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For Peer Review

# How the Gold Standard Functioned in Portugal:

## An Analysis of Some Macroeconomic Aspects

António Portugal Duarte <sup>a, b</sup> and João Sousa Andrade <sup>a</sup>

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### Abstract

Portugal was the first country in Europe to join Great Britain in the Gold Standard, in 1854, having abandoned the principle of free gold convertibility in 1891. By elucidating the historical choice of the Gold Standard by the Portuguese authorities, and analysing its macroeconomic behaviour, we prove that it is a mistake to compare different monetary systems with the same indicators. Our examination of demand, supply and monetary shocks in the context of a VAR model confirm the idea of appropriate application of the principles of classical economics to the Gold Standard in Portugal. We also prove that the principles of demand management were not compatible with the functioning of the Gold Standard.

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

*Keywords:* Gold Standard, Macroeconomic Stability, Convertibility, Portugal, VAR and Unit Roots.

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## I. Introduction

At the beginning of the nineteenth 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. Great Britain was the exception, establishing a *de facto* monometallic system in 1821.

The industrial revolution led to the emergence of Great Britain as the leading trading and industrial power, 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, in 1854, adhering to it for a considerable period, only abandoning it in 1891<sup>1</sup>. 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 Gold Standard in Portugal<sup>2</sup>.

The functioning of the Gold Standard 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 1854<sup>3</sup>.

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

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<sup>1</sup> It is also interesting to point out a Portuguese proposal of Carlos Roma (1798-1862) for the adoption of a common European currency, during the Gold Standard period, in 1861. See Cardoso (2004).

<sup>2</sup> See Mata and Valério (1993), Mendonça (1996) and Reis (1995, 2000, 2002).

<sup>3</sup> See Reis (1995).

1 Classical Gold Standard began to collapse, owing to the massive shocks of the  
2  
3 First World War.  
4

5 But if Portugal was one of the first countries to adhere to the Gold  
6  
7 Standard, it was the last European country to try restoring the full convertibility of  
8  
9 its currency, in 1931, at a time when financial crisis was looming in Europe<sup>4</sup>.  
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12 This paper aims to elucidate the historical choice of the Gold Standard by  
13  
14 the Portuguese authorities, and to analyse its macroeconomic behaviour. Certain  
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16 performance indicators of this system are compared with the systems that  
17  
18 followed it. With respect to comparison criteria, we will insist that to compare the  
19  
20 Gold Standard to other systems from the point of view of nominal stability we  
21  
22 must use different indicators.  
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26 The paper is composed of seven sections. The second section gives a  
27  
28 retrospective history of how Portugal came to adhere to the Gold Standard and  
29  
30 analyses some of the factors that contributed to that decision. The third describes  
31  
32 the functioning of the Gold Standard in Portugal and examines the reasons for its  
33  
34 collapse. The fourth compares different monetary systems in Portugal. Section  
35  
36 fifth looks at the stationary behaviour of macroeconomic series. Section sixth  
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38 suggests a VAR model for the Gold Standard period. After resolving some  
39  
40 identification problems, short-term shocks identified with supply, demand, and  
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42 money supply are studied. The last section concludes this work.  
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<sup>4</sup> See Macedo, Eichengreen and Reis (1995b), Reis (1995) and Santos (1995).

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

The anarchy of the monetary circulation prevailing in the first half of the nineteenth century<sup>5</sup> led to a realisation that the only way to solve the problem appeared to be a change to a monometallic system<sup>6</sup>.

On 1st May 1854 the so-called "Regenerador"<sup>7</sup> 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.

After a succession of technical changes<sup>8</sup>, the proposed reform became law on 29th July 1854, making Portugal the first country in Europe to join Great Britain in adhering to the Gold Standard. All the classical rules of the Gold Standard monetary system were enshrined in the drawing up of the Law's various articles, to reproduce the characteristics of the British Gold Standard<sup>9</sup>.

The choice of the moment to institute the gold monometallic system in Portugal is also interesting in that the decision was taken almost twenty years before the leading European countries shifted to the Gold Standard. It was left to Germany, the second largest economic power in Europe to start this change at international level, when, in 1872, it abandoned silver in favour of gold, also as the result of monetary reform<sup>10</sup>.

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<sup>5</sup> Bimetallism with the circulation of several foreign currencies in parallel with the coinage issued by the *Casa da Moeda*. (Portuguese mint).

<sup>6</sup> See Reis (1995).

<sup>7</sup> The "Regeneradores" were a political party claiming for deep reforms.

<sup>8</sup> See Esteves and Ferramosca (2000).

<sup>9</sup> See Reis (1995), Mendonça (1996), Esteves e Ferramosca (2000) and Reis (2002).

<sup>10</sup> See Eichengreen and Flandreau (1995) and Gallarotti (1995).

1 Since they were commercially dependent on Germany and were in close  
2 geographical proximity to it, Sweden, Denmark and Norway quickly followed  
3 suit, joining the Gold Standard in 1873 as part of the Scandinavian Monetary  
4 Union<sup>11</sup>. In a proper chain reaction, Holland and the countries in the Latin  
5 Monetary Union were also drawn towards gold monometallism. France, which in  
6 1873 restricted the free minting of silver, definitively adhered to the Gold  
7 Standard in 1878, along with Belgium and Switzerland<sup>12</sup>. At the end of the  
8 nineteenth century Spain was the only country in Europe to retain non-convertible  
9 paper money, although it had given up bimetallism in 1883<sup>13</sup>.

22 Portugal's 1854 decision is hardly surprising. None of the factors  
23 responsible for the emergence of the Gold Standard as international monetary  
24 system quite fits the events that led to Portugal's decision<sup>14</sup>.

29 In first place, Portugal's adherence to the Gold Standard was not favoured  
30 by technical issues<sup>15</sup>. When Portugal joined the gold monometallic system, the  
31 authorities were striving to supply a currency of acceptable quality and in  
32 sufficient quantity to facilitate low-value transactions, largely because of the Casa  
33 da Moeda's (national mint) technical limitations, since its economy was far less  
34 monetised in relation to those of most European countries.

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52 <sup>11</sup> See Henriksen and Koergard (1995).

54 <sup>12</sup> The decision by France to discontinue the free minting of silver was known as "the crime of  
55 1873". See Flandreau (1996).

57 <sup>13</sup> For a compiled list of countries and periods see Officer (2005).

58 <sup>14</sup> See Reis (1990, 1995), Flandreau (1995) and Einaudi (2001).

59 <sup>15</sup> Most countries would later benefit from the introduction of steam technology in the minting of  
60 coinage. See Redish (1990).

1 Second, there is nothing to lead one to conclude that Portugal's adoption  
2 of the Gold Standard was related to a "gold ideology" or that it was associated  
3 with the role played by an "urban-industrial class"<sup>16</sup>.  
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7 Third, it is hard to see that the adoption of gold could have been the result  
8 of being "dragged along" in the wake of certain other countries' adhesion, with  
9 others following suit. When Portugal decided to adhere to gold monometallism,  
10 only Great Britain was using this system<sup>17</sup>.  
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17 Finally, Portugal's joining was not determined by financial reasons. The  
18 adoption of the Gold Standard could also be related to reducing the costs of loans  
19 on the international capital markets, where it would operate as a sign of financial  
20 credibility<sup>18</sup>. However, there is no good reason to suppose that one of the factors  
21 responsible for Portugal's adhesion to the Gold Standard would have been easier  
22 access to the international capital markets; but this does not mean that it was not  
23 useful at a later stage.  
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34 As we cannot attribute a determining role to any of these factors, we have  
35 to conclude that Portugal's adherence to the model followed by Great Britain was  
36 encouraged by a set of specific circumstances, certain facets of which have  
37 considerable singularity.  
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43 The change to the new system was facilitated by (i) its low implementation  
44 cost, relative to the charges that would have resulted from the adoption of a silver  
45 monometallism, (ii) the fall of the international price of gold, (iii) the widespread  
46 circulation of gold coinage within Portugal and (iv) the fact that there was a  
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55 <sup>16</sup> See Reis (1995). If for Gallarotti (1995) only after the Paris Conference of 1867 this ideology  
56 has influenced other countries to adhere to the Gold Standard, for Flandreau (1995) the end of  
57 bimetalism was mainly due to misguided decisions and international political problems.  
58

59 <sup>17</sup> See Reis (1995), Bordo and Eichengreen (2001) and Meissner (2002).  
60

<sup>18</sup> As a "good housekeeping seal of approval". See Bordo and Rockoff (1996).

1 significant inflow of British gold coins, coming from Brazil, due to the  
2 repatriation of capital<sup>19</sup>.  
3  
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5 The 1854 decision can be seen as a purely natural response to the monetary  
6 chaos of the end of the 1840s<sup>20</sup>. When Portugal decided to implement the Gold  
7 Standard it was already virtually governed by it.  
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### 12 13 14 15 16 17 **III. Some Features of the Functioning of the Gold Standard in Portugal** 18

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22 The functioning of the Gold Standard in Portugal basically reproduces the  
23 characteristics of the British model. The divergences were not enough to prevent  
24 the Gold Standard from working well for 37 years, a longer spell than the classical  
25 Gold Standard period (1880 to 1914).  
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31 During that time, the money supply was made up of imported British  
32 sovereigns and half-sovereigns which, contrary to other foreign gold coins,  
33 remained legal tender, but they were accepted at par and not overvalued, as had  
34 happened up to the introduction of the new monetary system. They increased  
35 considerably in number as a result of the positive balance of payments situation,  
36 due largely to loans obtained on the international market and the capital flows  
37 from emigrants' remittances<sup>21</sup>.  
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48 The position of Portugal in terms of external payments meant that its  
49 economy became highly dependent on the evolution of the political, social and  
50 economic situation in Brazil, and on its main financial partner, Great Britain.  
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59 <sup>19</sup> See Mata and Valério (1993), Bordo and Schwartz (1995) and Reis (1995).

60 <sup>20</sup> See Reis (1995).

<sup>21</sup> See Mata and Valério (1995).

1 Monetary dependence on the outside world was nothing new, but in the  
2  
3 new monetary context it began to take on greater importance<sup>22</sup>. Portugal was not  
4  
5 merely before a Gold Standard, it was confronted by a sterling Gold Standard,  
6  
7 given the key role played by the sovereign and half-sovereign in monetary  
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9 circulation<sup>23</sup>. Among the various negative aspects that were to arise from that  
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11 situation, “wounded national pride” is conspicuous, due to the possibility of the  
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13 Portuguese economy becoming even more dependent on that of Britain.  
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17 Even though, exchange stability within the gold points was respected, by  
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19 and large, while Portugal remained within the Gold Standard, although there was  
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21 some foreign exchange volatility in the *sovereign/real* relation. This was  
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23 sometimes expressed in the breach of the import and export gold points<sup>24</sup>. The  
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25 Gold Standard thus represented an appreciable level of exchange rate stability, as  
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27 can be seen from the lower number of violations of the gold points.  
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31 But if the strict monetary discipline of the Gold Standard provided an  
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33 overall picture of nominal stability, the period when Portugal adopted it was  
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35 characterized by unrelenting deficits in the trade balance and persistent negative  
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37 balances in the public accounts. This was not unrelated to the adoption of a  
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39 number of “modernization” policies, associated with the creation of economic and  
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41 social infrastructures.  
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46 Despite all this, until 1890, Portugal managed to obtain long-term loans,  
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48 both at home and abroad, to cope with the trade deficit<sup>25</sup>. In addition, the country  
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50 succeeded in compensating for its negative trade balance by means of revenue  
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52 from the remittances of emigrants in Brazil and earnings from Portuguese  
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56 <sup>22</sup> In 1854 British gold coins accounted for 56% of the money supply, and in 1890, one year before  
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58 the Gold Standard was abandoned, it comprised 74%. See Sousa (1991) and Mata and Valério (1993).

59 <sup>23</sup> See Reis (1995).

60 <sup>24</sup> See Esteves and Ferramosca (2000).

<sup>25</sup> See Bordo and Schwartz (1995).

1 investments abroad, which were significant enough to achieve a series of balance  
2 of payments surpluses<sup>26</sup>.  
3  
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5 In the long-run, meanwhile, the accumulation of these balances in the  
6 public accounts, along with those in the trade balance, made the abandoning of the  
7 Gold Standard inevitable when the 1890-1892 crisis struck. The early 1890s were  
8 marked by a number of problems that led to a widespread lack of confidence,  
9 provoking the collapse of the Portuguese Gold Standard.  
10  
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12 Brazil was undergoing a period of social and political instability. The  
13 Brazilian crisis had the effect of reducing emigrants' remittances which made it  
14 hard to prop up the Gold Standard system<sup>27</sup>. Portugal also got itself embroiled in a  
15 diplomatic conflict with Great Britain, which led to the British ultimatum of  
16 January 1890, while, at the same time, the Baring Brothers crisis, further  
17 worsened an already delicate economic situation.  
18  
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20 Added to all this, an unsuccessful attempt to issue an external loan to  
21 obtain international liquidity resulted in a run on the banks to exchange notes for  
22 gold coins; when the monetary authorities were unable to meet this the  
23 abandoning of the Gold Standard was inevitable. There followed a period of  
24 monetary instability and flexible exchange rates, due to the suspension of the free  
25 gold convertibility on 9th May 1891.  
26  
27

28 Nevertheless, it seems that the possibility of restoring the Gold Standard  
29 was never formally given up by the Portuguese monetary authorities. But the  
30 project was never seriously considered, and so a definitive stabilization of the  
31 exchange rate was only achieved in July 1931.  
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34 However, if Portugal was the first country to join Great Britain in adhering  
35 to the Gold Standard, it was the last to restore the full convertibility of its  
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<sup>26</sup> See Lains (1995).

1 currency, which is once again surprising, since it was returning to gold at a time  
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3 when the beginning of an exceptionally turbulent period for the functioning of the  
4  
5 international monetary system was imminent<sup>28</sup>. Portugal was going back to gold  
6  
7 when other countries were leaving it.  
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10 The suspension of the pound sterling's gold convertibility on 21st  
11  
12 September 1931, as a consequence of the effects of the failure of the *Kreditanstalt*  
13  
14 and the German banking crisis, brought about the collapse of the monetary system  
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16 between the wars<sup>29</sup>. The countries that maintained important trading relations with  
17  
18 Great Britain were forced to abandon the Gold Standard. This occurred in  
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20 Portugal, which suspended the gold convertibility of its currency following the  
21  
22 British decision, just 82 days after its introduction.  
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26 The authorities then decided to peg the escudo to sterling, and a fixed  
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28 exchange rate regime operated in Portugal from 1931 to 1938<sup>30</sup>. Pegging the  
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30 escudo to the British currency was a way of ensuring the stability of the  
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32 Portuguese monetary unit that would function as a close substitute for the Gold  
33  
34 Standard.  
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38 After the Second World War, the escudo was pegged to the dollar. Even  
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40 though it was only in 1962 that Portugal joined the IMF, it can still be said that it  
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42 saw the same period of fixed exchange as the Bretton Woods system until the  
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44 early 1970s.  
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57 <sup>27</sup> Ibid.

58 <sup>28</sup> See Macedo, Eichengreen and Reis (1995a), Reis (1995) and Santos (1995).

59 <sup>29</sup> See Crabbe (1989), Bourget, Figliuzzi and Zenou (2002) and Hetzel (2002).

60 <sup>30</sup> See Banco de Portugal (1932), Bordo and Santos (1995) and Santos (1995).

#### IV. The Gold Standard in Portugal: some indicators

The data used have been taken from several sources as described in Table 1.

[Table 1 here]

[Figure 1 here]

For last years we have taken actual values and we built remain values of the series with growth rates from the above sources<sup>31</sup>.

The characterization of the Gold Standard period in Portugal is displayed in a comparative form in Table 2 and Figure 1. We have included the Bretton Woods period from 1949 to 1972, and the subsequent period up to the EMU, from 1973 to 1998. The values included are the mean ( $\mu$ ) of the variable indicated there and the standard deviation ( $\sigma$ ) of that variable. See Note 40 for the meaning of variables. The “•” over a variable means growth rate or first difference as all the variables are in logs. In Figure 1 we have not included the standard deviation of prices for the last period because it has a very high level.

[Table 2 here]

The results in terms of money, production and inflation, are not very different from those found in the literature<sup>32</sup>. Although the inflation rate was lower during the first period (0.2%), the standard deviation for inflation reached a higher value during the Gold Standard than during Bretton Woods.

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<sup>31</sup> The values for the money supply in 1891 and 1892 (-70%, +20%) can be considered as outliers. We have replaced this values by forecasted values using an ARIMA (1,1,2) estimated for the period from 1855 to 1889. By “Product” we mean GDP at 1855 prices, by “Inflation” the rate of growth of implicit GDP deflator and by “Money” the M1 stock which includes coin, notes and demand deposits outside the monetary sector.

<sup>32</sup> See Cooper (1982), Bordo (1993), Bordo and Santos (1995) and Bordo and Jonung (2001).

1 However, the comparison in terms of nominal stability, where the Gold  
2 Standard is concerned, should be made using prices<sup>33</sup>, and not the inflation rate<sup>34</sup>.  
3  
4 The main goal of the Gold Standard is price stability and not inflation stability.  
5  
6 Bearing this in mind, we can see how the Gold Standard period was one of great  
7  
8 price stability. Its standard deviation ( $\sigma_p$ ) was 1/3 of that occurring during  
9  
10 Bretton Woods. As we expected, product growth ( $\mu_p$ ) was substantially higher  
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12 during Bretton Woods, at almost 5% as against nearly 2%, during the Gold  
13  
14 Standard. There was also less product stability ( $\sigma_q$ ) during this period<sup>35</sup>. With  
15  
16 respect to the money supply ( $\mu_M$ ), we should note lower growth under the Gold  
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18 Standard and instability of such growth ( $\sigma_M$ ) in the period following Bretton  
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20 Woods. In short, we may conclude that the nominal stability during the Gold  
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22 Standard contrasts with the real stability of the Bretton Woods period.  
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## 37 V. Analysis of the Stationarity of the Series

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42 Before moving on to the study of the modelling of the Gold Standard  
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44 period, we should examine the characteristic of stationarity of the series involved  
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46 to avoid spurious regressions results<sup>36</sup>. Besides the most current augmented  
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51 <sup>33</sup> Accepting prices are stationary. A simple macroeconomic model was also developed to  
52 demonstrate that the Gold Standard stability must be analyzed in terms of prices and not inflation.  
53 To does interested we can send the extended version of this paper.

54 <sup>34</sup> As Bordo and Kydland (1996), did for some countries, following the early results obtained by  
55 Barsky (1987).

56 <sup>35</sup> Reis (2000) mention the phenomenon of real instability in periphery countries during the Gold  
57 Standard as reflecting the asymmetry of this system.

58 <sup>36</sup> Stationary means reversion to an equilibrium value or to a trend equilibrium value.  
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1 Dickey-Fuller tests for unit root<sup>37</sup>, in which we follow the methodology proposed  
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3 by Hamilton (1994), we performed other calculations, namely: the KPSS  
4  
5 stationarity test<sup>38</sup>; finding the limit values for  $\rho$  from the  $t_{ADF}$  test, at the level of  
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7 90%, in accordance with Stock (1991),  $R_1$  e  $R_2$  ratios of Bhargava (1986) with the  
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9 random walk null hypothesis against the alternative of stationarity, with and  
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11 without a constant, respectively; and, finally, the corrected ADF test, *DFGLS*, in  
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13 accordance with Elliot, Rothenberg and Stock (1996) and *DFGLU*, in accordance  
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15 with Elliot (1999). In the KPSS test we used the lags obtained in the first ADF test  
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17 that eliminate the auto-correlation problem by means of the LM test. The asterisks  
18  
19 have the usual meaning of rejection of the null,  $H(0)$ , \*\*\* at 1%, \*\* at 5% and \* at  
20  
21 10%, except for the KPSS test, where \*\*\* means non-rejection of stationarity at  
22  
23 10%.

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29 The results are given in Table 3, below.

30  
31  
32 [Table 3 here]

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34 Regarding Product and Prices in the 1854-91 period, all the tests indicate  
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36 that we should accept the stationarity of the respective series. The results are not  
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38 quite so clear with respect to Money: one test excludes the presence of a unit root  
39  
40 and another does not exclude stationarity. All the others correspond to a rejection  
41  
42 of stationarity. One reason for these results may lie in the limit value to the right  
43  
44 of  $\rho$ , a value very close to the unit.

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48 In the light of these results, in terms of the construction of VAR model, we  
49  
50 may opt for a model with variables on levels. As we shall see, special care is taken  
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52 with the stationarity of the model obtained.

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57 <sup>37</sup> Statistics  $t_{\rho = 1}$  and  $N \cdot (\rho - 1)$ , where  $N$  is the number of observations. See Dickey and Fuller  
58 (1979), Phillips (1987) and Phillips and Perron (1988). Although usually applied, we must be  
59 careful with the robustness of the ADF test. See, for example, Leybourne (1994).

60  
<sup>38</sup> See Kwiatkowski et al. (1992).

## VI. A VAR model for 1854-91

Following the Sims methodology<sup>39</sup> we will represent the macroeconomic behaviour of the Portuguese Economy by a VAR model (unrestricted and also restricted) with Product ( $Q$ ), Prices ( $P$ ) and Money ( $M$ )<sup>40</sup>. The model considered is of the type

$$\mathbf{A}(L) \cdot \mathbf{x}_t = \mathbf{A}_0 + \mathbf{e}_t \quad (1)$$

where

$$\mathbf{x}_t = \begin{bmatrix} Q \\ P \\ M \end{bmatrix} \quad (2)$$

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 model's constants, and  $\mathbf{e}_t$  the vector of errors with the normal I.I.D. characteristics.

To select the order for the VAR model we used Akaike, ( $AIC = N \cdot \log |\Omega| + 2 \cdot (k_{UR} \cdot K)$ )<sup>41</sup> 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  $\chi^2$  of order nine. The null

<sup>39</sup> See Sims (1980).

<sup>40</sup>  $Q$  represents the per capita GDP at 1855 prices;  $P$  the implicit deflator of GDP 100 in 1855; and  $M$  represents the per capita  $MI$  monetary stock. All the variables have been converted into logs, so our results are independent of the base year.

<sup>41</sup> 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.

1 hypothesis means the nullity of the coefficients of order  $k+1$  not presented on  
2  
3 order  $k$ .

4  
5 [Table 4 here]

6  
7  
8 As we can see, those two indicators and the LR test point in the same  
9  
10 direction: reject  $K = 4$  against  $K = 3$ ,  $K = 3$  against  $K = 2$  and finally  $K = 2$  against  
11  
12  $K = 1$ . The model that we are going to retain is thus of order 1. As Table 5 shows,  
13  
14 the root modules are below the unit, and so the model is stationary.

15  
16 [Table 5 here]

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19 The Choleski decomposition is used because we assume that a shock on  $M$   
20  
21 has only a contemporaneous effect on its own value; a shock on  $P$  has  
22  
23 contemporaneous effects on its value and on  $M$ ; and that a shock on  $Q$  has  
24  
25 contemporaneous effects on all the three variables of the model. More, the  
26  
27 evidence in terms of causality analysis justifies also our choice: the hypothesis  
28  
29 that  $M$  do not granger-cause  $Q$  and  $P$  is rejected as also as the hypothesis that  $P$   
30  
31 and  $M$  do not granger-cause  $Q$ .

32  
33  
34 Employing the Choleski decomposition, we estimated the error variance  
35  
36 decomposition of each variable in terms of their individual contribution. The  
37  
38 results for the fiftieth observation are given in Table 6.

39  
40 [Table 6 here]

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42  
43 We have to stress the influence of Product and Prices on Product and  
44  
45 Prices. Money plays little part in explaining the errors of these variables. Note too  
46  
47 the importance of Money and Product on Money itself. This behaviour may be  
48  
49 explained by the fact that, in fact, the money is based on the production of metal  
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51 and on fiduciary behaviour, which latter is dictated by the evolution of production.  
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## VI.1. The Study of Shocks on the Model Variables

Continuing with the Choleski decomposition, we show in Figure 2 below the effects of shocks and their standard deviation values<sup>42</sup>. The dimension of each shock is equal to the standard deviation of the estimation on each variable<sup>43</sup>.

As the model estimated are stationary (Table 5), all modules values are less than 1, the impulses resulting from shocks tend to become null with the passage of time. Analysis of this model should therefore lead us to choose a maximum period for which we can carry out a study on the effects of such shocks. For this we have chosen a period of ten years.

Graphic analysis of the effects of shocks shows that a shock to Product:

— has immediate deflationary effects, but after three or four years the effect is virtually null;

— has long-lasting effects on Product and Money. After 10 years Product and Money still register 1/3 and 36% of the percentage value of the shock on the Product<sup>44</sup>.

[Figure 2 here]

We can see what is happening when there is a shock to Prices:

— 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;

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<sup>42</sup> 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.

<sup>43</sup> We prefer this value because it represents the uncertainty associated with each variable.

<sup>44</sup> 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 Bayoumi and Eichengreen (1994), Bayoumi and Bordo (1998) and Keating and Nye (1998), too, failed to get the results expected for the case of the USA, contrary to what happened for the Great Britain.

1 — at the end of the 10 year period, the effect on prices is 0.16% of the initial  
2 shock. We may say, then, that the effects were nullified quickly.  
3  
4

5 Finally, we can look at the reactions to a monetary shock:  
6

7 — its effects on Prices vanish quite quickly, while on Product and Money they are  
8 more persistent. After 10 years, the effects on these last two variables are 4.1%  
9 and 4.5% of the initial percentage shock on Money.  
10  
11  
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14 The results found for shocks to products can also be regarded as increases  
15 in the demand for coined metal, and the results obtained here are in agreement  
16 with the analysis by Barro (1979) and McCallum (1989), for the short-term, and  
17 also with Rockoff (1984) from the long-term perspective.  
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24 Two additional conclusions should be stressed: the effects of Price shock  
25 on Prices themselves, and the effects of a Money shock on Prices. The effects on  
26 Prices of a shock to Prices themselves are quickly annulled<sup>45</sup> and a shock to  
27 Money has positive effects on Prices, which, however, tend to disappear  
28 quickly<sup>46</sup>. Another feature of shocks relates to the fact that Product variations are  
29 always accompanied by slightly higher Money variations. This behaviour ought to  
30 mean that in a small economy, like that of Portugal, the positive evolution of a  
31 Product is accompanied by a Money evolution motivated by a requirement related  
32 to circulation or even reserves (or net wealth held).  
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46 Having analysed the impulses on variables it seem to us that they indicate  
47 a confirmation of Gold Standard behaviour.  
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50 Product, Prices and Money are stationary variables. This means that no  
51 matter what the shock to each of them, it would end up being annulled, and thus it  
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56  
57 <sup>45</sup> During the Gold Standard the Portuguese money supply may be considered as a negligible part  
58 of the world money supply and so without influence over prices.  
59

60 <sup>46</sup> Bordo and Redish (1993) draw attention to deflationary policies in periods of non-convertibility  
as a way of resolving credibility problems.

would leave no permanent effects. In terms of macroeconomic behaviour, we found that the shocks to Product have very persistent effects on Product itself and on Money. Prices, too, have positive effects on Product and Money, although less important than shocks to Product. Finally, the effects of shocks in Money supply are not felt on Prices, and are felt in Product and itself, but extremely weakly. 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. This also means that the behaviour of the Bank of Portugal breaching the rules of the Gold Standard “on a persistent and considerable scale” (Reis (2002), p. 40) was an important contribution for the collapse of the Gold Standard.

## VI.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 overwhelmingly affect the product and demand shocks ( $\varepsilon_{D,t}$ ), or monetary shocks ( $\varepsilon_{M,t}$ ), which only influence prices and not the product. The errors of equation (1), instead of presenting the usual structure in a Choleski decomposition may take another form<sup>47</sup>, where supply shocks are constrained to influence only the product, demand shocks the product and prices and finally nominal shocks the product and money. This behaviour (Equation (3)) of errors was chosen and not more conventional ones because in those cases the null of the constrained hypothesis were rejected.

$$\begin{bmatrix} e_{Q,t} \\ e_{P,t} \\ e_{M,t} \end{bmatrix} = \begin{bmatrix} 1 & g_{12} & g_{13} \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} \varepsilon_{S,t} \\ \varepsilon_{D,t} \\ \varepsilon_{M,t} \end{bmatrix} \quad (3)$$

1 The likelihood ratio test leads to the non-rejection of the null hypothesis  
2  
3 for the constraint implied in Equation (3), its value was  $\chi^2 = 0.598$  (0.439), where  
4  
5 the respective significance level is in brackets.  
6  
7

8 Using the above decomposition, we again considered shocks of the  
9  
10 magnitude of the standard deviations associated with the estimation of the model.  
11  
12 The results are given in Figure 3.  
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14

15 [Figure 3 here]  
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17 We given a brief description of the results obtained. Supply shocks do not  
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19 affect Prices<sup>48</sup> and have lasting positive effects on Product and Money. After 10  
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21 years, the effects on production and Money are still 60% and 64% of the initial  
22  
23 percentage supply shock. Demand shocks have deflationary effects on the Product  
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25 and Money which are disappear relatively quickly. The effects of a demand shock  
26  
27 on Prices meant that by the third year less than 1/10 of the initial shock was  
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29 registered, and the effects disappeared swiftly<sup>49</sup>. Monetary shocks have positive  
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31 effects on all the variables in the model, although these effects disappeared  
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33 quickly with time<sup>50</sup>. The maximum effect on production occurred after three years  
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35 and represents 9.5% of the initial monetary shock. It is interesting to see that a  
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37 joint supply and demand shock is neutral. If the results are deflationary on the  
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39 Product, in the first three years, and on Prices, in the first four years, these quickly  
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41 converge to symmetrical values, nullifying any effect of these shocks in the  
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43 medium term.  
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51 <sup>47</sup> Sims-Bernanke decomposition. See Bernanke (1986).  
52

53 <sup>48</sup> It might be better to say that their effect is small and fleeting. Falling into what we could call an  
54  
55 example of beneficial deflation.

56 <sup>49</sup> Dibooglu (1998) using a model of a similar type to that used here, supports the temporary  
57  
58 growth of the effectiveness of demand shocks, which eventually accompanied the evolution of  
59  
60 monetary systems.

<sup>50</sup> This seems to support those who defend convertible systems as a way of achieving price  
stability. See Dowd (1993).

1 A better confirmation of the appropriate application of the principles of  
2 classical economics to the Gold Standard would be impossible to find. But this  
3 does not mean that we would uphold the old notion of the equilibrium and  
4 smoothness of such a system<sup>51</sup>. In our ideas and, why not say so, too, in our  
5 culture, demand policies and monetary policies hold an important position.  
6 Indeed, they either had harmful effects under the Gold Standard, or they had no  
7 significant impact at all. We agree with Mundell (1995), Bordo and Eichengreen  
8 (2001) and Reis (2002) when they attribute the disasters of inappropriate policies  
9 to the policies themselves, or to the actual system. The Gold Standard did not  
10 allow the use of the policies we have seen above<sup>52</sup>. It was able to exist because it  
11 corresponded to the political consensus of those represented in the governments  
12 that really held power<sup>53</sup>.

## 33 VII. Conclusion

34 Thirty-seven years of convertibility, apart from the three-month  
35 moratorium in 1876, demonstrated, for a peripheral country like Portugal, that the  
36 adoption of the Gold Standard in 1854, alone in following the example of Great  
37 Britain, was the right decision, and a practical one, given the chaos of the  
38 country's monetary situation. Even though the factors that motivated it were  
39 obviously different from those which, two decades later, led most other countries  
40 to adhere to the disciplinary rigour of that monetary system.

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51 The classical position of Bloomfield (1959) on these aspects is well known.

52 See Eichengreen (1996).

53 See Frieden (1992).

1 Remittances from emigrants and the ability to borrow on the markets  
2 enabled Portugal to become a net importer of gold, which was a crucial factor for  
3 maintaining the gold convertibility of the Portuguese currency. All this came to an  
4 end in 1891, when the country was unable to secure loans abroad and its monetary  
5 reserves were extremely depleted, largely thanks to the crisis in Brazil, the source  
6 of most of the emigrants' earnings, and the monetary authorities had no choice but  
7 to adopt a system of a flexible exchange rate for non-convertible paper money.  
8  
9

10 Portugal returned to gold in 1931, but at a devalued parity. In any case,  
11 this return lasted a brief 82 days. As had happened in 1891, suspension of  
12 convertibility again resulted from an international financial crisis. This act  
13 demonstrated the willingness of the authorities to peg the monetary unit to  
14 international benchmark currencies in an effort to achieve a situation of  
15 macroeconomic stability.  
16  
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18 The performance of the system in Portugal, compared with subsequent  
19 systems, was not much different, on the whole, from that experienced by other  
20 countries.  
21  
22

23 Prices between 1854 and 1891 were stationary, that is to say, they  
24 exhibited the characteristics that were expected from the Gold Standard from the  
25 outset. In an international market like the Gold Standard, the authorities, such as  
26 that of Portugal, could not control the money supply, and international  
27 competition would drive towards world equilibrium prices. We can thus see the  
28 absence of inertia in the actual behaviour of prices, which was not observed for  
29 the large important economies in the international context. Similarly, we can find  
30 in the modelling of supply, demand and monetary shocks, an illustration of the  
31 classical position of economics. But his last outcome also represents the reason  
32 why the Gold Standard could not exist after 1945. A world that began to demand  
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1 State intervention through demand policies and monetary policy initiatives with  
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3 the aim of achieving full employment is not compatible with the Gold Standard.  
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14  
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For Peer Review

Figure 1: Values for Prices; Inflation; Product and Money

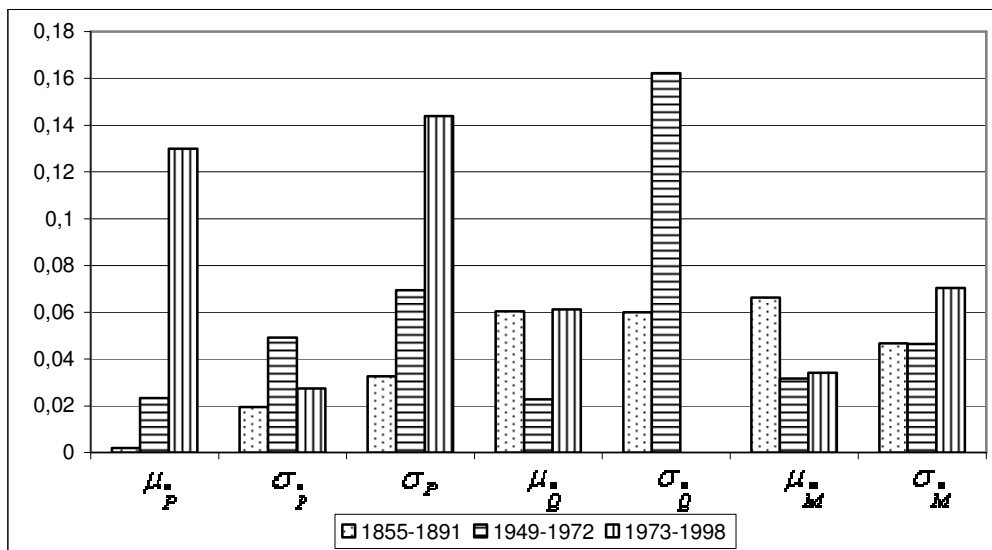


Figure 2: Standard Deviation Shocks (Choleski), 1854-91

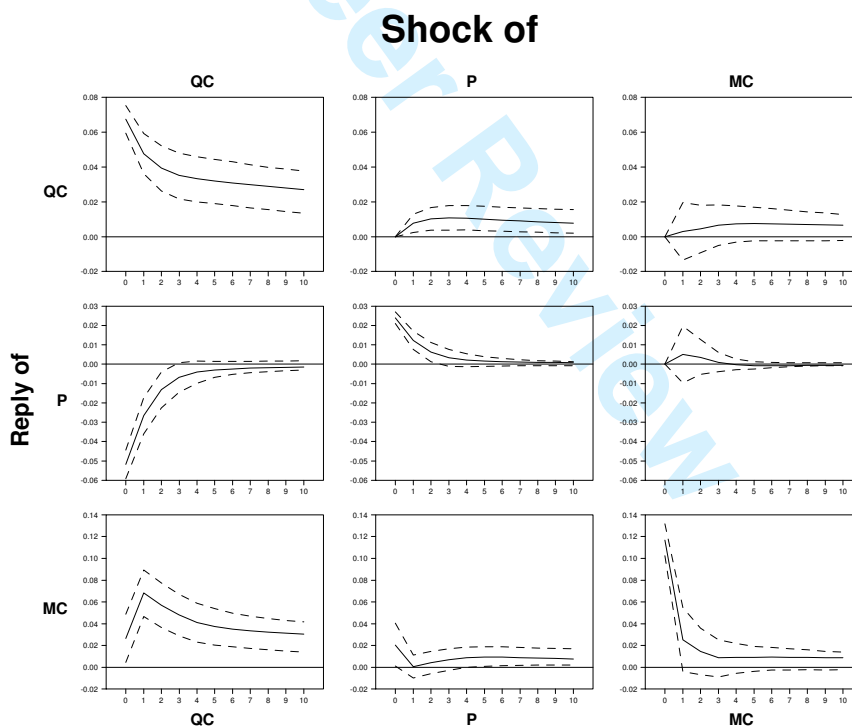
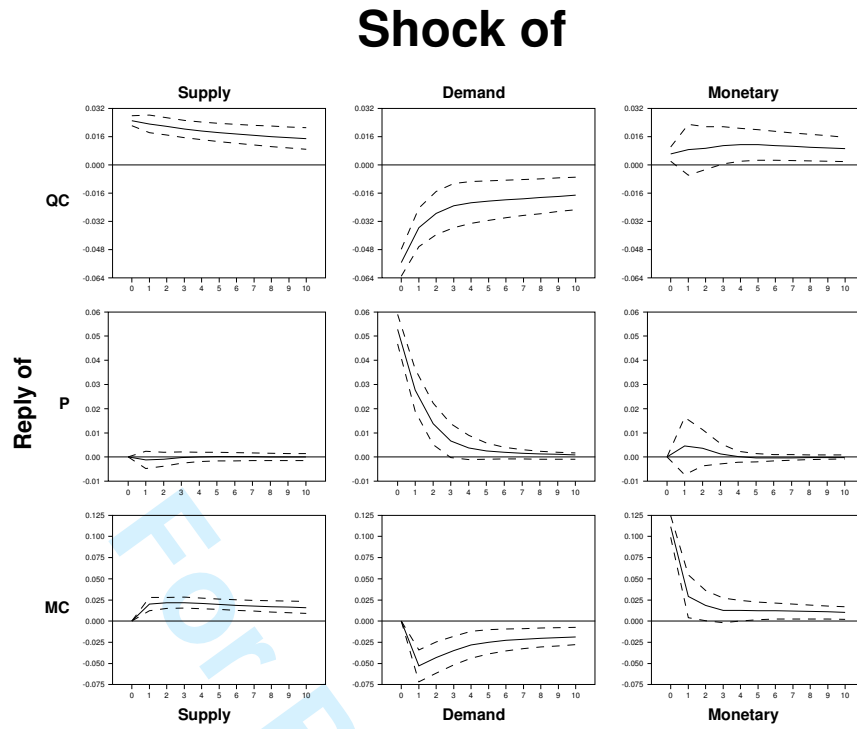


Figure 3: Standard Deviation Shocks (Sims-Bernanke), 1854-91



**Table 1: Data Sources**

GDP	
1854-1909	Nunes, Mata and Valério (1989)
1910-1952	Batista, Martins, Pinheiro and Reis (1997)
1953-1993	Pinheiro et al. (1998)
1994-1998	Banco de Portugal (1996, 1998, 2000)
M1	
1854-1912	Reis (1990)
1913-1946	Mata and Valério (1993: Table E.1.3)
1947-1993	Pinheiro et al. (1998)
1994-1998	Banco de Portugal (1996, 1998, 2000)
Population	
1854-1952	Nunes, Mata and Valério (1989)
1953-1993	Pinheiro et al. (1998)
1994-1998	Banco de Portugal (1996, 1998, 2000)

**Table 2: Values for Prices; Inflation; Product and Money**

Period	$\mu_P$	$\sigma_P$	$\sigma_P$	$\mu_Q$	$\sigma_Q$	$\mu_M$	$\sigma_M$
1855-1891	0.0019	0.0604	0.0600	0.0195	0.0663	0.0327	0.0467
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**

Test	Product	Prices	Money
$t_{\rho=1}$	-4.1**(T)	-4.3***	-2.3(T)
$N \cdot (\rho - 1)$	-23.6**(T)	-21.7***	-23.2**(T)
KPSS	0.08***(T)	0.1***	0.05***(T)
Stock ( $\rho_{m,M}$ )	[-,0.8]	[-,0.8]	[0.8,1.03]
$R_1$	-	0.9**	0.2
$R_2$	1.0**	-	-
DFGLS	-2.7*	-3.2***	-1.7
DFGLSU	-3.02*	-3.4***	-1.8

**Table 4: Selection of the VAR order 1854-1891**

Lags	AIC	SBC	LR
4	-569.6	-510.3	
3	-571.7	-526.0	9.936 (0.356)
3	-585.7	-539.1	
2	-595.2	-562.5	6.085 (0.731)
2	-599.4	-566.1	
1	-610.5	-591.5	6.855 (0.652)

**Table 5: Roots of the Characteristic Polynomial, 1854-1891**

Root	Module
0.95544	0.95544
$0.33190 - 0.023i$	0.3327
$0.33190 + 0.023i$	0.3327

**Table 6: Variance Decomposition – 50<sup>th</sup> Observation**

Influence of:	Q	P	M
Product	88.2	9.3	2.5
Prices	81.2	17.8	1.0
Money	55.8	6.0	38.2