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Equilibrium Exchange Rate and Misalignment
In Selected MENA Countries

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Abstract

The purpose of this paper is to estimate the equilibrium real exchange rate and derive the degree of misalignment for five MENA currencies: the Algerian Dinar, the Moroccan Dirham, the Egyptian Pound, the Tunisian Dinar and the Turkish lira. Exchange rate policy represents a key tool in macro-economic management and dominates the public policy debate today. How to assess whether exchange rate is undervalued or overvalued with respect to its equilibrium value is clearly at the heart of this debate. An extensive analysis of the degree of misalignment of the five currencies is undertaken on the basis of detailed country specific data. Overall, our results pick up almost perfectly the exchange rate policy episodes in the five countries. Our estimates suggest that the five countries exhibited some level of overvaluation during the last years of our sample period. If this trend were to continue, policy-makers would need to react either through a nominal devaluation or by adapting exchange rate policy to the new international economic and financial context.

1. INTRODUCTION

The purpose of this paper is to estimate the equilibrium real exchange rate and derive the degree of misalignment for five MENA currencies: the Algerian Dinar, the Moroccan Dirham, the Egyptian Pound, the Tunisian Dinar and the Turkish lira.

There is a consensus in the literature on the critical importance of the real exchange rate in macroeconomic management in developing countries. However, there is less consensus on the theoretical meaning of equilibrium real exchange rate, and on how to estimate it practically.

This paper computes a real effective exchange rate index for the five countries with respect to their main European trading partners. It implements a "model-based approach" in the spirit of Equilibrium Real Exchange Rate (ERER) first put forward by Edwards (1994), and Elbadawi (1994). The theoretical part shows how a simple reduced form can be derived from a rich structure that accounts for economic agents' expectations. The empirical part deals with the relationship between real exchange rate and economic fundamentals in the five countries.

The rest of the paper is organized as follows. An overview of the literature on the meaning and the estimation of equilibrium real exchange rate are presented in section two. In section three, a simple testable reduced form that captures the changes in economic fundamentals is derived. Section four examines the empirical results. The final section concludes.

2. LITERATURE REVIEW

The most widely used approach in estimating real exchange rate misalignment is indisputably the Purchasing Power Parity-based approach (PPP). The implementation of real exchange rate targeting policy has been usually based on PPP. Despite its simplicity, PPP approach relies on the unconfirmed law of one price built upon perfect market arbitrage argument. In addition, PPP approach can lead to misleading estimates because it fails to capture changes in equilibrium real exchange rate caused by factors other than price differentials between domestic and foreign countries.

The parallel market premium based approach is the second widely used approach, particularly in LDCs context. Typically, the authorities set an official exchange rate and an unofficial or parallel rate is driven by market

forces to meet the demand of agents who are legally constrained on the official market. The empirical evidence suggests that parallel market premium is far more volatile than deviations of observed rates from their equilibrium values (Montiel and Ostry 1994). Therefore, it is risky and inappropriate to assess the degree of misalignment by relying exclusively on such a measure.

The third stream of research on the determination of equilibrium real exchange rate is known as "model-based approaches". The main contribution of this body of work is to put forward the need to capture explicitly the economic factors in estimating equilibrium real exchange rate. The literature has proceeded in two separate directions. The first one includes Williamson's (1994) Fundamental Equilibrium Exchange Rate (FEER) concept, the IMF's (1994) Desirable Equilibrium Exchange Rate (DEER) concept and Stein's (1994) Natural Exchange Rate (NATREX) concept. The second direction consists of Edwards (1989, 1994) and Elbadawi (1994) and their concept of Equilibrium Real Exchange Rate (ERER).

The FEER, as defined by Williamson, is the real exchange rate that is expected to generate a current account balance equal to the underlying capital flow over the cycle, given that the country is pursuing internal balance. The DEER concept refers to the real exchange rate consistent with achieving a set of macroeconomic objectives (Bayoumi et al. 1994). Stein (1994) defines the NATREX concept as the real exchange rate that would prevail if speculative and cyclical factors could be removed while unemployment is at its natural rate.

The first common characteristic of the three concepts is that they rely on the Mundell-Fleming (M-F) model. The key property of this model is that the domestic economy's terms of trade are endogenous, since the home country is assumed to be large enough to be a price maker in the market for its exportable good (Agénor and Montiel 1999). As a result, the three concepts are more suitable for industrial countries than for LDCs countries.

The second feature of the (FEER), (DEER) and (NATREX) is their use of simultaneous equations structural models. By doing so, they capture macroeconomic interactions and allow for potential feedback among variables.

Nonetheless, this choice does not rule out a variety of drawbacks. The estimation of multi-equation macroeconomic models is extremely

demanding in terms of economic theory, of the power of statistical techniques, and of the availability and the quality of data (Ahlers and Hinkle 1999). In addition, the simulation results using large macro-econometric models have been short of robustness even for industrialized countries (Williamson 1994)¹.

In Edwards' and Elbadawi's framework, real exchange rate is defined as the relative price of tradable to non-tradable goods. This definition is more in line with a small open economy that exerts little control on its terms of trade. Edwards' model allows for both real and nominal factors to play in the short-run, but only real factors, the fundamentals, have an effect on ERER in the long run. In the short run, real exchange rate is affected by macroeconomic policies such as an excess supply of domestic credit, a fiscal deficit or a nominal devaluation. Edwards' empirical evidence shows that inconsistent macroeconomic policies lead to real exchange rate overvaluation and that nominal devaluation can be a prominent tool to hasten the adjustment process towards RER equilibrium².

Elbadawi (1994) adopts the concept of ERER and puts more emphasis on its inter-temporal nature. He uses co-integration techniques to estimate ERER for three countries (Chile, Ghana and India) over the period 1965-90.

3. TESTABLE VERSION OF REAL EXCHANGE RATE

3.1. RER as a forward-looking function of the fundamentals

There is a consensus in the literature that the most important fundamentals are: the international terms of trade (TOT), import tariffs (τ), government expenditure in non-tradable goods (G_N), net capital flows (NCF) and technological progress (TECH). For convenience, equilibrium RER is taken as a linear forward-looking function of the fundamentals.

¹ Using six multi-country macro-econometric models, Williamson estimated the FEER for G7 currencies (US \$, Yen, Deutsch Mark, French Franc, Pound, Lira and Canadian dollar). The results were disappointing, since the degree of variation among the estimates ranges between 13 percent for the FF, 20 percent for the US \$, 23 percent for the pound, 26 percent for the DM and 46 percent for the lira.

² The coefficient of nominal devaluation ranges from 0.47 to 0.7, which means that between 47% and 70% of nominal devaluation is converted into real devaluation in the first year. (Edwards 1989).

At any period t , only current and future expected values of the fundamentals matter in a decreasing scheme in real exchange rate determination.

$$RER_t = \alpha_0 + \alpha \text{TOT}_t + \alpha \delta \text{TOT}_{t+1} + \dots + \alpha \delta^{T-t} \text{TOT}_T + \beta \tau_t + \beta \delta \tau_{t+1} + \dots + \beta \delta^{T-t} \tau_T + \dots + \eta \text{NCF}_t + \eta \delta \text{NCF}_{t+1} + \dots + \eta \delta^{T-t} \text{NCF}_T + \theta \text{TECH}_t + \theta \delta \text{TECH}_{t+1} + \dots + \theta \delta^{T-t} \text{TECH}_T + \gamma \text{G}_N + \gamma \delta \text{G}_{N,t+1} + \dots + \gamma \delta^{T-t} \text{G}_{N,T} + \varepsilon_t$$

where the parameter $(0 \leq \delta \leq 1)$ reflects respective decreasing weights in RER determination.

This equation is assumed to hold for any period t , $(t=1, 2, \dots, T)$. By writing the equation for RER_{t+1} , and taking $RER_t - \delta RER_{t+1}$ we get:

$$RER_t - \delta RER_{t+1} = \lambda + \alpha \text{TOT}_t + \beta \tau_t + \eta \text{NCF}_t + \theta \text{TECH}_t + \gamma \text{G}_N + \xi_t$$

where $\lambda = \alpha_0 (1 - \delta)$ and $\xi_t = \varepsilon_t (1 - \delta)$.

The RER can be then solved forward by recursive substitution. By denoting the vector of parameters by Γ and by F the vector of the fundamentals.

$$\Gamma = (\lambda, \alpha, \beta, \eta, \theta, \gamma) \text{ and } F = (1, \text{TOT}, \tau, \text{NCF}, \text{TECH}, \text{G}_N)$$

The forward-looking expression of RER by assuming that T goes to infinity, is given by:

$$RER_t = \sum_{k=0}^{\infty} \delta^k \Gamma' F_{t+k}$$

Under the condition of stationarity in first differences of the fundamentals, the following cointegration relationship exists.

$$RER_t = \frac{1}{1 - \delta} \Gamma' F_t + \psi_t$$

where $(1/(1 - \delta))\Gamma'$ is the co-integration vector and ψ_t is a stationary error term.

3.2. Potential effects of exogenous shocks to the fundamentals

The purpose here is to discuss the expected effects of exogenous shocks to the fundamentals on the behavior of real exchange rate.

An exogenous improvement in terms of trade exerts two effects on real exchange rate. It stimulates firms to produce more exportable and less non-tradable goods. As a result, the relative price of non-tradable goods goes up and an appreciation of real exchange rate takes place. At the same time, domestic expenditure switches from domestic to importable goods due to the "substitution effect". On the other hand, a positive shock on terms of trade improves the trade balance and generates an "income effect" that results in a higher demand for non-tradable goods. To restore internal equilibrium real exchange rate depreciates. The total effect is unclear. Empirical literature, however, tends to report an appreciation of the real exchange rate following an improvement in terms of trade³.

An outward-oriented policy is expected to depreciate real exchange rate. In fact, by reducing tariffs, foreign goods become more attractive diverting domestic expenditure from non-tradable goods. As a result trade balance deteriorates. To bring equilibrium back, real exchange rate needs to depreciate. Nevertheless, this may not be enough if a large proportion of imports is used as inputs in exportable goods.

Net capital flows defined as the net foreign borrowing are expected to generate two effects. The direct effect leads to an excess demand for non-tradable goods⁴. That results in an appreciation of real exchange rate. The indirect effect takes place through the supply side of the economy by switching production from exportable goods to non-tradable ones and hence causing worsening of the trade balance. To re-establish equilibrium, real exchange rate needs to depreciate. Empirical evidence tends to support that a surge of capital flows into the country leads to a real appreciation of the exchange rate.

With regard to the effect of an increase in government consumption of non-tradables, the most widely documented finding is consistent with a real exchange rate appreciation. The argument is straightforward. An excess demand in the non-traded sector leads to a higher price of non-tradables, which appreciates the real exchange rate. However, this

³ The magnitude of the substitution effect depends on the price elasticity of the demand for imports and the magnitude of income effect depends on the price elasticity of the demand for exports. A higher TOT appreciates RER to the extent that it improves the trade balance. The presence of so called 'Dutch Disease' leads to the opposite result.

⁴ A higher capital flow leads also to a higher demand for importable goods.

argument leaves aside the issue of government consumption financing. If the Ricardian equivalence holds, higher government borrowing in the present means higher taxes in the future, and rational agents' adjust their consumption path by reducing their current demand for non tradables. In this case, the total effect is ambiguous.

4. EMPIRICAL FRAMEWORK

4.1 Data and proxies for fundamentals

Real exchange rate in our empirical framework refers to the real effective exchange rate index computed for each country with respect its European trading partners

$$\log RER = \sum_{j=1}^{10} \omega_j \log e_j (WPI_j CPI) \quad \Phi = 15.855 \quad T\phi = 1 \quad 0 \quad 0 \quad 1$$

(e_j) is the bilateral nominal exchange rate vis-à-vis country j, WPI_j is the wholesale price index of country j and proxies for the foreign price of tradable goods, CPI is the consumer price index of the home country and proxies for the domestic price of non-tradable goods, ω_j is the share of partner j in the home country's exports. Here we consider the eleven countries of Euroland. As Belgium and Luxembourg have a monetary union we end up with ten partners Trade shares are the averages over the whole period. Bilateral exchange rate data, wholesale price and consumer price indexes are drawn from IMF's International Financial Statistics. The weights are computed from CHELEM database (Harmonized Accounts on Trade and the World Economy database).⁵

The data on terms of trade (TOT) are constructed using the ratio of the price index of exports to the Euro zone to the price index of imports from the same zone. For commercial policy, the inward orientation indicator is defined as $[Y/(X+M)]$ - Y is GDP, X exports and M imports. Net capital flows are defined as increases in net foreign borrowing scaled by GDP. Total government consumption scaled by GDP is used as a proxy for non-tradable consumption by the government as no data are available on the latter variable. All variables, except net capital flows are taken in logarithm.

4.2. Stationarity tests and co-integration

⁵ CHELEM database, CEPII, Paris.

Table (1) reports unit root results of real exchange rate and its economic fundamentals. Two tests are performed: Augmented-Dickey Fuller (ADF) and Phillips-Perron (PP) tests. The test statistics show no evidence against the null hypothesis that there is a unit root in all the tested variables, but unambiguously reject non-stationarity in first differences. It follows that the real exchange rate and its economic fundamentals are integrated of order one.

The next step is to test for co-integration and to determine the co-integrating rank. The concept of co-integration raises two econometric questions. The first one is how to estimate the co-integrating vectors and the second is how to test whether the variables are co-integrated. The simplest way to answer these questions is to use Engle and Granger (1987) two-step procedure.⁶

Table (2) reports estimation results obtained from performing the first step of the Engle-Granger approach and shows the long-run parameter estimates obtained from OLS regression in levels.

OLS estimates are super-consistent but may be biased unless the R^2 is close to one. In our case, the quality of the fit provided by the co-integration equation is high enough for the five countries. It ranges between 0.83 for Egypt and 0.94 for Algeria and Tunisia.

⁶ Johansen method has several advantages. However, this method is extremely demanding in terms of the sample size, which makes it less robust than the single-equation alternatives to the selection of the lag length or the presence of serial correlation in the error correction component. Since our sample size is relatively short and contains no more than 28 observations for each country, we adopt the first two alternatives in investigating co-integration and estimating the error correction specification. We implement a set of specification and diagnostic tests to ensure that our results make sense.

Table 1. *Unit root Tests of Real Effective Exchange Rate and the Fundamentals*

		Level		First difference	
Country	Variable	ADF	PP	ADF	PP
Algeria	log RER	0.16	0.68	-4.19**	-3.71*
	log TOT	-1.57	-1.68	-3.21*	-4.98**
	log Close	-2.65	-1.73	-3.64*	-2.81#
	log GGDP	-1.70	-1.97	-3.20*	-5.55**
	NCF	-2.17	-2.22	-3.51*	-5.71**
Morocco	log RER	-0.82	-0.82	-2.09	-3.55*
	log TOT	-2.35	-2.05	-4.33*	-4.18**
	log Close	-2.93	-2.07	-3.61*	-4.80**
	log GGDP	-2.48	-2.08	-3.45*	-3.42*
	NCF	-2.58	-2.20	-3.87*	-3.99*
Tunisia	log RER	-0.92	-0.58	-3.25*	-2.84#
	log TOT	-2.04	-1.70	-3.91**	-3.93*
	log Close	-2.12	-1.95	-3.21*	-3.88*
	log GGDP	-1.93	-2.39	-3.80*	-5.50**
	NCF	-2.10	-3.24	-3.24*	-6.88**
Egypt	log RER	-2.52	-1.87	-3.68*	-3.36*
	log TOT	-1.61	-1.34	-2.95#	-3.30*
	log Close	-2.59	-2.17	-2.85#	-3.70*
	log GGDP	-0.42	-0.28	-5.51**	-7.62**
	NCF	-2.00	-2.11	-4.96**	-6.45**
Turkey	log RER	-0.52	-1.33	-2.94#	-6.53**
	log TOT	-0.99	-1.19	-4.83**	-6.61**
	log Close	-1.11	-1.32	-3.41*	-4.46**
	log GGDP	-1.84	-2.30	-2.73#	-5.51**
	NCF	-1.30	-1.97	-4.31**	-5.05**
Critical Values				ADF	PP
	1%			-3.75	-3.73
	5%			-3.00	-2.99
	10%			-2.64	-2.63

ADF: Augmented Dickey Fuller Test. PP: Phillips-Perron Test. (**), (*) (#) indicates respectively that the value of the statistic is significant at 1, 5 and 10 percent.

Chow's breakpoint test suggests that there are significant differences in real exchange rate behavior with respect to the fundamentals before and after 1985 for Morocco and 1986 for Tunisia. To overcome this problem a dummy variable (dum) corresponding to the breakpoint year has been incorporated into the regression.

ADF and PP test statistics suggest the stationarity of the estimated residuals. Since all both the dependent and the explanatory variables are integrated of order one, the stationarity of residuals provides the evidence for cointegration.

The estimated long-run parameters tend to support the theoretical expectations. The terms of trade coefficients are negative for the five countries and statistically significant except for Turkey. The negative sign implies that any improvement in the terms of trade leads to an appreciation of real exchange rate, suggesting that the "income effect" outweighs the "substitution effect".

The impact of an improvement in terms of trade on real exchange rate seems to be stronger in Morocco and Tunisia than in Algeria and Egypt. This difference may be explained by the structure of exports in these countries. The size of the "income effect" depends on the price elasticity of the demand for exports, which is higher for manufactured goods than for primary commodities. In Tunisia and Morocco average share of manufactured exports in total exports have reached 89 and 65 percent respectively over the period 1993-97 (IMF 1998). In Egypt and even more in Algeria oil remains by far the most important commodity exported. In addition, a recurrent feature in oil-exporting countries is to perceive drastic changes in oil prices as temporary and postpone real exchange rate adjustments (IMF 2000).

Table 2 *Long-Run Parameter estimates (Engle-Granger step one)*

	Algeria	Morocco	Tunisia	Egypt	Turkey
Constant	10.51 (8.02)	4.36 (2.42)	8.78 (5.85)	12.64 (7.59)	5.37 (6.69)
Log(TOT)	-0.57 (-7.98)	-1.03 (-3.43)	-1.15 (-4.58)	-0.63 (-2.01)	-0.10 (-0.65)
Log(Close)	-0.58 (-2.84)	-0.19 (-1.97)	-0.45 (-2.61)	-1.11 (-6.17)	-0.22 (2.32)
Log(GGDP)	-1.09 (-2.15)	-0.39 (-2.79)	-0.47 (-2.62)	-0.76 (-1.83)	-0.15 (-1.21)
NCF	-0.01 (-1.87)	-0.03 (-4.03)	-0.03 (-5.70)	-0.04 (-3.89)	-0.05 (-2.98)
Dum	-	0.28 (4.94)	0.31 (5.70)	-	-
Adj R ²	0.94	0.89	0.94	0.83	0.90
DW	1.56	1.34	1.26	1.51	1.67
Chow test	1.68 (0.19)	24.90 (0.00)	4.50 (0.01)	0.64 (0.70)	0.28 (0.94)
ADF	-4.26**	-3.71*	-3.27*	-3.46*	-3.98**

The dependent variable is log(RER). Dum is a dummy variable that takes 0 before 1985 and 1 after for Morocco, and 0 before 1986 and 1 after for Tunisia. The period of estimation is 1970-97. The numbers within the brackets refer to t-statistics. DW is the Durbin-Watson statistic.

The estimated coefficients of closeness indicator are negative as predicted by the theory, suggesting that the process of opening up of economy by implementing trade liberalization reforms deteriorates the trade balance forcing real exchange rate to depreciate. The sensitivity of real exchange rate to openness appears to be extremely high in Egypt and relatively low in Turkey and Morocco. Even though the implied elasticities offer interesting insights on exchange rate policy responses; they may not reliably reflect the potential effects of trade liberalization due to the imperfect proxy used to measure the inward indicator.

The estimated coefficients on government consumption scaled by GDP are negative and statistically significant except in Turkey and at lesser extent in Egypt. This negative sign tends to corroborate the fact that an increase in the demand for non-tradables by the government leads to a higher price of non-tradables, which appreciates real exchange rate. The size of the impact as suggested by the elasticity of the real exchange rate is globally consistent with the relative importance of the government sector in the five countries.

Finally, an increase in net capital flows appreciates the real exchange rate, which means that the direct effect of net capital flows on the price of non-tradables offsets its indirect effect on trade balance. Hence, domestic absorption increases and the composition of output shifts in favor of non-traded sector. The degree of responsiveness of real exchange rate to the net capital flows seems to be high in Turkey and Egypt, moderate in Morocco and Tunisia and relatively weak in Algeria. This finding may be explained by the fact that Turkey and Egypt have already liberalized their capital account and attract more flows than the three other countries.

Table (3) reports the adjustment speed and the short-run parameters from the error correction specification as suggested by the second step of the Engle and Granger procedure.

The results show that the error correction term, which measures the speed of adjustment of real exchange rate to its equilibrium level, is invariably significant in all countries. The estimated coefficients indicate that about 40 to 66 percent of deviations of real exchange rate from its equilibrium level are corrected within the subsequent year.

The adjustment speed appears to be high in Algeria, Turkey and Egypt, and relatively low in Tunisia and Morocco. One plausible explanation is associated with the difference in exchange rate regimes adopted in these countries. Flexible (Egypt and Turkey) and managed (Algeria and Tunisia) exchange rate regimes tend to adjust faster than a fixed exchange rate regime (Morocco).

From these estimates, the average duration required to eliminate 75 percent of a shock to real exchange rate is 15 months for Algeria, 19 months for Turkey, 20 months for Egypt, 24 months for Tunisia and as long as 32 months for Morocco.

The short-run effects of a nominal devaluation on the real exchange rate are captured in the error correction model through the inclusion of the variable (ΔNER). This variable refers to the change in nominal exchange rate undertaken by policy-makers to realign real exchange rate. The positive sign of the estimated coefficient of (ΔNER) suggests that in the five countries, the devaluation has not produced any perverse effects. The real exchange rate tends, on average, to depreciate soon after the devaluation.

The magnitude of the estimated coefficient points out the proportion of a nominal devaluation that passes through to real exchange rate depreciation

over one-year horizon. Our estimates suggest that the degree of pass-through ranges between 12 percent in Turkey and 47 percent in Egypt. Slightly more than one quarter of a nominal devaluation passes through to a real exchange rate depreciation for Algeria and about one fifth for Morocco and Tunisia.

Theoretically, a nominal devaluation can play a crucial role in bridging the gap between actual real exchange rate and its equilibrium level, and by doing so improves the current account balance.

Table 3. *Adjustment Speed and Short-Run Parameter Estimates (Engle-Granger step two)*

	Algeria	Morocco	Tunisia	Egypt	Turkey
EC(t-1)	-0.66 (-3.53)	-0.41 (-4.05)	-0.50 (-2.39)	-0.56 (-4.24)	-0.58 (-3.16)
$\Delta \log(\text{TOT})$	-0.21 (-1.51)	0.04 (0.33)	-0.39 (-1.33)	-0.31 (-1.50)	0.02 (0.23)
$\Delta \log(\text{Close})$	-0.36 (-1.53)	-0.10 (-1.43)	-0.10 (-0.50)	-0.25 (-1.54)	-0.14 (-1.42)
$\Delta \log(\text{GGDP})$	-0.47 (-1.25)	-0.04 (-0.53)	0.20 (1.02)	-0.48 (-1.94)	-0.31 (-2.33)
ΔNCF	-0.07 (-0.87)	-0.23 (-1.04)	-0.20 (-0.37)	-0.92 (-1.98)	0.06 (0.67)
ΔNER	0.27 (2.83)	0.18 (4.28)	0.19 (2.24)	0.47 (3.13)	0.12 (3.10)
Adj R ²	0.75	0.51	0.35	0.85	0.58
DW	1.17	2.30	1.39	1.90	1.77
Average duration to eliminate the effects of an exogenous shock to RER (in months)					
25 percent	3	7	5	4	4
50 percent	8	16	12	10	10
75 percent	15	32	24	20	19
99 percent	51	105	80	67	64

The dependent variable is $\Delta \log(\text{RER})$. The period of estimation is 1970-97. The numbers within the brackets refer to t-statistics. The coefficient associated with EC(t-1) is the speed of adjustment of the error correction term. Newey and West (1987) heteroskedasticity and serial correlation consistent estimates are used to obtain adjusted standard errors of the estimates.

However, the impact of devaluation depends on the size of nominal rigidities in the economy. When domestic prices and wages adjust quickly, any change in nominal exchange rate is largely offset by domestic inflation. Furthermore, a nominal devaluation brings about large and long-lasting effects on the real exchange rate only if a very restrictive monetary policy is implemented jointly with the devaluation (Edwards 1989). It has also been shown that the effectiveness of a nominal devaluation depends

on the credibility of policy makers and the ability of economic agents to expect the devaluation (Horn and Persson 1988).

4.3. Equilibrium exchange rate

So far we have estimated the relationship between real exchange rate and economic fundamentals. To assess the size of misalignment, the aim of the next step is to determine the equilibrium value of real exchange rate (ERER) over the sample period using the long-run parameter estimates and sustainable values of the fundamentals.

There are a number of different ways to compute the long-run sustainable values of the fundamentals. Time series decomposition methods (Beveridge-Nelson technique, moving-average and exponential moving average procedures, Hodrick-Prescott filter and Gonzalo-Granger technique) are the most commonly used approaches.

The basic principle of time series decomposition methods is that any non-stationary time series can be decomposed into permanent and transitory components. If a shock hits the permanent component, the effects should persist over time; hence the permanent component is a random walk. The transitory component is identified as the cyclical variation, which is expected to dissipate as the series tends to its permanent level.

The main pitfall of time series decomposition methods is to assume that any persistent shock is sustainable while any transitory shock is unsustainable. It is perfectly possible to argue that some permanent shocks to the fundamentals are not sustainable. This is particularly the case in developing countries, where macroeconomic imbalances tend to last for a long period of time.

An alternative approach to better characterize the concept of sustainability of the fundamentals is to search for desirable values for policy variables as suggested by Cottani, Cavalo and Khan (1990) and Baffes, Elbadawi and O'Connell (1999). The implementation of this alternative requires normative judgments to be made to replicate the level of sustainable fundamentals under policy-makers control.

In our long-run model, net capital flows, government consumption, and closeness indicator are policy-variables, they can be affected by policy-makers decisions. The observed levels of these variables may not correspond to sustainable levels. Conversely, terms of trade can be assumed as an exogenous non-policy variable. This assumption relies on

the fact that prices are set in international markets and individual MENA countries are price takers rather than price makers.

Net capital flows (NCF) are defined as increases in foreign borrowing, transfers and aid, minus net factor payments. Foreign borrowing is not a problem as long as it is financed on acceptable terms and used to raise capital stock and therefore future output. The country gets into trouble if the cost of external finance is high or if it spends borrowed resources on consumption rather than on investment (Kenen 2000). Actual net capital flows can then be compared to theoretically predicted ones in order to judge whether they have been sustainable or not. Practically, in years where the real cost of credit was lower than real economic growth, the observed values of NCF are considered as sustainable. However, in years where the real cost of credit exceeded expected growth, the observed values of NCF were regarded as excessive⁷.

As far as the government consumption is concerned, sustainable values are determined on the basis of sustainable values of the degree of openness (or the degree of closeness) using the benchmark results suggested by Rodrik (1998). First, we used five-year moving averages for the closeness indicator to filter out transitory shocks. We then compute the corresponding values of government consumption as a proportion of GDP.

Although a great deal of arbitrariness still enters into our calculations of the sustainable component of the fundamentals, the approach presented has several advantages. First, it does not use residuals-based estimates of misalignment assuming that RER has been, on average, in equilibrium during the estimation period. It also avoids a mechanical use of time series decomposition methods to extract the permanent component of the fundamentals. It allows the investigation of the sensitivity of the equilibrium RER with respect to the sustainable values of the fundamentals to be undertaken in a more transparent way.

4.4 Implied misalignment

Real exchange rate misalignment is defined as the percentage difference between the estimated equilibrium RER and the actual values of RER. This definition ensures that a positive (negative) value of misalignment will refer to an overvaluation (under-valuation).

⁷ Cavallo, Cottani and Khan (1990) for more details.

The size of misalignment can be decomposed into two components. The first one is the error correction term that captures the deviations of actual real exchange rate from the fitted values of real exchange rate as obtained from the first step of the Engle-Granger procedure. This component is sometimes used, wrongly, to estimate the degree of misalignment. The second component captures the gap between the actual values of the fundamentals and their long-run sustainable values.

Table (4) reports the size of misalignment of real exchange rate for the five countries over the period 1985-97 using sustainable values of the fundamentals as computed on the basis of the explanations given earlier.

For the Algerian Dinar (DA), our results indicate a degree of overvaluation under control up to 1987. Subsequently, the overvaluation of the DA increased substantially due mainly to a worsening in terms of trade and a deterioration in the current account position after the sharp decline of oil prices in 1986.

The large budget deficit financed by money creation resulted in inflationary pressures and an overvalued exchange rate. The gap between the equilibrium and actual real exchange rate stood at 66 percent in 1989 and 56 percent in 1990 despite a temporary oil price recovery related to the Gulf war. To face these macroeconomic imbalances, the Dinar has been downgraded 16 percent in 1989, 34 percent in 1990 and 43 percent in 1991 (World Currency Yearbook 1996). In addition, Algeria adopted a liberalization program in 1992-93 soon boosted by the implementation in 1994 of a stabilization and adjustment program supported by the IMF and the World Bank. The improvement of oil prices in 1996-97 contributed significantly to restoring external imbalances. By 1997, the degree of overvaluation of the Algerian Dinar real exchange rate fell to 6 percent.

Table 4. *Model-based misalignment of real exchange rate (1985-97)*

	Algeria	Morocco	Tunisia	Egypt	Turkey
1985	5	3	-3	28	67
1986	5	-1	-7	37	46
1987	6	-5	-8	46	33
1988	35	0	-9	45	29
1989	66	4	-7	22	24
1990	56	-8	1	18	13
1991	26	-7	6	14	9
1992	22	-5	9	5	5
1993	9	-3	11	3	4
1994	18	-2	9	2	-15
1995	17	1	4	2	5
1996	11	3	4	8	8
1997	6	7	5	14	7

Real exchange rate misalignment is computed as $\exp[(\text{Mis})-1]$. A positive (negative) value of misalignment refers to an exchange rate overvaluation (undervaluation).

Compared to the Algerian Dinar, the deviation of the Moroccan Dirham (DH) from its equilibrium value is much less worrying. According to our computation, the real exchange rate was undervalued 5 percent in 1987 and exactly valued in 1988.

Morocco experienced real growth of 10.4 percent and a current account surplus in 1988 (World Bank 2000). This expansion was short-lived since the economy slowed in the subsequent years and the current account surplus turned into deficit due the worsening in terms of trade. Morocco's real exchange rate appears to be overvalued by 4 percent in 1989, although nominal exchange rate of the DH was officially devalued by 8.9 percent during this year.

In 1990, Moroccan authorities forced a second devaluation of 9.3 percent. By the end of this year, our estimates indicate that Morocco's real exchange rate was undervalued by 8 percent. Although, the undervaluation lasted for several years (1990-94), its effects in promoting exports and FDI and providing incentives to restructuring the industrial sector are questionable. Current account deficit to GDP stood at 2.4 percent in 1994 and 4.7 percent in 1995.

A steady appreciation took place in the subsequent years partly as a result of Morocco's economic fundamentals worsening owing to the high frequency of drought years. Overall, equilibrium real exchange rate had

appreciated by 15 percent between 1990 and 1997, starting from an undervaluation of 8 percent in 1990, and ending by an overvaluation of 7 percent in 1997.

The Tunisian Dinar (D) experienced a significant appreciation during the late seventies and early eighties. To deal with this issue, the Dinar was linked in 1978 to a basket including the French Franc (FF), the German Mark (DM) and the US dollar (USD). This basket was expanded soon after by adding the Italian Lira (ITL), the Belgian Franc (BEF) and later the Dutch Florin (NLG).

According to our estimates, Tunisia's real exchange rate indicates an under-valuation of 3 percent in 1985 with respect to its equilibrium level. The Central Bank went on a more aggressive exchange rate policy allowing the Dinar to depreciate by 10 percent in 1986 and a gradual depreciation was kept up until 1989.

Our calculations imply that Tunisia's real exchange rate was undervalued by 7.5 percent on average during the 1986-89 period. This strategy helped Tunisia to overcome the collapse of oil prices in 1986 (oil accounted for 47 percent of its export earnings)⁸ and to build drastically up its external competitiveness. In the mid-1990s, Tunisia's structure of exports changed markedly from primary commodities to manufactured products. The ratio of exports as a share of GDP grew from 10 percent in the mid-1980s to 20 percent in the mid-1990s. Thanks to a sustained growth (roughly 4 percent during the period 1992-97); Tunisia has been able to preserve its macroeconomic performance despite the apparent overvaluation of its real exchange rate.

The real exchange rate of the Egyptian Pound (LE) experienced high levels of overvaluation during the late eighties. Our estimates reveal that the gap between real exchange rate and its equilibrium level was roughly about 40 percent during the 1985-88 period.

This disturbing degree of misalignment on the foreign exchange market is the result of a high inflation rate (above 20 percent), large fiscal and current account deficits (15 and 8 percent of GDP respectively).

To preserve the external competitiveness, a series of nominal depreciation of the Egyptian Pound were implemented. In 1988, the rate was increased from 0.7 LE to LE 1.1 per USD. In 1990, the central pool bank rate was

⁸ The World Bank Group, Tunisia Country Page (2000).

changed twice, first to LE 2.0 and then to LE 3.0 per USD (Ilker and Shabsigh 1999).

In 1991, Egypt embarked on an IMF-supported program to deregulate prices and foreign trade, restructure the financial system and reorganize the public sector. At the same time, Egypt opted to use the exchange rate as a nominal anchor to enhance the stabilization effort (Subramanian 1997), and mitigate the time inconsistency problem faced by the policy-makers (Agénor and Montiel 1999). On the basis of our estimates, the degree of overvaluation started to dwindle, falling from 18 percent in 1990 to 14 percent in 1991 and stabilizing around 3 percent over the period 1992-95.

This sharp decline in the magnitude of exchange rate overvaluation is due to the noteworthy recovery in Egypt's macroeconomic balances. By the end of the sample period, inflation stood at 7 percent and the current account surplus as a share of GDP amounted to 3.4 percent due to the impact of debt rescheduling and forgiveness⁹. As a result, the Egyptian real exchange rate resumed a steady appreciation reaching a two-digit level in 1997.

Finally, our results suggest that the real exchange rate of the Turkish Lira (LT) is overvalued compared to its equilibrium level by 67, 46 and 33 percent in 1985, 1986 and 1987 respectively.

This appreciation in real exchange rate is mostly due to the excessive and persistent public sector deficits that generate high inflation rates (50 percent on average during the period 1985-89) and lead to balance-of-payment difficulties. In spite of these macro-economic imbalances, Turkey began to receive substantial capital inflows in late 1980s, following the strong outward-oriented strategy and the full liberalization of the capital account.

The effectiveness of purchasing power parity-based policy whereby, the nominal exchange rate is adjusted by accounting for inflation differentials reduces the size of overvaluation in the post-1990 period except for the 1994 crisis. A sharp devaluation of 63 percent and a high level of international reserve losses accompanied the crisis of the Turkish Lira that occurred in 1994. By the end of 1994, inflation stood at 125 percent, and real GDP growth at (-6) percent¹⁰. Our estimates indicate an undervaluation of real exchange rate by 15 percent in 1994 followed

⁹ The rescheduling of Paris Club debt during the period 1991-96, resulted in a cumulative reduction in the net present value of the outstanding foreign debt stock of 55 percent. (Mongardini 1998).

¹⁰ . Turkey: Selected Issues and Statistical Appendix, IMF (2000).

immediately by a steady appreciation averaging 6 percent over the period 1995-97.

5. CONCLUSIONS

Exchange rate policy represents a key tool in macro-economic management particularly in LDCs and dominates the public policy debate today. The recent reforms adopted in MENA countries aiming at opening up their economies to trade and capital flows and allowing much more weight to market mechanisms raise the need to reexamine the current exchange rate management. In particular, to assess whether an exchange rate is undervalued or overvalued with respect to its equilibrium value. How to estimate the degree of misalignment? How much does the unsustainability of fundamentals account for in this degree of misalignment? And how much can a devaluation help in achieving equilibrium?

These questions are indubitably at the heart of the current macroeconomic debate. This paper is an attempt to answer these questions, for five MENA currencies, by estimating the equilibrium real exchange rate and assessing the degree of misalignment over the period 1970-97.

To achieve our purpose, this paper implements a specific variant of "model-based approaches" in the spirit of Equilibrium Real Exchange Rate (ERER) first put forward by Edwards (1994), and Elbadawi (1994). The empirical work applies the developments in non-stationary time series econometrics to deal with the relationship between real exchange rate and economic fundamentals in the five countries.

An error correction form is estimated and particular emphasis is put on analyzing the respective magnitude of the adjustment coefficients. Sustainable values of the policy variables are computed using an economic approach instead of mechanical time series decomposition into permanent and transitory components.

The degree of misalignment is estimated as the difference between the actual real exchange rate and its estimated equilibrium value. Finally an extensive analysis of the degree of misalignment is undertaken on the basis of detailed country specific data. Overall, our results pick up almost perfectly the exchange rate policy episodes in the five countries. Our estimates suggest that the five countries exhibited some level of overvaluation during the last years of our sample period. If this trend were to continue, policy-makers would need to react either through a nominal

devaluation or by adapting exchange rate policy to the new international economic and financial context.

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