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Exchange rate passthrough to domestic prices in some MENA countries

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Abstract

This paper examines the degree of exchange rate pass-through (ERPT) to domestic prices for five MENA countries. Using a cointegrated VAR (vector autoregression) for each country, the ERPT into consumer prices is found to be small in the long run in our sub sample. By analyzing impulse responses derived from the VECM (vector error correction model), we found that the ERPT degree decreases across the different price indices: the pass-through effect is the largest for import prices index, the second for producer prices index and the smallest on consumer prices index.

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1. Introduction

The Middle East and North Africa (MENA) region is now undergoing many political changes after the Jasmine Revolution in 2011, especially at the social level insofar as governments should adopt policies that help to realize economic inclusion and support the poor and vulnerable. Central banks therefore encouraged to fight against rising prices in order to maintain purchasing power and should define price stability as an explicit monetary policy objective, such as in an inflation targeting (IT) framework. Indeed, IT has become a popular monetary policy strategy since initially adopted by New Zealand in 1989. In the MENA region, inflation targeting already has been adopted officially by Turkey, Egypt, and Morocco; Jordan and Tunisia (among others) are slowly moving towards an IT regime.

Aimed to preserve price stability, this monetary policy requires a more flexible exchange rate regime. Thus, understanding and quantifying the transmission of exchange rate shocks to domestic prices, known as the exchange rate pass-through (ERPT), is of great importance.

Recently, most of the emerging countries abandoned fixed exchange rates in favor of floating exchange rates, which is consistent with monetary policy targeting inflation. Indeed, it is important to determine how inflation expectations are affected by exchange rate changes because it is a part of an inflation-targeting policy. In this study, we paid particular attention to modeling the transmission of changes in the exchange rate to domestic prices, in order to evaluate the degree of this imported inflation.

In fact, changes in exchange rates affect domestic prices directly by influencing the final prices of tradable goods and imported intermediate goods; or indirectly by affecting the relative price between domestic goods and imported goods and therefore local demand.

According to many empirical results, it is often assumed that the transmission of changes in the exchange rate to domestic prices is low and incomplete. Therefore, there is a rich literature focused on determining the theoretical foundations of the low pass-through: many authors state that the explanation is microeconomic, and others argue that it is mostly a macroeconomic phenomenon.

Taking into account the decline of ERPT may change the transmission mechanisms of international shocks and involves the conduct of monetary policy that must consider the low sensitivity of prices to exchange rate fluctuations in forecasting inflation.

The purpose of this article then is to study the response of domestic prices due to changes in the nominal exchange rate in five MENA countries Tunisia, Morocco, Turkey, Jordan, and Egypt using a VAR co-integrated approach for the period 1980-2015. We also examine specific policy-driven hypotheses in order to test the nullity of the long-run pass-through to consumer prices. Finally, we evaluate and compare the pass-through across the pricing chain. In comparison with previous research in these countries, this article is one of the few studies examining the low exchange rate pass-through.

The remainder of this article is organized as follows. Section 2 presents the methodology. Section 3 draws up an empirical literature review. Section 4 presents the data used in our estimations. Section 5 analyzes the empirical results relating to the co-integration analysis and the transmission of exchange rate shocks on different domestic prices. Finally, section 6 summarizes the main findings and provides the concluding remarks.

2. Empirical literature survey

Before conducting an empirical analysis, it is important to draw up an empirical literature survey that examines the exchange rate pass-through in the MENA countries.

Jebali, Moulahi and Mouha (2006) showed that a nominal exchange rate shock causes a rapid reaction of the general price level, which disappears after ten months. Thus, they concluded that the degree of pass-through of the nominal effective exchange rate into consumer prices indices was low in Tunisia for the period 1999 2006.

With the aim of verifying the necessary conditions for the adoption of a policy of inflation targeting in Tunisia, Chockri and Frikha (2011) examined the transmission channels of monetary policy through a structural VAR model during the period 1993 2008; using industrial production index, real exchange rate, consumer price index and interest rate. They found that exchange rate shocks led to a rapid rise in consumer prices in the short and medium run but disappeared in the long run.

According to Abida and Sghaier (2012) the ERPT degree of the nominal effective exchange rate into consumer and producer indices were low in Tunisia and Morocco between 1980 and 2010, and thus they concluded that the nominal exchange rate didn't play the role of a shock-absorber mechanism in these countries. Likewise, Charfi and Guermazi (2012) confirmed the low degree of ERPT in Tunisia for the period 1986 2010. They estimated a couple of equations using the seemingly unrelated regressions (SURE) method; on a monthly basis during the 1986 2010 period by the means of the consumer price index, the producer price index, the nominal exchange rate, foreign prices, and a monetary aggregate.

For Turkey, Dolores (2010) found a small pass-through of the nominal exchange rate indices into the prices of imports measured by the unit value indices in the short and long runs. Equally, Kara and Öğünç (2005) estimated a low pass-through degree of nominal exchange rates and import prices into consumer prices in Turkey using the VAR framework. They also suggested the decline of the pass-through degree after the adoption of an inflation-targeting policy combined with a floating exchange rate regime.

Sweidan (2013) estimated the exchange rate pass-through into import prices in Jordan. This study employed an error correction model using nominal exchange rates and aggregated and disaggregated import prices. The results asserted that nominal exchange rate pass-through elasticity coefficients in Jordan are all small in the short and long-runs.

Ali (2011) examined the determinants of the inflation in Egypt within a VAR framework using the real effective exchange rate and the consumer price index. The results confirmed a low exchange rate pass-through.

However, according to the previous literature, only the exchange rate pass-through into one of the domestic price indexes has been investigated in these countries. A suggested solution for this problem is to incorporate all measures of domestic inflation into the same model. We decided to use three price indices because this gives us the opportunity to compare the propagation of the exchange rate variations from one price stage to the next.

Moreover, it is worth noting that our methodology is different compared to the empirical studies previously cited. In fact, they investigate exchange rate pass-through using single-equation methods in which exchange rates and prices are exogenous, or they use a first-

difference VAR model that didn't take into account the possibility of co-integration among the variables in level. Therefore, this article aims to contribute to recent debates on the analysis of the transmission of changes in exchange rates for various domestic prices within a co-integrated framework, as done by Beirne and Bijsterbosch (2011)[1] and Ben Cheikh (2013).[2] Likewise, we note that our study is value-added compared to these studies because our model specification includes all three three domestic prices.[3]

3. Empirical methodology

In theory, there is a reciprocal relationship between exchange rate and inflation: high relative inflation of a country against its trading partners can lead to local currency depreciation, and exchange rate changes may affect prices and influence macroeconomic policies. VAR modeling seems to be the best approach to investigate different domestic price reactions to exchange rate changes, and to measure the interactions between these two variables and other macroeconomic factors.

According to the theoretical foundation of the exchange rate pass-through, and based on the concept of purchasing power parity (PPP) in international trade, there exists a long-run equilibrium between exchange rate and domestic prices. Then, we should use appropriate estimation techniques in order to investigate if a co-integrated equilibrium relationship exists among the variables in levels such as done by Johansen (1988, 1992). Accordingly, the VAR model is extended to the vector error-correction model, or VECM, if there is evidence of co-integration among the variables, which takes the following form:

$$\Delta x_t = \Gamma_1 \Delta x_{t-1} + \ldots . \Gamma_{p-1} \Delta x_{t-p+1} + \Pi x_{t-1} + \mu + \delta D_t + \varepsilon_t,$$

where x_t, is the endogenous variables vector with dimension k including the consumer, the producer, the import prices, the output, the monetary variable, and the exchange rate. μ is a constant term: a column vector with k elements. D_t is a vector of non stochastic variables including deterministic variables (centered seasonal dummies and intervention dummies) and weakly exogenous variables such as the oil price index. ε_t is a Gaussian error term with a zero mean and a positive symmetric covariance matrix Ω.

Through this VECM specification, it is possible to retrieve the short-run properties of the data (given in Γ_i) and the long-run information of the variables (contained in Π). Indeed, the rank r of Π is of central importance because it measures the number of co-integrating vectors. If $r \prec k$, Π can be expressed as $\Pi = \alpha\beta'$; α and β are two matrices of dimension $(k \times r)$ where α reflects the speed of adjustment and β contains the co-integrating vectors.

After determining the ERPT coefficient of the long-run based on the unrestricted VECM, we follow Beirne and Bijterbosch (2011) by imposing a number of restrictions on the long-run parameters to examine specific hypotheses on pass-through to check whether the response of

[1] Using a co-integrated VAR and impulse responses derived from the VECM, Beirne and Bijsterbosch (2011) assess the degree of the pass-through into consumer prices for nine central and eastern European Member states during the period 1995 2008. The variables specified in this study are harmonized consumer price index, producer price index, oil prices, the nominal effective exchange rate, and industrial production.

[2] By estimating a system of VECM models for twelve EA countries, Ben Cheikh (2013) found a wide dispersion of the exchange rate pass-through degree among countries. The variables used in this case are the nominal effective exchange rate, the consumer price index, oil prices, the real GDP, and the three-month interest rate.

[3] Beirne and Bijterbosch (2011) used only CPI and PPI and didn't include a monetary variable. Ben Cheikh (2013) used a monetary variable, and his analysis has been focused only on CPI.

consumer prices to exchange rate variations is complete or null. After conducting co-integration analysis, the impulse response function analysis was performed on the system of six-equation VECM in order to evaluate and compare the degree and timing of exchange rate pass-through into consumer, producer, and import prices.

4. Data

In this study, our analysis is focused on five MENA countries (Tunisia, Morocco, Turkey, Jordan, and Egypt). As a measure of domestic prices, we use the consumer price index, producer price index (proxied by the wholesale price index), and import price index (measured by the import unit value index). The domestic demand conditions are proxied by the real GDP and we use M1 as a monetary variable. The exchange rate is the nominal effective exchange rate measured as a weighted sum of the exchange rate of a country with its major trading partners, defined so that an increase in the index corresponds to an appreciation for the home country. We also add oil prices as an exogenous variable measured by the US prices of crude oil barrel.

The data are obtained from the International Financial Statistics (IFS) of the International Monetary Fund (IMF). These data are quarterly and span the period 1980:1 2015:2.

Moreover, because our data are high frequency (quarterly observations), all series are adjusted for seasonal effects via Sensus X-13.

Furthermore, the variables are formally tested for the order of integration using ADF, DFGLS and (KPSS) tests to ensure the robustness of the order of integration of the series. The majority of the variables in level are generated via an I(1) process and first-difference variables are stationary in at least two of the three tests, except for the consumer price index(CPI) in Tunisia which is found to be I(2) following ADF and DFGLS, and M1 in Turkey which is found to be I(1) using only the DF-GLS test.

Then, we determine the lag order of each VECM (we determine the optimal lag order for differenced variables) using the sequential modified LR test statistic.[4] After determining the optimal lag order of the model, we can now check for the co-integration of the series using the Johansen LR Trace test.[5]

5. Empirical results

Starting with the co-integration approach, we first analyze the long-term part of our baseline VECM.

Here, we focus on the first co-integrating vector which is the most statistically significant model because it provides the highest eigenvalue (Johansen and Juselius, 1992).

The unrestricted long-run parameters of each VECM are summarized in table I:

[4] The optimal lag order selected by the LR test is five for Tunisia, six for Morocco, Jordan and Egypt, and eight for Turkey.

[5] We found that there are two co-integration relations in Tunisia, three in Morocco and four in Turkey, Jordan, and Egypt.

Table I: Long-run matrix: Coefficient of first co-integrating vector

Country	*CV normalised on CPI*						
	CPI	**PPI**	**IMP**	**NEER**	**Y**	**M**	**Trend**
Tunisia	1	0.96* (0.15)	0.19* (0.06)	−0.17* (0.07)	6.86* (2.01)	−0.54 (0.48)	−0.06* (0.02)
Morocco	1	0.202 (0.42)	1.2* (0.18)	−0.25* (0.06)	2.3* (0.43)	−0.3 (0.18)	–
Turkey	1	1.91* (0.18)	0.99* (0.17)	−0.45* (0.11)	−2.23* (0.46)	0.32* (0.12)	–
Jordon	1	0.41* (0.12)	0.26* (0.09)	−0.12* (0.06)	0.99* (0.16)	0.26* (0.08)	−0.019* (0.00)
Egypt	1	0.88* (0.09)	0.05 (0.09)	−0.13* (0.09)	0.35 (0.32)	−0.17* (0.02)	0.008* (0.004)

Note: Standard errors are in parentheses. * denotes significance at the 5% level or below.

According to our results of the estimation of the unrestricted VECM, we find that in the long-run the exchange rate pass-through into consumer prices differs across the countries: Jordan has the lowest coefficient and Turkey experiences the highest degree of pass-through. Regarding the pricing chain, we show a positive coefficient associated with producer prices (PPI) and import prices (IMP), which are in most of the cases significant (except for PPI in Morocco and IMP in Egypt), meaning that a rise in PPI and IMP increases CPI and vice versa.

We also found a negative coefficient associated with the exchange rate series, showing that a depreciation of the domestic currency causes a rise in consumer prices in the long run. Concerning the output, we showed a positive coefficient associated with the output (except for Turkey) that is statistically significant (except for Egypt), indicating that real GDP and CPI move together in the long run. Regarding money, a negative relationship was found between M1 and CPI in the long run in Tunisia, Morocco, and Egypt (which is significant only in Egypt) whereas in Turkey and Jordan a rise in money was associated with a rise in consumer prices. Finally, the restricted trend is statistically significant in Tunisia, Jordan and Egypt.

The second step in our analysis consists of examining the adjustment coefficients (or loading factors) that describe the speed with which the long-run equilibrium is achieved. These results are provided in table II:

Table II: Loading factors

Country	CPI	PPI	IMP	NEER	Y	M
Tunisia	−0.034* (0.011)	0.054* (0.01)	−0.036 (0.043)	0.009* (0.004)	−0.004 (0.002)	−0.01 (−1.35)
Morocco	−0.018* (0.004)	0.04* (0.01)	0.19* (0.03)	0.023* (0.011)	0.01 (0.01)	0.05 (0.03)
Turkey	−0.031* (0.004)	0.05 (0.04)	−0.2* (0.06)	0.4* (0.09)	−0.06* (0.01)	−0.10 (0.09)
Jordon	−0.04* (0.013)	0.16* (0.06)	−0.002 (0.13)	0.33* (0.11)	−0.05* (0.02)	−0.19* (0.05)
Egypt	0.14* (0.06)	−0.03* (0.004)	-0.101 (0.11)	0.135* (0.048)	0.016 (0.01)	0.32* (0.05)

Note: Standard errors are in parentheses. * denotes significance at the 5% level or below.

As shown in table II, the coefficients of the α matrix associated with the CPI are statistically significant for all countries.[6] Indeed, these coefficients are found to be small, meaning that the speed of adjustment of consumer prices toward equilibrium is low in these countries (except for Egypt). Otherwise, this may explain the low degree of the exchange rate pass-through in the short-run found in the literature. Regarding the dynamics of adjustment to the long-run equilibrium of exchange rate equations, the NEER is found to be statistically significant and relatively quite high in all the cases, meaning that it plays an important role to reestablishing the long-run equilibrium. We also found that the coefficients associated with PPI are significant except for Turkey. Considering IMP, we show a not significant parameter in the majority of the cases (except for Morocco and Turkey), and this could be interpreted as a sign of exogeneity of this variable. Finally, production and money are found to be statistically not significant for the majority of countries (in three of five) considered in the α matrix.

After examining the unrestricted parameters of the VECM models and the speed of adjustment of the variables to the long run equilibrium, the final stage in our co-integration analysis consists of imposing restrictions on long-run parameters. The objective of this step is to check whether the ERPT on consumer prices is full or null. As shown in table III, we showed that H_1 was rejected in all countries, and that H_2 may be accepted only for Turkey. Thus, we could assert that EPRT is not complete for this sub-sample. Concerning H_3, the hypothesis of zero ERPT is rejected for all countries except for Tunisia, affirming that null ERPT is accepted when other variables in the system are constrained to have no effect on domestic consumer prices. Regarding H_4, it is clear that the hypothesis of zero ERPT with other unrestricted parameters cannot be rejected for all countries, suggesting that the ERPT into consumer prices is found to be null in the long run in our sub-sample.

Table III: Restrictions on long-run parameters

	Full ERPT		**Zero ERPT**	
Country	$H_1 : (1\ 0\ 0\ 1\ 0\ 0)$	$H_2 : (1\ \eta\ \nu\ 1\ \gamma\ \kappa)$	$H_3 : (1\ 0\ 0\ 0\ 0\ 0)$	$H_4 : (1\ \eta\ \nu\ 0\ \gamma\kappa)$
Tunisia	11.53 (0.04)	5.75 (0.01)	10.81 (0.05)	1.77 (0.18)
Morocco	39.05 (0.00)	14.08 (0.00)	36.27 (0.00)	1.54 (0.21)
Turkey	36.68 (0.00)	2.97 (0.08)	38.03 (0.00)	1.74 (0.18)
Jordon	57.6 (0.00)	4.11 (0.04)	53.31 (0.00)	2.71 (0.09)
Egypt	38.04 (0.00)	6.48 (0.01)	51.35 (0.00)	2.7 (0.10)

Note: Restrictions based on Likelihood Ratio tests with a chi-squared distribution, with the number of degrees of freedom equal to the number of restrictions imposed; p-values are in parentheses.

To reveal how domestic variables react to different shocks we calculated the impulse response functions. Usually, in VAR estimation, the most exogenous variables enter first into the VAR because the variables should be classed in descending order of exogeneity (Mishkin and Schmidt-Hebbel 2007). According to Ito and Sato (2007,2008), Coulibaly D.

[6] A lack of significance for these parameters indicates the presence of weak exogeneity. This means that the variable does not respond to or correct for deviations in the long-run equilibrium (Beirne and Bijsterbosch 2011).

and Kempf (2010), and Bwire, Anguyo and Opolot (2013), among others, we retain the following order:

$$Y \rightarrow M \rightarrow NEER \rightarrow IMP \rightarrow PPI \rightarrow CPI.$$

The first order is reserved for output changes, viewed as an exogenous supply shock, because real demand disturbances are not contemporaneously affected by other shocks, while real shocks have a simultaneous effect on other innovations. Monetary shocks are affected only by real shocks, but have a contemporaneously impact on the exchange rate and domestic prices. Exchange rate responds contemporaneously to real and monetary policy shocks but it only affects domestic prices. Thus, domestic prices take the last place in the system ordered according to the distribution chain: import prices, then producer prices and finally consumer prices.

Table IV: Impulse response along the distribution chain of pricing[7]

Accumulated response of IMP to 1% exchange rate shock					
Response horizon	**Tunisia**	**Morocco**	**Turkey**	**Jordon**	**Egypt**
1	0.055	0.013	0.010	0.011	0.013
4	0.081	0.055	0.098	0.048	0.038
8	0.129	0.156	0.344	0.117	0.276
24	0.339	0.298	0.439	0.133	0.461
Accumulated response of PPI to 1% exchange rate shock					
Response horizon	**Tunisia**	**Morocco**	**Turkey**	**Jordon**	**Egypt**
1	0.044	0.010	0.006	0.012	0.021
4	0.105	0.032	0.036	0.026	0.002
8	0.192	0.186	0.188	0.103	0.140
24	0.283	0.197	0.276	0.117	0.26
Accumulated response of CPI to 1% exchange rate shock					
Response horizon	**Tunisia**	**Morocco**	**Turkey**	**Jordon**	**Egypt**
1	0.053	0.002	0.008	0.005	0.004
4	0.061	0.013	0.033	0.019	0.015
8	0.108	0.126	0.199	0.093	0.092
24	0.122	0.155	0.306	0.104	0.102

Note: Response horizons 1, 4, 8, and 24 denote, respectively, one-quarter, one-year, and six-year responses after the initial shock.

If we compare the pass-through into consumer price estimates from the earlier co-integration analysis, it is clear that the estimates from the impulse response function analysis are somewhat lower. This could be explained by the longer time horizon in the co-integration approach compared to the impulse analysis. Because the adjustment process is not wholly reached during the considered time horizon in the impulse response analysis, the long-run effects outlined in the co-integration analysis is expected to be relatively higher. Otherwise, we observe that the passthrough degree is nearly similar across domestic prices and among the countries (except for Turkey). To ensure the robustness of these results, a sensitivity analysis was conducted using the generalized impulse response functions. Thus, we conclude that our results are broadly robust because we find the same impulse responses.

Considering the degree of the exchange rate passthrough along the distribution chain of pricing, we observe that consumer prices exhibits the least response compared to those of

[7] Table IV provides estimates of the impulse responses at 1, 4, 8, and 24 quarter time horizons. We report here the estimates for the response respectively of IMP, PPI, and CPI to an orthogonalized negative 1% shock imposed on the NEER.

producer prices, followed by import prices, except for Turkey, where the pass-through is found to be higher into consumer prices than into producer prices. Indeed, the decrease of the pass-through degree along the distribution chain can be explained by the decline in the part of goods affected by exchange rate shocks in the price indices along the distribution chain (Betts and Kehoe 2006).[8] In other words, this decline is due to the share of imported goods in the consumption basket or the relative importance of imported inputs (Burstein, Eichenbaum, and Rebelo 2006). Moreover, the smaller degree of ERPT into CPI compared to IMP and PPI can be due to the existence of local distribution costs, the role of substitution between goods in response to exchange rate changes (Burstein, Eichenbaum, and Rebelo 2002), the role of real rigidities in nominal wages (Ambler, Dib, and Rebei 2003), and the slow adjustment of goods prices due to nominal rigidities at the consumer level (Engel 2002).

6. Conclusion and policy implications

This article contributes to the empirical literature by estimating the long-run exchange rate pass-through into consumer prices in five MENA countries under a CVAR approach using co-integration tests. In accordance with the majority of empirical studies, we provide a strong evidence of partial long-run ERPT into consumer prices in five MENA countries.

The results of the Johansen co-integration procedure reveal the existence of at least two co-integrating vectors for each country of our sample. By estimating the coefficients of the long-run matrix for each unrestricted VECM, the degree of exchange rate pass-through into consumer prices is found to be low and quite dispersed across the countries. Moreover, the coefficients of the α matrix associated with the CPI are found to be small, meaning that the speed of adjustment of consumer prices toward equilibrium is low in these countries (except for Egypt). By imposing some restrictions on the VECM equations, the ERPT into consumer prices is found to be null in the long run in our subsample. Otherwise, the impulse response analysis derived from the VECM models indicates that the ERPT degree decreases across the different price indices: the pass-through effect is the largest for the import price index, the second for the producer price index, and the smallest for the consumer price index.

Because exchange rate is a channel of monetary policy transmission, it is important to assess the ERPT degree. Focused on the shock transmission by the exchange rate, many studies found that a low degree of exchange rate pass-through enables more flexibility in pursuing an independent monetary policy, which helps to perform an inflation-targeting strategy (Choudhri and Hakura 2006).

When prices are not very responsive to exchange rates, this means that nominal exchange rate fluctuations sustainably affect the real exchange rate. In this case, the chosen central parity should broadly comply with the equilibrium real exchange rate and the optimal policy is to fix the nominal exchange rate, because a floating nominal exchange rate fails to reach relative price adjustment (Bailiu and Bouakez 2004).

If the exchange rate pass-through into domestic prices is low and if consumers do not understand nominal exchange-rate changes as relative price changes in the short run, then this could lead to a dampening of expenditure-switching effects (Devereux and Engel 2003). Therefore, monetary policymakers cannot rely on the nominal exchange rate to achieve the necessary adjustment to real shocks, because nominal depreciation will not lead to a real depreciation and external imbalances will not be absorbed.

[8] For example, the share of tradable goods declines in price indices along the distribution chain.

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