

DETERMINATION OF THE EQUILIBRIUM REAL EXCHANGE RATE FOR THE PORTUGUESE ECONOMY USING THE FEER*

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1. INTRODUCTION

The real exchange rate is the relative price of a reference basket of goods between the national economy and abroad, where the basket's prices are compared after converted to a common unit. Its equilibrium path reflects at each moment the value of the real exchange rate which is compatible with full employment of productive factors and with the compliance to the intertemporal budgetary constraint between the domestic economy and abroad. In this context, the identification of persistent misalignments of the real exchange rate vis-à-vis its equilibrium values is a means of detecting imbalances in the economy. Although in a situation where no real perturbations occur the real exchange rate shall not be expected to shift away from its equilibrium, the contrary should happen during a real convergence process as that experienced by the Portuguese economy. Indeed, several researches argue that in the catching-up process resulting from the context of economic and monetary integration, the equilibrium real exchange rate in Portugal has tended to appreciate⁽¹⁾. In this framework the estimation of an equilibrium path for the Portuguese real exchange rate in recent years is particularly relevant. This is the objective of the current research.

The methodology is based upon the concept of Fundamental Equilibrium Exchange Rate (FEER) presented by Williamson (1983). This approach provides an alternative to the determination of the rate of equilibrium in the context of Purchasing Power Parity (PPP), which assumes a constant real exchange rate. Indeed, since real variables exhibit changes in the long-run, these should be expected to be embodied in the equilibrium real exchange rate. This issue has been widely explored in literature, and several empirical applications reveal not only a weak adherence of PPP to the behaviour of the real exchange rate — even in the long-run — but also the existence of long-run relationships between the behaviour of the real exchange rate and some real variables⁽²⁾ — e.g., relative productivity between the domestic economy and abroad.

The remainder of this paper is organised as follows: section 2 presents the FEER concept in further detail, highlighting its leading limitations; a simplified application of this methodology to the Portuguese economy in the period 1980-1995 is presented in section 3; the fourth section shows the results for the misalignments of the real exchange rate vis-à-vis its estimated equilibrium path. Section 5 concludes.

2. THE FEER APPROACH

FEER is the real exchange rate that is compatible with the existence of fundamental macroeconomic equilibrium — i.e., that associated to a balanced fundamental account (external equilibrium), in a context where output is at its potential level

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(1) See for instance Cunha and Machado (1993), Esteves (1993), Gaspar and Pereira (1995), Gaspar and Pinheiro (1994) and Rebelo (1992).

(2) For a revision of the literature see for instance Foot and Rogoff (1995), Rogoff (1996) and MacDonald (1995).

and no inflationary pressures exist (domestic equilibrium). For fundamental account we take the sum of the primary current account (CA) of the balance of payments to the net value of external flows of structural or fundamental capitals.

This concept of external equilibrium contrasts with the requirement of a permanently balanced CA as often is considered. Indeed, the fundamental account — which joins the flows in the balance of payments of a more permanent nature — is more adequate than the CA in assessing the exchange rate policy medium/long-run sustainability. When domestic saving differs from domestic investment opportunities measured at the world interest rate, countries will experience structural (or non-speculative) capital imports or exports throughout several years, alongside lasting CA imbalances. Therefore, the notion of external balance implicit in the FEER assumes the equality between the CA and the medium-run equilibrium value of net national saving, which may be assessed by the structural capital net flows.

2.1 Application limitations and difficulties

The implementation of the concept of FEER comprises some difficulties related to the concept of fundamental equilibrium. Indeed, the specification of the domestic and external macroeconomic conditions requires that judgements of value are made on what should be the appropriate policies; hence, the FEER is a normative concept⁽³⁾. For instance, the requirement of a permanently balanced fundamental account reflects a strict notion of external equilibrium, which has implicit a policy decision. This decision can be explained by authorities' concern with the behaviour of the fundamental account in the short-run. In fact, in theory the existence of external equilibrium requires only that net external debt is sustainable — for the economy to meet its liabilities without accumulating unemployed cash balances — which is com-

patible with alternative paths for the fundamental account⁽⁴⁾.

The determination of the fundamental account in practice also does not gather consensus, since the structural capital flows are not easy to identify. The capital items to be included in the fundamental account should be stable and permanent capital flows — i.e., those reacting to differentials between the yields of long-term domestic and external investments, or those reflecting changes in portfolio preferences, possibly lasting for years until the new portfolio equilibrium is met. These characteristics are, however, based on the investor's motives, which in turn are imperfectly correlated with any clear characteristic that can be isolated in the capital account data.

In addition to the application difficulties, the FEER approach encompasses some drawbacks. First, it renders a partial equilibrium analysis, subject to the Lucas' critique. In most empirical applications, as in this paper equilibrium values of domestic and external output are exogenously determined and are substituted in a previously estimated equation for the fundamental account (or for some current account items), which is then

(4) Dolado and Viñals (1991) consider the following equation for the fundamental account (FA):

$$fa_t = ca_t + i_t^* \cdot e_t \cdot b_{t-1}^* + sc_t$$

where ca stands for the current account balance, i^* is the foreign interest rate, e is the nominal exchange rate, b the net external debt deducted from the net balance of stable capitals and sc the net balance of stable capitals. The intertemporal constraint in an open economy can be derived from this equation. This is the condition required to achieve a stable net external debt to GDP ratio:

$$\begin{cases} by_t^* = \sum_{i=1}^{\infty} (1+\lambda)^{-i} \cdot E_t(bfy_{t+i}) \\ \lim_{N \rightarrow \infty} (1+\lambda)^N \cdot E_t(by_{t+N}^*) = 0 \end{cases}$$

where by^* and bfi stand respectively for the net external debt to GDP ratio and the fundamental account to GDP ratio. This condition differs from the intertemporal external constraint usually considered in the intertemporal CA equilibrium approaches, which imposes a null discount flow of current account balances. Underlying this divergence is the fact that the exclusion of stable capitals from the definition of debt implies that these flows shall never be reimbursed. Therefore, the FEER approach can be interpreted as implying a medium-term equilibrium notion, and not the Steady State solution where no capital movements take place.

(3) This characteristic is evident in Williamson (1991) — which recognises that the FEER should be known as the optimal or adequate real exchange rate instead of the equilibrium rate — and in Bayoumi *et al* (1994) — which uses the designation DEER (Desired Equilibrium Exchange Rate) for indicating the real exchange rate compatible with the desired domestic and external equilibrium positions.

solved in order to the real exchange rate in context of a balanced fundamental account. Second, the FEER methodology only allows to identify with some certainty greater misalignments, since it is highly sensitive to assumptions imposed in an *ad-hoc* manner (for instance, as regards stable capitals and domestic equilibrium) and to the value of the fundamental balance elasticities⁽⁵⁾. Third, since the FEER does not embody a notion of intertemporal equilibrium, it disregards the existence of an interaction between the deviations of the real exchange rate from equilibrium and the equilibrium path itself. If at a given moment the real exchange rate stands above the FEER, debt accumulation will occur. This being the case, for the intertemporal external constraint to be fulfilled the fundamental balance may have to exhibit surpluses sometime in the future. In this situation, the FEER — i.e., the real exchange rate compatible with a balanced fundamental account — will stand above the true equilibrium rate. Finally, since the FEER approach is not based upon an explicit theory of real exchange rate determination, it cannot identify the fundamental determinants of the equilibrium changes in the exchange rate, nor of the existence of misalignments.

3. EMPIRICAL APPLICATION

In this paper, we estimate one possible path for the equilibrium real effective exchange rate of the escudo between the first quarter of 1980 and the fourth quarter of 1995, taking the FEER as the equilibrium notion. Following the application developed by Dolado and Viñals (1991) we started by estimating a reduced form for the fundamental account, solved afterwards in order to the real exchange rate in a context of domestic equilibrium. An approximation to the domestic equilibrium was obtained through the trend values for the explanatory variables, which assumes that on average (i.e., apart from the effects of the economic cycles) the economy is at equilibrium or tends to equilibrium. As mentioned by Dolado and Viñals (1991), the specification of a reduced form for the

fundamental account has the advantage of estimating the structural component of net external capital flows, instead of taking these as given as in the previous application to the Portuguese economy. Indeed, Freitas (1992) only models the goods and services account, while Manteu and Mello (1992) and Luís (1993, 1996) only consider dependence on the exchange rate for the exports of goods and services, the imports of goods and services and emigrants' remittances. In addition to the modelling of the fundamental account, the major differences between this research and the previous ones consist of the update of the data used⁽⁶⁾ and its econometric methodology.

The determination of the fundamental account balance, necessary to the estimation, requires the specification of what are considered to be stable or structural capitals. An analysis of the behaviour of the various items of the long-term autonomous capital account — those most likely to be eligible to our definition — reveals the existence of similar behaviours: a relative stagnation up to 1986, followed by a strong growth ending most cases in 1989, and the maintenance of values clearly above those in the initial period afterwards. This behaviour was, however, determined by the process of liberalisation of foreign capital flows and by the Portuguese accession to the European Community. Therefore, it does not indicate that the motivations behind each type of investment are the same, neither that these are not of a speculative nature. Indeed, being statistically hard to separate structural operations from the speculative ones, as in other studies on Portugal we opted to consider net direct investment (i.e., the difference between foreign direct investment in Portugal and Portuguese direct investment abroad). We also noticed that the inclusion of net real estate investment does not change results in a significant fashion. Therefore, the fundamental account results from summing the primary current account balance to net direct investment.

The following were considered the leading determinants of the fundamental account: domestic

(5) This situation, which is implicitly considered in the 10 per cent intervals suggested by Williamson for the fluctuation of the G-7 currencies, is particularly evident in Bayoumi *et al.* (1994) or in Barrell and Wren-Lewis (1989).

(6) The path calculated for the FEER comprised the periods 1961-1990 in Freitas (1992), 1980-1992 in Manteu and Mello (1992) and Luís (1993) and 1980-1994 in Luís (1996). The three latter researches used values estimated in 1991 for the elasticities of the main CA items vis-à-vis the exchange rate.

demand in volume, foreign external demand in volume, the degree of openness of the economy, and the real effective exchange rate⁽⁷⁾⁽⁸⁾. Equation (1) is the dynamic regression in Error Correction Mechanism (ECM) estimated through ordinary least squares⁽⁹⁾. Values in brackets are the *t*-ratios, *T* is a linear trend⁽¹⁰⁾, *bfi* stands for the fundamental balance as a percentage of nominal GDP⁽¹¹⁾, *itcer* is the index of real effective exchange rate (defined so that an increase indicates a real appreciation), *lyr* is domestic demand in logarithms, *ldext* the external demand in logarithms and *g* is the degree of openness of the economy.

$$\begin{aligned} \Delta bfi_t = & 4.27 + 0.40T + 0.20\Delta bfi_{t-3} - 0.48\Delta ldext_{t-2} - \\ & (3.22)(3.28) \quad (2.23) \quad (-2.42) \quad (1) \\ & -0.37\Delta lyr_{t-4} - 0.57\Delta g_t - 0.72bfi_{t-1} - 0.19itcer_{t-1} - \\ & (-2.21) \quad (-4.57) \quad (-6.12) \quad (-4.28) \\ & -0.38lyr_{t-1} + 0.41ldext_{t-1} - 0.66g_{t-1} \\ & (-3.27) \quad (3.29) \quad (-4.45) \end{aligned}$$

Period of estimation: 1981:2 to 1995:4 *WD* = 42.2

DW=1.92; *R*²=0.65; *LM*~*F*(4,44)=1.11 (0.37);
ARCH~*F*(3,42)=0.31(0.82); *N*~ $\chi^2(2)$ =7.33 (0.03);
H~*F*(20,27)=0.64 (0.85); *RESET*~*F*(1,47)=0.56 (0.46)

(7) The used sources and the method of construction of our variables are described in Appendix. The stationarity of these series was studied previously to the formalisation of the equation to be estimated. All series appeared to be *I*(1) — i.e., stationary in the first differences.

(8) At a first stage the relative price of oil vis-à-vis the price of national goods and the differential of real long-term interest rate between Portugal and the leading countries of origin of direct investment were also used as explanatory variables, the latter to try illustrate the relative return of direct investment, as in Dolado and Viñais (1991). However, results were not satisfactory. Indeed, the first variable seems to be related with real exchange rate. Regarding the second, the quality of the series used was limited by the fact that no representative long-term interest rate for Portugal exists until the early 1990's; furthermore, the fact that direct investment flows were liberalised only between the second half of the 1980's and the early 1990's reduced the relevance of the relationship we wanted to study.

(9) Since the dynamic equation is considered only for *bfi*, we implicitly assume that regressors are weakly exogenous for the parameter we wish to estimate. If this was not the case, the ordinary least squares method would result in a loss of information.

(10) For some variables (*lyr*, *dext* and *g*) the hypothesis of these being *I*(1) with a drift was not rejected, which explains the inclusion of a linear trend in the estimated equation.

(11) Given that the explanatory variables are expressed in real terms, we opted for taking the fundamental account as a percentage of nominal GDP as the dependent variable.

with: *DW* the Durbin-Watson test for first-order autocorrelation in the residuals; *R*² the coefficient of determination; *WD* a Wald test for the existence of co-integration in the dynamic equation; *LM* the 4-lag residuals autocorrelation test, *ARCH* a LM statistic that tests autocorrelation of order 4 in square residuals, under the null hypothesis of no conditional autoregressive heteroskedasticity; *N* a normality test on residuals; *H* a statistic that tests the null hypothesis of non-conditional homoskedasticity against the alternative hypothesis of residuals correlated with the regressors and squared regressors; and *RESET* is a functional specification test taking the existence of correct specification as its null hypothesis, against the hypothesis of residuals correlated with the squared adjusted value of the endogenous variable. In parenthesis are the *p* values for each statistic.

The Boswijk test (*WD*) rejects the null hypothesis of no cointegration, even at a 1 per cent level of significance⁽¹²⁾⁽¹³⁾. Although the joint modelling of the fundamental account rises some problems of interpretation of the signs of the estimated coefficients, our results for the long-run coefficients appear to be consistent with the leading effects generally considered. Equation (2) translates the esti-

(12) According to Granger's representation theorem, if a model of variables with the same level of integration admits a ECM representation, then variables are co-integrated. Thus, a way of testing the existence of co-integration using the dynamic model consists of testing the significance of the Error Correction Term (ECT) — i.e., the term translating the long-run relationship. However, this test cannot be carried out with the usual *t*-ratio since the limit distribution of the estimators is not standard. In this context, Boswijk (1994) suggests that the null hypothesis of a null ECT should be tested using a Wald test (*WD*). A sufficient hypothesis for performing this test consists in having weakly exogenous explanatory variables for the parameters of the static regression (i.e., inference over the parameters of the static equation, conditional to the regressors, do not involve loss of information). The *WD* test is calculated as the usual *F*-test statistic (test statistic for the joint nullity of the ECT parameters), times the number of constraints to general model. In the case of regression (1), the critical value drawn from the Boswijk table when the dynamic model encompasses an unrestricted linear trend (i.e., when we do not force the trend to appear only in the ECT) equals 27.52 for a level of significance of 1 per cent.

(13) We also analysed the existence of co-integration in the static regression using the test of stationarity of residuals. As in the dynamic regression, the hypothesis of no co-integration was rejected at the 1 per cent significance (the ADF test equalled -6.22, and the 1 per cent critical value calculated using the table in Mackinnon (1991) equalled -5.69).

mated long-run relationship — i.e., the static equation implicit in dynamic equation (1)⁽¹⁴⁾.

$$bfi_t = 5.90 + 0.55T - 0.26itcer_t - 0.53lyr_t + 0.57ldext_t - 0.92g_t \quad (2)$$

The minus sign of the coefficient for domestic demand in volume seems to reflect the dominance of the positive effect of this variable on the demand for imports, over possible positive impacts on the supply of exports or on direct investment⁽¹⁵⁾. The positive coefficient estimated for external demand in volume is consistent with the expected positive effect on the demand for exports, and may also reflect some impact on direct investment⁽¹⁶⁾. The negative sign of the real exchange rate coefficient must be reflecting the effect of changes in the external competitiveness of the Portuguese economy on the goods and services account (assuming that the Marsall-Lerner condition holds), while the possibility of some negative impact on direct investment cannot be disregarded — since lower competitiveness is mirrored in a reduction in investment return⁽¹⁷⁾. Lastly, the degree of openness of the economy tries to reflect the effects of changes in the trade policy, therefore being particularly relevant in the period under scrutiny

(14) The long-run value of the first difference of a non-stationary variable with a drift is not null but depends on the value of the drift. Thus, the constant in (2) reflects not only its value in equation (1) but also the product of the values of the drifts for *lyr*, *ldext* and *g* by the sum of the short-run coefficients associated to the respective variables.

(15) If the economy's productive capacity is constrained, domestic demand measured by gross domestic product in volume terms may have a positive effect on the supply of exports, for a given price level. In turn, although domestic product is expected to yield a positive impact on Portuguese direct investment abroad (which would render a minus sign in the fundamental balance), the value of net direct investment is dominated throughout most of the sample period by foreign direct investment in Portugal, for which the growth of the domestic market may provide an incentive.

(16) The growth of the external markets may provide an incentive to Portuguese investment abroad. However, it should be noted that this variable was built on a foreign trade basis — as explained in Appendix — thus representing our leading trade partners' demand for imports, and therefore it may not render the best means of describing the size of the economies competing with Portugal in attracting investment. In fact, it may better reflect the developments in the economic course of the potential investor countries, which would lead us to expect a positive effect instead. Another reason for this variable to represent an incentive to investment in Portugal is the fact that a bulk of direct investment in Portugal aims at producing for the external market.

due to the accession of Portugal to the European Community. Its coefficient is negative indicating that the increase in the degree of openness shall have contributed to aggravate the trade deficit⁽¹⁸⁾. This situation is in line with the fact that, in the period following to the accession to the EC, the strong growth of domestic demand for manufactured goods, together with a trade pattern in the European economies adequate to this type of products, yielded a sharper growth of imports than that of exports.

Equalling the long-run equation (2) to zero and rearranging in order to *itcer* yields:

$$itcer_t = 22.7 + 2.1T - 2.0lyr_t + 2.2ldext_t - 3.5g_t \quad (3)$$

The estimated path for the FEER was obtained by expressing (3) in terms of the trend values for the explanatory variables, calculated through the Hodrick-Prescott filter.

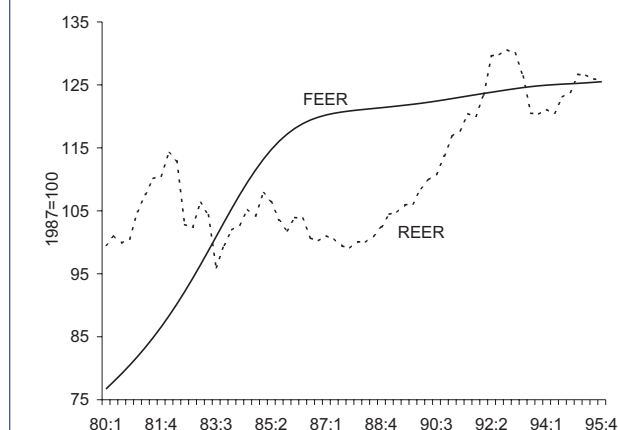
4. DISCUSSION OF RESULTS

According to our results (charts 1 and 2), the equilibrium real exchange rate recorded an appreciation trend over the course of the whole sample period (from the first quarter of 1980 up to the fourth quarter of 1995). Comparing the estimated equilibrium path with the behaviour of the observed real effective exchange rate allows for the identification of three distinct stages in the behaviour of the exchange rate gap, defined as to identify a positive (negative) value with the percentage of FEER that *itcer* has to depreciate (appreciate) so

(17) The real exchange rate is built using consumer price indices, which provide good indicators for the behaviour of labour costs, and these are important factors in determining companies' location.

(18) Krugman (1990) presents arguments indicating that the entry of southern countries in the European Community has a favourable effect on those countries' foreign trade, and arguments otherwise. On the one hand, it is mentioned that a negative effect should be expected, since southern countries present at start a higher level of protectionism than the core countries. On the other hand, the different sizes of the adhering countries and of the countries already belonging to the Community contributes to build a positive effect on trade, since in the case of the smaller country the demand elasticity of exports is higher than that of imports (since it is more likely that the countries in the Community produce close substitute goods).

Chart 1
EQUILIBRIUM REAL EXCHANGE RATE



that the fundamental account, measured in trend values, yields a null balance.

In the early 1980's the escudo recorded a significant overappreciation in real effective terms, which is coherent with the observed fundamental account deficits (amounting to about 4 per cent of GDP on average, between 1980 and 1983). To this behaviour contributed not only the expansionary macroeconomic policies implemented in a period of weakening world economy — linked to the second oil shock — but also the 6 per cent nominal valuation of the escudo in February 1980, alongside the deterioration in the terms of trade.

A period of intense real underappreciation took place in the second half of the 1980's, reaching its maximum in 1987, when the fundamental account recorded a surplus amounting to about 4 per cent of GDP. Indeed, while the estimated equilibrium rate maintained its appreciation trend throughout this period, the real exchange rate only started to exhibit an appreciation trend from mid-1988 onwards. The behaviour of the real exchange rate in this period was conditioned by a 12 per cent nominal effective devaluation, carried out in the context of the IMF 1983/84 stabilisation agreement, and by the maintenance of a crawling-peg policy up to 1990 (interrupted only in 1986).

Finally, worth noting is the alignment of the real effective exchange rate close to its equilibrium path throughout the first half of the 1990's. According to our estimates, since 1991 the exchange rate gap remained systematically below the 5 per cent threshold in absolute terms, reaching about

Chart 2
EXCHANGE RATE GAP



0.2 per cent in the last quarter of 1995. Likewise, this period also saw an improved stability in the Portuguese external accounts: from 1991 up to 1995, the fundamental account and the current account recorded on average balances around 0.7 per cent of GDP and -0.5 per cent of GDP, respectively.

Our findings confirm the main conclusions of previous applications of the FEER methodology to the Portuguese case (Freitas (1992), Manteu and Mello (1992) and Luís (1993 and 1996)). This research points, however, to a sharper real appreciation of equilibrium of the escudo throughout the 1980's and the early 1990's, hence strengthening the empirical evidence of an equilibrium real appreciation process in the Portuguese economy.

5. CONCLUSIONS

This research estimated the equilibrium path for the real exchange rate between 1980 and 1995. The methodology was based on the concept of fundamental equilibrium exchange rate. Despite some drawbacks of this approach, the size of the effects detected allows to conclude with some certitude that in the period under scrutiny the escudo recorded an equilibrium real appreciation. However, misalignments from equilibrium were much wider in the 1980's than in the first half of the 1990's — that is to say, the greater misalignments of the real exchange rate seem to have been contemporary to the greater flexibility of the Portuguese exchange rate regime.

REFERENCES

- Barrell, R. and S. Wren-Lewis (1989), "Fundamental Equilibrium Exchange Rates for G7", *Centre for Economic Policy Research*, no. 323, June.
- Bayoumi, T., P. Clark, S. Symansky, and M. Taylor (1994), "Robustness of Equilibrium Exchange Rate Calculations to Alternative Assumptions and Methodologies", *International Monetary Fund*, WP/94/17.
- Boswijk, H. P. (1994), "Testing for an Unstable Root in Conditional and Structural Error Correction Models", *Journal of Econometrics*, Vol. 63, no. 1, 37-60.
- Cunha, L. C. and J. A. F. Machado (1993), "Real Convergence and Real Appreciation", Universidade Nova de Lisboa, *Working Paper* no. 211, December.
- Dolado, Juan J. and José Viñals (1991), "Macroeconomic Policy, External Targets and Constraints: the Case of Spain", *CEPR Discussion Paper*, no. 505, January.
- Esteves, P. S. (1993), "Crescimento Económico e Taxa de Câmbio Real — A Experiência Portuguesa (1948-1992)", *Economic bulletin*, Banco de Portugal, December.
- Freitas, M. L. (1992), "Sobre a Futura Paridade do Escudo: Há lugar para uma apreciação real?", *Working Paper* no. 183, Universidade Nova de Lisboa, April.
- Froot, K. A., K. Rogoff (1995), "Perspectives on PPP and Long-Run Real Exchange Rates", *Handbook of International Economics*, Vol. III, Elsevier Science.
- Gaspar V. and A. Pereira (1995), "An Intertemporal Analysis of Development Policies in the EU", *Journal of Policy Modelling*, forthcoming.
- Gaspar, V. and M. Pinheiro (1994), "Desinflação e Competitividade", *Economic bulletin*, Banco de Portugal, June.
- Krugman, P. (1990), "Macroeconomic Adjustment and Entry into the EC: a note", de Unity with Diversity in the European Economy: *the Community's Southern Frontier*, 131-140, Eds.: C. Bliss and J. B. Macedo, Cambridge University Press.
- Luís, J. B. (1993), "Taxa de Câmbio de Equilíbrio e Sustentabilidade Intertemporal da Balança de Pagamentos", *Masters Degree Thesis Monetary and Financial Economies*, I.S.E.G.
- Luís, J. B. (1996), "A Taxa de Câmbio de Equilíbrio na Economia Portuguesa", *Draft*, February.
- MacDonald, R. (1995), "Long-Run Exchange Rate Modelling: A Survey of the Recent Evidence"; *International Monetary Fund*, WP/95/14, January.
- Mackinnon, J.G. (1991), "Critical Values for Cointegration Tests", *Long-run economic relationships*, Chapter 13, edited by Engle and Granger, Oxford University Press.
- Manteu, Cristina and A. S. Mello (1992), "Taxa de Câmbio de Equilíbrio Fundamental", *Economic bulletin*, Banco de Portugal, December.
- Rebelo, S. (1992), "Inflation in Fixed Exchange Rate Regimes: The Recent Portuguese Experience", Banco de Portugal, *Working Paper* no. 11-92, July.
- Rogoff, K. (1996), "The Purchasing Power Parity Puzzle", *Journal of Economic Literature*, Vol. XXXIV, no. 2, 647-668, June.
- Williamson, J. (1983), "The Exchange Rate System", Policy Analysis in International Economics, no. 5, *Institute for International Economics*, Washington D. C.
- Williamson, J. (1991), Equilibrium Exchange Rate: An Update, *Institute for International Economics*, Washington D.C.
- Williamson, J. (1994), Estimating Equilibrium Exchange Rates, *Institute for International Economics*, Washington D.C.
- Vidal, M. J. and T.B. Reis (1994), "Índice de Taxa de Câmbio Efectiva do Escudo: Estudo dos ponderadores do comércio externo e apresentação da nova metodologia", *Economic bulletin* Vol. 16, Banco de Portugal.

APPENDIX

DESCRIPTION OF THE DATA

The series considered which evidenced seasonal changes were seasonally adjusted using method X11-ARIMA.

Balance of Payments

Sample: 1980:1 up to 1995: 4; Source: Banco de Portugal

To the moment of preparation of this research, no series adjustment had been carried out to solve the series break in 1993 (due to the adoption of the INTRASTAT system and statistical harmonisation at the Community scale). However, since it would make no sense to include data up to 1992 only, we used the published values with no changes.

National Accounts

Sample: 1977:1 to 1995:4; Source: INE (Quarterly Accounts)

Since the period comprises a change in the base-year from 1977 to 1986, series were break adjusted — through maintaining the growth rates in volume and value terms implicit in the published series.

Degree of openness of the economy

Sample: 1977:1 to 1995:4

Calculated as the ratio of the sum of imports and exports of goods and services to gross domestic product, in volume terms.

Real effective exchange rate

Sample: 1980: 1 to 1995:4; Source: Banco de Portugal

Nominal effective exchange rate calculated according to the methodology presented in Vidal

and Reis (1994), and using consumer price indices for the calculation of the real exchange rate.

External demand in volume

Sample: 1977: 1 to 1996:1

Geometric average of the external demands of the European Union countries (excluding Belgium, Luxembourg, Ireland and Greece), Switzerland, United States of America, Japan and Canada, weighted by the share of these countries in Portuguese exports. The weights were calculated from data on merchandise exports in value, published by the INE. Weights were re-calculated every year. External demand was measured by the volume indices of imports of goods and services, using data released by the OECD for all countries except for Germany, Spain and Denmark — for which indices were calculated from the imports of goods and services in volume, from the respective National Accounts.

Relative oil prices vis-à-vis the price of national goods

Sample: 1980:1 to 1995:4

Ratio of the oil price index in escudos to GDP deflator. Oil prices were measured by the energy imports price index, calculated by the Direção-Geral das Relações Económicas Internacionais.

Long-term real interest rate differential between Portugal and the exterior

Sample: 1980:1 to 1995:4

For the Portuguese nominal interest rate we used the nominal long-term interest rate series published by the OECD, which necessarily yields a blurred approximation to this variable — since 10-year Treasury bonds only exist since June 1993,

while 2 to 5-year bonds exist since 1991. The nominal long-term external interest rate was calculated as a weighted average of the nominal interest rate series published by the IMF (government bond yields: yields to maturity of government securities or of other securities with longer maturities). “Exterior” in this context consisted of the leading countries of origin of direct investment in Portugal

(Germany, Spain, France, United Kingdom, United States, Japan and Switzerland), for which yearly moving weights were calculated using the sum of the absolute values of investment and disinvestment, of the exterior in Portugal and Portugal abroad. Nominal interest rates were deflated with the annual average growth of the retail price index of the period to which correspond the rates.