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Transmission of Nominal Exchange Rate Variation to Domestic Prices and Monetary Policy in Tunisia

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Since the end of 1987, Tunisia had targeted a stable real exchange rate to maintain competitiveness, rather than a nominal exchange rate that would serve as an anchor for inflation expectations. Currently, Tunisia is moving towards more flexible exchange rate regime and a monetary policy focused on preserving price stability while gradually liberalizing its capital account, so understanding and quantifying nominal exchange rate changes transmission into inflation is of great importance. A monetary policy which is aiming to preserve price stability requires the estimation of inflation reaction to nominal exchange rate movements known as "Pass through". The purpose of the paper is to assess this pass-through, in focusing on the relationship between inflation and the real exchange rate. Based on the standard definition of the real exchange rate referred to as the domestic relative price of tradable to non-tradable goods and in line with S. Edwards' model (2006), we try to separate the reaction of the price of tradables to variations in the nominal exchange rate (direct effect) of non-tradables prices (indirect effect). This question is addressed by estimating a couple of equations using Seemingly Unrelated Regressions (SURE) method, on a monthly basis over 1986-2010 period. The set of equation is gathering national prices, nominal exchange rates, foreign prices and control variables as a monetary aggregate. Results show a small amount of pass-through due basically to the composition of Consumption Price Index (CPI) which is administrated for the 1/3 of its components in Tunisia. Besides, results highlight that direct effect is larger than indirect effect that confirms the effectiveness of the nominal exchange rate as shock absorber.

Keywords: pass-through; nominal exchange rate; real exchange rate; monetary policy; Tunisian dinar.

JEL Codes: F31; E52

1. Introduction

Given the high degree of openness of the Tunisian economy, the transmission of nominal exchange rate variation to domestic prices plays a central role in conducting a monetary policy which is actually based on stabilizing prices and tend to move to an Inflation Targeting policy. Besides, Tunisia has taken steps to liberalize its capital account to achieve full convertibility by the mid of 1990, the objective is to reach a growing capital integration across the world. However, a gradual Capital account liberalization coupled with an independent monetary policy needs necessarily a more flexible exchange rate. The relationship between fixed exchange rates, perfect capital mobility and monetary policy independence is referred to as “the impossible trinity” as the three components cannot prevail at the same time. Under these conditions,

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moving to inflation targeting (IT) may require a certain degree of exchange rate flexibility that is why Tunisia tends to move closer to a free floating exchange rate system.

Therefore, it is important to assess the exchange rate pass-through given that the degree of domestic price responsiveness to exchange rate changes has important implications for monetary policy**.** Exchange rate pass-through to domestic prices measures the extent to which fluctuations in the nominal exchange rate affect domestic prices through the variations in the prices of imported goods. Domestic prices may be affected directly by the change in the prices of imported goods (final or intermediate), and also indirectly through the effects of exchange rate movements on aggregate demand. For instance, exchange rate depreciation affects net exports, which in turn influences domestic prices through the rise of aggregate demand, putting upward pressure on domestic prices. However, local prices may not be very responsive to the exchange rate when variations in imports costs are absorbed by intermediaries in the distribution channel. Therefore, the degree of exchange rate pass through will depend, among other things, on the competitive nature of the domestic market for importable goods and pricing-to-market behavior.

Unlike previous studies (Choudhri, and Hakura, 2006, Senhadji et al. 2007) that have focused their analysis only on the direct effect, this paper studies both the direct and the indirect effect. Therefore, the originality of the paper is to analyze the impact of the transmission of the nominal depreciation on the real exchange rate (RER = P_T/P_N) defined as the relative price of tradables to non tradables that captures both effects: direct and indirect one. When we introduce relative prices into the analysis, then the pass through does not only reflect an inflation problem but it highlights the effectiveness of the nominal exchange rate as a shock absorber to accommodate external shocks. Indeed, for the exchange rate to act as shock absorber, it is necessary for changes in the nominal exchange rate to be translated into real exchange rate.

The use of a SURE (seemingly unrelated regressions equations) analysis, to monthly Tunisian data from 1986 to 2010 enables us to estimate econometrically, two degrees of exchange rate pass-through in Tunisia: the direct effect and the indirect one by using and developing Edwards' 2006 model. Furthermore, the comparison between the direct and the indirect effect indicates the effectiveness of the nominal depreciation as a shock absorber.

The paper is organized as follows: section 2 presents a literature review about the subject and develops Edwards' 2006 model. Section 3 is interested in deriving the empirical model consisting in a system of equation to estimate two notions of pass through and presents the econometric methodology. Section 4 presents the empirical results. Section 5 concludes and offers some policy recommendations.

2. Literature Review

Theoretical literature is based on Taylor contribution which tried to explain the low impact of the exchange rate variation on prices. Indeed, Taylor (2000) has identified several macroeconomic keys, the most important are related to the inflationary environment and the real exchange rate. Taylor primarily supports the idea that countries with low inflation exhibit a low pass through while specifying that if inflation

is persistent, the firms anticipate that the monetary authority will ensure price stability by using monetary instruments when monetary policy is credible.

Taylor hypothesis was the subject of several empirical tests. Most authors have argued that a small degree of pass-through is preferred to a large one because a lower pass-through will result in a decline in inflationary pressures coming from abroad. Based on a sample of 71 countries including Tunisia, Choudhri and Hakura (2006) showed that the transmission degree of the exchange rate variation to prices is positively correlated to inflation over 1979-2000 and stressed on partial transmission for most countries under study. Other authors such as Ca'Zorzi et al. (2007) confirmed the positive correlation between the pass through and the inflation rate average, noting that the transmission is more rapid in emerging economies than in developed ones. This positive correlation was also found by Barhoumi and Jouini (2008) for a sample of developing countries over the period 1980-2003. These empirical studies have focused only on the direct pass-through by measuring the degree of transmission of the nominal exchange rate variation to consumer price variation via the import price. This point of view is too simplistic and tends to ignore the transmission of nominal exchange rate depreciation on non-tradable goods, and then the fundamental role played by the RER. Others were interested in the relationship between RER and inflation as Goldfajn and Valds (1999), who showed that an overvalued real exchange rate is an important determinant of the currency depreciation. Indeed, the depreciation can be used as an instrument to correct an initial overvaluation, and in this case, only the relative price tradables/nontradables will be affected but not inflation. The inflationary effects certainly appear, when the depreciation is excessive and exceeds the required amount to reach an equilibrium exchange rate. In the same vein, Goldfajn and Werlang (2000) found for a sample of 71 countries including Tunisia, that the RER misalignment is an important variable explaining exchange rate pass-through, for emerging countries.

We remember that in this work, we are interested first in assessing and explaining the transmission degree of the exchange rate variation into local prices (tradables and nontradables goods prices) in Tunisia. The methodology adopted, is developed theoretically by Edwards (2006) and is based on relative prices. Then, a distinction between the pass-through of exchange rate changes into the price of nontradabales *(indirect effect)* and into the domestic price of tradables *(direct effect*) is made. In this case, the pass through does not only reflects an inflation problem but it highlights the effectiveness of the nominal exchange rate as a shock absorber. In other words, for the exchange rate to act as shock absorber to accommodate external shocks, it is necessary for changes in the nominal exchange rate to be translated into real exchange rate.

2.1 Exchange Rate Pass-Through Model: Two Notions of Pass-Through

To derive the two notions of pass-through, we will consider the standard definition of the real exchange rate ρ as the (domestic) relative price of tradable to non-tradable goods (Edwards 1989, 2006)

$$\rho = P_T / P_N \quad (1)$$

Where, P_T is the domestic price of tradables and P_N is the price of nontradables.

On one hand, under the assumption that the law of one price holds for tradables; a higher nominal exchange rate (NER) that reflects a nominal depreciation will generate an increase in P_T. Notice that the nominal depreciation can be partially or totally transmitted to tradable prices depending on pricing to market behavior. On another hand, local goods may be substituted to importable goods; becoming more expensive after a nominal depreciation and a pressure may be put on non-tradable goods demand. If an expenditure switching effect from tradables to non-tradable happens it will increases the non-tradable price (P_N). Therefore, the nominal exchange rate will be an effective shock absorber, if and only if it generates an increase in ρ. To be assured that nominal exchange rate depreciation is transformed to real exchange rate depreciation, the impact of nominal depreciation should be higher when affecting tradable price (direct effect) than the non-tradable one (indirect effect). So, on the whole, while a high pass through for non-tradables will reduce the effectiveness of the nominal exchange rate variation, a high pass through for tradables will enhance its effectiveness.

To dissociate the direct effect and the indirect one, we assume that the law of one price holds for tradable and that P_N is the result of the clearing conditions in the non tradables market (Charfi-Marrakchi F. & Guermazi-Siala F. 2010).

2.1.1 The Law of One Price

The law of one price tells us that in an efficient market, identical products are sold at the same price everywhere around the world in the absence of transportation costs and taxes. Let's denote $\mathbf{P}_T$ the domestic price of the imported good, $\mathbf{P^*}_T$ the foreign price of the corresponding good in foreign currency, and **NER** the nominal exchange rate, defined in units of the home (importing country) currency relative to the foreign (exporting country) currency. In that way, if the law of one price holds, then:

$$P_T = NER \,.\, P^*_T \qquad (2)$$

A log transformation of equation (2) is given as follows:

$$Log\,(P_T) = Log\,(NER) + Log\,(P^*_T) \quad (3)$$

2.1.2 The Foreign Price

The foreign price $\mathbf{P^*_T}$ equals the exporters marginal cost MC_T multiplied by the markup $MKUP_T$ as follows:

$$P^*_T = MC_T \,.\, MKUP_T \quad (4)$$

The log transformation of the foreign price equation is given by

$$Log(\,P^*_T\,) = Log\,(\,MC_T\,) + Log\,(MKUP_T\,) \qquad (5)$$

If we substitute equation (5) into equation (3) gives

$$Log\,(P_T\,) = Log\,(NER) + Log\,(\,MC_T\,) + Log\,(MKUP_T\,) \quad (6)$$

We focus on how the markup and the marginal cost of production react after an exchange rate variation. The markup response is often viewed as an indicator of

changes in the competitive conditions confronting foreign exporters in the destination market. In this case, import prices react less than proportionally to changes in the nominal exchange rates. Estimated pass through elasticity represent the sum of:

- The response of markup to a unitary depreciation to counterbalance some of the increase of the price of imports.
- The changes in marginal costs, which are specifically attributable to exchange rate movements such as effects of imported inputs in production or wage sensitivity to exchange rates.

The market share of domestic producers relative to foreign producers determines how markup responds to a nominal exchange rate variation. As well, higher degree of price discrimination or a larger share of imported inputs in production in the destination country leads to higher predicted pass-through rates of exchange rates into import prices. In fact, exporters may opt for absorbing a part of the exchange rate fluctuations within the markup in order to avoid passing them through to the price in the importing country currency, called local currency pricing or pricing to market. So we can conclude that markups can include a specific term relative to the type of good and independent of the exchange rate, a component witch is related to the direct response to changes in exchange rate and finally other specific factors under the Central bank control that can influence local prices. Then, exchange rate variability can also matter as exporters compete for market share. Indeed, exchange rate pass-through may be lower when exporters try to maintain local market share, even when nominal exchange ate variability is high. (Froot and Klemperer; 1989)

$$Log\ (MKUP_T) = \beta_0 + \delta.\ Log\ (NER) + A\ .\boldsymbol{X_i} \qquad (7)$$

On the other hand, marginal cost is a function of demand conditions Y in the destination country, labor wages in the exporting country W, and commodity prices denoted in foreign currency FCP, that's:

$$Log\ (MC_T) = \eta_0\ Log\ (Y) + \eta_1\ Log\ (W) + \eta_2\ Log\ (NER) + \eta_3\ Log\ (FCP) \quad (8)$$

If we substitute equation (7) and equation (8) into (6) and introduce time, we get:

$$Log\ (P_t) = \beta_0 + (1 + \delta + \eta_2)\ Log\ (NER_t) + A\ .\boldsymbol{X_{it}} + \eta_0\ Log\ (Y_t) + \eta_1\ Log\ (W_t) + \eta_3\ Log\ (FCP_t) + \omega_t \qquad (9)$$

Where ω_t represents an error term with standard characteristics.

In Campa, Goldberg and Minguez (2005), considering "integrated world market" specification, $\eta_0\ Log\ (Y_t) + \eta_1\ Log\ (W_t) + \eta_3\ Log\ (FCP_t)$ is the opportunity cost of allocating the same goods to other customers. This implies that the appropriate measure proxy of the opportunity cost of exporting is the world market price of the product, noted as P^*_T. Given this assumption, equation (12) becomes as follow:

$$Log\ (P_t) = \beta_0 + \beta_1\ Log\ (NER_t) + A\ .\boldsymbol{X_{it}} + \boldsymbol{\beta_3}\ Log\ (P^*_t) + \omega_t \qquad (10)$$

where $\boldsymbol{\beta_1 = 1 + \delta + \eta_2}$ is the elasticity of the exchange rate pass-through to aggregate import prices and β_3 is the pass-through coefficient relative to foreign price changes.

2.2 Polynomial Distributed-Lag Model

However, according to the type of analysis to be done, Menon (2006) noticed that almost all empirical evidence on pass through used a Polynomial Distributed-Lag Model (PDL) to capture the dynamic responses of traded goods prices to exchange rate variations. The PDL methodology used ordinary least squares (OLS) to estimate pass-through. In regression analysis involving time series data, a distributed-lag model is one that includes current and lagged (past) values of the explanatory variable.

We know that asset prices such as exchange rate are non-stationary. If *OLS* is used to estimate a regression using non stationary data, then the problem of spurious regressions becomes a major concern. To avoid spurious regressions we used variables in first difference. Besides, assuming finite lags of some time periods, a distributed lag is a relation of the form:

$$\Delta \textbf{Log}\,(P_t) = \alpha + \sum_{j=1}^{M} \beta_j \Delta LogP_{t-j} + \sum_{k=0}^{N} \gamma_k \Delta LogNER_{t-k} + \eta\, \Delta \textbf{Log}\,(P^*_t) + A\, \boldsymbol{X_{it}} + \omega_t \quad (10)'$$

Where P_t is a price index either of importables or nontradables, *NER* is the nominal exchange rate, *P** is an index of foreign prices, $\alpha, \beta\, \gamma$ and η are parameters to be estimated, the $X_i s$ are control variables expected to capture changes in the markup and ω_t is an error term with standard characteristics (Campa, & Goldberg, 2006).

3. Data and Methodology

Generally and in most countries, there are important data limitations; in particular, very few countries have data on nontradables prices. Knowing that data limitations are more severe in emerging countries, the empirical analysis followed by many authors used the CPI index as a proxy for the domestic price of nontradables and the PPI (Producer price Index) as a proxy for the domestic price of tradables. This means that we will use ρ = PPI/ CPI, as a proxy for the real exchange rate in equation (1).

As the estimation consists to evaluate the impact of the transmission of nominal exchange rate variation to domestic prices (ie: tradables and non-tradables), two equations will be estimated. The first one concerns the direct effect where prices are represented by PPI and the second the indirect effect where prices are represented by CPI.

(I)

$$\begin{cases} \Delta \textbf{ Log } PPI_t = \alpha + \sum_{j=1}^{M} \beta_{1j} \Delta LogPPI_{t-j} + \sum_{k=0}^{N} \gamma_{1k} \Delta LogNER_{t-k} + A_1 X_{it} + \eta_1 \Delta \textbf{ Log } P^*_t + \omega_t \\ \Delta \textbf{ Log } CPI_t = \delta + \sum_{j=1}^{M} \beta_{2j} \Delta LogCPI_{t-j} + \sum_{k=0}^{N} \gamma_{2k} \Delta LogNER_{t-k} + A_2 X_{it} + \eta_2 \Delta \textbf{ Log } P^*_t + \varepsilon_t \end{cases}$$

Where, $\sum_{j=0}^{N} \gamma_{1k}$ and $\sum_{j=0}^{N} \gamma_{2k}$ are the short run coefficient of pass-through, $\sum_{j=1}^{M} \beta_{1j}$ and $\sum_{j=1}^{M} \beta_{21j}$ represent the inertial inflation and η_1 and η_2 represent the imported inflation.

The Δ operator refers to one year to year percentage changes computed on a monthly basis. The NER is the bilateral exchange rate against the euro since the Tunisian trade is done by approximately 70% with the euro zone. Thus an increase in *NER* reflects a bilateral nominal depreciation of the Tunisian dinar against the euro. We include *X* as a control variable which is the log of the monetary aggregate M3.

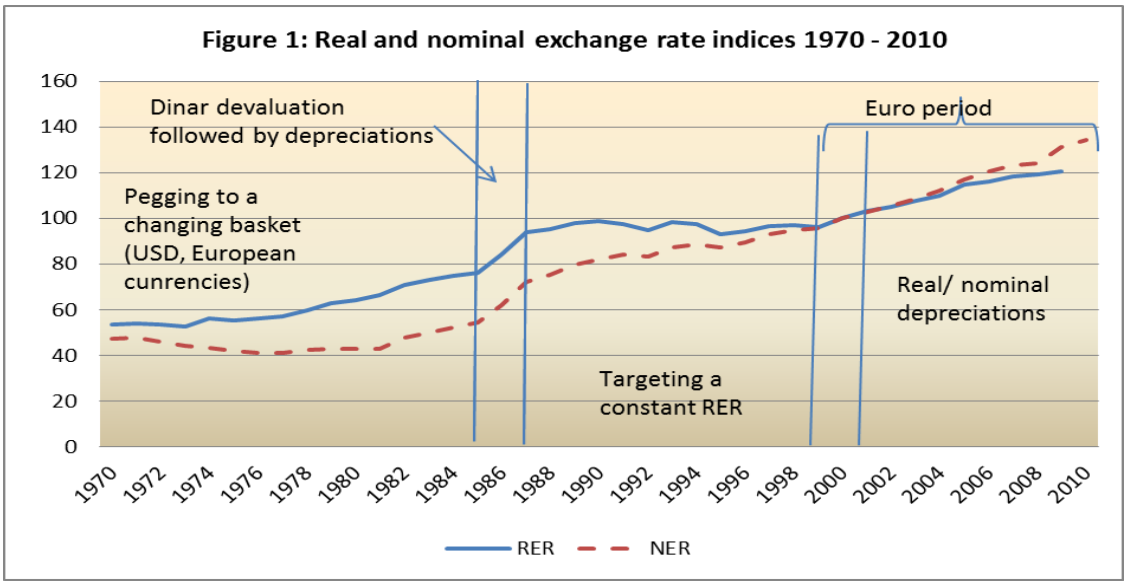
Since, the errors in the CPI and PPI equations are likely to be correlated; we estimated the two equations for each country simultaneously, using Zellner's *seemingly unrelated regressions* (SURE) procedure. In econometrics, the **seemingly unrelated regression equations** (SURE) model, proposed by A. Zellner (1962) is a generalization of a log linear regression model that consists of several regression equations, each having its own dependent variable and potentially different sets of exogenous explanatory variables. Each equation is a valid linear regression on its own and can be estimated separately, that is why the system is called *seemingly unrelated*. The model can be estimated equation-by-equation using standard ordinary least squares (OLS). Such estimates are consistent, however generally not as efficient as the SUR method, which amounts to feasible generalized least squares with a specific form of the variance-covariance matrix. The SUR model can be viewed as either the simplification of the general linear model where certain coefficients in matrix B are restricted to be equal to zero, or as the generalization of the general linear model where the regressors on the right-hand-side are allowed to be different in each equation. The SUR model can be further generalized into the simultaneous equations model where the right-hand side regressors are allowed to be the endogenous variables as well. In our case, applying SUR method permits to avoid error correlations.

Variables described in the empirical model (I) are presented as follows:
(CPI) and (PPI) are issued from various financial statistics (CBT)
NER (TND/€): defined in units of the home currency (Tunisian dinar: TND) relative to the foreign currency (euro: €) where data are issued from CBT website
CPI*is considered as euro zone CPI and data are issued from SFI (IMF).
M3 represents a monetary aggregate (source CBT).

A monthly database is used covering the period 1986:1 to 2010:6 and all data are computed in one year to year change basis to eliminate seasonality, then changes in CPI are referenced to nontradable inflation and changes in PPI as tradable inflation. The considered sample is divided into two sub-periods, given the change in the exchange rate policy in Tunisia since 2001. So, the subdivision is first based on economic intuition and later confirmed by the Chow test over the whole period for both equations described by the system (I).

3.1 Exchange Rate Policy in Tunisia

During the 1990s, Tunisia adopted a real effective exchange rate (REER) targeting policy that aimed at preserving the competitiveness of the country. Concretely, monetary authorities adjust periodically the nominal exchange rate to compensate for the differential of inflation relative to the trade partners; so as to maintain the REER constant. Since 2000, the central bank has implemented a more flexible exchange rate policy and adopted broad money as nominal anchor. The nominal effective exchange rate has depreciated by about 20 percent since 2000 to 2006 and about 35 percent since 2000 to 2010 (figure 1).



Source : Authors calculations'

Knowing that the breakpoints can be sensed (war, oil shock, exchange rate regime changes) and in this case it is sufficient to conduct the Chow test around the date when the structural change has taken place. That is why we consider a break point around the year 2000.

3.2 Specification and Stability Test (Chow Test)

The Chow test allows examining whether the parameters of the model are stable across different sub-periods. The idea is to match a separate equation for each sub-period and see if there is a significant difference. Indeed, a significant difference indicates a structural change in the relationship. To conduct this test, we have to divide the sample into two periods (before and after 2001, as shown by figure 1 and sensed accordingly) and each sub-period must contain more observations than variables to estimate in the equation.

The Chow test compares the sum of squared residuals, using a single equation for the total sample to the sum of squared residuals (SCR) obtained when separate equations are used for each sub-period.

Eviews reports two test statistics for the Chow test, which are:

- F statistic, based on the comparison of the SCR of the constrained sample forces (corresponding to the sub-period) to the SCR of the entire sample (whole period) and
- LR statistic (LR) which is a likelihood ratio statistic.

For both tests, the null hypothesis H_0 is the non-existence of a break point and therefore the non-existence of structural change (stability). The results for both equations (system I) are reported in Table 1, as follows:

Table 1: Stability tests for the period 1986:01- 2010:6

	Breakpoint	F statistic	LR statistic
Δ IPC	2000:12	2.7*** *(0.007)*	22.08*** *(0.0048)*
Δ IPP	2000:12	2.14** *(0.03)*	17.65** *(0.02)*

The numbers in parentheses are p-values.
(*) indicates rejection of the null hypothesis at 10%.
(**) indicates rejection of the null hypothesis at 5% and
(***) indicates the rejection of the null hypothesis at 1%.
Source: Author's calculations on Eviews.

From this table, it seems clear that 2000:12 represents a break point. The Chow test allows us to reject the hypothesis of stability for the sensed date, and to divide the sample into two sub-periods (1986:1-2000:12) and then (2001:1-2010:6).

Furthermore, to avoid the problem of spurious regression, all the variables entering the system of equations (I), have been tested for unit roots. Phillips-Perron unit-root tests, performed on all variables entering the two equations, suggest that all variables are I(1) in levels, and therefore I(0) in first difference. In other words, all variables entering the system of equations (I); are stationary in first differences.

Table 2: Unit root tests over the period (1986:1 – 2010:6)

Variable	PP	Variable	PP
NER	-3.08**	**Δ (NER)**	- 11.1***
CPI	-4.34**	**Δ (CPI)**	- 11.37***
PPI	-1.02***	**Δ (PPI)**	- 22.57***
CPI*	-3.14**	**Δ (CPI*)**	- 14.74***
M3	-0.36***	**Δ (M3)**	- 23.28***

PP represents Phillips Perron statistics
(*) indicates rejection of the null hypothesis at 10%.
(**) indicates rejection of the null hypothesis at 5% and
(***) indicates the rejection of the null hypothesis at 1%.
Source: Author's calculations on Eviews

4. Empirical Results

Remember that in July 1986 Tunisian dinar was devalued by more than 10% and tends to depreciate over 1987. The CBT pursued a crawling peg regime that aims to maintain a constant level of the real exchange rate (Figure 1) (Charfi-Marrakchi, 2009). Notice that under the period ranging from 1986 to 2000, the inflation rate was about 5.4% as shown by table (3).

Table 3: Inflation rate in Tunisia

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Inflation (%)	6.2	8.2	7.2	7.7	6.5	8.2	5.8	4	4.6	6.3	3.8	3.6
1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
3.1	2.7	2.9	1.9	2.8	2.7	3.6	1.9	4.5	3.1	4.9	3.7	4.1

Source: Authors calculations based on "CBT Financial Statistics" various issues.

Considering the first period (1986:1 – 2000:12), main results concerning exchange rate and inflation relationship is given by table (4). The model has a good fit as shown by the adjusted R^2, that explain more than 95 % of the variability in the non-tradable inflation rate for the first equation and 70% for the tradable inflation.

Table 4: Transmission of nominal exchange rate variation to domestic prices (19861:1 – 2000: 12)

	Δ CPI	**Δ PPI**
Constant	0.0006 (0.509)	-0.0005 (-0.78)
Δ NER	-0.063*** (-2.54)	0.135 (0.93)
Δ NER (-1)	0.0745*** (3.214)	-0.094 (-0.7)
Δ CPI*	0.07 (1.17)	-0.69** (-1.87)
Δ CPI(-1) / Δ PPI(-1)	1.028*** (13.53)	0.589*** (7.82)
Δ CPI(-2) / Δ PPI(-2)	-0.169* (-1.57)	0.26*** (3.49)
Δ CPI(-3) / Δ PPI(-3)	0.07 (0.99)	0.409*** (2.29)
Δ M3	0.004 (0.62)	-0.003 (-0.077)
R^2 adjusted	**0.96**	**0.70**
Observations	**330**	**330**
Inflation persistence	**0.9342**	**-**
Total effect of NER change	**0.0115**	**0.041**
Long run pass through	**0.1747**	

(***) significant at 5%, (**) significant at 10%, (*) significant at 15%

If we first consider the CPI equation (indirect effect), results show that a 10 percent depreciation in the NER will increase inflation by 0.12 percentage points. Although, this period is characterized by a large variation of the nominal exchange, the short run pass through is small because administrated prices account for almost a third of the CPI basket. We note either that the direct pass-through (0.041 is three-times larger than the indirect pass-through 0.012). So that nominal exchange rate variation impacts real exchange rate thus confirming the effectiveness of the nominal exchange rate as a shock absorber to accommodate external shocks. Results

highlight also an inflation persistence which is reflected by a high coefficient (highly significant) associated to a lag structure for the CPI.

The considered lag structure for inflation and nominal exchange rate year on year changes not only capture inflation persistence but also allow for a flexible parameterization of the dynamics of the pass through of exchange rate fluctuations to local prices. The long run pass through which can be extracted from equation (10)' is given by the formula below:

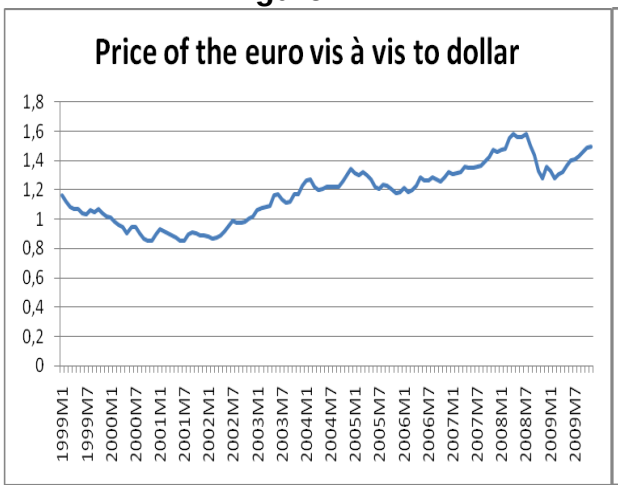
$$\beta_{LT} = \frac{\sum_{k=0}^{N} \gamma_{2k}}{1 - \sum_{j=1}^{M} \beta_{2j}}$$

Over this period, the pass through amounts to 0.17 which is comparable to the coefficient found by Choudri and Hakura (2006) that is in the range of 0.1 for 1979 – 2000 period. Although, the estimated pass through is low and significant, it could be even higher if the price of some imported goods was liberalized as administrated prices constitute an important component of the CPI basket.

Our results over the considered period corroborated also with those found by Goldfajn and Werlang (2000) who attributed the low pass through coefficient found to the quasi absence of misalignments for the considered countries. Indeed, between 1986 and 2000, the Tunisian RER moves closely to its equilibrium value (Charfi-Marrakchi, 2008). For this period, Tunisia avoided the pitfalls of targeting a constant real exchange rate rule, and the exchange rate policy proved to be fairly successful. The absence of significant shocks over the considered period, combined with prudent macroeconomic policy mix and price and wages rigidities permitted to the country to avoid a persistent high inflation (5.1 percent on average over 1990–99) and an exchange rate misalignment (Fanizza et al. 2002; Charfi-Marrakchi, 2008).

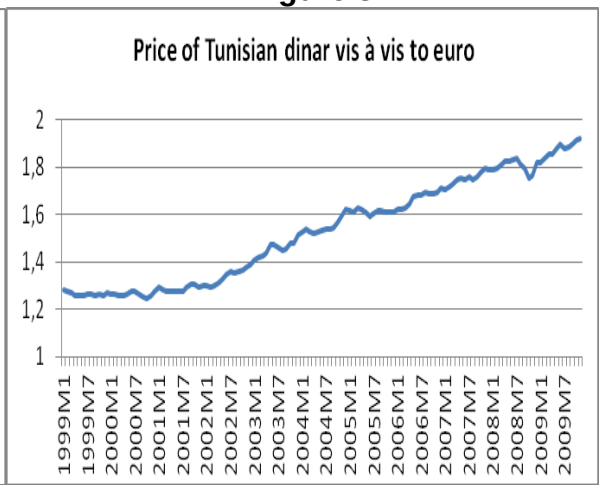
The second period is characterized by a gradual nominal and real depreciation, which are mainly explained by two factors among others. First, the depreciation reflects a series of negative shocks (the events of September 2001 in the U.S. and 2002 in Djerba) (Senhadji et al. 2007). Second, the euro has strengthened rapidly against the dollar as shown by (figure 2), which contributed to a depreciation of the Tunisian currency, since the euro is estimated to account for approximately 70% of the dinar's currency basket (Charfi-Marrakchi, 2009). Although the dinar has depreciated significantly (figure 3), the latest estimates suggest that the RER appears in line with economic fundamentals (IMF, 2010). At the same time, inflation has been subdued, averaging only 3.2 % over 2000 – 2006 compared to 5 % during the 1990s.

Figure 2:



Source: Authors calculations issued from "International Financial statistics IMF"

Figure 3:



Source: Authors calculations from the CBT statistics

Table 5: Transmission of nominal exchange rate variation to domestic prices (2001:1 – 2010: 6)

	Δ CPI	**Δ PPI**
Constant	0.002 (1.03)	-0.016*** (-3.37)
Δ NER	-0.032 (-1.07)	-0.17*** (-2.68)
Δ NER (-1)	-0.05 (-1. 14)	0.107 (1.108)
Δ NER (-2)	0.093*** (2.99)	0.082* (1.27)
Δ CPI*	-0.036 (-0.86)	0.69*** (6.14)
Δ CPI(-1) / Δ PPI(-1)	1.26*** (14.17)	0.96*** (10.34)
Δ CPI(-2) / Δ PPI(-2)	-0.16 (-1.09)	-0.10 (-0.82)
Δ CPI(-3) / Δ PPI(-3)	-0.194*** (-2.14)	0.0069 (0.087)
Δ M3	0.01 (0.67)	0.087*** (2.63)
R^2 adjusted	**0.93**	**0.96**
Observations	**226**	**226**
Inflation persistence	**0.905**	**-**
Total effect of NER change	**0.0082**	**0.019**
Long run pass through	**0.086**	

Over this period, the size of the pass through is less important than the first period, either for the direct effect or the indirect one. Furthermore, as for the last period the direct effect that amounts to 0.019 is higher than the indirect one that amounts to 0.0082 and in this case, each nominal depreciation will be followed by a real depreciation and can be used as an instrument to reduce the external imbalances. These results are consistent with those found by *Senhadji et al. (2007)*, who estimate

the short run pass through coefficient for Tunisia over 1995 – 2006 period, using a VAR model and found a coefficient ranging from 0.007 to 0.01. Our results show that the long run pass through amounts to 0.086 and are also comparable to the values found by *Senhadji et al. (2007)* ranging from 0.065 to 0.093.

On the whole, given that direct effect is higher than the indirect one for each period, nominal depreciation will be reflected by a real depreciation that allow external imbalances to be absorbed. Furthermore, a small pass through provide flexibility to conduct an independent monetary policy and facilitate the implementation of an IT policy. A low pass through will also, help monetary authorities to liberalize administrated prices which represent about the third of the (CPI) basket component and then, escape to the CBT control. Indeed, administered good prices are funded by the compensation fund which, in its turn, fed by budget expenditure. Therefore, these prices are not under the control of the CBT.

5. Conclusions and Recommendations

Being an important channel of transmission of monetary policy, this paper analyzes the transmission degree of nominal exchange rate variation to domestic prices and particularly the impact of exchange rate pass-through on monetary policy in Tunisia. Time series data models based on seemingly unrelated regression equations; SURE technique, provide estimates of direct and indirect exchange rate pass-through. The results issued from these models, applied to Edwards' 2006 analytical framework, over the 1986 – 2010 period, imply that the estimate of exchange rate pass-through is in the 0.0082–0.041 range, depending on the period and on whether it concerns direct or indirect pass through. The relatively low degree of pass-through in Tunisia is consistent with the estimates found in the literature, showing that the degree of pass-through in low inflation countries tends to be lower than that in high inflation countries.

The estimation results also show that the liberalization of administered prices would increase the degree of pass-through, giving that the direct effect based on PPI is higher than the indirect effect based on CPI, although it is difficult to precisely quantify by how much. The results also point to the fact that the current monetary policy framework, based on broad money targeting, combined with a supporting exchange rate policy can be used effectively to control inflation, including imported inflation.

For monetary policy to be effective in controlling inflation, we suggest that the share of administered prices should be reduced significantly through price liberalization to avoid inconsistencies between monetary and fiscal policies. Even if price liberalization may induce a short-term increase in inflation, which would require a monetary policy response, monetary policy will become more flexible and more efficient. Furthermore, price deregulation should translate into a less inflationary fiscal position. While the pass-through is relatively low, it remains significant. Thus, the econometric study highlights the importance of closely coordinating monetary and exchange rate policies. This is particularly important in view of Tunisia's transition toward inflation targeting.

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