From the Cyprus Pound to the Euro: How close is the Central Parity Rate to the Equilibrium Rate?

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Abstract

This paper attempts to shed light on the observed slowdown of the Cypriot economy just after its admission into the euro zone. The high GDP growth rates and the low unemployment and inflation rates during the pre-EMU period were followed by a lower GDP growth rate, higher inflation rate and higher current account deficit. In the context of equilibrium exchange rates, we focus on answering the question of whether EMU membership has affected the macroeconomic performance of Cyprus. Namely, we investigate whether the central parity rate (€1=0.585274) is the appropriate one in the sense that it is consistent with the macroeconomic fundamentals of the Cypriot economy. The results imply that Cyprus' inflation rate and its overall macroeconomic performance have not been influenced by the central parity rate. The interruption of the growing process of the Cypriot economy was mainly due to (a) domestic factors, such as the credit expansion; (b) external factors, such as the increase in global oil and food prices and (c) the current international financial crisis.

Keywords: Cyprus; EMU; BEER, Central Parity Rate

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1. Introduction

Cyprus is a small open economy which is characterized by a high output growth rate, low unemployment rate, low inflation rate and good overall macroeconomic performance. In addition it has strong trade linkages with most of the European Union (EU) countries. According to Constantinou *et al*. (2008), the share of imports from EU members in total imports was 68% in 2007, while the share of exports to EU members in total exports was 68.1%. Due to the fact that the ratio of total trade to GDP is about 100%, indicating that the Cypriot economy is highly open, the advanced trade interdependence with EU reveals that the Cypriot economy can be influenced by developments in the euro area and the EU as a whole.

Given the high degree of interdependence of the EU economies as well the participation of Cyprus in the euro area since January 2008, the macroeconomic performance of Cyprus is examined in relation to the euro area's macroeconomic developments. A first stylized fact is that Cyprus exhibits a high degree of real convergence with the European Monetary Union (EMU) since in 2007 Cyprus' real GDP per capita was 83% that of the euro area average. Furthermore, in terms of real GDP growth, Cyprus has performed better than the euro area. During the period 1991-1998, Cyprus' GDP grew at an annual average of 4.5%, while for the period 2000-2006 GDP it continued to grow at an annual rate of 3.6% on average. The Cypriot economy continued to grow after Cyprus' accession to the EU. Real GDP increased by 4.4% in 2007 compared with 4% in 2006. In line with the output growth of the Cypriot economy, unemployment decreased from 4.7% in 2006 to 4.1% in 2007. Similarly, inflation was slightly lower in 2007 (2.4%) compared to 2006 (2.5%). With respect to the fiscal stance of the Cypriot economy, we observe that prior to becoming an EU member the government deficit as a ratio of GDP was 6.4% and the public debt

ratio was 70.9%. In contrast for the fiscal year 2007, the Cypriot government had a budget surplus of 3.3% of GDP, while the public debt ratio has also been reduced from 64.8% in 2006 to 59.8% in 2007.

Cyprus' overall good macroeconomic performance, along with its fulfillment of the Maastricht convergence criteria, led to it being admitted to the EMU on January 1, 2008. Kyriacou and Syrichas (1999) argued that Cyprus' macroeconomic performance was expected to benefit from the introduction of the euro, even during the period when Cyprus was a candidate country. Thus, they pointed out that the convergence of the Cypriot economy with the euro area was expected to reduce price differentials between Cyprus and the other euro area members. Furthermore, Constantinou *et al*. (2008) argued that the adoption of the euro was expected to substantially reduce price differentials across EMU members. However, after joining EMU, the inflation rate in Cyprus increased from 2.4% in 2007 to 4.7% in 2008 and has remained above the euro area average rate since then. Apart from the increase in the inflation rate, the Cypriot economy presented signs of overall macroeconomic instability during the first year of EMU membership. A slowdown in GDP growth rate was detected, 3.8% in 2008 compared with 4.5% in 2007, and unemployment grew by 2.5% in 2008 compared with 3.1% in the previous year. Finally, the current account deficit as a ratio of GDP increased from 2.8% in 2007 to 15.8% in 2008.[1]

The present study is motivated by recent developments in the Cypriot economy. The main issue that we examine is whether the macroeconomic instability of the Cypriot economy in 2008 can be explained by the adoption of the euro and its participation in the eurozone. Specifically two main questions were addressed. First, was Cyprus ready to join EMU in January 2008? Secondly, was the central parity rate

[1] Orphanides (2008) provides an excellent review of the monetary policy in Cyprus as well of the overall macroeconomic performance of the Cyprus economy over the last twenty years.

of the Cyprus Pound-euro (CYP/EUR) exchange rate at the appropriate level? Given the fulfillment of the convergence criteria and the strong macroeconomic performance of Cyprus during the pre-entry period, there was no clear indication that Cyprus was not ready to join the euro area in 2008. Hence, in this paper we focused on the second question, namely, whether the central parity rate (€1=0.585274CYP) was the appropriate one in the sense of it being consistent with the macroeconomic fundamentals of the Cypriot economy at the time when it joined the eurozone.

Equilibrium exchange rates are defined as the exchange rates which are consistent with a set of fundamental macroeconomic variables (MacDonald, 2007). Therefore, the present analysis discusses and examines the case of the equilibrium exchange rate CYP/EUR in order to detect whether significant misalignments from its equilibrium rate can be detected. Such evidence was important information for the monetary authorities and the policy makers when they designed the exchange rate policy in the course of the fulfillment of the Maastricht criteria, which led to the eventual participation in the EMU. The presence of significant exchange rate misalignments could have caused important macroeconomic imbalances in the Cypriot economy. If Cyprus is shown to have joined the eurozone with an undervalued pound, we would then expect the Cypriot economy to face inflationary pressures. In contrast, if the domestic currency was overvalued at the time of the application to join the EMU, then we should expect that the Cypriot economy would face a loss in international competitiveness.

Given the above discussion and the need for all candidate EU countries to fulfill the convergence criteria in order to adopt the euro, the estimation of the corresponding equilibrium exchange rate is of crucial importance. Most of the recent empirical work on the issue has been carried out for the transition economies of

Central and Eastern Europe [see for example, Egert (2002); Egert and Lommatzsch (2003); Giannellis and Papadopoulos (2007)]. Employing the Behavioral Equilibrium Exchange Rate model, Pattichis *et al*. (2007) found that the real effective exchange rate of the Cyprus pound was close to its equilibrium rate. However, the derived information applies to the overall value of the Cyprus pound against a basket of currencies and not to the specific value of the Cypriot currency against the euro. Focusing on the bilateral Cyprus pound exchange rate against the ECU/euro, Giannellis and Papadopoulos (2010) have shown that the CYP/EUR exchange rate follows an equilibrium process towards the Purchasing Power Parity (PPP) condition.

In the present study, we introduce a direct as well as an indirect way to estimate the equilibrium value of the Cyprus pound. The direct procedure involves the examination of the Cyprus pound exchange rate vis-à-vis the euro, covering the period from 1993 to the time of the adoption of the euro. The indirect method aims to estimate the equilibrium value of the Cyprus pound against the currencies of the major EU members', covering the pre-EU membership period.[2] In doing so, we estimate ten bilateral exchange rates, taking the Cyprus pound as the reference currency. The ten currencies are decomposed into three categories: (a) the euro, which represents the single currency of the euro area, (b) currencies of EU members which are already members of the EMU, such as the Deutsche mark; the French franc; the Italian lire; the Spanish peseta; the Belgian franc; the Irish pound; the Dutch guilder and (c) currencies of EU members that do not participate in the EMU, such as the UK pound

[2]The different sample periods are applied here for comparative reasons. Namely, we have used two different sample periods depending on the status of Cyprus. During the first period Cyprus was a candidate for EU membership, while the second is a larger period covering Cyprus' candidature for both the EU and the EMU. By comparing the results, we aim to find whether EU membership has led the exchange rate closer to the equilibrium and the central parity rates.

and the Danish crone.[3] To the best of our knowledge of the literature, the present paper is the first work, which in the context of equilibrium exchange rates, attempts to determine whether EMU membership can explain the interruption of the increasing growth rate of the Cypriot economy.

There are several significant results that stem from our analysis. First, we found that the Cyprus pound was not significantly misaligned against the currencies of the main EMU members', such as the Deutsche mark and the French franc. Second, it was also demonstrated that with respect to the currencies of two EU but non-EMU members, there was minor misalignment against the Danish krone but substantially higher misalignment rate with respect to the UK pound. Finally, we showed that the Cyprus pound exchange rate vis-a-vis the euro has followed an equilibrium process towards the central parity rate, implying that the parity chosen for the adoption of the euro (€1=0.585274CYP) was consistent with the macroeconomic fundamentals of the Cypriot economy.

The remainder of the paper is organized as follows. The next section illustrates the theoretical model while section 3 describes the data set and its properties. Section 4 presents our estimation output and a concluding section summarizes and discusses the implications of the results.

2. Theoretical Framework

The methodological framework is a joint structure of the monetary model of exchange rate determination (Frenkel, 1976; Kouri, 1976; and Mussa, 1976, 1979) with the Behavioural Equilibrium Exchange Rate (BEER) model. The BEER model (Clark and MacDonald, 1998) involves the direct econometric analysis of the

[3]For the currencies which have been replaced by the euro, we calculate the "quasi" currencies by using the central parity rate of each currency against the euro.

behavior of the exchange rate. It does not actually rely on any theoretical model and the equilibrium rate is designated by the long-run behavior of the macroeconomic variables.

Following Clark and MacDonald (1998), we set as Z_1 a vector of macroeconomic fundamentals that affect the exchange rate in the long run, as Z_2 a vector of macroeconomic fundamentals that affect the exchange rate in the medium run and as T a vector of variables that affect the exchange rate in the short run. Then, the nominal exchange rate is defined as follows:

$$s_t = \beta_1 Z_{1t} + \beta_2 Z_{2t} + \tau T_t + u_t \quad (1)$$

where β_1, β_2 and τ are reduced form coefficients and u_t is the error term.

The current values of the medium-run and long-run fundamentals give the current equilibrium exchange rate, which is expressed by equation (2) below. By subtracting (2) from (1), we get the current misalignment, which is expressed by equation (3).

$$\overline{s_t} = \beta_1 Z_{1t} + \beta_2 Z_{2t} \quad (2)$$

$$s_t - \overline{s_t} = \tau T_t + u_t \quad (3)$$

What actually matters in our analysis is the total misalignment, that is the deviation of the actual exchange rate from the total equilibrium exchange rate. To estimate the total misalignment, we replace Z_1 and Z_2 in equation (1) with the long-run (or equilibrium) values of the fundamentals, $\tilde{Z}_1$ and $\tilde{Z}_2$, respectively. In other words, the total equilibrium exchange rate (BEER) is estimated by filtering the

fundamentals from speculative and cyclical factors. Maintaining the theoretical affairs of the monetary model[4], the BEER is given by:

$$BEER = (\tilde{m}_t - \tilde{m}_t^*) - \varphi(\tilde{y}_t - \tilde{y}_t^*) + \mu(\tilde{r}_{t+1} - \tilde{r}_{t+1}^*) \quad (4)$$

Comparing the BEER with the actual exchange rate we find out how much the latter deviates from the former. If the actual exchange rate, s_t, exceeds the BEER, the exchange rate is said to be overvalued, while if the actual exchange rate is less than the BEER, the exchange rate is undervalued. Thus, the total misalignment rate is given by

$$\xi_t = s_t - \beta_1 \tilde{Z}_{1t} - \beta_2 \tilde{Z}_{2t} \quad (5)$$

Finally, by adding and subtracting the current equilibrium exchange rate, $\overline{s}$, from the right-hand side of equation (5) and using equation (3), we can decompose the source of exchange rate misalignment, ξ:

$$\xi_t = (\tau T_t + u_t) + \beta_1 (Z_{1t} - \tilde{Z}_{1t}) + \beta_2 (Z_{2t} - \tilde{Z}_{2t}) \quad (6)$$

Equation (6) illustrates the sources of exchange rate deviation from its equilibrium value. These are: (i) the transitory factors that have a short-run effect on the exchange rate, (ii) the disturbance term and, finally and more importantly, (iii) the deviations of the macroeconomic fundamentals from their long-run (or equilibrium) values.

[4] According to the monetary model, the exchange rate is described by the following expression: $s_t = (m_t - m_t^*) - \phi(y_t - y_t^*) + \mu(r_t - r_t^*)$, in which s is the nominal exchange rate (domestic currency per unit of foreign currency) and m, p, y, r represent the domestic money supply, the domestic price level, the domestic real income and the domestic interest rate, respectively. (*) denotes the respective foreign variables.

3. Data

The data were retrieved from the *International Financial Statistics* of the International Monetary Fund and the OECD *Main Economic Indicators* databases. The dataset includes monthly observations on nominal exchange rates, interest rates, money supply and output for Cyprus, UK, Germany, France, Italy, Spain, Belgium, Denmark, Ireland, the Netherlands and the Euro Area. Data availability ranges from country to country. However, the general sample period is 1988:01-2007:12. The estimated period for the panel of the EU countries (EMU and non-EMU members) runs from 1988:01 to 2004:02, while the model of the whole Euro Area covers the period 1993:01-2007:12.

Exchange rates ***(s)*** are nominal cross rates of the Cyprus pound against a single currency. For example, to calculate the nominal cross exchange rate of the Cyprus pound vis-à-vis the UK pound we have used the Cyprus pound vis-à-vis the US dollar and the UK pound vis-à-vis the US dollar exchange rates. The same calibration applies in each case. Moreover, with respect to the EMU members, the exchange rates against the US dollar were available until 1998/12. This is because of the introduction of the single European currency in 1/1/1999. This gap is filled by euro rates adjusted by the corresponding fixed conversion rate. For example, in the case of Germany, we have multiplied the euro rate by 1.95583. For the euro exchange rate, prior to 1999, we have used the synthetic euro exchange rate vis-à-vis the US dollar, calculated as explained by Nautz and Offermanns (2006).

Nominal interest rate ***(r)*** is expressed by lending rates in all countries, except Denmark and the Euro Area, for which it is expressed by the discount rate and the interbank (overnight) rate, respectively. In order to confirm robustness, Cyprus' lending rate has been replaced by the above interest rates in the corresponding

models. Furthermore, money supply ***(m)*** is represented by M0 in the Cyprus/UK and Cyprus/Denmark models, and by M1 in the Cyprus/Euro Area model. For the rest of our panel, money supply is available until 1998:12. Obviously, this affects the EMU members, which after 1999 lost the ability to conduct monetary policy independently. It would not be appropriate to fill this gap with the absolute value of the EMU money supply. In contrast, we have used the change in money as a proxy of the money supply. For the period after 1999, the change in EU money supply has been applied. This allows us to capture the percentage change of money that each country-member faces from one period to another. However, money supply fluctuation cannot be captured for Belgium, because of insufficient data availability on money definitions for this country. When money supply is represented by absolute values (M0 or M1), this is expressed in natural logarithms. On the other hand, change in money is presented as a percentage. Finally, output variable ***(y)*** is represented by industrial production, which is expressed in natural logarithms in all models apart from the Cyprus/Euro Area model. For this model, the output variable is presented by the industrial production growth rate.

4. Empirical Results

4.1. Cointegration analysis

The application of Johansen's (1988, 1991) multivariate cointegration analysis allows us to obtain rich insights into possible long-run relationships among the nominal bilateral exchange rates of the Cyprus pound and the macroeconomic fundamentals.[5] The first stage of our analysis involves the examination of the

[5] Prior to the estimation of the VECM model we conduct unit root and stationarity tests to determine the stochastic properties of the data. We employ the Elliot *et al*. (1996) and Elliot (1999) GLS augmented Dickey-Fuller and Ng and Perron (2001) GLS versions of the modified Phillips-Perron

robustness of the Vector Error Cointegration Models (VECMs) by testing the constancy of their parameters using a battery of residual misspecification tests.[6] Table 1 provides substantial information on the stability of the estimated VECM models. Specifically, the null hypothesis of no serial correlation could not be rejected in each case. Moreover, we were unable to reject the null of homoskedastic errors in all cases apart from the Cyprus/Belgium model, since for the latter case the variance of the errors is not constant across the sample. Finally, the normality hypothesis is rejected in all models. Therefore, we note that our conditional VAR model is well specified, except for the presence of non-normality. Normality can be rejected as a result of skewness (third moment) or excess kurtosis (fourth moment). Since the properties of the cointegration estimators are more sensitive to deviations from normality due to skewness than to excess kurtosis we also report the third and fourth moment around the mean. It turns out that the rejection of normality is essentially due to excess kurtosis, and hence not so serious for the estimation results (see also Gonzalo, 1994).

Given the evidence of stability of the estimated models, the second step of our analysis involves testing for the existence of cointegration between the nominal exchange rate and the vector of fundamentals (m-m*, y-y*, r-r*) and the estimation of the corresponding statistical significant cointegration vectors. Based on Johansen's (1992a,b) testing methodology for the choice of the appropriate cointegration sub-

(1988) unit root tests. For robustness we also apply the Kwiatkowski *et al*. (1992) KPSS stationarity test. The results show that we are unable to reject the null hypothesis of a unit root in the data for the levels of the majority of the series, whereas the first differences of the series are I(0) processes. We also tested for the presence of structural breaks in the data using the two-break and one-break LM (Lagrange Multiplier) tests developed by Lee and Strazicich (2003, 2004). When the two-break LM test (Lee and Strazicich, 2003) shows that only one structural break is significant, we employ the one-break LM test (Lee and Strazicich, 2004). The overall evidence suggests that we could not reject the presence of a structural break. By modelling the implied structural breaks, we are still unable to reject the null hypothesis of a unit root in the levels of the series. Similarly, there is evidence that the series are difference stationary. To save space all unit root results are available upon request.

[6] To be specific we test the hypotheses of non-autocorrelated, homoskedastic and normally distributed residuals. The serial correlation hypothesis is tested through the Lagrange-Multiplier test in which the null states that errors are not serially correlated. Finally, White's heteroskedasticity test includes the null hypothesis of homoskedastic errors and the hypothesis of normal errors is tested through the Jargue-Bera test.

model, we chose to estimate a model with an unrestricted linear trend in the VAR equation and a constant restricted in the cointegrating vector in all cases besides Ireland, for which a model with an unrestricted constant in the VAR was chosen.[7]

Table 2 (panels A-J) reports the results of both the trace and maximum eigenvalue likelihood ratio test statistics, corrected by a small sample adjustment as suggested by Reimers (1992). This small sample correction is important because the Johansen test statistics are biased in small samples toward finding cointegration too often if asymptotic critical values are used. All test statistics are adjusted for degrees of freedom by multiplying the test statistics by $(T - pk)/T$, where T denotes the sample size, p the number of endogenous variables and k the lag length of the model. The adjusted trace and maximum eigenvalue statistics imply that cointegration between the nominal exchange rate and the macroeconomic fundamentals could be established in only six of the ten models, those of Cyprus/UK, Cyprus/Germany, Cyprus/France, Cyprus/Denmark, Cyprus/Belgium and Cyprus/Euro Area, in which cases the existence of one statistically significant cointegrating vector was identified.

4.2. Equilibrium exchange rates

The evidence from the cointegration analysis implies that the exchange rate behavior can be explained by the macroeconomic fundamentals in the Cyprus/UK, Cyprus/Germany, Cyprus/France, Cyprus/Denmark, Cyprus/Belgium and Cyprus/Eurozone. However, the estimation of the equilibrium value of the exchange rate is possible in five of these cases since neither the long-run exchange rate nor the equilibrium exchange rate can be estimated for the case of Belgium. The long-run

[7] We test the restricted against the less restricted model using their computed trace statistics. These tests follow the X^2 distribution and the degrees of freedom are as shown below:

1~2 (**c** d.f.), 2~3 (**v-c** d.f.), 3~4 (**c** d.f.) , 4~5 (**v-c** d.f.)

where *c* is the number of cointegrated vectors and *v* is the number of parameters.

exclusion test shows that both the output and the interest rate differentials could be excluded from the exchange rate equation.[8]

In the remaining models, by normalising the cointegrating vector, we can derive the reduced form equation which explains the relationship between the exchange rate and the fundamentals. Accordingly, the BEER is calculated by obtaining the sustainable values of the fundamentals using the Hodrick-Prescott (1997) filter. This filter entails a smoothing method which estimates the long-run components of the variables. Substituting the current values of the fundamentals by their sustainable values we calculate the equilibrium exchange rate. However, there has been a lot of criticism regarding the statistical properties of the H-P filter. One of the issues discussed is its poor performance near the end of the sample. Mise *et al*. (2005), Kaiser and Maravall (1999) and Baxter and King (1999) provide evidence of suboptimal H-P filtering at the endpoints. To avoid this inconsistency, following Kaiser and Maravall (1999), we estimate optimal Autoregressive Integrated Moving Average (ARIMA) forecasts and apply the H-P filter to the extended series.[9] As noted by Mise *et al*. (2005), this approach minimizes the standard deviation of revisions of the estimated time T cyclical components when this forecast-augmented approach is used in conjunction with the HP filter.

4.2.1 Cyprus pound per UK pound

The evidence of one cointegrating vector between the exchange rate and the macroeconomic fundamentals reveals that the monetary model establishes a valid long-run equilibrium condition for the Cyprus pound exchange rate vis-à-vis the UK pound. The weak exogeneity test, as shown in Table 3 (Panel A), argues that the

[8] The results of this test are not reported to save space. However, they are available on request.
[9] The forecasts are estimated by an ARIMA, using the TRAMO-SEATS program of Gomez and Maravall provided by Eviews 5.

exchange rate is driven to equilibrium by the money supply and the interest rate differentials. In addition, all variables are found to be statistically significant except of the relative money supply. The long-run exchange rate (current equilibrium) is given by

$$s = \underset{(0.05)}{-0.283} + \underset{(0.0012)}{0.0013}(m - m^*) - \underset{(0.47)}{1.168}(y - y^*) + \underset{(0.007)}{0.0137}(r - r^*) \qquad (7)$$

This finding is further supported by the long-run exclusion test, shown in the last column of Table 3 (Panel A). As a result, the money supply differential can be excluded from the cointegrating space. In addition, the estimated parameters in equation (7) are correctly signed and this is in line with the predictions of the monetary model. This means that a relatively higher output growth in Cyprus is expected to lead to an appreciation of the Cypriot currency. However, a relatively higher domestic interest rate will cause a depreciation of the Cyprus pound. Although the money supply differential seems to be correctly signed, we do not rely on this parameter since it is statistically insignificant.

Based on equation (7) and applying the modified Hodrick-Prescott filter we estimate the behavioral equilibrium exchange rate (total equilibrium). The left-hand side of Figure 1 illustrates the actual exchange rate along with the long-run exchange rate (current equilibrium) and the BEER (total equilibrium), while the right-hand shows the total misalignment. If the actual exchange rate is above the BEER, the domestic currency is said to be undervalued. This corresponds to positive values of the total misalignment on the right-hand side of Figure 1. In contrast, if the actual exchange rate is below the BEER, the domestic currency is considered as overvalued. This corresponds to negative values in total misalignment. Our findings show that the entire estimated period can be decomposed into three sub-periods.

The first sub-period, from 1988 to the end of 1993, corresponds to an undervaluation era for the Cyprus pound. The actual exchange rate illustrates a slight appreciation of the Cyprus pound, while the BEER implies higher appreciation for the Cypriot currency. The same status of exchange rate misalignment is found during the third sub-period from 1997 to the end of the sample. During 1997 the BEER implies a constant appreciation trend for the Cyprus pound, but the actual exchange rate does not follow a constant pathway. In 1997 the Cyprus pound started to depreciate against the UK pound, but after 2000 it follows an appreciating trend. These two undervaluation periods are interrupted by a unique overvaluation of the domestic currency during the second sub-period which lasts from 1994 to 1996. Although the BEER implies that the Cyprus pound should have started to depreciate in 1994, the actual exchange rate starts increasing only after 1995. On average, the exchange rate deviates from its equilibrium rate by 40%.

With respect to the main research question of the paper, the undervaluation status of the Cyprus pound and the high degree of trade relationships between Cyprus and UK could explain the observed increase in Cyprus' inflation rate from the beginning of 1999 until the middle of 2000 and from 2001 to 2003. Although since 1997 the Cyprus pound was continuously undervalued against the UK pound, we have observed a decline in Cyprus' inflation rate during the periods 2000/6 – 2001/1 and 2003/3 – 2004/3. This implies that Cyprus' inflation rate is not influenced exclusively by movements in the Cyprus pound per UK pound exchange rate. The reduction in the inflation rate is attributed to the applied exchange rate policy by the Cypriot monetary

authorities.[10] As a consequence, we can argue that Cyprus pound's undervaluation against the UK pound can only partially explain the Cypriot inflation rate fluctuation.

4.2.2. Cyprus pound per Deutsche mark

Likewise, cointegration analysis provides evidence that the monetary model can be considered as a valid long-run equilibrium condition for the Cyprus pound exchange rate vis-à-vis the Deutsche mark. This equilibrium relationship is driven by the money supply and interest rate differentials and the exchange rate itself. The second column of Table 3 (Panel B) illustrates that at the 10% significance level the output differential is the only endogenous variable in the exchange rate equation. However, the output and interest rate differentials are not statistically significant. This is shown in the following long-run exchange rate equation:

$$s = \underset{(0.26)}{-1.10} + \underset{(0.02)}{0.119}(m - m^*) + \underset{(3.75)}{0.68}(y - y^*) + \underset{(0.11)}{0.127}(r - r^*) \qquad (8)$$

The evidence of the long-run exclusion test (Table 3, Panel B) supports the exclusion of those variables from the exchange rate equation. Therefore, excluding the insignificant variables the estimated coefficient of the money supply differential is signed as expected. Namely, a relatively higher increase in the Cypriot money stock is expected to depreciate the Cyprus pound.

According to the estimation of the equilibrium exchange rate, the left- hand side of Figure 2 presents the observed exchange rate (actual), the current equilibrium (LRER) and the total equilibrium (BEER). The right-hand side presents the

[10] The exchange rate was used as an anchor for achieving low inflation and macroeconomic stability. For the period 1960-1972, the Cyprus pound was pegged to the UK pound and for a short time (1972-1973) it was pegged to the US dollar. From 1973-1992, the Cyprus pound was pegged to a basket of currencies, while from 1992 the Cyprus currency was pegged to the ECU (1CYP=1.7086ECU).

misalignment rate, which is calculated as the difference of the BEER from the actual exchange rate. As with the UK case, the whole period under estimation can be decomposed into three sub-periods: The first one is from 1988 to 1992, the second is from 1993 to 1997 and the third covers the period 1998 to the end of the sample. In the first and third sub-periods it is implied that the Cyprus pound was overvalued, while a single period shows that the Cyprus pound exchange rate against the Deutsche mark was above its equilibrium rate, i.e. Cyprus pound was undervalued. The unique undervaluation period lasts from 1993 to 1997. On average, the misalignment rate is 9%.

The BEER follows a decreasing trend from 1988 until 1995. In contrast, the actual exchange rate follows an increasing trend during the same period of time. The third sub-period, which is an overvaluation period for the pound, is a result of the general depreciation trend implied by the BEER. Again, the actual exchange rate implies a relatively stable exchange rate. These findings lead to the conclusion that the actual exchange rate has not deviated significantly from its equilibrium rate. As a result, we should expect neither inflationary pressures nor negative competitiveness shocks in the Cypriot economy. Since Germany is a leading economy in the euro zone and an important trade partner of Cyprus, a significant undervaluation rate of the Cyprus pound against the Deutsche mark could lead to higher inflation in the Cypriot economy. In contrast, Cyprus' competitiveness would be harmed by a significant overvaluation rate of the Cyprus pound. In the event of an overvalued currency, domestic goods become more expensive for foreign customers and the external demand for domestic goods declines. However, the equilibrium trend of the Cyprus pound per Deutsche mark exchange rate implies that trade with Germany and the

introduction of Cyprus into EMU do not entail any risk for the Cypriot macroeconomic stability.

4.2.3. Cyprus pound per French franc

We next examine the case of the Cyprus pound exchange rate vis-à-vis the French franc. As shown in the weak exogeneity test (Table 3, Panel C), this relationship is driven to equilibrium by the money supply and the output differentials. Equation (9) shows that all estimated coefficients are found to be statistically significant. Similarly, the long-run exclusion test (Table 3, Panel C) reveals that no variable can be excluded from the cointegrating space at the 10% significance level. However, at the 5% significance level the same test shows that the output differential should be excluded from the exchange rate equation.

$$s = \underset{(0.007)}{-2.45} - \underset{(0.0008)}{0.003}(m - m^*) + \underset{(0.15)}{0.57}(y - y^*) + \underset{(0.004)}{0.027}(r - r^*) \qquad (9)$$

The interest rate differential has the correct sign according to the predictions of the monetary model, whereas both the money supply differential and the output differential estimated coefficients carry the opposite sign to the predicted one. Therefore, a relatively higher interest rate in the Cypriot economy is expected to depreciate the Cyprus pound. Our findings imply that a relatively higher increase in the Cypriot money supply is expected to appreciate the domestic currency. Similarly, in contradiction to the monetary model, our findings imply that the Cyprus pound is expected to depreciate if Cypriot output grows more than French output.

Assuming that the money demand is stable, a higher level of domestic money supply will reduce interest rate and thus will lead to lower expected inflation. If we

also consider that expectations are rationally formed, the higher monetary expansion in Cyprus may make Cypriot goods preferable to foreign ones. Hence, the trade balance may improve and the Cyprus pound may appreciate. In contrast, the unexpected sign of the output variable may be explained by the effect of the increased income on domestic consumption. Imports may increase more than exports causing the trade balance to deteriorate. This creates depreciating pressures on the domestic currency.

Figure 3 shows that the Cyprus pound per French franc exchange rate is very close to its equilibrium rate. Although the long run exchange rate is very volatile, both the actual exchange rate and the BEER follow similar pathways. First, they do not exhibit high volatility. Second, they follow in general the same trend, i.e. appreciation or depreciation. This implies that the observed exchange rate follows an equilibrium process. This is shown by the misalignment rate shown in the right-hand side of the figure. The misalignment rate moves around the zero, implying that the actual exchange rate moves around the BEER. Until 1995, the Cyprus pound was slightly below the BEER but both follow an upward trend. Since 1996, both follow a decreasing trend. Only at the end of the estimated period do the actual exchange rate and the BEER follow opposite trends. Since 2003 the actual exchange rate shows that the Cyprus pound follows a depreciating trend, while the BEER shows that it should follow an appreciating trend. However, this deviation is not that high. On average, the actual exchange rate deviates from its equilibrium by only 1%.

With respect to the effects of the potential exchange rate misalignment to the Cypriot economy, our results demonstrated that Cyprus' macroeconomic performance is not expected to be negatively affected by the Cyprus pound per French franc exchange rate. This is due to the fact that the exchange rate moves toward its

equilibrium rate implying that there is no reason to expect any inflationary pressures or competitiveness problems to develop, generated by the undervaluation or overvaluation of the Cyprus pound against the French franc. This evidence is important for the Cypriot economy given that France is a major economy in the euro zone and one of the major trade partners of Cyprus. Likewise, Cyprus trade with France and Cyprus' membership in EMU are not expected to threaten its macroeconomic performance.

4.2.4. Cyprus pound per Danish krone

The estimated monetary model has also been shown to provide a statistically significant long-run relationship between the exchange rate and the macroeconomic fundamentals for the Cyprus pound exchange rate vis-à-vis the Danish krone. The weak exogeneity restriction test, reported in Table 3 (Panel D), implies that the exchange rate is driven to equilibrium by the exchange rate itself. Furthermore, the long-run exclusion test shows (Table 3, Panel D) that none of the variables can be excluded from the cointegrated space. This is in line with the estimated coefficients and the standard errors, as shown in the equation below

$$s = \underset{(0.14)}{-3.39} + \underset{(0.21)}{0.77}(m - m^*) + \underset{(0.28)}{3.01}(y - y^*) + \underset{(0.01)}{0.08}(r - r^*) \qquad (10)$$

Equation (10) shows that all coefficients are statistically significant and correctly signed, apart from the output differential variable. This means that a relatively higher increase in Cyprus' income is expected to depreciate the Cyprus pound and this may be attributed to the effect that higher domestic income has on domestic consumption and, as a consequence, on the trade balance.

Figure 4 presents the estimated equilibrium exchange rate. The left-hand side panel plots the actual exchange rate along with the current (long-run exchange rate) and the total (BEER) equilibrium exchange rates, while the right panel presents the misalignment rate. The latter is the difference between the BEER and the actual exchange rate. Positive values correspond to undervaluation periods for the Cyprus pound. These periods are small in duration and are observed at the beginning and at the end of the estimated period, i.e. 1988-1989 and 2001-2004. Conversely, negative values imply that the Cyprus pound is overvalued. This occurs during 1989-2001, covering almost the whole estimated period. Although the overvaluation period lasts longer than the undervaluation period, there is no evidence that undervaluation best characterizes the nature of the estimated exchange rate. The average misalignment rate is 2%, while the highest misalignment rate is less than 7%. This means that the actual exchange rate cannot be considered as misaligned in comparison to the estimated equilibrium exchange rate. This occurs because the actual exchange rate follows an equilibrium process. The left panel of Figure 4 illustrates that both the actual exchange rate and the BEER follow the same appreciating trend. An exception is the period 2000-2002, in which the BEER indicates a slight depreciating trend but, the actual exchange rate remains stable until the end of the estimated period.

Finally, based on the overall results we argue that the underlying evidence of overvaluation and undervaluation of the Cyprus pound could not lead to macroeconomic instability in Cyprus. Although an undervalued currency may provide a channel for the transmission of higher inflation from the foreign country to the domestic economy, the period of undervaluation of the Cyprus pound was short, and most importantly, the undervaluation rate did not exceed 7%. Similarly, the low overvaluation rate of the Cyprus pound during the period 1989-2001 could not cause

significant competitiveness problems for the Cypriot economy. Furthermore, the fact that Denmark is not one of the major trade partners of Cyprus explains why the Cypriot macroeconomic performance remains unaffected by these short periods of exchange rate misalignment.

4.2.5. Cyprus pound per Euro

This model estimates in a direct way the equilibrium exchange rate of the Cyprus pound against the single European currency. Unlike the previous models, which estimated the equilibrium value of the Cyprus pound against the currencies of two leading economies of the euro zone and two non-participants in the eurozone, we now provide an estimation of the equilibrium exchange rate of the Cyprus pound vis-à-vis the euro. As we have already shown by the cointegration results, a statistically significant cointegrating vector was identified between the exchange rate and the macroeconomic fundamentals and therefore the monetary model could be considered as a valid long-run equilibrium framework to explain the movements of this exchange rate. However, the money supply differential enters the long-run exchange rate equation with the wrong sign. This is shown in equation (11), which represents the current equilibrium exchange rate

$$s = \underset{(0.28)}{-1.478} - \underset{(0.03)}{0.121}(m - m^*) - \underset{(0.01)}{0.108}(y - y^*) \qquad (11)$$

According to the monetary model, the home currency is expected to depreciate if money supply grows more relative to that of the foreign country. In contrast, our model reveals that the home currency is expected to appreciate if the home country runs greater monetary expansion. As in the case of the Cyprus pound vis-à-vis the

French franc model, this may be explained by assuming constant money demand in both countries. Given this assumption, greater monetary expansion in the home country means that interest rates are falling more in the home country, causing lower expected inflation in this country. Then, home goods become preferable as they are cheaper relative to foreign ones. On the other hand, the output differential is signed as expected. Namely, the home currency is expected to appreciate if the home country grows more than the foreign country.[11]

The underlying equilibrium relationship is driven by the money supply differential and the exchange rate itself. This is implied by the weak exogeneity restriction test, shown in Table 3 (Panel E), which reports that at the 5% significance level the only endogenous variable to the exchange rate equation is the output differential. In addition, the long-run exclusion test provides evidence that neither the output differential nor the money supply differential should be excluded from the cointegrating equation.

The next stage entails the estimation of the total equilibrium exchange rate, which is the Behavioral Equilibrium Exchange Rate. Since the long-run exchange rate (current equilibrium) contains both trend and cyclical components, the BEER (total equilibrium) should contain only sustainable components. The left panel of Figure 5 illustrates the BEER along with the actual exchange rate and the fixed conversion rate at the time of the adoption of the euro (1/1/2008).[12] The actual exchange rate is very

[11] The period of estimation runs from 1993:01 to 2007:12. However, data on the Cyprus short-term interest rate are available only after 1996:01. To ensure robustness we have used two data sets, including the interest rate differential (1996:01-2007:12) and excluding it (1993:01-2007:12). The results from the first data set show that the interest rate differential should be excluded from the cointegrating space. Similarly, the corresponding estimated coefficient is found to be statistically insignificant in the long-run exchange rate equation. For this reason, we present and discuss the results from the second data set (1993-2007). The results from the first data set (1996-2007) are not reported to save space, but they are available on request.

[12] The terms "fixed conversion rate" and "central parity rate" have identical meaning. This rate is presented in natural logarithms, because both the actual and the equilibrium exchange rates are presented in logs.

close to its equilibrium rate. Both series follow the same downward trend, implying that the Cyprus pound has been properly appreciated during this time. The misalignment rate, which is the difference between the actual exchange rate and the BEER, is illustrated in the right panel of Figure 5. The misalignment rate moves around zero, implying once again that the Cyprus pound exchange rate vis-à-vis the euro follows an equilibrium process. On average, the misalignment rate is 3% and the highest misalignment rate does not exceed 7%.

The behaviour of the actual and the equilibrium exchange rates can be decomposed into five sub-periods. From 1993 to late 1996, both rates imply general stability which is consistent with the applied exchange rate policy in Cyprus. Since 1992 the Cyprus pound has been pegged to the ECU (1CYP=1.7086ECU), while since the birth of the euro, the Cyprus pound has been pegged to the euro (1CYP=1,7086EURO) within a fluctuation band of +/- 2.25%, which became wider (+/-15%) in 2001. During the sub-period 1997-2003, the Cyprus pound followed an appreciating trend as a result of the good macroeconomic performance of the Cypriot economy and the fulfilment of the inflation and interest rate convergence criteria. However, this trend was followed by a depreciating trend for the Cyprus pound during the next two years (2004-2005). This development may be attributed to the failure of Cyprus to join ERM II in September, 2004. Cyprus failed to join ERM not because of any exchange rate instability, but because of the unsatisfactory fiscal position of the Cypriot economy. During the last sub-period (2006-2007), the BEER implies a continuous appreciating trend for the Cyprus pound as a result of the high growth rates of the Cypriot economy and the fulfilment of the Maastricht convergence criteria. Nevertheless, the actual exchange rate has followed an upward trend since 2007, implying a slight depreciation of the Cyprus pound. Although this movement

was not consistent with the estimated equilibrium exchange rate, it can be considered as an attempt by the Cypriot monetary authorities to lead the exchange rate close to the central parity rate (i.e. fixed conversion rate).[13]

Overall, we found that the Cyprus pound was not monotonically overvalued or undervalued during the estimated period. In addition, the evidence reveals that the implied misalignment rate was close to zero during the whole period of estimation. However, compared to the actual exchange rate and the fixed conversion rate, the BEER implies that the Cyprus pound was undervalued at the end of the period of analysis. Despite this undervaluation and the fact that the BEER is not identical to the fixed conversion rate, we argue that Cyprus' macroeconomic balance is not expected to be negatively affected by the Cyprus pound exchange rate vis-a-vis the euro. The magnitude of the estimated misalignment rate cannot cause significant inflationary pressures or loss of competitiveness to the Cypriot economy. Finally, although the fixed conversion rate and the BEER are not equal at the end of the estimated period, the fact that they do not deviate significantly implies that the central parity rate (i.e. the fixed conversion rate of the Cyprus pound to the euro at the time of adoption of the euro) is an appropriate one.

5. Summary and concluding remarks

This paper attempts to shed light on the observed slowdown of the Cypriot economy after joining the euro zone. The high GDP growth rates and the low unemployment and inflation rates during the pre-EMU period were followed by a lower GDP growth rate, higher inflation rate and higher current account deficit.

[13] This rate is presented in the left panel of Figure 5 with a dotted line.

Although the participation of Cyprus in EMU was expected to eliminate price differentials across EMU countries, the inflation differential increased in 2008 compared to the corresponding levels in 2007. In this study, we aimed to find the reasons for this slowdown of the Cypriot economy in the context of equilibrium exchange rates. Along with the estimation of the equilibrium Cyprus pound exchange rate vis-à-vis the euro, we estimated the equilibrium value of the Cyprus pound exchange rate vis-à-vis nine European currencies. Seven of them have already been substituted by the single European currency, while the other two currencies do not participate in the euro zone.

The theoretical model used is based on the joint structure of the monetary model and the BEER approach, while the econometric methodology is based on the Johansen multivariate cointegration technique. The evidence of one statistically significant cointegrating relationship among the exchange rate and the macroeconomic fundamentals demonstrates that the monetary model establishes a valid long-run equilibrium condition for the examined exchange rates. However, our empirical results show that the equilibrium exchange rate can be estimated only for five bilateral exchange rates, i.e. the Cyprus pound vis-à-vis the euro, the Deutsche mark, the French franc, the Danish krone and the UK pound. The exchange rates against the mark and the franc provide significant information for the exchange rate against the euro because these two currencies constitute the core of the euro zone. The conomies of Germany and France are leading economies in the euro area and the macroeconomic developments in those economies significantly affect the value of the euro. On the other hand, the analysis of the exchange rates against the UK pound and the Danish crone provide information about how the Cyprus pound behaves against the currencies of two European countries which are not members of the euro zone. In

addition, the information derived from the exchange rate against the UK pound is significant because the UK is the largest non-EMU member trade partner of Cyprus.

Starting from the Cyprus pound exchange rate against EU members' currencies, the results imply that the Cyprus pound was not significantly misaligned against the two major members' currencies, i.e. the mark and the franc. On average, the actual exchange rate of the Cyprus pound against the Deutsche mark deviates from the equilibrium rate by 9%. Similarly, the average misalignment rate for the Cyprus pound vis-à-vis the French franc is only 1%. Assuming that the mark and the franc are the driving forces of the euro, these findings imply that prior to Cyprus' admission to the EU the Cyprus pound vis-à-vis the euro did not deviate significantly from its equilibrium rate. As a consequence, we argue that the reported deviation from the equilibrium could not cause significant macroeconomic imbalances to the Cypriot economy.

Similarly, the Cyprus pound against the Danish krone exchange rate was found to follow an equilibrium process. The average misalignment rate is 2%, while the highest misalignment rate is less than 7%. Hence, we do not expect that trade relationships with Denmark could cause any macroeconomic instability in Cyprus. In contrast, the Cyprus pound exchange rate against the UK pound is found to be significantly misaligned. On average, the misalignment rate is about 40%. The Cyprus pound was mainly undervalued against the UK pound. Because of the high trade interdependence between Cyprus and the UK, one could argue that the undervalued Cyprus pound increased inflation in the Cypriot economy. However, this cannot explain why the inflation rate increased after EMU membership. Although we accept that the undervaluation status of the Cyprus pound could cause inflationary pressures

in the Cypriot economy, this cannot be considered as the primary reason for the rise of Cyprus' inflation rate.

Turning to the Cyprus pound exchange rate against the euro, the estimated equilibrium exchange rate reveals that the Cyprus pound followed an appropriate appreciating trend. In other words, our results show that the above exchange rate has followed an equilibrium process towards the equilibrium exchange rate and the central parity rate. The misalignment rate moves around zero during the whole estimated period, while the average misalignment rate is only 3%. Given that the actual exchange rate, the BEER and the central parity rate do not deviate significantly from each other, we can infer that the central parity rate (€1=0.585274) is appropriate in the sense that it is consistent with the macroeconomic fundamentals. Therefore, Cyprus' macroeconomic instability cannot be charged to the erroneous determination of the central parity rate.

Finally, comparing the results of the pre-EU period with those of the pre-EMU (and post-EU) period, we observe that, in terms of exchange rate misalignment, the Cyprus pound exchange rate vis-à-vis the euro behaves similarly to the Cyprus pound exchange rates vis-à-vis the French franc and the Deutsche mark. After joining the EU, the Cyprus pound exchange rate vis-à-vis the euro continued to exhibit a small deviation from the equilibrium rate. Specifically, until the end of 2006 the exchange rate and the BEER moved closer to the fixed conversion rate (or equivalently, the central parity rate), implying that EU membership positively affected the Cypriot economy in its attempt to drive the exchange rate closer to the appropriate conversion rate.

Summing up, we found that the Cyprus' inflation rate was not influenced by the central parity rate and that the Cyprus pound undervaluation against the UK pound

can only explain a part of the increase in the inflation rate. Thus, the true reasons for the presence of macroeconomic instability in Cyprus are still under investigation. Syrichas (2008) argued that the increase in the Cyprus inflation rate is a result of domestic and external factors. The domestic factor stands for the increased consumption in Cyprus which was caused by the credit expansion in 2008. The latter was a result of the decline in the official interest rate of the Central Bank of Cyprus at the end of 2007 and the decline in the minimum reserve ratio to the euro zone's standards on January 1, 2008. The external factor refers to the increased global oil and food prices. Since we have shown that EMU participation is not directly linked with the increased inflation rate in Cyprus, we agree that the above factors explain the inflation pressures in Cyprus. Similarly, the increase in the current account deficit was due to high domestic demand and low external demand for domestic goods as a result of the global financial crisis. Finally, the increased unemployment rate and the slowdown in the GDP growth rate in Cyprus have been affected by the international financial crisis. Therefore, Cyprus' macroeconomic performance has not been harmed by its EMU membership. In contrast, it has been influenced by international cyclical disturbances.

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Table 1: Residual Misspecification Diagnostics (VECM Adequacy)

Model / **Null Hypothesis**	**No autocorrelation**	**Homoskedasticity**	**Normality**	
			Skewness	**Kurtosis**
Cyprus/UK	16.57 (0.41)	1047.6 (0.06)	*176.3 (0.00)*	
			11.66 (0.02)	*164.6 (0.00)*
Cyprus/Germany	12.805 (0.68)	943.21 (0.79)	*73.35 (0.00)*	
			10.70 (0.03)	*62.65 (0.00)*
Cyprus/France	19.76 (0.23)	961.88 (0.65)	*206.3 (0.00)*	
			7.67 (0.00)	*148.6 (0.00)*
Cyprus/Italy	10.16 (0.85)	1053. (0.05)	*249.2 (0.00)*	
			41.80 (0.00)	*207.4 (0.00)*
Cyprus/Spain	17.70 (0.34)	1202.04 (0.09)	*176.04 (0.00)*	
			13.10 (0.01)	*40.58 (0.00)*
Cyprus/Belgium	17.14 (0.04)	*521.8 (0.00)*	*36.52 (0.00)*	
			3.21 (0.36)	33.31 (0.00)
Cyprus/Denmark	13.76 (0.62)	173.52 (0.00)	*1104.4 (0.00)*	
			90.96 (0.00)	1013.4(0.00)
Cyprus/Ireland	11.52 (0.77)	987.14 (0.43)	*973.6 (0.00)*	
			33.92 (0.00)	*939.7 (0.00)*
Cyprus/Netherlands	17.27 (0.36)	919.8 (0.31)	*2955.7 (0.00)*	
			206.5 (0.00)	*2749.1 (0.00)*
Cyprus/euro area (1996-2007)	18.32 (0.31)	981.29 (0.48)	*59.96 (0.00)*	
			3.36 (0.49)	*56.59(0.00)*
Cyprus/euro area (1993-2007)	4.43 (0.88)	437.92 (0.14)	*52.84 (0.00)*	
			17.53 (0.00)	*5.41 (0.02)*

Notes:

1. The serial correlation hypothesis is tested through the Lagrange-Multiplier test in which the null states that errors are not serially correlated. White's heteroskedasticity test includes the null hypothesis of homoskedastic errors and the hypothesis of normal errors is tested through the Jargue-Bera test. Numbers in parentheses are p-values of accepting the null.

Table 2: Johansen multivariate likelihood cointegration tests

Panel A. Cyprus/UK

			5% Critical Values	
r	Trace	λmax	Trace	λmax
$r = 0$	68.19*	34.81*	54.07	28.58
$r = 1$	33.37	20.16	35.19	22.29
$r = 2$	13.22	10.40	20.26	15.89
$r = 3$	2.81	2.74	9.16	9.16

Panel B. Cyprus/Germany

			5% Critical Values	
r	Trace	λmax	Trace	λmax
$r = 0$	56.15*	30.93*	54.07	28.58
$r = 1$	25.22	12.31	35.19	22.29
$r = 2$	12.91	8.84	20.26	15.89
$r = 3$	3.83	3.53	9.16	9.16

Panel C. Cyprus/France

			5% Critical Values	
r	Trace	λmax	Trace	λmax
$r = 0$	58.28*	21.76	54.07	28.58
$r = 1$	34.52	18.58	35.19	22.29
$r = 2$	17.43	9.80	20.26	15.89
$r = 3$	6.78	7.27	9.16	9.16

Panel D. Cyprus/Italy

			5% Critical Values	
r	Trace	λmax	Trace	λmax
$r = 0$	45.40	27.47	54.07	28.58
$r = 1$	17.93	8.09	35.19	22.29
$r = 2$	9.37	7.07	20.26	15.89
$r = 3$	2.96	2.96	9.16	9.16

Panel E. Cyprus/Spain

			5% Critical Values	
r	Trace	λmax	Trace	λmax
$r = 0$	51.87	27.15	54.07	28.58
$r = 1$	22.72	16.45	35.19	22.29
$r = 2$	8.60	5.30	20.26	15.89
$r = 3$	3.59	3.79	9.16	9.16

Panel F. Cyprus/Belgium

			5% Critical Values	
r	Trace	λmax	Trace	λmax
$r = 0$	38.51*	22.41*	35.19	22.29
$r = 1$	16.10	10.15	20.26	15.89
$r = 2$	4.91	4.46	9.16	9.16

Panel G. Cyprus/Denmark

			5% Critical Values	
r	Trace	λmax	Trace	λmax
$r = 0$	105.77*	89.19*	54.07	28.58
$r = 1$	16.57	8.98	35.19	22.29
$r = 2$	7.59	4.31	20.26	15.89
$r = 3$	3.28	3.28	9.16	9.16

Panel H. Cyprus/Ireland

			5% Critical Values	
r	Trace	λmax	Trace	λmax
$r = 0$	38.04	17.98	47.86	27.58
$r = 1$	20.06	12.73	29.80	21.13
$r = 2$	7.33	7.47	15.50	14.26
$r = 3$	0.06	0.01	3.84	3.84

Panel I. Cyprus/Netherlands

			5% Critical Values	
r	Trace	λmax	Trace	λmax
$r = 0$	50.89	21.26	54.07	28.58
$r = 1$	19.62	13.03	35.19	22.29
$r = 2$	6.59	4.81	20.26	15.89
$r = 3$	1.79	1.79	9.16	9.16

Panel J. Cyprus/Euro Area

			5% Critical Values	
r	Trace	λmax	Trace	λmax
$r = 0$	69.74*	22.41*	35.19	22.30
$r = 1$	9.77	10.15	20.26	15.89
$r = 2$	2.31	4.46	9.16	9.16

Notes: r denotes the number of eigenvectors. Trace and λmax denote, respectively, the trace and maximum eigevalue likelihood ratio statistics. The 5% critical values are taken from MacKinnon *et al*. (1999; Tables III and IV). A structure of five lags was chosen for panels A, B, C, F, I, J and of seven lags for panels D, E, G, H, according to a likelihood ratio test, corrected for the degrees of freedom (Sims, 1980) and the Ljung-Box Q statistic for detecting serial correlation in the residuals of the equations of the VAR. In nine out of the ten panels, a model with no deterministic trend in the data and a constant term in the data and the cointegrating relationship is chosen according to the Johansen (1992 a, b, 1994) testing strategy. For the remaining panel (Cyprus/Ireland), a model with a linear deterministic trend only in the data is chosen following the same testing procedure.
(*) denotes statistical significance at the five percent critical level.
A small sample adjustment has been made in all the likelihood ratio statistics, equal to

$$-2\ln Q = -(T - kp)\sum_{i=r_{0+1}}^{k}\ln(1-\hat{\lambda}_i)$$

as suggested by Reimers (1992).

Table 3. Statistical Properties and Misspecification Tests of the Model

Tests for long-run exclusion and weak exogeneity

Panel A. Cyprus/UK

Variables/Null Hypothesis	Weak Exogeneity	Long run Exclusion
	LR statistic (p-value)	LR statistic (p-value)
S	3.21 (0.07)	N.A.
y-y*	15.19 (0.00)	8.08 (0.00)
m-m*	1.13 (0.28)	1.63 (0.20)
r-r*	2.58 (0.10)	4.51 (0.03)

Panel B. Cyprus/Germany

Variables/Null Hypothesis	Weak Exogeneity	Long run Exclusion
	LR statistic (p-value)	LR statistic (p-value)
S	1.09 (0.29)	N.A.
y-y*	3.53 (0.06)	0.04 (0.83)
m-m*	0.18 (0.66)	36.18 (0.00)
r-r*	0.31 (0.57)	1.56 (0.21)

Panel C. Cyprus/France

Variables/Null Hypothesis	Weak Exogeneity	Long run Exclusion
	LR statistic (p-value)	LR statistic (p-value)
S	10.74 (0.00)	N.A.
y-y*	0.50 (0.47)	3.16 (0.07)
m-m*	0.91 (0.33)	23.95 (0.00)
r-r*	3.75 (0.05)	6.79 (0.00)

Panel D. Cyprus/Denmark

Variables/Null Hypothesis	Weak Exogeneity	Long run Exclusion
	LR statistic (p-value)	LR statistic (p-value)
S	1.81 (0.17)	N.A.
y-y*	37.15 (0.00)	54.21 (0.00)
m-m*	8.62 (0.00)	14.12 (0.00)
r-r*	6.26 (0.01)	51.95 (0.00)

Panel E. Cyprus/Euro Area

Variables/Null Hypothesis	Weak Exogeneity	Long run Exclusion
	LR statistic (p-value)	LR statistic (p-value)
S	3.26 (0.07)	N.A.
m-m*	3.21 (0.07)	10.25 (0.00)
y-y*	67.86 (0.00)	64.22 (0.00)

Note: N.A. denotes not applicable.

Figure 1: Cyprus/UK Equilibrium Exchange Rate

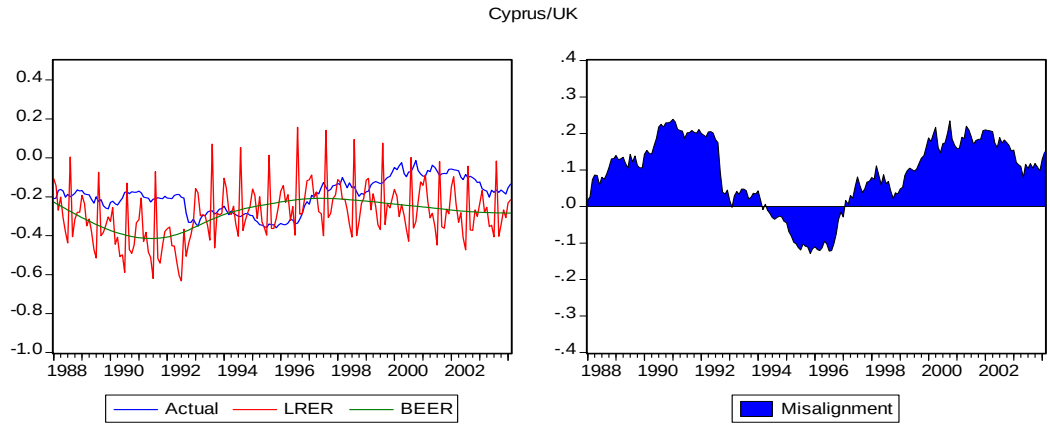

Figure 2: Cyprus/Germany Equilibrium Exchange Rate

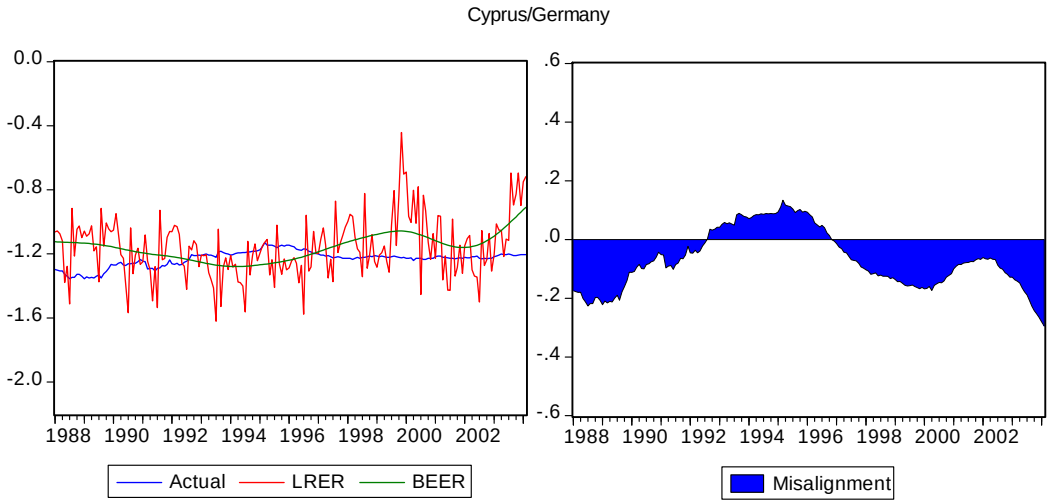

Figure 3: Cyprus/France Equilibrium Exchange Rate

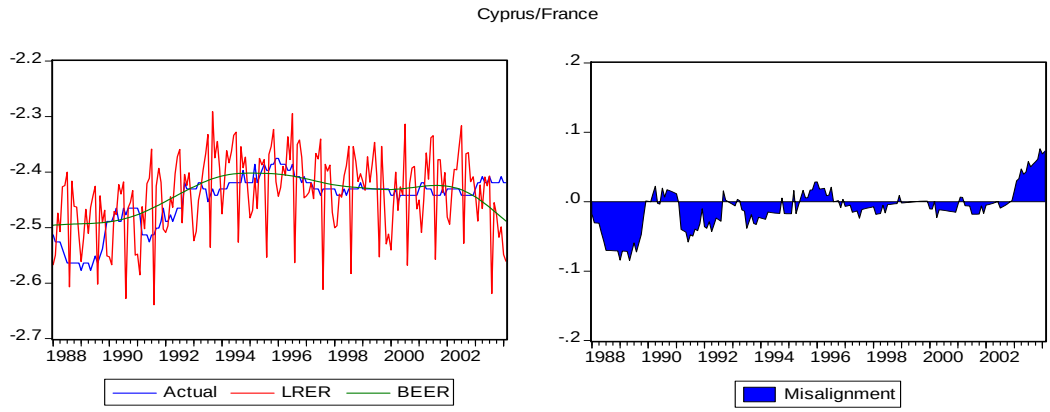

Figure 4: Cyprus/Denmark Equilibrium Exchange Rate

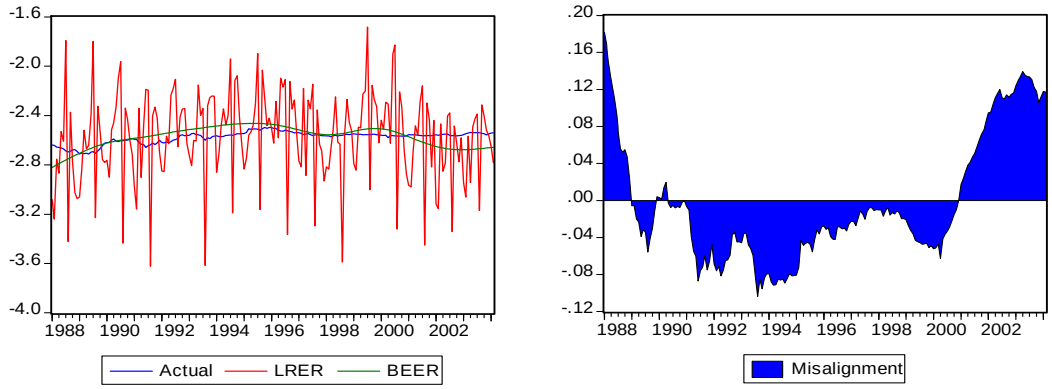

Figure 5: Cyprus/Euro Area Equilibrium Exchange Rate