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BANKS AND THE BRETTON WOODS
GOLD PUZZLE.**

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DO OLD HABITS DIE HARD? CENTRAL BANKS AND THE BRETTON WOODS GOLD PUZZLE.

Abstract

We assess the importance of individual and institutional experience in shaping macroeconomic policy by studying the persistence of gold standard monetary practices in the Bretton Woods system. Using new historical data from the IMF, we show that, although they were not required to, countries continued to back currency in circulation with gold. The longer an institution had spent in the gold standard before 1944 (and the older the policymakers), the tighter the link between gold and currency during Bretton Woods. Such “old habits” prevented dollars and gold from working as perfect substitutes and ultimately contributed to the demise of the Bretton Woods system. Our findings highlight the persistence of past practices, even in the face of radical institutional change, and its consequences on the international monetary system.

JEL Classification: N10, D83, E52, F33, M1

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Can the persistence of past practices and norms lead to unexpected macroeconomic policy consequences? Several recent articles in the field of behavioural economics have pointed out that past behaviours and experiences of individuals are strong determinants of their current economic practices and beliefs (Bertrand & Schoar 2003, Alesina & Fuchs-Schuendeln 2007, Malmendier & Nagel 2011, 2015, Koudijs & Voth 2016). This literature has focused on individual decisions but also points to institutional memory as a key area for future research (Camerer & Malmendier 2007, Bouwman & Malmendier 2015). Can the past experience of organizations explain their current strategy or policy? Is this a valid issue for macroeconomics?

With such questions in mind, this paper studies how gold standard 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 Bretton Woods agreement in 1944 were supposed to have eliminated them.¹ After the war, non-US central banks started to rebuild their gold stock, a move that was largely unanticipated by the founders of the Bretton Woods system. This phenomenon, which we refer to as the Bretton Woods “gold puzzle”, undermined confidence in the fixed gold-dollar exchange rate, pushed the US to suspend gold convertibility in 1971 and ultimately led to the demise of the Bretton Woods system; an event that is viewed as a key turning point in the history of international monetary affairs (Bordo 1993, Bordo & Eichengreen 1998, Obstfeld & Taylor 2004, Farhi & Maggiori 2017, Ilzetzki, Reinhart & Rogoff 2019). But the motivations behind the continued accumulation of gold reserves have remained somewhat of a mystery.² Under Bretton Woods, banknotes were no longer legally redeemable in gold at the central bank. Therefore, contrary to the classical (1880s-1914) and interwar gold standard, the Bretton Woods system did not require central banks to tie their hands by backing the issuing of banknotes with gold reserves. Only the USA – the anchor of the system – committed to convert dollars into gold on demand from other central banks (Bordo, Humpage & Schwartz 2015, p. 121).³ Moreover, since the yield on reserves in dollars (i.e. US government securities) was always

¹ 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.

² Kenen (1963), Machlup (1964), Gilbert (1968), Williamson (1973), Bordo & Eichengreen (1998).

³ According to the Articles of Agreement of the International Monetary Fund signed at Bretton Woods (22 July 1944), “the par value of the currency of each member shall be expressed in terms of gold as a common denominator or in terms of the United States dollar (Article IV, Section 1)”.

positive, holding gold reserves was costly for non-US countries. So why did monetary authorities around the world hold gold?

We cast a new light on that question using a new comprehensive dataset on foreign reserves and macroeconomic statistics for a large set of countries, assembled using the IMF archives.⁴ 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. Monetary authorities that had adhered to the gold standard were much more likely to back their currency in circulation under Bretton Woods than others. Even among countries which had been exposed to the gold standard, we find that the longer they had been on the gold standard before the war, the tighter the link between their gold holdings and currency in circulation. These results hold when we use gold reserves (as a % of GDP) or the gold share (i.e. gold reserves over total foreign reserves) as dependent variables.⁵ The magnitude of this “memory” effect is also large. The coefficient attached to currency in circulation (as a % of GDP) when the gold share is the dependent variable is always strictly above 1, and above 2 when we restrict our attention to within-country variation over time. These coefficients are remarkably similar to the ones estimated over the interwar gold standard (see Appendix II). Estimations with gold reserves as the dependent variable yield very similar results: countries that adhered to both classical and interwar gold standards continued to back between 40% and 50% of every new unit of currency issued with gold, thereby using a *de facto* cover ratio almost identical to those in effect during the gold standard. We interpret this finding as evidence of memory shaping monetary policy and perform several robustness checks to support it. Following Obstfeld et al. (2010), we provide evidence that our findings are not driven by an omitted variable bias or reverse causality issue that would lead to an increase in domestic money following an increase in foreign reserves.

⁴ Our sample represents, on average, 94% of gold reserves held outside the United States over the Bretton Woods era.

⁵ Since this paper focuses on the consequences of gold holding for the Bretton Woods system, we mostly show estimations using the gold share as dependent variable. However, all results are preserved when using gold reserves, expressed as % of GDP. In this case, the relationship between gold reserves and currency in circulation estimated under Bretton Woods is remarkably similar to average cover ratio under the gold standard (40-50%).

We further 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 turn 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 history for the making of monetary policy (James 1985, Capie 2010, Schenk 2010, Straumann 2010, Monnet 2018a).⁶ The second – the “individual memory” hypothesis – is that the personal experience of central bank governors matters (Romer & Romer 2004, Malmendier et al. 2017, Bordo & Istrefi 2018, Mishra & Reshef 2019). In this case, an older central banker is more likely to behave as if in the gold standard because his formative years happened during that period. Governors in place in the early 1950s but born in the 1880s or 1890s, for instance, were old enough to remember the stability of the pre-WWI gold standard and likely to be involved in 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 had their first professional experience when the interwar gold standard was collapsing and were therefore less likely to look at gold as a stable anchor of monetary policy.

Using new data on the identity and age of governors of central banks to proxy for “individual memory”, we find that the personal experience of governors mattered for gold accumulation. Central banks with an older governor were more prone to back currency in circulation with gold. More importantly, this “individual memory” effect does not disappear when confronted with proxies of “institutional memory”. These results suggest an independent (and strong) effect of personal experience in addition to the effect of institutional culture.

Our paper contributes to three different literatures. We first provide new evidence on the importance of corporate and personal history in shaping policy decisions. The persistence of gold standard practices is consistent with behavioural models arguing that decision makers give more weight to the information garnered from their personal experience (Gennaioli & Schleifer 2010). In search of an anchor, central bankers under Bretton Woods overemphasized the extent to which

⁶ Corporate culture, which is close to what Camerer and Malmendier (2007) call “corporate repairs”, is a familiar concept to business historians (Lipartito 1995, Rowlinson & Procter 1999) who have studied the transmission of norms within an organization over time.

gold reserves guaranteed the soundness of domestic money (Kriz, 1959). From a behavioural finance perspective (e.g. Malmendier & Nagel 2011, 2015; Koudijs & Voth 2016), it means that the portfolio of central banks was shaped by experience rather than by rational financial arbitrage between gold and other foreign exchange reserves (mostly US Treasury bills). It is also consistent with empirical findings on the role of the personal experience of leaders on organizational outcomes – as emphasized by Bertrand and Schoar (2003), Malmendier et al. (2011) and Benmelech and Frydman (2015) for CEOs of corporations, and by Romer and Romer (2004), Malmendier et al. (2017) and Bordo and Istrefi (2018) for board members of the US Federal Reserve System. We also distinguish the experience of the policymakers from the history of the organization itself, showing that both can matter and have a separate effect.

Second, this paper explores in a comprehensive manner the determinants of reserve holdings (gold or foreign exchange) during Bretton Woods. Although Eichengreen et al. (2017) and Ilzetzki et al. (2019) examine the evolution of reserve currencies and exchange rate arrangements after 1945, they do not study reserve holdings of individual countries. Studies of cross-country reserve holdings conducted in the 1960s and 1970s were based on limited statistical evidence and very short samples (Williamson 1973), whereas more recent studies do not include data on Bretton Woods and start only in the late 1970s (Obstfeld et al. 2010). This paper finally bridges this gap and, in doing so, challenges the conventional wisdom regarding reserves accumulation during Bretton Woods. In particular, our findings clearly show that demand for gold differed from the demand for foreign exchanges, and that reserves accumulation in that period was not purely “trade-based”; a common starting point in the literature (Williamson 1973, Obstfeld et al. 2010).

Finally, this paper has important implications for the literature on the history and design of the international monetary system. Our results are especially connected to recent studies discussing the historical (and current) role of a safe reserve asset (Eichengreen, Mehl and Chitu 2017, Farhi & Maggiori 2017, Bordo et al. 2019, Bordo & McCauley 2018, Gourinchas et al. 2019).⁷

⁷ Our argument is different from that of Bordo and Eichengreen (1998) and Eichengreen et al. (2017) who highlight autocorrelation in the level of gold and other international reserves in the 20th century. Our main result is not about path-dependency of the *level* of the gold stock itself but about the persistence of the practice to back currency by gold reserves.

Although we do not dismiss the importance of rational motives in explaining reserve accumulation, our results generally highlight the strong persistence and inertia in monetary practices. Writing during the Bretton Woods period, some prominent economists considered the possibility that central banks would tie domestic money to gold reserves, but 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).⁸ Contemporaries showed too much optimism about the disappearance of old habits. We show that, despite radical institutional changes, old habits prevented gold and dollars working as perfect substitutes and, as a result, impaired the functioning of the Bretton Woods system. Doing so, we also contribute to the large debate on the causes of the breakdown of the Bretton Woods arrangements (Bordo & Eichengreen 1998, Farhi & Maggiori 2017, Bordo & McCauley 2018, Ilzetzki, Reinhart & Rogoff 2019). Our results are also consistent with contributions that emphasized the detrimental effect of US policies on gold-dollar parity and the Bretton Woods system in the 1960s (Bordo & Eichengreen 2013, Bordo, Monnet & Naef 2019, Bordo 2020). We find that such a context triggered a general move back towards gold and gold standard practices, i.e. backing currency in circulation by gold reserves.⁹ Our results highlight the role of memory in explaining the intensity with which some countries did so.

The remainder of this paper is organized as follows. Section I reviews the Bretton Woods system, its difference with respect to the pre-WWII gold standards, and the puzzling resurgence of gold reserves after 1950. Section II presents the data and econometric framework as well as preliminary results regarding the positive correlation between the gold share and currency. Section III explores the role of institutional and personal memory. Robustness checks and extensions are performed in Section IV. Section V discusses the broader policy implications of our results. Section VI concludes.

⁸ 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)

⁹ For instance, we find that the relationship between the gold share and currency is stronger and more significant in the 1960s than in the 1950s, when the US did not maintain a stable monetary and fiscal policy, associated with Great Society and the Vietnam War.

I- Gold and the Bretton Woods system

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 1 July to 22 July 1944.¹⁰ The new international monetary system departed from the pre-WWI gold standard and the interwar gold exchange standard in four ways (Bordo & Eichengreen 1998). First, controls on capital and on current accounts were officially allowed to avoid destabilizing international movements of funds. Second, the International Monetary Fund (IMF) was created to provide short-term liquidity to domestic monetary authorities when needed and conduct surveillance of national policies to avoid destabilizing balance of payments imbalances. Third, the pegged exchange rate could be adjusted, under authorization by the IMF, in the case of fundamental disequilibrium. Fixed exchange rates were no longer defined in terms of gold parity but in terms of dollars (*Articles of Agreement of the International Monetary Fund*, 22 July 22 1944, Article IV, Section 1). 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 were abandoned everywhere in the world.¹¹ This 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. In some countries, 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 finally broke 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.¹² The United States –

¹⁰ 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. See Bordo (1993, 2017) and James (1996) for a description of the operations and key issues of the system. See Bordo and 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.

¹¹ 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).

¹² 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 favour 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”.¹³ 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 paid a (minor) part of their subscription to the IMF in gold (*Articles of Agreement of the International Monetary Fund*, 22 July 1944, Article III, section 3).¹⁴ Contrary to the principles of the gold and gold exchange standards that preceded the Second World War, the *Bretton Woods Agreement* nowhere requires countries to back their currency in circulation with gold or foreign exchange reserves.

The gold puzzle

The secondary role of gold under the new international system was such that, outside the United States, 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 at the Bretton Woods conference. In fact, since the yield on reserves in dollars (US government securities) was always positive, holding gold reserves was costly for non-US countries.¹⁵ 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 on its balance sheet as a function of the currency in circulation (notes

¹³ Speech by Lord Keynes on the International Monetary Fund debate, 23 May 1944. *Hansard Parliamentary Debates*, House of Lords, 5th Series, Vol. CXXXI, Cols. 838-49.

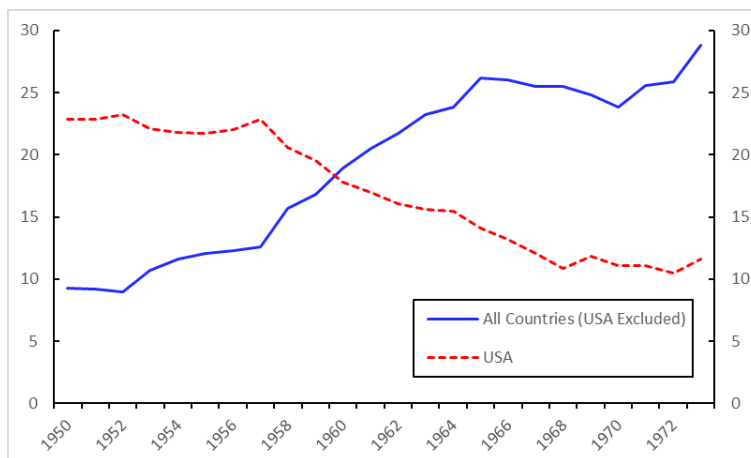
¹⁴ According to Article III, section 3 defined the subscription payment of IMF members as follows: “Each member shall pay in gold, as a minimum, the smaller of (i) twenty-five percent of its quota; or (ii) ten percent of its net official holdings of gold and United States dollars as at the date when the Fund notifies members under Article XX, Section 4(a) that it will shortly be in a position to begin exchange transactions.” The specific commitment of the US to pay in gold against dollars when asked by other members of the IMF was consistent with the fact that the US was the only country that had to define its parity in gold. This commitment was nevertheless not *stricto sensu* expressed in the 1944 Articles but inherited from the 1936 Tripartite Agreement (Bordo, Humpage & Schwartz 2015, p. 87). When the US stopped paying in gold in 1971, the parity of the dollar was still expressed in gold. The Jamaica Accord in January 1976 removed any reference to gold parity from the Article of Agreement of the IMF.

¹⁵ Based on the amount of gold held by central banks and the rate of return on T-bills between 1950 and 1971, we estimate an average opportunity cost of 0.2% of GDP per year per country.

and coins). The *de facto* ratio was often more important than the *de jure* requirement. The latter only provided a minimum (Morys 2013), and some countries (prominently France, the main holder of gold before WWII together with the USA) did not even have a *de jure* cover ratio under the gold standard (Bazot, Bordo & Monnet 2016).

Although gold was dead in theory, it remained alive in practice. Looking at cross-country reserves data between 1950 and 1970, two key facts emerge. First, the total amount of gold held by foreign monetary authorities increased throughout the Bretton Woods period. Starting in the mid-1950s, the demand for gold by non-US monetary authorities began to put pressure on the US gold stock. As shown in Figure 1, this trend accelerated starting in 1958-1959 when most countries started to open their current account and make their currencies fully convertible (Bordo 1993).¹⁶

FIGURE 1: GOLD AND INTERNATIONAL RESERVES, 1950-1971 (BILLIONS OF US\$)



Note: The 37 non-US countries cover 94% of gold reserves held outside of the US over Bretton Woods on average. Country names are reported in Appendix. 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. Figure 2.A shows a negative relationship between the cover ratio in 1950 – when countries entered Bretton Woods – and the change in the cover ratio from 1950 to 1970. Although some countries reduced their ratios, especially those that had inherited a very high ratio after the war because their gold reserves had been unaffected

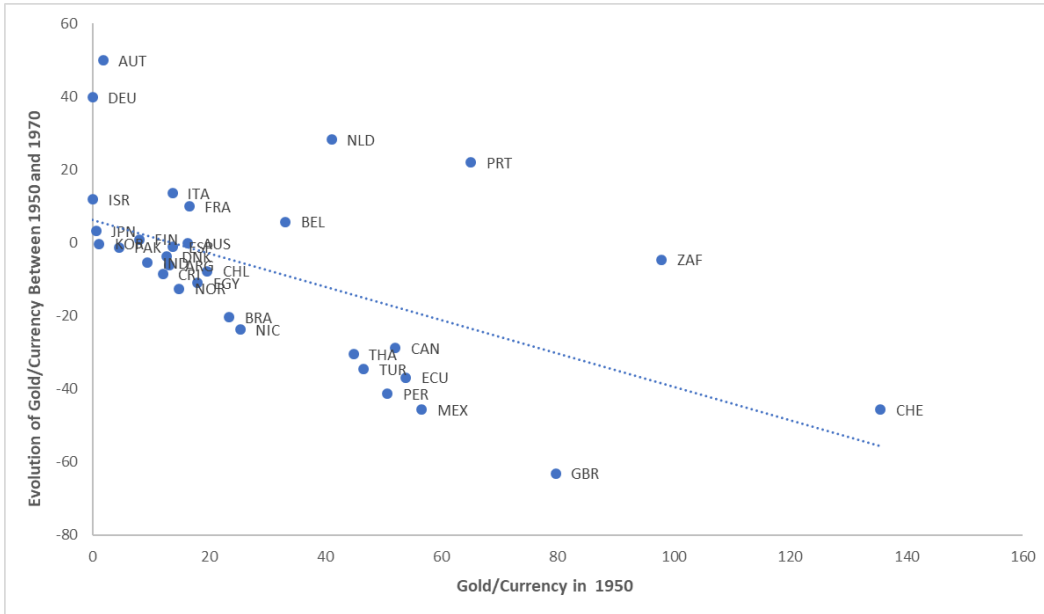
¹⁶ Although central banks had little opportunity to buy gold in 1944 – except at the US gold window – this changed when the London gold market reopened in 1954 (Kriz 1959, Kenen 1963, Bordo et al. 2017). It was then easier for central banks to replenish their gold stocks if they wanted to. From the mid-1960s onwards, various mechanisms between central banks were designed to avoid a further increase in non-US gold stocks (James 1996, Bordo et al. 2017). This temporarily reduced the accumulation rate of other countries (Figure 1), but ultimately proved insufficient.

(Switzerland, Great Britain, Canada, etc.), many kept their ratios stable. Several countries even increased their ratios, showing in fact a desire to “catch up” with the rest of the pack. Interestingly, a similar catch-up process is observed when looking at the gold share (Figure 2.B), although countries with a lower gold share in 1950 were not systematically those with a lower cover ratio.¹⁷ These two plots (Figures 2, A & B) thus suggest that some countries implemented systematic policies to target a certain level of gold reserves, relative to either currency in circulation or total foreign reserves, following rules inherited from the pre-war gold standard. One should not underestimate how this simple fact runs counter to Bretton Woods’ principles. Increasing the cover ratio and gold share – or keeping them stable – meant that countries had to buy gold to keep up with the unavoidable increase in their monetary base and foreign exchange over time. If the new Bretton Woods system had really stopped ancient practices, cover ratios should have decreased and converged towards very low values over the period. Figure 2 also shows the heterogeneity in the behaviour of countries which had a similar cover ratio or gold share in 1950. For example, among those with a cover ratio around 50% in 1950, some reduced their cover ratio by more than 25% over 1950-1970 (Mexico, Peru, Canada, etc.) whereas others increased it (Belgium, Netherlands, Portugal). We explore the determinants of this heterogeneity in gold holdings more formally in sections II and III.

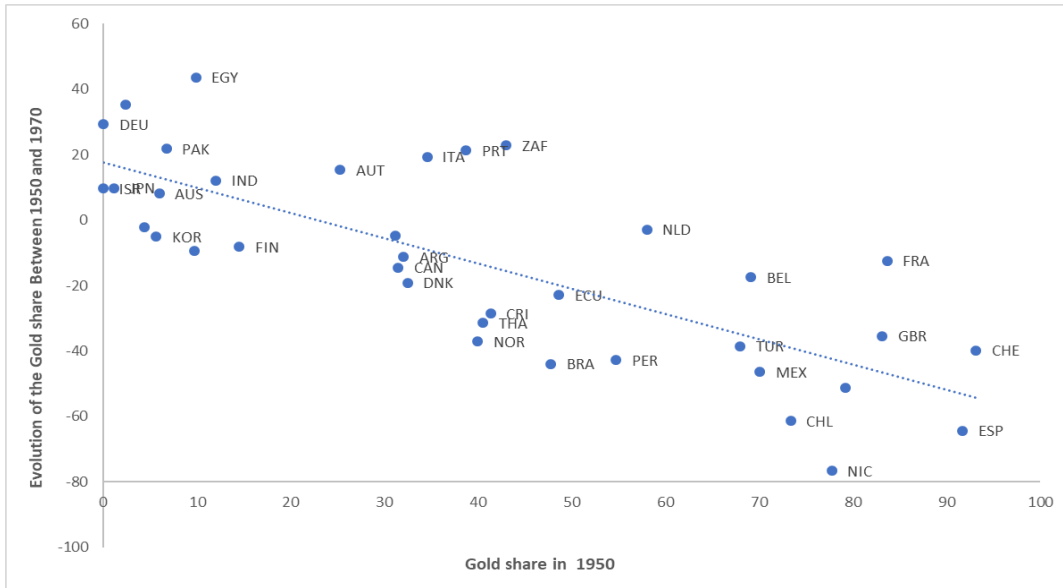
¹⁷ The gold share is simply computed as $\text{gold reserves}/(\text{gold} + \text{foreign exchange reserves}) * 100$.

FIGURE 2 : CATCHING-UP.

A) THE EVOLUTION OF COVER RATIOS OVER TIME (1950-1970)



B) THE EVOLUTION OF GOLD SHARES OVER TIME (1950-1970)



Note: Panel A reports the growth of the cover ratio (i.e. gold over currency) from 1950 and 1970 against the initial value of the cover ratio. Panel B reports the growth of the gold share (i.e. gold over total reserves) from 1950 and 1970 against the initial value of the cover ratio. Country names are reported in Appendix. Source: International Financial Statistics

Potential motives for gold holding

Why would monetary authorities keep accumulating gold? Some policymakers (Holtrop 1957) and bankers (Kriz 1959) suggested that a link between gold and the domestic money base survived because central bankers were in need of 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” behaviour (Machlup 1966, Williamson 1973). As a result, none of the quantitative studies on foreign reserves holding under Bretton Woods investigated the link between gold and domestic currency (see Grubel 1971, IMF 1971, Williamson 1973, Cohen 1975 for surveys of this literature). Another central explanation for the increase in gold holdings by other central banks was the loss of credibility of the US dollar over time, reflecting the run up in fiscal deficits which were largely money financed (Bordo, Monnet & Naef 2019). Expectations of a dollar devaluation pushed foreign central banks to acquire more gold to minimize the potential losses that would follow a devaluation (Kenen & Yudin 1965, Gilbert 1968, Officer & Willett 1969, Makin 1971). However, that explanation cannot explain the very uneven distribution and reconstruction of gold holding across countries (Figure 2).¹⁸

An alternative explanation favoured 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 used by monetary authorities to settle transactions, trade openness would determine the accumulation of gold reserves. However, little evidence of such behaviour has been presented so far. Kenen (1963) 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 holdings also appeared to be driven by political considerations (Gilbert 1968). France notoriously converted massive dollar holdings 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. 2019). On the

¹⁸ A very uneven reconstruction of gold holdings could be rationalized by heterogeneous expectations about the possibility of a dollar devaluation. In that case however, one would still need to rationalize why central banks held very different expectations in the first place. An alternative interpretation of this paper is to explore whether history and experience – i.e. “old habits” - shaped such expectations.

opposite side, the US was using political coercion to limit the purchase of gold by Germany and Japan (Gavin 2004).¹⁹ More generally, economists and policymakers became convinced that idiosyncratic political motives were the main drivers of gold holdings. We challenge such views in the next section by showing that more structural economic and institutional motives were at play.

II- Gold and currency under Bretton Woods

This section formally explores the motives behind gold holdings under Bretton Woods. Past studies of foreign reserve holdings conducted in the 1960s and 1970s were based on limited statistical evidence and very short samples.²⁰ Recent studies of foreign reserves holdings based on long samples do not include data on Bretton Woods and usually start in the late 1970s.²¹ We build on this literature for our empirical framework but apply it to reserves accumulation between 1950 and 1970.

The determinants of reserves holdings

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

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

¹⁹ It led one of the most famous international economists 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).

²⁰ 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 and 1965, and they did not discuss the hypothesis of currency in circulation being backed by gold reserves. More generally, econometric studies in that period were very limited and regressions, when used, were spurious because of unit roots.

²¹ These studies 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 and Inoue (2013) look at the determinants of gold reserves in the period 1979-2010 and find no correlation between gold reserves and the money supply.

where (i) $Gold\ share_{i,t}$ is the level of gold reserves divided by total foreign reserves (gold + foreign exchange) of country i in year t , (ii) $T_{i,t}$ denotes 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. To assess whether the relationship between macroeconomic variables and reserves holding was specific to gold reserves, we use the gold share as dependent variable, rather than the level of gold reserves-to-GDP. For robustness, Table 4 (Section IV) also reports estimations for gold and foreign exchange reserves (as a % of GDP) as dependent variables. We find that all our results are confirmed when using these different dependent variables.

In what follows, we focus our attention on the γ coefficient, which captures the relationship between the gold share 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 time-invariant variables (Section III). Trade-based accumulation motives specific to gold 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 (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).²² 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 a devaluation is expected.²³ Another key control is the exchange rate regime. A country with a fixed exchange rate needs more international reserves to defend its peg. Although all countries, except Canada, adopted a fixed exchange rate during this period, their peg had different degrees of flexibility. We follow here the *de facto* classification of Reinhart and Rogoff (2004). A lower value of this variable means a harder peg.²⁴ We also control for the logarithm of population to capture potential effects of the size of the country (a 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 (i.e. deposits). Obstfeld et al. (2010) found that in the post-Bretton Woods period, the holdings of foreign reserves correlated with broad money (i.e. currency in circulation + deposits) but not with the money base (i.e. currency in circulation).²⁵ By contrast, our hypothesis is that, during Bretton Woods, the holding of gold reserves correlated with currency in circulation.

Data sources and sample

We assemble a new cross-country database of reserves, monetary and macroeconomic statistics covering a large set of countries over the Bretton Woods period. Although individual series of reserves and money are provided by the IMF *International Financial Statistics* at an annual frequency, combining them is non-trivial because they are not expressed in the same unit;

²² The index is based on coding the text of the 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.

²³ The premium is the difference between the official exchange rate and the black-market exchange rate in New York (data from Reinhart & Rogoff (2004)). Such an undervaluation can be motivated by mercantilist purposes, with the exchange rate kept undervalued to promote exports (Aizenman & Lee 2008).

²⁴ The index is a *de facto* measure which captures how much flexibility was allowed by multiple exchange rates. In 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.

²⁵ 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 a currency board (where a monetary authority would back currency in circulation by foreign exchange reserves).

a complication that constrained previous research. Monetary statistics are expressed in contemporary domestic currency – which changes several times over the Bretton Woods period in some countries – whereas reserves are always expressed in current dollars. Historical GDP data, which are taken from the *Penn World Table* (2013), 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 change in currency denomination and official exchange rates using paper volumes of the *International Financial Statistics* published monthly since 1946. To our knowledge, we are the first to compile 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. Our dataset ends 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. On average, these countries account for 94% of gold reserves held outside the United States over the period. Table A.1 in the Appendix presents the sample of countries and descriptive statistics.

Besides macroeconomic and financial statistics, we also compile several indicators to measure past exposure of central bankers and central banks to the gold standard (to be used in section II), namely (i) the number of years spent by a country 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. Measures of central bank past exposure to the gold standard – adherence to the classical or interwar gold standard or – as a robustness check – the number of years in the gold standard – are taken from Officer (2008), Wandschneider (2008) and Mitchener and Weidenmier (2015). The number of delegates per country at the Bretton Woods conference is available in the transcripts of the conference published in Schuler and Rosenberg (2012). We used a more detailed list established by Schuler and Bernkopf (2014).

Data on the age of the governor of the central bank was obtained using a two-step process. We first look for the name of the ruling governor or president of the central bank for every year in our sample. This information is usually available on the websites of the central banks. Second, we

look for the biographies of these governors and their birth dates. When the information is not available on the website of the central bank, we use various sources, such as regional or national Who's Who, monographs on the history of the central banks, Wikipedia or genealogical websites containing sufficient biographical information. In total, the age of the governor was found for 85% of our sample (i.e. country-year observations).²⁶

Money rather than trade

Our first result is that the amount of currency in circulation and gold reserves (as a share of total reserves) are strongly positively correlated (Table 1). As a benchmark, we estimate γ around 2.1 (Table 1, column 1). When currency in circulation increases relative to GDP, countries increase their gold holding relative to foreign exchange reserves. This is evidence of the use of gold reserves to back currency in circulation. In a gold exchange standard where countries must still back their currency in circulation by foreign reserves, this coefficient should be equal to 1 or below 1 since gold and foreign exchange are (at least in theory) perfect substitutes and there is an opportunity cost to holding gold. In a system like Bretton Woods, where the rules of the international monetary system no longer required countries to back currency with foreign reserves (neither gold nor foreign exchange), we should not observe any significant correlation between the gold share and currency in circulation. This result suggests that the Bretton Woods system still functioned in part as a gold standard, that is, neither as a gold exchange standard nor as a system free of the currency/foreign exchange reserves nexus. In fact, as we show in Appendix II, these results are remarkably similar to when we estimate similar regressions on a (smaller) sample of countries that adhered to the gold standard in the interwar period. The interwar gold standard was not a genuine gold exchange standard (especially after the 1931 sterling devaluation), nor was Bretton Woods. The coefficient on trade (β) is never significant in Table 1. In addition, all other control variables have the expected signs (Table 1, columns 2 & 3) as they suggest that gold was accumulated for precautionary motives. Countries accumulate more gold reserves (relative to total reserves) when

²⁶ Building a database on central bank governors post-1970, Mishra and Reshef (2019) also experienced difficulties in finding biographical information. In many cases, only the name of the governor is available. Biographical information was especially difficult to find in politically unstable countries where the governors of central banks changed almost every year. The information is also missing for some years in the few countries which did not have a central bank in the 1950s.

their exchange rates are less flexible and when they have higher financial and trade openness. Like international reserves in general (and despite the opportunity cost of holding them), gold reserves serve as a buffer against international financial shocks and exchange rate depreciation.

The significance and size of the currency coefficient is also confirmed when introducing country fixed-effects (Table 1, column 3). This is not the case for the coefficient on deposits which turns out to be small and insignificant. The amount of within variation explained by the currency variable is sizeable (0.17). The coefficient attached to currency is larger in column 3: if anything, the pooled panel estimates (without country-fixed effects) underestimate the correlation between gold and currency within a country over time.

TABLE 1. GOLD AND CURRENCY IN CIRCULATION

VARIABLES	(1) Gold share	(2) Gold share	(3) Gold share
Trade	-0.0283 (0.0532)	-0.0844 (0.0721)	0.111 (0.262)
Currency	2.131*** (0.223)	1.532*** (0.240)	2.269** (0.910)
Deposits		0.811*** (0.129)	-0.595 (0.625)
Exchange rate premium		-0.592 (0.935)	0.386 (0.961)
Capital account openness		0.249*** (0.0347)	-0.0310 (0.0917)
Current account openness		1.216*** (0.228)	-0.642** (0.277)
FX flexibility		0.512** (0.244)	0.139 (0.338)
Population		1.625 (1.022)	-50.43** (23.43)
Constant	24.29*** (6.308)	-17.91 (19.45)	836.7** (381.6)
Observations	728	728	728
R-squared	0.139	0.279	0.173
Country FE	NO	NO	YES
Year FE	YES	YES	YES
Number of country	38	38	38

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Results are based on Equation (1) in the text. Columns (1) and (2) display the results of pooled panel estimations. Year-fixed effects are included in all estimations. Column (3) includes country-fixed effects, with standard errors clustered at the country level. The R-square reported in column (3) reports only the within variation explained by the variables of interest.

III- Memory and gold

Past exposure to the gold standard

The literature in behavioural economics has shown that the financial decisions of individuals are shaped by previous experience (Malmendier & Nagel 2011, 2015, Koudijs & Voth 2016). We test whether similar mechanisms can be observed for central banks' attitude towards gold. 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. We estimate the following model:

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

Where all variables have the same definition as in (1). GS_i 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 interwar gold standard was chaotic and of short duration – most countries left following the UK in 1931 and the average length was 6 years (Wandschneider 2008) – 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 interwar period, there are some reasons to believe that the gold standard's culture no longer prevailed.²⁷ Given that the variable GS is fixed over time within a country, we use a pooled panel estimator, and focus attention on τ .

²⁷ We set the gold standard variable to zero for countries that were colonies or British dominions before World War II, because we cannot assume that they had an independent gold policy throughout this period and that they had continuity in their political system and administration before and after independence (which is essential to our memory hypothesis). However, our results are not sensitive to this assumption. When, for dominions and colonies, we set the gold standard variable to be equal to the one attached to the colonizing country, we find a slightly lower coefficient on the interaction term (0.44 against 0.48 in column 1, Table 2), but the significance is unchanged. Likewise, results are similar if we exclude countries of the sterling area. For a recent detailed analysis of the politics of the sterling area,

Table 2 summarizes our key results. In column (1), the interaction term τ is positive and significant, implying 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 (larger than 1) is also in line with the results of Table 1. On the other hand, for countries previously outside the gold standard, the coefficient is below 1 and non-significant (0.5).²⁸ Table 2 also reports two important results. First, the attitude towards gold varies not only between countries in and out of the gold standard, but also *across* gold standard countries (Column 2): it is shown by estimating equation (2) using the number of years spent in the gold standard as a measure of exposure to norms and practices of the past. Second, we also perform an additional exercise to support our memory hypothesis using the number of delegates of each country at the 1944 Bretton Woods conference (Column 3). In opposition to our proxy of “gold standard exposure”, this measure can be interpreted as “Bretton Woods exposure”. When the conference took place, the war was not over yet and the US and the UK – the main powers at the conference – encouraged a lot of non-Western countries to participate (including former colonies, dominions, etc.). As emphasized by Helleiner (2014) and contributions in Scott- Smith and Rofe (2017), emerging countries from Latin America, Africa and the 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, Continental European countries and Japan – long-time adherents to the gold standard and key players of the pre-war monetary system – were mostly absent because of the war. Column 3 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 – mostly because of the contingencies of the war – were therefore less likely to behave as in the gold standard.²⁹

see Avaro (2020). These countries were under strong pressure from the United Kingdom to keep a large part of their reserves in pounds sterling rather than in gold or dollars.

²⁸ The coefficient attached to the gold standard variable (un-interacted) is negative. This captures the fact that, all else being equal, gold standard countries had, on average, less gold than others at the start of Bretton Woods. This is mainly due to the large depletion of gold reserves during the war.

²⁹ We recognize that the number of delegates is an imperfect proxy of the enthusiasm of countries for the new Bretton Woods system, and their willingness to embrace its new rules. This number might have also been affected by political and practical contingencies related to the war. For this reason, we do not interpret the magnitude of the coefficient *per se* but focus on its (negative) sign. Our interpretation is still justified by the fact that the number of delegates at the Bretton Woods conference was not mechanically related to pre-war adherence to the gold standard and was not proportional to pre-war relative power in the world economy (with the exception of US and UK delegates).

TABLE 2 : MEMORY

VARIABLES	(1) Gold share	(2) Gold share	(3) Gold share
Trade	-0.196*** (0.0736)	-0.241*** (0.0717)	
Currency	0.508 (0.385)	0.804** (0.393)	2.397*** (0.342)
Gold standard	-3.243 (4.074)		
Gold standard x currency	1.679*** (0.459)		
Gold standard (nb of years)		0.234** (0.0956)	0.457*** (0.0474)
Gold standard (years) x currency		0.0222** (0.0100)	
Delegates			3.218*** (0.548)
Currency & delegates			-0.242*** (0.0594)
Constant	-17.58 (19.12)	-14.24 (17.70)	-12.37 (19.95)
Observations	728	728	728
R-squared	0.313	0.365	0.387
Country FE	NO	NO	NO
Year FE	YES	YES	YES
Controls	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Standard errors are clustered at the country level. Results are based on Equation (2) in the text. Year-fixed effects are included in all estimations. Control variables are the same as in Table 1.

Personal experience vs. institutional memory

Our previous results are silent on how the habits and cultural norms of the gold standard transmitted over time. One interpretation of our findings is that institutions themselves have a memory, which pushes policymakers to behave as they did 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 the organization’s history for the making of

When we exclude the delegates of the governments in exile from our sample (France, Norway, Netherlands, Belgium) – which were constrained in practice to send delegates to the conference – the coefficient on the interaction term is even more negative (-0.57 vs. -0.24). Results available on request.

monetary policy and the choice of the exchange rate regime (James 1985, Capie 2010, Schenk 2010, Straumann 2010, Monnet 2018a).

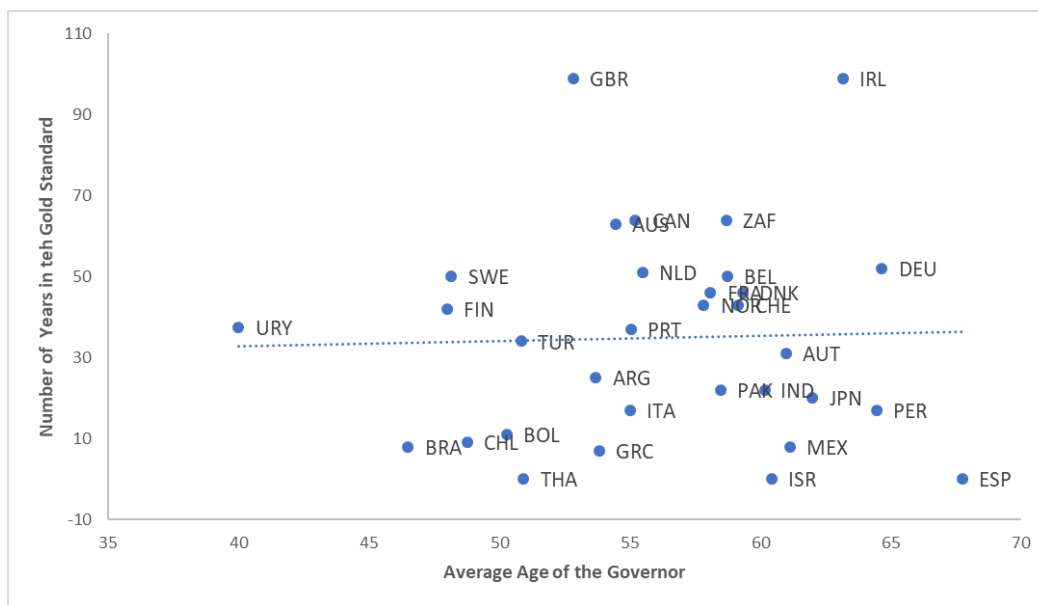
Another possible interpretation of our results – the “individual memory” hypothesis – is that they reflect the importance of the personal experience of central bankers (in the same vein as Romer & Romer 2004, Malmendier et al. 2017, Bordo & Istrefi 2018, Mishra & Reshef 2019). In that case, an older central banker is more likely to behave as if it were the gold standard because his formative years happened during that period. 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, the governor of the Swedish central bank in the early fifties (1951-1955), and Maurice Frère, his counterpart heading the central bank of Belgium (1944-1957). 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 – diverge 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 a 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 that in 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 (Aufrecht 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”.

FIGURE 3 : NUMBER OF YEARS IN THE GOLD STANDARD VS. AVERAGE AGE OF CENTRAL BANKS' GOVERNORS



Note: the figure displays the correlation between the number of years in the gold standard before the Second World War and the average age of central bank governors under Bretton Woods. Country names are reported in Appendix. Sources: see the text, Section II.

The heterogeneity in the profiles of central bankers is captured in Figure 3, which plots the (average) age of governors against the number of years spent by the institution in the gold standard. Interestingly, the correlation is flat between the two variables, suggesting that the personal experience of the governor can have explanatory power beyond the history of the central bank (as illustrated by the Belgium and Swedish cases).

We test formally the “individual memory” hypothesis in Table 3. Column 1 shows the results when we use equation (2) and interact the average 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.³⁰ 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, suggesting an independent effect of personal experience (or memory) in addition to the effect of corporate culture (or institutional memory). Moreover, the interaction term “Age of governors*currency” is similar in columns 2 and 3 (0.167 vs. 0.163).

Overall, we find that institutional memory and personal experience are not mutually exclusive. The age of the governor, however, might be associated with other institutional characteristics that we have some difficulties in capturing with the number of years in the gold standard, such as the reaction of the central bank to the end of the gold standard in the 1930s. Even if this is the case, it is still fully consistent with our argument that memory matters, in one form or another, to shape current policies.

³⁰ Since the variable “age” has mechanically a unit root in countries where the governors changed infrequently, we use the average age of governors over the period, as plotted in Figure 3.

TABLE 3 : PERSONAL EXPERIENCE AND INSTITUTIONAL MEMORY

VARIABLES	(1) Gold share	(2) Gold share	(3) Gold share
Trade	0.0382 (0.0650)	-0.0612 (0.0655)	-0.175*** (0.0676)
Currency	-9.698*** (3.689)	-10.09** (3.933)	-9.487*** (3.656)
Gold standard exposure		-18.39*** (4.787)	-0.0429 (0.100)
Gold standard exposure x currency		2.942*** (0.488)	0.0469*** (0.0104)
Age of governors	-2.699*** (0.484)	-2.331*** (0.515)	-2.138*** (0.489)
Age of governors * currency	0.192*** (0.0632)	0.167** (0.0675)	0.163** (0.0639)
Constant	103.4*** (25.92)	95.48*** (26.63)	95.28*** (25.58)
Observations	616	616	616
R-squared	0.324	0.363	0.396
Country FE	NO	NO	NO
Year FE	YES	YES	YES
Controls	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Results are based on Equation (2) in the text. All estimations are derived in a pooled panel. Year-fixed effects are included in all estimations. Control variables are the same as in Table 1. Columns (1) and (2) use the full sample for which information on the age of the governor is available. In column (2), the gold standard exposure is a dummy variable which takes the value 1 if the country adhered to both the classical and interwar gold standards. In Column (3) gold standard exposure is measured by the number of years a country adhered to the gold standard.

IV- Extensions and robustness

Alternative dependent variables

The results of the previous section used the gold share as a dependent variable. For robustness, as well as to provide more general interpretations, we turn in Table 4 to a more standard specification where the dependent variables are gold reserves and non-gold reserves (both as % of GDP).

Table 4 highlights several important findings. First, contrary to gold reserves, we find that non-gold holdings – mostly foreign exchange reserves – are positively correlated to trade openness (Table 4, column 1), and that this result survives the introduction of fixed effects (Table 4, column 5). Second, we still find a significant and positive – but smaller – coefficient on currency/GDP when non-gold reserves are used. However, it turns negative when we include country-fixed effects (Table 4, column 5). Finally, in the pooled panel, the interaction term between the gold standard exposure and currency in circulation is negative and significant for non-gold reserves (Table 4, column 2), but positive and significant for gold reserves (Table 4, column 4). This last result is confirmed when introducing country-fixed effects (Table 4, column 6).

TABLE 4 : NON-GOLD AND GOLD RESERVES AS DEPENDENT VARIABLES

VARIABLES	(1) Non-gold	(2) Non-gold	(3) Gold	(4) Gold	(5) Non-gold	(6) Gold
Trade	0.0334*** (0.00731)	0.0355*** (0.00733)	-0.0227** (0.0107)	0.0277*** (0.0104)	0.105*** (0.0247)	-0.00292 (0.0258)
Currency	0.0985*** (0.0268)	0.204*** (0.0458)	0.415*** (0.0369)	0.157*** (0.0324)	-0.247** (0.112)	0.271* (0.154)
Gold standard	-1.298*** (0.264)	0.199 (0.391)	0.757*** (0.215)	-2.916*** (0.486)		
Gold standard x currency		-0.198*** (0.0552)		0.486*** (0.0621)		
Constant	10.34*** (1.836)	10.24*** (1.844)	10.33*** (2.555)	10.57*** (2.442)	-129.2** (49.17)	4.771 (38.71)
Observations	728	728	728	728	728	728
R-squared	0.282	0.295	0.585	0.620	0.368	0.217
Country FE	NO	NO	NO	NO	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Number of country	38	38	38	38	38	38

Robust standard errors in
parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: P-value in parentheses. ***, **, * denote significance at the 1%, 5%, 10% levels. Control variables are the same as in Table 1. Columns (1) to (4) report results of pooled panel estimations. Country-fixed effects are used in columns (5) and (6), with standard errors clustered at the country level.

More importantly, the size of the γ coefficient (i.e. the interaction between gold standard exposure and currency) carries an interesting interpretation when gold reserves are the dependent variable. For countries with an experience in the gold standard, the (conditional) correlation between currency in circulation and gold reserves is 0.486 (Table 4, column 4). It implies that 49% of an additional unit of currency 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 40-50%, depending on the period and countries included in the sample (Bordo & Eichengreen 1998, Morys 2013). It provides additional evidence that countries with a gold standard history behave as in the gold standard.

Last, these estimations of the motives for foreign reserves holding contrast 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 reserves. It also shows that reserve accumulation during Bretton Woods was not purely “trade-based”; a common starting point in the literature (Williamson 1973, Obstfeld et al. 2010). Although this is the case for foreign exchange reserves, this is not the case for gold.³¹

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) was one of the first to discuss this potential endogeneity bias. A country may increase its money supply to buy reserves. If this is not fully sterilized, it creates a positive correlation between foreign reserves and currency. Sterilization of foreign exchange interventions is and was a common practice of central banks during Bretton Woods (Obstfeld 1980, Naef 2017, Monnet 2018b) because they usually wanted to avoid the size of their balance sheet and the money supply being determined by the exchange rate. But, we cannot rule out the possibility that it was incomplete. This 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

³¹ This result is reported in Section IV, where we explore the determinants of non-gold reserves.

exchange rate policy. In that 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 much more likely to be a concern for foreign exchange reserves because central banks did not use gold to intervene on foreign exchange markets.³² Facing an inflow of capital, banks could exchange foreign currency at the central bank against domestic currency, thereby increasing the foreign assets of the central bank and, if not fully sterilized, the domestic currency in circulation. Since gold was not used as a means of payment for private commercial and financial transactions however, this mechanism does not apply to gold reserves.³³ Since endogeneity issues are more likely to arise with foreign exchange and the correlation between currency and non-gold reserves is always lower than the correlation between currency and gold reserves, using the gold share as our main dependent variable implies that we may underestimate the correlation between gold and currency if there is any reverse causality (Table 4).

Hysteresis of the initial gold stock

It is very unlikely that the hysteresis of the initial endowment of gold after the war drives our results, for four main reasons.³⁴ First, although some hysteresis was certainly present for a few countries, especially the US and the UK, many countries in our sample actually lost most (if not all) their gold reserves during the war (Austria, Germany, Italy, France, Japan, Belgium, etc.). To the extent that these countries also had a long history in the gold standard, the hysteresis effect would actually play against our results. Second and more importantly, our paper mainly investigates the evolution of gold holdings (or the gold share) over time within countries, rather than differences in the level of gold reserves (or gold share) across countries per se. As Figure 2

³² The only exception were interventions by the United States (and then by the Gold Pool) to stabilize the dollar price of gold on the London gold market (Bordo et al. 2019).

³³ 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 however, but a deliberate policy of the central bank to back money supply with gold.

³⁴ These claims are formally supported by results available in the online supplementary material of the paper. We find that increases in the gold share are positively correlated with the growth of the currency in circulation and negatively correlated with the initial value of the gold share in 1950. Countries with a longer history in the gold standard were also more likely to increase their gold stock, gold cover ratio or gold share compared to their initial value in 1950.

highlights, our paper is motivated by a puzzling “catch-up” effect: countries with a lower ratio of gold reserves to currency (or to total reserves) after the war were precisely the ones that increased their gold reserves more aggressively during Bretton Woods. Our paper tries to rationalize the heterogeneity we observe in this catch-up effect. Saturating the estimations with country-specific variables that vary little over time implies that our panel results already come from the “within” variation (i.e. the speed at which different countries have re-accumulated gold over Bretton Woods), rather than the “between” variation in the panel, which may be driven by a hysteresis effect. Third, our key argument is not about the direct effect of past gold standard exposure on the gold stock (or hysteresis of the gold stock) but about the interaction term: the correlation between gold reserves and currency in circulation was higher in countries with a longer gold standard history. Finally, as we show in Table 5, the correlation between currency and gold share (observed in countries with a longer gold standard history) is in fact higher in the 1960s than in the 1950s. The coefficient attached to the interaction term is at least twice as high in the 1960s than in the 1950s, whether gold standard exposure is measured as a dummy (column 4 vs. column 2) or as the number of years (column 6 vs. column 3). This downplays the concerns that the level of gold observed right after the war (and therefore at the beginning of our sample) drives our results.

Geopolitical considerations

There are several reasons to believe that, as we argued in the introduction, idiosyncratic US political pressures (e.g. on Germany and Japan) or anti-US declarations (e.g. France) are not driving our key results. By construction, our panel estimations – and our results – capture structural patterns of correlation between gold and currency. In practice, political factors that are unrelated to the gold standard history are already captured (i) by the residuals, if they are short-lived and specific to one country (such as France in 1965 and 1966), (ii) the time-fixed effects, if they apply to all countries at the same time (such as are negative shocks to the gold-dollar parity caused by US politics) and/or (iii) by country-specific controls, or country fixed-effects (if they are slow moving or permanent over the 20 years of our sample). Second, our main results hold – and are in fact stronger – when we exclude the countries that were more likely to be subject to US political

pressures to prevent them from converting dollars into gold, i.e. Japan, Germany and countries in Latin and South America (Gavin 2004).³⁵

TABLE 5: SUBSAMPLES. 1950S VS 1960S.

VARIABLES	(1) Gold share 1950-1959	(2) Gold share 1950-1959	(3) Gold share 1950-1959	(4) Gold share 1960-1970	(5) Gold share 1960-1970	(6) Gold share 1960-1970
Trade	-0.276*** (0.100)	-0.303*** (0.101)	-0.326*** (0.0927)	-0.183 (0.111)	-0.188* (0.109)	-0.277** (0.108)
Currency	0.954*** (0.262)	0.0740 (0.434)	0.185 (0.432)	1.736*** (0.406)	0.206 (0.637)	0.823 (0.550)
Gold standard	9.666*** (2.807)	-2.257 (6.207)		11.58*** (2.375)	-8.122 (5.006)	
Gold standard x currency		1.492** (0.626)			2.837*** (0.653)	
Gold standard (nb of years)			0.301** (0.147)			0.118 (0.113)
Gold standard (years) x currency			0.0177 (0.0127)			0.0433*** (0.0129)
Constant	-4.676 (25.46)	-2.067 (25.15)	-5.937 (24.66)	-0.669 (26.43)	0.537 (26.76)	17.49 (23.56)
Observations	316	316	316	412	412	412
R-squared	0.373	0.383	0.427	0.343	0.371	0.428
Country FE	NO	NO	NO	NO	NO	NO
Year FE	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES

Robust standard errors in
parentheses

*** p<0.01, **

p<0.05, * p<0.1

Note: Results are based on Equation (2) in the text. All estimations are derived in a pooled panel. Year-fixed effects are included in all estimations. Control variables are the same as in Table 1. The sample of Columns (1) to (3) is restricted to 1950-1959 (pre-convertibility period) whereas the sample of Columns (4) to (6) is restricted to 1960-1970. Columns (1) and (4) look at the direct effect of gold standard exposure whereas Columns (2), (3), (5), (6) look at the non-linear effect through the interaction term. In columns (2) and (5), the gold standard exposure is a dummy

³⁵ These results are available in supplementary material but not reported in the paper because of space constraints. The coefficient attached to the interaction term (“gold standard*currency”) jumps to 3.362. The coefficient attached to “currency” in the estimation with country-fixed effects increases to 2.945. A final point relates to the choice of dependent variable. Using the gold share makes our results more immune to the influence of political pressure. For example, the French gold stock increased in 1965-1967 but not its gold share.

variable which takes the value 1 if the country adhered to both the classical and interwar gold standards. In Column (3) and (6) gold standard exposure is measured by the number of years a country adhered to the gold standard.

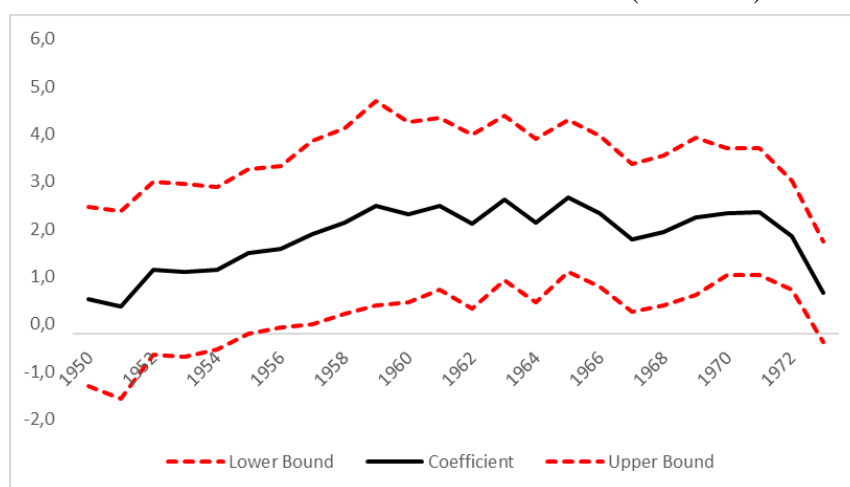
V- Implications: New perspectives on the Bretton Woods system

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 dollars would diminish US credibility, whereas restricting dollar issuance would push the world into a deflationary spiral. It followed from this argument that the fixed gold-dollar parity was unsustainable because the US had to issue too many 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, because 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, Gourinchas et al. 2019 for recent discussions of these debates). These two leading contemporary views of the Bretton Woods system assumed that countries were ready to treat dollars as a substitute to gold in their reserves, as long as the US balance of payments deficits was considered sustainable. On the contrary, our results suggest that foreign monetary authorities around the world did not give up references to the gold standard norms and never treated the dollar and gold as perfect substitutes, despite numerous schemes of central bank cooperation to support confidence in the dollar in the 1960s (James 1996, Schenk 2010, Bordo, Monnet & Naef 2019). Ultimately, the old habits of the central bankers prevented the Bretton Woods system from functioning as expected.

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. 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. It is easy to conjecture, for example, that gold standard practices could have disappeared if the US had pursued different policies in the 1960s or if it had not been required to express the parity of the dollar in gold by the 1944 Bretton Woods agreement. The fact that our key result (i.e., the coefficient attached to the interaction term) is stronger and more significant in the 1960s than in the 1950s (see Table 5) is consistent with the

interpretations that emphasized the detrimental effect of US policies on gold-dollar parity and the Bretton Woods system in the 1960s (Bordo & Eichengreen 2013, Bordo, Monnet & Naef 2019, Bordo 2020). To this literature, we add that such a context prompted central banks to reactivate old gold standard habits and practices, with an intensity that was proportional to their history under that system. Accordingly, we show that such practices eventually disappeared after the link between the dollar and US gold reserves was abandoned in August 1971, and world inflation made it impossible for the gold supply to follow the expansion of the money base in the subsequent years (Figure 4).³⁶

FIGURE 4 : CURRENCY-GOLD SHARE CORRELATION (1950-1973)



Note: The correlation between the gold share and currency (over GDP) is computed using the sample of countries which have been in both the classical and interwar gold standards and over 3- year rolling windows.

VI- Conclusion

It is commonly assumed that the histories of business or policy organizations shape their current behaviour. 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 through case studies (Lipartito 1995). A recent literature in corporate finance gives statistical evidence that managerial traits relate to corporate outcomes (Bertrand & Schoar 2003, Malmendier et al. 2011, Benmelech & Frydman 2015). However,

³⁶ A similar drop of the coefficient in 1971 is observed if we look at the correlation between gold reserves and currency in circulation (Monnet & Puy 2019).

quantitative evidence on the macroeconomic effects of both corporate culture and individual experience of policymakers is missing.

Looking at the radical change imposed by the Bretton Woods agreements, we investigate how monetary practices survived over the postwar period and argue that the 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) 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 & Romer 2002, Monnet 2014, 2018a). More generally, our findings call for further research on how the history of organizations and policymakers explain their current strategy or policy.

Appendix I: data sources

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. Reserve data cover 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).³⁷ Monetary statistics are also taken from IFS. Series of money are 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 are expressed in US dollars, we use 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 many countries the currency has changed over time). Nominal GDP and trade data from *Penn World Table* (2013) 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. Overall, our sample covers 38 countries, for a total of 729 observations.³⁸

³⁷ Kenen (1963) 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 reserves. 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.

³⁸ Due to some remaining irregular gaps in the data (especially monetary statistics in the early 1950s), our sample includes 729 observations rather than 798. 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.

TABLE A.1: SAMPLE AND DESCRIPTIVE STATISTICS

Countries	Years in the gold standard	Years in the gold standard as independent countries	Gold Share (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

Appendix II: interwar

This short appendix investigates the relationship between the gold share and domestic currency in circulation during the interwar gold standard. Our objective is to assess whether post-1945 central banks continued to act as during the pre-war gold standard.³⁹ The interwar gold standard is usually characterized as a gold exchange standard since the role of foreign exchange holding increased compared to the classical gold standard before 1914. Yet, it was still minor compared to gold reserves. The share of foreign exchange reserves peaked at 15% in the heyday of the interwar gold standard in 1928 and 1929 but was on average around 5% during the period because the holding of foreign exchange decreased sharply around and after the 1931 sterling devaluation (Bordo and Eichengreen 1998). Under Bretton Woods, the share of foreign exchange reserves was 30% in the 1950s and 40% in the 1960s on average. Contrary to the Bretton Wood period, interwar parities were defined in gold (and not deemed adjustable), gold cover ratios were still the norm and required central banks to hold gold as a percentage of their currency in circulation, and gold was not banned as a medium of exchange.

Our sample is restricted to 14 countries because of data availability. We focus on the years when these countries officially committed to maintain gold convertibility. The availability of control variables is also limited compared to the Bretton Woods period: we use the logarithm of population, bank deposits to GDP and the trade balance to GDP.⁴⁰ As for previous estimations, we always include year-fixed effects. Table A.1 shows that the coefficients on currency are very similar to the values estimated over the Bretton Woods period. They are above 1 in Pooled panel (= 1.173 with controls in column 4, Table A.1, compared to 1.5 in Bretton Woods with a similar specification in Table 1, col. 2) and above 2 when country-fixed effects are included (= 2.441 with controls in column 2, Table A.1, compared to 2.269 in Bretton Woods with a similar specification in Table 1, col.3). This comparison supports our argument that, under the Bretton Woods system,

³⁹ After the First World War, most countries returned to the gold standard (often not immediately and at a different parity than before the war) but rules were more flexible than during the classical gold standard for two reasons (Eichengreen 1992). First, some countries (including France and England) shifted to a bullion standard rather than a coin standard, meaning that the central bank could pay in bullion and no longer mint gold coins. Second, some countries adopted a gold exchange standard such that they would convert their currencies not into gold but rather into “gold-exchange” currencies (sterling and dollars).

⁴⁰ We use standard sources for GDP, trade, exchange rate population, and M1 data, published in Mitchell (2013) and Bordo and Meissner (2016). Currency in circulation in particular is from Mitchell (2013). Official foreign exchange and gold reserves data are from the League of Nations (as reproduced in Bordo and Eichengreen 1998).

countries continued to back their currency in circulation by gold reserves, as they used to under the gold standard before the Second World War.⁴¹

TABLE A.2: ESTIMATIONS OVER THE INTERWAR PERIOD

	(1)	(2)	(3)	(4)
Currency	2.128* (1.056)	2.441*** (0.776)	1.002*** (0.304)	1.173*** (0.402)
Trade	0.249 (0.917)	0.938 (0.915)	0.779*** (0.201)	1.648*** (0.323)
Constant	44.58 (29.09)	-6,167** (2,222)	33.82*** (7.225)	-143.5** (56.39)
Observations	89	89	89	89
R-squared	0.668	0.737	0.516	0.594
Country FE	YES	YES	NO	NO
Year FE	YES	YES	YES	YES
Controls	NO	YES	NO	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Standard errors are clustered at the country level. Results are based on Equation (2) in the text. Year-fixed effects are included in all estimations. Columns 1 and 2 include country-fixed effects. Columns 3 and 4 are pooled-panel estimations. Control variables are the logarithm of population, bank deposits to GDP and the trade balance to GDP. The sample is based on 14 countries, in the years they adhered to the gold standard between 1921 and 1936. United Kingdom and United States are excluded.

⁴¹ Economic historians will be interested to know that the high correlation between currency and the gold share is driven by the 1930s. After the 1931 sterling devaluation, remaining countries in the gold standard turned away from using foreign exchange as a substitute for gold.

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