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Estimating Egypt's Equilibrium Real Exchange Rate

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Abstract

In light of the real appreciation of the Egyptian pound over the last six years and Egypt's lackluster export growth, questions of external competitiveness and exchange rate policy have arisen. This paper sheds light on these issues by estimating empirically Egypt's equilibrium real exchange rate, that is, the rate that is consistent with fundamentals. The results show that, while the real exchange rate was substantially overvalued before 1993, today it is only moderately above the equilibrium rate. Moreover, the analysis shows that the recent appreciation of the pound does not indicate a worsening misalignment.

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Summary

In the last six years, the Egyptian economy has undergone significant economic reforms in favor of macroeconomic stability and market liberalization. The fruit of these reforms is just beginning to mature: the economy is experiencing substantially higher growth rates, led by higher domestic and foreign private investment; the fiscal and external positions are strong; and living standards have finally started to improve.

In light of the real exchange rate appreciation of the Egyptian pound over the last six years and lackluster export growth, questions of external competitiveness and exchange rate policy have arisen. This paper aims to shed light on these issues by estimating empirically Egypt's equilibrium real exchange rate, that is, the level of the real exchange rate that is consistent on balance with a viable external position.

The econometric results show that, while the real exchange rate was substantially overvalued before 1993, it has since moved closer to the equilibrium rate and is today only moderately above it. Moreover, the analysis shows that the real effective appreciation of the pound in the last six years is not an indicator of a worsening misalignment, but has been accommodated by the positive impact on Egypt's economic fundamentals and its external position of Paris Club debt forgiveness and rescheduling.

I. INTRODUCTION

1.   In the last six years the Egyptian economy has undergone significant economic reforms in favor of macroeconomic stability and market liberalization. The fruit of these reforms is just beginning to mature: the economy is experiencing substantially higher growth rates, led by higher domestic and foreign private investment, the fiscal and external positions are strong, and living standards have finally started to improve. With the aid of a precautionary stand–by arrangement from the International Monetary Fund and assistance from the World Bank, the Egyptian government is also implementing an extensive privatization program comprising two thirds of the public enterprise sector as well as the divestiture of public ownership in the financial sector; a rationalization of the tax system and implicit subsidies is also under way.

2.   Over the last six years the Egyptian pound has moved in a 3 percent range vis–à–vis the dollar and any upward or downward pressure on the exchange rate has been absorbed through passive intervention. There is no doubt that Egypt has prospered under this hard currency policy, with the exchange rate providing a nominal anchor. The benefits of this strategy include low inflation, disciplined financial policy, and a stable external environment. Capital inflows have bolstered long term growth prospects by increasing investment and confidence. At the same time, the real effective exchange rate has appreciated by about 40 percent during 1991–96 due to substantial inflation differentials in the early part of the period with partner countries. In light of this and modest growth recently in the non–oil export sector, the question arises as to whether the existing exchange rate regime is still consistent with external competitiveness and, more generally, with the evolving structural framework of the Egyptian economy.

3.   This paper adduces empirical evidence to discern the impact of the exchange rate arrangement on the Egyptian economy over the last ten years. The analysis centers around the estimation of the *equilibrium real exchange rate*, i.e. the level of the real exchange rate that is consistent on balance with a viable external position. In section II, we expand on the policy issue, the available measures of Egypt's external competitiveness and the need for a reference value of the real exchange rate. Section III summarizes the literature on the equilibrium real exchange rate and focuses on the seminal work by Sebastian Edwards. Section IV reviews the econometric results and derives the time series for the equilibrium real exchange rate. Finally, section V bears the conclusions.

II. EGYPT'S EXTERNAL COMPETITIVENESS

4.   A major policy challenge for an economy undergoing macroeconomic stabilization as well as the liberalization of the external sector is that of safeguarding external competitiveness. Macroeconomic stabilization is often associated with fiscal tightening and high real interest rates. If the capital market is sufficiently liberal, this will usually induce substantial capital inflows and put upward pressure on the real exchange rate. This has been

Egypt's experience over the last six years as well as that of most Asian and Latin American economies in 1980s and 1990s, most notably Chile, Malaysia, Mexico and Argentina.[2] In these circumstances, the policy maker is faced with the option of intervening in the exchange market and tighten fiscal policy to counteract the upward pressure and maintain the competitiveness of the tradables sector or, alternatively, of leaving the policy unchanged, thereby raising the specter of an unsustainable current account deficit down the road. In the case of Egypt, this policy dilemma translates into a choice between keeping the current peg or introducing (limited) flexibility in the exchange rate, hoping for a market driven correction to follow in the medium term.

5.   In the context of this policy dilemma, it is important to determine whether the real exchange rate appreciation is consistent with the fundamentals of the economy after the process of liberalization or if it represents an *overvaluation*—defined here as a short–term misalignment of the exchange rate induced by fiscal or monetary policy.[3] If the exchange rate is in line with fundamentals, there is no reason to believe that a move to a more flexible exchange rate would lead to the desired depreciation. On the other hand, if the real exchange rate is indeed misaligned, a flexible rate would tend to reduce the misalignment over the medium term.

A. The Real Effective Exchange Rate

6.   In examining the appreciation of the exchange rate, the evidence provided by the time series of the real effective exchange rate[4] can in some cases be misleading, since the source of a real appreciation that follows a successful stabilization can derive either from a change in fundamentals or from a misalignment of the exchange rate. As in the case of Egypt, this is usually the case after a period of structural reform when there is no clear baseline or reference point that can be considered in line with fundamentals. While a strong and sustained appreciation, prima facie, warrants a continuing assessment of external competitiveness,

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[2]See Quirk and Evans (1995).

[3]For a useful discussion of the definitions of overvaluation in the context of the behavior of the U.S. dollar in the first half of the 1980s', see Frankel (1993), Ch. 6.

[4]All references to the effective exchange rate in this paper refer to the CPI–based measure used by the International Monetary Fund. The nominal exchange rate used for the calculations of the effective exchange rates between January 1987 and February 1991 is a weighted average of the multiple exchange rates in place during this period (see appendix I), where the weights are derived from the share of the total external transactions volume that was effected through each rate. The time series of this weighted average nominal exchange rate is given in Appendix II. A similar weighted average was also computed by Egypt's central bank during the same period.

neither the time series alone, nor the comparison between the real and the nominal exchange rate, provide much evidence to resolve the question of misalignment.

Figure 1. Egypt: Nominal and Real Effective Exchange Rate
(Jan. 1987 - Dec. 1996, Jan. 1987 = 100)
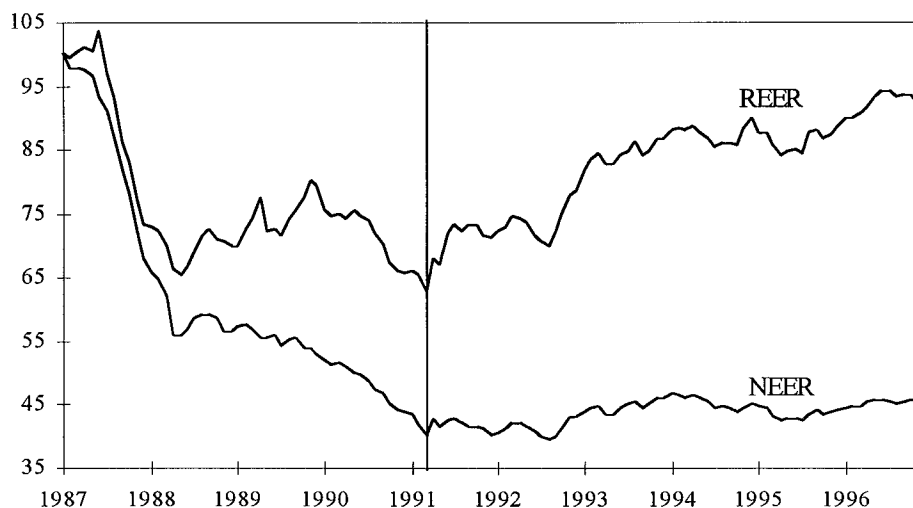
Source: IMF Information Notice System

7.   Consider for example figure 1, which depicts Egypt's real (REER) and nominal effective exchange rate (NEER) between January 1987 and December 1996. From this perspective, the REER at the end of 1996 has yet to reach the initial peak before the large depreciation at the end of the 1980s. In light of this base year, the REER appreciation in the last six years could be interpreted as a slow adjustment process following the strong depreciation of the 1980s, rather than an overvaluation.

8.   Nevertheless, a more careful analysis of the developments of the REER during this period tells a rather different story. Prior to the liberalization, the exchange system had been used for administering "allocation measures," with two official rates applied to different commodities, and an unofficial rate used for most private sector transactions.[5] The administered exchange rates led to specific commodity shortages, suggesting that the REER was overvalued at that time and that part of the subsequent depreciation can be attributed to the misalignment. In May of 1987, the Egyptian government began liberalizing the exchange system. The liberalization was pursued through, first, the introduction of a new interbank foreign exchange market (May 1987), later the establishment of a primary and a secondary exchange market in February of 1991, and ultimately by the unification of the two into a single

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[5]Cf. appendix I. See also Guitian, Manuel and Saleh M. Nsouli (1996).

free market in October 1991. Appendix I provides a summary of the different exchange systems during this period.[6]

9.   The introduction of an interbank foreign exchange market led to the large depreciation in the second half of 1987 and the first half of 1988. It resulted in a depreciation of 37 percent in the weighted average nominal exchange rate used for the NEER calculations. Between the second half of 1988 and the beginning of 1991, the NEER continued to depreciate steeply while the REER stabilized on average. This was the result of a large increase in the inflation differential with partner countries associated with higher import prices. The current account excluding official transfers did not change substantially and gross official reserves were relatively stable.

10.   Since February 1991, when the exchange system was fully liberalized, the developments of the REER are less clear. In spite of the large appreciation between 1991–94, the capital account has improved considerably, aided by large capital inflows amounting to an average of US$1.7 billion per year in 1991–94,[7] while the current account has remained mostly in surplus. Consequently, gross official reserves have been rising steadily, amounting to roughly US$20 billion at the end of 1996.

11.   This analysis of developments in the last ten years, albeit sketchy, shows the difficulty of analyzing external competitiveness based exclusively on the time series of the REER. While it may be tempting to dismiss the period 1987–90 and concentrate exclusively on the subsequent period, there are again no clear indications that February 1991 constitutes an appropriate base for the analysis. In essence, a view on the appreciation of the Egyptian pound over the last six years would partly be conditioned by the base year, given the implicit assumption that the initial level is in line with fundamentals.

B. Alternative Measures of Competitiveness

12.   Alternative measures of Egypt's external competitiveness are limited and provide a somewhat fragmentary explanation of the developments in the last ten years. Subramanian (1997) provides evidence on Egypt's wages in dollar terms and unit labor cost. He finds that dollar wages from 1991/92 to 1995/96 increased by 25 percent, while from 1991/92 to 1994/95 the unit labor cost in Egypt's public sector rose by 57 percent. By comparing the latter to the U.S. unit labor cost over the same period, we can derive the relative unit labor cost, which is estimated to have risen by about 50 percent.

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[6]See also Al-Azmeh, Arfan (1996).

[7]Cf. Subramanian, Arvind (1997).

13.   While not directly comparable with the REER, these two measures would seem to confirm the deterioration in external competitiveness. Nonetheless, it is important to bear in mind that a dollar wage index is also sensitive to the choice of the base year: the large depreciation prior to 1991 did in fact lead to a fall in dollar wages by 43 percent between 1989/90 and 1991/92. Moreover, the unit labor cost estimate may be overestimating the deterioration of competitiveness due to the lagged effects of the large depreciation on Egypt's cost of living, and thus on wages.

Figure 2. Cross–Country Wage Comparison, 1986–95
(Average monthly industrial wage rates in U.S. dollars)

Source: International Labour Office
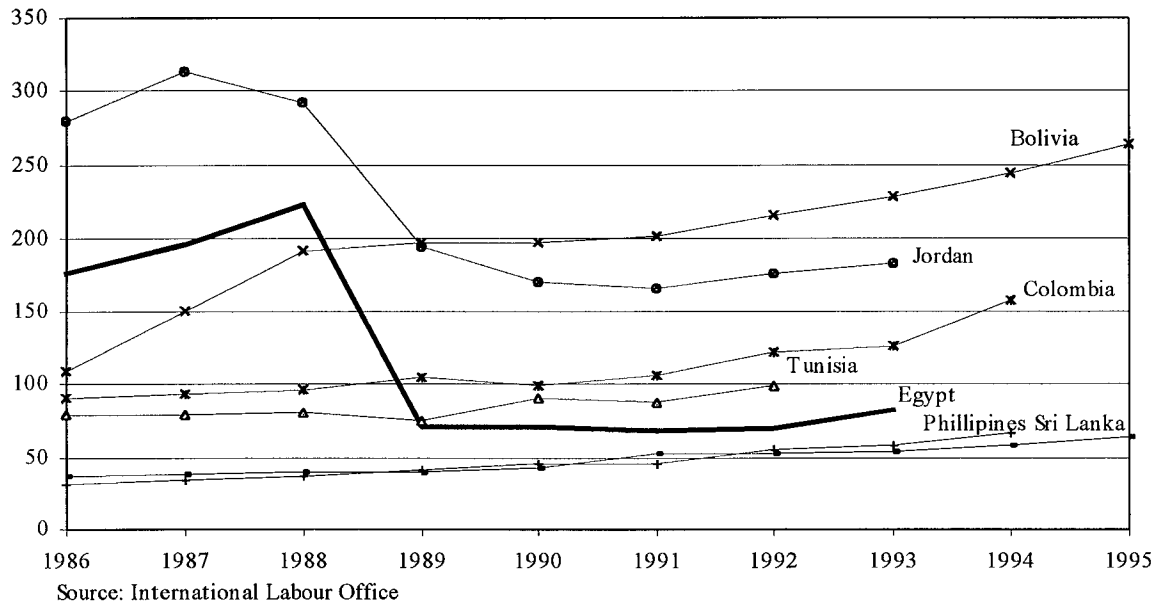
14.   Additionally, figure 2 provides a cross–country comparison of average industrial wage rates for a number of developing countries as reported by the International Labour Office.[8] All wages are expressed in terms of U.S. dollars per month. Egypt's wage rate is only reported up to 1993 and is shown in the figure by the thicker line. While at the beginning of this period Egypt's wage rate was one of the highest in the group of countries considered here, after the strong depreciation of 1988/89 the Egyptian wage rate has since remained one of the lowest in the group. At the end of 1993 it was in fact marginally above the average wage rate of the Philippines and Sri Lanka, and lower than the wage rates in Columbia, Jordan and Bolivia. Anecdotal evidence from Egypt's public sector wages—which account for 70 percent of total wages—suggests that after 1993 the wage rate grew moderately so that we would not expect this cross–country comparison to change substantially if more recent data were available.

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[8]International Labour Organization (1996).

15.   These alternative indicators provide additional evidence on Egypt's external competitiveness. Nonetheless, their limited frequency and incompleteness compared to the effective exchange rate hinders their use in analyzing the developments in the last ten years. In what follows, we will therefore concentrate exclusively on the effective exchange rate, mindful of the limitations of this measure outlined above.[9]

III. THE EQUILIBRIUM REAL EXCHANGE RATE

16.   The simple analysis of the time series of the real effective exchange rate in the previous section highlights the need for a reference rate that is consistent with economic fundamentals, the *equilibrium real exchange rate* (ERER). The ERER is derived from the empirical estimation of a simplified theoretical model of the economy. While it is a theoretical construct subject to the limitations of the necessary assumptions, it does provide a means to evaluate movements in Egypt's REER and give a quantitative answer to the policy issue of overvaluation outlined in section II. In this respect, the results ultimately depend on the quality of the theoretical model. Moreover, the comparison between the actual and the equilibrium rate will be independent of the base year, given that it is the differential between the two rates that matters.

17.   It is important to stress that, while the ERER provides an estimate of the medium term competitiveness of the economy, it does not give an indication of the long–term structural requirements of the economy. In particular, the ERER does not take into account the long–term growth benefits of a vibrant external sector. This is particularly relevant for Egypt, given that it is one of the more insulated economies in the Middle East and non–oil exports accounted for only 3½ percent of GDP in 1995/96. In this respect, while there is little doubt that the development of the Egyptian economy will require substantial investment in its export sector, the theory of the ERER does not pretend to be able to give answers to questions like long–term growth strategy.

A. A Summary of the Literature

18.   There is a relatively large theoretical and empirical literature on the equilibrium real exchange rate which can, for the most part, be classified into two categories.[10] The first category encompasses models of the economy that are essentially conceived to represent

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[9]See Lipschitz, Leslie and Donogh McDonald (1991); and Micossi, Stefano and Gian Maria Milesi-Ferretti (1995) for a discussion of the limitations of the effective exchange rate as a measure of competitiveness in the European context.

[10]For a good review of the literature on this subject, cf. Williamson, John ed. (1994), Ch. 1.

advanced economies. In the second category, models and empirical estimations are tailored to developing countries where a different set of structural issues are involved and the availability of data is rather limited. What is common between the two is the definition of the equilibrium exchange rate, i.e. the level of the real exchange rate that is consistent with internal equilibrium (in terms of the goods and labor market) and external equilibrium (in terms of a sustainable current account).

19.   In the first category, the theoretical models of the economy usually postulate a natural level of output or unemployment, like the well–known non–accelerating inflationary rate of unemployment (NAIRU). Short–run deviations from the natural level are brought about by monetary and/or fiscal policy, and the real exchange rate deviates from its equilibrium rate accordingly. Many of these models are now part of the standard textbook presentation of intertemporal models.[11] Clark (1995) provides a useful introduction to the concept of equilibrium real exchange rates and alternative competitiveness indicators. The work by Williamson (1994) is somewhat different in that it postulates a normative target for the current account which in turn identifies the equilibrium exchange rate. In this respect, the concept of equilibrium is normative rather than positive, and it is therefore appropriate to consider it a *desirable* equilibrium exchange rate, as it reflects a policy objective.

20.   Most of the empirical literature in this first group focuses on identifying equilibrium real exchange rates for G7 economies. The initial work in this area was done at the beginning of the 1970s at the International Monetary Fund (IMF) through the use of a multilateral exchange rate model (MEMR). More recently, Bayoumi et al. (1994) have reviewed the methodology used at that time and developed new estimates based on the current IMF multi–currency macroeconometric model (Multimod). Stein (1994, 1995) provides estimates of the U.S. dollar equilibrium exchange rate based on his concept of the natural equilibrium exchange rate (NATREX) and a review of the fundamental determinants of the equilibrium exchange rate.

21.   In the second category, the seminal work by Edwards (1989, 1994) represents the first substantial endeavor to build an equilibrium exchange rate model specifically for developing countries. Within this context, the ERER is defined as the relative price of tradables to non–tradables that, *ceteris paribus*, results in the simultaneous attainment of internal and external equilibrium. In estimating Egypt's ERER below, we will follow Edwards' methodology and will therefore expand on it at length. Elbadawy (1994) develops a simplified version of Edwards' model that requires a smaller set of fundamental variables, and using this framework provides estimates of the ERER for Chile, Ghana and India. Khan and Ostry (1991) provide panel data estimates of the elasticities of terms of trade shocks and changes in commercial policies to the ERER in a static model.

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[11]See, for example, Frenkel, Jacob A. and Assaf Razin (1987).

B. Edwards' Model

22.   Edwards' model is an intertemporal general equilibrium model of a small open economy in which both tradables and non–tradables are exchanged. Time is limited to two periods, identifying the short– and long–run behavior of the economy, but the model has also been extended to an infinite horizon without substantial differences.[12] Internal equilibrium is defined in the model as the clearing of all nontradable markets (static equilibrium). External equilibrium is attained when the net present value of future current accounts is non–negative, given the level of exogenous long–run capital inflows (dynamic equilibrium). These two equilibrium conditions identify a unique ERER. Agents in the model are endowed with perfect foresight so that they will immediately respond to an unsustainable current account by changing their consumption and investment decisions. A formal summary of Edwards' model is presented in Appendix II.

23.   The kernel of Edwards' empirical analysis is to determine the equilibrium real exchange rate by disentangling fundamental changes in the level of the actual rate from temporary influences brought about by nominal exchange rate shifts as well as monetary and fiscal policy. From the theoretical model, two equations are derived that describe (I) the factors determining the ERER; and (ii) the dynamics of the real exchange rate. By definition, the dependent variables of equation (I) are the fundamental factors affecting the ERER. Leaving the discussion of what those variables should be to the next section, the structural equation for the ERER will then be:

$$\log(e_t^*) = \beta_0 + \beta_i \log(FUND_{it}) + u_t \tag{1}$$

where e_t^* is the ERER and the $FUND_{it}$ is the vector of fundamental variables.

24.   Edwards' model also assumes that in the short–run the real exchange rate adjusts towards the equilibrium rate at a speed given by the parameter Θ. The equation defining these dynamics is given by:

$$\Delta\log(e_t) = \theta[\log(e_t^*) - \log(e_{t-1})] - \lambda[Z_t - Z_t^*] + \phi[\log(E_t) - \log(E_{t-1})] \tag{2}$$

where e_t is the real exchange rate, Z_t is a vector measuring fiscal and monetary policy, Z_t^* is a vector of policy measures that is consistent with the equilibrium rate, λ is the speed of adjustment to the policy gap, E_t is the nominal exchange rate, and ϕ is the speed of adjustment to depreciations. The intuition behind this dynamic equation is relatively straightforward: the

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[12]See Edwards, Sebastian (1994).

real exchange rate level adjusts between today and tomorrow in the direction of the equilibrium rate (first term on the right hand side) with some friction represented by the adjustment speed Θ—which can be thought of as the time needed for relative prices in the economy to adjust. In this process, though, changes in policy variables away from the optimal level (second term) and changes in the nominal rate (third term) may disturb this adjustment in either direction. In essence, this dynamic equation states that the real exchange rate has a *mean reversion* property in the long run, where the mean is the equilibrium rate.

25.   Substituting equation (1) in (2), it is possible to derive the following reduced form equation for the real exchange rate:

$$\log(e_t)=\gamma_0+\gamma_i\log(FUND_{it})+(1-\theta)\log(e_{t-1})-\lambda(Z_t-Z_t^*)_t+\phi NDEP_t+v_t \qquad (3)$$

where the parameters γ_i are a combination of the respective β_i and θ, and $NDEP_t$ is the nominal depreciation. Equation (3) can be estimated empirically. From the estimates of the parameters γ_i, the coefficients of equation (1) can then be derived, providing a derived estimate of the equilibrium real exchange rate. In deriving the ERER, it is assumed that the long run elasticities of the nominal depreciation and the policy variables are zero, i.e. all policy and nominal factors do not affect the equilibrium exchange rate.

C. Determinants of the Real Exchange Rate

26.   In order to proceed with the estimation of equation (3), the fundamental variables affecting the ERER need to be identified. Box 1 presents the fundamental and policy variables used by Edwards in his empirical study of 33 developing countries.

27.   For the specific case of Egypt, this data set should be augmented by the following fundamental variables in the estimation of the real exchange rate:

- The *debt service ratio* (DEBT).[13] If the debt service ratio falls permanently, this will improve the sustainability of the current account and thus lead to an appreciation of the ERER.

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[13]I am indebted to Arvind Subramanian for the idea of including this variable in the explanatory data set. While the literature on debt sustainability suggests that the debt interest ratio is a preferable measure of debt burden than the debt service ratio, in the case of Egypt the former is not available for the sample period.

Box 1. Determinants of the Real Exchange Rate in Edwards' Model

In his empirical study of 33 developing countries, Edwards identified the following set of fundamental variables affecting the ERER:

- The external *terms of trade* (TOT), defined as the ratio of the world price of a country's exports over the world price of its imports. An improvement in the terms of trade will have a positive impact on the current account, and thus lead to an appreciation of the ERER.

- *Government consumption of non–tradables* (GCN). An increase in public consumption of non–tradables vis–à–vis tradables will improve the current account, and thus lead to an appreciation of the ERER.

- *Controls over capital flows* (KCON). A liberalization of capital flows could either improve or worsen the capital account, depending on the interest rate differential between the domestic and the world economy prior to the liberalization (i.e. depending on whether the controls acted, on balance, to deter inflows or outflows). If the removal of such controls leads to a higher (lower) level of capital inflows, the ERER would appreciate (depreciate).

- The *severity of trade restrictions and exchange controls* (XCON). A liberalization of the current account usually leads to an increase of imports, a worsening of the current account, and thus a depreciation of the ERER.

- *Technological progress* (TECH). Technological progress will increase productivity in the economy, and thus lead to an appreciation of the ERER. This is the well–known Balassa–Samuelson effect which contends that productivity improvements will generally be concentrated in the tradables sector.

- The *ratio of investment to GDP* (INV). On the basis of the evidence in developing countries that investment is more import intensive than consumption, an increase in the ratio of investment to GDP will increase absorption, worsen the current account, and lead to a depreciation of the ERER.

In addition to the fundamental variables outlined above, Edwards uses the following proxies for monetary and fiscal policy:

- The *excess supply of domestic credit* (EXC), defined as the increase in domestic credit that is unmatched by higher growth in the economy. Under a flexible exchange rate, excessive monetary expansion will lower interest rates, boost the domestic demand for non–tradables, and thus induce an appreciation of the REER. Under a fixed exchange rate, an excessive monetary expansion would be immediately reversed by a capital outflow, leaving the REER unchanged.

- The *ratio of fiscal deficit to lagged high powered money* (DEH). Under a flexible exchange rate, an increase in the fiscal deficit relative to the monetary base in the previous period (loose fiscal policy) will increase domestic demand for non–tradables, and thus lead to an appreciation of the REER. Under a fixed exchange rate, loose fiscal policy will initially boost domestic demand with the upward pressure on interest rates dampened by capital inflows and no impact on the REER. In the long run, the higher demand for non–tradables will put upward pressure on inflation, and thus lead to a REER appreciation.

- A *Gulf War dummy* (GWAR) spanning the period August 1990 to March 1991. A negative exogenous shock like the Gulf War would put downward pressure on the REER.

- The variable for the nominal depreciation (*NDEP*) will be measured by changes in the NEER. As mentioned above, for the period January 1987 to January 1991, the nominal exchange rate underlying the calculation of the NEER is a weighted average of the multiple exchange rates in place at that time (see appendix II).

28.   While the data set outlined above is ideal for the empirical estimation of Edwards' model, it is clear that operationally some of these variables are not readily available. In his own empirical work, Edwards used proxies to substitute for such variables as GCN, KCON, XCON and TECH. In the case of Egypt, the limited availability and frequency of the required data necessitates estimating equation (3) under the following conditions:

- No data on government consumption of non–tradables is available (GCN). The closest proxy is overall government consumption as a percentage of GDP. Caution should therefore be used in interpreting the coefficient on this variable.[14]

- No well–defined measure of capital controls (KCON) is available either. To proxy, we use here the lagged capital account balance as a percentage of GDP, which is indirectly affected by controls.

- A well–defined measure of trade restrictions and exchange controls (XCON) is also not available. As a first approximation, we use a dummy variable to account for the trade and exchange liberalization in January 1991, when most exchange restrictions were lifted.

- In order to measure Egypt's technological progress, we will use total factor productivity estimates in Bisat et al. (1997).

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[14]An attempt was made to create a better proxy for GCN on the basis of the components of current and capital expenditure. Unfortunately, not enough information is available on the various non–tradable components of, say, goods and services and investment expenditure. Hence the formulation was quite arbitrary and the variable so constructed yielded worse results than overall government consumption in percent of GDP.

- Six out of eleven variables[15] in the data set are only available on an annual basis, compared to a monthly basis for the other seven. It made sense therefore to interpolate the monthly variables linearly, where necessary.[16]

A detailed analysis of the fundamental variables is provided in appendix III.

IV. ECONOMETRIC RESULTS

29.   In order to estimate equation (3), we test first for the stationarity of the fundamental variables and then proceed with the appropriate estimation procedure. Table 1 provides unit root tests for part of the fundamental variables using augmented Dickey–Fuller statistics. The results show that all variables, except for the terms of trade variable (TOT), can be considered stationary in first differences. For the variable TOT, we are unable to reject either the I(0) or I(1) process, possibly indicating that the variable is fractionally integrated. The difference stationarity of the real effective exchange rate is consistent with most other empirical studies of the real exchange rate.

A. Estimation Results

30.   While the unit root tests in table 1 clearly indicate the need for an alternative estimation procedure to least squares, standard cointegration analysis requires a strict classification of the regressors as either a I(0) or I(1) process. No allowance is made for fractionally integrated processes, as may be the case with our terms of trade variable. An alternative to this is Pesaran and Shin's (1995) method based on an augmented autoregressive distributed lag procedure (ARDL). Pesaran and Shin show that augmented ARDL estimates are asymptotically consistent and valid inferences on the long run results can be made using asymptotic theory. The benefit of the ARDL procedure is that it can be applied irrespective of whether the variables follow an I(0), I(1) process or are fractionally integrated. This clearly makes the estimation procedure independent of the assumed order of integration and therefore provides statistically more reliable estimates. For the details of the augmented ARDL procedure, the reader should refer to Pesaran M. H. and Y. Shin (1995).

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[15]These are: TOT, GCN, KCON, TECH, INV, and DEBT.

[16]To make sure that the linear interpolation does not affect our estimation, we compared correlation matrices before and after the interpolation. We found no statistically significant difference.

Table 1. Egypt: Unit Root Tests[17]

	Trend stationary, I(0)	Difference stationary, I(1)
Real effective exchange rate (REER)	-1.8710	(*) -5.0850
Terms of trade (TOT)	(*) -3.7323	(*) -2.9244
Government consumption in percent of GDP (GCN)	-2.0122	(*) -3.0319
Lagged capital account balance in percent of GDP (KCON$_{-1}$)	-2.6695	(*) -3.0873
Technological innovation (TECH)	-1.3905	(*) -3.8310
Debt service ratio (DEBT)	-1.0397	(*) -2.9846

31.   The first stage of the ARDL procedure involves the testing of a long–run relation between the fundamental variables. This is done by computing the F–statistics for testing the significance of lagged variables in an error correction formulation. In the data set for Egypt, the F–statistic of the significance test is 4.7941, well above the 99th percentile critical value of 4.540.[18] We can therefore reject the hypothesis of no significance.

32.   The second stage involves estimating short– and long–run estimates of equation 3 using the augmented ARDL procedure. Before proceeding with the results, it should be noted that a *specification search* procedure was adopted to eliminate statistically insignificant variables. This involves a recursive process of eliminating variables with the lowest t–statistics to get a more parsimonious description of the model. In some cases, this procedure also avoids serious multicollinearity problems.[19] We excluded from elimination the policy

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[17]Based on augmented Dickey–Fuller tests with an intercept but no linear trend. An asterisk (*) next to the statistics indicates that the corresponding hypothesis cannot be rejected at the 5 percent confidence interval.

[18]This test procedure actually involves a critical band rather than a single value. In our case the 99th percentile band is given by the critical values (3.267, 4.540), so we can safely reject the no significance hypothesis. Note that the F–distribution employed here is non–standard and is given in Pesaran, Hashem and Bahram Pesaran (1996).

[19]In the case of the Egyptian data set, there was a serious problem of multicollinearity between

(continued...)

variables, as they are an integral part of the short run model. Through the specification search procedure we eliminated the XCON and INV variables from the dataset as the coefficient on these variables were insignificant.

33.   Table 2 presents the short–term estimates of equation (3) following the ARDL procedure.[20] Overall, the table shows that all of the estimates on the fundamental variables and the nominal depreciation have the expected sign and are significant at the 99th percentile. In addition, the estimate on the error correction model estimate (ecm) is presented, which is highly significant and thus attests to the significance of the cointegration procedure.

34.   On the other hand, the proxies for monetary (EXC) and fiscal policy (DEH) perform poorly in the estimation. The coefficients on DEH and EXC are not statistically different from zero and the coefficient on EXC is not consistent with Edwards' model. The results on these variables are probably affected by the de facto change in exchange rate regime during the sample period, and thus provide limited insight into the effects of monetary and fiscal policy. Given Edwards' assumption that their elasticity in the long run is zero, the lack of significance will not actually affect our derivation of the ERER below.

35.   It is also worth highlighting that the estimated coefficient on the lagged REER of 0.7918 implies a relatively slow speed of adjustment to shocks in the fundamental variables. In fact, a positive unitary shock would be reflected in the equilibrium rate by 50 percent after 5 months, by 75 percent after 8 months, and by 90 percent after 11 months. While this may seem surprising, this coefficient is well within the range of results obtained by Edwards (1989) and Elbadawy (1994) for other developing countries.[21]

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[19](...continued)
the variables INV and TECH for obvious reasons.

[20]The estimation was done using the ARDL procedure in the Microfit 4.0 software package designed by Pesaran, M. Hashem and Bahram Pesaran (1996). We assumed that all fundamental variables could be cointegrated. In keeping with the Edwards model, we limited the maximum lag to one.

[21]Edwards' estimates for the speed of adjustment θ are in the range 0.739–0.941. Elbadawy's estimates are in the range 0.67–0.78.

Table 2. Egypt: Short–run ARDL Estimates
Dependent value: Real Effective Exchange Rate
Sample period: Feb. 1987 – Dec. 1996

	Coefficient	Std. Error	T–Value	T–Prob.
Lag(REER)	0.7918	0.0598	14.9589	0.000
Constant	2.3946	0.7658	3.1271	0.002
Terms of trade (TOT)	0.2629	0.0699	3.7632	0.000
Government consumption in percent of GDP (GCN)	0.1447	0.0627	2.3067	0.023
Lagged capital account balance in percent of GDP (KCON$_{-1}$)	-1.3170	0.3975	-3.3135	0.001
Technological innovation (TECH)	0.3773	0.2256	1.6726	0.097
Gulf war dummy (GWAR)	-0.0114	0.0036	-3.1354	0.002
Debt service ratio (DEBT)	-0.1592	0.0809	-1.9683	0.052
Nominal Depreciation (NDEP)	0.3502	0.0353	9.9193	0.000
Ratio of Fiscal Deficit to H–Money (DEH)	0.0139	0.0247	0.5597	0.578
Excessive Credit (EXC)	-0.0012	0.0129	-0.0977	0.922
ecm(-1)	-.20818	0.0529	-3.9329	0.000
Sample size = 119 observations	$R^2 = 0.6463$		$\sigma = 0.00714$	

36.   Table 3 gives the long–run estimates of the fundamental variables, given the underlying economic assumption that the long–run elasticities on the nominal depreciation and the policy variables are zero. The derivation of the long–run estimates using the ARDL procedure is consistent with Edwards' method outlined in the previous section. The results in Table 3 are encouraging as they show that all the long–run coefficients are statistically significant at the 99th percentile. We can therefore have sufficient confidence in the statistical significance of the ERER, as it is derived from these estimates.

Table 3. Egypt: Long–run ARDL Estimates
Dependent value: Real Effective Exchange Rate
Sample Period: Feb. 1987 – Dec. 1996

	Coeff.	Std. Error	T–Value	T–Prob.
Terms of trade (TOT)	1.2633	0.1767	7.1498	0.000
Government consumption in percent of GDP (GCN)	0.6951	0.2916	2.3839	0.019
Lagged capital account balance in percent of GDP (KCON$_{-1}$)	-6.3263	1.4384	-4.3982	0.000
Technological progress (TECH)	1.8125	0.7920	2.2885	0.024
Gulf War dummy (GWAR)	-0.0545	0.0171	-3.1976	0.002
Debt service ratio (DEBT)	-0.7645	0.3585	-2.1328	0.035

B. Derivation of the Equilibrium Real Exchange Rate

37.   Table 3 provides the long–run estimates that determine the ERER. These are in fact estimates of the β_i coefficients in equation (1). Following Edwards, we then calculate 12 month moving averages of the fundamental variables so as to smooth out temporary volatility.[22] These averages are then used to calculate the ERER as in equation (1).

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[22]This reduces our sample by 12 observations. The Gulf War dummy variable (GWAR) is not smoothed for obvious reasons.

Figure 3. Egypt: Actual vs. Equilibrium Real Effective Exchange Rate
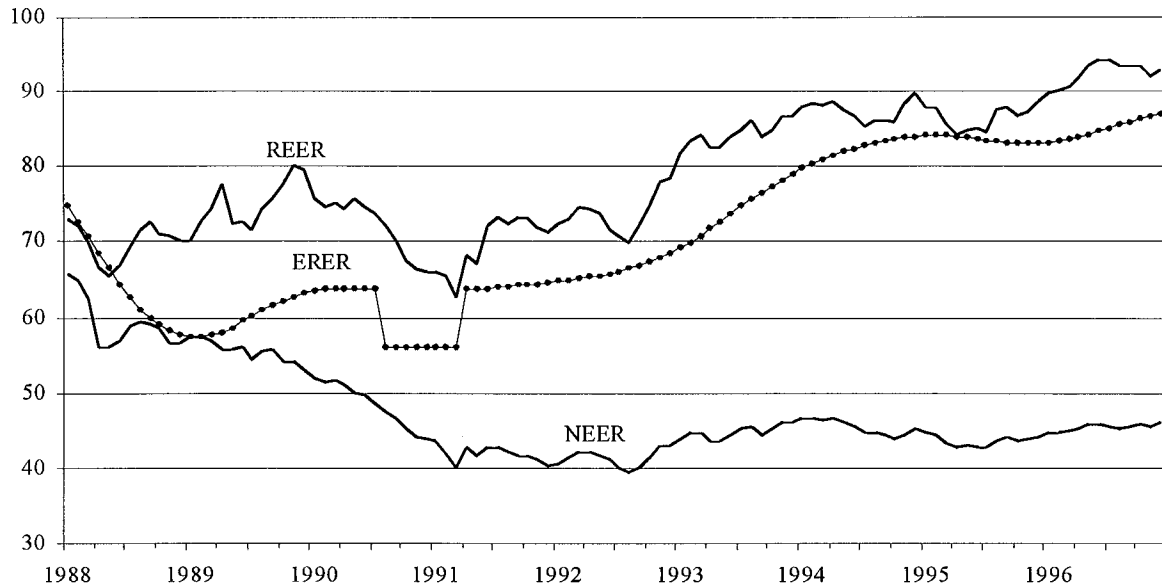(Jan. 1988 - Dec. 1996, Jan. 1987 = 100)

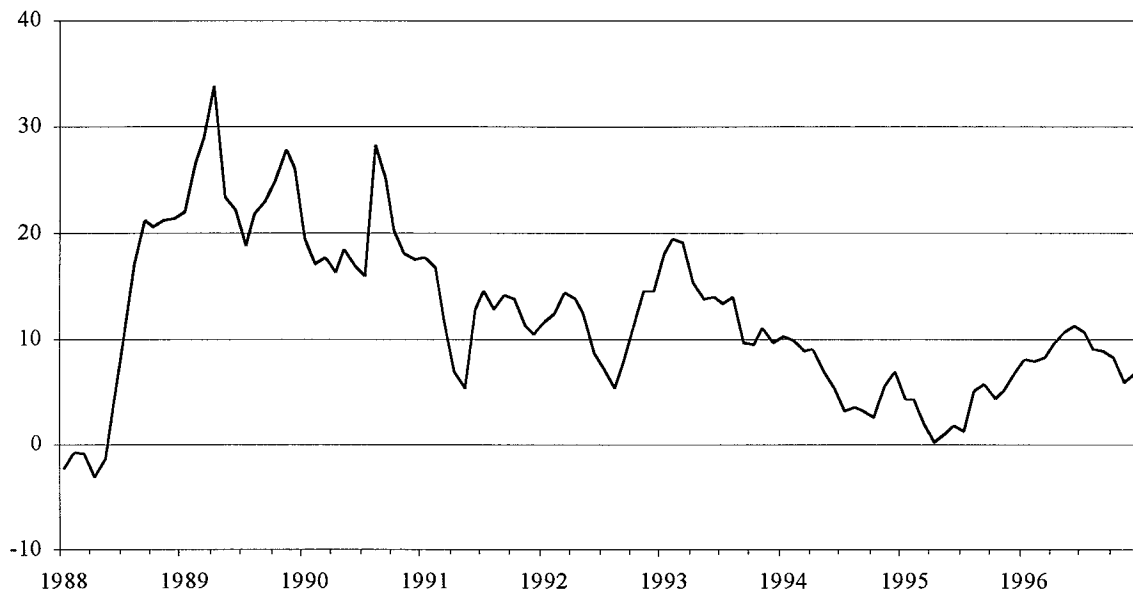Figure 4. Egypt: Difference Between Actual and Equilibrium Real Effective Exchange Rate
(In percent of actual rate, Jan. 1988 – Dec. 1996)

38.   Figure 3 presents the time series of the REER, the NEER and the estimated ERER
(marked with dots) for the period January 1988 to December 1996. The confidence interval
around the ERER is estimated to be equal to ±1.0026. When the actual rate is above (below)

the equilibrium rate, it indicates that the real exchange rate is overvalued (undervalued), because of temporary effects due to nominal depreciations, monetary and/or fiscal policy. Figure 4 presents the difference between the REER and the ERER for the same period.

39. The results shown in figure 3 and 4 are quite striking: while in the first part of the period up to the beginning of 1993, the REER is substantially misaligned with the equilibrium rate, since then the REER has moved closer to equilibrium and, in spite of a subsequent overvaluation in the second half of 1995 and the beginning of 1996, at the end of 1996 the difference between the actual and its equilibrium rate is about 7 percent. This suggests that Egypt's real exchange rate has on average moved closer to its equilibrium rate in the last six years. The two sharp dips in the time series of the ERER represent the estimated impact of the Gulf War from August 1990 to March 1991. The source of this change in the relationship between the actual and equilibrium real exchange rate is due to the large appreciation of the ERER in the period 1991–95.

Table 4. Egypt: Contribution of Economic Fundamentals
to the Equilibrium Real Exchange Rate
(January 1991 – December 1996)

	Elasticity	Contribution
Terms of trade (TOT)	1.2633	-28.37%
Government consumption in percent of GDP (GCN)	0.6951	-9.28%
Lagged Capital account balance in percent of GDP ($KCON_{-1}$)	-6.3263	-19.57%
Technical progress (TECH)	1.8125	26.94%
Gulf War dummy (GWAR)	-0.0545	8.28%
Debt service ratio (DEBT)	-0.7645	121.98%
Total		99.99%

40. In order to better understand the sources of this appreciation, Table 4 presents the breakdown in the contribution of the different fundamental variables during the last six years of the sample. The largest contribution by far is that of the reduction in the debt service ratio (DEBT), accounting for 122 percent of the increase in the ERER. The second largest contribution is technological innovation (TECH) accounting for 28 percent of the increase, followed by the impact of the Gulf War (GWAR, 8 percent). The other variables, instead, contributed to a depreciation in the ERER, with the worsening of the terms of trade (TOT)

accounting for a 28 percent decrease, capital controls accounting for a 20 percent decrease, and finally the scaling back of government consumption of non tradables accounting for a 9 percent decrease.

41.   Overall, these results seem to confirm the sizable impact of debt rescheduling and forgiveness on the external position of developing countries. In the case of Egypt, in the period 1991–96 the rescheduling of Paris Club debt implied a cumulative reduction in the net present value of the outstanding foreign debt stock of 55 percent, thus reducing the debt service ratio from 33 percent in 1991 to below 10 percent in 1996. At the same time, the ERER appreciated by about 35 percent. This empirical evidence is consistent with the theoretical analysis shown in appendix II, section B. Moreover, indirect support for this analysis also comes from the parallel literature on the impact of official development assistance (ODA) on developing countries' competitiveness: there it is shown that prolonged international aid, in the form of grants or concessional lending, will result in an (equilibrium) appreciation of the real exchange rate.[23] The theoretical argument behind this result runs parallel to the impact of the reduction in a country's debt burden argued above.

42.   On the basis of this evidence and the analysis above, it is therefore safe to conclude that the lifting of Egypt's *debt overhang* has had a significant impact on the external position of the economy, which is in turn reflected in the appreciation of the real exchange rate.

V. CONCLUSIONS

43.   In this paper, we set out to shed light on the developments in Egypt's external competitiveness in the last ten years through the estimation of the equilibrium real exchange rate. The results suggest that while the real exchange rate was substantially overvalued before 1993, it has since moved into closer convergence with the equilibrium rate; at the end of 1996, the REER is estimated to be some 7 percent appreciated vis–à–vis the ERER.

44.   It is important to interpret these results with caution. While the econometric results are statistically significant, the derivation of the equilibrium real exchange rate is ultimately dependent upon the assumptions underlying Edwards' model. The results should not therefore be taken as a conclusive determination of Egypt's equilibrium real exchange rate. Rather, this analysis is intended to offer an alternative insight into the developments of Egypt's competitiveness over the last ten years and any more recent developments not covered here would clearly alter these conclusions. Hence, these results should not be interpreted as suggesting an appropriate long–term growth strategy for the Egyptian economy. The theory of the equilibrium real exchange rate does not take into account the well–known benefits of a

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[23]Cf. Tsikada (1997) for a survey of the literature. Wijnberger (1986) shows that ODA had a significant impact on Egypt's real exchange rate in the 1980s.

dynamic export sector, which is particularly relevant in Egypt's case, given that non–oil export only account for about 3½ percent of GDP.

45.   In the course of estimating the equilibrium real exchange rate, we concluded that the Paris Club debt relief phased in during the period 1991–96 had a significant impact on Egypt's real effective exchange rate. This result is consistent with the theoretical model formally derived in appendix II. This is a novel result which may have important policy implications not only for Egypt but also for other developing countries which will benefit in the future from significant debt rescheduling, like those countries currently being considered for the multilateral initiative for highly indebted poor countries (HIPC).[24] We believe that this is fertile ground for future research.

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[24]For a summary of this initiatives as well as the benefits of debt relief in general, see Boote, Anthony R. et al. (1995)

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EGYPT'S EXCHANGE SYSTEM 1987–91

46.   The following is a summary of the liberalization of the exchange system in Egypt between 1987 and 1991. It draws extensively from past IMF staff reports. Until the full liberalization of the exchange system in February 1991, the IMF calculated a weighted average of the multiple exchange rates vis-à-vis the U.S. dollar for operational use. This measure was weighted by the share of the transaction volume exchanged at each exchange rate and underlies the calculations of the effective exchange rates in this paper. Figure 5 presents this weighted average for the period prior to the liberalization.

Figure 5. Egypt: Weighted Average Exchange Rate, 1987–91
(Egyptian pounds per U.S. dollar)
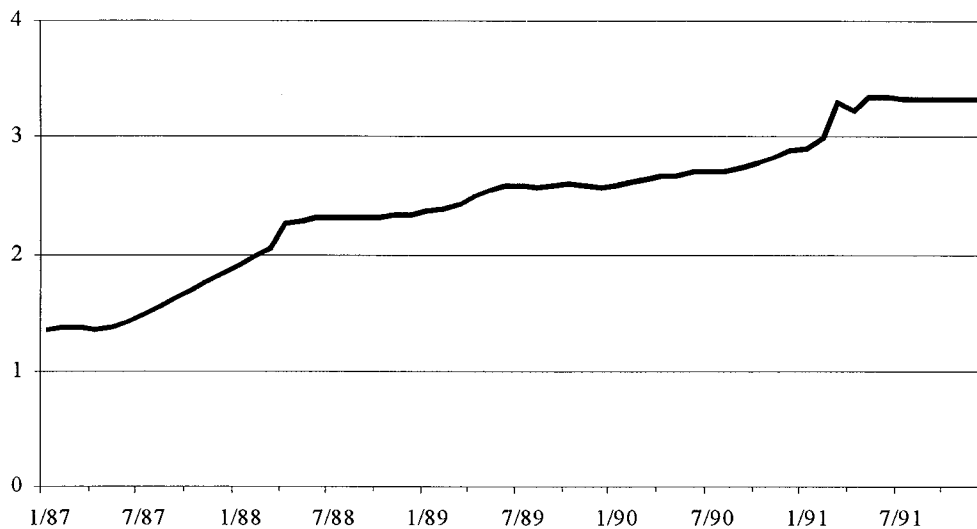
Source: IMF Information Notice System

A. Before May 1987

47.   Before the liberalization of May 1987, the interbank foreign exchange market was organized in two pools. The *central bank pool* handled exports of petroleum, cotton, and rice; Suez Canal dues; imports of essential foodstuffs (wheat, wheat flour, edible oils, tea, and sugar); insecticides and fertilizers; and most public sector capital transactions. The *commercial bank pool* received proceeds of worker remittances, tourism and exports not going through the central bank pool, while providing foreign exchange for public sector payments not covered by the central bank pool. Both rates were marked by heavy intervention and did not reflect market forces.

48.   In addition, a *non–bank free market*, formally illegal but officially tolerated, shared common sources of supply with the commercial bank pool (worker remittances and tourism)

and satisfied demand by the private sector for exchange. In addition, private sector payments could be effected by purchasing foreign exchange from residents holding *free accounts* with domestic banks.

49.   Transactions in the *central bank pool* were mainly at the official rate of LE 0.7 per U.S. dollar, although transactions under bilateral agreements and certain aid programs were effected at other rates. In the commercial bank pool, the *authorized bank rate* was set at LE 1.36 to the U.S. dollar. In the non–bank free market and for transactions in the free accounts, exchange rates were negotiated by the parties to the transaction.

B. Between May 1987 and February 1991

50.   On May 11, 1987 a *new bank foreign exchange market* was introduced, in which all authorized commercial banks and two travel agencies were allowed to operate. The initial rate was set at LE 2.165 to the U.S. dollar, closely reflecting the rate in the non–bank free market at that time. Subsequently, the new bank rate was set by committee to reflect supply and demand conditions in the interbank market. The old commercial bank pool ceased to exist in March 1989. At the same time, a limited number of private sector transactions were given access to the new bank foreign exchange market, once the debtors' balances in their free accounts had been drawn down.

51.   On the supply side, the resources in the new bank market were drawn mainly from workers' remittances, tourist expenditures, the purchase of foreign bank notes and travelers checks, and specified public and private sector export earnings. On the payments side, the new market was permitted to provide foreign exchange for specified public sector transactions, all private sector imports, and certain private sector invisible payments primarily related to imports. All other transactions were required to be financed through the central bank pool or the own exchange accounts market.

52.   During this period, the central bank pool rate was devalued a number of times. On August 15, 1989, the rate was increased from LE 0.7 to LE 1.1 to the U.S. dollar. However, foreign exchange receipts in the market were taxed, and users subsidized, so that the exchange rate effectively remained at LE 0.7 to the U.S. dollar. On July 1, 1990 the central bank pool rate was changed again to LE 2.0 to the U.S. dollar. In the meantime, the rate in the new bank foreign exchange market had steadily depreciated and at the end of 1990 it had reached LE 3.0 to the U.S. dollar.

C. After February 1991

53.   To simplify the exchange system and ensure a competitive exchange rate, the multiple exchange system described above was abolished on February 27, 1991 and replaced by a temporary dual exchange system consisting of a *primary market* and a *secondary (free)*

market. Initially, the primary and secondary markets were meant to coexist for one year and then be unified. It was subsequently decided to bring the unification of these markets forward in time. The unification occurred on October 8, 1991 and since then the Egyptian pound has been freely traded in a single exchange market.

SUMMARY OF EDWARDS' MODEL

54.   This appendix summarizes the real exchange rate model in Edwards (1989) and describes a comparative dynamics exercise to show the impact on the ERER of a reduction in the net present value of outstanding debt. As it is clear from the empirical analysis, the latter is the main feature characterizing the behavior of Egypt's real exchange rate in the first half of the 1990s'.

A. Edwards' Real Exchange Rate Model

55.   In trying to understand the effects of fundamentals, nominal depreciations and policy variables on the real exchange rate, Edwards developed an intertemporal model of a small open economy in full employment with no price rigidities and no intertemporal credit rationing. In the model time is limited to two periods, agents are endowed with perfect foresight and any debt accumulated in period 1 must be repaid in the second period (i.e. No–Ponzi condition).

56.   In setting up the model formally, we will follow the following conventions below. A tilde ($\tilde{\ }$) over a variable indicates the value of the variable in period 2. Partial derivatives will be noted by a subscript (i.e. R_q is the partial derivative of R with respect to q). The (world) price of the exportable commodity (X) is used as the numeraire throughout the model. Any other world price is indicated by a asterisk (*).

a. Production

57.   The economy is populated by a large number of profit maximizing firms that produce exportables (X), importables (M) and non–tradables (N). The economy is characterized by the usual assumptions of constant returns to scale and perfect competition. Producers therefore face the following revenue function, given the production possibilities function F( ) and available resources:

$$R=Max\{Qx+pQm+qQn|F(Q,V)\leq 0\} \tag{4}$$

where Qx, Qm and Qn are the quantities produced of exportables, importables and non–tradables respectively in period 1 or 2. The price of importables and non–tradables are given by p and q. Q is a vector in the production function that summarizes the quantities produced, and V is a vector of available resources. The supply functions for all three commodities can then be easily derived as the partial derivatives of R with respect to each commodity, i.e.

$$\frac{\delta R}{\delta i} = Ri = Qi \quad for \ i = x,m,n \tag{5}$$

Given the assumptions on technology, the supply function will have all of the standard properties.

b. Consumption

58.   A representative consumer in this economy maximizes the present value of utility, subject to the two period intertemporal constraint. Assuming a homothetic and time separable utility function, the consumer's maximization problem can be written as:

$$Max \ W\{U(Cn,Cm,Cx), \tilde{U}(\tilde{C}n,\tilde{C}m,\tilde{C}x)\} \tag{6}$$

subject to the intertemporal constraint:

$$Cx + pCm + qCn + \delta(\tilde{C}x + \tilde{p}\tilde{C}m + \tilde{q}\tilde{C}n) \leq Wealth \tag{7}$$

where W and U are the intertemporal and static utility functions; Cn, Cm, Cx ‘‘ ” ’ ” ’ ’’ are the consumption levels of N,M,X in period 1 (2); p and q ($\tilde{p}$ and $\tilde{q}$) are the prices respectively of importables and non–tradables in period 1 (2); and δ is the domestic discount factor which is assumed to be equal to $(1+r)^{-1}$, which is the inverse of the domestic real interest factor.

59.   Wealth accrues to the consumer in the form of income from labor services, income from renting of capital to firms, and government transfers. In period 1, wealth can therefore be expressed as:

$$Wealth = R(p,q;V,K) + \delta\tilde{R}(\tilde{p},\tilde{q};\tilde{V},K+I) - I(r) - T - \delta(\tilde{T}) \tag{5}$$

where $I(r)$ is investment in period 1 as a function of the real interest rate, T is a lump sum tax (transfer), discounted in the second period by the domestic discount factor.

60.   The consumption problem can be re–written as an expenditure minimization problem of the form:

$$E = Min\{Cx + pCm + qCn + \delta(\tilde{C}x + \tilde{p}\tilde{C}m + \tilde{q}\tilde{C}n)\} \quad s.t. \quad W(U,\tilde{U}) \geq \bar{W} \tag{6}$$

Given the assumption of homotheticity, exact price indexes (π and $\tilde{\pi}$) for period 1 and 2 can be introduced to define unit expenditure functions of the form:

$$E = E\{\pi(p,q), \delta\tilde{\pi}(\tilde{p},\tilde{q}); W\} \tag{7}$$

From this function, compensated demand function for each commodity in both periods can be derived by differentiating with respect to the relevant price:

$$\frac{\delta E}{\delta\pi}\frac{\delta\pi}{\delta i} = E_\pi\pi_i = D(i) \quad for \; i = p,q,\tilde{p},\tilde{q} \tag{8}$$

where $D(I)$ is the compensated demand function for the importables and non–tradables in each period. This demand function can also be reinterpreted as the share of overall private expenditure on commodities M and N.

c. Government

61.   The government in this economy consumes exportables, importables and non–tradables. Government revenue derives from lump sum taxes, proceeds from import tariffs, taxation of foreign borrowing by the private sector, and from borrowing abroad. The government's budget constraint states that the discounted value of government expenditure (including foreign debt service) has to equal the discounted value of government revenue. We can express the government's budget constraint in the following way:

$$\begin{aligned}Gx + p^*Gm + qGn + \delta^*(\tilde{G}x + \tilde{p}^*\tilde{G}m + \tilde{q}\tilde{G}n) = \\ = \tau(E_p - R_p) + \delta^*\tilde{t}(\tilde{E}_{\tilde{p}} - \tilde{R}_{\tilde{p}}) + b(NCA) + T + \delta^*\tilde{T}\end{aligned} \tag{9}$$

where Gi is government consumption on the specific commodity I; p^* is the price of importables net of tariff; δ^* is the world discount factor—which is assumed to be equal to the inverse of the world interest factor $(1+r^*)^{-1}$— τ is the import tariff rate; b is equal to $(\delta^*-\delta)$, i.e. the discounted value of tax payments per unit borrowed from abroad, NCA is the non–interest current account of the private sector in period 2; and T is the lump sum transfer from the private sector.

d. Equilibrium

62.   Equilibrium in this economy is defined by the budget constraint of the private sector, given by equation **(4)** and **(5)**, the government's budget constraint given by equation **(9)**, as well as the following market clearing conditions for the non–tradable sector:

$$R_q = E_q + Gn \quad and \quad \tilde{R}_{\tilde{q}} = \tilde{E}_{\tilde{q}} + \tilde{G}n \tag{10}$$

the following pricing equations:

$$p = p^* + \tau, \qquad \tilde{p} = \tilde{p}^* + \tilde{\tau} \tag{11}$$

and the definition for the price index of tradables:

$$P_T^* = \gamma P_m^* + (1-\gamma)P_x^*, \qquad \tilde{P}_T^* = \gamma \tilde{P}_m^* + (1-\gamma)\tilde{P}_x^*, \qquad (P_x^* = \tilde{P}_x^* = 1) \tag{12}$$

63.   Given these conditions and the assumption that the marginal productivity of capital in period 2 equals the domestic interest rates, there is only one *equilibrium real exchange rate* (ERER) for each period, defined as the international price of tradables (P^*_t) over the domestic price of non–tradables (P_n), that can satisfy all equilibrium conditions. The reduced form equation describing the ERER can therefore be written as:

$$ERER = HH(p^*, \tilde{p}^*, \tau, \tilde{\tau}, \delta, \delta^*, V, T, \tilde{T}, Gx, \tilde{G}x, ...),$$
$$ER\tilde{E}R = \tilde{H}\tilde{H}(p^*, \tilde{p}^*, \tau, \tilde{\tau}, \delta, \delta^*, V, T, \tilde{T}, Gx, \tilde{G}x, ...) \tag{13}$$

64.   It is important to note here that the ERER depends on two factors, the static internal equilibrium conditions, given by equation **(10)** and **(12)**, and the dynamic external equilibrium conditions, given by equation **(4)**, **(5)** and **(9)**. What is important in this respect is that a change in government consumption, prices, terms of trade, etc. tomorrow will not only affect the level of the ERER tomorrow, but it will also contribute to the allocation decision of the private sector today, given the perfect foresight assumption.

65.   In particular, it is worth highlighting that any change in taxation in period 1 will have no impact on the ERER in either period, since the private sector expects the reduction in taxation (T) today to be met by higher taxation tomorrow. This is the standard *Barro–Ricardo equivalence* theorem. In the same way, if the government were to borrow more from the international market in the first period and transfer it to the private sector, this would also

have no impact, given that the higher debt service payments in the following period would have to be met by higher taxation.

B.   The Impact of a Reduction in the Net Present Value of Outstanding Debt

66.   In order to analyze the effects of a reduction in the net present value of outstanding debt, we follow a similar simplification of the model described in (A.), as in Edwards, in order to give a graphical representation. In particular, we assume that there is no government consumption, no investment, and zero tariffs. We add the assumption that the government has an *inherited* debt stock (B) that needs to be repaid in full in period 2.[25] The intertemporal budget constraint for the economy as a whole can then be rewritten as:

$$E[\pi(1,p,q),\delta^*\tilde{\pi}(1,\tilde{p},\tilde{q});W]+B+\tilde{B}(1+\tilde{r}^*)=R(1,p,q;V)+\delta^*\tilde{R}(1,\tilde{p},\tilde{q};\tilde{V}) \qquad (14)$$

In addition, the following equilibrium conditions will need to hold:

$$R_q=E_q \quad and \quad \tilde{R}_{\tilde{q}}=\tilde{E}_{\tilde{q}} \qquad (15)$$

$$p=p^*, \quad \tilde{p}=\tilde{p}^* \qquad (16)$$

and equation **(12)**. The current account in both periods is then given by:

$$CA=R(\cdot)-\pi E_\pi-B, \quad \tilde{CA}=\tilde{R}(\cdot)-\tilde{\pi}\tilde{E}_{\tilde{\pi}}-(1+\tilde{r}^*)\tilde{B} \qquad (17)$$

67.   Edwards shows that the simple model above can be reduced to a set of equations in q, and $\tilde{q}$ that gives rise to Figure 6.[26] The determination of the equilibrium prices of non–tradables in both periods also determines the set of ERER for any given price vector of tradables (P_T). In essence, the line HH summarizes all static conditions in the economy, and $\tilde{H}\tilde{H}$ summarizes the dynamic conditions.

68.   Let us now consider the comparative dynamics of reducing the net present value of the outstanding stock of debt. In particular, we will assume for simplicity that at the beginning of period 1 international creditors forgive half of all outstanding debt. The question then is, what

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[25]A similar assumption underlies the model in Frenkel, Jacob A. and Assan Razin (1987), Ch. 8.

[26]For details, please refer to Edwards, *op. cit.*, pp. 25–27.

impact will this have on the ERER? The answer is relatively simple inasmuch as the debt forgiveness can be analyzed as a wealth increase in each period. The debt servicing in period 1 and 2 will not change, given the time separability of the utility function. The price of tradables will not change given that it is equal to the world price, but the price of non–tradables q and $\tilde{q}$ will change in response to the higher domestic demand brought about by the wealth effect of the debt forgiveness in both periods.

Figure 6. Determination of Equilibrium Real Exchange Rate
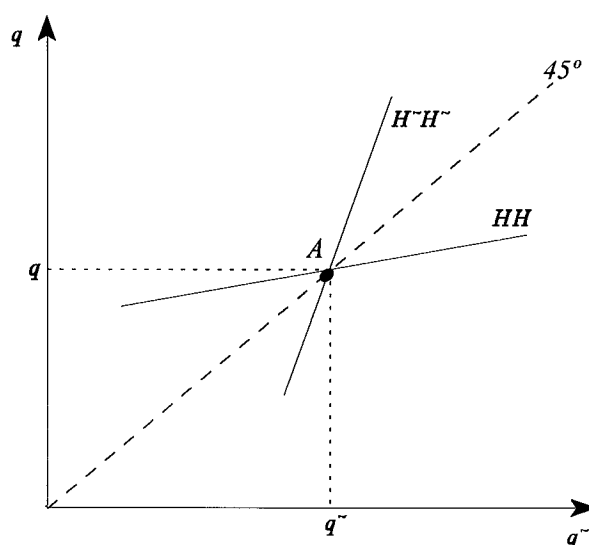
69.   In terms of our graphical representation of the equilibrium, this implies an upward shift of both lines HH and $H\tilde{H}\tilde{}$, as shown in Figure 7. The debt forgiveness will have an immediate impact on the government budget constraint for period 1. As such, line HH will move upwards and the ERER will be given by point B. In addition, depending on how quickly the government and the private sector adjust to the debt forgiveness in period 2 (the long run effect), the economy will then move gradually from point B to C. For the private sector, this corresponds to the realization that the outstanding debt stock will not be financed through higher taxation in the future. Throughout the process, the ERER will appreciate due to rise in the price of non–tradables.

70.   This comparative dynamics exercise shows that any debt forgiveness will have an immediate impact on the current account and will put upward pressure on the ERER through the wealth effect it produces. In addition, it also induces a long run appreciation of the ERER

through the dynamic impact on expected future taxation associated with the outstanding debt stock.

Figure 7. Effects of Debt Forgiveness on ERER
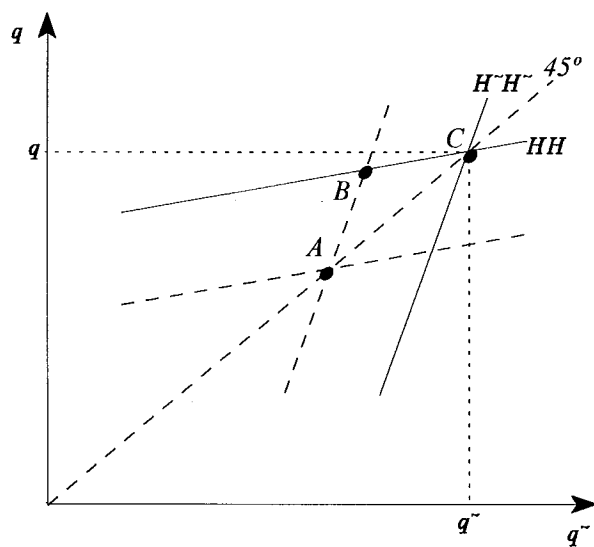
## EGYPT'S FUNDAMENTAL VARIABLES

71.   This appendix summarizes the developments of the fundamental variables used in estimating Egypt's ERER during the period 1987–96. The variables considered are the terms of trade (TOT), government consumption (GCN), the capital account balance (KCON$_{-1}$), total factor productivity (TFP), and the debt service ratio (DEBT).

A. Terms of Trade

72.   Figure 8 presents the time series of the terms of trade for the period under consideration. In response to the large depreciation, the terms of trade improved considerably during the period 1987–91, albeit not in a monotonic way. Part of the beneficial effects of the depreciation were in fact reversed in 1989, due to lower export prices (mainly oil and cotton). These unfavorable conditions did not continue and during 1990/91 Egypt's terms of trade improved again, mainly due to higher oil prices associated with the Gulf War and a contraction of wheat prices (one of Egypt's largest imports). Between 1992 and 1994, the terms of trade worsened by about 20 percent, as the price of oil weakened, while the prices of other commodities remained relatively stable. In 1995 and 1996, the terms of trade did not change substantially, as higher oil prices in 1996 were offset by higher import prices of wheat and maize.

Figure 8. Egypt: Terms of Trade, 1987–96
(1990=100)
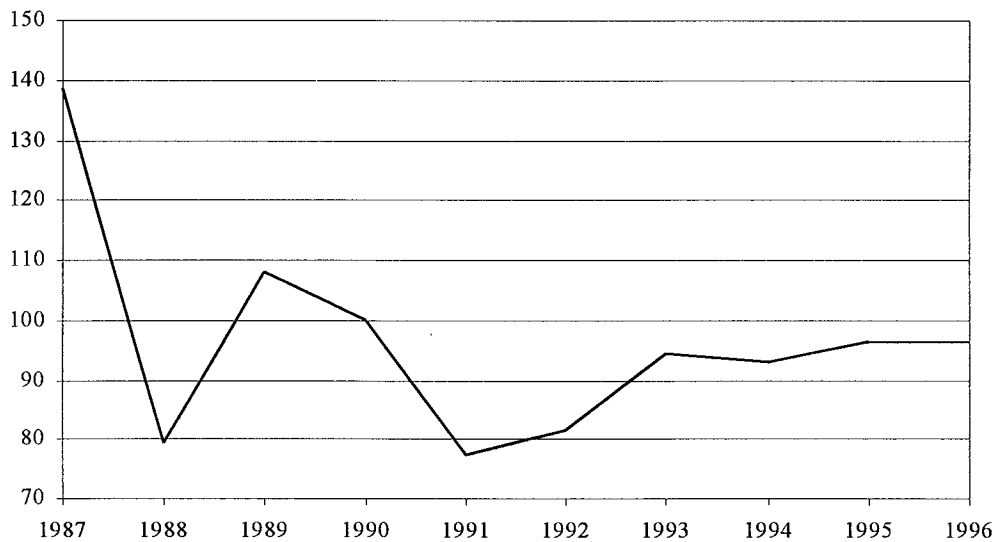

Source: IMF, World Economic Outlook

B. Government Consumption

73.   Figure 9 presents government consumption in percent of GDP for the period 1987–96. The time series reflects the policy of Egyptian authorities to consolidate the fiscal stance and scale back government operations in order to give the private sector greater investment opportunities. Between 1987 and 1992, this resulted in a reduction of government consumption of about 4 percent of GDP. In 1993–94, while the overall fiscal consolidation continued, expenditures on food subsidies and investment goods increased government consumption to about 11½ percent of GDP. These elements turned out to be temporary and were reversed in 1995–96, bringing the overall deficit to less than 1½ percent of GDP.

Figure 9. Egypt: Government Consumption, 1987–96
(In percent of GDP, fiscal year ending June)
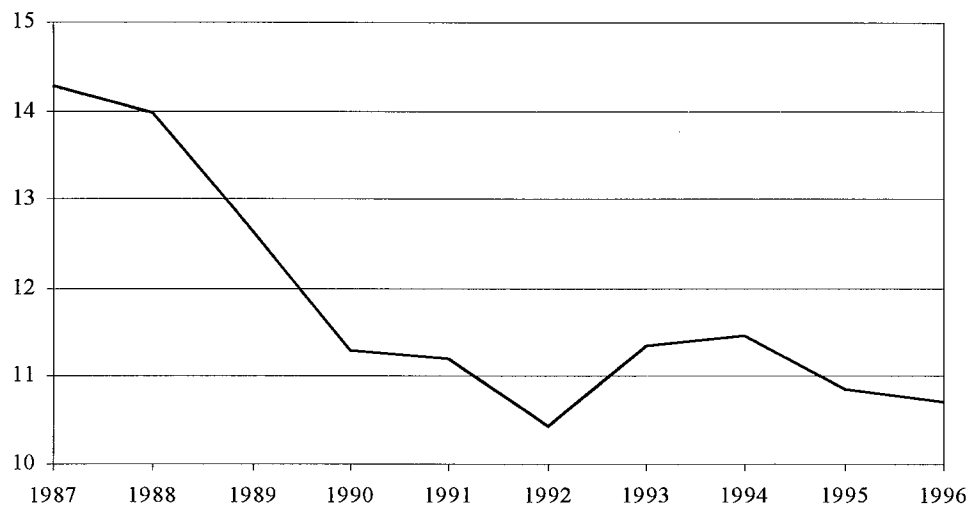
Source: Egyptian authorities; and IMF staff estimates.

C. Capital Account Balance

74.   Figure 10 presents the time series of the capital account balance in percent of GDP from 1987 to 1991. The capital account balance reflects the improving confidence in the Egyptian economy since the start of the liberalization in 1987. From a capital account deficit of 3 percent at the beginning of the period, the capital account turned to balance in 1990. The effects of the Gulf War in 1991 caused the account to record a deficit of 1½ percent of GDP. This was reversed by a substantial surplus in the following three years, brought about by large capital inflows, mainly from residents taking advantage of high real interest rates. Capital inflows paused in 1995, keeping the account roughly in balance, but continued again in 1996, this time driven by foreign interest in portfolio and foreign direct investment.

Figure 10. Egypt: Capital Account Balance, 1987–96
(In percent of GDP, fiscal year ending June)
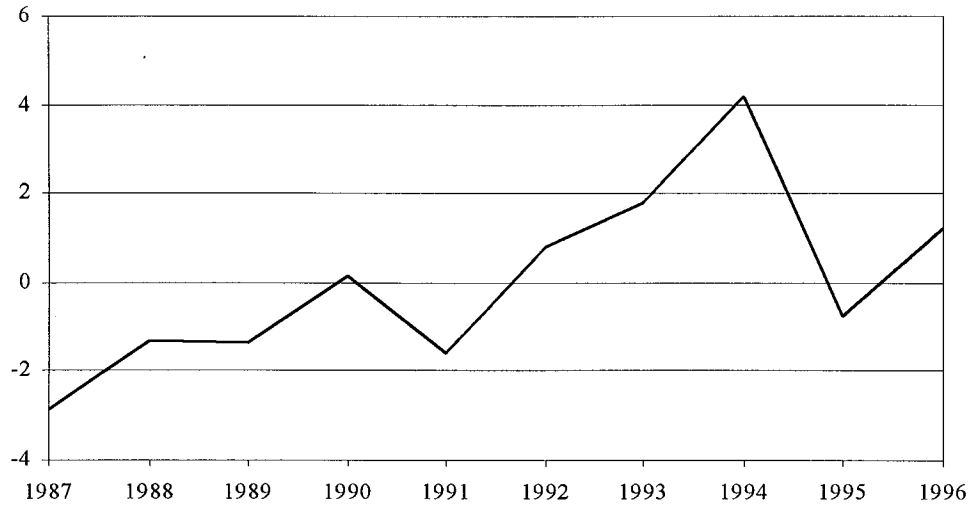
Source: Egyptian authorities; and IMF staff estimates.

D. Total Factor Productivity

75.   Figure 11 presents Egypt's total factor productivity for the period 1987–96, as estimated by Bisat et al. (1997). While in the first half of the sample, the estimate for total factor productivity fell substantially and was mostly negative, in the second half the time series shows a strong recovery suggesting strong productivity gains towards the end of the period. In comparison to the other variables in the data set, this estimate would suggest that productivity could have been affected by the scaling down of government investment in the first half of the sample. On the other hand, the second half shows a recovery in productivity that can be associated mostly with higher private sector investment.

E. Debt Service Ratio

76.   Figure 12 presents the time series of Egypt's external debt service ratio from 1987 to 1991. There is a clear jump in the series associated with the Paris Club debt relief agreed with the Egyptian authorities in July 1991. The debt relief entailed a cumulative reduction in the net present value of the outstanding foreign debt stock of 55 percent. Additional military debt owed to the United States was also forgiven in 1991. In turn, this has reduced the debt service ratio from 42 percent in 1990 to below 10 in 1996, an average savings of over US$3 billion dollars a year in debt service payments.
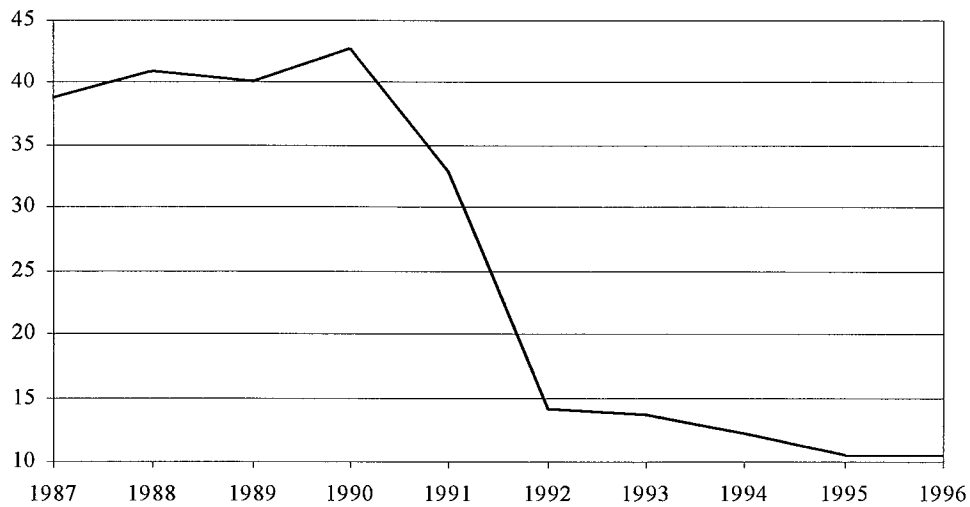
Figure 11. Egypt: Estimates of Total Factor Productivity, 1987–96
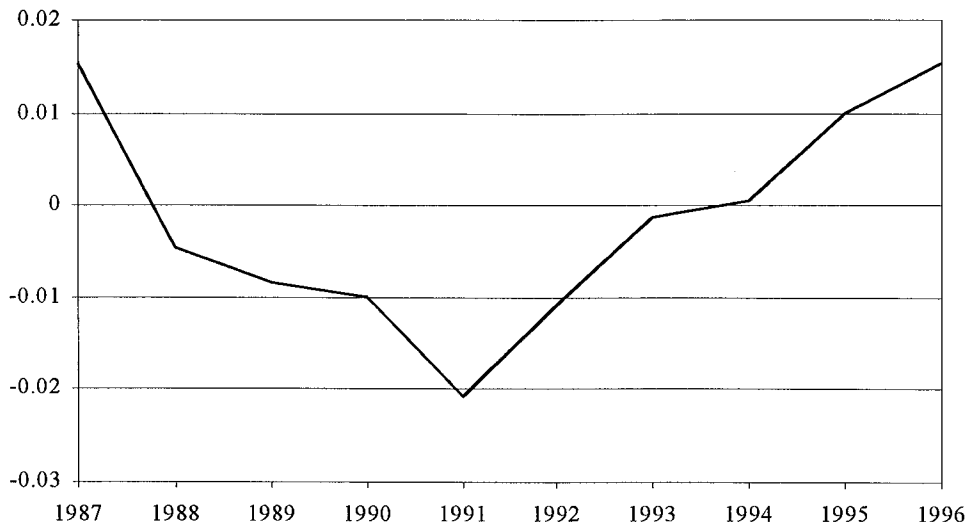
Source: Bisat et al. (1997)

Figure 12. Egypt: Debt Service Ratio, 1987–96

Source: Egyptian authorities; and IMF staff estimates.