

HOW THE GOLD STANDARD FUNCTIONED IN PORTUGAL: AN ANALYSIS OF SOME MACROECONOMIC ASPECTS

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Abstract

This paper studies the Gold Standard in Portugal. It was the first country in Europe to join Great Britain in 1854. The principle of free gold convertibility was abandoned in 1891. For the purposes of a macroeconomic study, we also extended the analysis up to 1913. Our study points out the mistake of comparing different systems with the same indicators. Examination of demand, supply and monetary shocks in the context of a VAR model confirm the idea that the principles of classical economics are appropriate for the Gold Standard in Portugal.

Key words: Gold Standard, Macroeconomic Stability, Convertibility, Portugal, VAR and Unit Roots.

JEL Classification: B10, C32, E42, E58, F31, F33 and N23.

1. Introduction

At the beginning of the 19th century, the monetary laws of many countries allowed coins made from various precious metals to be minted and circulated. Such commodity-money systems are known as bimetallic standards. Gold was used for high-value transactions, while silver, bronze or copper coins were used for the rest. Great Britain was the exception, establishing a *de facto* monometallic system in 1821².

The industrial revolution led to the emergence of Great Britain as the leading trading and industrial power in the 19th century, and as the main source of external finance. This fact encouraged other countries to try and tighten trading relations with Great Britain and to go to London for capital loans.

Portugal was the first European country to join Great Britain in the Gold Standard (G-S), in 1854, adhering to it for a considerable period, only abandoning it in 1891³. Besides a desire to share the same monetary system as its chief trading partner, the low price of gold and the circulation of British gold coinage at home may also have contributed to the adoption of the G-S in Portugal⁴.

The functioning of the G-S in Portugal was characterized by an overall picture of nominal stability, in terms of both exchange rates and prices, with product behaviour showing quite a favourable evolution in the light of the stagnation observed up to 1854⁵.

¹ The authors thank Adelaide Duarte, Mafalda Pereira and Marta Simões for their comments.

² Cf. Bordo and Schwartz (1997) and Eichengreen (1999).

³ Cf. Reis (1995) and Mendonça (1996).

⁴ Cf. Mata and Valério (1993) and Reis (2000).

⁵ Cf. Reis (1995).

Then followed a period of monetary instability and flexible exchange rates, as a result of the suspension of the free convertibility, a decision which was taken by all countries after 1913, when the international monetary system known as the classical G-S began to collapse, owing to the massive shocks of the First World War.

But if Portugal was one of the first countries to adhere to the international Gold Standard, it was the last European country to try restoring the full convertibility of its currency, in 1931, at a time when financial crisis was looming in Europe¹.

This paper aims to elucidate the historical choice of the G-S by the Portuguese authorities, and to analyse its macroeconomic behaviour. Certain performance indicators of this system are compared with the systems that followed it. With respect to comparison criteria, we would draw attention to the need to use different indicators for different systems, something that is largely ignored. We came to the conclusion in an earlier study² that, from the point of view of money and nominal income, the period 1854-1913 was very similar to the strict period of the G-S. This is why we have focused a certain amount of attention on comparing these two periods.

The data used have been taken from Nunes, Mata, and Valério (1989) and Batista, Martins, Pinheiro, and Reis (1997). The econometric program employed to process the series was RATS, version 5.04.

The paper is composed of seven points. Point 2 gives a retrospective history of how Portugal came to adhere to the G-S and analyses some of the factors that contributed to that decision. Point 3 describes the functioning of the G-S in Portugal and examines the reasons for its collapse in June 1891. Point 4 raises the issue of the presumable evolution of prices and inflation under the G-S, based on a very simple model by which conclusions are drawn with respect to those variables. Point 5 compares different monetary systems in Portugal and looks at the stationary behaviour of macroeconomic series. Point 6 concentrates on a description of the VAR model. Finally, we concentrate on the G-S period and after resolving some identification problems of the model, short-term shocks that are identified with demand, supply and money supply are studied. The last point, Point 7, concludes this work, while indicating some openings for future research.

2. The Process of Portugal's Adherence to the Gold Standard

The anarchy of the monetary circulation prevailing in the first half of the 19th century³ led to a realisation that the only way to solve the problem appeared to be a change to a monometallic system⁴.

On May 1st 1854, the 'regenerative' government of Fontes Pereira de Melo laid a proposal for the reform of the Portuguese monetary system before the Chamber of Deputies. The proposal envisaged the resolution of Portugal's monetary problems through the establishment of a monometallic gold system, exactly like the one operating in Great Britain since 1821.

The debate went on until the second half of May, with the arguments raised being technical⁵.

¹ Cf. Macedo, Eichengreen and Reis (1995), Santos (1995) and Reis (1995).

² Cf. Andrade (2003).

³ Bimetallism, with the circulation of several foreign currencies in parallel with the coinage issued by the *Casa da Moeda*. (Portuguese mint).

⁴ Cf. Reis (1995).

⁵ Cf. Esteves and Ferramosca (2000).

After a succession of technical changes, the proposed reform was approved on May 15th and became law on July 29th 1854, making Portugal the first country in Europe, to join Great Britain in adhering to the G-S. All the classical rules of the G-S monetary system were enshrined in the drawing up of the Law's various articles, to reproduce the characteristics of the British G-S¹.

However, Portugal's 1854 decision is hardly surprising. None of the factors responsible for the emergence of the G-S as the international monetary system quite fits the events that led to Portugal's adoption of the G-S².

In the first place, Portugal's adherence to the G-S was not favoured by technical issues³. When Portugal joined the gold monometallic system, the authorities were striving to supply a currency of acceptable quality and in sufficient quantity to facilitate low-value transactions, largely because of the Casa da Moeda's (national mint) technical limitations, since its economy was far less monetised in relation to those of most European countries.

Second, there is nothing to lead one to conclude that Portugal's adoption of the G-S was related to a "gold ideology" or that it was associated with the role played by an "urban-industrial class"⁴. It was only later, after the Paris Conference of 1867, that this ideology was to influence other countries to adhere to the G-S⁵.

Third, it is hard to see that the adoption of gold could have been the result of being "dragged along" in the wake of certain other countries' adhesion, with others following suit. When Portugal decided to adhere to gold monometallism, only Great Britain was using this system⁶.

Finally, Portugal's joining was not determined by financial reasons. The adoption of the G-S could also be related to reducing the costs of loans on the international capital markets, where it would operate as a sign of financial credibility⁷. However, there is no good reason to suppose that one of the factors responsible for Portugal's adhesion to the G-S would have been easier access to the international capital markets; but this does not mean that it was not useful at a later stage.

As we cannot attribute a determining role to any of the factors responsible for the emergence of the international G-S in Portugal's decision we have to conclude that the country's adherence to the model followed by Great Britain was encouraged by a set of specific circumstances, certain facets of which have considerable singularity.

First of all, the change to the new system was facilitated by (a) its low implementation cost, relative to the charges that would have resulted from the adoption of a silver monometallism, (b) the fall of the international price of gold, (c) the widespread circulation of gold coinage within Portugal and (d) the fact that there was a significant inflow of British gold coins, coming from Brazil, due to the repatriation of capital⁸.

Reis (1995), sees the 1854 decision as a consequence "of accidents of History", and a purely natural response to the monetary chaos at the end of the 1840s. But when Portugal decided to implement the G-S, it was already virtually governed by it, and so it was not a matter of choosing an ideal monetary system model, but, rather, a system that would be workable and with lower transaction costs.

¹ Cf. Reis (1995), Mendonça (1996) and Esteves and Ferramosca (2000).

² Cf. Reis (1990) and Reis (1995).

³ Most countries would later benefit from the introduction of steam technology in the minting of coinage. Cf. Redish (1990).

⁴ Cf. Reis (1995).

⁵ Cf. Gallarotti (1995) and Meissner (2002).

⁶ Cf. Reis (1995), Bordo and Eichengreen (1998) and Meissner (2002).

⁷ As a "good housekeeping seal of approval". Cf. Bordo and Rockoff (1996).

⁸ Cf. Bordo and Schwartz (1995), Reis (1995) and Mata and Valério (1993).

3. Some Features of the Functioning of the Gold Standard in Portugal

The functioning of the G-S in Portugal basically reproduces the characteristics of the British model. The divergences were not enough to prevent the G-S from working well for 37 years, a longer spell than the classical G-S period (1880 to 1914).

During that time, the money supply was made up of imported British sovereigns and half-sovereigns which, contrary to other foreign gold coins, remained legal tender, but they were accepted at par and not overvalued, as had happened up to the introduction of the new monetary system. They increased considerably in number as a result of the positive balance of payments situation, due largely to loans obtained on the international market and the capital flows from emigrants' remittances¹.

The position of Portugal in terms of external payments meant that its economy became highly dependent on the evolution of the political, social and economic situation in Brazil, and on its main financial partner, Great Britain.

Monetary dependence on the outside world was nothing new, but in the new monetary context obtaining in Portugal it began to take on greater importance². Portugal was not merely before a G-S, it was confronted by a sterling G-S, given the key role played by the sovereign and half-sovereign in monetary circulation³. Among the various negative aspects that were to arise from that situation, "wounded national pride" is conspicuous, due to the possibility of the Portuguese economy becoming even more dependent on that of Britain.

Even though, exchange stability within the gold points was respected, by and large, while Portugal remained within the international G-S, although there was some foreign exchange volatility in the *sovereign/real* relation. This was sometimes expressed in the breach of the import and export point of gold⁴. The G-S thus represented an appreciable level of exchange rate stability, and one that grew with the passage of time, as can be seen from the lower number of violations of the gold points.

But if the strict monetary discipline of the G-S provided an overall picture of nominal stability, the period when Portugal adopted it was characterized by unrelenting deficits in the trade balance and persistent negative balances in the public accounts. This was not unrelated to the adoption of a number of "modernization" policies, associated with the creation of economic and social infrastructures.

Despite all this, until 1890, Portugal managed to obtain long-term loans, both at home and abroad, to cope with the trade deficit⁵. In addition, the country succeeded in compensating for its negative trade balance by means of revenue from the remittances of emigrants in Brazil and earnings from Portuguese investments abroad, which were significant enough to achieve a series of balance of payments surpluses.

In the long-run, meanwhile, the accumulation of these balances in the public accounts, along with those in the trade balance, made the abandoning of the G-S inevitable when the 1890-1892 crisis struck. The early 90s were marked by a number of problems that led to a widespread lack of confidence, provoking the collapse of the Portuguese G-S.

¹ Cf. Mata and Valério (1995).

² In 1854 British gold coins accounted for 56% of the money supply, and in 1890, one year before the gold standard was abandoned, it comprised 74%. Cf. Sousa (1991), Mata and Valério (1993).

³ Cf. Reis (1995).

⁴ Cf. Esteves and Ferramosca (2000).

⁵ Cf. Bordo e Schwartz (1995).

Brazil was undergoing a period of social and political instability. The Brazilian crisis had the effect of reducing emigrants' remittances which made it hard to prop up the G-S system¹. Portugal also got itself embroiled in a diplomatic conflict with Great Britain, which led to the British ultimatum of 1890, while, at the same time, the Baring Brothers crisis further worsened an already delicate economic situation.

Added to all this, an unsuccessful attempt to issue an external loan to obtain international liquidity resulted in a run on the banks to exchange notes for gold coins; when the monetary authorities were unable to meet this the abandoning of the G-S was inevitable. There followed a period of monetary instability and flexible exchange rates, due to the suspension of the free gold convertibility on May 9th 1891.

Nevertheless, it seems that the possibility of restoring the G-S was never formally given up by the Portuguese monetary authorities. But the project was never seriously considered, and so a definitive stabilization of the exchange rate was only achieved in July 1931. This situation led to the adoption of a gold-exchange standard, following the recommendations of the 1922 Geneva Conference, under which full convertibility of the Portuguese currency could be restored relative to the British currency, convertible into gold, albeit at a devalued parity.

But if Portugal was the first country to join Great Britain in adhering to the international G-S system, it was the last to restore the full convertibility of its currency in 1931, which is once again surprising, since it was returning to gold at a time when the beginning of an exceptionally turbulent period for the functioning of the international monetary system was imminent². Portugal was going back to gold when other countries were leaving it.

The suspension of the pound sterling's gold convertibility on September 21st 1931, as a consequence of the effects of the failure of the *Kreditanstalt* and the German banking crisis, brought about the collapse of the system between the wars³. The countries that maintained important trading relations with Great Britain were forced to abandon the G-S. This occurred in Portugal, which suspended the gold convertibility of its currency following the British decision, just 82 days after its introduction.

The authorities then decided to peg the escudo to sterling, and a fixed exchange regime operated in Portugal from 1931 to 1938⁴. Pegging the escudo to the British currency was a way of ensuring the stability of the Portuguese monetary unit that would function as a close substitute for the G-S.

After the II World War the escudo was pegged to the dollar. Even though it was only in 1962 that Portugal joined the IMF, it can still be said that it saw the same period of fixed exchange as the Bretton Woods (B-W) system until the early 1970s.

4. Inflation and Prices under the Gold Standard

In order to find out about the characteristic of price and inflation stationarity under different systems, let us suppose a very simple macroeconomic model.

Let us take a product equation, (1.1), where current values are determined in accordance with a Phillips curve. Price behaviour is given by equation (1.2). The presence of lagged prices expresses a partial adjustment relation. Finally, equation (1.3) shows the behaviour of the amount of money in circulation. Besides the con-

¹ Cf. Reis (2000).

² Cf. Macedo, Eichengreen and Reis (1995), Santos (1995) and Reis (1995).

³ Cf. Crabbe (1989), Bourget, Figliuzzi and Zenou (2002).

⁴ Cf. Bordo and Santos (1995) and Santos (1995).

stant, it contains one component of partial adaptation and another that expresses what may be termed the “endogeneity” of its behaviour. Variables are expressed in logs.

$$y_t = \bar{y} + \gamma \cdot (p_t - p_{t-1}) \quad (1.1)$$

$$p_t = \beta_C + \beta_0 \cdot p_{t-1} + \beta_1 \cdot (y_t - \bar{y}) \quad (1.2)$$

$$m_t = \alpha_C + \alpha_0 \cdot m_{t-1} + \alpha_1 \cdot p_{t-1} \quad (1.3)$$

Substituting (1.2) in (1.1) we get, after simplifying,

$$p_t = \frac{\beta_C}{1 - \beta_1 \cdot \gamma} + \frac{\beta_0 - \beta_1 \cdot \gamma}{1 - \beta_1 \cdot \gamma} \cdot p_{t-1} \quad (1.4)$$

Reorganizing (1.3) in terms of prices and substituting in (1.4), we get:

$$p_t = \frac{\beta_C}{1 - \beta_1 \cdot \gamma} + \frac{\beta_0 - \beta_1 \cdot \gamma}{1 - \beta_1 \cdot \gamma} \cdot \left(\frac{1}{\alpha_1} \cdot m_t - \frac{\alpha_0}{\alpha_1} \cdot m_{t-1} - \frac{\alpha_C}{\alpha_1} \right) \quad (1.5)$$

While equation (1.4) interprets the behaviour of prices, only considering the real part of the economy, equation (1.5) shows price behaviour in terms of the real and monetary part of the economy.

We move on to compare the two states of the economy, an economy with a convertible currency and an economy with a non-convertible currency.

In the convertible currency situation, it is reasonable to assume that prices react to demand and will be flexible in the manner $\beta_0 = 0^1$. At the same time, we feel it is also reasonable to consider that productivity evolution in a competitive market will lead to $\beta_0 < 0$. Deflationary pressure is obvious, unless we see equation (1.6), which we get from (1.4),

$$p_t = \frac{\beta_C}{1 - \beta_1 \cdot \gamma} - \delta \cdot p_{t-1} \quad \text{where } \delta = \frac{\beta_1 \cdot \gamma}{1 - \beta_1 \cdot \gamma} \quad (1.6).$$

The two components that constitute the prices behaviour have negative values. If prices show high flexibility, then $\beta_1 \rightarrow 1$, and so $\delta \rightarrow 0$. But regardless of the situation, prices are far from displaying a unit root in their behaviour. We also see that (1.6) expresses the absence of a “buffer effect” of prices that is normally given by the inertia ($0 < \beta_0 < 1$) of its behaviour.

The situation in an economy with non-convertible currency is different. The parameters β_C and β_0 have quite different values. We may imagine $\beta_C > 0$ as a result of behaviours more remote from competitive ones. The presence of inertia in the evolution of prices that characterizes these systems can also lead to the situation of $\beta_0 = 1$. As a result, in this extreme case, instead of (1.6), we now have

$$p_t = \frac{\beta_C}{1 - \beta_1 \cdot \gamma} + p_{t-1} \quad (1.7)$$

The inflation rate now takes a positive constant value because of the new characteristics of the economy. The presence of a unit root in price is obvious.

We want to introduce in our analysis the monetary part. But before doing so, it is useful to clarify the signification of α_C in (1.3). Its value can be decomposed into

$$\alpha_C = \bar{y} + \alpha_v \quad (1.8)$$

thereby interpreting the effect of long-term growth of the economy on monetary circulation (\bar{y}) and the correction to the velocity of money circulation (α_v). But, in actual fact, this behaviour should only be taken in “managed currency” systems. There is no point in considering (1.8) in convertible currency systems.

¹ The “clearing markets” hypothesis.

In accordance with (1.5) we can admit that in convertible currency systems prices need not necessarily fall. For that, it is enough that α_C is sufficiently high. But this value in such systems may be taken as random¹.

We may look at the case of economies whose currency is non-convertible. We have the hypothesis of “managed currency” behaviour. The concept of exogenous money supply \bar{m}_t is now introduced, and the equality of equilibrium between money demand and supply, $m_t = \bar{m}_t$. Equations (1.5) and (1.7) thus undergo a slight change

$$p_t = \frac{\beta_C}{1 - \beta_1 \cdot \gamma} + \left(\frac{1}{\alpha_1} \cdot \bar{m}_t - \frac{\alpha_0}{\alpha_1} \cdot m_{t-1} - \frac{\alpha_C}{\alpha_1} \right) \quad (1.9)$$

This behaviour highlights the positive tendency in the growth of prices as a result of decisions on money supply that over-value full employment product growth or that over-correct foreseeable reductions in the velocity of money circulation.

We find from (1.6), (1.7) and (1.9) that the behaviour of prices is different in the two systems². It is interesting to note that in the case of non-convertible we move straightaway from prices to a regular behaviour of the rate of inflation.

As mentioned above, we conclude that there is no point in taking inflation rate characteristics, in terms of mean values and standard deviation, to compare the performances of the two systems³. On the contrary, we should compare periods (or economies) within a convertible system using the statistical characteristics of prices and, for a non-convertible system, we should use the inflation rate characteristics.

We have used simulated values to illustrate the consequences of not respecting this principle (see Table 1). We simulated a series of 150 observations, using only the last 101 values. The series of random values, u_t , was created as the probabilistic value in accordance with the Normal (0,1), for the values that are generated by a uniform distribution⁴. The price series in the convertible currency system is given by $P_t^C = u_t$, and in a non-convertible currency system by $P_t^{NC} = P_{t-1}^{NC} + u_t + 0,4 \cdot T_t$, where $P_1^{NC} = 1$. The price series show mean values equal to 100. We repeated the simulation 500 times, so that the mean price or inflation rate is the mean of these means, and the standard deviation the mean of the standard deviations. The coefficient of variation is given by the division of this last by the value obtained for the mean.

As we can see, the system to be regarded as the most stable depends on the variable chosen for comparison. If we take the inflation rate, the convertible system shows the highest value for the coefficient of variation. The opposite is found if we take prices. The most stable system now is that of currency convertibility. It does not make sense to compare the G-S with the later systems on the basis of the same variable, the inflation rate, as Bordo and Kydland (1995) did, following the earlier results obtained by Barsky (1987). In the same way as the test by Alogoskoufis and Smith (1991) and Alogoskoufis (1992) on the growth of the persistence of the G-S inflation for the following systems is deprived of meaning.

¹ Which does not mean that some authors have not tried to endogenize the behaviour of the monetary supply of precious metals. See Rockoff (1984) and McCallum (1989).

² Despite the result found by Barsky (1987).

³ Lee Craig and Spencer (1995) draw attention to the phenomenon of international integration of prices under the gold standard, linking it to a lower rate of inflation. This integration does not take the same form with national non-convertible currency.

⁴ In terms of the RATS econometric program, $u = \%invnormal(\%uniform(0,1))$.

5. The Gold Standard in Portugal: some indicators

5.1. General Indicators

The characterization of the G-S is displayed in a comparative form in Table 2. We have included in this table the B-W period from 1949 to 1972, and the subsequent period up to the EMU, from 1973 to 1998. The values included are the mean (μ) of the variable indicated there and the standard deviation (σ) of that variable.

The results are not very different from those found in Cooper (1982), Bordo (1993), Bordo and Santos (1995) and Bordo and Jonung (2001). Although the inflation rate was lower during the first period (0.2%), the standard deviation for inflation reached a higher value during the G-S than during B-W.

However, the comparison in terms of nominal stability¹, where the G-S is concerned, should be made using prices. We can see how the G-S was one of great price stability. As we expected, product growth was substantially greater during B-W, at almost 5% as against nearly 2%, during the G-S. There was also less product stability during this period. With respect to the money supply, we should note lower growth under the G-S and instability of such growth in the period following B-W. In short, we may conclude that the nominal stability during the G-S contrasts with the real stability of the B-W period.

5.2. Study of the Stationarity of the Series

Before moving on to the study of the modelling of the G-S period, we should examine the characteristic of stationarity of the series involved. Besides the most current augmented Dickey-Fuller tests for unit root², in which we follow the methodology proposed by Hamilton (1994), we performed other calculations, namely: the KPSS stationarity test³; finding the limit values for ρ from the t_{ADF} test, at the level of 90%, in accordance with Stock (1991); Bhargava's R_1 e R_2 ratios (1986), with the random walk null hypothesis against the alternative of stationarity, with and without a constant, respectively; and, finally, the corrected ADF test, *DFGLS*, in accordance with Graham et al. (1996) and *DFGLU*, in accordance with Elliot (1999). In the KPSS test we used the lags obtained in the first ADF test that eliminate the auto-correlation problem by means of the LM test. The asterisks have the usual meaning of rejection of H_0 , *** at 1%, ** at 5% and * at 10%, except for the KPSS test, where *** means non-rejection of stationarity at 10%. The results are given in Table 3.

Regarding Product and Prices in the 1854-91 period, all the tests indicate that we should accept the stationarity of the respective series. The results are not quite so clear with respect to Money. All the others correspond to a rejection of stationarity.

As we said at the outset, we have a second G-S period that lasted from 1891 to 1913. In this period of "extended G-S", only Prices can be taken as stationary. Product and Money are clearly not stationary. In the light of these results, in terms of the construction of VAR models, since we are interested in comparing the results, we have chosen a VAR model on levels for the second period.

¹ Accepting that prices are stationary.

² Statistics $t_{\rho=1}$ and $N \cdot (\rho - 1)$, where N is the number of observations. Cf. Dickey and Fuller (1979), Phillips (1987) and Phillips and Perron (1988).

³ Cf. D. Kwiatkowski and Shin (1992).

6. A VAR model for 1854-91 and 1854-1913

Moving on to the study of a VAR model with Product (Q), Prices (P) and Money (M)¹, the model considered is of the type

$$\mathbf{A}(L) \cdot \mathbf{x}_t = \mathbf{A}_0 + \mathbf{e}_t \quad (2.1)$$

where

$$\mathbf{x}_t = \begin{bmatrix} Q \\ P \\ M \end{bmatrix} \quad (2.2)$$

is the vector of the endogenous variables, $\mathbf{A}(L)$ the matrix of coefficients of the lags of \mathbf{x}_t , \mathbf{A}_0 the vector of the constants, and \mathbf{e}_t the vector of errors with the normal I.I.D..

To select the order for the VAR model we used Akaike, ($AIC = N \cdot \log|\Omega| + 2 \cdot (k_{UR} \cdot K)^2$) and Schwarz ($SBC = N \cdot \log|\Omega| + k_{UR} \cdot K \cdot \log(N)$) indicators, as well as a likelihood ratio test (LR) in accordance with the correction proposed by Sims (1980). The values obtained are given in Table 4. The value in brackets in the “LR” column is the significance level of the value of χ^2 of order 9. Those two indicators and the LR test point in the same direction: the model that we are going to retain is of order 1. As Table 5 shows, the root modules are below the unit, and so the model is stationary. Employing the Choleski decomposition, we estimated the error variance decomposition of each variable in terms of their individual contribution. The results are given in Table 6. We have to stress the influence of Product and Prices on Product and Prices.

6.1. The Study of Shocks on the Model Variables

Continuing with the Choleski decomposition, we show in Figures 1 and 2 the effects of shocks (standard deviation of each estimation) on each variable³. As the models are stationary, the impulses resulting from shocks tend to become null with the passage of time. For this we have chosen a period of ten years. Graphic analysis of the effects of shocks shows some similarities, but also differences, in the two models.

A shock to Product (see Figure 1): (a) has immediate deflationary effects, but after 3 or 4 years the effect is virtually null; (b) has long-lasting effects on Product and Money. After 10 years Product and Money still register 1/3 and 36% of the shock on Product, in the first model, and 27% and 30% in the second model⁴.

We can see what is happening when there is a shock to Prices: (a) its effects on Product and Money are important. After 10 years these variables still registered 39% and 42% of the percentage value of the shock on Prices, in the first model, and 44% and 20%, in the second model; (b) its effects on Prices themselves are different. In the first model, the effect is 0.16%, and in the second it is 22% (see Figure 2).

¹ Q represents the per capita GDP at 1990 prices; P the implicit deflator of GDP 100 in 1990; and M the per capita M1 monetary stock. All the variables have been converted into logs.

² Where N , k_{UR} and K represent the number of observations, the number of parameters for each equation of the unconstrained model and the VAR order, respectively.

³ We used the RATS monte2.prg program, which applies the methodology indicated in Sims and Zha (1999). Below, another RATS program is used, montezha.prg, applying the same methodology to the case of an above-identified model.

⁴ This result differs from that obtained by Bordo (1993) using a VAR model with an inflation rate and product variation rate, where supply shocks also affect inflation. For an explanation of this “strange result”, see Keating and Nye (1991) and Bayoumi and Eichengreen (1992). Bayoumi and Bordo (1998), too, failed to get the results expected for the case of the USA, contrary to what happened for the United Kingdom.

Finally, we can look at the reactions to a monetary shock: (a) in both models, the effects on Prices vanish quickly, while on Product and Money they are more persistent; (b) the deflationary effect of a growth of money, in the second model, is odd, to say the least, especially in the years close to the shock.

The results found for shocks to product can also be regarded as increases in the demand for coined metal, and the results obtained here are in agreement with the analysis by McCallum (1989), for the short-term, and also with Rockoff (1984), from the long-term perspective.

Two differences in the two models should be stressed: the effects of Price shock on Prices themselves, and the effects of a Money shock on Prices. In the model restricted to the G-S: the effects on Prices of a shock to Prices themselves are quickly annulled – which does not happen in the other model; and a shock to Money has positive effects on Prices, which, however, tend to disappear quickly – while in the other model, we find deflationary effects¹. Another feature of shocks, in either model, relates to the fact that, in the first model, Product variations are always accompanied by slightly higher Money variations, which does not happen in the second model.

Having analysed the impulses on variables, in the two models, it seems to us that they indicate a confirmation of G-S behaviours in the case of the first model. This is why our analysis now focuses solely on this period, and thus on the first model.

The results obtained above enable us to give some general characteristics for the G-S in Portugal. In this period, Product, Prices and Money are stationary variables. In terms of macroeconomic behaviour, we found that the shocks to the Product have very persistent effects on the Product itself and on the Money. The endogeneity of money and the behaviour of prices in a reality that is international are thus emphasized in this model of the Portuguese economy for the period 1854-1891.

6.2. Analysis of Supply, Demand and Monetary Shocks

These results may be regarded as confirming the classical hypothesis of supply shocks ($\varepsilon_{S,t}$) which affect the product and demand shocks ($\varepsilon_{D,t}$), or monetary shocks ($\varepsilon_{M,t}$), which are exerted on prices and not on production. The errors of equation (2.1), instead of presenting the usual structure in a Choleski decomposition,

$$\begin{bmatrix} e_{Q,t} \\ e_{P,t} \\ e_{M,t} \end{bmatrix} = \begin{bmatrix} g_{11} & 0 & 0 \\ g_{21} & g_{22} & 0 \\ g_{31} & g_{32} & g_{33} \end{bmatrix} \cdot \begin{bmatrix} \varepsilon_{Q,t} \\ \varepsilon_{P,t} \\ \varepsilon_{M,t} \end{bmatrix} \quad (2.3)$$

may take another form², where we define supply shocks as being exerted solely on production, demand shocks on prices, and nominal shocks that are exerted via a monetary equilibrium equation. The Equation (2.4) expresses this behaviour,

$$\begin{bmatrix} e_{Q,t} \\ e_{P,t} \\ e_{M,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ g_{31} & g_{32} & 1 \end{bmatrix} \cdot \begin{bmatrix} \varepsilon_{S,t} \\ \varepsilon_{D,t} \\ \varepsilon_{M,t} \end{bmatrix} \quad (2.4)$$

However, equation (2.4) implies an over-identification of order 1 of the matrix \mathbf{G} which is clearly rejected by a probability ratio test: $\chi^2 = 63.465$. Within the possible

¹ Bordo and Redish (1993) draw attention to deflationary policies in periods of non-convertibility as a way of resolving credibility problems.

² Sims-Bernanke decomposition. Cf. Bernanke (1986).

definitions of shocks, and bearing in mind the results obtained earlier, we eventually chose a model where the matrix $\mathbf{G} = \mathbf{G}^*$ took the following form

$$\begin{bmatrix} e_{Q,t} \\ e_{P,t} \\ e_{M,t} \end{bmatrix} = \begin{bmatrix} 1 & g_{12} & g_{13} \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} \varepsilon_{S,t} \\ \varepsilon_{D,t} \\ \varepsilon_{M,t} \end{bmatrix} \quad (2.5)$$

The likelihood ratio test leads to the non-rejection of the null hypothesis for a constraint implied in Equation (2.5), its value was $\chi^2 = 0.598$ (0.439), where the respective significance level is in brackets.

Using the above decomposition, we again supposed shocks of the magnitude of the standard deviations associated with the estimation of the model (see Figure 3).

Supply shocks do not affect Prices and have positive effects on Product and Money. After 10 years, the effects on production and Money are still 60% and 64%. Demand shocks have deflationary effects on the Product and Money. The effects of a demand shock on Prices meant that by the 3rd year less than 1/10 of the initial shock was registered¹. Monetary shocks have positive effects on all the variables². It is interesting to see that a joint supply and demand shock is neutral.

Better confirmation of the application of the principles of the classical economics of the G-S would be impossible to find. But this does not mean that we would uphold the old notion of the equilibrium and smoothness of such a system. In our ideas and in our culture, demand and monetary policies hold an important position. Indeed, they either had harmful effects under the G-S, or they had no significant impact at all. It seems to us that Mundell (1995) and Bordo and Eichengreen (1998) are equally correct when they attribute the disasters of inappropriate policies to the policies themselves, or to the actual system. The G-S did not allow the use of the policies we have seen above. It was able to exist because it corresponded to the political consensus of those represented in the governments that really held power³.

7. Conclusion

Thirty-seven years of convertibility demonstrate that the adoption of the G-S in 1854 was the right decision, and a practical one, given the chaos of Portugal's monetary situation. All this came to an end in 1891. Portugal returned to gold in 1931. This return lasted a brief 82 days. The G-S period for Portugal was, therefore, from 1854 to 1891, although certain of its macroeconomic characteristics remained in place until 1913. The performance of the system, compared with subsequent systems, was not much different, on the whole, from that experienced by other countries.

Prices were stationary, that is to say, they exhibited the characteristics that was expected of the G-S at the outset. In an international market like the G-S, a small economy, such as that of Portugal, has absolutely no chance of controlling the money supply, and international competition would drive towards single prices. Similarly, we can find in the modelling of supply, demand and monetary shocks, an illustration of the "classical" position of economics.

¹ Dibooglu (1998) supports the temporary growth of the effectiveness of demand shocks, which eventually accompanied the evolution of monetary systems.

² This support those who defend convertible systems as a way of achieving price stability. Cf. Dowd (1993).

³ Cf. Frieden (1992).

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Table 1 Simulated Results

—	Mean	Standard Deviation	Coefficient of Variation
P^C	100	1.00	0.010
\dot{P}^C	≈ 0	0.014	123.38
P^{NC}	100	34.00	0.34
\dot{P}^{NC}	0.013	0.004	0.301

Table 2 Values for Prices; Inflation; Product and Money

Period	$\mu \dot{P}$	$\sigma \dot{P}$	σP	$\mu \dot{Q}$	$\sigma \dot{Q}$	μM	σM
1855-1891	0.0019	0.0604	0.0600	0.0195	0.0663	0.0327	0.0467
1855-1913	0.0039	0.0508	0.0850	0.0142	0.0566	0.0287	0.0433
1949-1972	0.0233	0.0228	0.1622	0.0492	0.0317	0.0694	0.0464
1973-1998	0.1299	0.0612	1.0840	0.0275	0.0342	0.1439	0.0703

Table 3 Unit Root and Stationarity Tests, 1854-91 and 1854-1913

Test	Product	Prices	Money	Product	Prices	Money
$t_{\rho=1}$	-4.1**(T)	-4.3***	-2.3(T)	-2.3(T)	-3.9**(T)	-2.3(T)
$N \cdot (\rho - 1)$	-23.6**(T)	-21.7***	-23.2**(T)	-11.5(T)	-23.7**(T)	-7.9(T)
KPSS	0.08***(T)	0.1***	0.05***(T)	1.01(T)	0.28(T)	0.6(T)
Stock ($\rho_{m,M}$)	[-0.8]	[-0.8]	[0.8,1.03]	[0.8,1.03]	[-0.90]	[0.8,1.01]
R_1	-	0.9**	0.2	-	0.35	0.2
R_2	1.0**	-	-	0.33	-	-
DFGLS	-2.7*	-3.2***	-1.7	-1.6	-3.1**	-0.15
DFGLSU	-3.02*	-3.4***	-1.8	-2.1	-3.2**	-2.16

Table 4 Selection of the VAR order 1854-1891 and 1854-1913

Lags	AIC	SBC	LR	AIC	SBC	LR
4	-569.6	-510.3		-1001.0	-922.1	
3	-571.7	-526.0	9.936 (0.356)	-1005.9	-945.1	10.111 (0.341)
3	-585.7	-539.1		-1013.8	-952.5	
2	-595.2	-562.5	6.085 (0.731)	-1020.1	-977.2	9.658 (0.379)
2	-599.4	-566.1		-1019.5	-976.2	
1	-610.5	-591.5	6.855 (0.652)	-1034.5	-1009.7	2.206 (0.988)

Table 5 Roots of the Characteristic Polynomial, 1854-1891 and 1854-1913

Root	Module	Root	Module
0.95544	0.95544	0.97275	0.97275
0.33190 - 0.023i	0.3327	0.80776	0.80776
0.33190 + 0.023i	0.3327	0.39223	0.39223

Table 6 Variance Decomposition – 50th Observation

Influence of:	Q	P	M	Q	P	M
Product	88.2	9.3	2.5	79.8	18.3	1.9
Prices	81.2	17.8	1.0	62.8	31.3	5.9
Money	55.8	6.0	38.2	43.2	3.2	53.6

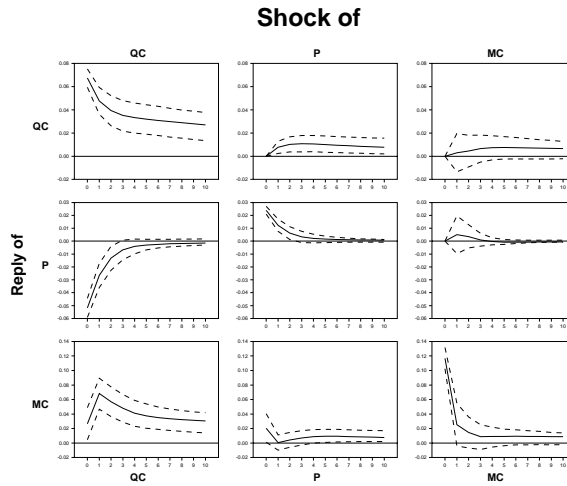


Figure 1 Standard Deviation Shocks (Choleski), 1854-91

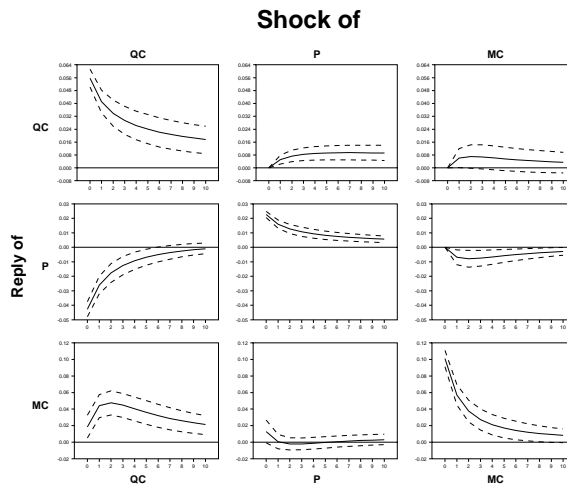


Figure 2 Standard Deviation Shocks (Choleski), 1854-1913

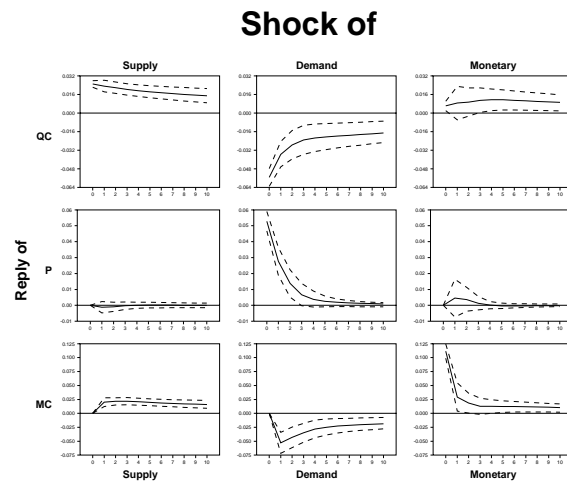


Figure 3 Standard Deviation Shocks (Sims-Bernanke), 1854-91