Bahmani-Oskooee and Goswami (2003) found support of the J-curve phenomenon in 2 out of 9 main trading partners of Japan over the period 1973-1998, Bahmani-Oskooee *et al*. (2005) found the presence of the J-curve effect in only 3 out of 23 countries for Australia over the period 1973–2001. Bahmani-Oskooee and Ratha (2007) found that the J-curve effect is present in only 5 out of 17 for Sweden over the period 1980:1-2005:4. However, Wilson (2001) found some J-curve effects for the case of Korea and no persuasive evidence for Singapore and Malaysia to the US and Japan over the period 1970 to 1996.

Other studies that dealt with the emerging and developing economies revealed similar results as those found for the more developed ones. Bahmani-Oskooee and Kanitpong (2001), found evidence of the J-curve for the bilateral trade between Thailand and each of its largest trading partners, the US and Japan. Arora *et al*. (2003) obtained the same results for India and its major trading partners the US and Japan over the period 1977:1-1998:3. However, Bahmani-Oskooee and Wang (2006) found little support (three countries) for the J-curve for China and its 13 major trading partners. Halıcıoğlu (2007) found evidence in support of the J-curve phenomenon for only 2 out of 13 trading partners of Turkey over the period 1985-2005. Bahmani-Oskooee and Kutan (2009), found evidence of the J-curve hypothesis for only 3 out of 11 East European emerging economies using monthly data over the period 1990:01-2005:06. Bahmani-Oskooee and Harvey (2009) also found evidence of the J-curve in only 5 out of 13 trading partners of Indonesia over the period 1974:1-2008:4. Bahmani-Oskooee and Cheema (2009) did not find much evidence in support of the J-curve for the bilateral trade of Pakistan and its 13 major trade partners over the period 1980-2003.

The third and most recent category of studies tried to further reduce the aggregation bias by treating exports and imports separately and by conducting the analysis on industry and commodity trade data. In fact, export and import flows may show opposite responses to currency depreciation. Moreover, it can be the case that each bilateral sector of trade may respond differently to exchange rate fluctuations. The results of this category of studies did not also provide strong evidence of the J-curve hypothesis and at the most, half the sectors examined revealed support for the J-curve phenomenon. Baek (2007) did not find any J-curve pattern for five forest products between Canada and the US over the period 1989 to 2005. Ardalani and Bahmani-Oskooee (2007) found a favorable long-run effect for the US bilateral trade in only 22 out of 66 sectors and a short-run J-curve pattern in only 6 sectors over the period 1991:01 to 2002:08. Bahmani-Oskooee and Bolhasani (2008) showed some evidence in support of the J-curve for the bilateral trade between the US and Canada over the period 1962-2004. They found that 50% of the 152 sectors had long-run effects and 66% had short-run effects. Bahmani-Oskooee and Wang (2008) detected the J-curve effect in 22 industries out of 88 for the trade flows between the US and China over the period 1978 to 2002. Bahmani-Oskooee and Hajilee (2009) found evidence of the J-curve in 23 out of 87 sectors for the trade flow between Sweden and the US over the period 1962-2004. Bahmani-Oskooee and Hegerty (2009) also found very little evidence of any J-curve for US-Japanese trade for about one third of the Japanese industries (in fact they detect positive long-run coefficients for only 41 of 117 industries). Bahmani-Oskooee and Mitra (2009) showed some evidence of the

J-curve hypothesis for trade between India and the US over the period 1962-2006. They found short-run effects for almost all the 38 industries examined, but long-run effects lasted in only half of them.

3. Data and Methodology

Previous studies on the J-curve have obviously undergone several stages of improvement. Most of them dealt with the aggregation bias by utilizing bilateral trade data or disaggregating bilateral trade data to the industry or commodity level. However, even with these improvements, the J-curve theory is still one of the most debated topics.

In order to evaluate the dynamic process between the trade balance and the exchange rate and hence sketch the shape of the curve of this relation, most of the recent studies employed the autoregressive distributed lag models, Bahmani-Oskooee and Hegerty (2010). Nevertheless, this type of specifications does not allow to highlight the specific effect of each intervention of the central bank. In fact, it is highly important to determine correctly the shape of this curve according to the type and the magnitude of the central bank intervention. State-space model is the most appropriate technique to this specification since it allows the actual and lagged coefficients associated to the exchange rate to vary over time. The basic idea motivating this is that the trade balance reacts according to a dynamic structure of time varying distributed lags that are affected by the type and the magnitude of central bank interventions.

The data used are quarterly series of export of goods, imports of goods, real effective exchange rates, industrial production indices and the openness degrees from 1993:01 to 2014:03. The data are drawn from the database of the Federal Reserve Bank of Saint Louis (FRED) and Bloomberg database.

Consequently, not only can we incorporate the exchange rate behavior to be estimated along with the observed data, but we can also apply the Kalman filter : A powerful recursive algorithm that computes optimal estimates for the model's time varying coefficients.

A state-space model consists of two equations: The measurement equation and the state equation. The measurement equation relates the observed variables (data) and the unobserved state variables, while the state equation describes the dynamics of the state variables.
In our case, the relationship between the balance of trade, industrial production, foreign industrial production, openness index and the real effective exchange rate can be written as:

$$\ln TB_t = \alpha_1 \ln IPI_t + \alpha_2 \ln IPI_t^* + \alpha_3 \ln O_t + \alpha_{4t} \ln r_t + \alpha_{5t} \ln r_{t-1} + \alpha_{6t} \ln r_{t-2} + \alpha_{7t} \ln r_{t-3} + e_t \quad (1)$$

where,
TB_t is a measure of the trade balance at time t defined as the ratio of nominal exports to nominal imports. IPI_t, is the industrial production index[3] at time t, IPI_t^* is the foreign[4] industrial production index at time t, O_t is a measure of the openness index at time t defined as the sum of exports and imports divided by the industrial production index, and r_{t-i} for $i = 0,1,2,3$ is the real effective exchange rate index at time $t - i$. α_i for $i = 1,2,3$ are the

[3] The Industrial Production Index usually reflect similar changes in overall economic activity and therefore Gross Domestic Product (GDP) or output.
[4] The Eurozone are taken as the trading partners of Tunisia. In fact, the Eurozone has been constituting more than two-third of Tunisia's trade during the sample period of the study.

elasticities of the trade balance with respect to the industrial production, foreign industrial production and openness degree respectively, whereas α_{it} for $i = 4,5,6,7$ are the time varying elasticities of the trade balance with respect to the real effective exchange rate index at time $(t - i + 4)$.

The state space formulation of the model given in equation (1) is as follows
Measurement Equation

$$\ln TB_t = [\ln IPI_t \quad \ln IPI_t^* \quad \ln O_t] \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} + [\ln r_t \quad \ln r_{t-1} \quad \ln r_{t-2} \quad \ln r_{t-3}] \begin{bmatrix} \alpha_{4t} \\ \alpha_{5t} \\ \alpha_{6t} \\ \alpha_{7t} \end{bmatrix} + e_t \quad (2)$$

State Equation

$$\begin{bmatrix} \alpha_{4t} \\ \alpha_{5t} \\ \alpha_{6t} \\ \alpha_{7t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \alpha_{4t-1} \\ \alpha_{5t-1} \\ \alpha_{6t-1} \\ \alpha_{7t-1} \end{bmatrix} + \begin{bmatrix} u_t \\ v_t \\ \varepsilon_t \\ \omega_t \end{bmatrix} \quad (3)$$

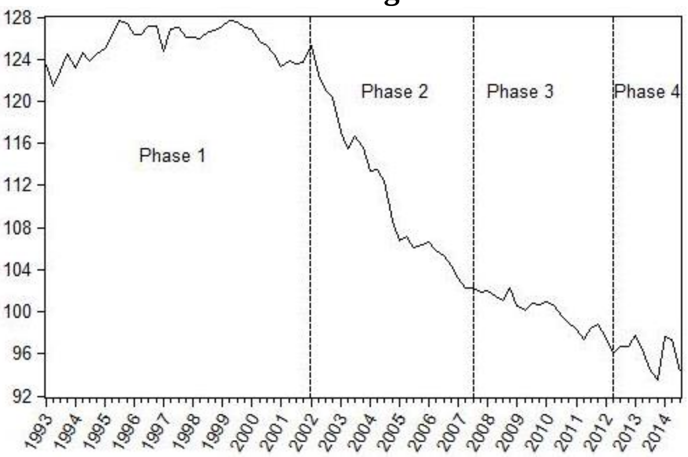
α_{it} for $i = 4,5,6,7$ are specified as random walks, allowing the disturbances affecting them to have a permanent effect.

We have tested many other model specifications in order to determine the type of the curve describing the dynamic relation between the trade balance and the exchange rate and the specification previously presented turned out to be the most robust one. In that specification the trade balance measure and the industrial production indices are adjusted for seasonality.

4. Results and Discussion

Figure 1 depicts three major central bank interventions between 1993 and 2012 that do not necessarily correspond to the same strategy of the monetary policy. It is important to note that for the post-revolution period, the central bank abandoned the inflation targeting strategy to adopt a more flexible exchange rate policy that resulted in a series of depreciations of the Tunisian Dinar with respect to the US Dollar and to the Euro. Moreover, we can easily notice that the accelerated devaluation process had started since 2002, then had been stable between 2008 and 2011 and had undergone a phase of fluctuations after the revolution.

Figure 1: Real Effective Exchange Rate Index for Tunisia



The four phases indicated by Figure 1 correspond to different exchange rate policies that are directly or indirectly motivated by the objective of improving the trade balance. Hence, it is crucial to employ a model specification whose coefficients are time varying in order to establish the dynamic structure that links the trade balance to the exchange rate. The estimation output for the trade balance model fitted to the domestic output, foreign output and openness degree is given in Table 1. The results given in table 1 reveal that the obtained signs of the coefficients associated with domestic output and with foreign output are in accordance with the standard Mundell-Fleming framework. Hence, for Tunisia domestic output raises imports and foreign output raises exports. However, the positive effect on the trade balance induced by the rise of demand in the Eurozone is higher than the negative effect resulting from an expansion of domestic output. In addition to that, the effect of the openness degree on the trade balance is found to be significant but its contribution to improving the trade balance is relatively weak.

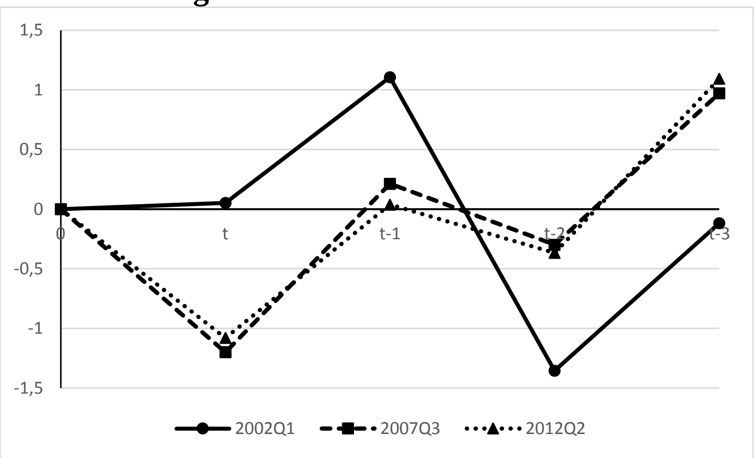
Table 1: Kalman Filter Estimation

Dependent variable, $\ln TB$	**Coefficient**	**Standard error**	**z-statistic**	**p-value**
$\ln IPI$	-0.195228***	0.001184	-164.9322	0.0000
$\ln IPI^*$	0.308172***	0.001294	238.1509	0.0000
$\ln O$	0.033799***	0.000312	108.4146	0.0000
	One step ahead predicted values			
	State Coefficient	**Root MSE**	**z-statistic**	**p-value**
$\ln r$	-1.329983***	0.052775	-25.20110	0.0000
$\ln r(1)$	0.360412***	0.076472	4.712964	0.0000
$\ln r(2)$	-0.232476***	0.076399	-3.042920	0.0023
$\ln r(3)$	0.887187***	0.052812	16.79906	0.0000

Note: *, ** and *** indicates significance at the 10%, 5%, and 1% significance levels respectively.

The dynamic structure of the average impact of the exchange rate on the trade balance exhibits alternating positive and negative effects. Nevertheless, these average effects are not very informative and do not provide any indication on the evolution of the impact on the trade balance after each central bank intervention.

Figure 2: The W-curve Pattern



From the series of the smoothed estimates for the state variables, those corresponding to each intervention of the central bank (2002Q1, 2007Q3 and 2012Q2) are collected and plotted against time. Accordingly, the dynamic structure of the effect of the central bank intervention on the trade balance is obtained and displayed in Figure 2. We can clearly notice that this structure follows a W-curve for the three major interventions of the central bank. In particular, a quasi-identical curve is found for the period between 2007 and 2011 and that between 2012 and 2014. It is also important to notice that the central bank intervention in 2002 generated a curve whose form is atypical. The effect on the trade balance is null instantaneously, positive in the subsequent period, significantly negative in the following period and almost null in the last period.

In short, on the contrary to our technical approach, a model with time invariant coefficients does not help in determining correctly the shape of the curve describing the dynamic structure of the effect of the exchange rate on the trade balance. In fact, the type of the central bank intervention, the exchange rate regime and the openness degree are among the major factors that could explain this source of invariability.

5. Conclusion

It is widely accepted that devaluation is one of the macroeconomic policies used by many economies to improve trade competitiveness. However, assessing correctly the overall effect of the exchange rate on the trade balance of a small open economy is crucial for policymakers. In this study, we consider the case of Tunisia and apply the Kalman filter technique to estimate its trade balance formulated according to a state space specification. Hence, the elasticities of the trade balance with respect to the real effective exchange rate are allowed to vary over time. Consequently, the shape of the curve describing the trade balance reaction to the central bank intervention is properly determined. Our results reveal several stylized facts. First, for Tunisia an expansion of domestic output worsens its trade balance and a rise in foreign output improves it, just in accordance with the standard Mundell-Fleming framework for a small open economy. Second, the improvement of Tunisia's trade balance is more dependent on the recovery of its trading partners than on its own growth. Third, the trade balance tends to oscillate in response to the central bank intervention, indicating that devaluation does not necessarily improve the trade balance. Hence, policymakers should be rigorous when using devaluation for Tunisia, as it may improve trade competitiveness but not necessarily its trade balance. In particular, the time after which the cost effect starts to outweigh the quantity effect should be well judged.

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