

A discusión

THE ROLE OF COMMODITY TERMS OF TRADE IN DETERMINING THE REAL EXCHANGE RATES OF MEDITERRANEAN COUNTRIES*

Mariam Camarero, Juan Carlos Cuestas and Javier Ordoñez**

WP-AD 2007-15

Editor: Instituto Valenciano de Investigaciones Económicas, S.A.

Primera Edición Julio 2007

Depósito Legal: V-3155-2007

IVIE working papers offer in advance the results of economic research under way in order to encourage a discussion process before sending them to scientific journals for their final publication.

* The authors gratefully acknowledge the financial support from the CICYT and FEDER project SEJ2005-01163, the Bancaja project P1.1B2005-03 and the Generalitat Valenciana Complementary Action ACOMP06/047. The three authors are members of the INTECO research group. The usual disclaimer applies.

** M. Camarero y J. Ordoñez: Jaume I University (Castellón, Spain); J.C. Cuestas (corresponding author): Department of "Fundamentos Análisis Económico", University of Alicante. Campus de San Vicente del Raspeig, Ap. Correos 99, 03080 Alicante, Spain. email: cuestas@merlin.fae.ua.es.

THE ROLE OF COMMODITY TERMS OF TRADE IN DETERMINING THE REAL EXCHANGE RATES OF MEDITERRANEAN COUNTRIES

Mariam Camarero, Juan Carlos Cuestas and Javier Ordoñez

ABSTRACT

The aim of this paper is to investigate whether there exists a long run relationship between the real exchange rate and the commodity terms of trade in the so-called “Mediterranean” or MENA countries. These economies are good candidates for this type of formulation, as they can be considered commodity exporting countries. Using cointegration techniques, we find long run relationships linking the real exchange rate and a commodity-based measure of the terms of trade. Thus, commodity terms of trade are a potential explanation for the apparent non-stationarity of MENA countries real exchange rate previously found in the empirical literature.

Classification J.E.L.: C22, F31

Key words: real exchange rate, terms of trade, commodity prices.

1 Introduction

Explaining the behaviour of the real exchange rates (RER hereafter) may be one of the most controversial macroeconomic issues. Many relevant empirical studies such as those by Meese (1990) Mussa (1990) and MacDonald and Taylor (1992) have found that the forecasts based on a random walk are a better approximation to its behaviour than those based on monetary models (Meese and Rogoff, 1983). As Backus (1984) points out, monetary models for real exchange rate determination performed relatively well until the seventies, but not afterwards probably due to the importance of the real shocks that affected the RER. ¹

Rogoff (1996) explains the RER deviations from its equilibrium value using real factors. Therefore, Purchasing Power Parity (PPP hereafter) would not hold due to the occurrence of permanent shocks that affect the real exchange rate. Within this literature, Evans and Lothian (1993) find that an important part of RER fluctuations have their origin in real shocks and, therefore, a random walk is not a good approximation for RER behaviour. ²

Based on previous empirical results on RER, it is possible to highlight some conclusions. First, that PPP is not always a good approximation for RER behaviour. Second, that, during the floating exchange rate period, simple monetary models have hardly been able to beat the random walk. Finally, those models which account for real shocks might be a better approximation for real exchange rate behaviour than the random walk. Therefore, an adequate model for the RER should explain deviations from its long-run equilibrium based on real shocks with enough frequency and volatility (Chen and Rogoff, 2003).

Among the real variables, shocks on commodity prices may be an essential explanatory factor in commodity exporting countries. Edwards (1985), explains the slow mean reversion of RER from the supply side. Additional results favourable to this hypothesis are those by Chen and Rogoff (2003), and Cashin, Céspedes and Sahay (2004), who find that for a large group of commodity exporting countries the most important factor in RER determination is a commodity-price-based terms of trade.

In this paper we aim to analyze whether there exists a long run relationship between the RER and a terms of trade variable based on commodity prices in the so-called “MENA Countries” (Algeria, Cyprus, Egypt, Israel, Jordan, Malta, Morocco, Syria, Tunisia and Turkey). In addition, unlike other papers, we concentrate on the real exchange rate against the European

¹There are important exceptions to this conclusion, as in MacDonald and Taylor (1994).

²In an eclectic model that also includes real variables Camarero, Tamarit and Ordóñez (2005), estimate a model for the euro-dollar exchange rate that beats the random walk.

Table 1: % of trade with the EU in total trade, 2002

Country	% Exports to the EU	% Imports from the EU
Algeria	63.9	56.0
Cyprus	49.3	41.8
Egypt	40.1	33.7
Israel	24.7	40.8
Jordan	6.4	29.9
Malta	38.9	55.7
Morocco	66.4	59.4
Syria	53.9	30.6
Tunisia	79.3	70.3
Turkey	51.5	45.5

Source: Direction of Trade Statistics Yearbook (IMF).

Union (EU). There are several reasons for the adoption of this approach. First, this group of countries has an asymmetric commercial relationship with the EU, as the majority of their trade is directed to this area (see Table 1), but their share in EU trade is below 3%. Second, they have a commitment with the EU for the creation of a Free Trade Area by 2010, on the basis of the Euroministerial Conference held in Barcelona in 1995. Third, former studies such as Sarno (2000), and Camarero, Cuestas and Ordóñez (2003) have highlighted that PPP does not hold for these countries. As the majority of these countries exports primary products, it is very likely that their RER depends on primary products prices. Actually, applying Johansen (1988, 1991) cointegration technique and following Cashin et al. (2004) approach, we provide empirical evidence on the fact that the major shocks that affects the RER long run equilibrium for some of these countries are related to commodity-price-based terms of trade shocks.

The remainder of this paper is organized as follows. In the next section we summarize some theoretical approaches for RER determination as a function of the terms of trade and, in particular, commodity prices. In the third section we review the empirical evidence on this topic and in the fourth, we present the results of our analysis. Finally, in the last section we report some concluding remarks.

2 Real Exchange Rate determination and commodity terms of trade

The real exchange rate and the terms of trade are two relative prices of great importance for any economy, as they play central roles in an open economy's adjustment to economic shocks. Many authors have studied the theoretical linkages between the two variables. The conventional wisdom is that there is a positive relationship linking them (an improvement in the terms of trade implies an appreciation of the currency).

One of the first theoretical contributions was made by Neary (1988). This author considers a small country that produces either tradable or non tradable goods in a competitive market and analyzes how RER equilibrates the balance of payments. According to this author, an improvement in the terms of trade requires a real appreciation of the currency in order to eliminate the non tradable demand excess generated by such improvement.

The model proposed by Blundell-Wignall and Gregory (1990) can be a starting point to understand the role of the terms of trade in real exchange rate determination for a small commodity-exporting country³. Their initial hypotheses are, first, as the country is small, that the terms of trade are exogenous⁴ and, second, that the only produced good is sold internationally at international prices and internally at monopoly prices. Under these assumptions the RER⁵ is a function of the terms of trade, given the demand and supply elasticities⁶.

Edwards (1985) in turn considers two channels through which the commodity price movements may affect the RER. First, an increase in commodity prices will increase national income, as these products are demand-inelastic, rising demand in general. This growth in demand will increase just non tradable goods prices, as tradables prices are fixed internationally. This will provoke a rise in CPI and, therefore, a real appreciation of the domestic currency. Second, an increase in commodity prices will generate a surplus in the trade balance, an increase in foreign reserves and, possibly, in the monetary base, yielding inflation and, thus, a real appreciation of the national currency.

In the above mentioned studies, the RER depends on the terms of trade

³We refer to those countries whose exports rely heavily on commodity products.

⁴Although reasonable in many instances, there are potential sources of endogeneity in this relationship.

⁵An increase in the RER means a real appreciation of the national currency.

⁶Note that although Blundell-Wignall and Gregory (1990) are considering the case of Australia as a commodity exporting country, the prices of the primary products do not appear explicitly in the RER determination.

(Neary, 1988, and Blundell-Wignall and Gregory, 1990) or on commodity prices (Edwards, 1985). Cashin, Céspedes and Sahay (2004) go beyond by establishing a theoretical framework that justifies the analysis of the relationship between RER and commodity terms of trade⁷ for commodity exporting countries. In a model with two countries, two sectors (tradable and non-tradable goods) and one factor (labour), mobile among sectors, an increase in the commodity world prices will rise wages in this sector. If wages between sectors equalize, the rise in wages in the non tradable sector will provoke an increase in the prices of these products, appreciating the RER. Thus, Cashin, Céspedes and Sahay (2004) arrive to a model where the mechanisms at work are similar to the traditional Balassa-Samuelson effect.

As a conclusion, all the above described theoretical approaches find that an improvement in the terms of trade will appreciate the currency⁸. In this case, the theoretical assumptions are that, as we concentrate on commodity-exporting countries, the main terms of trade shocks are exogeneous and related to international variations in the primary product prices. Thus, The expected long run equilibrium relationship is the following:

$$q_t = f \underset{(+)}{(pc_t)} \quad (2.1)$$

where q_t is the RER, pc_t is the commodity terms of trade and the positive relation means that in the long run, an increase in the commodity terms of trade will provoke an appreciation of the national currency in real terms.

3 Revision of previous empirical evidence

To the best of our knowledge the empirical evidence on the determinants of RER for developing countries and, in particular, the role of the terms of trade, is scarce. In contrast, there is an important bulk of literature on this topic for developed countries. In what follows we review the empirical literature for the two groups of countries. In table 2 we report a brief summary of this literature.

⁷Commodity terms of trade and real commodity prices are used in this paper to refer to a price index of a basket of commodity prices over an international index of export prices.

⁸However, Connolly and Devereux (1992) have challenged the conventional wisdom and showed that the direction of the relationship is ambiguous: the effects on an external import prices shock is uncertain, as income and substitution effects work in different directions. The only exception are the countries whose exports are dependent on commodities. In this case, the sign is unambiguously positive.

Table 2: Revision of the empirical literature

Paper	Countries	$q = f()$	Results
Blundell-Wignall & Gregory (1990)	Australia, New Zealand	Terms of Trade (TOT)	TOT explains RER.
Gruen & Wilkinson (1994)	Australia	Goods and services TOT, Real interest rates differential	RER explanatory variables: TOT, Real interest rate differential.
Amano & Van Norden (1995)	Canada	Primary products TOT (fuel and non-fuel)	There is a long run relationship between both variables. TOT cause RER.
Amano & Van Norden (1998b)	USA	Oil Real Price	Oil Real Prices explain RER.
Amano & Van Norden (1998a)	Germany, Japan and USA	Oil Real Price and Real Interest Rate Differential	RER has as explanatory variables Oil Real Prices and Real interest rate differential.
Chen & Rogoff (2003)	Australia, Canada and New Zealand	Commodity prices and productivity differential	RER explanatory variables: commodity prices and prod. differential. Residuals are persistent.
Cashin, Cespedes & Sahay (2004)	Commodity Exporters, among them: Morocco, Syria, Tunisia and Turkey	Real Commodity Prices	For most countries, a long run relationship RER / Real Commodity prices (explanatory variable).

Blundell-Wignall and Gregory (1990) analyze the relationship between the RER and the terms of trade for Australia and New Zealand, concluding that the terms of trade play an important role in determining the RER. Also for the case of Australia, Gruen and Wilkinson (1994) estimate the relationship among the RER and the terms of trade (goods and services in this case), finding that there is no evidence of a relationship linking them. Nevertheless, once the interest rate differential is introduced in the model, the RER movements appear to depend upon the terms of trade and interest rate differential.

Amano and Van Norden (1995, 1998a, 1998b) have devoted an important line of research to the role of the terms of trade. In the first paper, they analyze the long run relationship between the RER and the commodity terms of trade for Canada. They conclude that there is a relationship between the two variables, where causality goes from the terms of trade to the RER. In the second one, the authors study the relationship between the RER and the real oil price for the US, concluding that there exists a cointegration relationship between them. Finally, in the last paper, the authors introduce not only the real oil price, but also the real interest rate differential for Germany, Japan and the US. They analyze the cointegration relationships among those variables and find that the RER depends on the real oil price and the real interest rate differential. In a recent publication by the Bank of Canada, Issa et al. (2006) have found that the Canadian degree of dependence on oil export has increased during the nineties. Using cointegration tests with structural breaks the authors estimate a long-run relationship, where the long-run parameter has changed around 1992.

Chen and Rogoff (2003) analyze the RER behaviour for a group of three OECD members (Australia, Canada and New Zealand). They find that commodity prices have an important influence in the RER of Australia and New Zealand. However, the estimation residuals present slow mean reversion even before introducing productivity differentials in the non-tradable products sector.

In general, as Dungey (2004) remarks, the link observed between the real exchange rate and the commodity terms of trade for developed countries is strong, whereas in the case of developing countries the link seems to be weaker.

Cashin, Céspedes and Sahay (2004) study whether the RER depends in the long run on real commodity prices for commodity exporting countries. The authors consider, among the group of countries in their study, the cases of some Mediterranean countries such as Morocco, Syria, Turkey and Tunisia. They find that the RER depends on real commodity prices in the Mediterranean countries analyzed with the only exception of Turkey.

4 Empirical results for the Mediterranean Countries

4.1 Data

The basic data have been obtained from the *International Financial Statistics* (IFS), IMF. The variables used in the empirical analysis are the real exchange rate (q_t) and the commodity terms of trade (pc_t). The first one is computed as $e_t - p_t^* + p_t$ where e_t is the nominal effective exchange rate defined as the price of the domestic currency in terms of the foreign currency, p_t^* is the foreign price and p_t is the national Consumer Price Index. The nominal effective exchange rate and foreign prices have been computed for each country as a weighted average, using as weights the proportion of trade with their respective EU trade partners. This proportion have been obtained from *Direction of Trade Statistics Yearbook*, IMF.

Concerning the commodity terms of trade, this variable has been computed as:

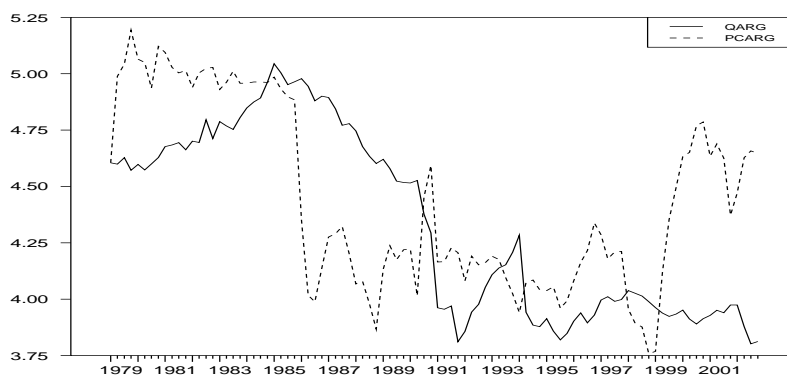
$$pc_t = \log \left[\frac{\exp \left\{ \sum_{i=1}^i [w_i (\ln P_i)] \right\}}{IVUX} \right] \quad (4.1)$$

where w_i are the weights (% of commodity i in total exports)⁹, P_i is the price of the commodity i and $IVUX$ is the index of unitary value of manufactured exports obtained directly from the IFS data base. This variable is computed by the IMF as unit value index of 20 industrial countries exports. We have used quarterly data from 1979:1 to 2002:4.

Previous to the econometric analysis, in figure 1 we report the RER and the commodity terms of trade. Looking at the graphs, it is possible to observe a co-movement between the two variables that can be a sign of a long-run relationship between them. It seems that the most important changes in the commodity terms of trade in the cases of Algeria, Egypt and Syria are linked with the fall in oil prices in 1986 and with the rises in 1999 and 2000.

⁹Obtained from Cashin, Céspedes and Sahay (2004).

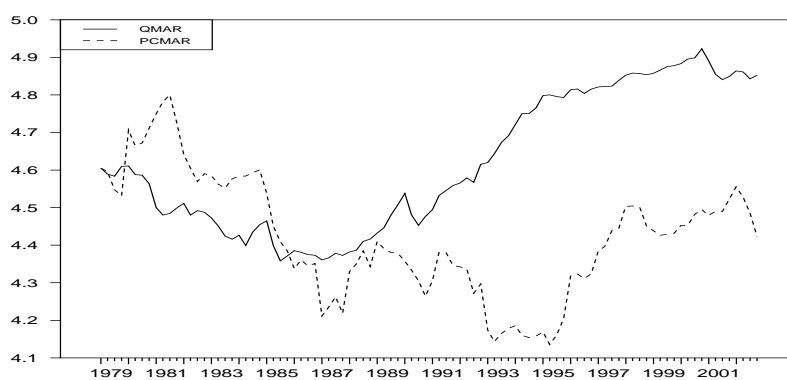
Figure 1: Real Exchange Rates and commodity terms of trade



(a) Algeria

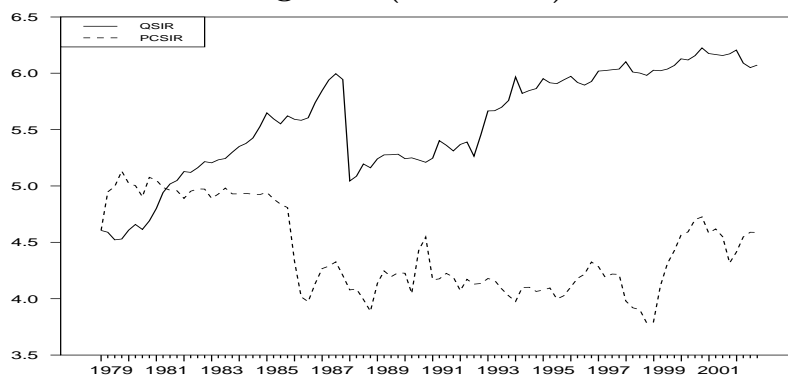


(b) Egypt

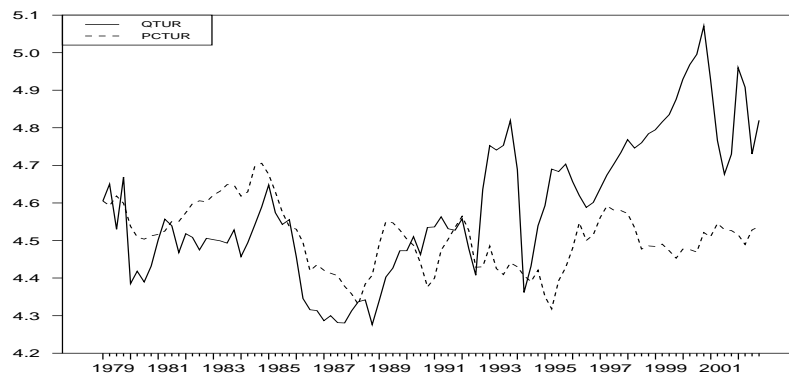


(c) Morocco

Figure 1 (continued)



(d) Syria



(e) Turkey

4.2 Cointegration analysis

Following the same model specification than Cashin et al. (2004)¹⁰, in this section we analyze the role of commodity terms of trade in the real exchange rate over the long run (equation 2.1) for the MENA countries:

$$q_t = f_{(+)}(pc_t)$$

applying the Johansen (1988, 1991) cointegration technique.

The empirical analysis of cointegration is based on the VAR(p) model with a constant restricted to lie in the cointegration space:

$$\Delta x_t = \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \alpha \beta' x_{t-1} + \alpha \delta_0 Ds_t + \Phi_1 Dp_t + \mu_0 + \varepsilon_t \quad (4.2)$$

where $x_t = \{q_t, pc_t\}'$, $\mu_0 = \alpha \beta_0 + \alpha_{\perp} \gamma_0$, so that β_0 is an intercept in the cointegration relations and γ_0 is equal to zero. The coefficient δ_0 stands for mean shifts in $\beta' x_t$ as a result of mean shifts in the variables that do not cancel in the cointegrating relationships. These mean shifts are captured by a set of dummy variables Ds_t . Dp_t stands for permanent impulse dummies¹¹.

Concerning the lags of the VAR models, as a result of a previous specification analysis, we have included 1 lag for Morocco, 2 lags for Algeria, Egypt and Turkey, and, finally, 4 in the case of Syria¹².

The baseline model was carefully checked for signs of misspecification using a variety of diagnostic tests, reported in tables 3 and 4. At this stage, even after the inclusion of the dummy variables, there are still some normality and ARCH problems in the RER equation for Morocco. However, since

¹⁰The main differences between our contribution and Cashin et al. (2004) is that we compute a specific real effective exchange rate vs. the EU in order to stress the importance of the EU on these countries trade, whilst Cashin et al. (2004) use a general real effective exchange rate vs. the rest of the trading partners, obtained directly from the IMF. Additionally, we extend the analysis to other MENA countries not considered by Cashin et al. (2004). The cointegration approach is also different, since we apply Johansen (1988, 1991), and Cashin et al. (2004) apply Gregory and Hansen (1996) residual based test with endogenous structural changes and obtain the long run equations by Fully Modified Least Squares. Note that in the present article structural changes are treated as exogenous. These differences might yield to differences in the results.

¹¹See the appendix for a detailed description of both Ds_t and Dp_t for each country

¹²In this section we present the results for Algeria, Egypt, Morocco, Syria and Turkey. For the rest of countries it has not been possible to find a cointegration relationship between the RER and the terms of trade and, therefore, the results are omitted although available from the authors upon request.

Table 3: Univariate misspecification tests

Univariate	Algeria		Egypt		Morocco		Syria		Turkey	
	Δq_t	Δpc_t	Δq_t	Δpc_t	Δq_t	Δpc_t	Δq_t	Δpc_t	Δq_t	Δpc_t
ARCH	0.67	0.30	1.83	0.19	4.89	0.10	7.67	3.02	0.17	0.59
J-B(2)	3.46	3.24	1.69	2.53	6.91	1.40	3.95	3.21	2.57	1.05
Skewness	-0.36	-0.29	-0.28	-0.27	0.25	-0.17	0.16	-0.01	-0.16	0.20
Kurtosis	3.58	3.57	2.73	3.44	3.24	4.09	3.70	3.59	3.48	3.11

Note: A significant test statistic (5%) is given in bold face.

the normality problem arises from an excess of kurtosis, the estimators by maximum likelihood are robust (Gonzalo, 1994). Moreover, the multivariate tests point to the absence of specification problems.

Table 5 presents the Johansen stationarity test. In all cases the null hypothesis of stationarity is rejected, except for the case of Syria. Therefore, we exclude Syria from the rest of the cointegration analysis.

The choice of the cointegration rank is based on the Bartlett corrected trace test. The 5% critical values for this test have been simulated to account for the shift dummies restricted to the cointegration space. According to the results reported in table 6, we might accept $r = 1$ in all the cases.

Once the cointegration rank has been determined, we analyze the hypothesis of long run exclusion of the variables. In the cases of Algeria, Egypt and Turkey the restricted constant is not significant, i.e. the intercept in the data cancels in the cointegration space¹³.

The identified cointegration vectors are presented in table 7. In all the cases the commodity terms of trade estimated parameter is close to unity (with the exceptions of Morocco and Egypt) and positively signed but Morocco. A possible explanation for this result may be that the main products that Morocco exports (phosphate, fish and lead) are relatively demand-elastic and, therefore, the RER appreciates as the commodity terms of trade fall, i.e. as the commodities become cheaper, the revenues from exporting these products increase, appreciating the exchange rate in real terms.

The restricted dummy variables are related to shocks that have permanent effects on the variables and that do not cancel out in the cointegration space. In particular, for Algeria, the first one is related to a large and sudden fall in

¹³In particular, the long run exclusion test results for the restricted constant are the following: Algeria $\chi^2(1) = 0.32$, p-val.= 0.57; Egypt $\chi^2(1) = 2.07$, p-val.= 0.15; Turkey $\chi^2(1) = 0.25$, p-val.= 0.62.

Table 4: Multivariate misspecification tests

Algeria	Autocorrelation : Ljung-Box	$\chi^2(84) =$	97.6	p-val.	0.14
	LM ₁	$\chi^2(4) =$	3.68	p-val.	0.45
	LM ₄	$\chi^2(4) =$	3.72	p-val.	0.44
	Normality	$\chi^2(4) =$	5.78	p-val.	0.21
Egypt	Autocorrelation: Ljung-Box	$\chi^2(84) =$	95.8	p-val.	0.17
	LM ₁	$\chi^2(4) =$	3.17	p-val.	0.52
	LM ₄	$\chi^2(4) =$	3.54	p-val.	0.47
	Normality	$\chi^2(4) =$	4.31	p-val.	0.36
Morocco	Autocorrelation: Ljung-Box	$\chi^2(88) =$	101	p-val.	0.16
	LM ₁	$\chi^2(4) =$	7.06	p-val.	0.13
	LM ₄	$\chi^2(4) =$	1.97	p-val.	0.74
	Normality	$\chi^2(4) =$	3.23	p-val.	0.52
Syria	Autocorrelation: Ljung-Box	$\chi^2(76) =$	95.6	p-val.	0.06
	LM ₁	$\chi^2(4) =$	1.31	p-val.	0.85
	LM ₄	$\chi^2(4) =$	2.26	p-val.	0.68
	Normality	$\chi^2(4) =$	8.34	p-val.	0.08
Turkey	Autocorrelation: Ljung-Box	$\chi^2(84) =$	0.57	p-val.	0.57
	LM ₁	$\chi^2(4) =$	2.24	p-val.	0.69
	LM ₄	$\chi^2(4) =$	5.18	p-val.	0.26
	Normality	$\chi^2(4) =$	9.54	p-val.	0.05

oil prices, and the second one to a RER depreciation due to a stabilization and structural adjustment process started in 1994 supported by the World Bank and the International Monetary Fund. In the case of Egypt, the dummy variable reflects the effects on the RER of a set of economic reforms initiated by president Mubarak. The restricted dummy variable picks up, for the case of Morocco, after a sudden fall in phosphate price during 1987, which is the most important commodity in the exports of this country. Finally, the dummy variable for Turkey is related to a shift in the monetary policy of the Central Bank of this country, with the aim of limiting the volatility of the currency as well as keeping the value of the Turkish Lira in real terms.

The estimated error correction models are presented in table 8. After testing for exogeneity in the commodity terms of trade, the null hypothesis could not be rejected, so that we have been able to reduce the system and to estimate just the RER equation (the so-called partial system) for each country. From table 8 it is possible to point out that the adjustment parameters¹⁴ are pretty small with the only exception of Turkey. It means that the shocks

¹⁴The t-Student statistics of the α parameters are below the critical value computed by Ericsson and Mackinnon (2002) of -3.25 (5%) to test for cointegration in error correction models.

Table 5: Johansen's stationarity tests

Countries	q_t	pc_t
Algeria	31.7 [0.00]	32.9 [0.00]
Egypt	7.30 [0.03]	6.22 [0.04]
Morocco	23.6 [0.00]	5.35 [0.07]
Syria	0.02 [0.88]	8.67 [0.00]
Turkey	17.1 [0.00]	13.6 [0.00]

Note: p-values are in brackets

Table 6: Trace test for the cointegration space

Countries	p-r	r	Eigenvalue	Trace	Trace*	P-val.	P-val*	CV 95	CV 90
Algeria	2	0	0.32	38.23	36.68	0.00	0.00	26.57	24.80
	1	1	0.02	1.57	0.78	0.85	0.96	12.77	11.57
Egypt	2	0	0.21	24.02	23.02	0.01	0.02	24.97	22.51
	1	1	0.02	1.53	1.19	0.86	0.91	12.22	10.47
Morocco	2	0	0.29	37.04	36.72	0.00	0.00	24.46	22.17
	1	1	0.05	4.57	4.55	0.35	0.35	12.14	10.28
Syria	2	0	0.32	38.97	36.01	0.00	0.00	19.99	17.79
	1	1	0.04	3.75	3.04	0.46	0.58	9.13	7.50
Turkey	2	0	0.20	29.24	28.14	0.00	0.00	24.76	22.33
	1	1	0.08	7.80	7.55	0.09	0.10	12.22	10.44

Note: The symbol * means Bartlett corrections. The last two columns are the simulated critical values when dummy variables are restricted in the cointegration space (except in the case of Syria that are standard critical values), using a simulation procedure developed by instructors at the 2003 Econometric Summer School in Copenhagen S. Johansen, K. Juselius, A. Rahbek and B. Nielsen.

Table 7: Identified cointegration vectors

Algeria	$q_t = 0.99pc_t + 1.35ds911_t + 1.69ds942_t$ (33.6) (4.55) (5.42)
Egypt	$q_t = 1.82pc_t + 1.65ds903_t$ (11.6) (1.73)
Morocco	$q_t = -0.56pc_t + 0.54ds871_t + 6.94$ (-1.12) (3.13) (3.02)
Turkey	$q_t = 0.99pc_t + 0.36ds924_t$ (146) (7.73)

Note: t-Student are given in parenthesis. ds_{xxy} is a dummy variable that takes 1 from 19xx:y to the end of the sample and 0 in the rest.

that affect RER last for a long time. Thus, the estimated life of shocks is quite long for Egypt and Morocco (17.2 and 8.5 years, respectively) whereas for Algeria and Turkey the half life of shocks is 5.6 and 0.7 years, respectively, very close to those estimated in the literature. The relatively large speed of mean reversion found for Turkey might be explained by the fact that Turkey has been a high inflation country (McNown and Wallace, 1989; Zhou, 1997).

Parameter constancy is checked using the recursive test procedures proposed by Hansen and Johansen (1999). Figure 2, shows the test of constancy of β (panel a) and of the loadings α (panel b) for Algeria. According to these tests the cointegration space is stable¹⁵.

Finally, in order to test the stability of the error correction model, we report the CUSUM test. As we can see from figure 2 panel (c) there are no stability problems, as the representation of the test remains within the confidence intervals¹⁶.

5 Concluding remarks

The relatively weak empirical evidence about PPP fulfillment found in the so-called MENA Countries has recommended to look for additional factors that may explain the shocks affecting the RER in the area. Based on the economic links that exist between these countries and the EU, as well as the important weight that primary products have in the bilateral trade, we have applied cointegration techniques to look for a long-run relationship between

¹⁵Similar results are obtained for the rest of the countries. Although we do not present them in the article, they are available upon request.

¹⁶Again, as the results for the other countries are very similar to those for Algeria, we do not report the graphs, that are available upon request.

Table 8: Estimated error correction models

Algeria:

$$\begin{aligned} \Delta q_t = & 0.14\Delta q_{t-1} - 0.03(ect)_{t-1} + 0.11d823_t - 0.11d824_t - 0.11d903_t - 0.35\Delta ds911_t \\ & \quad (3.07) \quad (-6.03) \quad (3.83) \quad (-3.77) \quad (-3.74) \quad (-11.7) \\ & - 0.21d914_t - 0.36\Delta ds942_t + 0.014sea_t - 0.03sea1_t - 0.034sea2_t + \hat{u}_t \\ & \quad (-7.07) \quad (-11.9) \quad (1.58) \quad (-3.26) \quad (-3.82) \end{aligned}$$

Autocorrelation: $F(5,77) = 0.54$, p-value = 0.74 ; Normality: $\chi^2(2) = 5.19$, p-value = 0.07
ARCH: $F(4,74) = 0.73$, p-value = 0.57 ; Heteroskedasticity (x_i^2): $F(10,71) = 0.49$, p-value = 0.88
Heteroskedasticity ($x_i x_j$): $F(11,70) = 0.45$, p-value = 0.92

Egypt:

$$\begin{aligned} \Delta q_t = & 0.15\Delta q_{t-1} + 0.07\Delta pc_t - 0.01(ect)_{t-1} - 0.34d893_t - 0.66\Delta ds903_t - 0.25d911_t \\ & \quad (2.84) \quad (1.67) \quad (-4.66) \quad (-7.20) \quad (-12.9) \quad (-5.05) \\ & + 0.23d924_t + 0.03sea_t + 0.03sea1_t + 0.012sea2_t + \hat{u}_t \\ & \quad (4.81) \quad (2.17) \quad (2.52) \quad (0.85) \end{aligned}$$

Autocorrelation: $F(5,78) = 0.19$, p-value = 0.96; Normality: $\chi^2(2) = 2.77$, p-value = 0.25
ARCH: $F(4,75) = 0.75$, p-value = 0.56 ; Heteroskedasticity (x_i^2): $F(10,72) = 0.93$, p-value = 0.50
Heteroskedasticity ($x_i x_j$): $F(13,69) = 0.87$, p-value = 0.58

Morocco:

$$\begin{aligned} \Delta q_t = & 0.06\Delta pc_t + 0.22\Delta q_{t-1} - 0.02(ect)_{t-1} - 0.05d811_t - 0.05d852_t - 0.06d902_t \\ & \quad (1.64) \quad (2.68) \quad (-4.40) \quad (-3.63) \quad (-3.59) \quad (-4.35) \\ & - 0.004sea_t - 0.01sea1_t - 0.008sea2_t + \hat{u}_t \\ & \quad (-0.97) \quad (-2.66) \quad (-2.00) \end{aligned}$$

Autocorrelation: $F(5,80) = 0.64$, p-value = 0.66 ; Normality: $\chi^2(2) = 1.40$, p-value = 0.49
ARCH: $F(4,74) = 0.70$, p-value = 0.59 ; Heteroskedasticity (x_i^2): $F(9,75) = 0.64$, p-value = 0.75
Heteroskedasticity ($x_i x_j$): $F(12,72) = 0.52$, p-value = 0.89

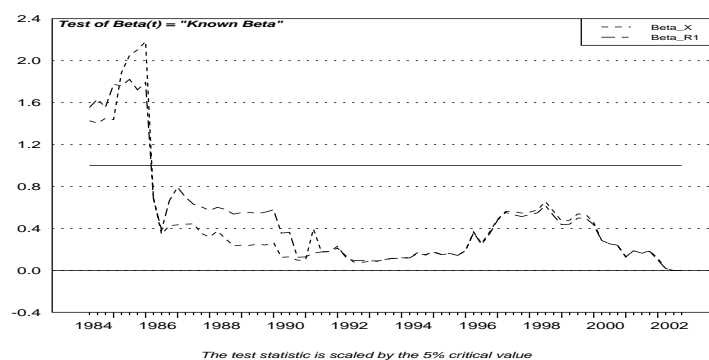
Turkey:

$$\begin{aligned} \Delta q_t = & 0.12\Delta q_{t-1} - 0.21(ect)_{t-1} - 0.28d801_t + 0.21\Delta ds924_t - 0.31d942_t - 0.02sea_t \\ & \quad (1.57) \quad (-3.96) \quad (-4.74) \quad (3.66) \quad (-5.26) \quad (-1.26) \\ & - 0.03sea1_t - 0.048sea2_t + \hat{u}_t \\ & \quad (-2.06) \quad (-2.85) \end{aligned}$$

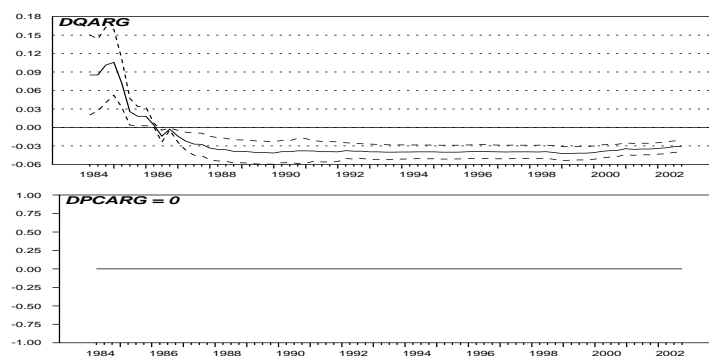
Autocorrelation: $F(5,80) = 1.01$, p-value = 0.41 ; Normality: $\chi^2(2) = 5.83$, p-value = 0.05
ARCH: $F(4,77) = 3.02$, p-value = 0.02 ; Heteroskedasticity (x_i^2): $F(7,77) = 0.87$, p-value = 0.53
Heteroskedasticity ($x_i x_j$): $F(8,76) = 1.01$, p-value = 0.39

Note: *ect* is the error correction term, *sea*, *sea1* and *sea2* are three centered seasonal dummies and \hat{u}_t are the estimation residuals. *dsxx* is a dummy variable that takes 1 from 19xx:y to the end of the sample and 0 otherwise, while *dxx* is a dummy variable that takes 1 in 19xx:y and 0 otherwise. t-Student statistics are reported in parenthesis.

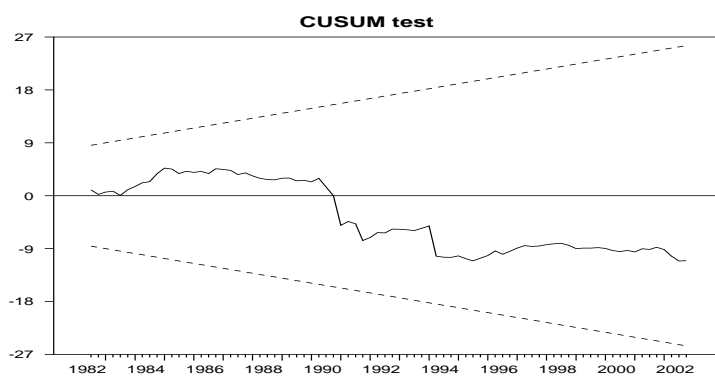
Figure 2: Structural stability tests for Algeria



(a) β stability test



(b) α stability test



(c) CUSUM test

the RER against the EU and a commodity-based terms of trade variable.

Some conclusions can be drawn from the obtained empirical results. First, that the assumption, commonly maintained in the theoretical models, of weak exogeneity of the commodity terms of trade is confirmed by the data. Second, that the link between the two variables, RER and commodity terms of trade is positive (with the exception of Morocco), so that an improvement in the latter appreciates the currency, as predicted by the theory. Third, a stable cointegration relation and error correction model has been estimated for four countries in the area: Algeria, Egypt, Morocco, and Turkey. Finally, concerning the half life of the shocks affecting the real exchange rate (and derived from the error correction model) although Algeria and Turkey do not present signs of persistence, it is still relatively large for Egypt and Morocco.

A Dummy variables

The dummy variables included for each country are the following¹⁷:

Algeria: d823, d824, d861, d891, d903, ds911, d914, ds942, d992;

Egypt: d861, d891, d893, ds903, d911, d924, d992;

Morocco: d801, d811, d852, ds871, d902, d931;

Syria: d861, d881, d903, d911, d992;

Turkey: d801, ds924, d942;

where $d_{xxy} = 1$ in 19xx:y and 0 otherwise ('blip' dummy), and $ds_{xxy} = 1$ from 19xx:y to the end of the sample and 0 otherwise ('step' dummy)¹⁸.

¹⁷Due to socio-political shocks it is necessary to intervene the models with a number of dummies.

¹⁸'Step' dummy variables are restricted to the cointegration space and appear in first differences in the dynamics. 'Blip' dummies are not restricted.

References

- Amano, R. A. and S. Van Norden (1995): “Terms of trade and real exchange rates: The Canadian evidence”, *Journal of International Money and Finance*, vol. 14, pp. 83–104.
- Amano, R. A. and S. Van Norden (1998a): “Exchange rates and oil prices”, *Review of International Economics*, vol. 6, pp. 683–694.
- Amano, R. A. and S. Van Norden (1998b): “Oil price and the rise and fall of the US real exchange rate”, *Journal of International Money and Finance*, vol. 17, pp. 299–316.
- Backus, D. K. (1984): “Empirical models of the exchange rate: Separating the wheat from the chaff”, *Canadian Journal of Economics*, vol. 17, pp. 824–846.
- Blundell-Wignall, A. and R. G. Gregory (1990): “Exchange rate policy in advanced commodity exporting countries: The case of Australia”, Working Paper 83, OECD Economics and Statistics Department.
- Camarero, M., J. C. Cuestas and J. Ordóñez (2003): “La paridad del poder adquisitivo en los Países Terceros Mediterráneos”, Mimeo.
- Camarero, M., J. Ordóñez and C. Tamarit (2005): “The Euro-Dollar exchange rate: is it fundamental?”, in *Exchange rate economics*, The MIT Press, Cambridge, pp. 277–306.
- Cashin, P., L. Céspedes and R. Sahay (2004): “Commodity currencies and the real exchange rates”, *Journal of Development Economics*, vol. 75, pp. 239–268.
- Chen, Y.-C. and K. Rogoff (2003): “Commodity currencies”, *Journal of International Economics*, vol. 60, pp. 133–160.
- Connolly, M. and J. Devereux (1992): “Commercial policy, the terms of trade, and the real exchange rate”, *Oxford Economic Papers*, vol. 44, pp. 507–512.
- Dungey, M. (2004): “Identifying terms of trade effects in real exchange rate movements: evidence from asia”, *Journal of Asian Economies*, vol. 15, pp. 217–235.
- Edwards, S. (1985): “Commodity export prices and the real exchange rate in developing countries: Coffee in Colombia”, Working Paper 1570, NBER.

- Ericsson, N. R. and J.G. MacKinnon (2002): “Distributions of error correction tests for cointegration”, *Econometrics Journal*, vol. 5, pp. 285–318.
- Evans, M. D. D. and J. R. Lothian (1993): “The response of exchange rates to permanent and transitory shocks under floating exchange rates”, *Journal of International Money and Finance*, vol. 12, pp. 563–586.
- Gonzalo, J. (1994): “Five alternative methods of estimating long-run equilibrium relationships”, *Journal of Econometrics*, vol. 60, pp. 203–233.
- Gregory, A. W. and B. E. Hansen (1996): “Tests for cointegration in models with regime and trend shifts”, *Oxford Bulletin of Economics and Statistics*, vol. 58, no. 3, pp. 555–560.
- Gruen, D. and J. Wilkinson (1994): “Australia’s real exchange rate -Is it explained by the terms of trade or by real interest differentials?”, *Economic Record*, vol. 70, pp. 204–219.
- Hansen, H. and S. Johansen (1999): “Some tests for parameter constancy in cointegrated VAR-models”, *Econometrics Journal*, vol. 2, pp. 306–333.
- Issa, R., R. Lafrance and J. Murray (2006): “The Turning Black Tide: Energy Prices and the Canadian Dollar”, Working Paper 2006-29, Bank of Canada.
- Johansen, S. (1988): “Statistical analysis of cointegrated vectors”, *Journal of Economic Dynamic and Control*, vol. 12, pp. 231–254.
- Johansen, S. (1991): “Estimation and hypothesis of cointegration vectors in gaussian vector autoregressive models”, *Econometrica*, vol. 59, pp. 1551–1580.
- MacDonald, R. and M. P. Taylor (1992): “Exchange rate economics: A survey”, *IMF Staff Papers*, vol. 39, pp. 1–57.
- MacDonald, R. and M. P. Taylor (1994): “The monetary model of the exchange rate: long-run relationships, short-run dynamics and how to beat the random walk”, *Journal of International Money and Finance*, vol. 13, pp. 276–290.
- McNown, R. and M. Wallace (1989): “National price levels, purchasing power parity and cointegration: A test of four high inflation economies”, *Journal of International Money and Finance*, vol. 8, pp. 533–545.
- Meese, R. A. (1990): “Currency fluctuations in the post-Bretton Woods era”, *The Journal of Economic Perspectives*, vol. 4, pp. 117–134.

- Meese, R. A. and K. Rogoff (1983): “Empirical exchange rate models of the seventies: do they fit out of sample?”, *Journal of International Economics*, vol. 14, pp. 3–24.
- Mussa, M. (1990): “Exchange rates in theory and in reality”, *Essays in International Finance*, vol. 179, Princeton University Department of Economics and International Finance Section, Princeton, New Jersey.
- Neary, P. (1988): “Determinants of the equilibrium real exchange rate”, *The American Economic Review*, vol. 78, pp. 210–215.
- Rogoff, K. (1996): “The purchasing power parity puzzle”, *Journal of Economic Literature*, vol. 34, pp. 647–668.
- Sarno, L. (2000): “Real exchange rate behaviour in the Middle East: A re-examination”, *Economics Letters*, vol. 66, pp. 127–136.
- Zhou, S. (1997): “Purchasing power parity in high-inflation countries: A cointegration analysis of integrated variables with trend breaks”, *Southern Economic Journal*, vol. 64, pp. 450–467.