MEMORY AND THE INTERNATIONAL MONETARY SYSTEM

CAN OLD HABITS EXPLAIN THE BRETTON WOODS "GOLD PUZZLE"?

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PRELIMINARY DRAFT – DO NOT QUOTE OR CIRCULATE

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Why did monetary authorities hold large gold reserves under Bretton Woods (1944-1971) whereas only the USA had to? We argue that gold holding was driven by institutional memory and persistent habits of central bankers. Countries continued to back currency in circulation by gold reserves, following rules of the pre-WWII gold standard. The longer an institution spent in the gold standard (and the older the policymakers), the stronger the correlation between gold reserves and currency. Since dollars and gold were not perfect substitutes, the Bretton Woods system never work as expected. Our results show that even after radical institutional change, history still shapes decisions of policymakers.

Keywords: Bretton Woods, gold, foreign reserves, culture, norms, gold standard, central banks

JEL codes: D8, E5, F5, F55, M14, N1

Can the persistence of past practices and norms lead to unexpected economic policy consequences? Several recent articles in the field of behavioral economics have pointed out that past behaviors and experiences of individuals are strong determinants of their current economic practices and beliefs (Alesina and Fuchs-Schuendeln 2007, Malmendier and Nagel 2011, 2015, Koudijs and Voth 2016). This literature has focused on individual decisions but also points out to institutional memory as a key area for future research (Camerer and Malmendier 2007; Bouwman and Malmendier 2015). Can the past experience of organizations explain their current strategy or policy?

With such questions in mind, this paper studies how gold standard's practices survived among monetary authorities after the Second World War (WWII), although the aftermath of the Great Depression, the shock of the war and the creation of the Bretton Woods system in 1944 were supposed to have eliminated them.[2] It is well known that some countries other than the US started to reconstruct their gold stock after the war, a phenomenon we refer to as the Bretton Woods "gold puzzle". But the motivations behind this behavior have remained somewhat of a mystery (Kenen 1963, Machlup 1964, Gilbert 1968, Williamson 1973, Bordo & Eichengreen 1998). Banknotes were no longer legally redeemable in gold at the central bank under Bretton Woods. Therefore, contrary to the classical (1880s-1914) and interwar gold standard, the Bretton Woods system did not impose that central banks tie their hands by backing notes issuance with gold reserves. Only the USA committed to convert dollars in gold on demand from other central banks. In fact, since the yield on reserves in dollars (US government securities) was always positive, holding gold reserves was costly for non-US countries. Overall, holding gold was neither legally necessary nor economically sensible. So why did monetary authorities around the world hold gold?

This paper casts a new light on that question using a new comprehensive dataset on gold reserves and macroeconomic statistics for a large set of countries assembled using the IMF archives. We highlight two key findings. First, the amount of gold that countries accumulated under Bretton Woods was still connected to their domestic money supply (currency in circulation), even after accounting for all other potential accumulation motives. Second the intensity with which they did so was a function of their past exposure to the gold standard, before WWII. We show that

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[2] Some countries did not have a central bank, implying that the Treasury was the "monetary authority". In some countries, the management of foreign reserves was performed by the central bank on behalf of the Treasury. In the remainder of the paper, we refer interchangeably to central banks and monetary authorities.

monetary authorities which had been exposed to the gold standard were much more likely to back their currency in circulation by gold reserves under Bretton Woods than others. We also find that this result holds among countries that experienced the gold standard: the longer they had been on the gold standard before the war, the higher the correlation between their gold holdings and currency in circulation. We interpret this finding as evidence of memory shaping monetary practices. The magnitude of this "memory" effect is also large: according to our estimations, countries which had adhered to both classical and interwar gold standards continued to back between 40% and 50% of every unit of currency issued with gold; thereby using a cover ratio almost identical to those in effect during the gold standard.

We also investigate how the (old) habits of the gold standard transmitted over time and affected monetary policy decisions decades later. We explore two hypotheses. The first is that institutions themselves have a memory, which in turns pushes policymakers to behave like in the past. This "institutional memory" hypothesis is consistent with historical studies that have shown the importance of a gold standard culture in interwar central banks (Eichengreen & Temin 2000, Mouré 2002) and, more generally, the importance of corporate culture and organization's history for the making of monetary policy (James 1985, Capie 2010, Monnet 2018). The second - the "individual memory" hypothesis - is that the personal experience of central bankers matters (Malmendier et al. 2017, Bordo & Istrefi 2018). In that case, an older central banker is more likely to behave like in the gold standard simply because his formative years happened during the gold standard. Think for example about governors in place in the early 50's but born in the 1880s or 1890s (as in Germany, Austria, Mexico, Switzerland or Belgium in the 1950s). They are old enough to remember the stability of the pre-WWI gold standard and were likely to be involved (or to be observers) during the attempts at restoring the gold standard in the 1920s. For them, the failure of the gold standard in the early 1930s looked like the exception, rather than the norm. By contrast, the central bankers born in the 1910s (Greece, Finland, Norway, Sweden etc., in the 1950s) either never worked under the gold standard or had their first professional experience took place when the interwar gold standard was collapsing. They are less likely to associate the gold standard with periods of economic stability and to look at gold for an anchor of monetary policy.

Using the number of years institutions spent under a gold standard and the age of central bank governors to proxy for both channels (respectively), we find that personal experience of governors mattered. The older the governor of the central bank, the higher the correlation between

currency in circulation and gold reserves. More importantly, this "individual memory" effect does not disappear when confronted to proxies of "institutional memory". In fact, in many instances, we find that the age of the governor tends to dominate our "institutional memory" proxies, suggesting an independent (and strong) effect of personal experience in addition to the effect of corporate or institutional culture.

From an academic perspective, the paper makes two important contributions. First, to our knowledge, we are the first to explore, in a rigorous manner, the determinants of reserve holding (gold or foreign exchange) between 1950 and 1970. Past studies of foreign reserve holding conducted in the 1960s and 1970s were based on limited statistical evidence and very short samples. In contrast, recent historical studies on international reserves holding do not include data on Bretton Woods and usually start in the late 1970s. This paper finally bridges this gap and, in doing so, challenges the conventional wisdom regarding reserve accumulations during Bretton Woods. In particular, our findings clearly show that reserve accumulation in that period was not purely "trade-based"; a common starting point in the literature (Obstfeld et al. 2010).

Second, it provides new evidence on the macroeconomic effects of corporate culture and individual experience of policymakers. The persistence of gold standard practices is consistent with behavioral models arguing that decision makers do not consider all the information available to them but overemphasize the information their minds focus on (Gennaioli & Schleifer 2010; Bordalo et al. 2012). In search for an anchor, central bankers under Bretton Woods overemphasized how gold reserves guaranteed the soundness of domestic money (Kriz 1959). In the behavioral finance context (e.g Malmendier and Nagel (2011, 2015) and Koudijs and Voth (2016)), it means that the portfolio of central banks was shaped by experience rather than by rational financial arbitrage between gold and US Treasury bills, the main vehicle for foreign exchange reserves. It is also consistent with empirical findings on the role of personal experience of an organization's leader on organizational outcomes – as emphasized by Malmendier et al. (2011), Benmelech & Frydman (2015), Bernile et al. (2017) about CEOs of corporations, and by Malmendier et al. (2017) and Bordo & Istrefi (2018) about the board members of the US Federal reserve. We add new findings to this growing literature on the effect of personal culture on management by distinguishing between the experience of the policymakers on one hand and the history of the organization on the other hand. We show that both mattered and they had a separate effect.

This paper also has important implications for the past (and current) design of the financial system. Writing during the Bretton Woods period, some prominent economists considered the possibility that central banks would tie domestic money to gold reserves but they quickly dismissed this hypothesis on the basis that such practices, inherited from the gold standard, would have been "naïve, obsolete and primitive" (Machlup, 1966, p.190-191) or "an irrational act based on traditional superstitions" (Williamson, 1973, p.689).[3] Contemporaries showed too much optimism about the disappearance of old habits, and that those old habits prevented the Bretton Woods system to function as intended. Given the intensity of the memory effect we identify, it was impossible that the Bretton Woods system would work as expected by its founders; a point we discuss further in Section V. More generally our results are connected to recent studies discussing the historical and current role of a safe reserve asset in the international monetary system (Eichengreen, Mehl and Chitu 2017, Farhi and Maggiori 2017).

The remainder of this paper is constructed as follows. Section I presents the postwar Bretton Woods system, and explains in what respect it differed from the pre-WWII classical and interwar gold standards. It also highlights the puzzling resurgence of gold reserves after 1950. Section II presents the data and econometric framework, and preliminary results regarding the positive correlation between gold reserves and currency. Section III explores the role of institutional and personal memory behind this correlation. Robustness checks are performed in Section IV. Section V discusses the broader policy implications of our results, and in particular their consequences for the international monetary system. Section VI concludes.

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[3] The full quote is "it is of course possible that countries may actually determine their reserve holdings with reference to their money supplies even if this is an irrational act based on traditional superstitions, but there is no persuasive evidence that they do." (Williamson, 1973, p.689)

I- Gold and the Bretton Woods system

The agreement

The Bretton Woods System was created by the 1944 Articles of Agreement to design a new international monetary order at a multilateral conference held in Bretton Woods (USA) from July 1st to July 22nd, 1944.[4] The Articles of agreement were eventually ratified in December 1945 and the system started to be implemented after the conference of Savannah in March 1946. The new international monetary system departed from the pre-WWI gold standard and the interwar gold exchange standard in four ways (Bordo and Eichengreen 1998). First, controls on the capital and on the current accounts were officially allowed to avoid destabilizing international movements of funds. Second, the International Monetary Fund (IMF) was created, in charge of providing short-term liquidity to domestic monetary authorities when needed and providing surveillance of national policies to avoid destabilizing balance of payments imbalances. Third, pegged exchange rate could be adjusted, under authorization of the IMF, in case of fundamental disequilibrium. Fixed exchange rates were no longer defined in terms of gold parity but in terms of dollars. Only the US dollar was defined as convertible into gold at $35 per ounce. Fourth – and most important for the purpose of this article – gold coinage as well as the commitment of central banks (or the Treasury in countries without a central bank) to redeem banknotes in gold was abandoned everywhere in the world.[5] It meant that, in principle, monetary authorities were no longer required to back currency in circulation by gold reserves in order to maintain the credibility of their currency in the eyes of the public.[6] The interwar gold standard had already limited the redeemability of notes at the central banks to bullion instead of coins, thus discouraging private holding of gold but without legally breaking the link between gold and money. In 1944, the Bretton Woods system finished to break that link.

Of course, gold had not been completely abandoned and remained the final means of settlement between the monetary authorities of the main trading nations.[7] The United States –

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[4] See Bordo (1993, 2017) and James (1996) for a description of the operations and key issues of the system. See Bordo & Eichengreen (1993), Schuler and Rosenberg (2012), Helleiner (2014) and Scott-Smith and Rofe (2017) for more detailed accounts of the conference and the subsequent events.

[5] Strong limits were also imposed on gold holding and gold transactions by citizens and firms. Some countries, like the US and the UK, forbade private holding of gold entirely (Kriz 1959).

[6] A few countries however maintained a legal ratio (Aufricht 1967, Bordo & Eichengreen 1998). See discussion below.

[7] In practice, most of the settlements were made in foreign currencies - the dollar mostly and, to a minor extent, the pound sterling.

which kept more than 90% of gold reserves held in the world by monetary authorities after the war – was in favor of maintaining an international role for gold but even Keynes – author of the English plan at the Bretton Woods conference – advised to "continue to use gold and its prestige as a means of settling international accounts".[8] In the end, gold received only two official roles. First, the United States should be prepared to exchange gold for dollars when requested by other central banks. Second, IMF member countries could pay their subscription to IMF in gold (but this was not mandatory).

The gold puzzle

"The United States must hold its reserves essentially in gold […] while other countries are free to hold their reserves in any combination of gold and dollars they wish, including 100 percent in dollars" (Gilbert 1968, p.4). As suggested by this quote from the economic adviser of the Bank of International Settlements, central banks outside the US were not required to hold gold. Holding only foreign exchange was entirely consistent with the functioning and rules of Bretton Woods. The secondary role of gold under the Bretton Woods system was such, outside the United States, that the appropriate level of gold reserves by central banks – i.e. the level ensuring the proper functioning of the international monetary system – was never defined or even discussed. In fact, since the yield on reserves in dollars (US government securities) was always positive, holding gold reserves was costly for non-US countries. Overall, holding gold was neither legally necessary nor economically sensible.

This situation was in sharp contrast with the classical and interwar gold standard, during which countries complied with a *de facto* or *de jure* cover ratio. The cover ratio expressed the amount of gold reserves that the central bank (or the Treasury) had to keep in its balance sheet as a function of the currency in circulation (notes and coins). The *de facto* ratio was often more important than *de jure* requirement as the latter only provided a minimum (Morys 2013). Some countries (prominently France, the main holder of gold before WWII together with the USA), did not have a *de jure* cover ratio under the gold standard (Bazot, Bordo & Monnet 2016).

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[8] Speech by Lord Keynes on the International Monetary Fund debate, May 23, 1944. *Hansard Parliamentary Debates,* House of Lords, 5th Series, Vol. CXXXI, Cols. 838-49.

Although gold was dead in theory, it remained alive in practice. Looking at cross-country reserve data between 1950 and 1970, two key facts emerge. First, the total amount of gold held by foreign monetary authorities increased throughout Bretton Woods. Starting the mid-1950s, the demand for gold by non-US monetary authorities started to put pressure on the US gold stock. As shown on Figure 1, this trend accelerated starting 1958-1959 when most countries started to open their current account and make their currency fully convertible (Bordo 1993).[9]

FIGURE 1: GOLD AND INTERNATIONAL RESERVES, 1950-1971 (BILLION OF $)
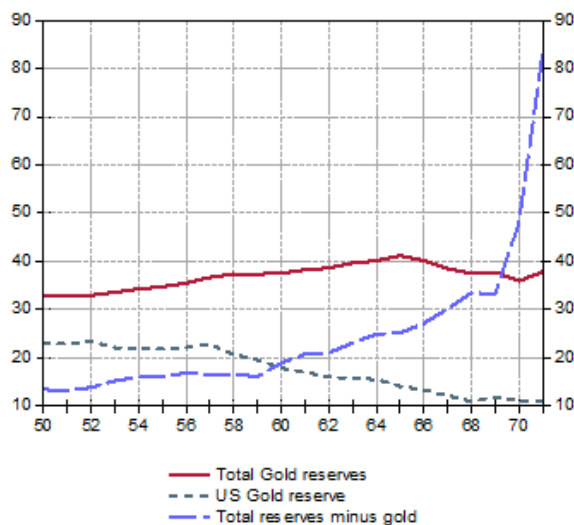

Source: International Financial Statistics

Second, and more importantly, we find that countries that started with a lower gold ratio at the beginning of the period increased it over time, showing in fact a desire to "catch up". Figure 2 shows a negative relationship between the cover ratio in 1950 – when countries entered Bretton Woods – and the growth rate of the cover ratio from 1950 to 1970. Only a few countries, which had inherited a very high ratio after the war because their gold reserves had been unaffected, reduced their ratios (Switzerland, Great Britain, South Africa, Canada etc.). Again, one should not underestimate how this simple fact runs counter to Bretton Woods' common intuition. Increasing the cover ratio or keeping it stable meant that countries had to buy gold to keep up with the

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[9] Although central banks had little opportunity to buy gold in 1944 - except at the US gold window - it changed when the London gold market reopened in 1954 (Kriz 1959, Kenen 1963, Bordo et al. 2017). It was then easier for central banks to replenish their gold stocks if they wanted to.

unavoidable increase in their monetary base over time. If the new Bretton Woods system had really stopped ancient practices, cover ratios should have converged towards very low values over the period. The correlation on Figure 2 suggests that the reconstruction of the gold stock was not a purely idiosyncratic process, but that it was indeed motivated by considerations concerning the cover ratio. We explore this hypothesis more formally in sections II and III.

FIGURE 2: CATCHING-UP. THE EVOLUTION OF COVER RATIOS OVER TIME (1950-1970)
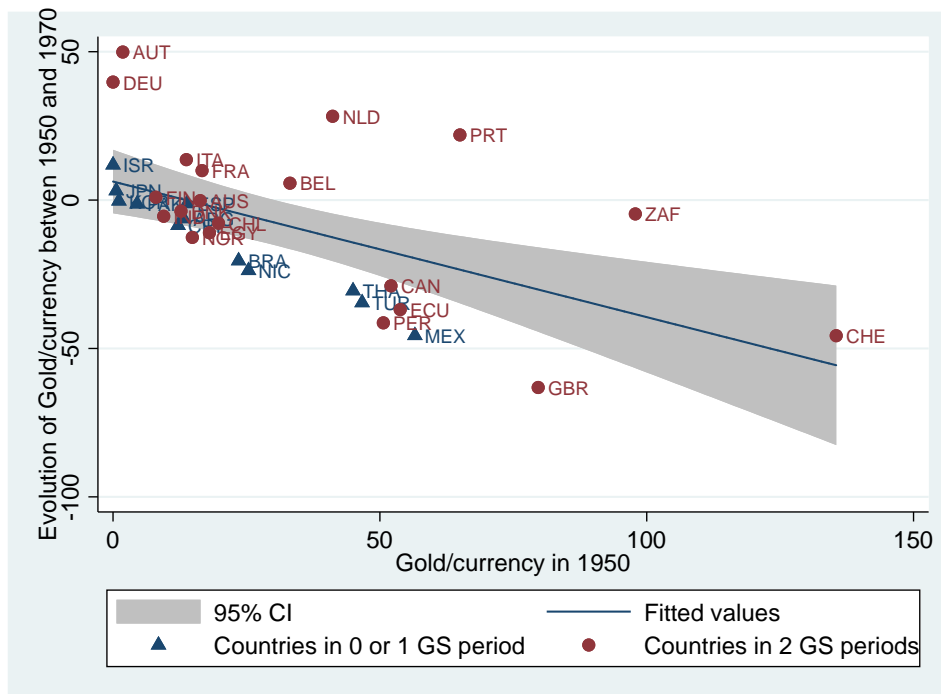
Note: Uruguay and Ireland are excluded from the graph because they cover ratio is not available in 1950. Red dots indicate countries that participated in both Gold Standard periods (the pre-WWI Gold Standard and the interwar Gold Standard). Blue triangles indicate countries that knew only one (or none)

Potential motives for gold holding

Why would monetary authorities keep accumulating gold? Some policymakers (Holtrop 1957, 1963) and bankers (Kriz 1959) suggested in their writings that a link between gold and the domestic money base survived because central bankers were in need for an anchor for monetary policy. In the uncertain postwar world, such an anchor was found in past practices: an increasing ratio of money supply to gold (or foreign exchange) reserves would indicate excessive inflationary pressures. Economists were however reluctant to believe in such "irrational" and "primitive"

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behavior (Machlup (1966) and Williamson (1973)).[10] As a result, none of the studies on foreign reserves holding under Bretton Woods investigated the potential link between gold and domestic currency (see Grubel 1971, IMF 1971, Williamson 1973, Cohen 1975 for surveys of this literature).

The most common explanation for the increase in gold holdings by other central banks was the loss of credibility of the US dollar over time, especially in the 1960s due to the increase in military spending caused by the Vietnam War and the absence of US national stabilization policies (Bordo, Monnet and Naef 2017). Expectations of a dollar devaluation pushed foreign central banks to acquire more gold to minimize the potential losses that would follow a devaluation (Kenen and Yudin 1965, Gilbert 1968, Officer and Willett 1969, Makin 1971). Such explanation cannot explain however, the uneven distribution and reconstruction of gold holding across countries.

An alternative explanation favored by contemporary economists was that the holding of gold reserves had the same determinants as foreign exchange reserves (despite the opportunity cost of holding reserves), and in particular trade openness (Triffin 1947, 1960; Grubel 1971; Williamson 1973). If central banks could buy gold on the market and if gold was actually used by monetary authorities to settle transactions, trade openness would be the key variable determining the accumulation of gold reserves. However, little evidence of such behavior has been presented so far. Kenen (1963), for example, noted that only foreign exchange reserves behave as working balances and that central banks bought gold when reserves increased, but did not sell gold when reserves decreased.

In the 1960s, gold holding appeared to be driven by political motives (Gilbert 1968). France notoriously converted massive dollar holding in gold at the US gold window in 1965-1966 to express disagreement with the dominant position of the US in the international monetary system (Bordo et al. 2017). On the opposite, the US was using political coercion to limit the purchase of gold by Germany and Japan (Gavin 2004). It led one of the most famous international economist of the times to argue that the only motive of reserve holding (both gold and foreign exchange) was to keep up with other countries and show strong political power (Machlup 1966). More generally, economists and policymakers became convinced that idiosyncratic political motives were the main drivers of gold holding. We challenge such views in the next section.

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[10] After the Second World War, Switzerland and Belgium did not abandon their gold cover ratios (Aufricht 1967). They were set at 1/3 and 40% of notes in circulation respectively. Gilbert (1968, p. 7) notes that "This legal provision is a leftover from the days gold coins were in active circulation and has little relation to present-day conditions". We will show below that other countries followed similar policies, even if they were not constrained by law.

II-   Gold and currency under Bretton Woods

This section explores formally the motives behind gold holdings under Bretton Woods. Past studies of foreign reserve holding conducted in the 1960s and 1970s were based on limited statistical evidence and very short samples.[11] Since then, to our knowledge, no article has attempted to estimate the determinants of foreign reserve holding (gold or foreign exchange) between 1950 and 1970. Modern studies of foreign reserves holding with the longest samples typically do not include data on Bretton Woods and usually start in the late 1970s.[12] However, we build on this recent literature for our empirical framework.

The determinants of reserves holding

Following the standard literature on foreign reserves (Lane & Burke 2001, Rodrik 2006, Aizenman & Lee 2008, Obstfeld et al. 2010), we estimate the following equation:

$$Gold_{i,t} = \alpha + d_t + \beta T_{i,t} + \gamma M_{i,t} + \theta Z_{i,t} + \epsilon_{i,t} \quad (1)$$

where (i) $Gold_{i,t}$ is the level of gold reserves divided by GDP of country i in year t (ii) $T_{i,t}$ denotes the trade openness – measured as exports plus imports over GDP – of country i in year t (iii) $M_{i,t}$ denotes the level of currency in circulation (banknotes and coins) divided by GDP and (iv) $Z_{i,t}$ represents a set of control variables to be discussed below. Finally, d_t represents year-fixed effects and α a constant. We estimate the equation using OLS and cluster standard-errors at the country level.

In what follows, we focus our attention on the γ coefficient, which captures the relationship between gold and currency in circulation. As usual in the literature (e.g. Obstfeld et al. 2010), we compare a pooled panel estimation with a country-fixed effects estimation. The pooled panel is especially useful for further analysis where we try to disentangle the effects of country-specific but

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[11] To our knowledge and according to Williamson (1973), Courchene and Youssef (1967) is the only empirical study that documented a positive correlation between money and foreign reserves for this period. However, evidence was limited to country-by-country correlations between 1960 to 1965, and they did not discuss the hypothesis of currency in circulation being backed by gold reserves. More generally, econometric studies of the time is very limited and regressions, when used, were usually spurious because of unit roots.

[12] These studies typically find a correlation between the total money supply (including deposits) and total foreign reserves (Obstfeld et al. 2010) but not between the money base (currency in circulation) and reserves. Aizenman & Inoue (2013) look at the determinants of gold reserves on the period 1979-2010 and find no correlation between gold reserves and the money supply.

time-invariant variables (Section III). Trade-based accumulation motives would result in a positive β, as shown by recent empirical and theoretical studies of foreign exchange reserves (Rodrik 2006, Aizenman & Lee 2008, Obstfeld et al. 2010, Jeanne & Rancière 2011, Jeanne & Sandri 2016). Idiosyncratic political reasons for holding gold reserves would appear in the residuals rather than in any fundamental determinant of the holding of foreign exchange reserves. In contrast, a positive value of γ, of magnitude close to past cover ratios, would confirm our hypothesis that monetary authorities still behave as in the gold standard.

Control variables

Year-fixed effects capture the potential loss of credibility of the US dollar over-time as well as the yield on foreign exchange reserves (or, put differently, the time-varying opportunity cost of holding gold). Other controls included in $Z_{i,t}$ are in line with the state-of-the-art literature on reserve holding (Lane & Burke 2001, Rodrik 2006, Aizenman & Lee 2008, Obstfeld et al. 2010) which has especially emphasized the importance of (i) current account and capital account openness and (ii) the exchange rate regime. We use the index of capital account liberalization of Quinn and Toyoda (2008).[13] A higher index value (from 0 to 100) stands for a higher capital account openness. To account for exchange rate misalignment and current account openness, we control for current account surplus (as a % of GDP) and the exchange rate premium. If the premium is positive, the exchange rate is overvalued, and devaluation is expected.[14] Another key control is the exchange rate regime. A country with a fixed exchange rate needs more international reserves to defend its peg. We follow here the classification of Reinhart and Rogoff (2004). A lower value of this variable means a harder peg.[15] We also control for the logarithm of population to capture potential effects of the size of the country (proxy for political power) that would not be captured by the size of GDP. Finally, we follow Obstfeld et al. (2010) and control for other forms of money

[13] The index is based on coding the text of IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) since 1950. No *de facto* measure of capital account openness is available for this period.

[14] The premium is the difference between the official exchange rate and the black-market exchange rate in New York (data from Reinhart and Rogoff (2004)). Such an undervaluation can be motivated by mercantilist purposes, with the exchange rate kept undervalued to promote exports (Aizenman and Lee 2008).

[15] The index is a de facto measure which captures how much flexibility was allowed by multiple exchange rates. Under the Bretton Woods period, only Canada managed a free float for several years. Other countries had to maintain their peg within a 2% band. But several countries had multiple exchange rates, especially in the 1950s.

(i.e. deposits). They found that in the post-Bretton Woods period, the holding of foreign reserves correlates with broad money (currency in circulation + deposits) but not with the money base (currency in circulation).[16] By contrast, our hypothesis is that, during Bretton Woods, the holding of foreign reserves correlates with currency in circulation.

Data sources and sample

To perform our estimations, we assemble a new cross country database of reserve, monetary and macroeconomic statistics covering a large set of countries over the whole Bretton Woods period. Although individual series are typically provided by the IMF at an annual frequency, combining them is highly non-trivial because they are not expressed in the same unit; a complication that constrained previous research. For instance, although monetary statistics are expressed in contemporary currency - and change frequently over the Bretton Woods period -, reserves are always expressed in current dollars. Historical GDP data, which are typically taken from the *Penn World Table*, are expressed in today's local currency. To express all nominal values in the same unit (i.e. the domestic currency of 1971) and obtain comparable ratios across countries, we tracked each changes in currency denomination and official exchange rates using paper archives of the *International Financial Statistics* published monthly since 1946. To our knowledge, we are the first to compile a such a database for the Bretton Woods period.

A detailed presentation of sources and construction of variables is presented in the data appendix. The quality of monetary statistics is uneven in the first years of operation of the Bretton Woods system and nominal GDP are available for a limited number of countries in the aftermath of the war. For this reason, our sample starts in 1950. We stop in 1970. We do not include the year 1971 because end of the year data would include the reaction of countries to the closure of the US gold window – the *de facto* end of the Bretton Woods system – in August 1971. We managed to obtain comprehensive data for 38 countries over the period. On average, these countries account for 93% of gold reserves held outside of the United States over the period. Table 4 in the Appendix

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[16] They interpret the first result as evidence of the buffer function of foreign reserves in a globalized world (protecting the domestic banking system against sudden capital outflows), and the second result as the absence of currency board (where monetary authority would back currency in circulation by foreign exchange reserves).

present the sample of countries and descriptive statistics. Overall, our sample includes 729 observations.[17]

Besides macroeconomic and financial statistics, we also compile for each country, several indicators to measure past exposure of central bankers and central banks to the gold standard, namely (i) the number of years in the gold standard (ii) the number of delegates at the Bretton Woods conference and (iii) the age of governors heading central banks over the Bretton Woods period. These variables are presented in Section III. Their sources are described in the appendix. The identity and age of the governors of central banks was reconstructed from a variety of national sources that vary from one country to another.

Money rather than trade

After estimating equation (1), our first key finding emerges. We find that the amount of currency in circulation and gold reserves are strongly positively correlated (Table 1). Without controls, we estimate γ around 0.5 (Table 1, column 1). Interestingly, the coefficient on trade (β) is lower, and becomes insignificant once we add standard controls (Table 1, column 2). Importantly, the significance and size of the currency coefficient is confirmed when introducing country fixed-effects (Table 1, column 3). This is not the case for the coefficient on deposits which turns small and non-significant. In addition, all other control variables have the expected signs (Table 1, columns 2 & 3). Countries accumulate more reserves when they have a larger current account surplus and an undervalued exchange rate (see Aizenman & Lee 2008), when their exchange rates are less flexible (see Obstfeld et al. 2010), when they are more financially open (Rodrik 2006). Indeed, like international reserves in general (and despite the opportunity cost to hold them), gold reserves serve as a buffer against international financial shocks and exchange rate depreciation.

These result contrasts sharply with the results of Obstfeld et al. (2010) over the post-Bretton Woods period, which show that only deposits are positively associated with (foreign exchange) reserves. More importantly, the size of the γ coefficient carries a nice interpretation. We estimate it around 0.3 (between 0.27 and 0.36), which implies that 30% of an additional unit of currency

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[17] For nine additional countries, we collected statistics on money, reserves, trade and GDP but were not able to have all the control variables. Results are similar if these countries are included in the estimations.

was backed by gold reserves. In the gold standard, the average cover ratio (i.e. the ratio of gold reserves to currency in circulation) was around 40%, depending on the period and countries included in the sample (Bordo & Eichengreen 1998, Morys 2013). Although the average cover ratio was lower during Bretton Woods, we find that monetary authorities continued to back their currency with gold using a growth target almost similar to that of the gold standard.

TABLE 1: GOLD AND CURRENCY IN CIRCULATION

Dependent variable: Gold reserves	Pooled Panel. Full sample		Country Fixed Effects. Full sample
	(1)	(2)	(3)
Trade	0.051***	0.000	-0.002
	(0.01)	(0.01)	(0.02)
Currency	0.498***	0.365***	0.271*
	(0.05)	(0.03)	(0.17)
CONTROLS			
Deposits		0.151***	0.007
		(0.02)	(0.06)
XE premium		-0.262	-0.068
		(0.19)	(0.14)
Capital Acc. index		0.025***	0.017*
		(0.00)	(0.01)
Current account		0.096***	0.029
		(0.03)	(0.04)
Peg		-0.109***	-0.058*
		(0.02)	(0.03)
log(pop)		-0.581***	-0.283
		(0.13)	(2.39)
Gold standard		0.722***	
		(0.13)	
R2	0.35	0.60	0.22
N	770	729	729

Note: year-fixed effects are included in all estimations. P-value in parentheses. ***, **, * denote significance at the 1%, 5%, 10% levels.

III-   Institutional memory

Past exposure to the gold standard

The literature in behavioral economics has shown that the decisions of individuals are shaped by previous experience (Malmendier and Nagel 2011, 2015, Koudijs and Voth 2016). We test whether similar mechanisms can be observed for organizations. Our hypothesis is that countries that have been more exposed to the gold standard norms and practices before the Second World War were more likely to follow the gold standard rule of backing their currency by gold reserves during Bretton Woods. To test this hypothesis, we first use a variation of equation (1) and interact the variable "currency in circulation" with a variable capturing exposure to gold standard practices. Our new equation (2) is as follows:

$$Gold_{i,t} = \alpha + d_t + \beta T_{i,t} + \gamma M_{i,t} + \theta Z_{i,t} + \delta GS_i + \tau(GS_i * M_{i,t}) + \epsilon_{i,t} \quad (2)$$

Where all variables have the same definition with the exception of GS_i, which captures the exposure to previous periods of gold standard. As a start, we impose that GS takes the value 1 if a country has been in both the classical gold standard (1880s -1913) and the interwar gold standard (1920s-1936), and zero otherwise. This definition is consistent with the fact that we want to capture full exposure to gold standard norms and practices. As the inter-war gold standard was of short duration (most countries left following England in 1931) and chaotic, it is unlikely that the gold standard's norms were fully integrated during this period in countries which had not been in the classical gold standard before. If a country had been on the classical gold standard (before the First World War) but had not joined again in the inter-war period, there are some reasons to believe that the gold standard's culture had no longer prevailed. Given that the GS is fixed over time, we use a pooled panel estimator, and focus attention on τ.

In column 1 of Table 2, the interaction term τ is positive and significant, and takes a higher value (0.44) than the coefficient on currency in Table 1 (columns 2 & 3). This result is an evidence that backing gold reserves was more pervasive in countries that had been fully exposed to the gold standard before the Second World War. The size of the coefficient (around 0.4) is also in line with the cover ratios of the gold standard. Column 2 shows results when we recode our gold standard variable (GS_i) by setting a value equal to 0 for countries which were not independent before WWII

(colonies and British dominions). The coefficient on the interaction term is slightly higher (0.48 vs. 0.44), suggesting that gold standard norms were more persistent in countries that had full political sovereignty under the gold standard, which are also the ones that experienced more continuity in their political system and administration.

Table 2 reports three additional exercises highlighting the robustness of that baseline result. First, we estimate (2) with country-fixed effects, restricting the sample to countries for which GS equals 1 (thereby excluding countries that never knew the gold standard). The coefficients on currency are significantly higher than in Table 1, column 3, when the full sample is considered (Column 3). Indeed, accounting for country-fixed effects, the relationship between gold and money was higher in countries that had been in the gold standard than in others. Consistent with previous results, the coefficient is also higher (0.56 vs 0.49) when colonies and British Dominions are excluded (Column 4). Second, restricting again attention to countries that have been in the gold standard, we estimate (2) using the number of years spent in the gold standard as a measure of exposure to norms and practices of the past. Once again, we find that the length of the exposure to the gold standard matters for post-WWII behavior (Column 5). The coefficient on the interaction term is also higher when we exclude countries which were not independent before WWII (Column 6).[18] Quantitatively, the coefficient on the interaction term (0.012) implies that 20% of an extra unit of currency would covered by gold in Peru – a country that spent 17 years in the gold standard – against 44% in Portugal – a country that spent 37 years in the gold standard.

Finally, Column 7 in Table 2 performs a "falsification test" using the number of delegates of each country at the 1944 Bretton Woods conference. In opposition to our proxy of "gold standard exposure", this measure can be interpreted as a "Bretton Woods exposure". Countries with a higher number of delegates at the Bretton Woods conference were more active in the design of the new postwar system and its thinking, which was in opposition to the gold standard mentality.[19] In fact, as emphasized by Helleiner (2014) and contributions in Scott-Smith and Rofe (2017), emerging countries from Latin America, Africa and Middle East played a central role at the conference, with a large number of delegates, hoping that the conference would lead to a new order. By contrast,

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[18] Colonies and British dominions (India, Canada, etc.) spent many years in the gold standard under British influence but did not acquire gold standard habits proportional to this experience, compared to countries that already enjoyed full sovereignty.

[19] This reasoning does not apply to the US and the UK, the leaders of the conference. The US is, by construction, excluded from the estimation. We keep the United Kingdom in the estimations, but results are unchanged if excluded.

Continental European countries and Japan – long time adherent to the gold standard and key players of the prewar monetary system – were mostly absent because of the war. Column 7 shows that the interaction term between currency and the number of delegates at the Bretton Woods conference is negative. Countries which had been more involved in the design of Bretton Woods were therefore less likely to behave as in the gold standard.

TABLE 2: INSTITUTIONAL MEMORY.

Gold reserves	Pooled Panel. Full sample	Pooled. Panel. Full sample	Fixed effects. Sample: GS =1	Fixed effects. Sample: GS =1 (colonies excluded)	Pooled panel. Sample: Years in the Gold Standard > 0	Pooled panel. Sample: Years in the Gold Standard > 0	Pooled panel. Full sample.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Trade	-0.028 (0.01)	-0.027* (0.01)	-0.054 (0.04)	-0.045 (0.04)	-0.005 (0.01)	-0.033** (0.01)	0.005 (0.01)
Currency	0.116*** (0.03)	0.157*** (0.03)	0.492** (0.22)	0.556** (0.24)	0.179** (0.07)	-0.125 (0.11)	0.449*** (0.07)
Gold standard	-2.655*** (0.39)						0.701*** (0.13)
Gold standard (excl. non-indep.)		-2.916*** (0.48)					
Currency*Gold Standard	0.443*** (0.05)						
Currency*Gold Standard (excl. non-indep.)		0.486*** (0.06)					
Gold standard (n° of years)					-0.016 (0.01)		
Gold Standard (n°of years ; excl. non-indep.)						-0.030* (0.02)	
Currency*Gold Standard (n°of years)					0.004** (0.00)		
Currency*Gold Standard (n°of years ; excl. non-indep.)						0.012*** (0.00)	
Delegates							0.146* (0.08)
Currency*Delegates							-0.019* (0.01)
Controls	YES	YES	YES	YES	YES	YES	YES
R2	0.64	0.67	0.31	0.42	0.71	0.75	0.66
N	729	629	439	343	633	508	729

Note: year-fixed effects are included in all estimations. P-value in parentheses. ***, **, * denote significance at the 1%, 5%, 10% levels.

Personal experience vs. institutional memory

Our previous results are silent on how the habits and cultural norms of the gold standard actually transmitted over time. One interpretation of our findings is that institutions themselves have a memory, which pushes policymakers to behave like in the past. This "institutional memory" hypothesis would be consistent with historical studies that have shown the importance of a gold standard culture in interwar central banks (Eichengreen & Temin 2000, Mouré 2002) and, more generally, the importance of corporate culture and organization's history for the making of monetary policy (James 1985, Capie 2010, Monnet 2018).

Another possible interpretation of our results - the "individual memory" hypothesis - is that they reflect the importance of personal experience of central bankers (Malmendier et al. 2017, Bordo & Istrefi 2018). In that case, an older central banker is more likely to behave like in the gold standard simply because his formative years happened during the gold standard. Think for example about governors born in the 1880s or 1890s (as in Germany, Austria, Mexico, Switzerland in the 1950s). They are old enough to remember the stability of the pre-WWI gold standard and were likely to be involved (or to be observers) during the attempts at restoring the gold standard in the 1920s. For them, the failure of the gold standard in the early 1930s looked like the exception, rather than the norm. By contrast, the central bankers born in the 1910s (Greece, Finland, Norway, etc., in the 1950s) either never worked under the gold standard or had their first professional experience took place when the interwar gold standard was collapsing. They are less likely to associate the gold standard with periods of economic stability and to look at gold for an anchor of monetary policy.

This possible difference in personal attitude towards gold, and its potential (independent) effect on monetary policy, is well captured by the stark contrast between Mats Lemne (1951-1955), the governor of the Swedish central bank in the early fifties, and Maurice Frère (1944-1957), his counterpart heading the central bank of Belgium. Although both Sweden and Belgium had spent fifty years in the gold standard before the Second World War, the average cover ratio for Sweden under Bretton Woods was 13% compared to 40% in Belgium. How did the two institutions – both heavily exposed to the gold standard in their past – diverged so much in their attitude towards gold? Maurice Frère, born in 1890, studied economics in Brussels under the classical gold standard (from 1908 to 1912), worked for the Belgian administration in the economic office in London, and had an important role as an economic expert working for the Belgian government and the League of

Nations in the war and interwar (Wellens 1976). As such, he was a witness and active participant to the international conferences on war reparations and monetary stabilization (i.e. return to the gold standard) after the First World War, from Genoa (1922) to Lausanne (1932). In the early 1930s, Belgium was also one member of the "gold bloc", that is the few countries that remained in the gold standard even after Britain and the United States left in 1931 and 1933. Belgium devalued in 1935 and left the "gold bloc", but de facto then followed a bullion gold standard, which was abandoned only in 1940 (van der Wee 2012). Frère became the governor of the Bank of Belgium in 1944 and, as such, was a key player in the postwar monetary stabilization. Partly because of a drastic stabilization, the monetary situation of Belgium was better than other European countries in the late 1940s and the central bank opposed the plan of the government to devalue at the same time as other European countries in 1949. According to Maurice Frère (1960), gold reserves were enough to maintain the parity and the government pushed for the devaluation for fiscal reasons only. During these events, the Bank of Belgium clearly expressed a commitment to gold standard practices (Cassiers and Ledent 2006) and the postwar law of the central bank did not abandon the reference to a legal requirement of gold reserves equal to 30% of notes issue (Aufricht 1967). In many respects, Maurice Frère was a man of the gold standard.

In stark contrast, Mats Lemne was a man of Bretton Woods and the postwar order. Born in 1919, he was only five years old when Sweden returned to the gold standard in 1924 and twelve years old when Sweden left the gold standard in 1931 (Straumann et al. 2017). During the 1930s, Sweden adopted an original system of price level targeting – inspired by writings of Knut Wicksell – which was later celebrated for its modernity and flexibility (Jonung 1979, Rathke et al. 2017). Sweden had low gold reserves at that time and acquired a large stock of foreign exchange reserves in order to defend its peg while targeting a domestic objective (Rathke et al. 2017). Contrary to Belgium, the practices of the gold standard already belonged to the past when Mats Lemne became governor of the Riksbank in 1951. While, in Belgium, Maurice Frère epitomized monetary orthodoxy against reluctant governments, Mats Lemne had strong personal links with the postwar Ministry of Finance in Sweden and was appointed to implement credit policies that would be consistent with the economic objectives of the government. According to historians Larsson and Soderberg (2017, p.47) his appointment was "an important factor in the politicization of the Riksbank policy".

Testing formally the "individual memory hypothesis", Table 3, column 1, shows the results when we use equation (2) and interact the age of the governor with currency/GDP. We find a positive and significant interaction, implying that central banks with an older governor had a higher correlation between gold and currency in circulation.[20] These results show that personal experience is indeed a key variable to explain the persistence of habits over time. In columns 2 and 3, we test whether the personal experience of the central bank's governor still matters when we also include the interaction of currency and gold standard exposure in the estimation. We find that both interaction terms matter, although *age*currency* is barely significant (the p-value is 0.13) when the

TABLE 3: PERSONAL EXPERIENCE AND INSTITUTIONAL MEMORY

Gold reserves	Full Sample	Full Sample	Full sample	Sample: Years in the Gold Standard > 0	Sample: Years in the Gold Standard > 0
	(1)	(2)	(3)	(4)	(5)
Trade	-0.001	-0.011	-0.011	0.013	0.013
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Currency	-0.650	-0.501	-0.652	-2.806***	-2.879***
	(0.42)	(0.42)	(0.42)	(0.80)	(0.85)
Gold standard	0.023	-3.862***			
	(0.27)	(0.47)			
Gold standard (excl. non-indep.)			-3.194***		
			(0.61)		
Gold standard (n° of years)				-0.023	
				(0.21)	
Gold standard (n° of years; excl. non-indep.)					0.013
					(0.03)
Age of governor	-0.328***	-0.227***	-0.267***	-0.390***	-0.461***
	(0.00)	(0.05)	(0.06)	(0.11)	(0.11)
Currency*age of governor	0.019**	0.011	0.014**	0.056***	0.056***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Currency*gold standard		0.472***			
		(0.05)			
Currency*Gold standard (excl. non-indep.)			0.432***		
			(0.07)		
Currency*Gold Standard (n°of years)				0.000	
				(0.00)	
Currency*Gold Standard (n°of years; excl. non-indep.)					-0.000
					(0.00)
Controls	YES	YES	YES	YES	YES
R2	0.64	0.67	0.66	0.72	0.76
N	617	617	617	406	322

Note: year-fixed effects are included in all estimations. P-value in parentheses. ***, **, * denote significance at the 1%, 5%, 10% levels.

[20] Since the variable "age" has mechanically a unit root in countries where the governors changed unfrequently, we have used the average age of governors over the period (results are however similar when we use the age for each year).

gold standard exposure of non-independent countries is considered in the same way as for independent countries (column 2). Hence, we observe an independent effect of personal experience in addition to the effect of corporate culture. More striking are the results in columns 4 & 5 when we consider the interaction between currency and the number of years in the gold standard and we restrict the sample to countries that adhered at least a year to the gold standard. In these two specifications, the effect of the number of years spent in the gold standard disappears, whereas the interaction of currency and the age of the governor is significant and takes a much higher value than in the previous estimations (0.056 vs 0.019 in column 1). The difference of practices between countries which had been in the gold standard before World War II is better captured by the age of policymakers than by the number of years they spent in the gold standard. Results are similar if previously non-independent countries are excluded (column 5).

Overall, we find that institutional memory (or corporate culture) and personal experience are not mutually exclusive: even among countries that had been exposed the gold standard, the experience of policymakers has more predictive power than the history of the central bank in the gold standard. Still, our results do not mean that "institutional memory" does not matter. The age of the governor could simply be be associated with other institutional characteristics that we have some difficulties to capture with the number of years. In that case, the fact that the age of the governor tends to dominate our "institutional memory" proxies might simply reflect other effects of corporate culture which are not captured by the length of the gold standard experience. Yet, even if it is the case, it is still fully consistent with our argument that memory matters, in one form of the other, to shape current policies.

IV-   Extensions and Robustness

Alternative dependent variables

The results of the previous section have shown that monetary authorities continued to use gold to back currency in circulation, and that they were more likely to do so if they had been in the gold standard before. Was it specific to gold reserves? Can we interpret our results in terms of a portfolio choice? Estimations in Table 4 address this question. We still find a significant and positive – but smaller – coefficient on currency/GDP when non-gold reserves (i.e foreign exchange) are the dependent variable. However, it is not robust if we include country-fixed effects

(Table 4, column 8). Accordingly, we find a strong, significant and robust coefficient on currency/GDP when the share of gold in total foreign reserves (*goldshare*) is used as the dependent variable (Table 4, columns 5-6, 9). In the pooled panel, the interaction term of *gold standard exposure*currency* is also positive and significant (column 6). Monetary authorities did not treat gold and foreign exchange reserves in the same way. The allocation between the two forms of reserves was not driven by financial motives but by the persistence of past behavior. We discuss in Section V the consequences of such allocation for the international monetary system.

Reverse causality and sterilization

As emphasized in Obstfeld et al. (2010), there could be reverse causality between reserves and currency in circulation if there is incomplete sterilization (although the authors provide convincing evidence that it is not a problem in their post Bretton Woods sample). Heller (1976) and Genberg & Swoboda (1993) already discussed this potential endogeneity bias. A country may increase its money supply to buy reserves. If this is not fully sterilized, it will create a positive correlation between foreign reserves and currency. Sterilization of foreign exchange interventions is and was a common practice of central banks (see for example Obstfeld 1983) because they usually wanted to avoid that the size of their balance sheet and the money supply were determined by the exchange rate. But we cannot rule out the possibility that it was incomplete. The reverse causality issue, however, is more likely to be severe at higher frequencies (monthly, quarterly) when full sterilization is not always possible. A significant reverse causality bias at the annual frequency would mean that countries allowed their domestic money supply to be mainly influenced by their exchange rate policy. If it were the case, controlling for current account surplus and exchange rate misalignment (exchange rate premium) would lower the potential omitted variable bias.

More importantly, simultaneity issues due to imperfect sterilization are more likely to be a concern for foreign exchange reserves because central banks did not use gold to intervene on foreign exchange markets (because, as explained in section I, gold could only be traded to settle transactions between central banks).[21] If there is an inflow of capital, banks would obtain foreign currency that they can exchange at the central bank against domestic currency. In this case, there

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[21] The only exception were interventions to stabilize the dollar price of gold on the London gold market (Bordo et al. 2017).

will be an increase in the foreign exchange assets of the central bank and, if it is not sterilized, a simultaneous increase in domestic currency in circulation. Since gold was not used as a means of payment for private commercial and financial transactions, this mechanism does not apply to gold reserves. It is possible that, facing an increase in the domestic money supply due to international capital flows, the monetary authorities decide to increase their gold reserves to back the money supply. This phenomenon is not an endogeneity bias but a deliberate policy of the central bank to back money supply with gold.

TABLE 4: DETERMINANTS OF NON-GOLD RESERVES AND SHARE OF GOLD IN TOTAL RESERVES

	Pooled Panel						Country-Fixed Effects		
	Total Reserves	Total Reserves	Non Gold Reserves	Non Gold Reserves	Goldshare	Goldshare	Total Reserves	Non Gold Reserves	Goldshare
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Trade	0.015	0.015	0.039***	0.042***	-0.215***	-0.233***	0.102**	0.105***	0.111
	(0.01)	(0.01)	(0.01)	(0.01)	(0.08)	(0.08)	(0.04)	(0.02)	(0.26)
Currency	0.504***	0.496***	0.076***	0.272***	1.558***	0.275	0.024	-0.247**	2.269**
	(0.04)	(0.07)	(0.02)	(0.05)	(0.23)	(0.35)	(0.17)	(0.11)	(0.91)
Gold standard	-0.798**	-0.872**	-1.521***	0.603	10.731***	-3.212			
	(0.39)	(0.42)	(0.31)	(0.37)	(1.94)	(3.81)			
Currency*Gold standard		0.119**		-0.077***		0.525**			
		(0.05)		(0.03)		(0.22)			
Controls					YES				
R2	0.55	0.55	0.29	0.32	0.30	0.32	0.35	0.37	0.17
N	729	729	729	729	729	729	729	729	729

Note: year-fixed effects are included in all estimations. P-value in parentheses. ***, **, * denote significance at the 1%, 5%, 10% levels.

V- Implications: New perspectives on the Bretton Woods system

The Bretton Woods system suffered from three key issues, namely (i) a lack of adjustment mechanisms (ii) an insufficient amount of international liquidity and (iii) insufficient confidence in the US dollar (Bordo 1993). The persistence of gold standard practices that we document are directly related to the last two problems and have major implications for the history the international monetary system.

Triffin (1960) famously claimed that the Bretton Woods system was doomed to failure because of a fundamental dilemma (later called the "Triffin dilemma"): expanding the volume of foreign reserves held in dollar would diminish the US credibility, whereas restricting dollar issuance would push the world in a deflationary spiral. It followed from this argument that the fixed gold-dollar parity was unsustainable because the US had to issue too much dollars to follow the expansion of international trade. Triffin's view was challenged by other economists arguing that the system could function with the US keeping a thin film of gold – if US policies were sufficiently credible – as US short-term liabilities financed investment that was beneficial for the world (Despres, Kindleberger & Salant 1966, McKinnon 1969; see Farhi & Maggiori 2017, Bordo & McCauley 2018 for recent discussions of these debates). After the collapse of the Bretton Woods system, it became obvious that the dollar did not need to be backed by gold to remain the leading international currency. Triffin's view was in fact still very much rooted in the gold (exchange) standard's mind. His argument that a shortage of dollars would push the world into deflation was shaped by the view that money issuance needed to be backed by foreign exchange reserves (if not only gold). His idea that the increase of the ratio of dollars to US gold reserves would undermine the confidence in the dollar relied on the gold standard's vision that a currency would not be accepted internationally without being sufficiently backed by a large gold stock. Triffin may have been wrong in theory, but he was very influential and definitely not alone to believe in the relationship between gold reserves and confidence in currency. This belief actually contributed to the third problem of the Bretton Woods system: confidence in the dollar. Despres, Kindleberger & Salant (1966), McKinnon (1969) were probably right to state that the credibility of the dollar peg to gold should not depend on the ratio between dollars and the US gold reserves. However, as described in the previous section, foreign monetary authorities were not ready to give up references to the gold standard' norms and references. The Bretton Woods agreement had resulted in major institutional change for the international monetary system and had limited the role of gold to a very narrow function. However, since the reference to gold was not completely abolished, other countries still used gold as an anchor for their domestic policy, although they did not have to. It is only after the link between the dollar and US gold reserves was abandoned in August 1971 (and that world inflation made impossible for gold supply to follow the expansion of the money base in the subsequent years) that the practices of the gold standard eventually disappeared. Figure 4 shows that the five-year rolling correlation between gold reserves (over GDP) and currency (over GDP)

immediately plunged after the closing of the US gold window in 1971, soon approaching an insignificant level. Figure 4 displays results for countries with GS=1, and results are similar for the full sample.

FIGURE 3: FIVE-YEAR ROLLING WINDOW. CORRELATION BETWEEN CURRENCY-TO-GDP AND GOLD-TO-GDP (1950-1973)
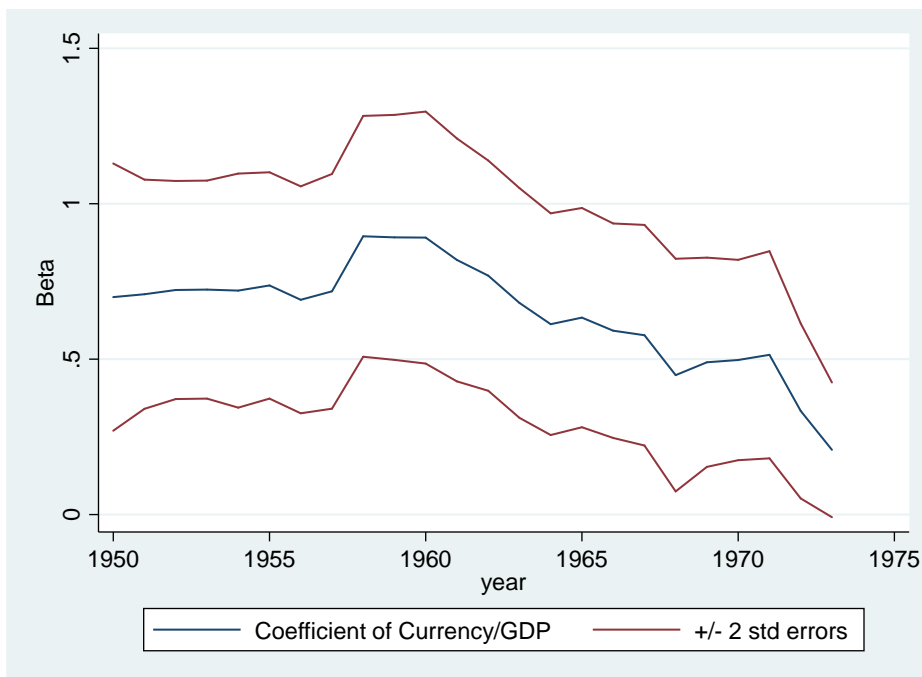
Note: Pooled Panel. Sample if restricted to countries which have been in both the classical and interwar gold standards.

The evidence presented in this paper also suggests that the end of the Bretton Woods system in 1971 might have been more destabilizing than what is usually thought for central banks around the world, which had previously continued to manage their gold reserves in function of their money supply. Perfect substitutability between dollar and gold was never a feature of the Bretton Woods system, despite the original intentions of its founders and despite numerous schemes of central bank cooperation designed to keep the dollar price of gold under the period (James 1996, Schenk 2010, Bordo, Monnet and Naef 2017).

This does not mean however that our results should be interpreted in a purely deterministic way. Central bank habits do not persist independently of the historical context. Countries did not expressed willingness that the world goes back to the gold standard, although they referred to past behavior to guide their current domestic policy. It is easy to conjecture, for example, that such practices could have disappeared if the US did not have been required to hold gold reserves by the

Bretton Woods agreement, or if, the US policies had been fully credible in the 1960s such that the international role of the dollar could have been maintained without breaking the convertibility of US gold reserves (McKinnon 1969, Bordo and McCauley 2018). In any event, the US obligation to provide gold to other central banks was ultimately the Achilles' heel of the system since it allowed speculative behavior by central banks that did not believe in the credibility of the dollar and wanted to protect their assets against a possible devaluation of the dollar (Officer and Willett 1969, Makin 1971, Eichengreen 2006, Bordo et al. 2017). The devaluation of the dollar finally materialized in 1971, together with the closure of the US gold window.

VI- Conclusion

It is commonly assumed that the history of business or policy organizations shape their current behavior. Past experiences of hyperinflation are used, at least anecdotally, to rationalize the aversion against price instability of central banks. Business history has provided many examples of the strength of corporate culture though case studies (Lipartito 1995, 2008). A recent literature in corporate finance gives statistical evidence that managerial traits relate to corporate outcomes (Malmendier et al. 2011, Benmelech & Frydman 2015, Bernile et al. 2017). However, quantitative evidence on the macroeconomic effects of corporate culture and experience of policymakers is missing.

This paper argues that the postwar international monetary system would have functioned differently if monetary authorities had not followed practices inherited from their past. Central banks under Bretton Woods still tied their hands by backing money supply with gold reserves (although devaluation remained an option, contrary to the gold standard). This is consistent with some accounts of contemporary central bankers (Holtrop 1957, 1963) as well as with some recent research which has shown that – contrary to a widely held view – inflation stabilization was a key objective of central bank in the 1950s and 1960s, well before the Great Inflation of the 1970s (Romer and Romer 2002, Monnet 2014, 2018). Thus, this paper reopens the debate about the potential impact of the end of the Bretton Woods system on monetary policy in the 1970s. More generally, it calls for further research on how history of central banks still shape their current monetary policy.

Data appendix

We use standard and well-established data sources for control variables, GDP and trade. All data are annual. The foreign reserve data (gold and non-gold) are taken from *International Financial Statistics* (IFS) published by the International Monetary Fund. According to the Bretton Woods agreement, countries had to provide such data to the IMF. The IMF was in charge of building a coherent and harmonized definition of foreign reserves across countries. Data include reserves of all monetary authorities (central bank, Treasury and any other parastatal organization which had a role in foreign exchange intervention on the behalf of the State). [22] Monetary statistics are also from IFS. As for foreign reserves, countries had to send such data to the IMF. These data were also published in Mitchell (2013) with the distinction between banknotes (i.e. currency in circulation) and total M1 (banknotes, short-term deposits with the central bank and other monetary institutions). Given data limitations for the Bretton Woods period, we use M1 instead of M2. M1 does not include long-term deposits.

A tedious task has been to convert all nominal values in the domestic currency of 1971, such that we can have comparable ratios across countries. Since foreign reserves were expressed in dollar, we have used exchange rates from IMF statistics (end of the year) to convert them. Monetary statistics are expressed in the domestic currency of the contemporaneous year (in numerous countries, the currency has changed over time). Nominal GDP and trade data from Penn World Table are expressed in domestic currency of 2014. To obtain comparable values, we track changes in currency denomination using paper volumes of the *International Financial Statistics* published monthly since 1946, and converted all values in the domestic currency of 1971.

Measure of central bank past exposure to the gold standard - adherence to the classical or interwar gold standard or – as a robustness check – number of years in the gold standard - are taken from Eichengreen (1992), Officer (2008), Mitchener & Weidenmier (2015). Pre-WWII cover ratios were taken from the *Statistical Yearbooks* of the League of Nations. The number of delegates per country at the Bretton Woods conference is available is the transcripts of the conference published in Schuler, K., & Rosenberg, A. (Eds.). (2012). The Bretton Woods Transcripts. *Center for*

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[22] Kenen (1964) and Naef (2017) highlight that some countries used various techniques to misreport their holding of foreign exchange reserves (although such practice should have led to IMF sanctions). As far as we are aware, such misreporting happened only for foreign exchange. For instance, the Bank of England would report a higher level of foreign exchange by swapping dollars with the US Federal Reserve days before the publication of its balance sheet.

Financial Stability. We have used here a more detailed list established by Kurt Schuler and Mark Bernkopf. Schuler, K., & Bernkopf, M. (2014). "Who was at Bretton Woods. *Center for Financial Stability*." http://www.centerforfinancialstability.org/bw/Who_Was_at_Bretton_Woods.pdf

Data on the age of the governor of the central bank was obtained following a two-step process. First, we look for the name of the ruling governor or president of the central bank for every year in our sample. This information is available on the websites of the central banks. Second, we looked for the biographies of these governors and their birth date. When the information was not available on the website of the central bank, we used Wikipedia and various other sources – depending on the country – such as regional or national Who's Who, monographs on the history of the central bank or genealogical websites containing sufficient biographical information. We found the relevant information for 535 observations only (whereas our benchmark estimation sample includes 729 observations). The information was especially difficult to find in politically unstable countries where the governors of the central banks changed almost every year.

Countries	Years in the gold standard	Years in the gold standard as independent countries	Goldshare (mean, in%)	Reserves/GDP (mean, in %)	Gold Reserves/GDP (mean, in %)	Currency/GDP (mean, in %)
ARG	25	25	41	2	1	9
AUS	63	0	12	7	1	5
AUT	31	31	34	10	4	11
BEL	50	50	66	13	8	20
BOL	11	11	33	2	1	6
BRA	8	8	44	3	1	6
CAN	64	0	38	6	2	5
CHE	43	43	79	26	20	17
CHL	9	9	47	2	1	4
CRI	18	18	14	3	0	5
DEU	52	52	37	6	2	6
DNK	46	46	26	4	1	6
ECU	21	21	42	4	2	5
EGY	36	0	49	10	3	17
ESP	0	0	57	4	2	11
FIN	42	42	17	4	1	4
FRA	46	46	71	4	3	12
GBR	96	96	67	4	3	8
GRC	7	7	21	5	1	8
IND	22	0	28	3	1	11
IRL	99	0	5	19	1	10
ISR	0	0	5	9	1	7
ITA	17	17	48	6	3	11
JPN	20	20	9	4	0	8
KOR	0	0	1	5	0	5
MEX	8	8	33	3	1	4
NIC	17	17	11	3	0	3
NLD	51	51	65	13	9	11
NOR	43	43	14	6	1	10
PAK	22	0	19	5	1	16
PER	17	17	42	4	2	6
PRT	37	37	61	23	14	14
PRY	0	0	4	2	0	6
SWE	50	50	30	4	1	8
THA	0	0	23	15	3	11
TUR	34	34	60	3	1	6
URY	40	40	85	9	7	6
ZAF	64	0	64	7	4	5

BIBLIOGRAPHY

Aizenman J. & Lee L., (2008). "Financial versus Monetary Mercantilism: Long-run View of Large International Reserves Hoarding," The World Economy, Blackwell Publishing, vol. 31(5), pages 593-611, 05

Aizenman, J., & Inoue, K. (2013). Central banks and gold puzzles. *Journal of the Japanese and International Economies*, *28*, 69-90.

Alesina, A., & Fuchs-Schündeln, N. (2007). Goodbye Lenin (or not?): The effect of communism on people's preferences. American Economic Review, 97(4), 1507-1528.

Aufricht, H. (Ed.). (1961). *Central Banking Legislation: A Collection of Central Bank, Monetary, and Banking Laws*, volume 1, International Monetary Fund.

Aufricht, H. (Ed.). (1967). *Central Banking Legislation: A Collection of Central Bank, Monetary, and Banking Laws*, volume 2, International Monetary Fund.

Bazot, G., Bordo, M. D., & Monnet, E. (2016). International shocks and the balance sheet of the Bank of France under the classical gold standard. *Explorations in Economic History*, *62*, 87-107.

Benmelech, E., & Frydman, C. (2015). Military CEOs. *Journal of Financial Economics*, *117*(1), 43-59.

Bernile, G., Bhagwat, V., & Rau, P. R. (2017). What doesn't kill you will only make you more risk-loving: Early-life disasters and CEO behavior. *The Journal of Finance*, *72*(1), 167-206.

Bordalo, P., Gennaioli, N., & Shleifer, A. (2012). Salience theory of choice under risk. *The Quarterly journal of economics*, *127*(3), 1243-1285.

Bordo M.D, (1993), "The Bretton Woods International Monetary System: A Historical Overview", in *A Retrospective on the Bretton Woods System*, edited by Michael D. Bordo and Barry Eichengreen, pp. 3-98. Chicago: University of Chicago Press,

Bordo M. D. & Eichengreen B. ed. (1993), *A Retrospective on the Bretton Woods System*. Chicago: University of Chicago Press.

Bordo M. D. & Eichengreen B. (1998), "The Rise and Fall of a Barbarous Relic: The Role of Gold in the International Monetary System," NBER Working Papers 6436,

Bordo, M. D., & McCauley, R. N. (2018). Triffin: dilemma or myth? (No. w24195). National Bureau of Economic Research.

Bordo, M., Monnet, E., & Naef, A. (2017). The Gold Pool (1961-1968) and the Fall of the Bretton

Woods System. Lessons for Central Bank Cooperation (No. w24016). National Bureau of Economic Research.

Bordo, M. D., & Istrefi, K. (2018). Perceived FOMC: The Making of Hawks, Doves and Swingers (No. w24650). National Bureau of Economic Research.

Bouwman, C. H., & Malmendier, U. (2015). Does a Bank's History Affect Its Risk-Taking?. *American Economic Review*, 105(5), 321-25.

Camerer, C. & Malmendier, U. (2007), "Behavioral economics of organizations" in: P.Diamond and H. Vartiainen (eds.), Behavioral Economics and Its Applications, Princeton University Press.

Capie, F. (2010). *The Bank of England: 1950s to 1979.* Cambridge University Press.

Cassiers, I., & Ledent, P. (2006). "Learning to manage external constraints: Belgian monetary policy during Bretton-Woods era (1944–1971)", IRES Discussion Paper, 2006032.

Cohen, B.J (1975), "International reserves and liquidity", in *International Trade And Finance*, ed. P. B. Kenen, 41, p.1-52. Cambridge: Cambridge University Press.

Courchene, T.J., and G. M. Youssef, (1967), "The demand for international reserves." *The Journal of Political Economy*, 404-413.

Despres, E., Kindleberger, C. P., & Salant, W. S. (1966). *The dollar and world liquidity: a minority view.* Brookings Institution.

Eichengreen B. (2006), *Global Imbalances and the Lessons of Bretton Woods,* Cambridge, MIT Press.

Eichengreen, B., & Temin, P. (2000). The gold standard and the great depression. Contemporary European History, 9(2), 183-207.

Eichengreen, B., Mehl, A., & Chitu, L. (2017). How Global Currencies Work: Past, Present, and Future. Princeton University Press.

Farhi, E., & Maggiori, M. (2017). A Model of the International Monetary System. *The Quarterly Journal of Economics*, 133(1), 295-355.

Frère, M. (1960). La restauration monétaire de la Belgique. *Revue d'économie politique*, 70(6), 82-108.

Genberg, H. & Swoboda A., (1993), "The provision of liquidity in the Bretton Woods system." A Retrospective on the Bretton Woods System: Lessons for International Monetary Reform, ed. M.Bordo & B. Eichengreen, University of Chicago Press, p.269-316.

Gennaioli, N., & Shleifer, A. (2010). What comes to mind. *The Quarterly journal of economics*,

125(4), 1399-1433.

Gilbert, M. (1968). The Gold-Dollar system: conditions of equilibrium and the price of gold (Vol. 70). International Finance Section, Princeton University.

Grubel, H.G (1971), "The demand for international reserves: a critical review of the literature." Journal of Economic Literature, 9.4: 1148-1166.

Helleiner, E. (2014). *Forgotten foundations of Bretton Woods: International development and the making of the postwar order*. Cornell University Press.

Heller, H.R. (1976). "International Reserves and World-Wide Inflation." Staff Papers-International Monetary Fund, 61-87.

Holtrop, M.W. (1957), "Method of monetary analysis used by de Nederlandsche Bank." Staff Papers-International Monetary Fund 5.3,: 303-316.

Holtrop, M.W. (1963), Monetary policy in an open economy: its objectives, instruments, limitations, and dilemmas. International Finance Section, Department of Economics, Princeton University.

Horsefield, K., ed. (1969). The International Monetary Fund, 1945-1965: Twenty Years of International Monetary Co-Operation. Vol. 3, Documents. Washington, D.C.: International Monetary Fund.

James, H., (1985), *The Reichsbank and Public Finance in Germany, 1924–1933: A Study of the Politics of Economics during the Great Depression* (Schriftenreihe des Instituts für Bankhistorische Forschung, number 5.) Frankfurt a/M: Fritz Knapp

James, H., (1996),, *International Monetary Cooperation Since Bretton Woods*, Washington DC, Oxford University Press et FMI.

Jeanne, O., & Ranciere, R. (2011). The optimal level of international reserves for emerging market countries: a new formula and some applications. *The Economic Journal*, 121(555), 905-930.

Jeanne, O., & Sandri, D. (2016). *Optimal reserves in financially closed economies* (No. w22139). National Bureau of Economic Research.

Jonung, L. (1979). Knut Wicksell's norm of price stabilization and Swedish monetary policy in the 1930's. *Journal of Monetary Economics*, 5(4), 459-496.

International Monetary Fund (IMF), 1971, *International Reserves. Needs and Availability,* Papers and Proceedings. Seminar at the International Monetary Fund, Washington DC.

Kelly, M.G. (1970), "The demand for international reserves." *The American Economic Review* ,

655-667.

Kenen P. B. (1960), " International Liquidity and the Balance of Payments of a Reserve-Currency Country," *Quarterly Journal of Economics,* November.

Kenen, P. B. (1963). Reserve-asset preferences of central banks and stability of the gold-exchange standard (No. 10). International Finance Section, Dept. of Economics, Princeton University.

Kenen, P.B., & Yudin E.B. (1965), "The demand for international reserves." The Review of Economics and Statistics, 242-250.

Koudijs, P., & Voth, H. J. (2016). Leverage and beliefs: personal experience and risk-taking in margin lending. *American Economic Review*, 106(11), 3367-3400.

Kriz, M. A. (1959). *Gold in world monetary affairs today* (No. 34). International Finace Section, Department of Economics and Sociology, Princeton University.

Kriz, M. A. (1967). *Gold: barbarous relic or useful instrument?* (No. 60). International Finance Section, Dept. of Economics, Princeton University.

Larsson, M., & Söderberg, G. (2017). *Finance and the Welfare State: Banking Development and Regulatory Principles in Sweden, 1900–2015*. Springer.

Lipartito, K. (1995). "Culture and the practice of business history". *Business and Economic History*, 1-41.

Lipartito, K. (2008). Business culture. In The Oxford Handbook of Business History.

Lane, Philip R., and Dominic Burke. 2001. "The Empirics of Foreign Reserves." Open Economies review, 12(4): 423–34.

Machlup, F. (1964), "Plans for the Reform of the International Monetary System", Princeton Essays in International Economics. Princeton University, International Finance Section.

Machlup, F. (1966), "The need for monetary reserves." PSL Quarterly Review 19.78.

Makin, John H., 1971, "The composition of international reserve holdings: A problem of choice involving risk.", *American Economic Review*: 818-832.

Malmendier, U., & Nagel, S. (2011). Depression babies: do macroeconomic experiences affect risk taking?. The Quarterly Journal of Economics, 126(1), 373-416.

Malmendier, U., Tate, G., & Yan, J. (2011). Overconfidence and early-life experiences: the effect of managerial traits on corporate financial policies. *The Journal of finance*, 66(5), 1687-1733.

Malmendier, U., & Nagel, S. (2015). Learning from inflation experiences. The Quarterly Journal of Economics, 131(1), 53-87.

Malmendier, U., Nagel, S., & Yan, Z. (2017). ''The making of hawks and doves: Inflation experiences on the FOMC'' (No. w23228). National Bureau of Economic Research.

McKinnon, R. I. (1969). Private and Official International Money: The Case for the Dollar. Princeton Essays in International Economics. Princeton University, International Finance Section.

Mitchener, K. J., & Weidenmier, M. D. (2015). Was the classical gold standard credible on the periphery? Evidence from currency risk. *The Journal of Economic History*, 75(2), 479-511.

Monnet, E. (2018), *Controlling Credit. Central banking and the planned economy in postwar France, 1948-1973*, Cambridge University Press.

Mouré, K. (2002). *The Gold Standard Illusion: France, the Bank of France, and the International Gold Standard, 1914-1939*. Oxford University Press.

Naef, A. (2017). Dirty float or clean intervention? The Bank of England on the foreign exchange market, 1952-72. *University of Cambridge Mimeo*.

Obstfeld, M. (1980), "Sterilization and offsetting capital movements: Evidence from West Germany, 1960-1970." NBER Working paper, n°494

Obstfeld, M. (1993). "The Adjustment Mechanism," in: A Retrospective on the Bretton Woods System: Lessons for International Monetary Reform, ed. M.Bordo & B.Eichengreen, p. 201-268, National Bureau of Economic Research, Inc.

Obstfeld, M., Shambaugh J.C, & Taylor, A.M (2010), "Financial Stability, the Trilemma, and International Reserves." *American Economic Journal: Macroeconomics* 2.2 , 57-94.

Officer, L. H., & Willett T.D, (1969), "Reserve-asset preferences and the confidence problem in the crisis zone." *The Quarterly Journal of Economics*: 688-695.

Officer, L. H. (2008). Gold standard, EH. net encyclopedia. *Whaples R, http://eh. net/encyclopedia/article/officer. gold. standard*.

Penn Word Table: Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer (2013), "The Next Generation of the Penn World Table" available for download at www.ggdc.net/pwt

Quinn, D. P. & Toyoda A.M. (2008). "Does Capital Account Liberalization Lead to Economic Growth?", Review of Financial Studies, 21(3):1403-1449.

Rathke, A., Straumann, T., & Woitek, U. (2017). Overvalued: Swedish monetary policy in the 1930s. *International Economic Review*, 58(4), 1355-1369.

Reinhart C.M. & Rogoff K.S (2004). "The Modern History of Exchange Rate Arrangements: A

Reinterpretation," The Quarterly Journal of Economics, , vol. 119(1), pages 1-48, February.

Rodrik, D. (2006). "The Social Cost of Foreign Exchange Reserves." International Economic Journal, 20(3): 253–66

Rowlinson, M., & Procter, S. (1999). Organizational culture and business history. Organization Studies, 20(3), 369-396.

Schenk, C. R. (2010). The decline of sterling: managing the retreat of an international currency, 1945–1992. Cambridge University Press.

Scott-Smith, G., & Rofe, J. S. (Eds.). (2017). *Global Perspectives on the Bretton Woods Conference and the Post-War World Order*. Springer.

Singleton, J., & Schenk, C. R. (2015). The shift from sterling to the dollar, 1965–76: evidence from Australia and New Zealand. *The Economic History Review*, 68(4), 1154-1176.

Straumann, T. (2010). *Fixed ideas of money: Small states and exchange rate regimes in twentieth-century Europe*. Cambridge University Press.

Straumann, T., Kugler, P., & Weber, F. (2017). How the German crisis of 1931 swept across Europe: a comparative view from Stockholm. *The Economic History Review*, 70(1), 224-247.

Triffin, R. (1947), "National central banking and the international economy", Board of Governors, Federal Reserve System.

Triffin, R. (1960). *Gold and the Dollar Crisis*. New Haven, Conn.: Yale University Press.

Van der Wee, H. (2012). "Belgian Monetary Policy under the Gold Standard during the Interwar Period". In *The Gold Standard Peripheries* (pp. 130-144). Palgrave Macmillan, London.

Wellens, R. (1976). Inventaire des papiers de Maurice Frère, gouverneur de la Banque nationale de Belgique. Archives générales du Royaume de Belgique.

Williamson, J. (1973) "Surveys in applied economics: International liquidity". *Economic Journal* 83(September):685-746