THE PORTUGUESE DISINFLATION PROCESS:

ANALYSIS OF SOME COSTS AND BENEFITS

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Abstract

This study aims to analyse the Portuguese economic policy of disinflation through a nominal stabilization policy of the Portuguese escudo. We study the pegging of the Portuguese escudo (PTE) to the Deutsch mark (DM) knowing the reputation of the *Bundesbank* for its anti-inflationary *record* and the role played by the Deutsch mark in the stability processes of foreign exchange and European price levels. The study was based on the attainment of co-integrating relations using Johansen's methodology, the construction of a Near-VAR model and the establishment of a simulation analysis. The acceptance of German monetary policy and the pegging of the escudo to the Deutsch mark allowed the Portuguese economy to achieve its primary goal of price stability. However, despite the credibility and stability gains obtained, the adoption of a disinflation policy led to a real appreciation of the escudo. This study tries to clarify the influence that an appreciation of the real exchange rate can have on GDP and price levels. It cannot be denied that Portugal has made great progress in its European integration, successfully integrating into the group of EMU member-states. However we can point to a decrease in Portuguese competitiveness as the price paid for the disinflation process. This reflects itself in lower wages, which in turn limit output growth. We find that it is of primary importance to realise both the benefits of disinflation, and the costs of the policies in terms of output.

JEL classification: C32, C51, E42, E58, F31, F33

Keywords: Monetary Policy, European Union, disinflation, co-integration, Near-VAR and simulation.

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I. Introduction

Once the effects of the two oil shocks of 1973 and 1979 had worn off, we witnessed disinflation processes in most industrialized countries during the 80s and the 90s, particularly among the European Monetary System (EMS) member-States[2].

As for the EMS non member-states, this phenomenon was most noticeable in the United States, Canada, New Zealand, Australia, Sweden and Japan[3].

Among the EMS member-states, France, Ireland and Italy had the highest inflation rates on 13th of March 1979, the date in which the system was introduced. These were the countries that, during the 80s early 90's, disinflated the most. Because of Germany's anti-inflation tradition, it had the lowest inflation rates in the EMS during this period, with the Deutsch mark functioning as a nominal anchor within the system[4].

During that period, Portugal also went through a disinflation experience. After reaching an inflation rate of almost 30% at the end of 1983, Portugal saw this value reduced to about 5%, by 1994 and has continued to see inflation fall to the present day. This disinflation process is inevitably associated with the adoption of a nominal stabilization policy of the Portuguese escudo, in line with its participation in the Exchange Rate Mechanism (ERM) of the EMS[5].

In parallel with the credibility gains, the disinflation processes may also have led to costs in output and employment which are mainly due to the loss of competitiveness, and the consequences of real exchange rate appreciation. In the case of Portugal, the costs of disinflation seem to have been temporary, and only apparent for a relatively short period of time.

This report is structured in the following way: Section II presents a historical retrospective view of the disinflation process in Portugal and analyses some costs and benefits of this process. Section III lays out the data and how the series used were handled. Section IV analyses the existence of a co-integration relation. Section V describes the construction methodology of a Near-VAR model for both Portuguese and German economies and also analyses its main features. Section VI complements the latter section, evaluating the results of a simulation analysis. Finally, section VII concludes this report.

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[2] See Ball (1993), Neely and Waller (1996) and Todter and Ziebarth (1997). Loureiro (1999: 51-130), that we will follow closely, presents a good chronology of the events. See also Ferreira (1993), Gaspar (1994), Barbosa and Machado (1996), Maior (1999: 69-177) and Gaspar and Abreu (1999). For an alternative view about experiences of disinflation in Latin America and Central and Eastern European countries, see, for example, Edwards (1992), Calvo and Végh (1994) and Bruno (1995).

[3] In the majority of cases, the disinflation programs of these countries were based on inflation target policies, identifying price stability as the main goal of monetary policy, subordinating other potential goals to the latter. See, for example, Mishkin and Posen (1997), Debelle (1999) and Meyer (2001).

[4] See Giavazzi and Giovannini (1989) and Cohen and Melitz (1989). See also Dias (1996).

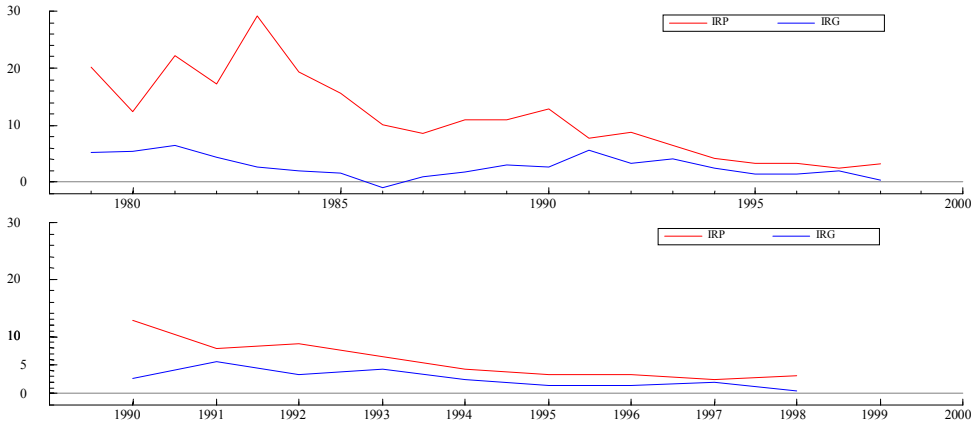
[5] Portugal formally joined the exchange rate mechanism of the EMS in April 1992.

II. The Portuguese Disinflation Process

The disinflation experience in the Portuguese economy began in 1990 when Portugal adopted a nominal stabilization policy of the escudo in relation to the Deutsch mark[6].

For a better understanding of the Portuguese disinflation process, Figure 1 shows the evolution of inflation rates, measured as the average annual growth of the Portuguese and German Consumer Price Indexes (CPI) for the periods 1979 to 1998, and 1990 to1998.

Figure 1: Portuguese and German Inflation Rates

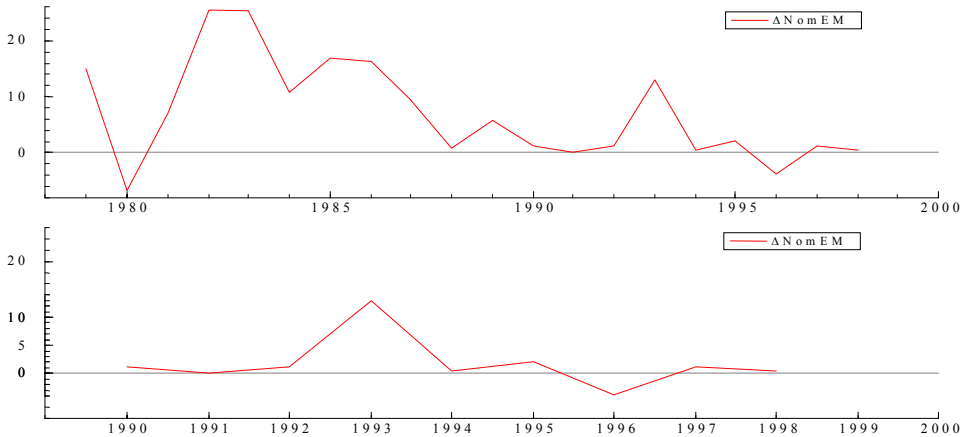


Source: OECD Data Base Main Economic Indicators, published by Estima, USA, www.estima.com.

It can easily be seen that after a rise in inflation rates at the beginning of the 80s the Portuguese inflation rate reached a maximum value of about 30% by the end of 1983. It also recorded its biggest differential compared to Germany at that time. Such a high inflation led to successive devaluations of the escudo in an attempt to maintain the competitiveness of Portuguese industry abroad.

Following, the reduction in the devaluation of the escudo, and the large fall in oil and dollar prices, a significant reduction in the inflation rate (to an approximate value of 11% in 1986 and 9% in 1987) became possible. One of the main reasons for the reduction in inflation during the 80's seems to have been associated with the deceleration in the devaluation of the Portuguese escudo, which began in 1983, as shown in Figure 2.

Figure 2: Nominal variation of the Escudo in relation to the Mark



Source: OECD Data Base Main Economic Indicators, published by Estima, USA, www.estima.com.

[6] See Banco de Portugal (1997-8: 5), Economic Report, September.

The exchange rate policy was therefore helping us towards the goal of anti-inflation; in other words, fighting inflation meant disregarding the concern previously shown, for reinforcing competitiveness abroad of the Portuguese economy. In fact, in the period prior to Portugal's adhesion to the European Economic Community (EEC), the exchange rate regime was characterised by the maintenance of a crawling peg regime for the escudo, with its major aim being the levelling of inflation rates between Portugal and its major commercial partners.

However, the success of the integration of the Portuguese economy into the European market was deeply dependent on the ability of the monetary authorities to reduce the inflation rate to the levels of the German economy. With this in mind, it was necessary to pursue a less accommodating exchange rate policy than the one implied by the crawling peg regime.

In October 1990, the crawling peg policy was substituted by a policy based on a limited floatation of the escudo in relation to the five main currencies of the ERM of the EMS. Portugal then began adopting an exchange rate policy based on the nominal stability of the escudo. As a result of this policy, the escudo maintained a very high level of stability[7].

However, in September 1992 we witnessed a deep crisis in the EMS, which resulted in the exit of the pound sterling and the Italian lira from the system and the succession of some realignments, that culminated in the expansion of the foreign exchange floatation bands to 15% in August 1993. As pointed out by Loureiro (1999: 109), this crisis had its initial phase at a time when there was a wide consensus that the EMS was definitely a stable and credible arrangement. However, later events proved that such views were excessively optimistic.

The escudo was also affected by the turbulence that affected the ERM, and it became the target of speculative pressures that were fought off by the sale of foreign exchange reserves, and by increasing short-run interest rates, as well as using capital exit controls.

Notwithstanding the need to repel the speculative attacks that had to be faced, the escudo ended up being devaluated by 6% and then 6,5%, following devaluations of 6% and 8% in the peseta, in November 1992 and May 1993, respectively. In this context, it is not difficult to understand the behaviour of the escudo in relation to the mark between 1992 and 1994, as shown in Figure 2.

Nevertheless, the realignments of the escudo did not aim to change the generic option for a foreign exchange stability policy that was being followed[8]. Therefore, following the turbulent period, the escudo was always maintained within the limits of the previous floatation band of 6%, having, in fact, appreciated against the Deutsch mark in 1996. It was, therefore, possible to continue the progress of the disinflation process, and culminate in the continuous reduction of the inflation rate. Following a downward trend, which began in 1990, the Portuguese inflation rate converged to the average value of the European Union (EU) in 1995. It stayed below the reference value for the purpose of applying price stability criteria within the EMU from 1997 up to the end of the period in analysis.

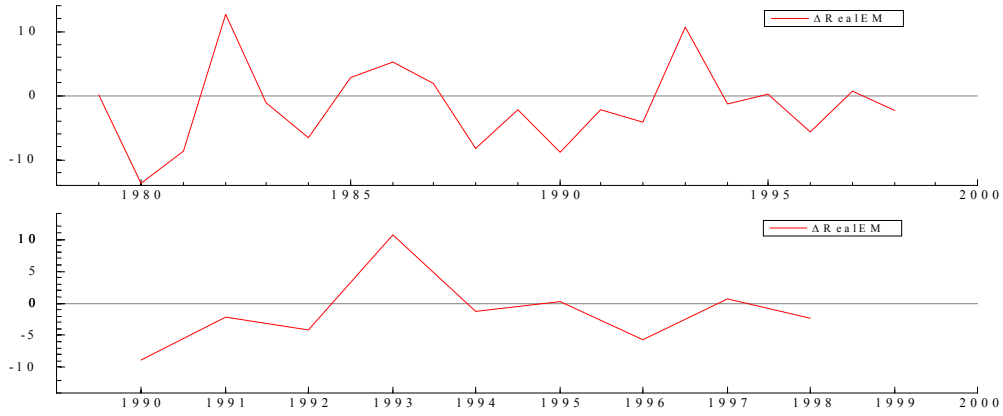
[7] See Gaspar (1994: 35). See also Banco de Portugal (1997: 146), Annual Report of 1997.
[8] See Banco de Portugal (1993: 215), Annual Report of 1993.

In this context, we can conclude that the Portuguese disinflation process took place, at least since 1990, in a gradual and continuous way, with the nominal stabilization policy of the escudo assuming a decisive role. Furthermore, the evolution of international price levels, the decrease in wages and the maintenance of output below the level of its tendency may also have been favourable to the decrease in price levels.

Now it is important to analyse some of the costs and benefits associated with the disinflation process.

Observing again Figures 1 and 2, we may conclude that after the integration of Portugal and Spain into the EEC in January 1986, there was a tendency to level the inflation rates between Portugal and Germany. This was achieved through a gradual reduction in the growth of the Portuguese economic price levels. However, even with this strategy, the inflation differential was systematically unfavourable to Portugal, which together with an insufficient nominal depreciation of the escudo in relation to the mark led to a real appreciation of the Portuguese escudo. This is illustrated in Figure 3 and is particularly apparent near the bottom where it corresponds to the period in which there was a sustained disinflation process in Portugal.

Figure 3: Real Variation of the Escudo to the Mark



Source: OECD Data Base Main Economic Indicators, published by Estima, USA, www.estima.com.

In fact, with the exception of the period between 1992 and 1994 the gradual and continuous process of disinflation started in 1990, and was characterized by a real appreciation of the Portuguese escudo against the German currency.

In face of this evidence, a question a arises regarding how a small open economy like the Portuguese one, with a weak currency, did not experience a financial crisis due to the speculative attacks that the escudo suffered.

The fact that the Portuguese economy was involved in a process of European integration must have made a contribution, therefore allowing it to benefit from all the credibility, stability and discipline conferred by the tacit acceptance of the anti-inflation monetary policy of the *Bundesbank*, and by the pegging of the escudo to the Deutsch mark. Thus, under the wing of the ERM of the EMS and the EU, the maintenance of an anti-inflation policy as well as the nominal stability of the escudo, allowed Portugal to avoid, even after abolition at the end of 1992, the last international capital

mobility restrictions, the effects of the speculative attacks on the escudo and so avoided abrupt falls in the stock of foreign reserves as a result of the strong devaluation expectations of its currency[9].

The Portuguese disinflation process also had psychological effects on the economic agents that were trying to reverse the tendency that was seen and that had seemed to become a vicious circle of inflation-devaluation-inflation, thus contributing to the reduction in inflationist expectations[10]. Due to this strategy, the Portuguese economy was also able to achieve its main goal of price stability, which was explicitly assumed by the political authorities, allowing it to remain integrated with the other EMU participating countries.

Nevertheless, if it is agreed that Portugal has made great progress in its European integration process, it should also be mentioned that as a result of the disinflation there was a reduction in Portuguese competitiveness due to the real appreciation of the escudo, which is now obviously reflected in lower wages, thus affecting output growth and, consequently, the employment level, particularly in the sectors open to international competition.

In this context, we describe a disinflation strategy which is more or less successful[11], but which also raises the question of the know-how necessary to evaluate the relative performance of such a strategy.

One of the simplest ways of measuring the disinflation costs is through the sacrifice ratio calculation[12]. This ratio indicates the percentage of output falls (in relation to the equilibrium output or potential output), per perceptual figure reduced in the inflation rate.

For the period between 1980 and 1994, Barbosa and Machado (1996: 48) calculated the sacrifice ratio for the Portuguese economy obtaining a value of 0,66. However, in order to assure the value obtained, the authors calculated it in comparative terms with other European countries' disinflation experiences. Therefore the Spanish, French, Irish and Italian cases were analysed, and it was concluded that, with exception of the latter, the sacrifice incurred in Portugal was inferior to those that were common in the other countries. The disinflation costs in Portugal seem to be relatively modest and so these results may help us to understand the interest in the current participation of Portugal within the EMU, seeing that a large portion of the costs have already been covered.

However, as described by Neely and Waller (1996: 10), there may also be benefits in terms of output seeing that the reduction of the inflation rates to lower levels (as in those countries where the

[9] See Duarte (2001: 22-3).

[10] As observed by Dias (1996: 1), the devaluation practices that only aimed to replace foreign competitiveness would lose their reputation. This was seen as synonymous with a non-strict implementation of the policy. Gaspar (1994: 36), which goes further stating that a competitive disinflation strategy may be compatible with participation in an organised exchange rate regime, while the alternative strategy, of a competitive devaluation, is not. In this context, the sustained disinflation experience seemed to move the goal of the Portuguese economy's competitiveness, which was necessary to update and obtain productivity gains, as the lever of the competitive devaluation was lost. However, facts showed another reality: the maintenance of competitiveness through the practice of low wages. See Duarte (1997: 149-170).

[11] Cf. Barbosa and Machado (1996: 47).

[12] See, for exemple, Ball (1991) and Ball (1993). See also Neely and Waller (1996) and Thornton (1996), where the sacrifice ratio is faced with other alternatives forms for measuring costs and benefits of disinflation.

currencies are pegged) may later stimulate its own output, by allowing better organization of the resources and better decision making by the economic agents.

Thus, if it is agreed that the loss of competitiveness due to the real appreciation of the escudo led to costs in terms of output and employment, it is also true that the realignment, which had occurred by the end of 1992 and 1993, allowed Portugal to recover some of its lost competitiveness. This was especially the case in the beginning, when a new cycle of foreign exchange stability, based on a gradual and continuous disinflation process definitively made the inflation rates in Portugal converge to the lower levels traditionally registered by Germany[13].

From our present study, it may be concluded that the output costs may have eventually been distributed throughout time. The disinflation strategy thus created the necessary conditions for the formation of a macroeconomic stability board in the context of the actual Portuguese participation in the euro area.

III. Data

Time series were used with quarterly data covering the period between 1977 and 1998. Whenever the series were available on a monthly basis, the respective quarterly value was obtained by using the last value of each quarter. This was the case with the series price levels (Consumer Prices Index) in both economies, the real exchange rate and the German interest rate.

In general, the data was obtained from statistical sources published by OECD[14]. The aim was to obtain the highest possible number of observations therefore it was sometimes necessary to integrate more recent series with other older ones. Without this procedure it would not have been possible to use a significant number of observations.

In determining the real exchange rate series between Portugal and Germany the nominal bilateral exchange rate series of the escudo was used against the Deutsch mark along with the price levels index of both economies.

To allow easier analysis of the price level evolutions and to eliminate problems of relation magnitude in the international comparison of the GDP values, the price levels and output series were expressed in simple indexes based on the year 1990. GDP was evaluated at constant prices.

Short-run nominal interest rates were used. In Portugal's case, we used active bank operation rates for periods of 180 days up to one year. For Germany, we used the monetary market interest rates.

With the exception of the interest rates, all the series were converted into logs.

The results were obtained by using econometric software PcGive, version 10[15].

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[13] In the general debate about whether or not a gradual disinflation process is more or less advantageous than a "shock therapy", see for example De Grauwe (1989), Ball (1990), Ball (1993) and Buiter and Grafe (2001).

[14] The OCDE Data Base Main Economic Indicators, published by Estima, USA (www.estima.com). For Portugal we also used data from the National Institute of Statistics and from the Bank of Portugal.

[15] See Doornik and Hendry (2001), for the GiveWin 2, and Hendry and Doornik (2001), for the PcGive 10.

IV. Co-Integration

The estimation technique used in the co-integration time series was the application of the maximum likelihood method developed by Johansen[16]. Using this methodology, we will first proceed to the specification of a system from domestic and foreign variables. To do this, we only need two of the domestic variables to be I(1)[17].

It was also necessary to define the nature of the variables. The Real Exchange Rate between Portugal and Germany (ErPG), the Consumer Price Index of Portugal (CPIP), the Nominal Interest Rate of Portugal (iP) and the Gross Domestic Product at constant prices of Portugal (GDPP) were considered as endogenous variables. These variables were defined as part of the co-integration space. On the other hand, the exogenous variables, where the Consumer Price Index of Germany (CPIG), the Nominal Interest Rate of Germany (iG) and the Gross Domestic Product at constant prices of Germany (GDPG) are included, was defined outside the integration space. The constant and the seasonal received different treatment. While the first was defined outside the co-integration space, the latter, was always considered to make part of that space. The trend was excluded from the analysis.

The auto-correlation was evaluated equation by equation. In face of the non-exclusion of the auto-correlation, lags of superior order were chosen. We reached therefore eight lags for the endogenous variables, and no lags were retained for the exogenous variables[18]. Assuming the non-existence of auto-correlation, we continued with the co-integration analysis by choosing a number of co-integrating vectors.

Having the values of the λ max (maximum eigenvalue) as a base and the trace tests for a confidence interval of 95%, the number of the co-integration vectors found coincided with the number of the endogenous variables used, as can be observed in Table 1.

Table 1: Co-integration Analysis (λ max and trace tests)

λ	r = p	*λ max*	*λ max* (A)	95%	*Trace*	*Trace* (A)	95%
0.458132	p = 0	49.02**	29.41*	27.1	120.8**	72.48**	47.2
0.410487	p ≤ 1	42.28**	25.37*	21.0	71.78**	43.07**	29.7
0.225008	p ≤ 2	20.39**	12.24	14.1	29.5**	17.7*	15.4
0.107651	p ≤ 3	9.112**	5.467*	3.8	9.112**	5.467*	3.8

(A) The correction of freedom grade was used here; the observations number (T) was replaced by T-n.m, where n is the number of variables and m is the number of lags.

In this situation, we may conclude that the variables are jointly stationary[19].

The conditions were therefore established that allowed us to move forward to the construction and estimation of a Near-VAR model for both the Portuguese and German economies.

[16] See Johansen (1995) and Hansen and Juselius (1995). See also Hendry and Juselius (2000).
[17] The other may be I(0). See Johansen (1995). See also Hansen and Juselius (1995). Marques (1998) and Andrade (1999) give some examples. See also Duarte (2001). As it is very long, only the final results will be presented. However, the full results may be requested through the following E-mail: portugal@fe.uc.pt.
[18] See Doornik and Hendry (1997: 58-78).
[19] See Johansen (1995) and Hansen and Juselius (1995). See also Hendry and Juselius (2000: 25).

V. A Near-VAR Model for the Portuguese and German Economies

In this section an attempt is made to describe the construction methodology of a Near-VAR model for both the Portuguese and German economies: a model from which the results of the Portuguese disinflation process will be evaluated. The use of a Near-VAR model allowed us to reduce the sur-parametrisation problem inherent in the VAR model. In this section the main features of such a model will also be considered.

V.1. Construction Methodology

In order to construct the Near-VAR model it was necessary to proceed to the formulation and estimation of a system. In the formulation of this system, as well as the real exchange rate between Portugal and Germany, the remaining group of domestic macroeconomic variables, that is, the Consumer Price Index, the short-run nominal interest rate and the GDP at constant prices of Portugal were also included as endogenous variables. As for the German economy, these last three variables were also included in the formulation of the system, were defined as exogenous variables. As in the co-integration analysis, eight lags were retained for the endogenous variables, and no lags were considered for the second group of variables. The constant (C) and the various seasonal (S) were treated similarly. The system was estimated using the Ordinary Least Squares (OLS) method.

This was followed by the formulation and estimation of the initial model. This first model is formed by using four equations, each one being associated to an endogenous variable. Therefore the model initially appears in the form of a VAR, as in its four equations the variables show the same number of lags, and are thus estimated equation by equation, using the OLS method.

With the first estimation complete, the process of model reduction begins, having a significance level of the t statistic (*t-prob* value) of each of the variables as a base. The aim is, then, to eliminate the variables that present themselves as statistically insignificant from the formulation model. It was admitted as a null hypothesis, for a critical level of 5%, that the variables are not significant. This means accepting the null hypothesis when the statistic value of the Likelihood Radio test (LR-test) is superior to the critical value or rejecting the null hypothesis if this is not the case. The latter situation allows us to say that the variables are statistically significant. The process of model reduction cannot go forward.

In a first reduction, all variables whose significance level of the statistic t was the same or superior to 25% were eliminated from the equation model. As if by mere coincidence the same variables would be excluded from each of the equations, leaving us with a Near-VAR model. Its estimation was done using the Full Information Maximum Likelihood (FIML) method. The application of the Likelihood Ratio test allowed us to accept the null hypothesis, that is, to conclude that the eliminated variables were in fact statistically insignificant. Therefore, it was possible to carry on with the process of model reduction.

In the reductions that followed, a significance level of the statistic t equal or superior to 20%, 15%, 10% and finally 5% was adopted respectively as criterion for the selection of potentially insignificant variables. However, in the case of the endogenous variables, the elimination of the higher lags was always pursued.

Nine reductions were done, and whatever the variable, or group of variables, that we were trying to exclude from the model formulation, the use of the Likelihood Ratio test would reject the null hypothesis. Thus, it was not possible to continue with the reduction process. All the variables that formed the model equations were significant. However, as can be observed from the final results of the model reduction tests, during its construction, a total of seventy-eight variables were eliminated, because they were statistically considered to be insignificant[20].

Final results of the reduction tests model:

Model 2 → Model 11: Chi^2 (78) = 73.101 [0.6357]

System 1 → Model 11: Chi^2 (78) = 95.846 [0.0830]

Having concluded the construction process, the final model may be represented in the following way.

Final Near-VAR model for the Portuguese and German economies:

$$ErPG_t = \beta_0^{(1)} + \sum_{i=1}^{4} \beta_{1i}^{(1)} . ErPG_{t-i} + \sum_{j=1}^{4} \beta_{2j}^{(1)} . CPIP_{t-j} + \sum_{k=1}^{3} \beta_{3k}^{(1)} . iP_{t-k} + \\ + \sum_{l=1}^{6} \beta_{4l}^{(1)} . \mathrm{GDPP}_{t-l} + \beta_{S1}^{(1)} . S_1 + \beta_{S2}^{(1)} . S_2 + \beta_{S3}^{(1)} . S_3$$

$$CPIP_t = \beta_0^{(2)} + \beta_1^{(2)} . ErPG_{t-1} + \sum_{j=1}^{8} \beta_{2j}^{(2)} . CPIP_{t-j} + \sum_{k=1}^{8} \beta_{3k}^{(2)} . iP_{t-k} + \\ \sum_{l=1}^{6} \beta_{4l}^{(2)} . \mathrm{GDPP}_{t-l} + \beta_5^{(2)} . CPIG_t + \beta_7^{(2)} . GDPG_t + \\ + \beta_{S1}^{(2)} . S_1 + \beta_{S2}^{(2)} . S_2 + \beta_{S3}^{(2)} . S_3$$

$$iP_t = \beta_0^{(3)} + \sum_{j=1}^{2} \beta_{2j}^{(3)} . CPIP_{t-j} + \beta_3^{(3)} . iP_{t-1} + \beta_4^{(3)} . GDPP_{t-1} + \\ + \beta_7^{(3)} . GDPG_t + \beta_{S1}^{(3)} . S_1 + \beta_{S2}^{(3)} . S_2 + \beta_{S3}^{(3)} . S_3$$

$$GDPP_t = \beta_0^{(4)} + \beta_2^{(4)} . CPIP_{t-1} + \sum_{k=1}^{7} \beta_{3k}^{(4)} . iP_{t-k} + \sum_{l=1}^{6} \beta_{4l}^{(4)} . GDPP_{t-1} + \\ + \beta_6^{(4)} . iG_t + \beta_{S1}^{(4)} . S_1 + \beta_{S2}^{(4)} . S_2 + \beta_{S3}^{(4)} . S_3$$

[20] The Near-VAR model was initially constructed using the first difference of each variable. However, it had to be abandoned as a number of tests showed the non-stability of the model. The construction of a Near-VAR model with the variables in level was then brought forward, leading to the conclusion, as seen in the following pages, that the final model obtained was already stable.

V.2. Main Features of the Model

With analysis of the main features of the model we aim to evaluate the quality of the Near-VAR model obtained. Several tests were carried out, that included not only a careful study of the regression residuals, but also an evaluation of the model stability[21].

For the residuals analysis, it was necessary to find out if there were any auto-correlation, normality or heteroscedasticity problems in each of the model equations. To this effect we carried out single equation tests[22].

We began by testing the auto-correlation of the residuals by applying a Lagrange Multiplier test type (LM-test) based on the F-statistics and using four lags. Normality tests were performed using the Chi^2 statistical value as a reference. To conclude this first analysis, Autoregressive Conditional Heteroscedasticity (ARCH tests) were also performed using the F-test form once more and four lags. For all of these tests, a critical level of 5% was used.

The results of the application of a test summary give the essential of the previous tests:

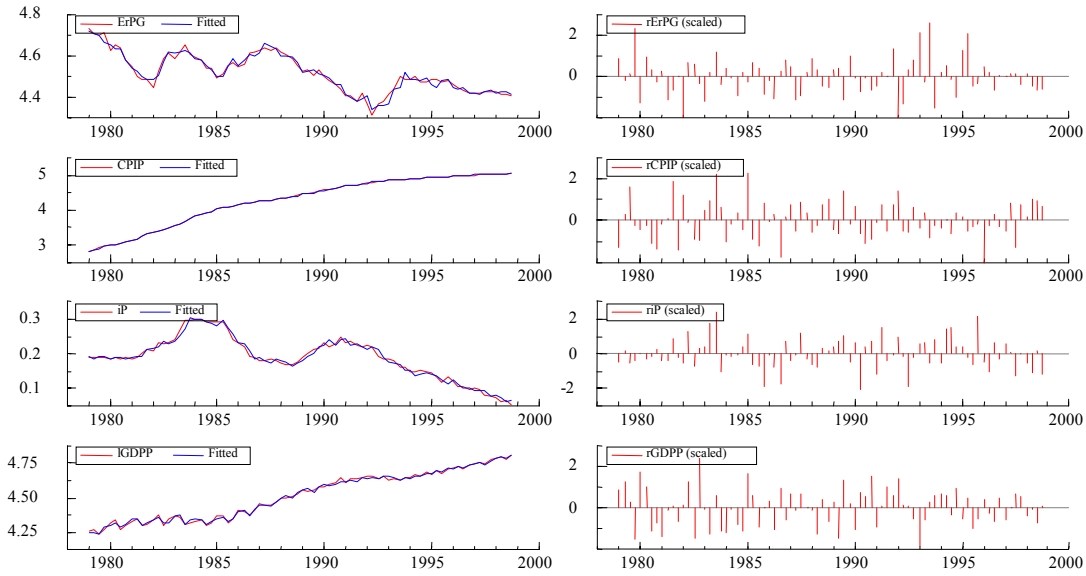
ErPG : AR 1 – 4 F(4, 37) = 2.5266 [0.0570]
CPIP : AR 1 – 4 F(4, 37) = 1.9897 [0.1163]
*iP : AR 1 – 4 F(4, 37) = 5.5068 [0.0014]***
*GDPP : AR 1 – 4 F(4, 37) = 7.6611 [0.0001]***
ErPG : Normality Chi^2 (2) = 4.4699 [0.1070]
CPIP : Normality Chi^2 (2) = 1.3496 [0.5093]
iP : Normality Chi^2 (2) = 1.579 [0.4541]
GDPP: Normality Chi^2 (2) = 0.56602 [0.7535]
ErPG : ARCH 4 F(4, 33) = 0.28257 [0.8872]
CPIP : ARCH 4 F(4, 33) = 0.15816 [0.9579]
iP : ARCH 4 F(4, 33) = 0.2554 [0.9043]
GDPP: ARCH 4 F(4, 33) = 0.21532 [0.9280]
Vector AR 1 – 4 F(64,166) = 1.2095 [0.1697]
Vector normality Chi^2 (8) = 8.3916 [0.3962]

From the results obtained it is possible to understand that, despite the existing auto-correlation problems in the interest rate equations and Portugal's GDP, there are no problems concerning normality, nor in the ARCH tests, meaning that the estimated model is a reasonable model. The overall model specification tests (Vector error auto-correlation test – Vector AR and Vector normality test) confirm the quality of the Near-VAR model obtained, accepting the absence of auto-correlation and the residual normality for the whole model.

Following the previous analysis, a graphic representation of the effective and estimated values of the variables was drawn against time (on the left hand side of Figure 4) and the residual scale of the model (on the right hand side of Figure 4).

[21] See Doornik and Hendry (2001: 222-231). Marques (1998: 113-146) presents a synthesis of the main evaluation tests for the quality of the models obtained through the "specific-to-general" approach, that is, by using a methodology very similar to the one used in this study.
[22] As for the auto-correlation and normality, specification tests were also used for the whole model. See Doornik and Hendry (2001: 232).

Figure 4: Effective and Estimated Values and Residual Scale



It can easily be seen that the estimated model follows the evolution of the variables over several years. The main characteristic of the graphs is the presentation of an evolution very similar to a situation in which "the variables were closely tracked and the residuals seemed well behaved"[23]. In fact, even during the periods when important political-economical events took place and there was outstanding importance put upon the operations of the Portuguese and German economies, we may verify that the estimated values did not depart from the effective evolution values of the variables. In the case of the CPIP variable, both series are practically the same. It is, therefore, clear that the estimated model works well.

Now focusing our attention on the right hand side of Figure 4, it can be seen that it is not possible to detect a regular tendency of the residuals throughout the period. For any of the analysed variables, the residuals show relatively random behaviour being positive at times and negative at others. As not all of them are positive or all negative, it is not possible to find a pattern of behaviour in the residuals that suggests the existence of any form of auto-correlation, confirming the results of the first analysis, that is, that we are in presence of a reasonable model.

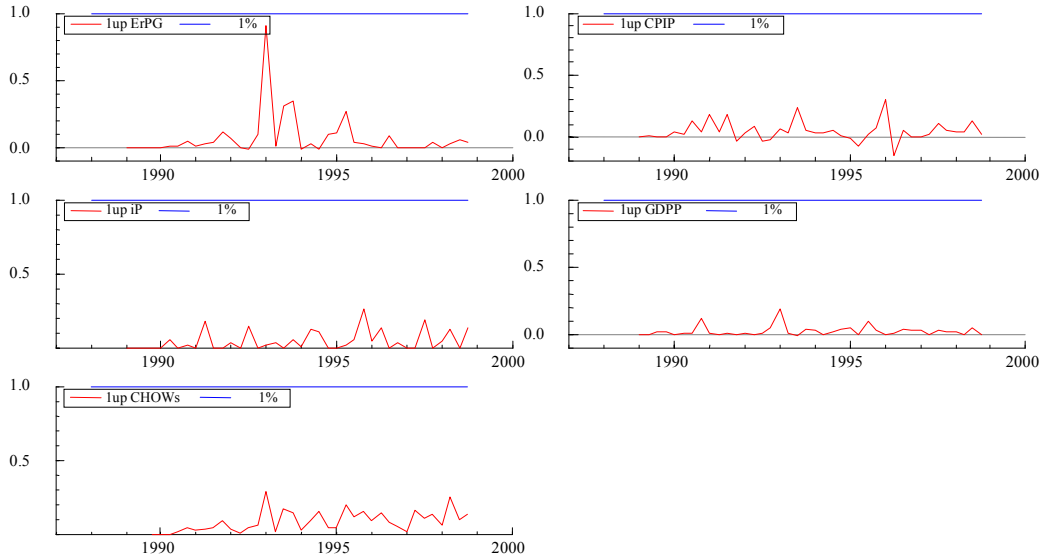
Then, the stability of the model parameters was evaluated by using two Chow-type tests normally known as 1-step Chow-tests and Break-point Chow-tests. In this context, recursive estimation was performed from an initial model with 36 observations. The stability tests were developed to a significance level of 1%.

In Figures 5 and 6 the output of the recursive analysis is shown.

The 1-step test (known as "*lup*" in Figure 5) is done on each of the four equations, as well as on the whole model (known as "*lup CHOWs*"). In total, for the first parameters stability test, we have five graphs.

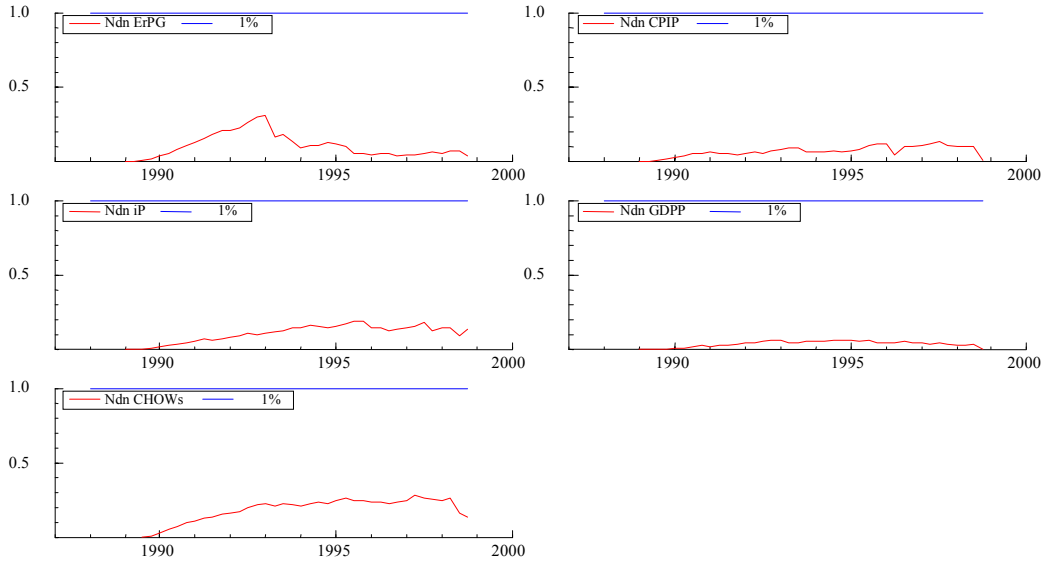
[23] Cf. Doornik and Hendry (1997: 113).

Figure 5: Recursive Estimation Statistics (1 Step Chow Tests)



Similarly, the Break-point test (denominated "*Ndn*" in Figure 6) has also been done on each of the four equations and on the entire model (test denominated "*Ndn CHOWs*"). Therefore, for the second chow tests type, we also have five graphs.

Figure 6: Recursive Estimation Statistics (Break-Point Chow Tests)



As can easily be seen from an analysis of Figures 5 and 6, for any of the four equations and for both tests, the parameter stability is clearly acceptable. Some instability concerning the real exchange rate can just be detected through the first test, coinciding with the collapse of the EMS in August 1993. However, not even during this period, marked by a number of strongly disturbing phenomena in the foreign exchange market operation, can we state that there was an exception to the parameters stability, since the straight line that defines the significance limit of 1% was never reached. Furthermore, this situation diminishes considerably when the stability is analysed through the second type of tests. In fact, everything seems to indicate that we are in the presence of a phenomenon with

endogenous features, suggesting that the model obtained may be used to explain the registered evolution of the variables throughout the period in analysis.

Observing the test results for the whole model, it can also be seen that the parameter stability cannot be rejected, giving us, therefore, the conclusion that the final model with different lags for the endogenous variables is acceptable.

Through the results achieved from both types of Chow's tests it has then been proved once again, the constructed Near-VAR model is sound.

Finally, a dynamic analysis was performed on the roots of the model to evaluate their stability. The main results of this analysis are represented in Figure 7, corresponding to the Roots of Companion Matrix:

Figure 7: Stability of the Model (Roots of Companion Matrix)

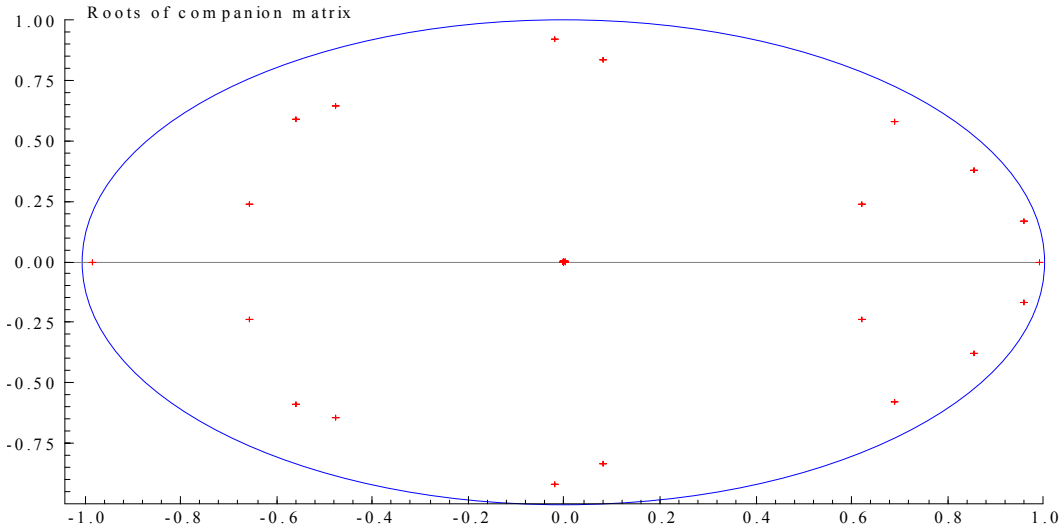


Figure 7 shows the non-existence of roots outside the companion matrix. Were this the case it would indicate the presence of an explosive model. On the other hand, it has been shown that the roots of the model present, in absolute terms, are values of less than one, and are within the unit circle, thus confirming the stability of the model.

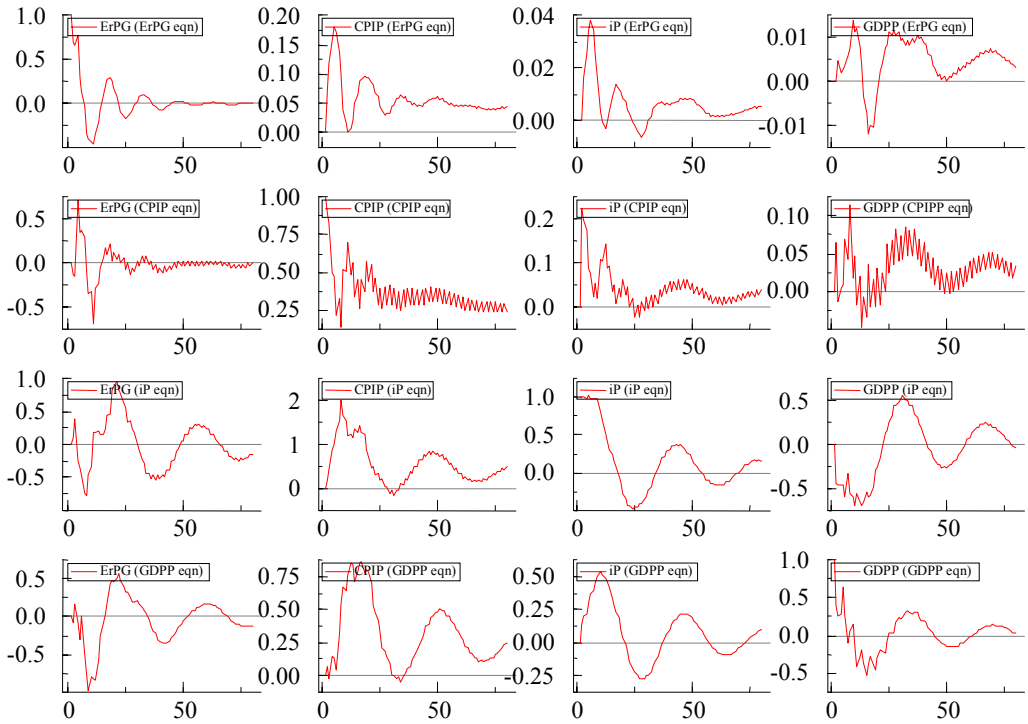
Thinking in this way, it was possible to go ahead with a simulation analysis, from which we evaluated the main effects of the Portuguese disinflation process.

VI. Simulation Analysis

With this Simulation Analysis we aim to evaluate, in an approximate way, the effects of the Portuguese disinflation process. For this, a unit shock is initially introduced into each of the endogenous variables, and the results of that impulse are then analysed, in the remaining endogenous variables. This study intends to clarify the influence that the real exchange rate appreciation may have on output and price levels.

We document in Figure 8 the results throughout eighty periods. As the variables are in levels, the shock results always tend to be zero.

Figure 8: Simulation Analysis (80 periods)



The first row of graphs shows the result of a unit variation in the real exchange rate for all the endogenous variables. Positive variations in the real exchange rate are equivalent to the existence of a real depreciation. Negative variations correspond to a real exchange rate appreciation. The second group of graphs show us the consequences of a unit variation in the CPI of the Portuguese economy for all endogenous variables. From now on the CPIP will simply be referred to as "price levels". In the third line of graphs the "response" of a unit variation in the short-run nominal interest rate is analysed. Finally, the fourth group of graphs measures the impact on the endogenous variables due to a unit impulse in the Portuguese GDP.

VI.1. The Impact of a Unit Shock on the Real Exchange Rate

Let us suppose that the existence of a unit shock in the real exchange rate leads to a real appreciation of the escudo relative to the Deutsch mark[24]. As can easily be seen from Figure 8, the appreciation of the real exchange rate will last for seven quarters, after which the opposite situation will be observed.

During the appreciation phase we witness a successive reduction in the price levels, reaching a maximum variation of about 18% within five quarters. The price levels continue to drop in the following periods, but as the real exchange rate appreciation is being attenuated, the price levels observe successively inferior variations. Three years after the shock the price levels do not show any sign of change.

[24] The situation manifested in Figure 8 is exactly the opposite. An initial real depreciation of the escudo is verified following the shock in the real exchange rate. However, we will opt for doing an analysis diametrically opposed, having no consequences from it since the symmetry of the analysis is maintained for all variables and throughout the whole period.

The impact of the real appreciation of the escudo on the short-run interest rate is similar to that observed on the price levels, although the variations recorded in that variable are significantly smaller. In fact, the short-run interest rate, after six periods, drops by only 0,038 units, recording successive minor drops later that eventually cancel themselves after ten quarters.

Finally, it can be seen that the Portuguese economy output registered a fall in the sequence of the real exchange rate appreciation process. Although not very significant, it will last for about three years. The loss of competitiveness associated with the real appreciation may explain the drop in output, which records its highest variation after eight quarters. Moreover, the fall in output is stressed at a time when the Portuguese economy was entering a phase characterised by a real depreciation, reversing its course from there. This new course observed in output is explained by the real depreciation of the escudo registered in the meantime, allowing the Portuguese economy to recover some of its previously lost competitiveness.

Sixteen periods after the unit shock a real appreciation of the escudo is observed once again, although with a lower dimension. The price levels register new reductions, but of less amplitude. As in the first periods, the fall in price levels is directly related to the loss of competitiveness due to the real exchange rate appreciation, trying to compensate for it. The course of the interest rate, with a few exceptions, is similar overall to the price levels. Successive falls in output are observed, and reinitiated, by the end of this second phase of the real appreciation. However the negative impact on output continues to be of little significance, never recording falls above 0,7%.

Surpassed by some short and medium run volatility in the real exchange rate, this variable tends to approach zero after almost ten years from its introduction.

VI.2. The Impact of a Unit Shock on Price Levels

We chose again, to begin with a symmetric analysis of the results observed in Figure 8. Beginning with this assumption, it can be shown that the unit shock leads to a reduction in price levels throughout the period, although the initial path is almost cancelled out by the end of eight quarters, the period where this variable registers its lowest fall, followed by further reductions. Six years after the introduction of the shock, the price levels tend to zero.

As a result of this impulse, a very significant “response” of the real exchange rate is observed, with an obvious real appreciation of the escudo of approximately 0,72 units by the end of the first year. However, only three periods from this date, the real exchange rate inverts its course completely, and then a real depreciation is observed, having almost the same amplitude as the previous variation. This real depreciation lasts for eight periods, allowing the Portuguese economy to recover the competitiveness that it was on the verge losing due to the successive minor reductions in price levels. When the price levels fall again we observe a new real exchange rate appreciation from the fourth year, but with much less significance than before.

As for the interest rates, after observing a relatively steep drop in the first two quarters, they tend to follow the evolution of price levels, although recording insignificant falls. The effects on the interest rate tend to draw to zero six years after the shock on price levels occurred.

A general drop in output is still perceptible, but is less significant when compared with the fluctuations of price levels. The most marked fall comes at the end of the second year, when a reduction in output of about 11% is observed. Counteracting the general tendency, this variable suffers an increase between the third and fifth years. However, during this phase of growth, output does not increase by more than 5%. Six years after the introduction of the shock in price levels, the output resumes its descending course registering new falls, although relatively insignificant ones. The reduction in price levels seem, therefore, to have led to moderate activity costs, which are distributed throughout the period.

VI.3. The Impact of a Unit Shock on the Interest Rate

Observing Figure 8 once again, it can be seen that a unit shock in the interest rate leads to an oscillating behaviour of this variable.

In "response" to the interest rate drop, real exchange rate depreciation is observed, while in the rising phase a real appreciation of the escudo is registered. The real exchange rate behaviour is perfectly understood within the context of perfect capital mobility. The impact of the shock on the real exchange rate is relatively strong, and is apparent in several situations that are more than in proportional to the interest rate variation.

After the unit shock in the interest rate, the price levels usually register a rather accentuated reduction, particularly noticeable in the initial phase of the most marked fall of the interest rate. During this period, the price levels even reach variations that are more than proportional to the initial impulse that occurred in that variable, thus reflecting the decrease of the capital cost more noticeably.

As for output, a growth in "response" to the drop in interest rate is observed, and a fall is noted when interest rates increase. This situation is explained by the effects that the shock on the interest rate may have had on investment. The reaction of output to the interest rate impulse is relatively significant throughout the period.

VI.4. The Impact of a Unit Shock on Output

As was observed with the interest rate, it can be shown that the unit shock in output leads to an oscillating behaviour of the variable during the period of analysis.

In "response" to the fall in output, a real depreciation of the escudo is observed, while in the growth phase a real exchange rate appreciation is registered. This real exchange rate evolution ends up performing in an anti-cyclic way, contributing to the expansion of the activity when a fall in output occurs, but halting it when pressures are observed on the demand. The shock impact on the real exchange rate is considerable.

Following the impulse effect on output, price levels register quite a strong reduction tendency. During the most noticeable phases of decreasing output, the most significant price level reductions are registered. These are mainly due to the fact that the decrease in the level of economic activity leads to a decrease in the demand and, consequently, to a price level reduction.

As for the interest rate, a decrease in this variable in "response" to the fall in output is observed, along with an increase during the growth phases in the level of economic activity. The interest rate thus contributes indirectly, to avoiding the development or even emergence of inflationary pressures. The reaction of the interest rate is relatively significant, especially in the first five years.

VII. Conclusion

The aim of this study is to analyse the Portuguese disinflation process, which is based on the nominal stabilization policy of the escudo executed at the beginning of the 90s. Knowing the anti-inflation reputation of the *Bundesbank* and the role played by the German currency in the stability process of foreign exchange and of European price levels, the pegging of the Portuguese escudo to the Deutsch mark was studied. This study was also based on the attainment of co-integrating relations, on the construction of a Near-VAR model and on the accomplishment of a simulation analysis.

It was therefore possible to conclude that the acceptance of the German monetary policy and the pegging of the escudo to the Deutsch mark allowed the Portuguese economy to experience a sustained process of disinflation, as well as successfully achieving the main aim of price stability. However, associated with the gains reached in credibility and stability, the adoption of a disinflation policy led to a real appreciation of the escudo against the mark.

The aim was then to clarify the influence that the real exchange rate appreciation may have had over output, the interest rate and on price levels. If it is agreed that Portugal made enormous progress in its European integration process, allowing it to become part of the group of countries participating in the euro zone, it should also be mentioned that there was a reduction in Portuguese competitiveness, which restricted its own output growth. However, due to the continuous and gradual nature of the disinflation process, everything seems to indicate that the output costs may turn out to be less significant and well distributed throughout the period.

Moreover, through the disinflation process and European integration, Portugal may benefit from an increasing mobility of capital and from a more efficient functioning of financial markets, allowing a significant reduction in interest rates, a phenomenon that may have worked in an anti-cyclic way in face of the reduction in the level of economic activity.

The nominal stability policy of the escudo may serve as an example for other small economies that may be presently involved in the European integration process. In this context, future studies will analyse the disinflation benefits, as well as the output costs of such policies in countries such as the Czech Republic, Estonia, Hungary, Poland and Slovenia.

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