The Rise and Fall of a Barbarous Relic:

The Role of Gold in the International Monetary System [1]

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Abstract

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In this paper we analyze the changing role of gold in the international monetary system, in particular the persistence of gold holdings by monetary authorities for 20 years following the breakdown of the Bretton Woods system and the Second Amendment to the Articles of Agreement of the International Monetary Fund which severed the formal link to gold. We emphasize four points.

First, the gold-exchange standard was a relatively recent arrangement that emerged only around 1900 in response to a set of historically-specific factors, factors which also help to account for its smooth operation. How long those factors would have continued to support it will never be known, for a great war and then a great depression intervened before they could be put to the test.

Second, a system which relied on inelastically-supplied precious metal and elastically-supplied foreign exchange to meet the world economy's incremental demand for reserves was intrinsically fragile, prone to confidence problems, and a transmission belt for policy mistakes. Proposals to finesse the liquidity problem through periodic adjustments in the price of gold were not feasible, given the damage this would do to the credibility of the authorities' commitment to maintain convertibility at the prevailing price.

Third, network externalities, statutory restrictions, and habit all contributed to the persistence of the practice of holding gold reserves. But the hold of even factors as powerful as these inevitably weakens with time. And the effects of their erosion are reinforced by the rise of international capital mobility, which increases the ease of holding other forms of reserves, both unborrowed and borrowed, and by the shift to greater exchange-rate flexibility, which according to our results diminishes the demand for reserves in general.

Fourth and finally, network externalities, in conjunction with central bankers' collective sense of responsibility for the stability of the price of what remains an important reserve asset, suggest that the same factors which have long held in place the practice of holding gold reserves, when they come unstuck, may become unstuck all at once.

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1. Introduction

Robert Mundell is renowned, even notorious, for advocating a role for gold in the international monetary system. Far from plumping for the sort of textbook gold standard that never has and never will exist, however, Mundell has always based his case on a nuanced view of the historical role of gold. The gold standard, in his view, always functioned as a gold-exchange standard in which specie was supplemented by foreign-exchange reserves issued by the leading international economic and financial power. There was nothing unstable or undesirable about this system so long as the price of gold was appropriately set. In particular, the gold-exchange standard allowed the world to economize on the costs of producing specie reserves and functioned smoothly when the reserve-currency country followed responsible policies.

Moreover, Mundell has always emphasized continuity in the evolution of international monetary arrangements, pointing to similarities in the structure of the prewar and interwar gold-exchange standards. He suggests that the Bretton Woods System of pegged-but-adjustable exchange rates is best understood as a gold-exchange standard (or more precisely as a gold-dollar standard) until the United States severed the gold-dollar link at the end of the

1960s.[2] The post-1973 shift to managed floating is seen as an aberration in which the stability and predictability of fixed exchange rates were allowed to go by the board, but even these developments have produced less real change than meets the eye. Floating, in this view, because it gave monetary authorities the license to pursue inflationary policies, has actually increased the demand for reserves and the demand for reserves of dollars and gold in particular. Indeed, persistence of gold in the portfolios of central banks points to a latent demand for monetary reform in which exchange rates are again pegged and the global supply of liquidity is managed by a world monetary authority that uses gold as one form of backing for its liabilities.

In this paper we relate our own account of the rise and fall of the gold-based international monetary system to Mundell's interpretation. We seek to understand the motives for recent central bank sales of gold, and we ask whether the yellow metal is likely to retain a monetary role in the 21st century.

We report new evidence on the determinants of central banks' demands for gold using data spanning more than a century of international monetary history. We estimate the canonical model of the demand for reserves, which relates central bank holdings to country size, exposure to international transactions, and balance-of-payments volatility.[3] This allows us

[2] Mundell refers to the Bretton Woods System as it operated through 1971 as the gold-convertible dollar standard.

[3]See for example Kenen and Yuden (1965) and Heller (1966).

to test propositions that flow from Mundell's analysis and to speculate on the future monetary role of gold.

While our analysis is broadly consistent with Mundell's, we hold a less universalist view of the gold-exchange standard and argue that the international monetary system is accurately portrayed as a gold-exchange standard for at most seven decades from 1900. We emphasize that the system was buttressed for most of its existence by special factors with no counterpart today, early on by the insulation from political pressures enjoyed by central banks and later by capital controls that limited international financial flows. More generally, we are less confident than Mundell of the stability of a multiple reserve-asset system.[4]

We argue that the disintegration of the gold-exchange standard in the 1930s and the collapse of the Bretton Woods System in 1971-3 both reveal the fragility of this system. In our view, more than an inappropriately set price of gold that limited the supply of international liquidity was responsible for stability problems in these two periods. Rather, the collapse of the interwar system and the collapse of Bretton Woods both reflected flaws in the structure of the gold-exchange standard, specifically, the tendency for such a system to amplify and propagate the effects of unstable policies in the reserve-currency countries, and the further tendency for the repercussions of those policies to destabilize the monetary system itself.

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[4]Our emphasis on the fragility of the gold-exchange standard is consonant with theoretical work pointing to the inevitability in the long-run of the collapse of any commodity price support scheme in the face of unforeseen shocks. See Townsend (1977), Salant (1983) and Buiter (1989).

Finally, we consider some hypotheses to explain the persistence of gold holdings by monetary authorities for 20 years after the breakdown of the Bretton Woods System and after the Second Amendment to the Articles of Agreement of the International Monetary Fund severed the formal link to gold. We distinguish three proximate explanations: network externalities which encourage the maintenance of the same international monetary practices as one's neighbors and therefore cause existing practices to become locked in, simple inertia in central bank behavior, and inertia in statutory requirements. We find some support for all three hypotheses. We suggest that this evidence as well as recent official gold sales bode ill for the future monetary role of gold.

2. Perspectives on the Past

In this section we review the development of the international monetary system from the late-19th century gold-exchange standard through the post-World War II gold-dollar standard.

A. The Gold Standard

The international gold standard developed out of the commodity-money standards that prevailed for many centuries up through and including the nineteenth. Prior to its advent, economies relied on a variety of commodity standards--silver standards, copper standards, and bimetallic standards among them. The pivotal development prompting the emergence of the gold standard in the nineteenth century was, in a sense, the industrial revolution, or more

broadly the technological and organizational advances associated with the advent of modern economic growth. With advances in shipbuilding and armaments technologies, warfare became more expensive, increasing the financial requirements of the state. This led to the issue of public debt and the development of financial institutions that served as bankers to the state. Out of these arrangements emerged modern central banks. In return for extending them exceptional privileges, governments asked their bankers to discharge a range of public functions. These eventually included overseeing the monetary system, which in practice meant acting as steward of the gold standard. The development of the steam engine brought steam power to the mint and made practical the minting and issuance of token subsidiary coinage, facilitating the transition from silver and bimetallism to gold.[5] The development of double-entry bookkeeping, the establishment of the accountancy profession, and improvements in information technology -- all corollaries of the industrial revolution -- encouraged the spread of fractional-reserve banking, which allowed specie and specie-backed currency and coin to be supplemented with bank deposits and other near monies. Central banks followed suit, buying

[5]The problem with token coinage was that its face value exceeded the intrinsic value of its metallic content by definition, creating an incentive for counterfeiting and discouraging the authorities from issuing tokens. The constraint bound because the smallest practical gold coin was too valuable for day-to-day transactions. It was necessary to supplement gold with silver coinage (silver coins of comparable weight being worth only one-fifteenth as much). Issuing token coins and paper money was only practical once steam power permitted them to be stamped and printed with a precision that precluded easy counterfeiting. See Redish (1990).

up circulating gold in exchange for token coin and paper money that then provided the basis for domestic circulation.[6]

Once this movement toward the gold standard was initiated, it gained momentum. The shift to gold fed on itself through the operation of network externalities. There were advantages, in other words, to maintaining the same monetary arrangement as other countries. Doing so simplified trade. It facilitated foreign borrowing.[7] And a common standard minimized the confusion caused by the inter-circulation of coins minted in neighboring countries. Thus, when Germany went over to gold in 1871, using the reparations received from its victory over France in the Franco-Prussian War, it brought Denmark, Norway, Holland and Sweden and the members of the Latin Union in its train. And once this influential group had joined together on the gold standard, other countries were drawn to follow.

B. The Gold-Exchange Standard

Circa 1880, when this process really got underway and it could for the first time be said that there existed a gold-based system of international scope, the system in place is accurately portrayed as a gold standard, not a gold-exchange standard.[8] In 1880, the foreign exchange reserves of central banks and governments amounted to less than 10 per cent of

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[6]Still, over much of the world, gold continued to circulate and provided the basis for day-to-day transactions. Things changed after World War I, as we explain below.

[7]As emphasized by Bordo and Rockoff (1996).

[8]On the transition from silver and bimetallism to gold and this convention of dating the emergence of a truly international gold standard around the first half of the 1880s, see Eichengreen and Flandreau (1996).

their gold reserves.[9] (See Figure 1.)[10] The practice of holding foreign exchange was the exception, not the rule.[11] But the share of foreign exchange in world official reserves then began its steady rise (as seen most clearly in Lindert's data, as in Appendix 1, Figure 1). Its upward trajectory was then interrupted by the Baring Crisis and the 1893 panic. By the turn of the century, however, the accumulation of foreign-exchange reserves was again proceeding, this time at an even faster pace than before. On the eve of World War I, the ratio of foreign exchange to gold reserves was 50 percent above its 1880 level.[12] This suggests that the shift

[9]These estimates for the 1880-1913 period are for 16 countries. For the interwar and post-World War II periods, we use a larger sample of 21 countries. Lindert (1967, 1969), by comparison, provides annual data on official foreign exchange reserves for 35 countries beginning in 1880 and a larger group of countries beginning somewhat later. He does not, however, provide annual data for individual countries' gold reserves over the 1880-1913 period, instead interpolating this series for the world between four benchmarks. In our work we have assembled annual estimates for a limited sample of countries rather than relying on interpolation. In addition, we limit our attention to countries for which the ancillary data used in the demand-for-reserves equations estimated below are consistently available. Notwithstanding these differences, Lindert's series and our's paint broadly the same picture (see Appendix 1, Figure 1).

[10]Gold reserves are valued at official prices throughout. Appendix 1, Figure 2 shows market values for gold reserves in the post-1973 period.

[11]The principal countries holding foreign exchange reserves in 1880 were Austria, Belgium, Canada, Denmark, Finland, Germany and Sweden. Source: Lindert (1967), Table 2-C.

[12]Lindert's alternative series suggests an even more impressive rise, with the share of foreign exchange reserves in the total doubling between 1880 and 1913. If like Lindert one considers the foreign-exchange assets of private as well as official financial institutions, then the relative rate of growth of foreign exchange claims is more impressive still.

from the gold to the gold-exchange standard can be regarded as a post-1895 -- even a post-1900 -- phenomenon.[13]

Central banks were naturally attracted by the possibility of substituting interest-earning foreign assets for gold in their portfolios, although in some cases the monetary statutes under which they operated provided only limited leeway for this. But as with the rise of the gold standard, the technological and organizational advances associated with the transition to modern economic growth encouraged the practice. The emergence of a global economy characterized by high levels of international trade and lending encouraged countries seeking to capitalize on the existence of international markets but for whom the accumulation of gold reserves was prohibitively expensive to opt for the more economical option of holding interest-bearing exchange reserves.[14] The growth of deep, broad and liquid financial markets in London, Paris, Amsterdam, Zurich and Berlin and of an efficient gold market in London reduced the costs of shifts between gold and interest-bearing assets. Improvements in transportation and communication, notably the growth of cable traffic, allowed governments and central banks headquartered in remote locations to undertake more frequent portfolio shifts. The emergence of a truly international capital market encouraged the practice of holding foreign exchange reserves, lenders often requiring governments borrowing abroad to

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[13] Below, in the context of an econometric analysis of the demand for gold and foreign exchange, we find that the Chow statistic indicating a structural break in the determinants of the gold/total reserves ratio peaks in 1900-1901, consistent with this interpretation.

[14] The role of income levels as a determinant of countries' reliance on gold versus foreign-exchange reserves is a theme of Eichengreen and Flandreau (1996).

hold their loan proceeds on deposit in the financial center where their bonds were underwritten and marketed.[15]

By the turn of the century, then, there existed a truly global gold-exchange standard. A large literature seeks to understand its operation. One strand of work, originating with Hume (1752), focuses on the adjustment mechanism and specifically on the importance of relative prices as opposed to income and wealth effects in bringing about changes in the level of spending and in the distribution of gold reserves. Later treatments in this spirit build on Mundell (1963, 1971).

In contrast, the modern literature, inspired by work on reputation and time inconsistency, focuses on the political and economic factors which lent credibility to the authorities' commitment to gold convertibility.[16] In the early 20th century, credibility derived from the protection central banks enjoyed from pressure to subordinate exchange-rate policy to other goals. In many countries the right to vote was limited until after World War I, circumscribing the ability of those subject to unemployment to object when monetary policy was targeted at other variables. Neither trade unions nor parliamentary labor parties had developed to the point where workers could insist that defense of the exchange rate be

[15] The integration into this expanding international economy of Russia and India, two leading holders of foreign exchange reserves, epitomizes the process. Russia borrowed in Paris and held foreign balances there as collateral (Feis 1930). India went onto the gold standard at the end of the 19th century, when the British sovereign was made legal tender there and the colonial government established a reserve in London (Keynes 1913).

[16] Here we compress arguments made in Bordo and Kydland (1995) and Eichengreen (1996).

tempered by other goals. Central banks and governments were therefore free to do what was necessary to defend their currency pegs.[17]

The credibility of that commitment had the effect of loosening the constraints on policy. Because capital tended to flow in stabilizing directions, it was only rarely necessary to apply harsh monetary measures in response to temporary disturbances. As in Svensson's (1994) model of target zones, the existence of the exchange rate band defined by the gold import and export points, plus a credible commitment to defend it, gave the domestic authorities leeway to vary interest rates in response to shocks.[18]

The adequacy of the global supply of liquidity was a major issue through the middle of the 1890s. The world price level trended downward from 1873 through 1893, provoking populist agitation against the gold standard, as given classic expression in William Jennings Bryan's "cross-of-gold" speech. At that point the constraint was relaxed by a series of gold discoveries, most notably in Western Australia and South Africa. This may have been less the stabilizing response of the system to the rising real price of gold than a corollary of the continued expansion of the international economy of which the gold standard was a part.[19] In

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[17] The United States, where universal male suffrage prevailed, provides proof by counter-example; the US came within a hair's breadth of being driven off the gold standard by populist agitation in the 1890s. See below.

[18] Evidence on the operation of these mechanisms is to be found in Hallwood, MacDonald and Marsh (1996) and in Bordo and MacDonald (1997).

[19] See Rockoff (1984) and Eichengreen and McLean (1994). A notable exception to this generalization is the cyanide process for extracting gold from impure ore; Rockoff shows

(continued...)

other words, discoveries may have been the product not so much of any induced response to changes in the real gold price as of the penetration of agriculture into what had previously been sparsely settled regions of the world. (Recall Sutter's Mill, where two generations earlier the great California gold rush had been set off by the settlement of what came to be known subsequently as the Gold Country. The immediate event precipitating the discovery was the construction of a lumber mill on the American River.) The irony, then, is that the equilibrating response -- flow supplies of gold -- reflected the fact that the global gold standard was superimposed on a disequilibrium system of changing migratory patterns and a changing geography of agricultural production.[20]

The fortuitous elasticity of the flow supply of new gold limited the need to supplement specie with foreign exchange. Nevertheless, the share of international reserves accounted for by foreign exchange continued to rise, from 16 per cent in 1903 to 21 per cent in 1910.[21] Exchange reserves held in sterling, francs and marks loomed large relative to the gold reserves of the British, French and German central banks. (Exchange reserves were 75 per cent of the reserve-currency countries' gold reserves in 1913 according to Lindert, 1969.) Questions

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[19](...continued)
that the rise in the real price of gold starting in the 1870s induced scientists in several countries to work simultaneously on its development.

[20]An additional equilibrating mechanism was shifts of gold from nonmonetary to monetary uses. See Bordo (1981) and Cagan (1965) for evidence that this force and the response of gold production to changes in the real price worked with very long lags.

[21]We refer to data for 35 countries. See Lindert 1967, Table 5-4 and Table 2-C.

quietly arose about the ability of the reserve-currency countries to honor their commitment to convert foreign exchange into gold in the event that foreign claimants all suddenly developed cold feet.[22]

How long this system would have lasted will never be known, for it was disrupted by the approach of World War I. Mounting political and military tensions raised doubts about whether countries would honor their unconditional commitment to redeem their foreign liabilities. As war loomed, they began shifting from foreign exchange into gold, the share of foreign balances in global reserves (35 countries) falling from 26 per cent in 1910 to 23 per cent in 1913 (Lindert 1967).

C. The Interwar Gold-Exchange Standard

The international system reconstructed following World War I was similar to its prewar predecessor. Gold convertibility again provided the basis for the monetary circulation. The combination of a fixed gold price with the freedom to import and export gold held exchange rates within narrow bands.

The principal differences between the prewar and interwar systems were four. First, countries now withdrew gold coin from circulation and concentrated it in their central banks (or at institutions like the Bank of England, which held it on their behalf).[23] Second, the dollar emerged as sterling's rival for the status of leading reserve currency, reflecting the growing

[22] The definitive treatment of these issues is De Cecco (1974). See also Triffin (1964).

[23] In most cases this was done during the war itself, when gold was regarded as a national resource that could not be allowed to flow abroad and possibly fall into enemy hands.

economic and financial power of the United States and the creation in 1913 of the Federal Reserve System, a central bank with the capacity to guarantee the liquidity of the market. Third, in a number of major countries, most notably the US and UK, wages and prices no longer responded to changes in market conditions as freely as before.[24] Fourth and finally, compared with their prewar predecessors, interwar central banks responsible for managing the monetary system had more varied motives, came under more political pressure, and possessed less credibility. Universal male suffrage and the rise of trade unionism and parliamentary labor parties politicized monetary policy. Authors like Cassel, Keynes and Hawtrey articulated theories linking monetary policy to employment and advertized their wares in popular publications and official testimony.

Mundell has argued that the fatal flaw in the interwar system was the failure of countries to set the gold price appropriately and to properly manage the global supply of liquidity.[25] The interwar gold standard was an engine for deflation, in this view. While prices had risen significantly in the United States between 1914 and 1925, the dollar price of gold was left unchanged; according to Mundell, this rendered the dollar overvalued in terms of gold by as much as 35 to 40 percent. Other countries which restored their prewar parities, most

[24] A large literature debates the question of whether there was a significant decline in wage and price flexibility over the World-War-I watershed. Recent work suggests that the case is strongest for the US, where the 1920s saw the rise of personnel departments and other institutionalized forms of labor relations, and in the UK, where union density rose sharply during the war and the government adopted an unemployment insurance scheme, sector-specific minimum wages (under the provisions of the Trade Boards Act), and other flexibility-reducing policies.

[25]Mundell (1994) pp.6,8; Mundell (1995), p.455.

notably Britain, experienced even more inflation over this interval than the United States. Higher commodity prices in conjunction with an unchanged nominal price of gold meant that the global supply of liquidity was inadequate. Central banks strapped for reserves raised their discount rates in the desperate effort to obtain them, imposing deflationary pressure under whose weight the gold standard edifice eventually crumbled.

This view must come to grips with the fact that the gold cover ratio (the ratio of gold to the sum of notes and central bank sight deposits) was in fact little changed, having fallen only from 48 per cent in 1913 to 41 per cent in 1925.[26] 41 per cent was still considerably in excess of the gold required by statute, which lay in the 29 to 34 per cent range.[27] While price levels were higher than a decade earlier, so were gold stocks, reflecting mining and the concentration of monetary gold in the vaults of central banks. Indeed, the $3 billion of gold coin withdrawn from circulation provided the entire increase in gold cover required by statute between 1913 and 1928. And if the stock of gold was not enough, it could be supplemented by rebuilding the foreign exchange component that countries had liquidated during the war and in its wake. In the event, the share of foreign exchange in central bank reserves rose from 29 per cent in 1924-6 to 42 per cent in 1927-8, somewhat higher than the 1910 benchmark of 36 per cent.[28] In any case, it is hard to argue that a global liquidity shortage constrained the

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[26] League of Nations (1930), Annex XIII, Table III.

[27] Depending on how much foreign exchange was also held by central banks authorized by statute to do so.

[28] It then fell back to 37 per cent in 1929 as financial instability loomed (Nurkse,

(continued...)

growth of notes and sight liabilities in the second half of the 1920s, when they expanded at an annual average rate of four per cent.[29]

Admittedly, there was the question of whether this configuration was dynamically stable. Penetration of overseas regions of recent European settlement having run its course, there were few prospective gold discoveries on the horizon, rendering the flow supply of new gold relatively inelastic.[30] For incremental liquidity the system depended on its ability to

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[28](...continued)
1944, Appendix I).

[29]Cassel (1928) shared Mundell's worry about the adequacy of the world's stock of monetary gold now that the U.S. price level was so much higher (and the real price of gold was so much lower). But his preferred solution was not to change the real gold price, which would have created what we refer to now as time inconsistency problems. Starting with his contributions to the Expert Committee at the Genoa Conference in 1922 (of which he was a member), Cassel stressed the need to economize on monetary gold by withdrawing gold coin from circulation and encouraging central banks to supplement their gold reserves with convertible foreign exchange. Critical for encouraging this practice, he emphasized, was central bank cooperation, for a coordinated international reduction in gold cover ratios would be less threatening than unilateral action to the credibility of monetary policy. In contrast, Charles Rist's solution in fact anticipated Mundell, arguing that the interwar "gold shortage" could have been alleviated by readjusting the price of gold in terms of the dollar and pound in 1924-25 "to bring the purchasing power of gold nearer to what it would have been if the rise in prices had been due to an increase in the production of gold and not to monetized debt." Cortney (1961), p.8.

[30]Cassel (1928) emphasized the progressive exhaustion of the South African mines on which the world depended so heavily for its incremental supplies of gold. While not questioning that new deposits would be discovered, he anticipated the picture of a relatively inelastic flow supply as described in the text. Bordo and Eichengreen (1997) demonstrate that had the Great Depression not terminated the gold exchange standard that the post-World War I deflation would have encouraged sufficient gold production and shifts of gold from nonmonetary to monetary uses to allow the principal countries to satisfy their legal gold reserve ratios. Their simulations are based on econometric estimates of relatively but not totally inelastic flow supplies of new gold.

pyramid additional foreign exchange reserves on a relatively static base of monetary gold.[31] Contemporaries were not oblivious to the exchange-overhang problem -- to the fact that the system depended on exchange reserves for incremental liquidity, but that augmenting them could at the same time undermine confidence in the ability of the reserve-currency countries to convert them -- that had arisen in the first decade of the 20th century. Only after World War II was this problem given a name -- the "Triffin Dilemma" — but it was well known before. Writing in 1929, for example, the monetary expert Feliks Mlynarski warned that "banks which had adopted the gold exchange standard will become more and more dependent on foreign reserves, and the banks which play the part of gold centers will grow more and more dependent on deposits belonging to foreign banks. Should this system last for a considerable time the gold centers may fall into the danger of an excessive dependence on the banks which accumulate foreign exchange reserves and vice versa the banks which apply the gold exchange standard may fall into an excessive dependence on the gold centers. The latter may be threatened with difficulties in exercising their rights to receive gold, whilst the former may incur the risk of great disturbances in their credit structure in the case of a sudden outflow of reserve deposits."[32]

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[31] In actual fact, new gold supplies rose significantly in the 1930s, following the collapse of commodity prices (and the consequent increase in real gold prices). But this price-level collapse was precisely the disaster that the progressive accumulation of foreign balances was meant to head off.

[32] Mlynarski (1929), p.89. Clearly, the "Triffin Dilemma" might equally well be labeled the "Mlynarski Dilemma."

The immediate problem, however, was neither the prospective foreign exchange overhang nor the putative gold shortage. Rather, it was the international distribution of reserves. Between 1927 and 1930, the gold reserves of three countries -- France, Germany and the United States -- rose from 56 per cent to 63 per cent of the world total. These trends reflected unstable monetary policies on the part of the newly-created Federal Reserve System, sterilization of reserve inflows by the Bank of France, and efforts by the Reichsbank to rebuild its reserve position following the German hyperinflation.[33] The actions of these three central banks thereby imparted powerful deflationary impulses to the rest of the world. In addition, the UK suffered from persistent competitiveness problems which forced the Bank of England to follow contractionary monetary policies to maintain gold convertibility. The UK's weak position threatened the stability of one of the key reserve countries and hence of the system itself.

Meanwhile, the decline in central bank credibility, reflecting increasing pressures to pursue domestic stabilization goals, meant that capital no longer flowed in stabilizing directions. Before the war, when a central bank allowed the exchange rate to weaken in response to a temporary shock, interest rates would fall, stimulating the economy, since currency traders expected the currency to appreciate subsequently, given the credibility of the commitment to hold it within the gold points. Now that the depth of that commitment had come into question, however, any weakening of the exchange rate might only excite

[33] See Eichengreen (1992) and Meltzer (1996).

expectations of a further weakening, with counterproductive interest-rate effects.[34] Thus, the scope for stabilizing monetary policy was limited. In addition, the existence of two competing reserve currencies, sterling and the dollar, that were close substitutes in portfolios heightened the system's fragility by providing easy opportunities for shifting between them.

As soon as doubts surfaced about the stability of the reserve currencies, central banks scrambled to liquidate their exchange reserves and replace them with gold. The share of foreign exchange in global reserves plummeted from 37 per cent at the end of 1930 to 13 per cent at the end of 1931 and 11 per cent at the end of 1932 (Nurkse, 1944, Appendix II). This collapse of the foreign-exchange component of the global reserve base exerted deflationary pressure on the world economy. Despite that there was only so much gold to go around, central banks around the world wanted more. To attract it they jacked up interest rates in the face of an unprecedented slump.

It is unnecessary to choose between unstable policies and an unstable international system as the cause of the Great Depression. The two sources of instability interacted and compounded one another. More than any other episode, the Depression revealed the fragility of the gold-exchange standard and the tendency for its operation to aggravate policy mistakes.[35]

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[34] As in the model of unstable target zones presented by Bertola and Caballero (1992). Eichengreen and Jeanne (1997) illustrate the applicability of this model to the interwar period.

[35] Our view is thus different from Mundell's, as expressed for example in Mundell (1995, p.458), "It is a mistake, though a common one, to blame the gold standard for the

(continued...)

With the liquidation of foreign exchange reserves, the gold-exchange standard collapsed back into a gold standard of the late-19th century variety. This shift was only temporary, however; between 1931 and 1936 the residual gold bloc collapsed, and the remaining gold-standard countries went onto floating rates. Recent research suggests that this was not entirely bad; abandoning gold convertibility allowed countries to adopt reflationary monetary policies and halt the downward spiral of prices and economic activity.[36]

At the same time, there is a sense in which the gold-exchange standard was never really abandoned. While US President Roosevelt unpegged the dollar from gold in 1933, he repegged it in 1934 at $35 a fine ounce. His decision to effectively put the dollar back on gold, albeit at a devalued rate, worked to preserve the currency's status as a reserve asset.

D. The Postwar Gold-Dollar Standard

Given US economic preponderance, the dollar was the basis for international monetary relations after World War II. The disagreements between the US and UK delegations at Bretton Woods are well known. What is relevant for our purposes is that the British delegation was strongly opposed to the reestablishment of a gold-based international monetary system, while the US insisted on a role for gold. In part this divergence of opinion is

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[35](...continued)
deflation and the great depression. The gold standard, however, is just a mechanism that worked well when it was managed well and worked badly when it was mismanaged." Our view emphasizes in contrast intrinsic instabilities in the system and their tendency to interact with policy problems.

[36] As argued by Eichengreen and Sachs (1985) and Mundell (1995).

explicable in terms of self-interest: following World War II the US held a majority of the free world's monetary gold reserves. But American attitudes cannot be understood without reference to the fact that gold convertibility had been a continuous fact of economic life in the United States with the exception of nine short months in 1933-4. The gold price of $35 established by Roosevelt in January 1934 remained the terms under which the US stood ready to convert dollars under the Bretton Woods System. Tradition cast a long shadow.

Bretton Woods departed from the prewar and interwar gold standards in four ways. Pegged exchange rates became adjustable subject to the existence of a "fundamental disequilibrium." Controls on capital- and (for a transitional period) current-account transactions were permitted to limit international capital flows. (This was a way of providing the central bank with the credibility needed to operate a system of pegged exchange rates despite the politicization of the monetary policy making; the circle was squared by using controls to loosen the links between exchange rate management and internal financial conditions.) The International Monetary Fund was created to provide surveillance of national economic policies. And limits were imposed on the right of private citizens, as distinct from governments and central banks, to hold, import and export gold.

These innovations addressed the major worries that policy makers inherited from the 1930s. They were concerned that there should exist an alternative to deflation for eliminating payments deficits. They insisted on a mechanism for containing destabilizing capital flows. They sought to economize on gold in order to prevent a global liquidity shortage. And they

recognized the need for a mechanism to influence governments whose policies threatened to destabilize the international system.

But none of these innovations eliminated the fundamental problem with the gold-exchange standard, namely, the need to accommodate the expanding world economy's demand for liquidity without at the same time destabilizing the system. Under the gold-exchange standard this demand could be met only by pyramiding a growing quantity of foreign exchange reserves on an inelastic gold base. As early as 1947 Triffin had pointed to this problem as the weak link in the Bretton Woods chain.[37] The flow supply of new gold had always been inelastic, but this was especially so in a policy-making environment in which governments now resisted any fall in the price level (rise in the real price of gold). Economic growth was unusually rapid in the post-World War II quarter century, further aggravating the excess demand for reserves.

The problem, then, was that the acceptability of foreign-exchange reserves hinged on the willingness and ability of the reserve-currency country to convert its liabilities into gold. But under the postwar gold-dollar standard, increases in the demand for reserves were met mainly by increases in the ratio of dollars to monetary gold. As the foreign liabilities of the reserve-currency country grew, the credibility of its commitment to keep them as good as gold might be cast into doubt.

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[37] See Triffin (1947).

There was no obvious way around this dilemma. If the reserve-currency country neglected its deficits, its external liabilities would continue to mount relative to its gold reserves, aggravating the confidence problem. If it imposed restrictive policies, it would starve the world of reserves and stifle trade and growth. If it revalued its gold as Rueff, Harrod, Busschau, Gilbert, and Mundell advocated, raising the gold/exchange-reserve ratio by increasing the nominal price of the yellow metal, it would be regarded as reneging on its commitment to convert its liabilities into gold at a fixed price.[38] This would reduce the willingness of governments and central banks to hold its liabilities and undermine the system as a whole (as happened with sterling after 1949 and 1967).[39, 40]

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[38]In fact Mundell advocated both raising the price of gold and the creation of SDRs as ways of preserving the Bretton Woods dollar-gold standard. Mundell (1991), p.223.

[39] There was reason to expect that a country which revalued its gold reserves once might well do so again. This would have given other countries an incentive to shift out of foreign exchange and into gold in anticipation and only accelerated the eventual collapse of the gold-exchange standard. In his own writings, Mundell tends to minimize the importance of this time-inconsistency problem, suggesting that gold revaluation was a viable option for solving not only the problems of the Bretton Woods System but eliminating the excess demand for gold in the Great Depression as well. See Mundell (1995), p.458. Some variants of this proposal (e.g. Rueff 1972) entailed using the profits from the increase in the dollar price of gold to liquidate the outstanding dollar balances. For this to be effective it would have been necessary to proscribe central banks from holding foreign exchange reserves in the future. And, aside from the French, the major governments would have rejected this notion of returning to a pure gold standard. Indeed, Mundell (1973) was opposed to Rueff's solution for a return to a pure gold standard because of its deflationary consequences. We return to this issue below.

[40] In addition, there was the problem that raising the dollar price of gold would reward two pariah nations, the USSR and South Africa, which were major gold producers.

In any case, such a solution would only postpone the inevitable. In a rapidly growing world, it was only a matter of time before the gold scarcity would resurface, precipitating a crisis.[41] Opposition to gold revaluation was shared by most officials and academics, who believed that the creation of the SDR was preferable to attempting to resurrect the gold-exchange standard (Williamson, 1977, p.35).

Keynes had sought to meet this problem by empowering his clearing union to issue "bancor," an international reserve asset that could be used to supplement supplies of the yellow metal.[42] The more conservative US design for the IMF limited countries' right to draw from the Fund to a third of what Keynes proposed and linked those drawings to the gold that governments deposited with the Fund, thereby effectively eliminating its capacity to create paper gold.

As a result, the share of foreign exchange in global international reserves rose over the first two post-World-War-II decades. From the early 1960s members of the Bellagio Group, of which Mundell was a member, sounded warnings and advocated the creation of a synthetic

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[41]For other arguments against this solution, see Williamson (1977), pp. 33-34. For a contrary view see Meltzer (1991). Bordo and Eichengreen (1997) analyze the inevitability of the collapse of a hypothetical gold exchange standard constructed after World War II in a world where the Great Depression and the revaluation of gold to $35 per ounce by the US had not occurred.

[42] In recent writings, Mundell (1983, 1994, 1995) has advanced parallel proposals for the creation of an international reserve money, to be backed in whole or partially with gold, to regulate the global supply of international liquidity.

reserve asset. Such arguments found official expression in the 1963 IMF *Annual Report* and in a 1964 report of a G-10 study group.

The response, an amendment to the IMF Articles of Agreement creating Special Drawing Rights (SDRs), came finally in 1968. The delay reflected divisions between France and the United States and within the US government itself. The Johnson Administration recognized that the creation of the SDR might prevent a crisis of the dollar, but it also worried that the creation of a rival might reduce the US currency's international role. Ultimately the United States conceded that something had to be done because the alternative to the gold-exchange standard was generalized disorder. For the French, on the other hand, the collapse of the gold-exchange standard would make possible a return to a pure gold standard of the 19th-century variety and an end to America's "exorbitant privilege" of underwriting its external deficits courtesy of foreign central banks and governments.[43] Consequently, while other countries favored the creation of SDRs, the French insisted that the scheme be activated only after the United States first eliminated its payments deficit. By the time the US satisfied this precondition in 1969 and the SDR scheme was finally activated, issuing SDRs only served to aggravate worldwide inflation.

The first Triffin-like crisis occurred in March 1968, after the collapse of the Gold Pool established by the US and seven other central banks to reduce the pressure on US reserves. The subsequent creation of a two-tier arrangement within which participants agreed to neither

[43] See Bordo, Simard and White (1995).

sell nor buy gold from the market transformed the Bretton Woods System. The two-tier market demonetized gold at the margin and cut the link between gold production and other market sources of gold and official reserves. Together with the pressure that the US placed on other monetary authorities to refrain from converting their dollar holdings into gold, it shifted the world onto a de facto dollar standard.[44] The final collapse of the system then followed, precipitated by mounting world inflation triggered in part by expansionary US monetary policy, itself a reflection of the growing preference of the monetary authorities for full employment over price stability and budget deficits associated with the Vietnam War and spending on social programs.

As with the breakdown of the interwar standard four decades earlier, Bretton Woods collapsed in the face of growing imbalances between the policies of its principal members. The United States was unwilling to follow the stable financial policies required of the reserve center country, while the major European countries, for their part, were increasingly reluctant to import US inflation.[45] The collapse of the system was symbolized by closure of the US gold window on August 15, 1971, a decision triggered by French and British intentions to convert

[44]See Bordo (1993) and Garber (1993).

[45]A complementary explanation of the events leading to collapse is growing misalignment in real exchange rates between the US and its principal competitors in the face of differential productivity trends. See Balassa (1964) and Marston (1987). In this view, expansionary US monetary and fiscal policies exacerbated the misalignment by further overvaluing the dollar (Obstfeld 1993).

their dollars into gold.[46] The rest is history, as they say: half-baked reforms failed to rise, and by 1973 the Bretton Woods System was no more.

3. Speculations About the Future

A striking aspect of the subsequent system of generalized floating is the continued role of gold. Gold reserves, in ounces, remained basically unchanged for two decades after 1971, notwithstanding the elimination of the last official link between currencies and gold by the Second Amendment to the IMF Articles of Agreement. The dollar value of monetary gold stocks soared, rising six fold at market prices. The other side of this coin (as it were) is that the value of monetary gold reserves failed to keep pace with the value of world trade, which expanded enormously over the period: the global gold/import ratio fell from 15 per cent to 10 per cent over the first two post-Bretton Woods decades. It follows that the ratio failed to keep pace with the growth of total reserves (Figure 1). Still, the persistence of gold in the reserve portfolios of central banks is remarkable.

Only after 1989 did this begin to change.[47] Over the 1990s to date, central banks have sold off about five per cent of their gold. The share of gold in their international reserves has fallen to less than 25 per cent from some 35 per cent in 1989 (market value). In 1992-3 the Netherlands and Belgium sold some 9 million and 5 million ounces, respectively (roughly one quarter and one third of their total reserves). Belgium sold a further 5.6 million tons in 1995.

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[46]The recent definitive treatment of this history is James (1996).

[47]Although both the US and the IMF in fact sold some gold reserves in the 1970s.

Canada reduced its gold reserves from 17 million to 4 million ounces between 1988 and 1995. The Reserve Bank of Australia quietly disposed of nearly 80 per cent of its gold. The Argentine Central Bank sold virtually all its gold reserves in the first half of 1997. In October 1997 a group of experts appointed by the Swiss government proposed that Switzerland sell more than half its gold reserves. The following month the Bundesbank announced that for some time it had been lending part of its gold reserves on the London bullion market.

Together these moves raise the question of whether we are now witnessing a break with the past. To answer that question, we must first understand the reasons for the persistence over the earlier period of the practice of gold reserves. We consider five hypotheses.[48]

A. Memory and Habit

The most popular explanation is memory and habit, specifically, memories of the association of gold with monetary stability and habits derived therefrom. The public -- and for that matter monetary policy makers -- may not understand the connection between gold reserves and price stability, but their recollection of the historical record leads them to believe that such a connection exists. This renders politicians reluctant to modify or revoke the

[48]In a sense, the problem is that we have many explanations and only one data point. But the fact that central banks are now liquidating what may be a substantial share of their gold reserves may help us to discriminate among these hypotheses. An adequate explanation for the phenomenon, in other words, must be capable of explaining both why the practice of holding gold reserves persisted for more than two decades after the breakdown of Bretton Woods and why it declined in the 1990s. In addition, some of these hypotheses can be tested using cross-country and time-series data on central bank portfolios.

statutes requiring the central bank to hold gold reserves for fear of encouraging reckless policies. It renders central bankers reluctant to liquidate their gold reserves for fear of exposing themselves to similar criticism.

It follows that as the gold standard becomes ancient history, memories should fade and with them the association of gold with price stability. As central banks display a growing commitment to policies of stable money even under fiat-money standards, the idea that gold is necessarily associated with price stability should weaken and disappear. Parliaments and presidents who were hesitant to revoke statutes requiring the central bank to hold gold reserves may then finally gain the courage to do so.[49]

B. Lobbying by Gold-Mining Interests

Mining interests lobby for central banks to continue to provide part of the demand for the world's gold stock. They oppose central bank sales of gold for fear that these will drive down the market price of their industry's product. Organizations like the World Gold Council circulate publications arguing the case for the maintenance of gold reserves. But as economic

[49] These arguments suggest a continuous process in which gold reserves are drawn down as the hold of memory and habit gradually loosens. But experience suggests that the process develops discontinuously -- that central banks as a group hold onto the bulk of their gold reserves until they reach a tipping point where they revalue and/or sell off a substantial share of their gold. If so, memory and habit, while part of the story, are at best an incomplete explanation. A counter argument is that memory may be a strictly generational phenomenon. Thus, Lucchetti and Sesit (1997) quote a Bank of England official that central banks are moving to "a new generation of managers who don't carry the baggage of their predecessors." Having grown up in an era of floating exchange rates, Lucchetti and Sesit continue, "younger bankers have no psychological ties to gold, which anchored the post World War II monetary system."

growth proceeds and extractive industries like gold mining account for a progressively smaller share of GNP, there is reason to think that their lobbying efforts will have less effect. Thus, the declining effectiveness of pressure from the gold interests may explain why a number of central banks have begun to draw down their gold reserves.[50]

C. Collective Responsibility

A third possibility is that central bankers feel collective responsibility for supporting the practice of holding gold reserves. If one important central bank begins selling off its gold, others might scramble to do likewise before the market price collapsed, and the practice would disintegrate. Hence, central banks, particularly those holding relatively large quantities of gold, realize that their individual actions may have undesirable systemic repercussions.

This "not-on-my-watch" hypothesis has the merit of consistency with the model of network externalities invoked above to explain the rise of the gold standard. It is consistent with the observation that those central banks which have been in the vanguard of gold sales have been medium sized or relatively small, the implication being that they are least likely to set off a collective scramble out of gold. And it can explain why the process of liquidating gold reserves, once it gets underway, may be sudden and discontinuous.[51]

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[50]What these dynamics cannot explain is why the process should proceed so discontinuously. And if this explanation is generally correct, it is paradoxical that the central banks of countries like Canada and Australia, where the gold-mining industry is disproportionately important, have been among the first to sell off their gold reserves.

[51]Again, however, the explanation is at best partial, for it does not explain why central bankers feel a collective responsibility for the maintenance of the practice in the first place.

D. Gold as a War Chest

Gold has traditionally been held as a war chest. Countries concerned that potential belligerents will not redeem their monetary obligations have an incentive to hold reserves in the form of an asset that is not subject to such risk. Recall the shift out of foreign exchange by Germany and other countries in the years leading up to World War I. It can be similarly argued that East-West tensions encouraged the maintenance of gold reserves after World War II, and that the end of the Cold War has facilitated the decline of the practice.[52]

E. Gold as an Inflation Hedge

A final explanation emphasizes gold's value as an inflation hedge. The return on gold is thought to vary negatively with the return on other assets in high inflation periods, but not necessarily in periods when inflation is low. Hence, central banks, like other investors, will have an incentive to hold gold for portfolio-diversification purposes in high-inflation periods like the 1970s but not in low inflation periods like the 1990s. This explanation has the merit of helping to explain the persistence of central banks' gold holdings into the high-inflation period that followed the breakdown of Bretton Woods and the increasing liquidation of gold reserves starting in the early 1990s, when the transition to low inflation in the major advanced economies had been secured. And in fact, standard calculations confirm that the covariance of

[52]The problem is that those countries which have taken the most dramatic steps to draw down their gold reserves (Canada, Australia and Belgium among them) were never deterred by the threat of Cold-War conflict, one presumes, from holding dollar-denominated assets. Those countries to which this argument most plausibly applies have not been in the vanguard of those drawing down their gold reserves.

the returns on gold and U.S. equities was negative in the high inflation period 1973-83 but positive in the low inflation period 1984-96.[53]

The problem for proponents of this view is to explain why gold has this special characteristic as a regime-specific inflation hedge. It makes sense that investors should want to move into gold and other real assets in periods when inflation is eroding the value of financial assets. But existing accounts of this inflation-hedge story remain incomplete. It is unclear why inflation is not similarly good for equity markets (equities being claims on real assets, in other words).[54] And it is not clear why the correlation between the return on gold and the return on other assets varies as it does with the monetary regime.

4. Evidence

To analyze these issues systematically, we estimated demand-for-reserves functions, relating the log of reserves to measures of economic size (log GNP), openness (the import/GNP ratio), and balance of payments variability (the three year moving standard deviation of the log of exports).[55] We gathered annual data on these variables from 1880

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[53]To be more precise, we calculated the beta on these two asset classes, normalizing the covariance between the two returns by the variance of the return on the stock index. This yielded a beta of -0.85 for gold in the high inflation period but 0.40 in the subsequent low inflation era.

[54]Non-neutralities in the tax system affecting the after-tax value of corporate profits in high-inflation environments have been cited in this connection.

[55]We also included in some of our regressions short-term interest rates and the rate of change in the price of gold as opportunity cost variables. As in other studies, the opportunity cost variable was generally insignificant except in the recent managed float (Landell-Mills,

(continued...)

through 1995 for a sample of 21 countries.[56] We included dummy variables for individual years, since specification tests suggested these were appropriate. And to shed light on compositional issues, we estimated separate equations for the demand for gold or for the ratio of gold to total reserves, depending on the hypothesis under consideration.[57]

Table 1 reports the results for the benchmark specification for total reserves and gold reserves. GNP and the import share enter with their expected signs. The income elasticity of demand for both gold and total reserves is unity or just above. Greater openness as measured by the import share translates into greater demand for both gold and total reserves over the entire period. While export variability enters positively as a determinant of the demand for gold but negatively as a determinant of the demand for total reserves, both coefficients differ insignificantly from zero at conventional confidence levels. Although standard arguments suggest that the demand for reserves should increase with balance-of-payments variability, there are notorious difficulties with measuring balance-of-payments variability independently of the reserve changes that are the variable to be explained. In particular, export variability will be inadequate when shocks to the balance of payments stem mainly from the capital

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[55](...continued)
1989). Hence, these regressions are not reported.

[56]Australia, Argentina, Belgium, Brazil, Canada, Chile, Denmark, Finland, France, United Kingdom, United States, Greece, Germany, Italy, Japan, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland. For the 1880-1913 period because of data gaps we omitted Brazil, Chile, Greece, Portugal, Spain.

[57]Estimating separate equations for both gold and foreign exchange reserves as well as the total would have been redundant, given adding-up constraints.

account, while actual variability will not be appropriate when it is expected (as opposed to actual) balance-of-payments shocks that motivate the demand for reserves. While for all these reasons it is unsurprising that the coefficient on export variability is not well defined, this coefficient still displays the expected positive sign and generally differs from zero at standard confidence levels except in the Bretton Woods period in the case of gold and under Bretton Woods and the post-Bretton Woods float in the case of total reserves. We take these changes over time (specifically, the declining significance of our export-revenue-based payments variability measure) as evidence of the growing importance of capital-account shocks as the period progressed.

To substantiate our interpretation of the timing of successive stages in the development of the gold-exchange standard, we conducted Chow tests for breaks in the demand for reserves. Separately for the prewar era (1882-1913), the interwar period (1923-39), the Bretton Woods period (1951-70) and the floating period (1973-95), we tested for a structural break in each year. The resulting series of test statistics are shown in Figures 2-5. We are interested in identifying the years in which the test statistic peaks, which is the most likely period of structural shift.

Figure 2 suggests a break in the demand for foreign exchange reserves in the second half of the 1890s and in the ratio of gold reserves to total reserves in 1900-1901. (Critical values are 2.37 at the 95 per cent confidence level and 3.32 at the 99 per cent level.) This is

consistent with our interpretation dating the emergence of a global gold-exchange standard as late as 1895 or 1900.

Figure 3, for the interwar period, suggests breaks in the demand for international reserves in 1931, when Britain and other countries abandoned gold convertibility, severing the link between domestic nominal variables and central bank gold reserves, and again around 1935, when the residual Gold Bloc began to splinter. The break in the determinants of the gold/total reserve ratio is centered on 1931; there is no comparable break in the mid-1930s, by which time the foreign-exchange component of the system had been largely liquidated.

Figure 4, for the Bretton Woods period, suggests stability in the determinants of the share of gold in total reserves when the sample is limited to 1959-1970 (a period sometimes referred to as that of the convertible Bretton Woods System). Over the longer period 1951-1970, in contrast, there are breaks toward the beginning of the period, not surprisingly given that foreign exchange was scarce in the early ‘fifties, after which the dollar shortage receded.

Finally, Figure 5, for 1973-95, shows considerable evidence of instability. The Chow tests for a shift in the demand for gold and the share of gold in total reserves peaks around 1987-88, just before gold sales get underway.[58]

One explanation for changes over time in the share of reserves held in gold, suggested by Mundell’s writings, emphasizes the volatility of monetary policy in the reserve currency

[58] The relationship determining the demand for foreign exchange appears to shift earlier, in the late ‘seventies and early-to-mid ‘eighties, a phenomenon for which a myriad of explanations suggest themselves.

countries.[59] We measured volatility as a 3-year moving standard deviation of the log of the monetary base and took the reserve-currency countries to be Britain under the gold standard, the US, the UK and France in the interwar period, the US under Bretton Woods, and the US, Germany and Japan under the post-Bretton Woods float.[60] When we measure policy using changes in the monetary base, volatility enters positively for the heyday of the Bretton Woods System (1959-70), a period when the United States came in for criticism for neglecting its responsibilities as a reserve-currency country, but with a zero coefficient otherwise (see Table 2).[61]

When we measure volatility by the twelve month standard deviation for each year of the exchange rate of the reserve-currency country or countries, we similarly find that volatility encouraged central banks to hold gold rather than foreign exchange in the post-Bretton Woods period of floating (1973-95), but not before (see Table 3).[62] This lends support to the Mundellian view that policy instability in the reserve-currency countries provided a motive for holding gold rather than foreign exchange. Plausibly, the relevant measure of instability was monetary-policy related under Bretton Woods and exchange-rate related thereafter.

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[59]See e.g. Mundell (1983), p. 192 and Mundell (1994), p.22.

[60] Where there was more than one reserve-currency country, we used the three-year moving standard deviation of the log of the aggregate money supplies converted into dollars.

[61] When we measure policy by changes in M2, however, this result evaporates.

[62]For the interwar period we used the pound dollar exchange rate; for the postwar period, the trade weighted dollar exchange rate.

To test Mundell's hypothesis that world inflation after the advent of floating rates stimulated the demand for gold, we add a proxy for this to our specification.[63] In Table 4 we report regressions for the demand for gold and the ratio of gold to total reserves. World inflation enters as predicted only in the post-Bretton Woods years, as if only then was inflation sufficiently persistent that actual inflation predicted future inflation and correspondingly affected the demand for reserves (Table 4).[64] An alternative specification, in which we instead added a high-inflation dummy variable which takes on a value of unity when the inflation rate exceeded 3 per cent, produced basically the same result. These regressions suggest that the shift from high inflation in the period 1973-83 to low inflation in 1984-95 reduced the demand for gold as a share of total reserves by about eight per cent. For the post-Bretton Woods float, then, the results support Mundell's view that rise in inflation in the 1970's increased the demand for gold reserves, while the decline in inflation since the early 1980's reduced it.

To analyze the sources of persistence in the demand for gold reserves, we added three final regressors. One is the lagged dependent variable, which we interpret as a measure of simple inertia or historical persistence. Interpretation of the coefficient on the lagged dependent variable is not straightforward, of course: a large coefficient could indicate that a greater propensity to hold gold reserves in the past has the effect of encouraging the central

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[63]See Mundell (1983, 1994, 1995). We used the weighted average of the G-5 inflation rate and, alternatively, the inflation rates of the same core countries as in the regressions with a measure of the volatility of monetary policy.

[64]For direct evidence on this, see Alogoskoufis and Smith (1991).

bank to hold more gold reserves in the present, but it could also simply be picking up the effects of random factors which cause some countries to hold more gold than others. Some countries may hold unusually high quantities of gold, in other words, because of persistent error terms rather than hysteresis in portfolio behavior per se.[65] A standard approach to estimation in this case is to instrument the lagged dependent variable (Liviatan, 1963). Since the instrumental variables are uncorrelated in the probability limit with the disturbance, substituting the instrumented value of lagged reserves will yield consistent estimates.[66] Here the obvious instruments are lagged incomes, the lagged import ratio, and lagged export variability. Intuitively, including only the predicted, or systematic, component of lagged reserves enhances the plausibility of our interpretation that the lagged value is picking up inertia in the demand for reserves rather than persistent random effects.

Our second ancillary variable is a measure of network externalities, namely, the global gold reserve ratio. If the attractions of holding gold rise with the number of other countries which do the same and with the amount of gold they hold, then a given country's holdings should increase with the global ratio.

Our third ancillary variable measures statutes requiring central banks to hold reserves. If the demand for gold reserves is persistent because statutory requirements are persistent,

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[65] Furthermore, the combination of autocorrelated errors and lagged dependent variables introduces the possibility of biased coefficient estimates due to the correlation between the lagged variable and the error term.

[66] Although those estimates will not be efficient if the adjustment has not deal with the autocorrelation of the disturbance terms.

then this variable should have an independent effect after controlling for other determinants of the demand for reserves. We use a dummy variable for the presence or absence of statutory gold reserve requirements.[67]

When included one at a time (Table 5), each of these ancillary variables enters with its expected positive sign and a coefficient that differs from zero at standard confidence levels. When included together, all three variables matter, although lagged holdings and statutory requirements tend to dominate.

The instrumented lagged dependent variable enters with large coefficients in the gold-reserves equation, suggesting considerable persistence. Statutory requirements are highly significant determinants of the demand for gold in the Bretton Woods years and marginally significant in the interwar years. The fact that the coefficient on this variable is insignificant for our 115 years as a whole reflects its significant negative coefficient for the period 1880-1913. Over much of this period, two of the most important gold standard countries, the United States and France, were not required to hold gold by statute.[68] It is their inclusion that produces the negative coefficient for the gold-standard years. The effect of the global gold

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[67]Unfortunately, we were unable to obtain this information for the post-Bretton Woods period. See Appendix 3 for the individual country gold statutes for the three regimes ending with Bretton Woods.

[68] After France abandoned the free coinage of silver in 1873, she adopted a limping gold standard in which silver remained legal tender although it was not freely coined. Bank of France notes were convertible into gold or silver coin by residents and foreigners only at the option of the authorities. The U.S. officially joined the gold standard in 1900 but it was only with the founding of the Federal Reserve in 1914 that statutory gold reserve requirements were instituted.

ratio is ambiguous: while generally positive in sign, its coefficient differs insignificantly from zero in the demand-for-gold-reserves equation but does differ significantly from zero in the ratio-of-gold-to-total-reserves equation.

On balance, we conclude that there is some evidence supporting all three historical explanations for the persistence of gold reserves: simple inertia, network externalities, and statutory requirements.

To analyze the impact on the demand for reserves of the shift from fixed to floating rates, we added a dummy variable for the exchange rate regime (equaling one for countries with pegged rates, zero for those with floating rates).[69] Table 6 shows the effect of the exchange rate regime on the demand for gold and the demand for total reserves. The exchange rate regime matters in the gold standard years (when it enters negatively and significantly for 1882-1913 and 1923-39 in the equations for both gold and total reserves). This is not surprising; the ability of poor countries with a history of running fiat money systems to accumulate the reserves necessary for the operation of a specie standard was one of the principal constraints on going on gold (Eichengreen and Flandreau 1996). The negative coefficient is again evident in the post-1972 period, especially in the equation for gold; the

[69] The exchange rate regime data were gathered mainly from IMF and League of Nations publications; for help with them we thank Rex Ghosh. For the data on capital controls we are grateful to Gian Maria Milesi-Ferretti.

results thus suggest that countries with floating currencies had a significantly lower propensity to hold gold.[70]

To account for the impact on the demand for reserves of the relaxation of capital controls, we added dummy variables for two measures of capital controls: current account restrictions and capital account restrictions. Tables 7-8 present the results. Countries with such restrictions in place appear to have a significantly greater propensity to hold reserves in general and gold reserves in particular, a result driven largely by behavior in the post-Bretton Woods period.[71] The post-Bretton Woods years are the period of highest capital mobility, so these results support the argument that countries' growing ability to borrow abroad -- an ability presumably not shared by countries with capital controls in place -- diminished their need to hold reserves. In the equations where the dependent variable is gold reserves, current-account restrictions enter with a strongly positive sign, as if the removal of controls leads countries to reduce their gold reserve holdings in particular. A possible interpretation is that countries that seek to integrate themselves into the world economy attach less value to the war-chest argument for holding gold.

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[70] Interestingly, the coefficient for floating-rate countries is positive and significant in the Bretton Woods years. This result is driven mainly by Canada, a gold mining country which held large reserves.

[71] It should be noted that there is, however, evidence that the presence of capital account restrictions significantly *reduced* the demand for gold reserves in the Bretton Woods years. We examined also the effects of the presence of export-proceed-surrender requirements; the results for these were virtually identical to those for capital-account restrictions. In contrast, there was little evidence that the presence or absence of multiple exchange rates had much affect on reserve-holding behavior one way or another.

These results paint a less than rosy picture of the future monetary role for gold. Experience to date suggests that the move to floating rates and international capital mobility has progressively diminished central banks' appetite for gold. Habit, network externalities and lingering statutory requirements have all encouraged the authorities to hold onto their gold reserves for longer than might otherwise be expected. But while these effects introduce persistence into the demand for gold, such sources of persistence tend to die out over time. Each of these sources of inertia in central bank gold holdings is likely to have weaker effects in the future than in the past.

5. Conclusion

Again recapitulating all our results would make a long paper even longer. The briefest summary would emphasize four points.

First, the gold-exchange standard was a relatively recent arrangement that emerged only around 1900 in response to a set of historically-specific factors, factors which also help to account for its smooth operation. How long those factors would have continued to support it will never be known, for a great war and then a great depression intervened before they could be put to the test.

Second, a system which relied on inelastically-supplied precious metal and elastically-supplied foreign exchange to meet the world economy's incremental demand for reserves was intrinsically fragile, prone to confidence problems, and a transmission belt for policy mistakes. Proposals to finesse the liquidity problem through periodic adjustments in the price of gold

were not feasible, given the damage this would do to the credibility of the authorities' commitment to maintain convertibility at the prevailing price.

Third, network externalities, statutory restrictions, and habit all contributed to the persistence of the practice of holding gold reserves. But the hold of even factors as powerful as these inevitably weakens with time. And the effects of their erosion are reinforced by the rise of international capital mobility, which increases the ease of holding other forms of reserves, both unborrowed and borrowed, and by the shift to greater exchange-rate flexibility, which according to our results diminishes the demand for reserves in general.

Fourth and finally, network externalities, in conjunction with central bankers' collective sense of responsibility for the stability of the price of what remains an important reserve asset, suggest that the same factors which have long held in place the practice of holding gold reserves, when they come unstuck, may become unstuck all at once.

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