Federal Reserve Bank of Dallas
Globalization and Monetary Policy Institute
Working Paper No. 201
http://www.dallasfed.org/assets/documents/institute/wpapers/2014/0201.pdf

Stability or Upheaval? The Currency Composition of International Reserves in the Long Run*

Barry Eichengreen
University of California, Berkeley

Livia Chiţu
European Central Bank and Paris School of Economics

Arnaud Mehl
European Central Bank

October 2014

Abstract

We analyze how the role of different national currencies as international reserves was affected by the shift from fixed to flexible exchange rates. We extend data on the currency composition of foreign reserves backward and forward to investigate whether there was a shift in the determinants of the currency composition of international reserves around the breakdown of Bretton Woods. We find that inertia and policy-credibility effects in international reserve currency choice have become stronger post-Bretton Woods, while network effects appear to have weakened. We show that negative policy interventions designed to discourage international use of a currency have been more effective than positive interventions to encourage its use. These findings speak to the prospects of currencies like the euro and the renminbi seeking to acquire international reserve status and others like the U.S. dollar seeking to preserve it.

JEL codes: F30, N20

* Barry Eichengreen, University of California, Berkeley, Department of Economics, 508-1 Evans Hall, MC #3880, Berkeley, CA 94720-3880. Tel: 510-642-2772. eichengr@econ.berkeley.edu. Livia Chiţu, European Central Bank, Kaiserstraße 29, D-60311 Frankfurt am Main, Germany. Tel: + 49-69-1344-86-83. Livia.Chitu@ecb.europa.eu. Arnaud Mehl, European Central Bank, Kaiserstraße, 29, D-60311 Frankfurt am Main, Germany. Tel: + 49-69-1344-86-83. Fax: +49-69-1344-76-66. arnaud.mehl@ecb.europa.eu. We are grateful to Menzie Chinn, Jeffrey Frankel and Morten Ravn for helpful comments. The views in this paper are those of the authors and do not necessarily reflect the views of the European Central Bank, the Eurosystem, the Federal Reserve Bank of Dallas or the Federal Reserve System.

1. Introduction

The currency composition of international reserves has long figured prominently in the literature of international economics. Questions here include what accounts for the continued dominance of the dollar in global foreign exchange reserves: the size of the American economy, the extent of its trade links and the liquidity of its financial markets on the one hand, or inertia and the persistence of past patterns on the other. Subsequently, attention has turned to the scope for the euro to rival the dollar as a reserve currency and at what point the characteristics of the euro area might be such as to encourage central banks to hold euros in amounts comparable or even in excess of their holdings of dollars. And, most recently, investigators have asked when the Chinese renminbi might acquire a significant reserve currency role.[1]

A limitation of previous studies is their very limited evidentiary base. Data on the currency composition of international reserves are made available to the public by only a small number of central banks.[2] The IMF publishes only global aggregates and, recently, breakdowns between advanced economies and emerging and developing countries.[3] Earlier investigators have assembled these aggregated data from the IMF's website and publications starting in the early 1970s, a time that conveniently coincides with the end of the Bretton Woods System, which is sometimes thought to have occasioned a shift in the demand for international reserves.[4]

Investigators using these data have generally found that the demand for a currency as international reserves is strongly increasing in issuing country size, presumably because size is a determinant of the capacity of a country to issue the safe and liquid assets that are attractive as a form of reserves, and also because the availability of reserves in a particular currency plausibly influences how many other countries hold it. Early adoption will then encourage additional countries to hold that same currency in an environment where network effects are important. Such studies also find that persistence is strong, perhaps indicative of habit formation and reluctance on the part of reserve managers to radically alter the composition of their reserve portfolios. Evidence of the importance of policy in the reserve-currency-issuing economies is weaker. For example, inflation as a measure of policy credibility and as a determinant of the rate of return on holding a particular currency shows up as significant in some studies but not in others.

---

[1] For early discussions of the euro's future and a review of the debate by the time of the advent of the single currency, see e.g. Bergsten (1997), Feldstein (1997) and Portes and Rey (1998). Recent reviews of the prospects for the Chinese renminbi as an international currency include Chinn (2012), Subramanian and Kessler (2012), Eichengreen (2013), Prasad (2014) and Fratzscher and Mehl (forthcoming).

[2] Truman and Wong (2006) describe the available data.

[3] These IMF data, also known as the Currency Composition of Official Foreign Exchange Reserves (COFER) data base, are confidential; the individual country data have been used only by two internal IMF staff studies (Dooley, Lizondo and Mathieson, 1989, and Eichengreen and Mathieson, 2001).

[4] See for example Eichengreen (1998), Chinn and Frankel (2007, 2008) and Li and Liu (2008).

But the generality of these findings is an open question, insofar as they are derived from data for a limited period, typically from the final breakdown of the Bretton Woods System to the eve of the euro in 1998. This is a distinctive economic and monetary period, when the dollar dominated reserve holdings and the issuers of other potential reserve currencies, such as Germany and Japan, actively discouraged international use of their national units. The extent to which patterns in this period generalize has not been systematically studied. Whether relationships identified for this period are stable over longer periods of time has not been investigated.

In particular, whether the demand for reserves denominated in different currencies was altered in fundamental ways by the shift from fixed to flexible exchange rates has not been tested systematically. As Frenkel (1978) observed in the wake of the transition to floating, the absence of legal obligation to peg the exchange rate, together with the absence of the associated need for international reserves denominated in the reference or anchor currency (i.e. the US dollar under the Bretton Woods System), could in principle have fundamentally altered the demand and composition of reserves. In theory, flexible exchange rates could have enabled countries to economize on reserves, and specifically on the dollar reserves that were the principal vehicle for foreign exchange market intervention in the earlier period.

But this hypothesis, which we term the "upheaval hypothesis," could not be tested because the data did not provide much information on the currency composition of reserves for the pre-floating-exchange-rate era – that is, from the late 1940s to the early 1970s.[5] Relatedly, the sample of observations available to earlier researchers investigating structural instability in the demand for reserves in the 1970s and 1980s was too small for definitive conclusions.[6]

This is our motivation in this paper for extending the data base on the currency composition of international reserves backward and forward in time. Our time series span the two-thirds of a century from 1947 to 2013. We ask whether standard specifications fit to data for the fourth quarter of the 20th century also fit this longer time span. We investigate possible structural breaks in the determinants of the currency composition of international reserves around the time of the collapse of the Bretton Woods System.

Like previous studies, we find strong size network and persistence effects, along with policy-credibility effects, as determinant of reserve currency status. In addition, we find evidence of a structural shift in the determinants of reserve currency shares around

[5] A partial exception is Schenk (2010), who assembles data on the share of the dollar, sterling and a residual "other currencies" category for the period 1950-1982.

[6] For instance, Heller and Kahn (1978) examined whether there was a change in the demand for international reserves in 1973 due to the change from fixed to floating exchange rates, using data for the period 1964-76. Their results suggest that there was indeed a shift by industrial countries but not by non-oil developing countries. However, Heller and Kahn also stressed that they had a very short period available for formal statistical testing and that their conclusions should at best be regarded as preliminary (see also Crockett, 1978; Saidi, 1981; and Levy, 1983).

the time of the breakdown of the Bretton Woods System, with persistence and credibility effects growing stronger and network effects weakening.

The long time-span covered by our new series also enables us to consider the policies that governments and central banks have pursued to encourage or discourage the international use of their currencies, policies that to our knowledge have not been systematically studied before. We assemble new data on these policies and examine their importance. We find that it has been easier historically to discourage than encourage the use of a currency as international reserves. Intuitively, binding capital controls and related policies suffice to discourage international use of a country's currency. Conversely, while opening the capital account is helpful for enhancing the attractions of a currency as international reserves, doing so is not sufficient, by itself, to result in significant adoption. Fostering international use presupposes, among other things, building deep and liquid financial markets and creating confidence in the future policy, steps that require more than short-run policy interventions. It follows that negative policies designed to discourage international currency use have a stronger short-run impact than positive policies to promote it.

The next section of the paper provides an overview of the data. Section 3 then describes the econometric methods used to estimate their determinants. Section 4 reports and interprets basic findings, while Section 5 provides some robustness checks. In Section 6 we discuss further results, notably those for the effects of policy variables, while Section 7 concludes.

2. Overview of the Data

Our data on the currency composition of foreign exchange reserves are drawn from a volume published by the International Monetary Fund to take stock of its first 20 years of existence (Horsefield, 1969), which we used to gather data for the late 1940s and the 1950s; from the Fund's annual reports, which we used to gather data for the 1960s, 1970s, 1980s and 1990s; and from the COFER data base, which provided data for the period 1999-2013. (See Appendix 1 for details on how the data were assembled.[7])

These sources report reserves held in U.S. dollars (including Eurodollars) and British pounds from 1947, in French francs and German deutschemarks from 1970, and in Dutch gilders, Swiss francs and Japanese yen from 1973. Reserves held in ECU were reported starting in 1987. The franc, deutschemark, gilder and ECU were then succeeded by the euro starting in 1999. Australian dollar and Canadian dollar reserves are reported

[7] Throughout, these are "allocated" foreign exchange reserves; there is also a residual unallocated component, attributable to central banks that decline to report the currency composition of their reserves (including certain major official reserve holders in Asia, which we do not analyze – more on this below).

starting in 2012.[8] In all, eleven currencies were at one point or another reported as reserve currency units by the IMF.

An important issue is whether to adjust the data for valuation effects due to exchange rate changes. These can produce changes in the value of foreign reserves held in different currencies without any action by central banks holding reserves. While the early empirical literature on the currency composition of foreign reserves ignored this complication, recent studies have computed currency shares at constant exchange rates and shown that such valuation effects can be important.[9] We report results both with and without valuation adjustments.

Note that reserves held in different currencies are available at the aggregate level only, not for individual countries.[10] Inability to use panel-data methods is not of concern for our purpose, however. We are mainly interested in testing the "upheaval hypothesis" and understanding the role of common forces affecting all reserve holders over the long run. What matters most for this is the time dimension, which is emphasized in our new data set.

Figure 1 shows the currency composition of foreign reserves since 1947. A striking feature of the figure is the dominance of the British pound in the aftermath of World War II, when it accounted for more than 80 per cent of foreign exchange reserves. This is then followed by a sharp reversal, with the dollar quickly overtaking sterling and accounting for more than 50 per cent of identified foreign exchange reserves by the early 1950s. The dollar's rise then continues through the mid-1970s.[11] Sterling's share similarly continues to decline, reaching the low single digits at around the same time.

Some fluctuations around these trends plausibly reflect exchange rate changes. For example, the dollar's declining share of global reserves after 1976 in part reflects the dollar's depreciation in the course of the subsequent decade, interrupted by its recovery in the first half of the 1980s (Frankel, 2007). Sterling's accelerating fall in the late 1960s and early 1970s similarly reflects the impact of the devaluation of the pound around the time of the collapse of the Bretton Woods System, just as its further drop in 1976 reflects

[8] For part of the period there is in addition a small residual category of "claims in other currencies." Before 2005 the IMF did not distinguish between reserves in "other currencies" (reserves whose currency of denomination was reported but which was other than one of the currencies distinguished in its reports) and reserves whose currency of denomination was not reported to the Fund. In 2005 the IMF revised its data back to 1994, distinguishing the two types of "others." However, since we do not have information on the distinction prior to 1994, we do not analyse the "other currencies" category prior or subsequent to this.

[9] See Truman and Wong (2006) and Ouyang and Li (2013), for example. See also Dominguez, Hashimoto and Ito (2012) for an attempt to estimate valuation effects as determinants of changes in reserve composition in emerging markets in early stages of the global financial crisis.

[10] Countries typically do not publish the composition of their reserve holdings. Short time series have been published by some countries, however (see ECB, 2013).

[11] This is the case of Eurodollar assets, which are included along with U.S.-issued reserve assets denominated in dollars.

in part the balance-of-payments and currency crisis that year.[12] This is an indication that it will be important, especially when considering relatively short-term fluctuations, to analyze currency holdings at constant as well as current exchange rates (contrast Figures 1 and 2).

Starting in the 1970s we then observe the rise of the deutschemark and the euro as international reserves. The lines representing these currencies trend upward until the outbreak of the euro area sovereign debt crisis in 2010.[13] We also see the rise and fall of the Japanese yen, whose share in global reserves peaks in the late 1980s and early 1990s, coincident with the end of the "bubble economy" and the onset of the Japanese economic and financial crisis, along with the rise of various subsidiary reserve currencies.

Figure 3 shows these developments from another perspective. It plots the Hirschman-Herfindhal (HH) index for the concentration of foreign exchange reserves from 1947 through 2012, where a value of unity indicates total concentration of reserves in one currency. Two versions of the index are displayed: the simple HH index, and the index adjusted for the number of currencies in the global reserve portfolio.[14] The indices confirm the high concentration of reserves in one currency (sterling) immediately after World War II, the subsequent rapid fall in concentration as sterling is liquidated and the dollars are earned, then the growing concentration of reserves in dollars in the 1960s and 1970s, and finally very gradual movement in the direction of less dollar-concentrated reserve portfolios.

Still, it is the reversal of fortunes at the beginning of the period that is the figure's most striking feature. Understanding how this came about requires first understanding why sterling appeared so dominant after World War II. Sterling and the dollar each accounted for roughly 40 per cent of global foreign exchange reserves in the 1920s and early 1930s (Eichengreen and Flandreau, 2009). Britain and America's departures from the gold standard in 1931 and 1933 then led foreign central banks to liquidate their sterling and dollar holdings. France and other members of the gold bloc continued to hold limited amounts of dollars, as did a number of Latin American countries. The Central European countries that relied on exchange control to manage their balances of payments in the 1930s partially rebuilt their sterling reserves after 1933, as did the Scandinavian countries, which were de facto or de jure members of the sterling bloc. Nonetheless, reserves held in sterling and the dollar were small in the late 1930s by the standards of both the 1920s and the period after World War II.

The overwhelming dominance of sterling in 1947 thus reflected the willingness of the United Kingdom's wartime allies to accept sterling-denominated claims on the British government in payment for materiel provided to the British economy and its armies overseas. Many of the sterling balances held in 1947 were accumulated in these special

[12] See Cairncross and Eichengreen (1981) and Burk and Cairncross (1992).

[13] The impact of the crisis on the euro's international role is analyzed by ECB (2013).

[14] A number that rose with time, most notably in the 1970s, when the two lines in the figure converge.

wartime circumstances. It followed that many of sterling's holders wished to transform it into other reserve assets as soon as permitted, where the dollar was the obvious alternative, or to use it to purchase merchandise (that is, to liquidate it entirely), which they did over time. Hence the reversal of fortune evident in Figure 1.

The constraints on these operations were several. First, there were regulatory restrictions. Britain imposed regulations limiting the conversion of sterling balances held in London by overseas official and private holders, and it negotiated similar regulatory arrangements with other countries. Some of these "blocked" sterling balances could be used for purchases of merchandise and/or other assets within the sterling area (the group of countries that held most or all of their reserves in sterling in London, pegged their exchange rates to sterling, and maintained a common system of exchange controls vis-à-vis the rest of the world) but not elsewhere, and specifically not for purchases of dollars or payments to the so-called dollar area. In addition to members of the sterling area, sterling reserves were also held by members of the so-called transferable account area. Its members, mainly European countries, were permitted to use their sterling reserves for payments between transferable accounts and sterling area accounts but not for payments with members of the dollar area (so-called American account countries).[15]

The effect was to limit the scope for converting sterling into dollars or using it to purchase merchandise, in the dollar area in particular. Sterling could be redistributed among sterling area countries, but their governments and residents could liquidate their sterling reserves only by using them in settlements with the United Kingdom itself, which maintained a variety of trade and capital controls to limit the practice.

To be sure, controls could be evaded, and some sterling balances, such as the sterling earnings of American account countries, were freely convertible into dollars. But such conversions were limited by a second factor, namely the danger of capital losses on residual sterling balances if the resulting loss of reserves by the U.K. forced it to devalue the currency, as in 1949.[16] Avoiding self-defeating action was not easy, however, since it required collective action, and since the incentive remained for individual parties to surreptitiously diversify if they could get away with it. The relatively elaborate sterling, transferrable and American account arrangements of the late 1940s can be thought of as monitoring and enforcement technologies designed to support such collective action and prevent the disorderly liquidation of sterling reserves.

Finally, there were political constraints. Many of the postwar holders of sterling were Britain's wartime allies. Many shared a common colonial heritage and were members of the British Commonwealth. This caused governments to hesitate in taking steps to maximize the value of the national reserve portfolio at the expense of the U.K. and the rest of the sterling area.

---

[15] Details on these arrangements may be found in Schenk (1994, 2010).

[16] The dilemma was analogous to that facing 21st century emerging markets holding mainly dollars as reserves in periods when questions are raised about the prospective stability of the dollar. Diversifying out of dollars may precipitate the dollar depreciation that portfolio managers fear if it goes too far, too quickly.

3. Specification

Our basic specification relates foreign currency holdings to a lagged dependent variable, issuing-country size and exchange rate appreciation. The lagged dependent variable aims to capture persistence or inertia effects of the sort discussed in Triffin (1960).[17] Relative size can be motivated by theoretical models of random matching games that see the emergence of international currencies as the solution to a "double coincidence of wants" problem where the incentive of an agent to accept a nation's currency depends how often he/she trades with a national from that country, as discussed in e.g. Matsuyama, Kiyotaki and Matsui (1993). We measure relative size as the share of a reserve currency issuing country in global GDP, taking data from Maddison (2010).

This is a good place to highlight the distinction between network effects and persistence and to emphasize that one does not imply the other. Persistence can have other sources besides network effects giving rise to first-mover advantage. Examples include habit formation or the absence of low-cost alternatives to the dominant unit for providing reserves on the scale demanded. Conversely, network effects may increase the attractions of a particular standard (in this case, a currency standard) at a specific point in time without preventing market participants from shifting to another standard at the next point in time, assuming that mechanisms making for lock-in are weak and agents can coordinate their actions (as argued by David 1986, 1990). The success with which open standards for personal electronics have been developed in recent years, weakening lock-in and facilitating shifts between operating systems, illustrates the point (see West, 2007).

The credibility term is motivated by the idea that exchange rate depreciation can make holding a currency unattractive and discourage its international use (and conversely appreciation), as in Devereux and Shi (2013). We proxy credibility effects with the average rate of currency appreciation vis-à-vis the S.D.R. basket over the preceding five years, in the spirit of Chinn and Frankel (2007).[18]

In focusing on the lagged dependent variable, country size and exchange rate trend appreciation in our baseline specification, we follow the existing empirical literature (see e.g. Chinn and Frankel, 2007, 2008; and Li and Liu, 2008). Similarly, in interpreting these variables in terms of persistence, network and policy-credibility effects, we build on analytical models emphasizing these factors. The idea that network effects are an important determinant of international currency choice was analyzed by Krugman (1980, 1984), who focused on the increasing returns and multiple equilibria that result from economies of scale in a partial equilibrium model of currency exchange. In his model, a collective choice to engage in trade using a particular unit reduces transactions costs, in turn further encouraging the practice. Strategic externalities and economies of

[17] See also Krugman (1980, 1984), Matsuyama, Kiyotaki and Matsui (1993) and Rey (2001).

[18] We calculate trend appreciation using data from the IMF's *International Financial Statistics*.

scale also feature in the random matching game of Matsuyama, Kiyotaki and Matsui (1993). Rey (2001) stresses the self-reinforcing effects on transaction costs of using a particular unit in foreign exchange markets arising from the pattern of real bilateral trade (what she calls "thick market externalities"). Devereux and Shi (2013) take the argument to a dynamic general equilibrium model in which vehicle currencies enable agents to economize on the number of currency trading posts.[19]

Of course the assumption that country size is the best, or for that matter an adequate, measure of these network effects can be disputed. In what follows we consider also alternative proxies, such as the volume of the issuing country's foreign exports or market liquidity, which is often thought to be important to the choice of a particular unit as a reserve currency (as in e.g. Portes and Rey, 1998 and Papaioannou and Portes, 2008).

Similarly, persistence effects reflecting habit formation have been considered in the earlier analytical literature (see e.g. de Vries, 1988). Again, however, whether our proxy, the lagged dependent variable, is in fact capturing habit formation as opposed to serially correlated omitted variables can be questioned. Long ago, in early econometric work on partial adjustment models, Griliches (1961) suggested instrumenting the lagged dependent variable as a means of addressing this problem. We implement a version of his approach in Section 5 below.

Analogously, it can be questioned whether contemporaneous exchange rate changes are the best measure of policy credibility. To address concerns about the adequacy of the proxy, in further robustness checks we consider also annual CPI inflation rates, exchange rate volatility, the level of public debt, bond yields, and the current account balance as additional measures of policy credibility (again in Section 5 below).[20]

Finally, we take advantage of the long span of our sample period to assemble information on policy measures taken by the major reserve currency issuers (the U.S., the U.K., Germany and Japan) to encourage or discourage use of their currency as international reserves. These include whether the capital account was open or closed, whether the stated position of the authorities in the issuing country was supportive or opposed, and whether exchange rate arrangements and agreements were supportive in the sense we define below. In constructing these measures we draw on a large range of sources, including Fukao (1990), Henning (1994), Schenk (2010), Tavlas (1991), Takagi (2011) and Takeda and Turner (1992).[21]

[19] A different approach is that of Lyons and Moore (2009) who develop a model in which the pattern of currency trade is driven not by merchandise trade but by asset trade and the information it conveys. In their model, if the information available to market participants is insufficiently symmetric, currency pairs never trade directly and an international (vehicle) currency is used instead.

[20] We take data for these variables from the IMF's *International Financial Statistics, Global Financial Data* and Fratzscher, Mehl and Vansteenkiste (2011).

[21] An overview of the resulting indices is in Appendix 2.

We include time effects throughout. Doing so is important given that our data span a long period by the standards of the previous literature. The time effects capture changes in the structure of the international monetary and financial system as well as other global changes in the world economy for which we do not otherwise control.[22] In addition, we estimate the resulting equations with random country effects to account for unobserved country-specific variation.[23]

This is an unbalanced sample by currency and year, raising the question of how to treat the missing observations. One option is to proceed with the unbalanced panel, because these are the data that official sources provide. Another is to fill in values of zero for the missing observations, since the IMF presumably saw no need to report reserves held in French francs and deutschemarks before 1970, or gilder, Swiss francs and yen before 1973 or Australian dollars before 2012 because such holdings were very small (effectively zero by the standards of reserves held in the form of U.S. dollars).[24] We report results using both procedures in what follows.

To test for shifts around the time of the collapse of Bretton Woods, we interact these variables with a post-1973 dummy variable. We test for changes in the overall relationship and in the sign and size of the individual coefficients. In robustness checks we also run rolling Chow tests to investigate whether years other than 1973 qualify as breaks.

4. Results

Tables 1 and 2 summarize the basic regression results when the share of identified foreign exchange reserves held in a particular currency purged of valuation effects is used as the dependent variable. Column 1 reports basic results with the three basic explanatory variables. Column 2 is then for the pre-1973 period and column 3 for 1973 on. Column 4 includes interaction terms with a post-1973 dummy variable as a way of

[22] Including an entire vector of year effects would absorb all time series variation common to all currency units and introduce a large number of additional coefficients to be estimated. We therefore included instead a vector of non-overlapping five-year effects.

[23] Earlier studies for shorter periods have similarly used random country effects (e.g. Ouyang and Li 2013). Estimates obtained with fixed effects yield economically implausible coefficients for the size variable, and are probably distorted by the time fixed effects (insofar as the estimates become close to those obtained with random effects, once we do not include time effects). The Hausman test rejects random effects relative to fixed effects at the 10% level of confidence only. We also correct for heteroskedasticity and clustering when computing panel-consistent standard errors. One might also wish to correct for left-censoring of the estimates that include values of zero with Tobit estimates (which also means dropping the correction for heteroskedasticity and clustered heterogeneity, implying inefficient standard errors). We report Tobit estimates in robustness checks, together with system GMM estimates to account for possible endogeneity arising e.g. from the dynamic specification of our model (see Section 5 below).

[24] Just as reserves held in other currencies were even smaller throughout the period and are therefore not reported.

testing for post-1973 structural shifts. Table 2 substitutes zeroes for missing observations of the dependent variable in Table 1.[25]

The basic results are consistent with what previous investigators found for the recent period, albeit with some differences. Consider Table 1. Evidence of persistence is strong; a coefficient of 0.9 on the lagged dependent variable indicates a half-life of roughly seven years. This suggests that, in order to adequately understand the evolution of currency shares, it is important to consider medium-term evolutions, as we do here. But this point estimate also indicates that the share of a currency in global reserves can be halved in less than a decade, which is what happened to sterling between the mid-1960s and early 1970s. The coefficient on size is important throughout, consistent with the emphasis of previous authors on network effects.[26] The full sample estimates reported in column 1 suggest that the short run (one year effect) of an increase in a reserve-currency-issuing country's share of global output of 10 percentage points corresponds to an increase in the share of its currency in global reserves of roughly two percentage points in the short run and almost 30 percentage points in the long run.

The effects of policy credibility as measured by the trend rate of appreciation of the exchange rate are more complex. Previous studies reported mixed results for this variable; our results are mixed as well. In Table 1 policy credibility shows up as positive after 1973, as expected, but significantly negative, somewhat counter-intuitively, before. In Table 2, where we add the zero observations, however, the policy credibility measures for the pre-1973 period turns positive, though it is insignificantly different from zero.[27] The safest interpretation would appear to be that policy credibility had weaker effects before 1973 than after. Tables 3 and 4 show that most of these results carry over when

[25] This will be evident from the increase in the number of observations.

[26] Chinn and Frankel (2007), and other authors following them, suggest that the relationship between reserves in a particular currency and the issuer's relative economic size should be nonlinear, an effect which they seek to capture with a logistic transformation of the dependent variable. A logistic transformation of the dependent variable is not practical here because such a nonlinear transformation may lead to inconsistent estimates (especially when reserve currency shares are close or equal to zero). In their original discussion of the issue, which arose in the context of log-linearized versions of the gravity model of trade, Santos-Silva and Tenreyo (2006) stressed that nonlinear transformations of the dependent variable may lead the error term to depend on the regressors in the presence of heteroskedasticity, which violates the conditions for OLS consistency. Moreover, they show that zero observations create a related bias. Insofar as zero observations evidently occur for small reserve-currency-issuing countries, as is our case here, this again suggests that the errors may depend on the regressors (recall that one of them in our equation is country size). This may again lead to possible inconsistent estimates. Note that when we include both relative country size and relative country size squared (to capture nonlinearities in country size), their coefficients are individually indistinguishable from zero (although the two size terms are jointly significant).

[27] Arithmetically, the negative coefficient on the credibility-related exchange rate term for the period before 1973 reflects the fact that sterling depreciated on two occasions in this period, when the share of sterling reserves was relatively high, and that the deutschmark appreciated in the early 1970s, when the share of deutschmark reserves was low.

we instead compute currency shares without adjustment for valuation effects, as in earlier studies.[28]

Comparing our results for the full sample period with the benchmark linear estimates of Chinn and Frankel (2007, Table 8.4, p. 303), our estimates of the size effect (designed to capture network effects) are about twice as large (but they are exactly the same when we restrict the estimation period to post-1973, as they do). Those of the lagged dependent variable (designed to capture persistence effects) are the same. And the estimate for the exchange rate trend (designed to capture credibility effects) is essentially identical to theirs, except that in our sample it is statistically significant.[29]

However, there are significant differences between sub-periods, lending support to the "upheaval hypothesis" that the collapse of Bretton Woods occasioned a fundamental change in the determinants of the composition of reserves. Consider again Table 1. The coefficient capturing network effects is much smaller in the second period than in the first. The change in magnitudes is statistically significant at the 1% confidence level.[30] This evidence suggestive of a weakening of network effects is consistent with the so-called "new view" of the international monetary system (see e.g. Eichengreen, Chiţu and Mehl, 2014) in which, due to the weakness of network increasing returns, there is more space today for multiple reserve currencies to coexist. At the same time, there is evidence of an increase in persistence. The coefficient on this variable is larger after 1973 than before, and the difference is statistically significant at the 5% level of confidence.[31]

These results are intuitive. That inertia is stronger post-Bretton Woods reflects the fact that the post-1973 period has not seen a rapid shift from one currency to another comparable to the shift from sterling to the dollar that occurred between 1947 and 1973. Before 1973, serious doubts about the prospects for sterling as a reserve currency caused reserve managers to question their habits and move away from the currency; that the United States has, for the most part, avoided creating equally serious doubts about the dollar has allowed persistence effect to, well, persist. That network effects are less strong is similarly intuitive. Financial and transactions technologies have continued to advance.

[28] Table 3 reports results with missing observations and Table 4 without. The main difference is that the interaction term for policy credibility and the post-1973 period dummy in column 4 is now insignificantly different from zero. That this result changes is not surprising, since allowing for exchange rate effects in the dependent variable creates the potential for spurious correlation with the exchange rate when the latter is included as an independent variable. We are therefore more inclined to trust the estimates of credibility effects in Tables 1 and 2.

[29] Note that we compute the exchange rate as SDRs per national currency unit, whereas Chinn and Frankel compute it as national currency units per SDR, which explains the difference in the reported sign of the effect.

[30] According to a Chow test.

[31] Our most extensive discussion of the "old" and "new" views is in Chitu, Eichengreen and Mehl (forthcoming). In practice, the large coefficient on the lagged dependent variable (evidence of significant – but not insurmountable – persistence effects) may reflect the obstacles to the quick liquidation of sterling reserves discussed in Section 3.

Currency swap markets have developed. Hedging instruments have proliferated. Information on foreign exchange markets has become more freely available. All this has allowed central banks and others engaged in international transactions to conduct their transactions – and hold reserves against associated contingencies – in currencies other than the dominant one(s) without incurring costs as large as before, thereby weakening network effects.

The alternative to using historical information and priors as a basis for hypotheses about structural shifts in the relationship between reserves and their determinants is to let the data speak. When we run rolling Chow tests for the coefficients on persistence, issuing-country size as a proxy for network effects, and policy credibility, the test statistic is largest in 1960. This was the year when US official foreign monetary liabilities first exceeded US gold reserves and when Triffin (1960) warned that a run by official foreign creditors that would exhaust US gold reserves was now possible. There is evidence of another structural break in 1966. This was the year preceding the second post-World War II devaluation of sterling, which was already then of great concern to investors, and was followed by another discrete decline in sterling reserves. It was the year immediately before France's withdrawal from the Gold Pool, which collapsed shortly afterwards, under which the United States and European countries holding dollar reserves agreed to reimburse the United States for a portion of the gold it lost when other countries converted their dollars into gold.[32] It was also a year of heightened concern over the future of the Bretton Woods System and hence of the dollar peg.[33] The only other Chi-square-statistics that come close to rivaling the 1960 and 1966 values are in 1973-4, the first years of the floating exchange rate era, in line with the "upheaval hypothesis."

Dividing the sample in 1966 as opposed to the early 1970s has minimal impact on point estimates and confidence intervals.[34] Nonetheless, the fact that the sharpest shift in the relationship between the currency denomination of foreign reserves, on the one hand, and persistence, issuing-country size and policy credibility, on the other, occurs in the 1960s rather than in 1971-4 highlights how contemporaries may have overestimated the extent to which the actual collapse of Bretton Woods would tarnish the attractions of the dollar. It highlights how they may have overestimated the extent to which the demand for and composition of reserves would be altered in fundamental ways by the *actual* shift from fixed to flexible exchange rates, as opposed to *anticipations* thereof.[35]

[32] The Gold Pool is the subject of Eichengreen (2007), Chapter 3.

[33] One indication is that there is a sharp local peak in the number of books citing Bretton Woods, according to Google's Ngram Viewer around 1966-1968. 1968 was in turn a key year in negotiations to create Special Drawing Rights as a possible alternative to dollar reserves; an amendment to this effect to the IMF's Articles of Agreement was drafted and ratified by a growing number of countries in the course of the year, although the amendment only came into effect in 1969 and actual SDRs were only issued (in small amounts) starting in 1970.

[34] Note also that dividing the sample in 1960 leaves too few observations for meaningful estimates for the preceding period.

[35] As aforementioned, see e.g. Frenkel (1978) and Heller and Kahn (1978).

But regardless of whether one places the shift in 1960, 1966 or the early 1970s, our results are consistent with the fact that the determinants of the demand for and composition of international reserves fundamentally changed by the time of the breakdown of Bretton Woods.

5. Robustness

We subjected these results to a number of robustness tests, which confirm our main findings. We examined the impact of financial market development and liquidity, emphasized previously by inter alia Portes and Rey (1998) and Papaioannou and Portes (2008). Following Chinn and Frankel (2007, 2008) we added (the logarithm of) foreign exchange market turnover (in billions of US dollars) as a measure of liquidity. This required us to limit the sample to the period since 1973 due to the unavailability of earlier data on turnover.[36] The new variable enters with a positive coefficient indistinguishable from zero, although it is difficult to say whether this reflects the absence of an effect or the more limited sample size (see the first column of Table 5).

An alternative is to use stock market capitalization relative to GDP as a measure of financial market liquidity and development, in the manner of Rajan and Zingales (2003).[37] We constructed estimates of stock market capitalization by taking data from Rajan and Zingales (2003) and Beck et al. (2009).[38] The estimates, reported in columns 2 to 5 of Table 5, again show market development and liquidity as entering with an insignificant coefficient and adding little to the variation explained by the equations in Section 4.[39]

In Table 6 we controlled for a number of additional potential determinants of reserve currency choice, such as the public debt-to-GDP ratio, fiscal balance-to-GDP ratio, current account balance-to-GDP ratio, volume of exports in goods, long-term bond

[36] Foreign exchange turnover was taken from the BIS Triennial Surveys of global foreign exchange market activity back to 1986 as well as from G30 and national central bank reports for the period 1973 to 1986, as in Chinn and Frankel (2007, 2008). Following the practice of these other authors they were linearly interpolated to annual data.

[37] Chen, Peng and Shu (2009) and Huang et al. (2014) use stock market capitalization as a measure of liquidity and financial development and find that it is economically important and statistically significant in the recent period. A further alternative would be to use bond market capitalisation as a metric, but data then would have an insufficiently long time span: BIS data usually go back to the mid-1990s and those from Beck et al. (2009) to the late 1980s.

[38] We used the Rajan and Zingales (2003) data for the period 1950-1999 (linearly interpolated to annual data) and the data in Beck et al. (2009) for the period 1999-2013. The data on nominal GDP were taken from the IMF's *International Financial Statistics*.

[39] Another alternative still is to substitute the log level of market capitalization for country size. In this case, stock market capitalization enters positively (but insignificantly) before 1973, while the interaction term for the post-1973 is negative (but also insignificant). This echoes the pattern found in the baseline model for economic size. Hence it is hard to know whether results obtained using this specification are in fact capturing the effects of market development and liquidity, or those of country size, with which market capitalization is correlated. This causes us to prefer the results shown in Table 1 and discussed in the text.

yields, exchange rate volatility (as estimated from GARCH(1,1) models (which may be thought of as alternative measures of policy credibility), as well as reserve-currency-country exports of goods (which might be thought of as an alternative measure of network effects). The results are reported in columns 1 to 6, respectively. The main results were again robust to these changes. In particular, the coefficients on persistence, network effects and credibility were little different from those obtained with our basic model in Table 1. There was similarly little change in the estimated structural shifts pre- and post-1973. Of the additional control variables, only public debt and the fiscal balance enter significantly. This is consistent with Frankel (2013)'s observation that the two periods when the downward trend in the dollar's share starting in the mid-1970s paused – namely the 1990s and the most recent few years – are also the two periods when the US budget balance improved.

In addition, we estimated the same equation excluding the euro and replacing the exchange rate trend with CPI inflation as still another measure of policy credibility (the results are not reported for sake of brevity). The main findings were robust to these changes as well.[40]

In Table 7 we report panel Tobit estimates to control for the boundedness of reserve currency shares, which may lead to censoring insofar as several units bounce close to near zero values, while only a few are closer to the distribution's center (as noted before, one then has to forego robust standard errors adjusted for clustering). The results are again unchanged from those for our basic model in Table 1. The estimates of column 4 (where we allow for the possibility of a structural break in 1973) are virtually identical to those in Table 1.[41]

Finally, in Table 8 we adjust for possible endogeneity using GMM. The estimation results are obtained with a collapsed set of instruments, as suggested in Roodman (2009), in order to minimize instrument proliferation bias.[42] These new estimates are again very close to those obtained with our baseline specification.

[40] One exception was that the effect for the credibility of policies measured by inflation rates was found to have weakened post-1973 (not increased). This is likely to reflect the correlation between relatively high British inflation and the falling share of sterling in international reserves over the earlier period. U.S. inflation in the later period, evidently, had a smaller and less significant effect, on the other hand.

[41] The reason is that we have no right/left-censored variables, in fact, so that Tobit estimation is actually not needed. When we obtain estimates without missing observations, the standard errors become quite large, however, which might be due to the fact that they are not robust to heteroskedasticity.

[42] In constructing the instrument matrix, we treated persistence, size and credibility as endogenous and the year dummies as exogenous. The very high *p*-value of the Hansen statistic (which overwhelmingly suggests that the instruments are orthogonal) likely indicates that the number of instruments remains still very large relative to the number of currency units despite the Roodman (2009) correction. Moreover, there is evidence of significant dynamic effects at only the 25% level of confidence, as measured in the first-order serial correlation of the first-differenced disturbances of the estimated models (and evidence of second-order serial correlation in two specifications).

6. Policy Variables

The long span of our new series allows us to consider whether, not only factors like persistence, network effects and credibility, but also policies to encourage or discourage the international use of particular national units had a bearing on international reserve currency status.

One potential explanation for the continued dominance of the U.S. dollar is the reluctance of other countries to permit international use of their currencies. Germany in the 1960s and 1970s used capital controls and other measures to limit the accessibility and liquidity of the deutschemark as a way of discouraging central banks from holding deutschemark reserves, on the grounds that their doing so might undermine the Bundesbank's efforts at inflation control. Japan between the 1950s and the early 1980s similarly maintained a panoply of controls and regulatory restrictions designed to limit official foreign holdings of the yen, on the grounds that such holdings would complicate its pursuit of industrial policies.

We consider measures adopted to support and discourage use of their national currencies as foreign reserves by these two countries and, in addition, by the United States and the United Kingdom.[43] The UK, as noted, took a variety of steps in the 1940s and 1950s to limit the liquidation of sterling reserves; subsequent policy initiatives, such as the City of London's financial "big bang" liberalization in 1986, can be seen as supporting sterling's international role. The United States for its part adopted a number of policies to support the dollar's international role, such as the Interest Equalization Tax in 1963 and the Voluntary Credit Restraint Program in 1965, designed to limit capital outflows, stem gold losses, and foster confidence in official convertibility of the dollar. We distinguish four categories of measures related to: (a) regulation of the capital account of the balance of payments, (b) official positions and verbal interventions on internationalization, (c) reform and regulation of the exchange rate system-cum-regime, and (d) other miscellaneous measures. Under each category we further distinguish measures designed to encourage international use of the currency from measures to discourage it. This gives us a total of eight dummy variables capturing eight categories of potential policy effects.

Figure 4 provides an overview of the measures. Policy measures that aim to discourage international currency use are shown as negative entries to facilitate visual interpretation. However, they are coded as standard 0/1 dummies in the empirical estimations, in the same manner as policy measures that aim to explicitly encourage international currency use.

The results, in Table 9, confirm that policies matter, but not all policies and not all in the same way. In particular, it would appear that it is easier to discourage than to promote reserve currency use. Policies that aim to support currency use are often

[43] We are not aware of similar measures adopted by other countries in our data set.

unsuccessful, with a few notable exceptions. There is evidence that opening up the capital account helped to strengthen the importance of a particular unit as a reserve currency after 1973. But other supportive policies were less obviously important. Their effect is typically found to be insignificant.[44]

In contrast, policies that aim to *discourage* currency use have often had significant effects. This is the case of unsupportive official positions, of unsupportive exchange rate regime measures (i.e. devaluing/debasing one's currency, like the repeated devaluations of sterling between 1947 and 1976 or those of the US dollar in the early 1970s), and of other unsupportive measures that may have dented confidence in a unit as a store of value (e.g. like the collapse of the Gold Pool or discussions about an IMF substitution account in the case of the dollar).[45]

In addition, we find, counter-intuitively, that restrictive capital account measures are associated with an increase (not a decrease, as expected) in the share of a particular currency in global reserves after 1973. But this probably means that the results are here dominated by the capital controls introduced by Germany and maintained by Japan after the collapse of Bretton Woods, which were relatively ineffective in stemming capital inflows compared to earlier restrictions.

Note that our earlier findings on structural changes in the coefficients on network effects are not altered by adding the policy variables. This is further evidence in favor of the "upheaval" hypothesis that the determinants of the demand for and composition of international reserves changed significantly around the time of the collapse of Bretton Woods.

7. Conclusions and Implications

We have analyzed whether the demand and composition of international reserves was fundamentally altered by the shift from fixed to flexible exchange rates following the collapse of the Bretton Woods System. In doing so we have utilized newly assembled data on the currency composition of reserves, its determinants and policy measures intended to encourage or discourage the internationalization of national currencies since World War II.

We have found strong evidence of a shift in the determinants of currency shares of globally held reserves around the time of the breakdown of Bretton Woods. Our findings suggest that the effects of inertia and the credibility of policies on reserve

[44] Together with the effect of capital openness before 1973, which is found to be still positive and of the same size, however. Note also that supportive miscellaneous measures are found to have a *negative* and significant effect (at the 15% level), which suggests that they were unsuccessful, insofar as they produced an effect opposite to the one expected a priori.

[45] In general, the effect of unsupportive official positions and unsupportive exchange rate regime-related initiatives is economically smaller than that of other unsupportive measures.

currency choice have become stronger post-Bretton Woods, while those associated with network effects have become weaker.

That the effects of inertia have become stronger may be seen as acting in favor of the leading currency, namely the dollar, a fact further underscored by the resilience of its share in global reserves since the financial crisis (a period encompassed by our data). In contrast, that network effects have become weaker may be seen as working against the dollar's first-mover advantage. As emphasized above, persistence can have other sources besides network effects giving rise to first-mover advantage, such as habit formation or the absence of viable alternatives for providing reserves on the scale demanded. At the same time, the observation that persistence is not guaranteed by network effects suggests that its existence, and the dollar's continued dominance, should not be taken for granted.

In addition, our results suggest that the policy toolkit to encourage reserve currency status and overcome inertia effects has been dominated in the past by two instruments: macroeconomic stability and capital account openness. The policy toolkit available to discourage international currency use has additional instruments, including official statements and, exchange-rate-regime-related measures. These appear to have had larger and more powerful effects.

These last findings have obvious implications for China's earlier policies of discouraging international use of the renminbi and now its efforts to promote it. They are consistent with the effectiveness of China's capital controls in limiting international use of the currency and the evidence of Huang, Dali and Fang (2014) that the renminbi still punches below its weight as an international reserve unit. There is ample earlier precedent for the effectiveness of such restrictive policies. At the same time, our findings suggest that while capital account liberalization may be necessary for renminbi internationalization, it will not suffice, and that the success of the other policy initiatives needed to achieve this goal cannot be taken for granted.

References

Beck, Thorsten, Aslı Demirgüç-Kunt and Ross Levine (2009), "Financial Institutions and Markets Across Countries and over Time: Data and Analysis,, *World Bank Policy Research Working Paper* 4943, May 2009.

Bergsten, Fred (1997), "The Dollar and the Euro," *Foreign Affairs* 76, pp. 83-95.

Burk, Kathleen and Alex Cairncross (1992), *Goodbye, Great Britain: The 1976 IMF Crisis*, New Haven: Yale University Press.

Cairncross, Alec and Barry Eichengreen (1981), *Sterling in Decline: The Devaluations of 1931, 1949 and 1967*, Oxford: Blackwell.

Chen, Hongyi, Wensheng Peng and Chang Shu (2009), "The Potential of the Renminbi as an International Currency," unpublished manuscript, Hong Kong Institute for Monetary Research, Barclays Capital and Hong Kong Monetary Authority (February).

Chinn, Menzie (2012), "A Note on Reserve Currencies with Special Reference to the G-20 Countries," note prepared for the International Growth Centre (IGC), India Central Program, 23 April 2012.

Chinn, Menzie and Jeffrey Frankel (2007), "Will the Euro Eventually Surpass the Dollar as Leading International Currency?" in Richard Clarida (ed.), *G7 Current Account Imbalances and Adjustment*, Chicago: University of Chicago Press, pp.283-338.

Chinn, Menzie and Jeffrey Frankel (2008), "Why the Euro Will Rival the Dollar," *International Finance* 11, pp. 49-73.

Chiţu, Livia, Barry Eichengreen and Arnaud Mehl, "When Did the Dollar Overtake Sterling as the Leading International Currency: Evidence from the Bond Markets," *Journal of Development Economics*, forthcoming.

Crockett, Andrew (1978), "Control Over International Reserves," *IMF Staff Papers* 25, pp. 1-24.

David, Paul (1986), "Narrow Windows, Blind Giants and Angry Orphans: The Dynamics of Systems Rivalries and Dilemmas of Technology Policy," Technology Innovation Project Working Paper no. 10, Center for Economic Policy Research, Stanford University (March).

David, Paul (1990), "The Economics of Compatibility Standards: An Introduction to Recent Research," *Economics of Innovation and New Technology* 1, pp. 3-41.

Devereux, Michael and Shouyong Shi (2013), "Vehicle Currency," *International Economic Review* 54, pp. 97-133.

De Vries, Casper (1988), "Theory and Relevance of Currency Substitution with Case Studies for Canada and the Netherlands Antilles," *Review of Economics and Statistics* 70, pp. 512-515.

Dominguez, Kathryn, Yuko Hashimoto and Takatoshi Ito (2012), "International Reserves and the Global Financial Crisis," *Journal of International Economics* 88, pp. 388-406.

Dooley, Michael, Saul Lizondo and Donald Mathieson (1989), "The Currency Composition of Foreign Exchange Reserves," *IMF Staff Papers* 35, pp. 385-434.

Eichengreen, Barry (1998), "The Euro as a Reserve Currency," *Journal of the Japanese and International Economies* 12, pp. 483-506.

Eichengreen, Barry (2007), *Global Imbalances and the Lessons of Bretton Woods*, Cambridge, Mass.: MIT Press.

Eichengreen, Barry (2013), "Number One Country, Number One Currency?' *World Economy* 36, pp. 363–74.

Eichengreen, Barry, Livia Chiţu and Arnaud Mehl (2014), "Network Effects, Homogeneous Goods, and International Currency Choice: New Evidence on Oil Markets from an Earlier Era," *ECB Working Paper* no.1651 (February).

Eichengreen, Barry and Marc Flandreau (2009), "The Rise and Fall of the Dollar, or When did the Dollar Replace Sterling as the Leading Reserve Currency?" *European Review of Economic History* 13, pp. 377-411.

Eichengreen, Barry and Donald Mathieson (2001), "The Currency Composition of Foreign Exchange Reserves: Retrospect and Prospect," in Charles Wyplosz (ed.), *The Impact of EMU on Europe and the Developing Countries*, Oxford: Oxford University Press.

European Central Bank (2013), *The International Role of the Euro*, Frankfurt: ECB.

Feldstein, M. (1997), "EMU and International Conflict," *Foreign Affairs* 76, pp. 60-73.

Frankel, Jeffrey (2007), "Exchange Rate Policy," in Martin Feldstein (ed.), *American Economic Policy in the 1980s*, Chicago: University of Chicago Press, pp. 293-341.

Frankel, Jeffrey (2013), "The Latest on the Dollar's International Currency Status", *Vox*, 6 December 2013.

Fratzscher, Marcel and Arnaud Mehl (2013), "China's Dominance Hypothesis and the Emergence of a Tri-polar Global Currency System," *Economic Journal*, forthcoming.

Fratzscher, Marcel, Arnaud Mehl and Isabel Vansteenkiste (2011), "130 Years of Fiscal Vulnerabilities and Currency Crashes in Advanced Economies," *IMF Economic Review* 59, pp. 683-716.

Frenkel, Jacob (1978), "International Reserves: Pegged Exchange Rates and Managed Float," in Karl Brunner and Allan Meltzer (eds), *Public Policies in Open Economies*, Carnegie-Rochester Conference Series on Public Policy 9, pp. 111-140.

Fukao, Mitsuhiro (1990), "Liberalization of Japan's Foreign Exchange Controls and Structural Changes in the Balance of Payments," *Bank of Japan Monetary and Economic Studies* 8, pp. 101-164.

Griliches, Zvi (1961), "A Note on the Serial Correlation Bias in Estimates of Distributed Lags," *Econometrica* 29, pp.65-73.

Henning, Randall (1994), *Currencies and Politics in the United States, Germany and Japan*, Washington D.C.: Institute for International Economics.

Heller, Robert and Mohsin Kahn (1978), "The Demand for International Reserves under Fixed and Floating Exchange Rates," *IMF Staff Paper*s 25, pp. 623-649.

Horsefield, Keith (1969), *The International Monetary Fund 1945-1965: Twenty Years of International Monetary Cooperation: Chronicle*, Washington, D.C.: IMF.

Huang, Yiping, Wang Daili and Fan Gang (2014), "Paths to a Reserve Currency: Internationalization of RMB and its Implications," unpublished manuscript, National School of Development, Peking University and National Economic Research Institute, China Reform Foundation (March).

International Monetary Fund (various years), *Annual Report*, Washington D.C.: IMF.

International Monetary Fund (various years), *Balance of Payments Manual*, Washington, D.C.: IMF.

International Monetary Fund (various years), *International Financial Statistics*, Washington, D.C.: IMF.

Krugman, Paul (1980), "Vehicle Currencies and the Structure of International Exchange," *Journal of Money, Credit and Banking* 12, pp. 513-526.

Krugman, Paul (1984), "The International Role of the Dollar: Theory and Prospect," in John Bilson and Richard Marston (eds), *Exchange Rate Theory and Practice*, Chicago: University of Chicago Press, pp.261-278.

Levy, Victor (1983), "Demand for International Reserves and Exchange Rate Intervention Policy in an Adjustable Peg Economy," *Journal of Monetary Economics* 11, pp. 89-101

Li, David and Linlin Liu (2008), "RMB Internationalization: An Empirical Analysis," *Journal of Financial Research* 11, pp. 1-16.

Lyons, Richard and Michael Moore (2009), "An Information Approach to International Currencies," *Journal of International Economics* 79, pp. 211–221.

Maddison, Angus (2010), *Statistics on World Population, GDP and Per Capita GDP, 1-2008 AD*, unpublished manuscript, University of Groningen.

Matsuyama, Kiminori, Nobuhiro Kiyotaki and Akihiko Matsui (1993), "Toward a Theory of International Currency," *Review of Economic Studies* 60, pp. 283-307.

Ouyang, Alice and Jie Li (2013), "Too Big to Change: The Stabilizing Force of Reserve Currency Preferences in the International Monetary System," *Emerging Markets Finance and Trade* 49, pp.120-133.

Papaioannou, Elias and Richard Portes (2008), "The International Role of the Euro: A Status Report," *European Economy-Economic Papers* No. 317, Directorate General Economic and Monetary Affairs, European Commission.

Portes, Richard and Hélène Rey (1998), "The Emergence of the Euro as an International Currency," *Economic Policy* 13, pp. 307-343.

Prasad, Eswar (2014), *The Dollar Trap: How the US Dollar Tightened its Grip on Global Finance*, Princeton: Princeton University Press.

Rajan, Raghuram and Luigi Zingales (2003), "The Great Reversals: the Politics of Financial Development in the Twentieth Century," *Journal of Financial Economics* 69, pp. 5-50.

Rey, Hélène (2001), "International Trade and Currency Exchange," *Review of Economic Studies* 68, pp. 443-464.

Roodman, David (2009), "A Note on the Theme of Too Many Instruments," *Oxford Bulletin of Economics and Statistics* 71, pp. 135-158.

Saidi, Nasser (1981), "The Square-Root Law, Uncertainty and International Reserves Under Alternative Regimes," *Journal of Monetary Economics* 7, pp. 271-290.

Santos Silva, Joao and Silvana Tenreyro (2006), "The Log of Gravity," *Review of Economics and Statistics* 88, pp. 641-658.

Schenk, Catherine (1994), *Britain and the Sterling Area: From Devaluation to Convertibility in the 1950s*, London: Routledge.

Schenk, Catherine (2010), *The Decline of Sterling: Managing the Retreat of an International Currency, 1945-1992*, Cambridge: Cambridge University Press.

Subramanian, Arvind and Martin Kessler (2012), "The Renminbi Bloc is Here: Asia Down, Rest of the World to Go?" Working Paper no. 12-19, Washington, D.C.: Institute for International Economics (October).

Takagi, Shinji (2011), "Internationalizing the Yen, 1984-2003: Unfinished Agenda or Mission Impossible?" *BIS Papers* 75, Basle: Bank for International Settlements.

Takeda, Masahiko, and Philip Turner (1992), "The Liberalization of Japan's Financial Markets: Some Major Themes," *Economic Papers* 34, Basel: Bank for International Settlements.

Tavlas, George (1991), "On the International Use of Currencies, the Case of the Deutsche Mark," *Essays in International Finance* no.181, International Finance Section, Department of Economics, Princeton University (March).

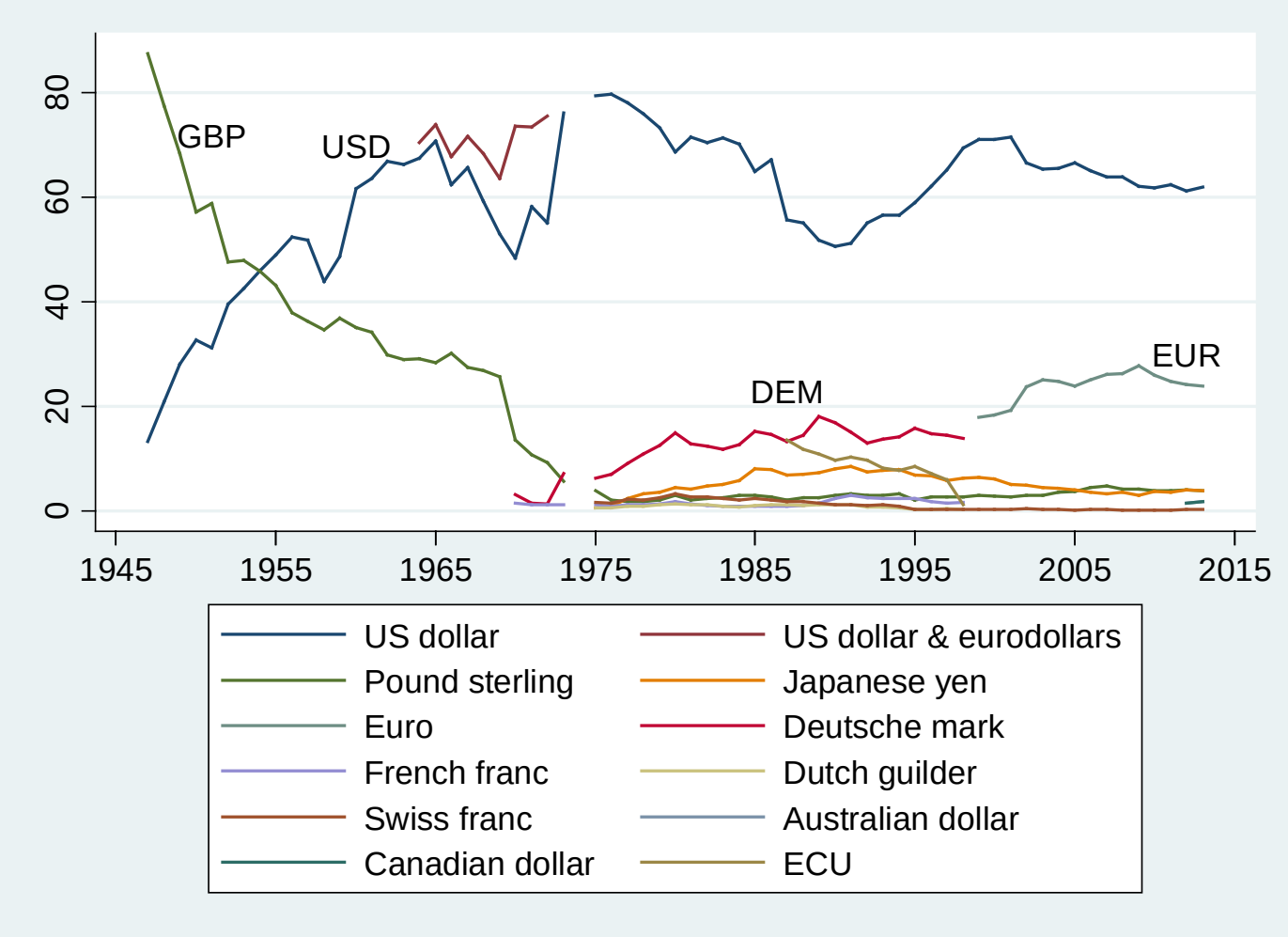
Triffin, Robert (1960), *Gold and the Dollar Crisis: The Future of Convertibility*, New Haven: Yale University Press.

Truman, Edwin and Anna Wong (2006), "The Case for an International Reserve Diversification Standard," Working Paper no. 06-2, Washington, D.C.: Institute for International Economics (May).

West, Joel (2007), "The Economic Realities of Open Standards: Black, White and Many Shades of Gray," in Shane Greenstein and Victor Stango (eds), *Standards and Public Policy*, Cambridge: Cambridge University Press, pp. 87-122.

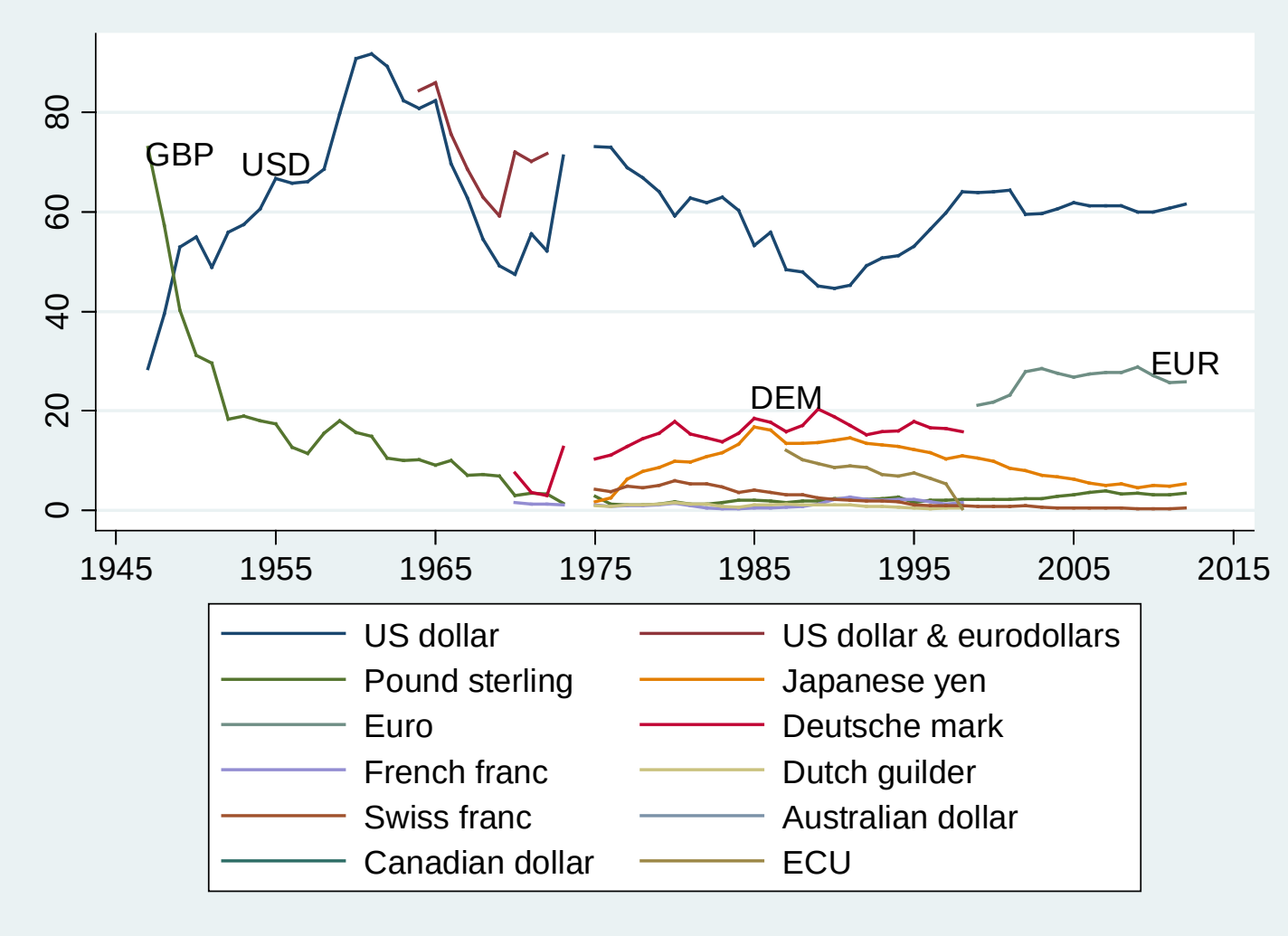
Wong, Anna (2007), "Measurement and Inference in International Reserve Diversification," Working Paper no. 07-6, Washington, D.C.: Institute for International Economics (July).

Figure 1: Currency Composition of Globally Disclosed Foreign Exchange Reserves *(1947-2013, %)*



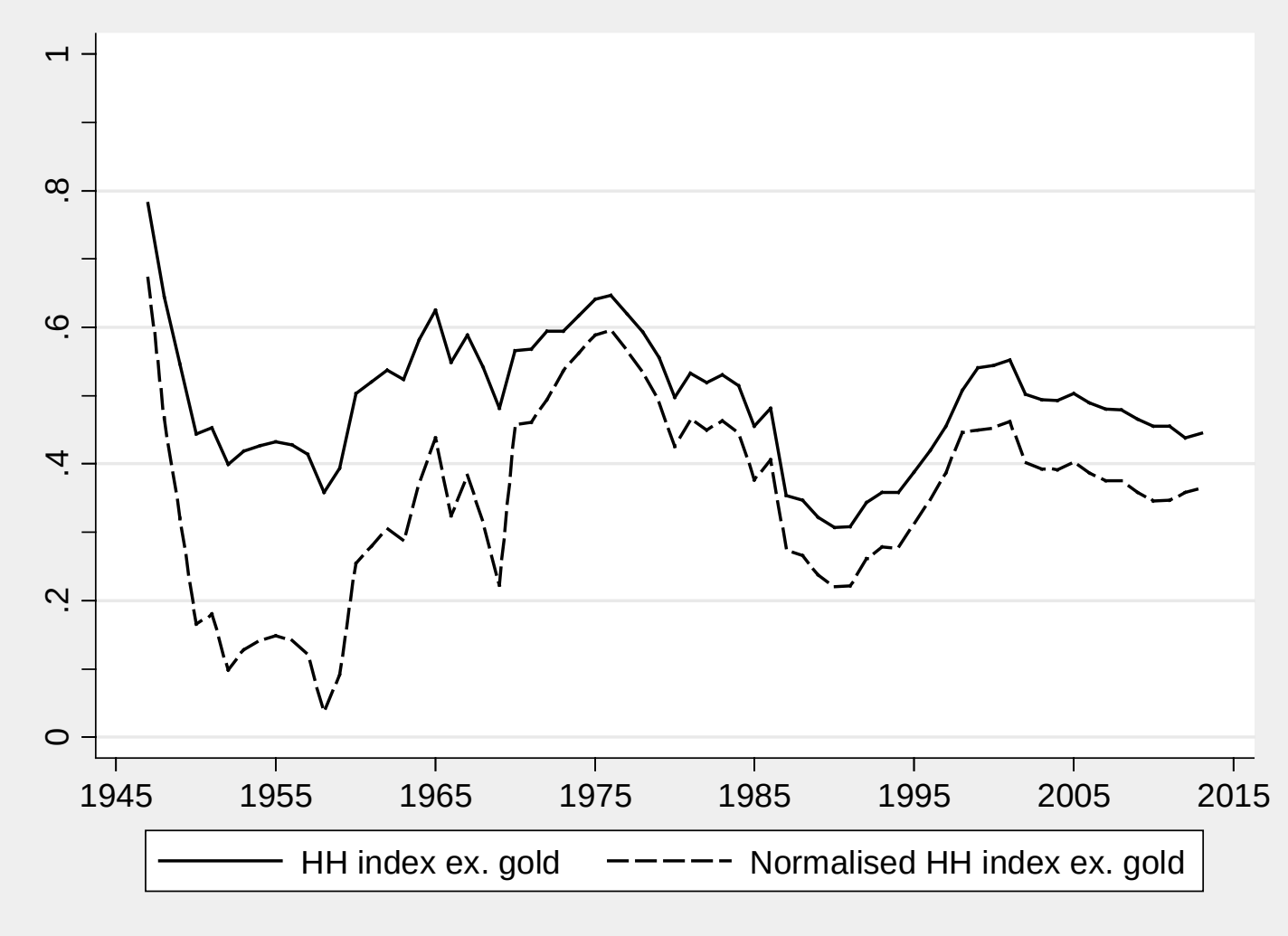
Sources: Authors' calculations based on IMF data and sources (see Appendix 1). *Notes*: The currency shares are derived from US dollar-denominated amounts for the period 1947-1969 and 1999-2013 as well as from SDR-denominated amounts for the period 1970-1972. The currency shares for the period 1973-1999 are directly provided by the IMF in its annual reports (based on SDR valuation). Starting in 1979 the Fund added the SDR value of ECUs issued against the US dollar to the SDR value of US dollar reserves; after 1987 the ECU was treated as a separate unit. The currency shares reported here exclude unallocated foreign exchange reserves post-1994 (i.e. about 40% of total foreign exchange reserves at the end of the sample).

Figure 2: Currency Composition of Globally Disclosed Foreign Exchange Reserves at *Constant* Exchange Rates *(1947-2012, %)*



Sources: Authors' calculations based on IMF data and sources (see Appendix 1). *Notes*: see Figure 1. Currency shares at constant exchange rates calculated using the BIS methodology (and 2012 as base year), as described in Wong (2007). The currency shares reported here exclude unallocated foreign exchange reserves post-1994 (i.e. about 40% of total foreign exchange reserves at the end of the sample), as in Figure 1.

Figure 3: Currency Concentration of Globally Disclosed Foreign Exchange Reserves *(1947-2013)*

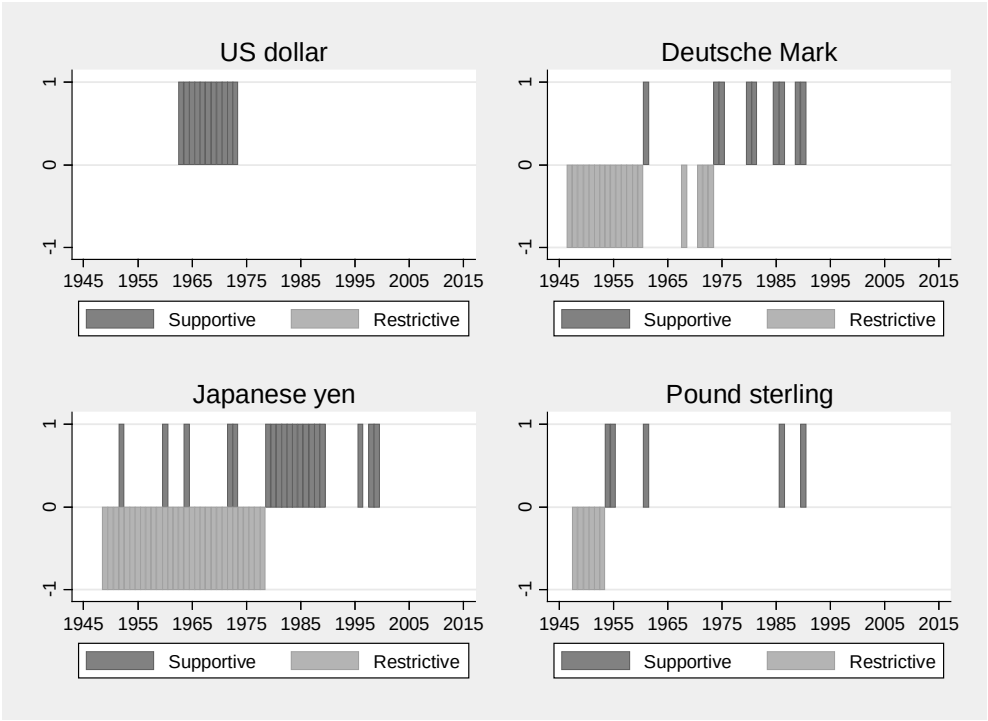


Sources: Authors' calculations based on IMF data and sources (see Appendix 1). *Notes*: the chart shows the basic and standardised Hirschman-Herfindhal (HH) indices calculated for the currency breakdown of global foreign exchange reserves since 1947, i.e. the sum of squared reserve currency shares (also scaled by a function of the number of currency units in each year, in the case of the standardised index). An index value of 1 indicates a monopolistic market; an index value of 0 indicates a perfectly competitive market.

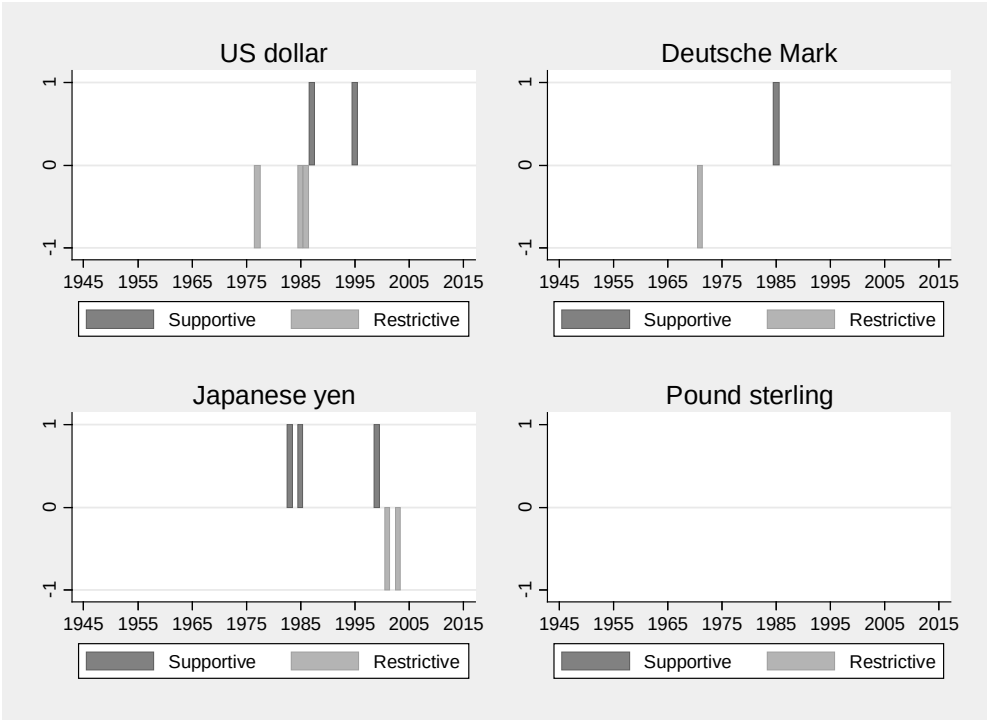
Figure 4: Policy Measures Adopted to Support/Discourage International Currency Use

(1947-2013)

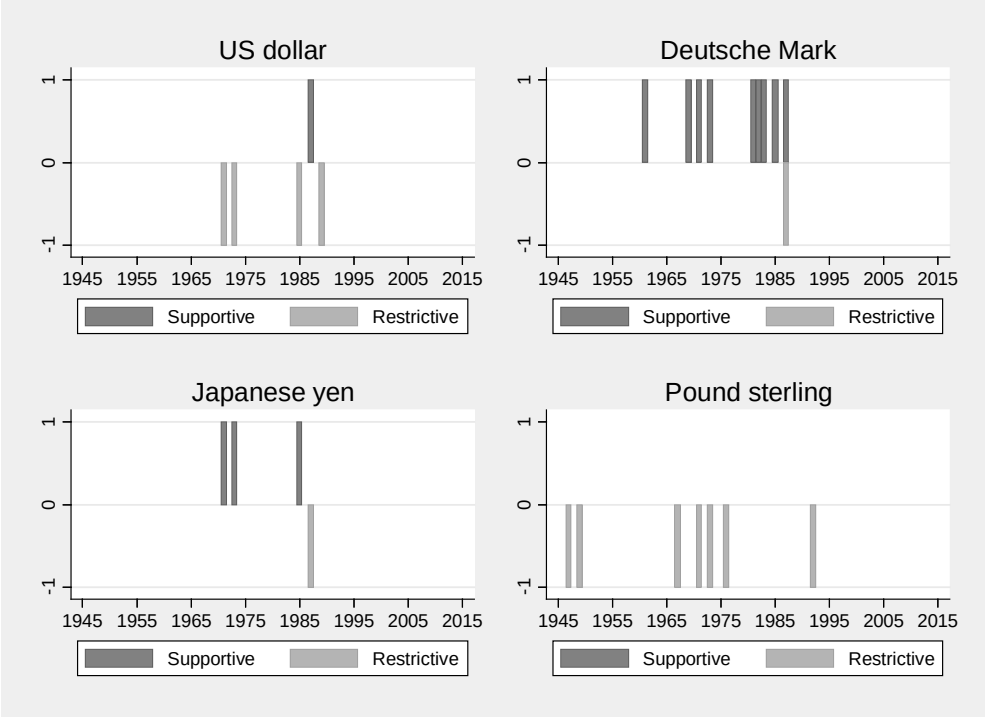
a. ***Regulation of the capital account of the balance of payments***



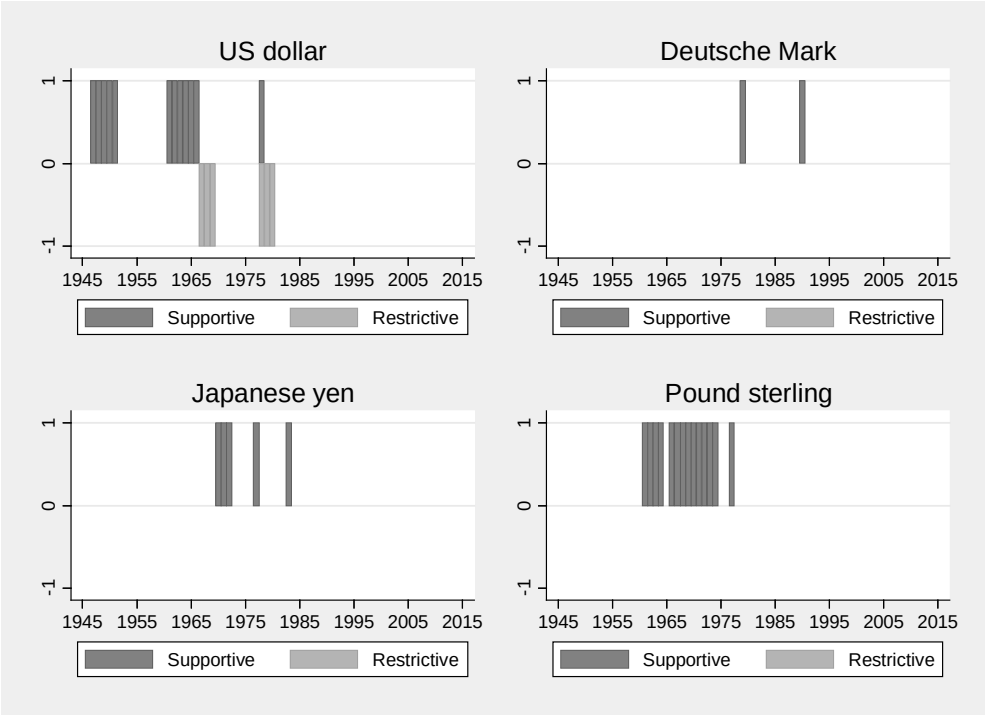
b. ***Official position and verbal interventions on internationalization***



c. ***Reform and regulation of the exchange rate system-cum-regime***



d. ***Other measures***



Sources: Authors' compilation from Fukao (1990), Henning (1994), Schenk (2010), Tavlas (1991), Takagi (2011) and Takeda and Turner (1992). *Note*: The figures provide an overview of selected policy measures taken in the US, Germany, Japan and the UK with a view to supporting (positive entries) or restricting (negative entries) the international use of their respective currencies. Policies are broken down by country and measure type, including: regulation of the capital account of the balance of payments, (b) official positions and verbal interventions on internationalisation, (c) reform and regulation of the exchange rate system-cum-regime, and (d) other miscellaneous measures. Restrictive policy measures are shown as negative entries to facilitate visual interpretation. However, they are coded as standard 0/1 dummies in the empirical estimations, similarly as supporting policy measures.

Table 1: Basic Estimates

	(1) Full sample	(2) Pre-1973	(3) Post-1973	(4) Full sample
Inertia	0.927***	0.758***	0.954***	0.886***
	(0.021)	(0.037)	(0.009)	(0.024)
Network effects	0.216***	0.815***	0.115***	0.426***
	(0.066)	(0.113)	(0.024)	(0.080)
Credibility	0.051**	-0.599***	0.043*	-0.382***
	(0.022)	(0.033)	(0.024)	(0.092)
Post-73 dummy				2.921***
				(0.943)
Inertia × post-73 dummy				0.045**
				(0.023)
Network effects × post-73 dummy				-0.242***
				(0.075)
Credibility × post-73 dummy				0.428***
				(0.116)
Constant	-0.010	-5.725***	0.302	-2.739**
	(0.295)	(0.460)	(0.317)	(1.095)
Currency effects	YES	YES	YES	YES
Time effects	YES	YES	YES	YES
Observations	271	42	229	271
No. of groups	8	4	8	8
R^2 (overall)	0.993	0.988	0.995	0.993

Note: The table reports random effects estimates of our baseline equation where reserve currency shares purged of valuation effects are regressed on their standard determinants over selected sample periods, namely: the full sample (in column 1); 1947-1972 (in column 2), 1973-2013 (in column 3) and the full sample allowing for a structural break in the estimated coefficients (in column 4). The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p<0.1.

Table 2: Basic Estimates without Missing Observations

	(1) Full sample	(2) Pre-1973	(3) Post-1973	(4) Full sample
Inertia	0.942***	0.924***	0.954***	0.935***
	(0.019)	(0.040)	(0.009)	(0.025)
Network effects	0.174***	0.258*	0.115***	0.228**
	(0.064)	(0.136)	(0.024)	(0.090)
Credibility	0.055***	0.037	0.043*	0.039
	(0.020)	(0.048)	(0.024)	(0.044)
Post-73 dummy				1.235
				(1.267)
Inertia × post-73 dummy				0.011
				(0.014)
Network effects × post-73 dummy				-0.089[#]
				(0.057)
Credibility × post-73 dummy				0.006
				(0.060)
Constant	0.044	-0.902	0.302	-0.973
	(0.181)	(0.680)	(0.317)	(1.271)
Currency effects	YES	YES	YES	YES
Time effects	YES	YES	YES	YES
Observations	356	127	229	356
No. of groups	8	7	8	8
R^2 (overall)	0.993	0.991	0.995	0.993

Note: The table reports random effects estimates of our baseline equation where reserve currency shares purged of valuation effects are regressed on their standard determinants over selected sample periods, namely: the full sample (in column 1); 1947-1972 (in column 2), 1973-2013 (in column 3) and the full sample allowing for a structural break in the estimated coefficients (in column 4) and where missing observations before 1970 are replaced with zeros (except for the Australian dollar, the Canadian dollar and the euro). The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p<0.1, [#]p ≤0.15.

Table 3: Estimates without Adjustment for Valuation Effects

	(1) Full sample	(2) Pre-1973	(3) Post-1973	(4) Full sample
Inertia	0.937***	0.939***	0.967***	0.957***
	(0.016)	(0.008)	(0.015)	(0.008)
Network effects	0.202***	0.253***	0.084*	0.223***
	(0.052)	(0.012)	(0.049)	(0.015)
Credibility	0.058**	0.063	0.048***	0.110
	(0.024)	(0.122)	(0.017)	(0.113)
Post-73 dummy				1.126
				(1.013)
Inertia × post-73 dummy				0.003
				(0.015)
Network effects × post-73 dummy				-0.116**
				(0.055)
Credibility × post-73 dummy				-0.062
				(0.123)
Constant	-0.482***	-1.095	-0.150	-1.318
	(0.185)	(0.784)	(0.112)	(1.045)
Currency effects	YES	YES	YES	YES
Time effects	YES	YES	YES	YES
Observations	278	42	236	278
No. of groups	10	4	10	10
R^2 (overall)	0.994	0.972	0.997	0.994

Note: The table reports random effects estimates of our baseline equation where reserve currency shares in nominal terms are regressed on their standard determinants over selected sample periods, namely: the full sample (in column 1); 1947-1972 (in column 2), 1973-2013 (in column 3) and the full sample allowing for a structural break in the estimated coefficients (in column 4). The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Estimates without Adjustment for Valuation Effects and Missing Observations

	(1) Full sample	(2) Pre-1973	(3) Post-1973	(4) Full sample
Inertia	0.945***	0.940***	0.967***	0.948***
	(0.016)	(0.011)	(0.015)	(0.012)
Network effects	0.177***	0.216***	0.084*	0.199***
	(0.055)	(0.036)	(0.049)	(0.034)
Credibility	0.059***	0.063	0.048***	0.072
	(0.022)	(0.054)	(0.017)	(0.058)
Post-73 dummy				0.772
				(0.885)
Inertia × post-73 dummy				0.009
				(0.017)
Network effects × post-73 dummy				-0.085*
				(0.052)
Credibility × post-73 dummy				-0.025
				(0.058)
Constant	-0.449**	-0.679	-0.150	-0.978
	(0.186)	(0.583)	(0.112)	(0.903)
Currency effects	YES	YES	YES	YES
Time effects	YES	YES	YES	YES
Observations	363	127	236	363
No. of groups	10	7	10	10
R^2 (overall)	0.994	0.991	0.997	0.995

Note: The table reports random effects estimates of our baseline equation where reserve currency shares in nominal terms are regressed on their standard determinants over selected sample periods, namely: the full sample (in column 1); 1947-1972 (in column 2), 1973-2013 (in column 3) and the full sample allowing for a structural break in the estimated coefficients (in column 4) and where missing observations before 1970 are replaced with zeros (except for the Australian dollar, the Canadian dollar and the euro). The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** $p<0.01$, ** $p<0.05$, * $p\leq0.1$.

Table 5: Estimates with Liquidity

	(1) Full sample	(2) Full sample	(3) Pre-73	(4) Post-73	(5) Full sample
Inertia	0.958***	0.926***	0.759***	0.955***	0.886***
	(0.014)	(0.020)	(0.038)	(0.007)	(0.022)
Network effects	0.094***	0.219***	0.820***	0.111***	0.437***
	(0.032)	(0.061)	(0.111)	(0.017)	(0.076)
Credibility	0.047[#]	0.051**	-0.563***	0.043*	-0.335***
	(0.030)	(0.023)	(0.066)	(0.023)	(0.120)
FX turnover	0.232				
	(0.203)				
Stock market cap./GDP		0.059	0.432	-0.059	0.599
		(0.192)	(0.359)	(0.189)	(0.658)
Post-73 dummy					3.305***
					(1.190)
Inertia × post-73 dummy					0.044*
					(0.023)
Network effects × post-73 dummy					-0.251***
					(0.073)
Credibility × post-73 dummy					0.381***
					(0.141)
Stock market cap./GDP × post-73 dummy					-0.576
					(0.755)
Constant	-1.124	-0.085	-6.078***	0.376	-3.151***
	(1.121)	(0.444)	(0.230)	(0.468)	(1.053)
Currency effects	YES	YES	YES	YES	YES
Time effects	YES	YES	YES	YES	YES
Observations	213	271	42	229	271
No. of groups	8	8	4	8	8
R^2 (overall)	0.995	0.993	0.988	0.995	0.993

Note: The table reports random effects estimates of our baseline equation where reserve currency shares purged of valuation effects are regressed on their standard determinants over selected sample periods and controlling for market liquidity proxies, namely: the logarithm of foreign exchange turnover (in column 1) and the ratio of equity market capitalization to GDP (in columns 2 to 5). The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p<0.1, [#]p ≤0.15.

Table 6: Estimates with Additional Controls

	(1)	(2)	(3)	(4)	(5)	(6)
Inertia	0.876***	0.883***	0.903***	0.888***	0.882***	0.882***
	(0.023)	(0.024)	(0.017)	(0.025)	(0.027)	(0.024)
Network effects	0.433***	0.436***	0.354***	0.416***	0.436***	0.435***
	(0.070)	(0.079)	(0.057)	(0.085)	(0.085)	(0.079)
Credibility	-0.449***	-0.384***	-0.431***	-0.384***	-0.387***	-0.384***
	(0.085)	(0.087)	(0.047)	(0.093)	(0.088)	(0.089)
Post-73 dummy	2.653**	2.990***	2.393**	2.906***	2.908***	3.010***
	(1.098)	(0.980)	(0.938)	(0.930)	(0.959)	(0.927)
Inertia × post-73 dummy	0.034#	0.044**	0.033***	0.045**	0.042*	0.042*
	(0.023)	(0.021)	(0.008)	(0.022)	(0.024)	(0.022)
Network effects × post-73 dummy	-0.182**	-0.236***	-0.188***	-0.248***	-0.233***	-0.236***
	(0.072)	(0.068)	(0.030)	(0.070)	(0.078)	(0.073)
Credibility × post-73 dummy	0.510***	0.422***	0.479***	0.430***	0.436***	0.448***
	(0.107)	(0.108)	(0.056)	(0.118)	(0.104)	(0.113)
Public debt	-0.011***					
	(0.004)					
Fiscal balance		0.075*				
		(0.040)				
Current account balance			-0.010			
			(0.017)			
Export volume				0.124		
				(0.304)		
Bond yields					-0.010	
					(0.060)	
FX volatility						-23.704
						(16.550)
Constant	-1.150	-2.391**	-2.153**	-4.327	-3.059***	-2.659**
	(1.464)	(1.029)	(1.022)	(4.173)	(1.059)	(1.052)
Currency effects	YES	YES	YES	YES	YES	YES
Time effects	YES	YES	YES	YES	YES	YES
Observations	259	271	257	271	259	271
No. of groups	7	8	8	8	7	8
R^2 (overall)	0.993	0.993	0.993	0.993	0.993	0.993

Note: The table reports random effects estimates of our baseline equation where reserve currency shares purged of valuation effects are regressed on their standard determinants over the full sample (1947-2013) allowing for a structural break in the estimated coefficients and controlling for additional determinants of reserve currency choice, namely: the public debt-to-GDP ratio, fiscal balance-to-GDP ratio, current account balance-to-GDP ratio, volume of exports in goods, long-term bonds yields and FX volatility (as estimated from GARCH(1,1) models). The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p<0.1, #p ≤0.15.

Table 7: Tobit estimates

	(1)	(2)	(3)	(4)
Inertia	0.923***	0.758***	0.917***	0.886***
	(0.020)	(0.083)	(0.039)	(0.028)
Network effects	0.225***	0.815***	0.200**	0.426***
	(0.060)	(0.258)	(0.090)	(0.089)
Credibility	0.050	-0.599[#]	0.049[#]	-0.382*
	(0.038)	(0.387)	(0.031)	(0.204)
Post-73 dummy				2.921**
				(1.374)
Inertia × post-73 dummy				0.045[#]
				(0.027)
Network effects × post-73 dummy				-0.242***
				(0.087)
Credibility × post-73 dummy				0.428**
				(0.207)
Constant	-0.478	-5.725**	0.271	-3.491***
	(0.927)	(2.566)	(0.518)	(1.261)
Country effects	YES	YES	YES	YES
Time effects	YES	YES	YES	YES
Observations	271	42	229	271
No. of groups	8	4	8	8
Log likelihood	-582.4	-114.4	-412.4	-576.1
Left-censored observations	0	0	0	0
Right-censored observations	0	0	0	0

Note: The table reports panel tobit estimates of our baseline equation where reserve currency shares purged of valuation effects are regressed on their standard determinants over selected sample periods, namely: the full sample (in column 1); 1947-1972 (in column 2), 1973-2013 (in column 3) and the full sample allowing for a structural break in the estimated coefficients (in column 4). The standard errors reported in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$, [#] $p \leq 0.15$.

Table 8: Estimates with Adjustments for Endogeneity

	(1) Full sample	(2) Pre-1973	(3) Post-1973	(4) Full sample
Inertia	0.891***	0.758***	0.926***	0.885***
	(0.014)	(0.037)	(0.010)	(0.025)
Network effects	0.322***	0.815***	0.180***	0.429***
	(0.054)	(0.113)	(0.025)	(0.081)
Credibility	0.034[#]	-0.599***	0.026	-0.383***
	(0.018)	(0.032)	(0.018)	(0.091)
Post-73 dummy				2.926**
				(0.946)
Inertia × post-73 dummy				0.044*
				(0.023)
Network effects × post-73 dummy				-0.241**
				(0.074)
Credibility × post-73 dummy				0.424***
				(0.114)
Constant	-0.131	-4.039**	0.322	-2.734**
	(0.489)	(1.190)	(0.430)	(1.100)
Currency effects	YES	YES	YES	YES
Time effects	YES	YES	YES	YES
Observations	271	42	229	271
No. of groups	8	4	8	8
Number of instruments	201	42	197	270
p-value of AR(1)	0.248	0.252	0.221	0.244
p-value of AR(2)	0.0597	0.302	0.501	0.0745
p-value of Hansen statistic	1	1	1	1

Note: The table reports system GMM estimates of our baseline equation where reserve currency shares purged of valuation effects are regressed on their standard determinants over selected sample periods, namely: the full sample (in column 1); 1947-1972 (in column 2), 1973-2013 (in column 3) and the full sample allowing for a structural break in the estimated coefficients (in column 4). The estimation results are obtained with a collapsed set of instruments, as suggested in Roodman (2009), to minimize instrument proliferation bias. The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p<0.1, [#]p ≤0.15.

Table 9: Estimates with Policy Measures

	(1) Full sample	(2) Pre-1973	(3) Post-1973	(4) Full sample
Inertia	0.944***	0.787***	0.984***	0.912***
	(0.027)	(0.098)	(0.012)	(0.032)
Network effects	0.212**	0.761***	0.060	0.390***
	(0.088)	(0.288)	(0.045)	(0.098)
Credibility	0.028	-0.313	0.004	-0.356
	(0.021)	(0.423)	(0.014)	(0.301)
Post-73 dummy				3.373**
				(1.631)
Inertia × post-73 dummy				0.039
				(0.034)
Network effects × post-73 dummy				-0.220*
				(0.122)
Credibility × post-73 dummy				0.375
				(0.319)
Capital account *(supportive)*	0.115	0.513	0.532#	0.045
	(0.311)	(0.449)	(0.372)	(0.262)
Capital account *(restrictive)*	1.240**	-0.674	3.330#	1.957
	(0.581)	(1.812)	(2.242)	(1.506)
Official position *(supportive)*	-0.479	0.000	-0.443	-0.232
	(1.415)	(0.000)	(1.351)	(1.438)
Official position *(restrictive)*	-3.211***	-4.633#	-1.932***	-2.826***
	(1.000)	(3.120)	(0.560)	(0.855)
Exchange rate regime *(supportive)*	-0.088	0.000	0.083	-0.145
	(0.755)	(0.000)	(0.863)	(0.740)
Exchange rate regime *(restrictive)*	-2.194**	-2.135	-2.469***	-1.871*
	(0.964)	(4.786)	(0.657)	(1.074)
Other measures *(supportive)*	-0.507#	-1.731#	0.130	-0.456
	(0.319)	(1.114)	(0.713)	(0.329)
Other measures *(restrictive)*	-5.645***	-10.114***	-3.550***	-5.728***
	(0.847)	(3.756)	(0.388)	(0.868)
Constant	-0.258	-5.499***	0.230**	-3.415**
	(0.184)	(1.610)	(0.097)	(1.627)
Country effects	YES	YES	YES	YES
Time effects	YES	YES	YES	YES
Observations	271	42	229	271
No. of groups	8	4	8	8
R^2 (overall)	0.994	0.991	0.996	0.995

Note: The table reports random effects estimates of our baseline equation where reserve currency shares purged of valuation effects are regressed on their standard determinants over selected sample periods, namely: the full sample (in column 1); 1947-1972 (in column 2), 1973-2013 (in column 3) and the full sample allowing for a structural break in the estimated coefficients (in column 4) controlling for policy measures that aim to support or restrict international currency use of the US dollar, Pound sterling, Deutsche Mark and Japanese yen. The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p<0.1, #p ≤0.15.

Appendix 1: Data on Reserve Composition

Our paper aims to present the first estimates of the currency composition of global foreign currency reserves spanning nearly seven decades (1947-2013).

Any such analysis must take into account the fact that the definition of foreign exchange reserves may change over time.[46] We attempt to harmonize the definition of reserves over the period by following the standard IMF guidelines as closely as possible (see the 6th edition of the IMF Balance of Payments Manual, hereafter referred to as BPM6). According to these guidelines, a country's international reserve assets include "those external assets that are *readily available* to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange rate, and for other related purposes (such as maintaining confidence in the currency and the economy, and serving as a basis for foreign borrowing). Reserve assets must be *foreign currency assets* and assets that actually exist." (See IMF BPM6, Chapter 6, p.111)

A challenge is the reluctance of official reserve holders to disclose the currency composition of their holdings. Almost half of the currency composition of official reserves holdings reported to the IMF is undisclosed.[47] After the Asian crisis, policy-makers made efforts to increase the transparency of reserve data in the interest of global financial stability. This led the IMF Executive Board to approve in 1998 a Reserve Template for SDDS subscribers to provide guidance on how to report data on reserve holdings.[48] In subscribing to SDDS obligations, reporting countries provide a breakdown by asset class and location of their holdings monthly and – on a voluntary basis – whether those holdings are denominated in "SDR" or "non-SDR" currencies (currencies that enter into the make-up of the SDR basket).

But the IMF also has a long tradition of publishing in its annual reports, and other publications, breakdowns by currency of denomination of official reserves held worldwide. These data are available at the annual frequency, albeit not fully harmonized. One of the earliest efforts by the IMF to gather and publish such data was made in its Annual Report for 1951 (see below). In subsequent Annual Reports, the IMF periodically provided updates of the currency denomination of global reserve holdings. The currency units reported in the issues of the Annual Reports published in the 1950s and 1960s included only the dollar and sterling (alongside gold). However, in the wake of the collapse of the Bretton Woods system in the early 1970s, the number of currency units reported started to increase to include e.g. the deutsche mark, Swiss franc, French franc, Dutch guilder and the Japanese yen.

[46] According to conventions used by the IMF's Special Data Dissemination Standard (SDDS) in its Reserve Template, Total Official Reserves is the broadest definition of international reserves. Assets held by governments and monetary authorities for reserve purposes are interchangeably called "foreign reserves," "official reserves" and "international reserves". International reserves include foreign currency and non-currency reserves (i.e. monetary gold, Special Drawing Rights (SDRs), reserve position at the International Monetary Fund and other reserve assets). In this paper we focus on the first component, i.e. the foreign currency component.

[47] For more information on the efforts of the IMF to obtain harmonized data on currency composition of reserve assets at the individual country-level, see Dominguez et al. (2012), p. 391.

[48] See also http://www.imf.org/external/np/sta/ir/IRProcessWeb/index.aspx.

In 2005 the IMF began publishing data on the currency composition of official global foreign exchange reserves on a quarterly basis (with back data starting in 1999), in what is now known as the Currency Composition of Official Foreign Exchange Reserves (COFER) database. These data are submitted to the IMF on a voluntary and confidential basis by 114 member countries, comprising all 24 industrial countries and 90 out of 160 developing countries. The data are published in aggregate form for three groups: all countries, industrial countries and developing countries and for the following currencies: US dollar, euro, pound sterling, Japanese yen and, since December 2012, the Australian dollar and the Canadian dollar.

In addition, the COFER database distinguishes between "allocated reserves," i.e. those whose currency composition is disclosed, and "unallocated reserves," i.e. those for which this is not the case. Before 2005, moreover, the IMF did not distinguish between reserves in "other currencies" (i.e. reserves that were not denominated in the main reserve currencies, but that they were denominated in other units) and reserves in "unspecified currencies" (i.e. reserves for which one does not know the currency of denomination simply because countries did not report it to the Fund, which means that they could be denominated in the main reserve currencies or in any other currencies). In 2005, the Fund revised all its estimates back to 1995. What is available for the prior period (i.e. between 1947 and 1994) is a mix of "other" currencies and "unspecified" currencies.

We digitized the annual data on the currency composition of global official foreign exchange reserves available from various IMF Annual Reports published between 1947 and 1998 and complemented these data with COFER estimates starting in 1999. This involved examining the 50 or so Annual Reports published prior to the advent of the euro in 1999. Whenever we found several competing estimates for a year we took the most recent one.

1947-1957: We used the data in Horsefield (1969, Table 8, p. 371), drawn in turn from the IMF's *International Financial Statistics*. We preferred his estimates to those in the IMF's Annual Reports published between 1947 and 1957 because Horsefield's estimates include official holdings only, whereas those of the IMF's Annual Reports include also private claims. The Annual Report for 1951 mentions how for 1949 and 1950 "dollar holdings include private and official balances as well as holdings of US Government securities with original maturities of up to 20 months" (see IMF 1951, Table VIII, p. 17). Moreover, it is worth stressing that, alongside holdings in dollars and sterling, there was also a third category reported for this period, namely "other currencies," which included credit balances in the European Payments Union (EPU), deposits with the BIS, and errors and omissions.[49]

1958-1959: We took the data from the IMF's Annual Report for 1960 (Table 12, p. 60). We then computed global foreign exchange reserves as the difference between total reserves (as provided by the IMF) and gold. Along with sterling and dollars, other reserve currencies reported included credit balances in the EPU and currency deposits with the BIS as well as net errors and omissions.

[49] The European Payments Union operated from July 1950 to December 1958 to facilitate trade between Western European countries using the US dollar as a payment currency.

1960-1969: Here we started with data from the Annual Report for 1970 (Table 2, p. 18). It reports official claims on the US payable in US dollars and in foreign currency, including US treasury securities, foreign currency series (Roosa bonds) and outstanding Federal Reserve swap commitments (which, on average, accounted for some 10 per cent of total official claims on the US in the 1960s). For our purposes, we only took official claims payable in US dollars and not those payable in other currencies in order not to overstate the share of the US dollar. The IMF reports official claims on the United Kingdom broken down into (i) claims arising from the use of credit facilities excluding US credits; (ii) claims held by the rest of the sterling area countries; (iii) sterling claims held by others (including claims arising from using credit facilities). We took all three types of claims. "Other currencies" for this period refers to official holdings of Eurodollars, official claims arising from the use of credit facilities (excluding US creditors) by France, official holdings of currencies other than US dollars and sterling (as estimated by IMF staff, covering 47 countries) and some residuals. The latter includes "important holdings of French francs by countries in the franc area."

We then computed total foreign reserves by subtracting from the total amount of reserves provided by the IMF: (i) gold reserves, (ii) official claims on the US payable in foreign currencies and (iii) reserve positions in the Fund.[50] Figures provided by the IMF for the first half of the 1970s include the estimated change in the level of holdings due to the general realignment of currencies in 1971, the US dollar devaluation in 1973, and the widespread floating of currencies since 1974. Finally, it is to be noted that, after the creation of the SDR in 1969, the IMF started publishing reserve amounts valued in SDR billions. It is these amounts that we used to calculate currency shares (i.e. without converting them to US dollars, as they may introduce some valuation changes; see Wong (2007)).

1970-1972: We took the data from the IMF Annual Report for 1977 (Table 13, p. 44). Amounts are provided in SDR billions. Official claims on the United States cover here "only claims of countries, including those denominated in the claimant's own currency". Since these claims are no longer provided separately, we assumed that the latter represented 15% of the claims on the US based on information provided in previous IMF Annual Reports. We calculated the official claims on the US payable in US dollars by subtracting the estimated claims denominated in the claimant's own currency.

The category "other currencies" includes here official deutsche mark, claims on the Federal Republic of Germany, official French franc claims on France, other official claims on countries denominated in the debtor's own currency, official foreign exchange claims arising from swap credits and related assistance, official holdings of Eurocurrencies, claims on the IBRD and IDA. The IMF stresses that some member

[50] According to the IMF, "a country's "reserve position in the IMF is the sum of (a) the "reserve tranche," that is, the foreign currency (including SDRs) amounts that a member country may draw from the IMF at short notice; and (b) any indebtedness of the IMF (under a loan agreement) in the General Resources Account that is readily available to the member country, including the reporting country's lending to the IMF under the General Arrangements to Borrow (GAB) and the New Arrangements to Borrow (NAB). While a member country must present a declaration of balance of payments-related need to make a purchase in the reserve tranche (reduction in reserve position), the IMF does not challenge a member's request for reserve tranche purchases" (IMF BPM6, Chapter 6, p. 114).

countries did not classify all of their foreign exchange claims that they reported to Fund staff, which explains the existence of a residual. The latter also comes from differences between data on US and UK currency liabilities, on the one hand, and data on official foreign exchange reported in the IMF's International Financial Statistics, on the other hand.

1973-1999: We took the currency shares provided by the IMF in its Annual Reports for the years 1983, 1985, 1990, 1997, 2000, 2003 and 2005 (NB: actual amounts were not provided by the IMF on a regular basis in its publications). The IMF stresses that "starting with 1979 [i.e. the date of their creation], the SDR value of European currency units (ECUs) issued against U.S. dollars is added to the SDR value of U.S. dollars, but the SDR value of ECUs issued against gold is excluded from the total." It is also worth noting that European currency units (ECUs) are treated as a separate currency from 1987 onwards, which may contribute to a decline in the share of the US dollar in 1987. The format of the reported data over this period was akin to that of the COFER data. The currency units reported included the US dollar, pound sterling, deutsche mark, French franc, Swiss franc, Dutch guilder, Japanese yen and "unspecified currencies", i.e. foreign exchange reserves whose currency composition information is not submitted to the IMF.

1999-2013: We took the IMF COFER data which provide a currency breakdown of globally disclosed foreign exchange reserves in US dollars, euro, Japanese yen, pound sterling and Swiss francs. We also have data on reserves in Canadian dollars and Australian dollars, which are reported from December 2012 onwards.

Appendix 2: Overview of Selected Policy Measures to Support/Discourage International Currency Use *(1947-2013)*

a. US dollar

Capital account measures

Supportive of international currency use		Discouraging international currency use	
1963	Interest equalization tax created		
1965	Voluntary credit restraint program		
1974	Interest equalization tax lifted		

Official position & verbal interventions *(US Treasury)*

Supportive of international currency use		Discouraging international currency use	
1987	Baker talks the dollar up	1977	Blumenthal talks the dollar down
1995	Rubin's "strong dollar" policy	1985	Baker talks the dollar down
		1986	Baker talks the dollar down

Exchange rate regime-related measures

Supportive of international currency use		Discouraging international currency use	
1987	G6 (Louvre) agreement	1971	Dollar convertibility suspended
		1973	Dollar allowed to float
		1985	G5 (Plaza) agreement
		1989	Unraveling of Louvre agreement

Other measures

Supportive of international currency use		Discouraging international currency use	
1947	Start of the Marshall Plan	1967	France leaves the "gold pool"
1951	End of the Marshall Plan	1968	Collapse of the "gold pool"
1961	Creation of the "gold pool"	1969	Creation of the SDR
1963	Creation of the G10	1978	Substitution account discussed

b. Pound sterling

Capital account measures

Supportive of international currency use		Discouraging international currency use	
1954	De facto convertibility	1948	Restrictions to convertibility
1961	Acceptance of IMF art. VIII		
1986	City of London's big bang		
1990	Intra-EU capital movements fully liberalised		

Official position & verbal interventions

Supportive of international currency use		Discouraging international currency use	

Exchange rate regime-related measures

Supportive of international currency use		Discouraging international currency use	
		1947	Sterling convertibility crisis
		1949	Sterling devaluation
		1967	Sterling devaluation
		1971	End of Bretton Woods
		1973	Generalised floating
		1976	Sterling crisis (IMF SBA)

Other measures

Supportive of international currency use		Discouraging international currency use	
1961	Bilateral concerté		
1964	End of bilateral concerté		
1966	BIS group arrangement I		
1968	BIS group arrangement II		
1971	End of BIS group arrangement I		
1974	End of BIS group arrangement II		
1977	BIS group arrangement III		

c. Deutsche Mark

Capital account measures			
	Supportive of international currency use		Discouraging international currency use
1961	Acceptance of IMF art. VIII	1968	D-Mark bond-issues managed by German banks only
1974	Cash-deposit requirement lifted	1971	Non-resident money market purchases restricted
1975	Foreign deposit interest payment freed	1972	Non-resident bond market purchases restricted
1980	Non-resident bond purchases allowed	1973	Non-resident equity market purchases restricted
1981	Non-resident security purchases allowed		
1985	D-Mark bond-issues managed by foreign banks		
1986	Non-straight fixed rate bonds allowed		
1989	Minimum maturities for public placements reduced		
1990	Intra-EU capital movements fully liberalised		

Official position & verbal interventions *(Bundesbank)*			
	Supportive of international currency use		Discouraging international currency use
1985	D-Mark to remain "competitive"	1971	Diversification of the international monetary system "everything but positive"

Exchange rate regime-related measures			
	Supportive of international currency use		Discouraging international currency use
1961	Revaluation of the D-Mark	1987	G6 (Louvre) agreement
1969	Revaluation of the D-Mark		
1971	D-Mark allowed to float		
1973	D-Mark re-allowed to float		
1981	EMS realignment		
1982	EMS realignment		
1983	EMS realignment (& D-Mark "dominance" theory)		
1985	G5 (Plaza) agreement		
1987	EMS realignment		
1992			ERM crises
1993			ERM crises

Other measures			
	Supportive of international currency use		Discouraging international currency use
1979	Creation of the EMS		
1990	Germany monetary unification		

d. Japanese yen

Capital account measures			
	Supportive of international currency use		Discouraging international currency use
1952	Overseas accounts for banks	1949	1st FX and Trade Control Law
1960	Yen accounts for non-residents	1972	Capital controls strengthened
1964	Acceptance of IMF art. VIII		
1972	Private FX holdings allowed		
1973	Inward FDI allowed		
1979	Bond purchases by non-residents allowed		
1980	New FX and Trade Control Law		
1981	Foreign trade finance in yen		
1982	Long-term foreign lending in yen		
1983	Liberalisation of "Samurai" bond issuance		
1984	FX conversion limits lifted, euro-yen bond issuance liberalised, etc.		
1985	Witholding tax on foreign interest payments lifted, etc.		
1986	Offshore market opened		
1987	Restrictions on euro-yen CP issues lifted		
1988	Other restrictions lifted		
1989	Yen deposits by non-residents facilitated		
1996	Announcement of "big bang"		
1998	New FX and Control Law		
1999	New measures to enhance bond market liquidity		

Official position & verbal interventions *(Ministry of Finance)*			
	Supportive of international currency use		Discouraging international currency use
1983	Yen 's role as "policy objective"	2001	Yen's role has changed "little"
1985	Yen's role to be "promoted"	2003	Yen's role capped by Japan's decline
1999	Study Group on yen's role		

Exchange rate regime-related measures			
	Supportive of international currency use		Discouraging international currency use
1971	Yen allowed to float	1987	G6 (Louvre) agreement
1973	Yen re-allowed to float		
1985	G5 (Plaza) agreement		

Other measures			
	Supportive of international currency use		Discouraging international currency use
1970	First "Samurai" bond issue		
1972	Interbank FX transactions allowed		
1977	First euroyen bond		
1983	Yen/Dollar committee created		

Sources: Authors' compilation based inter alia on Fukao (1990), Henning (1994), Schenk (2010), Tavlas (1991), Takagi (2011) and Takeda and Turner (1992).