A measurement of asymmetry in the running of the classical gold standard [1]

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Abstract

The recent crisis in the Eurozone has revived discussions on the adoption of symmetric policies aimed at preventing fundamental disequilibria within systems characterized by fixed exchange rates among different currencies, or by a monetary union, where a single currency has replaced the system's national currencies, as in the case of the Eurozone itself. In monetary history this debate has often been focussed on previous systems having these features, and in particular on the working of the gold standard: on whether its members pursued, in fact and to what extent, symmetric policies to preserve the system's stability. In this paper (1) we survey the features of few international monetary systems that have in common symmetry as a balancing factor, and (2) we explore the meaning and consequences of asymmetric monetary policies under the gold standard. (3) We also offer a new measure of asymmetry in the running of the gold standard for the biggest five European economies in the pre-WW1 period (UK, Italy, France, Germany and Spain). We use this measure to draw policy implications deriving from the gold standard constraints.

Keywords: Gold Standard, Eurozone, asymmetry, convertibility ratio, apprehension ratio

JEL codes: N13, E52, E58

1. Introduction: how symmetry should work

Any system of fixed exchange rates should imply the adoption of macroeconomic policies – both monetary and fiscal policies - aimed at avoiding fundamental disequilibria inside the system, through symmetry of behaviour of both surplus and deficit countries, that is expansionary domestic macroeconomic policies in surplus countries, and tight policies in deficit countries. It is, however, very difficult to translate this pattern of behaviour into positive, binding provisions. A good example in this regard is the Bretton Woods system, based on fixed exchange rates, which was born out of the idea of Keynes that adjustments between creditor and debtor nations should be symmetric. The Articles of Agreement of the International Monetary Fund (IMF) introduced the concept of a "fundamental disequilibrium" as the trigger of changes in the parity rates if symmetric policies could not be attained, without distinction between surplus and deficit countries. However, the United States, at the outset of the system the overwhelmingly dominant economy and the most powerful creditor nation - the "hegemonic" country - , did not accept a system that would force it to adjust its policies or to revalue its currency. The system lacked an institutionally sanctioned symmetry. Being the dollar the world's reserve currency – the only currency directly convertible into gold - the US creditor position meant a shortage of dollars for deficit countries and worked mainly as a mechanism of adjustment for these countries, which had either to adopt deflationary policies or, in case of a fundamental disequilibrium, to adjust their parities. Similarly, when the US moved later on to a position of trade deficit external liabilities exceeded the value of its gold holdings, the United States preferred to avoid any adjustment, rather suspending the convertibility of dollars into gold, in 1971. This marked the end of the Bretton Woods system, and the start of floating currencies, while the gold anchor was abandoned. The asymmetry of the system brought in the end to its demise.

All the more so symmetry is required when the system is not made of currencies of different countries, but of a single currency adopted by all the countries participating in the system, that is when we have a monetary union[2], as the Eurozone. However, in the Eurozone an issue of symmetrical monetary policies

cannot arise, just because there is a single monetary policy even when, *de facto,* countries remain, structurally and cyclically, in a different position. To rebalance disequilibria, and to avoid deflation in the deficit (or "peripheral") countries, the only available macroeconomic instrument is fiscal policy, which would mean expansionary policies by the surplus countries, and the opposite by deficit countries. Aggregate demand management through fiscal policies is, however, severely constrained in the Eurozone by the behaviour of the hegemonic country - Germany – and more generally by the fiscal consolidation embedded in the balanced budget principle, introduced in some countries by a constitutional amendment. Moreover, the "escape lane" sanctioned by the IMF Articles of Agreement – exchange rate parity adjustments – is precluded by the very existence of a single currency, while crucially no exit procedure from the monetary area is even envisaged in the legislation (some attempts were made in this direction at the height of the Greek crisis, as a temporary return to the drachma, but they didn't come to fruition).

These experiences seem to point out that, if a specific country emerges at the centre of the system as the hegemonic country, and if it sticks to an asymmetric behaviour, the whole system becomes dysfunctional. For "peripheral" countries that are in a situation of deficit, the only possible resort appears to lay in internal devaluations of prices and wages, and/or in supply-side measures, aimed at giving them the competitiveness which cannot be recovered through currency devaluations. As observed in the recent Eurozone crisis, these measures may well be needed, but they do not seem to have been enough to achieve the intended macroeconomic stabilisation within the Eurozone.

In this paper, we consider the relevant features of the gold standard and how symmetry works within the system (Section 2); the gold convertibility ratio, which is the pivot of the whole system (Section 3); central banks' attitudes to symmetry (Section 4); the obstacles to symmetry in the gold standard (Section 5). We then develop an empirical analysis to measure symmetry in five European countries (Section 6), and finally draw conclusions, including whether the gold standard collapsed because of asymmetries (Section 7).

2. The gold standard and symmetry

The gold standard has often been praised for its potential, market-induced, non-discretionary symmetry, which would automatically rebalance positions of credit and debit between countries adhering to the system. In a simplified model of the gold standard (gold *specie* standard), the money supply consists entirely of gold, which is also accepted in the settlement of debt between countries; and the underlying theoretical assumption is that prices adjust passively to changes in the money supply, barring changes in the real product and in the velocity of money (i.e. the quantity theory of money). If, for some reason, in a certain country a payment deficit and an outflow of gold occur, the money supply is by definition reduced and the price level falls. As a consequence, the economy becomes more competitive, exports increase and foreign accounts are finally rebalanced, while exchange rates remain unchanged: an affirmation of "internal" over "external" devaluations[3]. The opposite of course happens if a country is in surplus. The gold standard functions symmetrically in this basic model without any government intervention.

The use of gold as the only domestic currency, if ever existed, was then followed by government induced changes, which is by the use of gold substitutes as currency: paper currency, and the demand deposits created through the banking system. If, differently from the model above, in the real world the money supply is made - rather than of gold only (which may instead assume a very limited role, for reason of convenience if not for other motives) - of these substitutes, there is not a market induced, automatic mechanism that reduces the amount of money in case of an external deficit and an outflow of gold (and vice versa in case of surplus): there is not an embedded symmetry. Governments have to "create" a threshold to contain the supply of money in relation to the available gold in reserve, that is, they have to define a legally binding ratio between the gold reserve and the money supply, the "conversion ratio".

Therefore, any gold standard country has two targets: 1) a legal, binding target: the gold convertibility of its currency at a fixed rate, assured by maintaining a certain, legally defined, ratio between the gold reserve

and the money supply (whose components are in turn legally defined, including certain money aggregates); 2) a non-statutory "rule of the game": to make changes in the monetary aggregates coherent with the evolution of the country's foreign balance, in order to reach that symmetry which, in the theoretical model, is by definition assured.

The historical evolution of the gold standard shows the relevance of the interaction of these two targets and their relative importance in abiding by symmetry, or in preferring certain degrees of asymmetry. Three factors favoured symmetry: 1) a solid anchor was provided by gold, as the common standard to which every adhering currency was legally bound; 2) socio-political conditions allowed macroeconomic domestic policies, particularly flexibility in wages and prices adjustments, that would have been very difficult to achieve in subsequent times; 3) parity changes (changes in the gold content of the national currency) and even temporary inconvertibility might occur, though under exceptional circumstances. Point 1) – currency convertibility into gold - was the real pivot of the whole system and, being a legal requirement, represented the most compelling constraint of policy behaviour; point 2) was particularly notable in the period before WW1, but conditions radically changed during the War and in its aftermath; point 3) permitted some flexibility in entering and exiting the standard, a particularly relevant alternative during and after the War. As a matter of fact, the erosion – sometimes gradual, other times abrupt - of conditions under 2) and 3) led to increasing difficulties in preserving the anchor, the currency link to gold (condition 1), and finally to the collapse of the system in the 1930s.

If we consider the three components of money creation by the central bank – the foreign channel (changes in the gold and foreign exchange reserve induced by the foreign balance), the banking and market channel (discount and advances to the banking sector, open market operations), and the Treasury channel (advances to the Treasury and purchase of government securities on the primary market) - in a gold standard regime the first component is the most critical, while the other two (Treasury and "banking/market") are, or can be, under a more direct control of the central bank. The balance of payments

has a potential impact on the country's reserves that lies at the centre of the monetary system: in principle, a foreign surplus generates an inflow of gold, and an increase in the gold/foreign exchange reserve as a consequence. Changes in the gold reserve are, therefore, the main variable that the monetary authorities have to follow closely in order to maintain the domestic and foreign convertibility of the national currency. The other two, being more directly under central bank's control, can be adjusted in order to offset or enhance the effects of the first channel.

As we shall see in our quantitative analysis in Section 6, under the gold standard the amount of money that the central bank creates is a dependent (endogenous) rather than an independent variable, and it is not fully subject to government or central bank determination[4].

The domestic and international targets were linked. The link between these two objectives was given by the role of gold as backing of both the national currency and the country's exchange rate against other gold currencies. A loss of gold reserves due to a balance of payments deficit might hinder the domestic convertibility and therefore cause restrictive monetary and credit policies. But an increase in the gold reserve due to a foreign surplus might not cause an expansion in the monetary aggregates. We shall examine, in Section 5 the reasons for which this course of action might be followed. Here it is sufficient to mention two reasons of concern for the central bank: 1. an expansionary monetary policy could potentially endanger the legal requirement of gold convertibility of its currency; 2. this policy might create inflationary pressures and risk price stability. In both cases asymmetry would result. Worthwhile to note that the conversion ratio was a binding legal constraint; while symmetry – to which a scholar of today pays attention as a balancing factor in an international monetary system and defines it as one of the "rules of the game" of the gold standard – was perhaps not always in the minds of policymakers, in the absence of

any macroeconomic framework to evaluate the effects of their initiatives on the international arena and in the prevalence of domestic interests over international cooperation.

As our analysis will show, the observance of this rule – any influence of external factors on domestic monetary aggregates – might find a formidable obstacle in the compliance with binding provision regarding convertibility and in the prevalence of the national interest. These were perhaps the main, embedded sources of asymmetry.

In questioning the degree of symmetry or asymmetry of the gold standard, previous studies have been focussed on changes in interest rates (the official "discount rate") to proxy changes in monetary policy; we use for the same purpose changes in the monetary base. The reasons for this are twofold. On the one side, monetary conditions could be affected by the central bank not only by changes in the discount rate and open market operations (money creation through the "banking/market" channel), but also through Treasury financing (depending on the relevance of the Treasury channel in money creation). On the other side, there is the practical motive that changes in the monetary base were more frequent than those in discount rates, and thus allow us to identify better and more accurately changes in policy.

Our paper is far from exploring a new ground, as demonstrated by the long list of references at the close of every book dealing with this topic[5]. Our task – to trace the reaction of monetary policy to the evolution of the country's foreign accounts and international reserve, i.e. a monetary policy complying with symmetry - deals, however, with an issue that is receiving renewed interest: the analysis and measurement of the supposed symmetry in the behaviour of countries either on a fixed exchange rate system or on a single currency, as a way to maintain the system stable, and in the end to insure its survival, in particular in periods of international stress.

We deal with the period between the second half of the 19th century (specific starting years vary according to the availability of data for different countries), as the beginning of the "universal" or classical gold standard era; and the start of the WW1, which marked the first crisis of the system and perhaps the beginning of its collapse. During that period, conditions existed for a relatively smooth functioning of the system and – therefore – for the potential implementation of symmetric policies. As mentioned, we focus on five central banks representing the most important European economies in terms of real GDP (UK, Germany, France, Italy and Spain)[6].

We consider these five countries as gold standard members. In fact, the situation was more complex. The institutional framework of these countries changed over time, so that various situations of convertibility, *de jure, de facto* and inconvertibility occurred. Up to 1914, all the five countries surveyed here were on a gold standard basis, with some *caveats*: the French franc gold content was defined in 1803, at 290.322 milligrams of fine gold. For the lira the Italian government adopted in 1862, after the creation of the Kingdom of Italy, the same parity. From 1865 these currencies belonged to the Latin Monetary Union (LMU). For a while, the two countries were on a bimetallic standard (gold and silver). They were in and out gold convertibility depending on different circumstances. Italy was in the years preceding the WW1 on a *de facto* convertibility. Spain's peseta was introduced as the national currency in 1868 with the same metallic content as the French franc and the Italian lira. It also passed through phases on inconvertibility, and was for a while on a bimetallic standard. It did not however formally belong to the LMU, and finally suspended convertibility in gold in 1883, though restricted by law the amount of notes issued by the central bank. Germany joined the gold standard in 1871-73, having the Reichsmark a gold content of 358.422919 milligrams of fine gold. The United Kingdom was on a gold standard basis since 1821, with a gold content for the pound of 7.322882 grams of fine gold (123.2745 troy grains of gold of 22 carats). These countries had to suspend convertibility at the outbreak of WW1, in 1914.

3. Conversion ratio and “apprehension ratio”

We will measure whether, and to what extent, the monetary policies of those five countries were coherent with symmetry as above defined; since these policies were constrained by the binding provision of a certain currency conversion ratio, it is necessary to consider how this ratio can be used for an international comparison.

In the basic model of gold standard (gold *specie* standard) each ounce of gold that leaves the country to pay for a trade deficit means, at the same time, a reduction of the central bank’s reserve and of the money supply in an equal amount. The ratio reserve/money supply is thus always “one”. But, if the money stock is made, mainly, of paper currency (circulation) and bank deposits, a ratio lower than “one” is the norm. In order to reach and maintain the objective of convertibility, it is necessary that the ratio is kept at a certain, prudential level. To use Bagehot’s terminology, that ratio should not fall below an “apprehension minimum”[7].

Two issues arise, for the purpose of calculation: the assets and liabilities to be included in the ratio; the appropriate level of the ratio. They varied according to different legislations and we consider the two issues separately.

Regarding the international assets to be included in the ratio, suffice to say here, that in some countries gold only was considered, but in other countries that came to adopt the gold *exchange* standard regime, foreign currencies held by the central bank were also included in the international reserve.

In reference to liabilities, the concept of money supply (the various monetary aggregates) as a broad measure of money – important as it is to detect inflationary pressures and for assessing the monetary policy stance - was never adopted to calculate the legal conversion ratio[8]. According to some legislations, circulation only was included, but more often, also the bank reserves, that is the balances held by the banking system at the central bank. In this case, the denominator of the ratio coincided with the “monetary

base", or "central bank money": a much narrower definition of the money supply in the country. Moreover, in some countries circulation was composed not only of central bank's banknotes, but also of notes and coins issued by the Treasury. Finally, few countries had, at least for a while, a plurality of banks of issue (Italy had three, until 1926), and in other countries (the UK, for instance) banknotes issued by commercial banks were also in circulation.

Regarding the level of the conversion ratio, as determined by law, it might also vary according to different countries and legislations, and change over time, also according to specific assets and liabilities to be covered[9]. An exemplification of calculations of this ratio in different legislations is given here[10]: In France, a maximum of note circulation was prescribed, irrespective of the amount of the reserves. In the UK, the amount of notes should not exceed the amount of the gold reserve by more than a stated amount, the "fixed fiduciary issue" (UK Bank Act 1844). While in the US, the gold reserve should not fall below a fixed percentage of the note issue, the percentage lying "between 30 and 40 percent"; this percentage system sometimes applies to bank reserves also[11].

The ratio was of an "arbitrary and variable character"[12]. Hawtrey noted:" A gold reserve is held with a view to contingencies, particularly to…an adverse balance of payments…It is impossible to calculate beforehand the magnitude of these contingencies, and the conclusions arrived at on the subject have everywhere been empirical. They have been picked up from experience with little assistance from the theory…Accordingly gold reserve laws are commonly enacted requiring the gold held to be not less than, say, 30 per cent or 40 per cent, or 1/3 of the note issue"[13].

Not considering specific legislations, Hayek empirically assumed that "to start with a gold reserve amounting to only a third of the total monetary circulation [he means here "all sight liabilities of the central banks plus the circulation of government paper money"]…would probably provide a margin amply

sufficient…"[14]. As noted above, Bagehot preferred to speak of an "apprehension minimum", below which the authorities would consider their currency's convertibility in danger. However, he observed that "there is no 'royal road' to the amount of the 'apprehension minimum'...The apprehension minimum is not always the same"[15]. So, he did not give any specific percentage or absolute level, only observing that London, as an international financial centre, had an enormous amount of short-term foreign liabilities, at the mercy of foreign holders, with a very small amount of assets (gold in reserve)[16]. Keynes perhaps ironically wrote of whatever percentage that may "assuage their [the central banks'] fears"[17].

Considering the different legislations, our approach to the calculation of the appropriate ratio for an international comparison could have been twofold:

(1) Either to rely on a "legal approach", that is to rely on the specific legislations of any country here considered, both for the aggregates to be included in the calculation, and for the appropriate ratio to be chosen. This approach has two major difficulties: we should look very carefully at those legislations, that are often quite complex and changing over time and thus difficult to interpret and be used for international comparisons (as noted, often the ratios were different according to different types of liabilities, and coverage might sometimes be made of different instruments, that is, not only of metal or foreign currencies). In addition, from an economic perspective, legal provisions might be "inadequate" because, for instance, circulation not issued by the central bank, important as it might be from a monetary point of view, might not be included in the legal ratio; which could well lead to a misleading picture on the true inflationary pressures in the economy.

(2) Or to use an "economic approach", by choosing: a) a common definition of assets and liabilities that may encompass the various components of the money supply and reserves, in order to have a more economically significant measure of the monetary policy stance; and b) a single ratio of the chosen assets and liabilities, notwithstanding the diverse ratios/limits used in the various countries considered in our

analysis. If our aim is to compare monetary policies of different countries and assess the stance of their policies in relation to the two above mentioned objectives, it is relevant to take a common yardstick.

It is evident that if the statutory conversion ratio was different, a country might be compelled to adopt a certain policy that another country, with a different statutory ratio, might well avoid. This brings us to adopt in this paper the "economic approach"[18], comforted in this by previous studies on similar subjects (see Bloomfield and Nurkse[19]). By using a common definition of "monetary base"[20] and "reserve", and a common ratio, the inter-country comparison is made simpler. Regarding the choice of the monetary aggregates, by "assets" we shall mean the components of the international reserve (gold and foreign exchange); by "liabilities" we shall mean the monetary base, that is noted in circulation and the reserves held by banks at the central bank ("bank balances"). We shall not include, however, in the monetary base metallic coins; this is in the assumption that they – mostly used for retail transactions - were not directly convertible into reserve assets (gold, foreign currency). Therefore we have adopted in the paper a narrow definition of the monetary base, made of the total amount of notes in circulation plus banks' reserves at the central bank.

About the level of the conversion ratio, even being well aware that any choice is ultimately to some extent arbitrary, rather than simply discretionary, on the basis of the actual experience of how monetary policy was conducted at the time, and of the comments and estimates given by the economists mentioned above, a certain percentage might be tentatively adopted. We shall call it "apprehension ratio" (AR), using Bagehot's terminology. Broadly following Hawtrey and Hayek, we might assume that a ratio of 35% could be considered as the "apprehension level", below which any actual coverage ratio would be seen as insufficient.

Following the economic approach, we have therefore included in the ratio the following components:

$$Coverage\ ratio\left(CR,\%\right)=\frac{Metallic\ \mathrm{Re}serves+Foreign\ Exchange\ \mathrm{Re}serves}{Circulation\left(notes\right)+Banks\ reserves}x100$$

Therefore, the "apprehension ratio" (AR), in our approach, takes the place of the different "conversion ratios", defined by law in any observed country, while – to add another acronym – by "coverage ratio" (CR) we mean the actual ratio that can be historically observed, year by year, in those countries.

4. Central banks' attitudes to symmetry

We intend to measure symmetry in section 6 by observing how and to what extent a change in the international reserve of the central bank is accompanied by a change in the same direction of the monetary base. We need to clarify this point.

Let's suppose that the central bank has an international reserve of (say) 35 m and a monetary base of 100 m. The coverage ratio is 35%, compliant with what we have called "apprehension ratio" (AR), as the yardstick on which to measure symmetry. If the reserve falls by 5 m (for instance, because of a trade deficit), and if the monetary base (notes circulation, plus bank balances) declines by the same amount, the required 35% AR would not be reached[21]. In order to maintain the required ratio of 35%, a bigger fall in the monetary base, from 100 to 85.7 m, would be needed (35:100 = 30:85.7). The deflationary effect of a fall in the reserve is powerful indeed. This necessary, huge fall in the monetary base cannot be reached other than by also decreasing the central bank's domestic assets: advances to the banking system and/or Treasury securities held by the central bank.

In a system made of just two countries, what should the second country do following an increase of its reserve from 35 m to 40 m (due, for instance, to a trade surplus with the first)? The monetary base should rise – one might argue in a similar way – from 100 to 114.3 m, in order to maintain the 35% ratio. If the

increase in the monetary base were just equal to the increase in assets, i.e. from 100 to 105, the coverage ratio would exceed the apprehension level of 35%[22]. The central bank domestic assets should also increase by the same percentage in order to avoid "excess reserves", i.e. a coverage ratio higher than the AR. The central bank has thus an available margin to expand the money base further.

Symmetry can therefore be interpreted in two ways: a) In a passive sense, the central bank complies with symmetry (the **rule** of the game) simply by permitting an *absolute* correspondence between a change in its international assets, that is in the gold/forex reserve, and a change in its liabilities, even though the coverage ratio falls below the AR (in case of a foreign deficit) or increases above that level (in case of surplus). b) In an active sense, whereby a deliberate action of the central bank aims to stick to the AR. This means a *proportional* contraction (increase) of domestic assets.

5. Obstacles to symmetry

All the obstacles to symmetry can be related to one overwhelming factor: the asymmetrical consequences of the ratio required by law (the AR, in this paper). While a deficit country incurring a shortage of gold/foreign exchange had to deflate in order to bring the coverage ratio back to the required level (the AR), a surplus country with an available margin was "under no similar compulsion to take measures of the opposite kind"[23]. (Interestingly enough, we find this same issue in the dysfunctionality of the Bretton Woods system, at least until the US was in a position of creditor, and of the Eurozone). Regarding the gold standard, this meant that a foreign surplus – and a consequent increase in the international reserve – did not oblige the central bank to expand its policy. The central bank might follow this course of action for different reasons: a precautionary motivation, an inflationary concern, national prestige, bank's profitability. In this regard, a short explanation is due. The binding target of the conversion ratio might

induce the central bank not to expand its monetary policy, because this action might potentially endanger that ratio. The central bank might prefer, in other words, to have a cushion to defend convertibility, and maintain a higher coverage rate, in case of a future gold outflow in different circumstances. This behaviour tended to maintain in the system excess reserves[24].

In addition, if the inflow of foreign money was seen with concern as inflationary, the central bank might not only not to behave symmetrically, but also act to sterilize the inflow through opposite operations (that is, by reducing its domestic assets).

Another obstacle to symmetry goes under the generic name of national interest. Both created what has been termed as the restrictive, deflationary bias of the gold standard, the result of an "ideology"[25] rather than the application of the rules of the game. Related to this argument of "prestige", the surplus country has a vested interest in maintaining the asymmetry. First, there is sort of a "moral issue": the surplus country sees its surplus as "an indication of the virtuous qualities of its policy, to which all other countries should aspire"[26]. Second, any attempt to cooperate internationally, symmetrically, in order to soften any deflationary pressure elsewhere, would mean to try to rebalance its position, towards reducing, or eliminating, its surplus through expansionary, inflationary, measures, and its very (perceived) political and economic hegemony as a consequence.

In the pre-WW1 period, there was, both in legislation and in the prevailing public opinion, a strong emphasis on the necessity to curb any monetary over-expansion, for a better defence of a country's price stability and economic competitiveness. Underlying this view was the belief that money should be solidly anchored to a scarce commodity (gold). Powerful policy instruments were in force to potentially deflate the money supply, as regulatory ceilings to paper circulation and burdensome, progressive taxation if it exceeded certain levels. All this reinforced the "restrictive bias" of the gold standard in those years.

An additional obstacle to symmetry was the fact that, particularly in the pre-WW1 period, central banks' policy was largely influenced by considerations related to their own profitability as quasi-private concerns (they were often structured as joint-stock companies, under private ownership), or to their role of assuring orderly conditions in the domestic money market, as *primus inter pares*, rather than as an institution serving a public interest[27].

Even when central banks behaved symmetrically – for instance, by raising the discount rate or introducing tighter conditions for the availability of central bank funds to the banking system[28], in case of a trade deficit and a fall in foreign reserves - these measures were taken with the main purpose of changing the composition of the central bank's portfolio, rather than influencing the amount of credit to the economy. On the other side, if the coverage ratio increased thanks to growing foreign reserves, a recourse to lowering the discount rate might occur not so much to favour other countries and rebalance the system (that is, symmetry), but to protect the central bank's profitability by minimizing holding of non-generating-income assets as gold, or for technical reasons related to the smooth working of the money market.

Unrelated to trade balance considerations (flows), another factor of potential asymmetry was related to the country's international investment position, IIP (stock). A country might experience a significant inflow of foreign capital, in particular when a traumatic event occurs[29], which may positively alter foreign investors' perspective. While this inflow increases the international reserves, it also generates a foreign debt, which may prove in the end unsustainable. The country's net international investment position might become increasingly negative. In particular, if the maturity distribution of foreign debt is such that it is mostly made of short-term liabilities, the country can be very cautious in adopting a looser monetary stance, being concerned by sudden withdrawals of foreign funds and its inability to repay.

Concluding on asymmetry, these considerations lead us to conclude that this rule of the game was not generally observed (as Section 6 will show). A similar conclusion was drawn by Bloomfield, in his survey on this issue, when he says that monetary policy was not "automatic", but also that – if there was "discretion"- "the quality of management was very poor", responding – we might add – more to criteria of management of a private enterprise than to public policy purposes. We agree with Bloomfield that there was "no awareness of the rules of the game"[30]. We shall try to test these points in the following Section 6.

Section 6. Empirical analysis to measure symmetry in five European countries

Our evaluation of the degree of symmetry will not be made on a qualitative basis, which is by taking into account the relevance of the specific possible motivations of asymmetry given in Section 5, but on a quantitative analysis, as explained more in more details at Sections 6.1 and 6.2.

We try to respond to two basic questions:

- Whether central banks acted symmetrically according to this rule of the game of the gold standard, and whether a common pattern of behaviour can be detected in a cross-country observation of their policies;
- Whether the observance of the legal conversion ratio was an effective constraint for the central banks to behave asymmetrically, and to what extent.

In our paper, in order to verify whether central banks acted symmetrically, we measure the degree of correlation between changes in international reserves and in the monetary base. The empirical analysis is carried out by a simulation of the monetary reaction function: by which we mean the central bank's reaction, as expressed in changes in the monetary base (MB), to changes in the coverage ratio (CR) and its

deviations from the apprehension ratio (CR-AR35%), and in the international reserves (R). Therefore, R, CR and CR-AR35% are the explanatory independent variables, and MB is the dependent variable.

In this way, we can check *ex post* the actual "bias" of monetary policy towards each of these objectives and thus identify and measure the asymmetry bias of the central bank. This check is done in a *counterfactual way*: what should have been the monetary authorities' policy if they had wanted to be fully coherent with the conversion ratio determined by law (the AR, in this paper)? What should have been their policy had they wanted to keep close track of international reserves, i.e. to observe symmetry? And how close (far) was their actual behaviour to (from) those policies?

We have also analysed changes in the current account (CA) as an independent variable; however, as we show in the analysis below, changes in CA – which are often inconsistent with changes in international reserves - are not a good indicator to explain central banks' policy decisions for two reasons: the current account data are very volatile and do not appear as a reliable source of information for our purposes; the normative variable that central banks had to follow was instead the amount of officially held reserves (gold and foreign currencies). The probable explanation for the often large difference between changes in current account balances and in official reserves is that the monetary authorities preferred to keep these balances within the banking system, that is, to maintain in the private sector part of the foreign investment position of the country, therefore stabilizing the monetary base.

In order to assess the symmetry or asymmetry of monetary policy we will run in Section 6.1 an estimate of the determinants of monetary policy at the time, and then in Section 6.2, we analyse how much each country followed symmetry and, when they did not follow it as a policy criterion, which role was played by the apprehension ratio in explaining such a behaviour.

6.1 Estimate of the central bank reaction function

We have estimated a panel with fixed effects from 1894[31] to 1913 to account for the main determinants in the changes in the monetary base in the form of changes in either total reserves held at the central bank (R), or the coverage ratio (CR)[32]. We have used the Augmented Dickey-Fuller test as well as the Levin-Lin-Chu test to assess the stationarity of the panel, with both the variables in levels and in rates of change. We cannot reject the presence of unit roots when the variables are in levels, while there is no stationarity when using data in rates of change. Therefore we have estimated a panel with fixed effects and the variables in rates of change for the five countries under analysis. The results are summarised in the table below.

[Table 1: Panel data estimation results (changes in the monetary base as the dependent variable)]

Variables	**Coefficient** (t-statistic)
Constant	1.323 (2,314)***
Total Reserves, Central Bank	0.998 (40,650)***
Current Account balance	-0.001 (-0.846)
Coverage Ratio	—1,071 (—51.020)***
R^2	0.969
F-statistic	358,376***
Durbin Watson statistic	2.148
Total observations	100

Note: (***) significant at 2.5% level. Cross-section fixed effects estimate. Cross section effect coefficients: Italy, -0.86; United Kingdom, -1.044; France, -0.355; Spain, 0.090; Germany, 2.171.

Both changes in total reserves held by the central bank and in the coverage ratio are significant variables in the explanation of changes in the monetary base in the countries analysed. Changes in the current account balance are not significant though. An increase in reserves would contribute positively to the expansion of the monetary base. Much less so in the case of an increase in the coverage ratio; as discussed in previous Sections, central banks operated paying particular attention to an apprehension ratio in order to maintain convertibility. Consequently, an increase in reserves would not imply an increase in the monetary base if it did not raise the coverage ratio to or above the (35%) apprehension ratio. This quite prudent rationale is confirmed by the results offered by our panel estimates; as the sign of the coverage ratio coefficient shows, an increase in the coverage ratio was not necessarily followed by an acceleration in the monetary base growth. This result points at an asymmetry in the running of the gold standard[33].

6.2 Simulation exercise: a normative approach

Even though the results so far confirm that the main driver of changes in the monetary base were changes in reserves and in the difference between the coverage ratio CR and the apprehension ratio AR, the above estimation exercise cannot address the question on how symmetrical or asymmetrical central banks were, that is, how and to what extent they complied with this rule of the game[34]. To do so we ask how central banks should have behaved if changes in the monetary base (notes and banks' reserves) had been fully coherent with: (1) changes in their reserves (that is, symmetry in the running of the gold standard, see equation 1 below) and (2) changes in their coverage ratio (CR) (see equation (2)), and in particular changes in the deviations of CR from AR of 35% (see equation 3 below).

(1) Reserves-based rule. The gold standard symmetry rule: a policy rule based on changes in the reserves held by the central bank:

$$MB_t = MB_{t-1} \times \left(1 + \Delta R\right), \text{ being } \Delta R = R_t - R_{t-1} \quad \text{(Eq. 1)}$$

(2) Coverage ratio-based rule: a policy rule based on changes in the CR irrespective of its level:

$$MB_t = MB_{t-1} \times \left(1 + \Delta CR\right), \text{ being } \Delta CR = CR_t - CR_{t-1} \quad \text{(Eq. 2)}$$

(3) Apprehension ratio-based rule: a policy rule based on changes in the deviations of the CR from the AR, 35%:

$$MB_t = MB_{t-1} \times \Delta\left(CR - 35\%\right)_t \quad \text{(Eq. 3)}$$

Concerning our analysis below, we use the following sample periods in our five European economies: UK (1870 - 1913), Germany (1876 – 1913), France (1860 – 1913), Italy (1894 - 1913) and Spain (1874 – 1913)[35]. We have used different reaction functions with several specifications, all of which share a high degree of inertia[36] in the changes made to the amount of money in the economy. Due to the lack of availability of higher frequency data, all the variables used are annual (the sources are detailed in the appendix). Finally, the dependent variable is the monetary base narrowly defined, with notes (and not coins) in circulation pus banks' balances at the central bank.

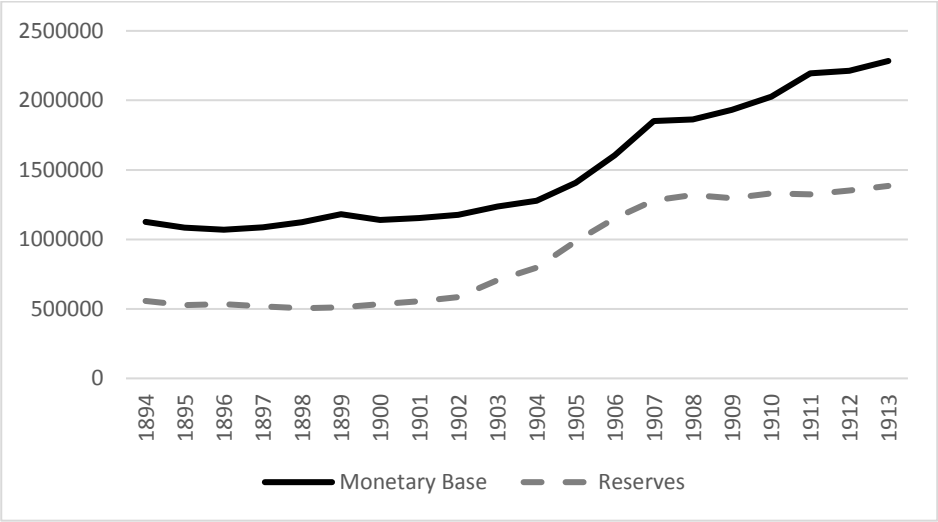
Italy (1894-1913)

(1) As shown in Figure 1 below, the trend of the monetary base and the reserves held by the Bank of Italy ran in parallel from 1894 to 1906, which is the expected outcome of a gold standard economy (where – as stressed above - the amount of money issued by the central bank is connected to its metallic reserves holdings). From 1907 to 1913 though the rate of growth of the monetary base is

notably higher than that of the reserves, which had a relative stagnation since 1907. The reaction of monetary base changes to changes in the reserves is shown by the correlation coefficient between changes in the monetary base and changes in reserves: it is high and reveals the expected positive value in a gold standard country (0.58, see Table 1, Annex). Out of the 20 year period analysed 70% of the years when reserves increased (decreased) the central bank reacted increasing (decreasing) the monetary base. It is important to note that this does not indicate a one to one response of money growth to changes in reserves, but in our view it is a sufficiently strong indication of the underlying determinants of monetary policy at the time [37]. A further analysis of the rate of growth of the monetary base at the time suggests however that the Bank of Italy did not merely follow symmetry – that is changes in the monetary base following changes in reserves - as a criterion for the running of the gold standard, but also other criteria.

(2) We have analysed the correlation between changes in the monetary base and changes in the coverage ratio. Confirming the remarks made above, the negative sign of this correlation shows that there were periods where reserves grew and the monetary base did not increase accordingly (or even did not increase at all). This result suggests a cautious behaviour followed by the Bank of Italy: the Bank did not expand the monetary base when the increase in reserves was not sufficient to keep the Bank in a safe position to maintain lira convertibility. We have tested this hypothesis by analysing the correlation between changes in the monetary base and those of the coverage ratio in respect to the apprehension ratio: the sign of the correlation with changes in the monetary base is as expected and also quite strong (0.60), as more than 80% of the years when the ratio was above (below) 35% the central bank expanded (contracted) the amount of money in circulation.

[Figure 1: Italy. Monetary base and Reserves (1894-1913). All in million lira]



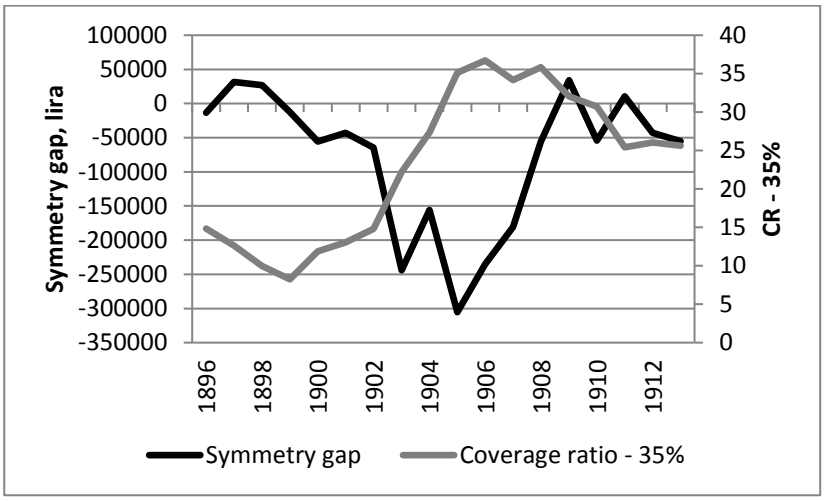
The trends and correlations stated above are confirmed when we address in a counterfactual way which *should have been* the monetary policy compatible with changes in reserves and in the apprehension ratio. As shown in Figures 2 a and b below, the Bank of Italy's monetary policy decisions from 1894 to 1899 very much followed the prescription of a gold standard symmetry rule, mainly governed by changes in reserves. However, from 1900 to 1908 the monetary base did not follow the same expansionary path in the face of a continuous increase in reserves and in the coverage ratio. In those years the Bank of Italy seemed to have been more conservative and thus less expansionary than what the application of a symmetry rule would have prescribed.

These discrepancies between the actual monetary base changes and those prescribed by the gold standard symmetry rule can well be interpreted as a *symmetry gap* in the application of the gold standard; where the gap is calculated as the difference between the actual monetary base and the one prescribed by changes in reserves (i.e. Equation 1 above)[38]. In the case of Italy, the symmetry gap depicts an overall negative pattern along the sample, with an average of -131,642 million lire, amounting to - 9% under-issue of money on average per year from 1894 to 1913.

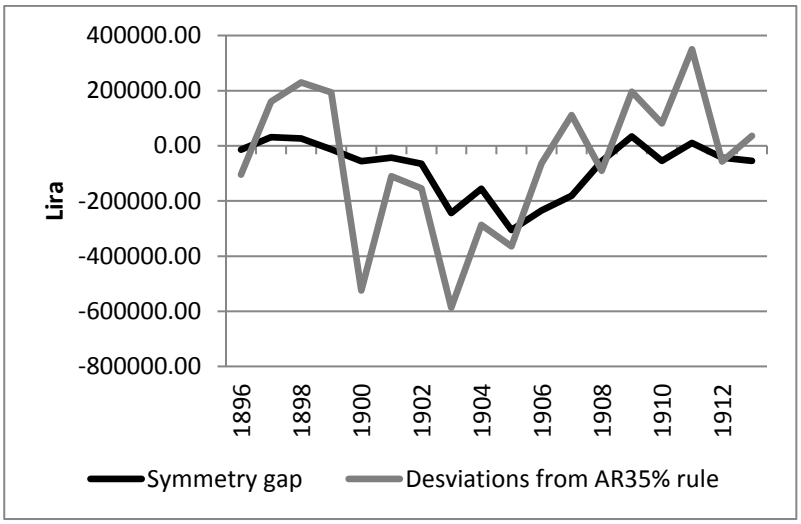
When compared to the apprehension ratio rule (see Equation 3 above), the gap is even greater: from 1899 to 1905, the issue of notes by the Bank of Italy was far below the rate prescribed by the deviations of the coverage ratio from the 35% apprehension ratio (see Figure 2b below). This was a period when the coverage ratio not only increased but maintained a level well above the 35% ratio, and yet the Bank of Italy would not increase accordingly the monetary base. As shown in Figure 2a below, only when a comfortable position was reached (1905 onwards), with a coverage ratio well above the 35% apprehension ratio, the Bank seemed to be more willing to increase the amount of notes in circulation, as shown in the fall in the symmetry gap. This suggests a very conservative bias adopted by the Bank in order to preserve an even greater than 35% coverage ratio, which indeed impeded the fulfilment of asymmetry.

[Figure 2: Symmetry gap. Italy (1894 – 1913)]

a. Symmetry gap and coverage ratio



b. Symmetry gap and an apprehension ratio rule



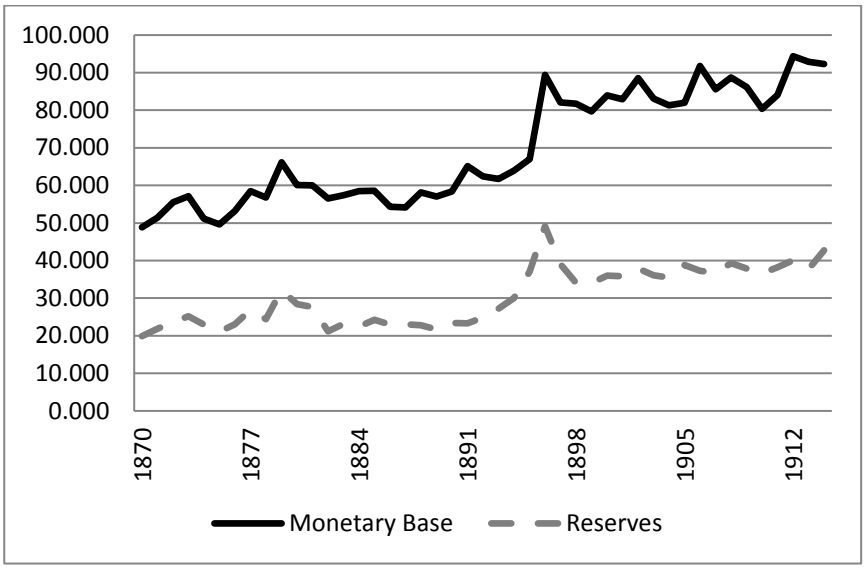
In sum, the Bank of Italy did not just mirror every change (either positive or negative) in the reserves in order to change the monetary base but appears to have adopted instead an implicit desired AR minimum level deemed compatible with the fulfilment of convertibility, indeed higher than the 35% ratio. Whenever the AR did not reach that ratio new additions to the stock of reserves were not passed on to the amount of money in the economy but kept at the Bank of Italy as a safety buffer. However, the adoption of such an AR desired level seemed to have lost relevance at the end of the sample, in the years running up to WWI.

United Kingdom (1870-1913)

(1) The Bank of England was at the epicentre of the world monetary system and followed the prescriptions of the gold standard; thereby changes in reserves were very much followed by changes in the monetary base in the economy: out of the 42 years analysed, more than 81% of the years when reserves increased (decreased) the Bank expanded (contracted) the monetary base accordingly, which is reflected in a quite high correlation ratio between changes in reserves and changes in the monetary base (0.74). Both the monetary base and total reserves held by the Bank

of England showed a continuous increasing and very similar pattern throughout the sample (see Figure 3 below).

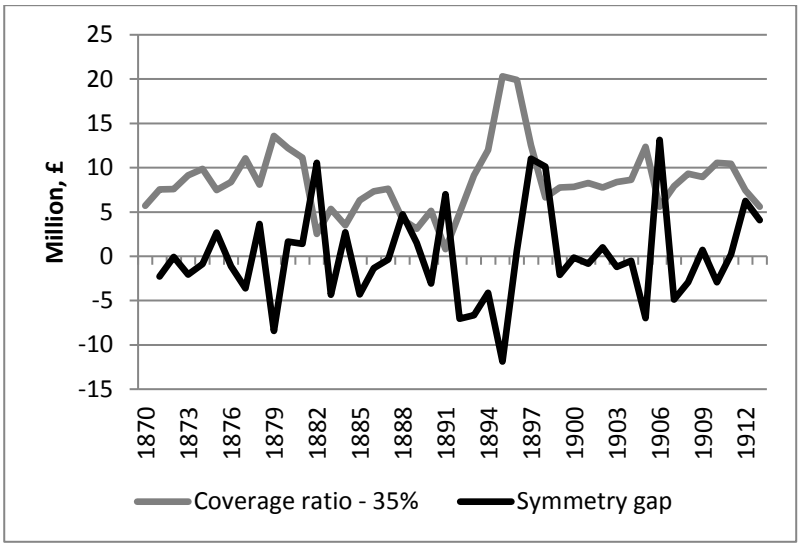
[Figure 3: Monetary base and Reserves (1870-1913). All in million pounds]



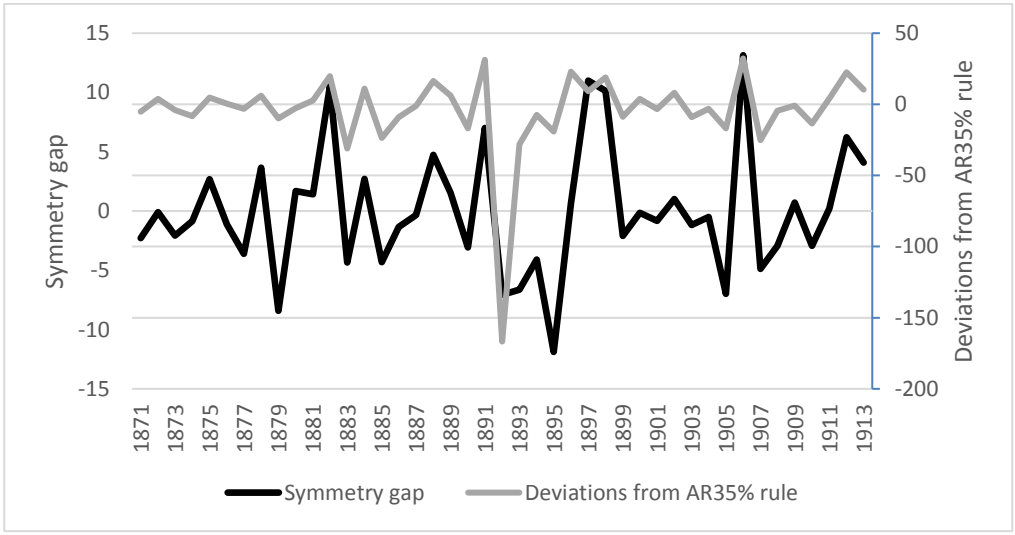
(2) We compare now the actual changes in the monetary base in the UK from 1870 to 1913 to those prescribed by the gold standard reserves' rule (see Equation 1 above). This analysis suggests that the Bank of England very much followed symmetry: the symmetry gap exhibits very mild fluctuations around the zero line (with a very close to zero average gap, - 0.025 million pounds, which amounts to a negligible - 0.03% under issue bias per year on average, see Figure 4 below). Moreover, the coverage ratio exceeded the 35% apprehension ratio all throughout the sample and the size of this gap does not seem to have a significant influence in the amount of bank notes issued by the Bank of England. This all suggests a quite symmetrical application of the gold standard.

[Figure 4: UK, gold standard rules as a benchmark]

a. Symmetry gap and coverage ratio



b. Symmetry gap and an apprehension ratio rule

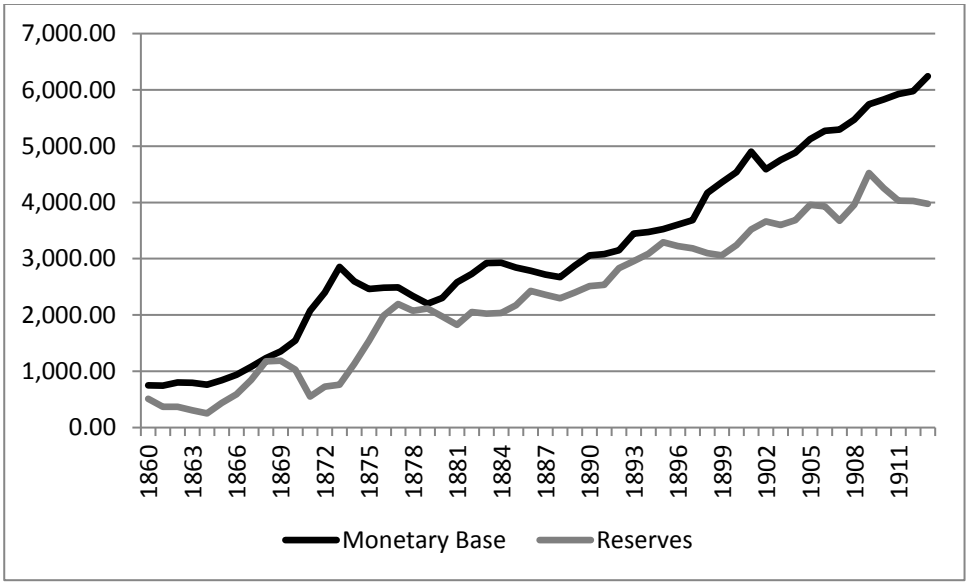


France (1860 – 1913)

(1) During these years the monetary base grew at a quite stable pace throughout the sample, and at a faster rate than reserves did (see Figure 5 below). The correlations between changes in the monetary base on the one side and in reserves and the coverage ratio are insignificant (-0.05 and -

0.38 respectively); as with Italy, what the negative correlation to changes in the coverage ratio indicates is that the Bank of France did not expand the amount of notes when the coverage ratio increased irrespective of its level. However, 74% of the years in this period the monetary base changed following the sign of the deviation of the coverage ratio from the 35% apprehension ratio: that is, an expansion/contraction in the monetary base when the coverage ratio was above/below 35%. This points at the *de facto* adoption of other criteria, and not merely the fulfilment of symmetry, such as the achievement of an implicit apprehension ratio, as the criterion to determine the amount of notes issued by the Bank.

[Figure 5: France. Monetary base, Reserves and Current account balance (1860-1913). All in million French Francs]



(2) However, when we compare the actual rate of growth of the monetary base with the running of the reserves and apprehension ratio rules (equations 1 and 3 above) we observe important discrepancies (see Figure 6b below), as well as an overall asymmetric (under-issue) bias in the application of the gold standard (with -33.01 million francs average), accounting for an under issue

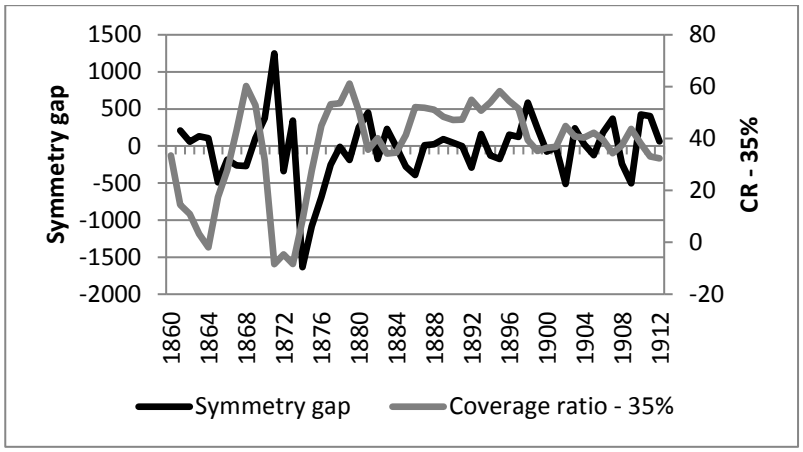
of money of -1% on average per year. In order to identify this bias more clearly we can make a distinction between two time periods in the sample:

(a) From 1860 to mid-1870s and with the exception of 1871, the Bank of France's symmetry gap can be explained by the deviations of the coverage ratio from a 35% apprehension ratio. Only when the coverage ratio had been raising well above the apprehension ratio did the Bank of France allow for the monetary base to increase, even above the prescriptions of the symmetry rule (see 1867 -1871 in Figure 6a below) [39]. The same rationale applies to the under issue of money from 1872 to 1877, which was preceded by several years of a fall in the coverage ratio (which even hit the 35% apprehension ratio). This is the time period when the asymmetry bias of the Bank is more acute, with a – 8.9% under issue of notes on average per year and indicates that it followed a very conservative monetary policy: the monetary base did not grow even if when the coverage ratio had reached the 35% ratio, which suggests that the Bank of France may have been adopting (*de facto*) even a higher apprehension ratio in these years.

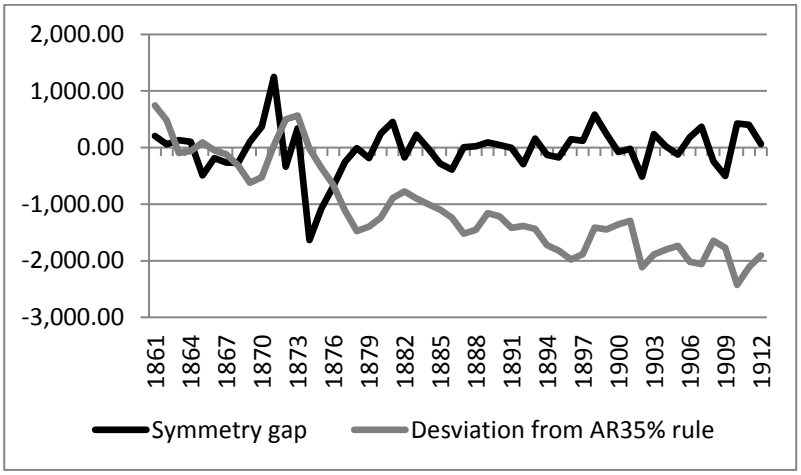
(b) From 1878 to the start of WW1 the Bank of France seemed to have followed a reserves rule, with the symmetry gap being negligible and fluctuating around zero (see Figure 6b below).

[Figure 6: Symmetry gap. France (1861-1912)]

a. Symmetry gap and coverage ratio



b. Symmetry gap and apprehension rule

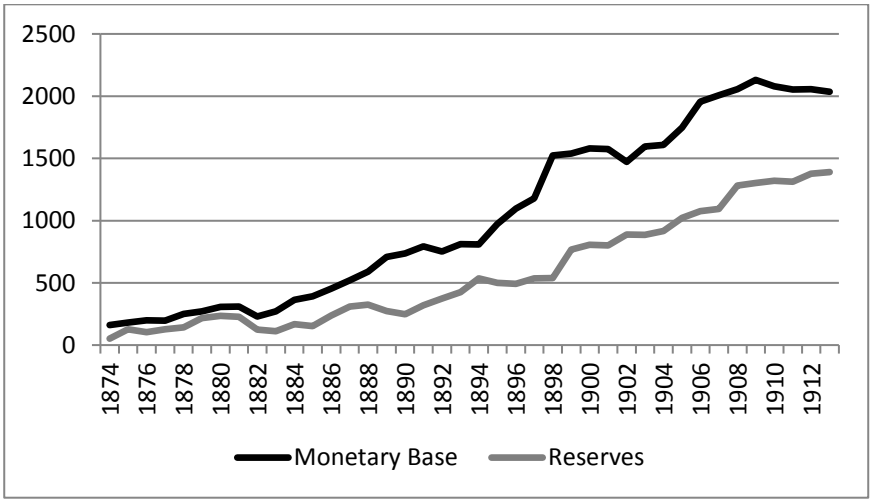


Spain (1874 – 1913)

In 1874 the Bank of Spain was granted the monopoly of notes issue for the whole country and following a monetary contraction in the early 1880s, it suspended convertibility of notes in gold in 1883. Even though not formally on the gold standard since then, the Bank of Spain ran a monetary policy very much linked to the stock of metallic reserves available at the time, which can be interpreted as the running of a gold standard rule 'in the shadow'.

(1) From 1874 to 1881 the monetary base followed a very much stable and low growing pace, in fact slower than that of the reserves held at the Bank (see Figure 7 below), which increased steadily from 1885 on. From 1882 onwards, the monetary base followed a continuous growing trend, higher than that of the reserves. In more than 60% of the years when reserves increased (decreased) did the monetary base also increase (decrease) as expected; and in 76% of the years when the coverage ratio was above (below) the 35% apprehension rate did the base also increase (decrease).

[Figure 7: Spain. Monetary base and Reserves (1874-1913). All in million Pesetas]



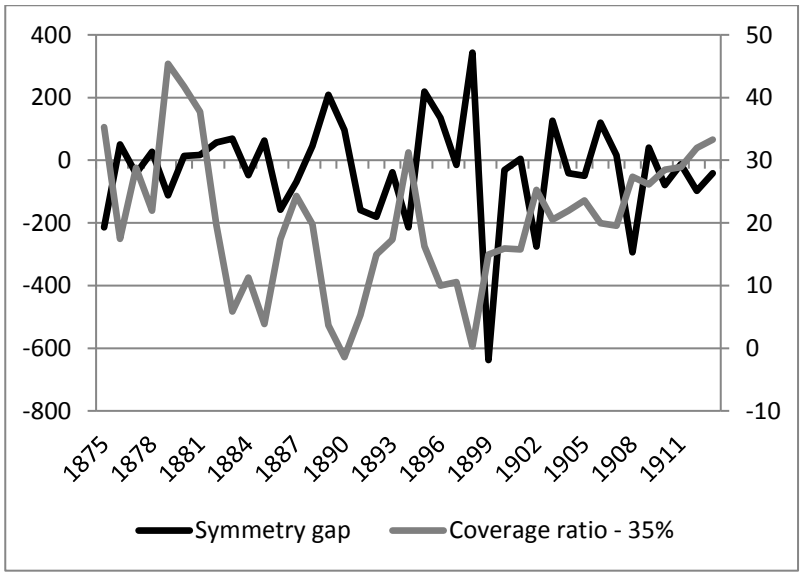
(2) However, when we compare the rate of growth of the monetary base with the prescriptions of the reserves and the apprehension ratio rules we can observe that, overall, monetary base changes were not always in line with changes in reserves (see Figure 8 a below), resulting in an asymmetry gap; (a) the under issue of notes from 1866 to 1894, when the Bank seemed to have paid more attention to how close the (falling) coverage ratio was to the apprehension ratio and, in particular, to the need to keep up a considered as a safety ratio around or even higher than 35%; and (2) the

over issue of notes in the mid and late 1890s, which coincides with a very difficult economic and political time: Spain ran successive public deficits to pay for the expenses of the independence wars in Cuba and the Philippines, which in the end imposed a strong pressure on the Bank of Spain to monetise the deficit. After the introduction of a new fiscal and monetary stabilisation plan in 1902 (the so-called 'Villaverde Plan'), the economy resumed more balanced budgets and a more stable monetary policy, which is shown in a significantly smaller symmetry gap.

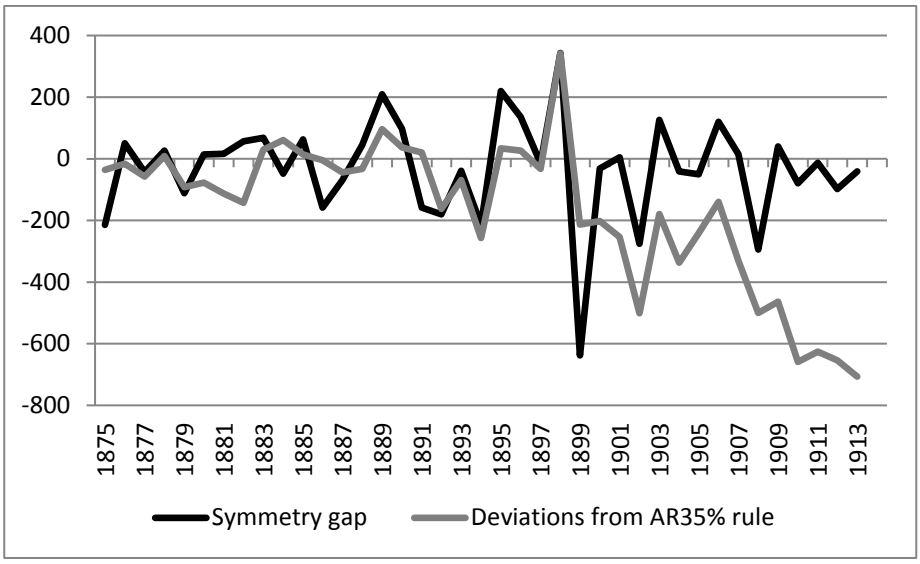
Overall, the Bank of Spain followed consistently a more conservative policy than the one prescribed by the fulfilment of symmetry, with an overall (average) under-issue bias of - 29 million Pesetas, which amounts to an under issue of notes of - 2.8% per year on average.

[Figure 8: Spain, gold standard rules as a benchmark. In million Pesetas]

a. Symmetry gap and coverage ratio



b. Symmetry gap and apprehension rule



Germany (1876 – 1913)

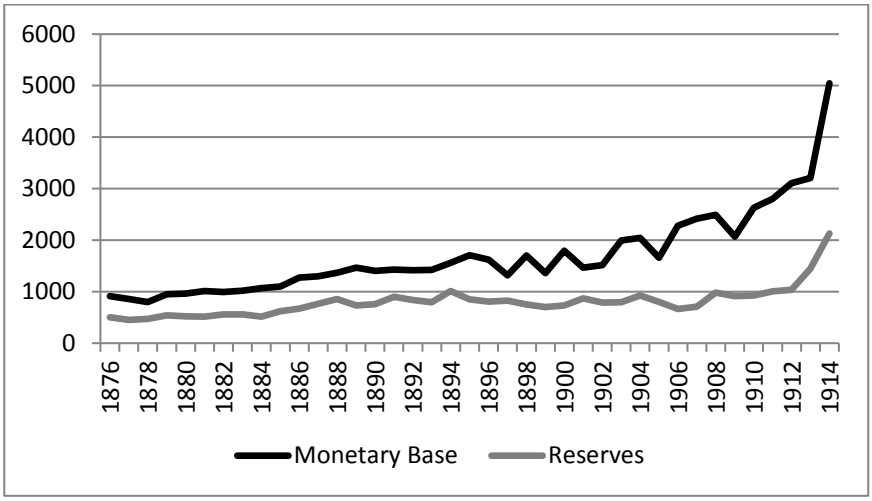
(1) From approximately 1876 to 1894 the growth of the monetary base followed a very stable path, along with that of reserves. However, as shown in Figure 9 below, since the mid-1890s onwards the trend of the rate of growth of the monetary base was significantly higher than that of reserves, which remained stagnated until 1908. Following James (1997), the main Reichsbank's concerns were the preservation of the gold stock and the ability to respond to financial distress in case needed. So rather than altering the stock of gold, the Bank resorted to its discount rate and adjustments in its assets portfolio as means to achieve a certain ratio of notes to gold holdings. In practice, this meant the management of the gold standard through the regulation of domestic credit via changes in interest rates. In this sense, the Bank conducted a very 'modern' monetary policy through the application of rules rather than personal judgement.

(2) The result of this strategy was the overall fulfilment of the symmetry rule until mid-1890s. As shown in Figure 10 below, from 1876 to 1894, the symmetry gap is certainly modest and very

similar to that of the Bank of England's (- 0.1%). This coincides with a period of an accumulation of reserves by the Reichsbank well above the 35% apprehension ratio. However, the fulfilment of the symmetry rule became much more loose and erratic since 1901, when the coverage ratio fell significantly, even below the 35% apprehension ratio in some years.

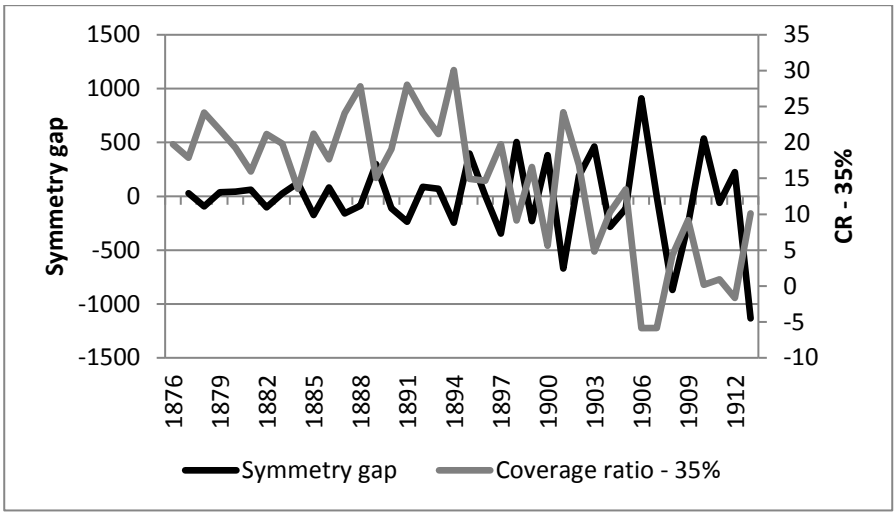
Overall, the Reichsbank ran a monetary policy consistent with the symmetry rule, with just an average – 19.13 million RM under-issue bias for the whole period, which amounts to a -1.1% under issue on average per year.

[Figure 9: Germany. Monetary base and Reserves (1875-1913). All in million RM.]

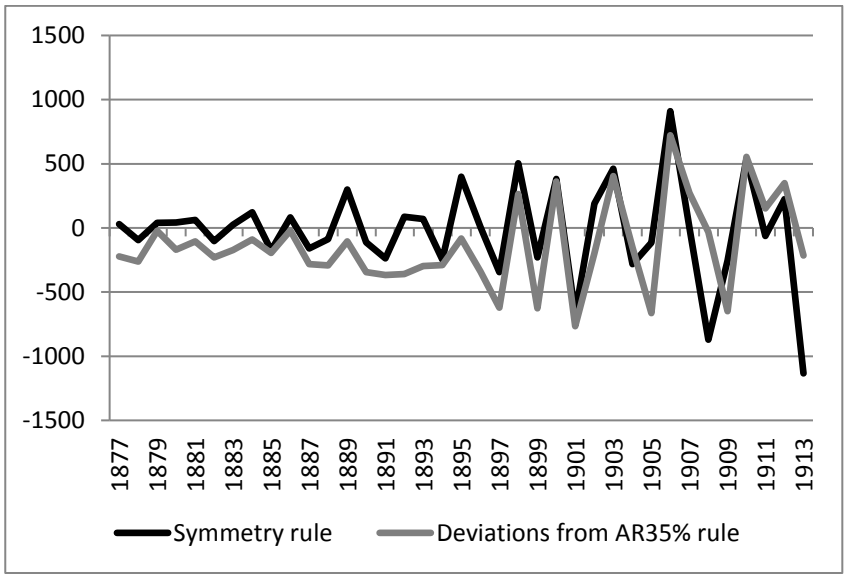


[Figure 10: Germany, gold standard rules as a benchmark. All in million RM.]

a. Symmetry gap and coverage ratio



b. Symmetry gap and apprehension rule



7. Conclusions and political implications

We can now try to give an answer to the two basic questions raised at the beginning of Section 6: whether central banks acted symmetrically; and whether their policy was affected by the observance of the legal, mandatory conversion ratio. As regards the first question, our empirical results are as follows):

Table 2. Summary of results: Measurement of asymmetry in the running of the gold standard

Annual percentage deviation from the 'reserves rule' (symmetry), $MB_t = MB_{t-1} \times \left(1 + \mathrm{D}R\right)$

	(Yearly average, %)
Spain	-2.8%
France	-1%
Italy	- 9%
Germany	-1.1%
UK	-0.0003%

Note: A negative/positive sign indicates an under issue/over issue of currency as compared to the symmetry rule.

Regarding our second question, these results point out to an important distinction between the UK and the other four countries. As shown in Section 6.2, these four countries seemed to have paid attention to the deviations of the coverage ratio from a (high) safety ratio in order to maintain convertibility. What we have observed is that this safety ratio was a sort of benchmark, prudentially adopted, and set above the legally required 35% ratio seemed to have been significantly higher than the figures suggested in the literature, and indeed well above 35%. In this vein, only having achieved that safety ratio the interested country would feel comfortable enough to follow the symmetry rule. Or, in other words, our *ex post* analysis

suggests that achieving such a safety ratio seemed to have been taken as a pre-condition to be able to abide by symmetry in the running of the god standard. This seems to be particularly relevant for Italy.

On the one hand, Italy and Spain exhibit asymmetry, resulting in an under-growth of the monetary base throughout the sample. As regards Italy, the explanation lies in the application of an alternative policy rule, by which the monetary base did not grow following an expansion of reserves until they reached a certain 'safety ratio': a desired safety ratio that seems to be higher than the AR of 35%. As regards Spain, it was mainly the pressure of the government on the central bank what explains the deviations observed from the symmetry rule; once these pressures mitigated in the early 1900s the Bank of Spain followed in greater extent the gold standard rules even though the country was on an only *de facto* gold standard. Germany and France did not follow symmetry consistently throughout the sample either, and displayed (though to a lesser extent) a not-negligible under issue policy bias.

On the other hand, the United Kingdom, the epicentre of the monetary system at the time followed symmetry in the running of the gold standard. The UK was comfortably within the AR and foreign investors had confidence in the strength of the pound, so that the central bank could promptly adjust its monetary policy to changes in its gold reserve.

The consequences resulting from the running of the gold standard with a deficient degree of symmetry should not be underestimated, as countries like Germany and France refused to let the increase in reserves to be reflected in a greater amount of money supply. All the more so, Italy and Spain This created tension in the system, as countries like Italy or Spain would find it more difficult to regain competitiveness, and thus a greater internal devaluation was needed to be able to compete with their trade (surplus) partners[40].

Were the asymmetries of the pre-WW1 period the origin of the gold standard's final collapse? The straight answer is negative: all the five countries here surveyed had to suspend the standard at the outbreak of the war, if not before such as Spain in 1883; it was the War, with the huge expansion of the money supply, dramatic inflation and social unrest that made later in the 1930s the gold standard unable to survive. In the post-war period, Britain had lost her hegemonic status and symmetry together with it.

And, as pointed out in Section 1, the asymmetry of the hegemonic country (the US) under the Bretton Woods System might well explain its collapse.

Should we infer from these experiences that symmetry of the hegemonic country is the precondition for a fixed rate system (or for a currency union with a single currency) to survive? And, referring to the Eurozone, should we think that Germany – unquestionably the hegemonic country – is behaving asymmetrically and that the Eurozone should collapse as a consequence? Another paper would be needed to answer these questions.

Appendix

Table 1: Correlation with annual changes in the monetary base

	Reserves (annual change, %)	**Current Account** (annual change, %)	**Coverage Ratio** (annual change, %)	**Apprehension Ratio** (deviation from 35%)
Italy	0.58	0.11	-0.06	0.60
UK	0.73	-0.15	0.04	0.28
France	-0.05	0.07	-0.38	-0.08
Spain	0.27	0.40	-0.07	-0.30
Germany	0.20	-0.06	-0.64	-0.45

Source: Own calculations.

Statistical sources

Italy: Monetary Base (MB), Reserves (R), Current Account balance (CA), Coverage Ratio (CR), Apprehension Ratio (AR), 1895 – 1913. Own calculation of the narrow monetary base as the summation of banks' balances at the Bank of Italy and the notes issued by the Bank of Italy, Bank of Naples and Bank of Sicily (from Caron et al. 1993). Total metallic reserves and foreign exchange reserves of all the banks of issue in Italy (all from Caron et al. (1993): 'I Bilanci degli istituti di emissione in Italia, 1894-1990'; data on the current account balance from B. Mitchell's (2007): 'International Historical Statistics (1750 – 2005)'. Own calculation of the coverage ratio figures.

United Kingdom: Monetary Base (MB), Reserves (R), Current Account balance (CA), Apprehension Ratio (AR), 1871 – 1913. Own calculation of the narrow monetary base as the summation of banks' balances at the Bank of England, total metallic reserves (both from the Bank of England historical balance sheets' database) and notes in circulation from Mitchell's (2011): 'British Historical Statistics'; data on the current account balance from B. Mitchell's (2011): 'British Historical Statistics ' (coins in circulation have not been included). Own calculation of the coverage ratio figures.

France: Monetary Base (MB), Reserves (R), Current Account balance (CA), Apprehension Ratio (AR), 1860 – 1913. We have calculated the narrow monetary base figures from B. Mitchell's (2007): 'International Historical Statistics (1750 – 2005)' and Baubeau (XXXX). Total metallic reserves from the Bank of France archives; data on the current account balance from B. Mitchell's (2007): 'International Historical Statistics (1750 – 2005) '. Own calculation of the coverage ratio figures.

Spain: Monetary Base (MB), Reserves (R), Current Account balance (CA), Apprehension Ratio (AR), 1874 – 1913. Total metallic reserves from Martín Aceña and Pons (2005), in Carreras and Tafunell (eds.) Estadísticas Históricas de España. Own calculation of the narrow monetary base as the summation of banks' balances at the Bank of Spain (only available from 1900 onwards, from Martín Aceña and Pons (2005), in Carreras and Tafunell (eds.) Estadísticas Históricas de España) and total notes in circualtion (from G. Anes (1974): 'Una serie de base monetaria (1874-1915)', in Schwartz and Tortella (eds.) Banca Española en la Restauración). Data on the current account balance has been proxied by the trade balance from Tena (2005), in Carreras and Tafunell (eds.) Estadísticas Históricas de España. Own calculation of the coverage ratio figures.

Germany: Monetary Base (MB), Reserves (R), Current Account balance (CA), Apprehension Ratio (AR), 1876 – 1913.We have used total metallic reserves from Deutsche Bundesbank (1976): Deutsches Geld- und Bankwesen in Zahlen 1876 – 1975; data on the current account balance from B. Mitchell's (2007): 'International Historical Statistics (1750 – 2005)'. Own calculation of the apprehension ratio figures and of the narrow monetary base.

Notes and references

[1] We would like to thank Professors Wood and Capie for their very helpful comments on previous versions of the paper, as well as Dr Jordi Vila and Dr Jose Luis Cendejas for his very valuable technical assistance in Section 6.1.

[2] See the Introduction in Capie and Wood (2003), *Monetary Unions. Theory, History, Public Choice*. Routledge.

[3] The first author who made clear the proper working of a monetary system based on gold was David Hume: "On the Balance of Trade", in *Essays and Treaties on Several Subjects*, 1764

[5] Amongst some of the seminal works, Arthur Bloomfield, *Monetary Policy Under the International Gold Standard: 1880-1914*, 1959. Federal Reserve Bank of New York; Michael Bordo and Anna Schwartz (Eds.)' *A Retrospective on the Classical Gold Standard, 1821-1931*. NBER; Barry Eichengreen and Marc Flandreau *The Gold Standard in Theory and History*. 1985, Routledge.

[6] As per the GDP levels in real terms (million 1990, international Geary-Khamis dollars) in 1914, the world ranking is the following: UK 226,864; Germany 202,207; France 134,230; Italy 95,413; Spain 41,075. See Maddison, Angus: The World Economy: Historical Statistics, OECD 2003.

[7] Bagehot W.: Lombard Street. A Description of the Money Market, Richard Irwin, 1962 (1873), p 157.

[8] Note that, in line with what has been told so far, the difference between monetary base, created by the central bank, and money stock, which includes bank deposits, is relevant. In Italy, in 1911 for instance, we have:
- Monetary base 2.6 bln.
- Money stock (total circulation, plus bank deposits) 9.5 bln.
(Source: Banca d'Italia: I bilanci degli istituti di emissione 1894-1990, Laterza, 1993; and website: statistiche storiche).

[9] See League of Nations: Legislation on Gold, 1930, for a summary of various countries laws on this topic in the post-WW1 period.

[10] We shall follow Keynes' Treatise on Money, Macmillan, 1965 (1930), vol II, pp 265-269, but it is not the only partition, see Bloomfield: Monetary Policy, cit, p 18).

[11] Worthwhile observing that Keynes does not recommend neither this specific percentage, nor a percentage system in general, nor – for what matters – any of the two above mentioned alternatives. He is, as well known, in favour of a managed currency, where discretion takes place of any rule, having the central bank policy to be aimed at domestic monetary and financial stability, irrespective of constraints caused by ratios/limits of any kind.

[12] Keynes J.M.: A Tract, p 166.

[13] Hawtrey R. G.*: The Gold Standard in Theory and Practice*, Longmans, Green and Company, 1931, p 50.

[14] Hayek F.A.: Monetary Nationalism and International Stability, August Kelly, 1989 (1935), p 87.

[15] Bagehot, cit, p 157.

[16] Bagehot W.: Lombard Street, cit, p 322. This was a consequence of the legal provision (the Bank Act 1844) that linked the amount of gold to banknote only, not considering the bank balances at the central bank.

[17] p 271.

[18] It is however interesting to observe that an attempt made on the basis of the "legal approach" (A), referred to a specific country (Italy), leads to similar conclusions on the monetary policy stance of that country: both the economic and the legal perspective point out to the fact that in the first years of the 20th century, and up to the WW1, Italy might have had room for a more expansionary monetary policy thanks to a positive trend in its international reserves, but was reluctant to do that, probably concerned by fears the lira's convertibility ratio (See Roselli, Alessandro: *Symmetry under the gold standard. The case of Italy 1894-1914*, mimeo, 2016. Forthcoming).

[19] Quoted above.

[20] The adoption of a more "economically significant" ratio would require to use as the denominator the total money supply - M1 or greater aggregate– which would be the best indicator of monetary stability. We have used here the monetary base because it is the best proxy to what different legislations stated as the denominator at the time.

[21] (x:100=30:95; x=31.6; 31.6<35)

[22] (x:100=40:105; x=38.1>35)

[23] Bloomfield A.: Monetary Policy, cit, p 23.

[24] It is worthwhile to remind a very different perspective, brought by a critic of the gold standard, John Maynard Keynes. He – as early as in 1923, in front of an enormous inflow of gold in the US - observed approvingly: "the Federal Reserve Board began to ignore this ratio [the required coverage ratio] and to accept gold without allowing it to exercise its full influence, merely because an expansion of credit and prices seemed at that point undesirable…the gold was not allowed to exercise the multiplied influence which the pre-war system presumed". (Keynes, J. M. A Tract p. 198).

[25] Eichengreen B., Temin P.: Fetters of Gold and Paper, NBER Working paper, 2010, p 4.

[26] Goodhart C., Tsomocos D.: International Monetary Regimes, in Capitalism and Society, vol 9, issue2, 2014, p 4.

[27] This is a very controversial question on the evolution of central banks and their role in modern economies studied in detail in Goodhart (1988) and Congdon (1981).

[28] By raising the quality of eligible collateral, for instance.

[29] Two cases are exemplary in this regard: after the stabilization of the Reichsmark in 1924, a huge inflow of money occurred in Weimar's Germany (1924-30), which proved unsustainable when the world crisis erupted and that money flew back. Greece experienced a relevant capital inflow when it joined the euro in 2001 and we are witnessing the consequences now.

[30] P. 26 and 24.

[31] This is because 1894 is the first years for which we have all the data available for the five countries considered; and 1913 is the final year before the suspension of the gold standard during WWI.

[32] We have estimated the model with fixed effects given that it is not a sample of fully homogeneous economies and each country ran the gold standard with its own specificities. In addition, as to the preference for a fixed rather than a random effects panel, the Haussmann test shows no significant differences in the estimated values.

[33] The results of these estimates must be interpreted with caution: the value of the coefficients of the reserves and the coverage ratio are significant but seem to point at a close to linear relation between them, which would recommend the speficication of a different panel or the assessment of the effects of each variable individually. The latter we do in section 6.2.

[34] This type of simulation, ex post, analysis are very much used in monetary policy analysis since the mid-1990s onwards, following the seminal work of John Taylor in 1993 on the analysis of the US Fed policies in the previous decades. Since then, multiple similar analyses have been made by using a policy reaction function as a benchmark to assess ex post the inflationary bias of the central bank (see Taylor, 1993, 1999, 2009).

[35] We have not included the US given that the US Federal Reserve did not start to operate as a single central bank for the whole country until 1914. We have added Spain so we can analyse the monetary policy of a formally non-gold standard country at the time. Further details on the dataset and the sources used can be found in the Appendix above. As regards the other countries, we have chosen the starting dates corresponding to the availability of data or a significant monetary event in the country, such as the establishment of the central bank (Italy, Germany) or the monopoly of note issue granted to the central bank (Spain).

[36] The analysis of the total and partial correlation of the monetary base series clearly reveal a strong autoregressive structure of order 1.

[37] Just to put this analysis in a contemporaneous comparable context, the Bundesbank's monetary targeting policies in the 1970s and 1980s were labelled as a successful rule-based and very much credible monetary strategy, and on average the central bank hit its monetary growth intermediate targets only 50% of the time (see Issing, 200X and Bofinger, 2001). Of course this reinforces the idea that a policy rule is not a mechanistic way to run policy decisions but a consistent strategy to make them and communicate with the public which ultimately enhances credibility over the medium and long term.

[38] According to this definition, the deviations of the black line (Figures 2 a, b) from the zero line reveal asymmetries in the running of the gold standard; either an over-issue of liquidity (over-expansionary policy) when positive values or too conservative when negative values.

[39] However France was under a bi-metallic standard before 1873 and thus the interpretation of our estimates in this period must be taken with caution.

[40] An alternative would be for the deficit countries to trade more with other countries, not adhered to such fixed exchange rate regime, be it the gold standard or the Eurozone.