

Steiner, Andreas

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**A Tale of Two Deficits:  
Public Budget Balance of Reserve Currency Countries**

**Andreas Steiner**

Working Paper 97  
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INSTITUTE OF EMPIRICAL ECONOMIC RESEARCH  
Osnabrück University  
Rolandstrasse 8  
49069 Osnabrück  
Germany

# A Tale of Two Deficits: Public Budget Balance of Reserve Currency Countries

Andreas Steiner\*

University of Osnabrueck

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## Abstract

Central banks invest their foreign exchange reserves predominantly in government bonds. The global accumulation of reserves therefore affects the equilibrium in the market for government bonds of reserve currency countries. By means of a panel data analysis we examine the relationship between reserve currency status and public budget balance during different constellations of the international monetary system: the sterling period (1890-1935) and the dollar dominance (since World War II). We show for both periods that reserve currency status significantly lowers the fiscal balance. Any additional dollar of reserves lowers the center's balance by 0.7-1.4 dollars. These novel findings show that reserve currency status increases sovereign debt of the center country.

**Keywords:** Reserve Currency, Public Balance, International Monetary System, Panel Data Analysis.

**JEL Classification Numbers:** F31, F33, F41, H62, E62, C23.

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\* Address: University of Osnabrueck, Institute of Empirical Economic Research, Rolandstrasse 8, D-49069 Osnabrueck, Germany, e-mail: [asteiner@uni-osnabrueck.de](mailto:asteiner@uni-osnabrueck.de). The author is grateful to Michael Bordo, Peter H. Lindert and Moritz Schularick for providing historical data. The author would like to thank Thomas Grjebine, Yilin Hou, Gian-Maria Milesi-Ferretti, Moritz Schularick, Alfons Weichenrieder, Frank Westermann, Joachim Wilde, seminar participants at the Deutsche Bundesbank and University of Osnabrueck and participants at the ZEW conference on "Recent Developments in Macroeconomics", the annual meeting of the Verein für Socialpolitik, the annual congress of the International Institute of Public Finance and the EEA-ESEM meeting in Gothenburg for their helpful comments and suggestions.

# 1 Introduction

This paper provides an empirical examination of the relationship between reserve currency status and government finances. Since central banks hold their foreign exchange reserves preferably in the form of government bonds issued by the center country of the international monetary system, the reserve-providing country faces an additional demand for its sovereign bonds. By implication, reserve currency status facilitates the financing of fiscal deficits.

The empirical importance of the relationship between public finances and reserve currency status is characterised by three stylised facts:

- 1) Central banks' international reserves have increased considerably. The annual average growth rate between 1880 (1970) and 2010 has been 7.2% (12.2%). Since this rate exceeds the US inflation rate, which averaged 2.4% between 1880 and 2010, reserves have risen in real terms. Reserves have also increased relative to the economic size of the US, which might be considered as backing the real value of dollar exchange reserves. US real GDP has grown at an average annual rate of 3.2% during the period of consideration.
- 2) Central banks' reserves have been increasingly held in the form of foreign assets at the expense of gold. The share of foreign exchange reserves in total reserves<sup>1</sup> has risen from 9.5% in 1899 to 95.5% in 2010 (see Figure 1).

[Figure 1 about here.]

- 3) A considerable share of foreign exchange reserves has been invested in government bonds of reserve currency countries. By way of example, in 2010 35.2% of global foreign exchange reserves were invested in US Treasuries (see Figure 1).

These facts imply that foreign central banks are major players on the market for safe government bonds. They hold a considerable share of government debt of the center countries. Their rising demand for government bonds generates a dilemma: Triffin (1960) points out that the objectives of providing an increasing amount of reserve assets and of fixing the real value of these assets are incompatible in a monetary system that uses national currencies as reserves. While Triffin focused on the implications for the balance of payments of the center country, the modern dilemma is a fiscal problem arising from central banks' preference for

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<sup>1</sup>Total reserves are defined as the sum of gold, convertible foreign exchange, unconditional drawing rights with the IMF (the country's reserve position in the Fund) and special drawing rights (SDRs). While historically reserves consisted of gold and foreign assets, drawing rights with the IMF arise from countries' capital shares in the IMF and SDRs were created in 1969 as a response to the "dollar shortage".

government securities (Obstfeld, 2011a, 2011b and Prasad, 2011). Obstfeld (2011b, p.10) concludes with respect to the US:

”So global reserve growth requires the ongoing issuance of gross government debt. This requires, in turn, that the government run continuing deficits, or that it issue debt to acquire assets likely to be inherently riskier than the corresponding liabilities. Just as in the classic Triffin dilemma, global reserve growth is largely driven by deficits - not national balance of payments deficits, but government deficits.”

Center countries have to run fiscal deficits if they want to satisfy the increasing demand for safe assets.<sup>2</sup> At the same time, the increasing demand for reserve assets lowers their interest rate, which, in turn, may lower fiscal discipline. If center country governments optimize intertemporally, their equilibrium response is to run lower fiscal balances *ceteris paribus*.

If there exist perfect substitutes for sovereign bonds of the center country, foreign central banks crowd-out the private demand for government bonds and the equilibrium on the sovereign bonds market is unaffected. Under the more realistic assumption that there are no perfect substitutes<sup>3</sup>, the price of government bonds rises and lowers the effective interest rate. The public budget constraint of the center is relaxed. Its sovereign debt rises.

This paper contributes to the preceding literature in several dimensions. First, we extend the literature on the determinants of the public budget balance by explicitly taking account of countries’ reserve currency status. While the existing literature explains public budget balances by economic and political factors, it disregards that the supply of government bonds is not only supply-driven, but depends on private and official demand for such bonds alike. The equilibrium approach to fiscal policy pioneered by Barro (1979) focuses on economic factors that affect public finances. In this type of model, optimal tax rates are smooth over time. Deficits result from exceptional spending like the financing of wars and countercyclical policies. The importance of political and institutional factors for public finances is theoretically grounded by Alesina and Tabellini (1990). Empirical contributions of Roubini and Sachs (1989a, 1989b) show that coalition governments, left-wing parties and short terms of office are associated with larger deficits. While the findings are confirmed by Grilli et al. (1991), De Haan and Sturm (1997) and De Haan et al. (1999) do not find a robust relationship between political factors and government finances. To the best of our knowledge, the effect of reserve currency status on public debt has not been investigated before.

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<sup>2</sup>In principle, the provision of public assets can be reconciled with a balanced public budget if the public sector purchases foreign assets.

<sup>3</sup>If home bonds and foreign reserve bonds were perfect substitutes, central banks could hold home bonds instead of foreign reserves (see Canzoneri et al., 2013).

Our second contribution concerns the data set: The construction of a panel data set covering 120 years of public budget history allows us to examine the determinants of fiscal balances in the long run. Moreover, we can identify the changing influence of certain determinants over time. While existing panel studies examine more recent periods (i.e. Tujula and Wolswijk, 2007, and Woo, 2003), long-run studies using historical data are usually time-series analyses focusing on a single country (i.e. Barro, 1986 and Bohn, 1998 for the US; Barro, 1987, for the UK). The analysis of the determinants of fiscal balances in a historical panel is new.

Third, this paper contributes to the literature that examines the consequences of reserve currency status. Reserve currency countries are often considered to enjoy an "exorbitant privilege" (see Gourinchas and Rey, 2007; Gourinchas et al., 2010), because they are able to issue debt in their own currency and at low interest rates. We focus on one aspect of this privilege, which has been undervalued so far: Reserve currency countries face a relaxed public budget constraint.

Finally, this paper is linked to studies examining the relationship between the key currency role of the dollar and the financing of the US public deficit (i.e. Kitchen and Chinn, 2011; Krishnamurthy and Vissing-Jorgenson, 2012). Favilukis et al. (2012) report that the downward trend in the US net foreign asset position since 1994 can entirely be attributed to the purchase of US safe assets by foreigners. While these studies focus on how reserve status affects the interest rate, we show that besides this price effect there is also a quantity effect: Reserve status increases the level of government debt.

This paper makes reference to a recent literature investigating the scarcity of safe assets and its global implications (IMF, 2012; Dooley et al., 2004). Caballero and Farhi (2013) and Gourinchas and Jeanne (2012) provide theoretical approaches that emphasise the central role of governments and public debt in the production of safe assets.

The remainder of the paper is organized as follows. The next section traces the evolution of the international monetary system since the establishment of central banks and explores the importance of government securities as central bank reserve assets. Implications of being the reserve currency provider are discussed in Section 3. Section 4 provides an empirical analysis of the effect of reserve currency status on the public budget balance. Concluding remarks are offered in Section 5.

## 2 Foreign exchange reserves in historical perspective

This section provides historical evidence of the increasing role of foreign exchange reserves in total reserves and illustrates the rise and fall of national currencies as reserve assets. It then summarises the evidence on the asset classes in which central banks invest their foreign exchange reserves.

### 2.1 A short history of reserve currencies

#### *Sterling dominance (1880-1913)*

The classical gold standard, which emerged during the 19th century as a by-product of the foundation of central banks, gradually turned into a gold-exchange standard, where gold was supplemented by foreign assets denominated in gold-convertible currencies. In the period preceding World War I, apart from the Bank of England, most central banks held some foreign exchange reserves in addition to gold and operated under a de facto gold-exchange standard (see Bloomfield, 1963). According to the estimates of Lindert (1969) the share of foreign exchange assets in total reserves (sum of gold and foreign exchange) rose from 12.7% in 1880 to 23% in 1913. While the shares of Deutsche mark and French franc in total reserves both accounted for roughly 15% in 1899, the franc's share rose to 31% in 1913 at the expense of sterling. With Canada being the only country holding sizeable dollar reserves<sup>4</sup>, the dollar share in global foreign exchange holdings was below 2% in 1913.

#### *Dual reserve currency system (1920-1939)*

While the monetary system after World War I was based on the same pillars as its predecessor, the evolution of the gold-exchange standard was characterized by two main changes: First, foreign exchange grew relative to total reserves. Second, the dollar emerged as important reserve currency and shared the role of dominant reserve currency with pound sterling during the interwar years. The changing importance of key currencies in total foreign exchange reserves is illustrated in Figure 2.

[Figure 2 about here.]

The creation of the Federal Reserve System in 1913 is an important factor that facilitated the emergence of the dollar as key currency. Moreover, after 1914 the US turned from net debtor to net creditor, while the net foreign asset position of the UK deteriorated. According to the estimates of Eichengreen and Flandreau (2009), dollar reserves accounted

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<sup>4</sup>Although small in absolute terms, the entire foreign assets of the Philippine Treasury were denominated in dollar.

for 18.2% of total foreign exchange reserves in 1920. In 1924, the dollar overtook sterling as most important reserve currency for the first time. In the 1930s, however, pound sterling regained its leading role.

### *Dollar dominance (since World War II)*

After World War II, the dollar consolidated its role as key currency. Its predominant role was backed by official US policy.<sup>5</sup> The gold-dollar standard collapsed in 1971 when the US revoked its commitment to exchange dollars for gold at the predefined price. Despite the dollar devaluation, its share in foreign exchange reserves did not drop. On the contrary, it reached its peak in 1975, when 75% of global foreign exchange reserves were denominated in US dollars. This share then declined gradually and reached a lower floor of 50% in 1990. Since then, dollar accounted for a relatively stable share of two thirds of total exchange reserves despite the creation of the Euro.

## **2.2 Types of reserve assets**

While individual central banks usually do not report the currency composition of their foreign exchange reserves, they provide even less information with respect to the type of assets they hold. Since reserves have to be readily available at known value in times of financial distress, the set of assets is restricted to safe short-term liquid assets.<sup>6</sup> Government bonds fulfill these conditions. Bloomfield (1963) notes for the period up to 1913 that external assets were held in the form of foreign bills, balances with foreign correspondents and foreign bonds. For the well studied case of Norway, Øksendal (2008) reports that exchange reserves were composed of British consols, French rentes and German government bonds for liquidity purposes.

Table 1 provides data on the share of government bonds in central banks' foreign assets in the interwar years for a number of countries. It shows that government bonds were an important reserve asset although their share was rather unstable. The countries of the sterling area<sup>7</sup> invested their foreign exchange reserves predominantly in British Treasury bills (see Nurske, 1944, p.60).

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<sup>5</sup>US tax laws were amended in 1961 (section 895) stating that foreign central banks' income from obligations of the US should be exempt from taxation.

<sup>6</sup>The Group of Ten (1965) defines reserves as "those assets of [a country's] monetary authorities that can be used, directly or through assured convertibility into other assets, to support its rate of exchange when its external payments are in deficit" (p. 21).

<sup>7</sup>The sterling area was formed by countries that decided to peg their exchange rate to the pound sterling after its devaluation in 1931. The group consisted of the British Commonwealth of Nations as well as independent countries, among them the Scandinavian countries, Japan and Portugal. The sterling bloc existed until World War II.



[Table 1 about here.]

More precise statements are possible with respect to the role of US Treasuries since World War II. The Flow of Funds data of the FED show that official foreign institutions constitute a major source of demand for US Treasury bonds. The left hand panel of Figure 3 visualizes the enormous increase in the real value of outstanding US Treasury debt since the early 1980s. This increased supply was absorbed by foreign official holders of Treasuries: Their share in total Treasury debt securities outstanding has risen from 6% in 1970 to 40% in 2009 (see right hand panel of Figure 3). The declining share in recent years (35.9% in 2010) can be explained by the FED's massive purchase of US Treasuries resulting from its policy of quantitative easing. Notwithstanding, between 2000 and 2010, 49% of the increase in Treasuries was purchased by foreign official institutions. Foreign official investors hold the majority of total Treasuries in foreign hands (75% in 2010).

[Figure 3 about here.]

### **3 Implications of reserve currency status**

This section discusses the theoretical argument that the reserve-providing country faces lower interest rates and a relaxed public budget constraint.

#### **3.1 Implications for interest rates**

A reserve currency country is characterised by the unique situation that its assets are held by two types of foreign agents: private and official ones. First, alike any financially integrated economy, the reserve currency country receives loans from private foreign lenders as a result of their portfolio optimisation. Second, in contrast to the rest of the world, foreign central banks provide loans to the reserve currency country equal to the amount of foreign exchange reserves they hold.<sup>8</sup> These loans are primarily granted to the sovereign of the reserve currency country. Thus, the reserve currency country faces an additional demand for its sovereign bonds. In line with a simple demand-supply framework without total crowding-out of private by official demand, the amount of debt and the price of assets are higher than without reserve currency status.

These effects are intensified by the fact that the demand for safe reserve assets is relatively insensitive to their return because perfect substitutes are unavailable. For the early

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<sup>8</sup>For the role of foreign exchange holdings and their determinants refer, among others, to Aizenman and Lee (2007), Cheung and Qian (2009) and Jeanne and Rancière (2011).

period of the dollar standard Aliber (1964) and Gemmill (1961) report that the share of foreign exchange in total reserves is independent of interest rates.<sup>9</sup> More recently, Krishnamurthy and Vissing-Jorgenson (2012) show that foreign central banks' investment decisions are insensitive to interest rates.

Moreover, the demand for Treasury bonds by foreign central banks substantially lowers their interest rate, which, in turn, softens the public budget constraint. This effect has been present in the UK during the sterling dominance. When sterling reserve accumulation resulted from trade with the UK, the demand for UK Treasury bills rose, which lowered their discount rate (see Nurske, 1944, p.61). For the more recent dollar dominance, a series of papers documents that foreign central banks' asset demand lowers US interest rates.<sup>10</sup>

On theoretical grounds, Caballero and Krishnamurthy (2009) show that the global demand for a safe store of value rises US asset prices and lowers interest rates. Caballero et al. (2008) derive low US interest rates as the equilibrium outcome of different levels of financial development.

### 3.2 Implications for the public budget

This section takes a supply-side view and demonstrates that it is in the own interest of the reserve-providing country to increase government debt. Our starting point is the public budget identity, which is given by

$$D_t = (1 + i_t)D_{t-1} - S_t \tag{1}$$

where  $D$  denotes the level of public debt at the end of year  $t$ ,  $i$  the nominal interest rate and  $S$  the primary government surplus. Scaled by nominal GDP, the dynamics of public debt can alternatively be expressed as

$$d_t = \left( \frac{1 + i_t}{1 + g_t} \right) d_{t-1} - s_t \tag{2}$$

where variables denoted by lower cases are scaled by GDP (e.g.  $d = \frac{D}{Y}$ ) and  $g$  is the growth rate of nominal GDP. After adding standard assumptions and some algebraic manipulation (see Bohn, 1995, 2005), the intertemporal budget constraint of fiscal policy can be obtained as

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<sup>9</sup>“The general conclusion from recent empirical investigations is that foreign official institutions do not shift funds from dollar assets into gold, or into reserve assets denominated in other currencies, in response to changes in interest rates” (Aliber, 1964, p.448).

<sup>10</sup>Refer to Krishnamurthy and Vissing-Jorgensen, 2012; Warnock and Warnock, 2009; Kitchen and Chinn, 2011; Beltran et al., 2012.

$$d_t = \sum_{j=0}^{\infty} \frac{1}{\prod_{k=0}^j (1 + r_k)} E_t[s_{t+j}] \quad (3)$$

where the "return on debt" is defined as  $r_k = (1 + i_k)/(1 + g_k)$ .  $E_t$  denotes conditional expectations. The constraint requires that the present value of future primary surpluses equals the initial level of debt. If a country attains reserve currency status, its interest rate decreases. We denote this lower interest rate by  $i^{RC}$ . Equation (3) shows that for lower future interest rates the intertemporal budget constraint is satisfied for a higher level of public debt  $d$ .<sup>11</sup> In other words, for a given stream of future surpluses, a larger level of current debt is compatible with the intertemporal budget constraint. This also holds if reserve currency status is considered to be temporary: If the country enjoys reserve status from now until period  $N$ , in equation (3)  $i$  is replaced by  $i^{RC}$  for  $0 \leq j \leq N$ . By implication, in the limit the budget constraint is satisfied for a higher current level of sovereign debt.

According to simple economics of intertemporal choice, lower interest rates induce substitution and income effects. Optimizing agents exchange future consumption for present one. The income effect depends on the sign of agents' net wealth: The effect is positive for borrowers and negative for creditors. Textbook analysis of intertemporal choice assumes that there exists one homogenous asset with given interest rate. In our case it is more plausible to assume that the degree of asset substitutability is limited. A decrease in interest rates of sovereign bonds does not affect the return of other assets in which the sovereign itself may invest. This implies that the income effect of the sovereign is positive if it is a borrower and zero if it is a creditor. The net effect of combined substitution and income effects is unambiguously positive. The optimal government response to a lower interest rate is an increase in present consumption.

There exists, however, a caveat: According to the theory on public spending governments do not optimize intertemporally; expenditures are determined independently of interest rates. Deviations from a balanced budget are explained by economic shocks or political considerations (e.g. Barro, 1979; Alesina and Tabellini, 1990.)<sup>12</sup> However, even if interest rates do not enter the government's objective function directly, they affect the intertemporal budget constraint. As soon as a government becomes a net debtor because of deficit spending, lower lending rates imply that a given stream of surpluses is compatible with a larger current deficit.

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<sup>11</sup>If lower interest rates enhance economic growth, this rise in  $g$  additionally lowers  $r$ .

<sup>12</sup>Ricardian equivalence implies that private agents correct the intertemporally suboptimal allocation of government spending. Private agents increase present consumption in place of the government when the cost of government debt decreases.

## 4 Regression analysis

### 4.1 Data

To study the effect of reserve currency status on the government budget balance we assembled a new annual dataset covering 24 industrialised countries over the years 1890-2009. The limitation on industrialised countries is due to data availability and the attempt to form a relatively homogeneous country group, which warrants pooling. For each variable we use one main data source, which provides data from the start of the series until 2009 (International Financial Statistics start in 1948 at the earliest, for World Development Indicators the longest series date back to 1960). These series are complemented by alternative sources that provide historical data: The most important are Bordo et al. (2001), Lindert (1969) and Mitchell (2007). The definitions of the variables and their data sources are listed in Appendix A. Appendix B enumerates the countries of our sample.

At the core of our dataset are yearly data of central banks' international reserves and their composition (gold vs. foreign exchange). In contrast to the main data set, which contains country-specific data for our 24 sample countries, foreign exchange reserves are measured as the global aggregate. For reserve currency countries matters the reserve demand emanating from the rest of the world. In particular, our data on foreign exchange include the reserve stocks of emerging and developing countries, where the major part of reserve accumulation has taken place since the East Asian financial crisis. With their beginning in 1948, we use the IMF world series on foreign exchange. For the period 1890-1913 world reserves are calculated as the aggregate of 35 countries (see Lindert, 1969). Aggregate reserves in the interwar period are the sum over 21 countries as provided in the Statistical Yearbooks of the League of Nations (see Bordo and Eichengreen, 2001). Currency shares in these foreign exchange reserves shed light on the dynamics of reserve currency status. These shares are based on various sources, which are listed in Appendix C.

Data on reserve assets categorized into different key currencies are not available at the global level.<sup>13</sup> Hence, the division of the demand for foreign exchange in different reserve currencies is calculated. The procedure, which is the same for all reserve currencies, is illustrated by way of example for sterling reserves: Changes in total reserves and changes in their composition result from valuation changes (exogenous) and active reserve policy (endogenous). Since only purchases and sales of reserves affects the bonds market of the center country, we try to isolate reserve changes due to active reserve policy. To this end, the total level of foreign exchange reserves is first converted into sterling and then multiplied

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<sup>13</sup>While some central banks report the annual change in the holdings of foreign exchange reserves listed by currency of denomination, others do not provide this breakdown.

by the sterling share in total foreign exchange reserves. The difference in sterling reserves between two years is our measure of sterling demand. While this method filters out the effect of exchange rate changes, we are unable to separate the effect of changes in the market value of reserve assets from active reserve policy.

This demand for assets of the major reserve currencies is illustrated in Figure 4. It highlights several facts: First, the demand for reserve assets is highly volatile. Second, annual reserve changes amounting to 1% of GDP of the reserve country are rather the rule than the exception. This is an economically significant value. Third, changes relative to national GDP have been small in France, but large in the US and Germany. Fourth, the time series illustrate the fall of the sterling and the rise of the dollar as reserve currencies. While demand for sterling is often negative, dollar assets were sold on a net basis only in few occasions. Since 1983 the demand for dollar reserves has been positive in any year.

[Figure 4 about here.]

Table 2 provides data on the demand for reserves relative to GDP of the issuing countries. The largest relative demand for reserve assets has been recorded in Germany and the US since 1995. Before 1970 the demand for reserve assets was economically less significant relative to GDP.

[Table 2 about here.]

Since foreign exchange reserves are not entirely invested in government bonds, our measure of reserve demand provides an upper bound for the demand of government bonds. Given the lack of more precise data, we rely on this proxy variable for the period before WW II. Beginning in 1948 the Flow of Funds provide data on the amount of US Treasuries held by foreign official institutions, which we then use in the analysis.

The dependent variable of our regression analysis is the government budget balance expressed as a ratio of GDP in decimal terms. The choice of control variables follows the seminal papers of Roubini and Sachs (1989a, 1989b), De Haan and Sturm (1997) and Woo (2003). In particular, the following determinants of government surpluses/deficits are considered:

*Inflation:* Inflation erodes the real value of taxes if there is a collection lag, defined as a time difference between the moment the tax obligation arises and the moment of tax payment. Moreover, if tax law specifies a value expressed in national currency, inflation decreases its real value. In contrast, in the presence of progressive tax rate schedules government income benefits from higher inflation rates. The overall effect has to be determined empirically.

*Growth of GDP:* If government spending is used as an anticyclical instrument to smooth the business cycle, deficits emerge when GDP growth is temporarily low. In periods of relatively high GDP growth, governments may reduce their spending and amount surpluses in their budget balance. The built-in stabilizer of fixed tax rates works in the same direction: Whereas tax income is high during booms, it decreases during recessions.

*Demographic structure:* Economies with relatively old societies spend a larger share of income for social welfare like pensions and health. The dependency ratio of persons over 65 years (relative to its world average) is expected to negatively affect government finances.

*Unemployment rate:* If the rate of unemployment is high, government spending is high due to social assistance transfers. At the same time, low economic activity depresses tax revenue. Therefore, the unemployment rate is expected to negatively affect the government budget balance.

*External shocks:* Negative external shocks might be accommodated by an increase in government spending. The growth rate of the terms of trade multiplied by trade openness is used as a proxy for external shocks.

*Relative income:* Real per capita GDP relative to the world average is introduced to control for the stage of development. Relatively poor countries are more likely to have inefficient tax and spending systems. As a result, government budget deficits might arise.

*Military expenditure:* The involvement of a country's armed forces in wars and peace-keeping operations generates costs, which are often transitory and unforeseen. Smooth tax rates imply that these exceptional expenditures generate deficits, which are subsequently financed over long time periods. By way of example, the two World Wars increased public debt of the participating countries considerably. It then took many years to lower public debt to pre-war levels.

For most countries, the World Development Indicators provide data on military expenditures (relative to GDP) since 1988. To identify periods of abnormally high or low military expenditures, we calculate the deviation of military expenditures from their country-specific mean and use this variable in our empirical analysis. Because historical data on military expenditures is missing, in our long-run analysis we use a dummy variable for wars instead, which takes on the value one during World War I and World War II.

*Interest rate:* Interest rates on sovereign bonds determine the cost of debt financing. For investors they convey information about the riskiness of the bonds; for debtors they are expected to work as automatic stabilizers. High interest rates limit spending of indebted countries whereas creditor countries are characterised by lower interest rates. Since high interest rates imply that a present deficit has to be balanced by larger future surpluses, it is less favourable to substitute future consumption by present one. Optimising governments

are expected to run higher budget balances.

The inclusion of interest rates as a determinant of public budget balances poses one major caveat: Interest rates are endogenous. They are determined by the level of government debt and the contemporaneous deficit (see Laubach, 2009). To circumvent the econometric problem of endogeneity, we use an instrumental variable approach in the regressions including interest rates.

*Left-wing government:* Left-wing governments are ideologically in favour of a higher degree of public intervention. According to the partisan approach, they focus on economic growth and low unemployment while low inflation rates are a less important objective. Therefore, left-wing governments might be more prone to increase expenditures and generate deficits than right-wing governments.

*Civil liberties/Democracy:* Countries with reliable institutions and a sound legal and political system are expected to attract private foreign capital flows, which facilitates the financing of government budget deficits. This effect works in addition to the impact of reserve currency status. We use an index of civil liberties, based on measures for personal freedom, human rights, rule of law and economic rights, to proxy for country risk. This measure is available from 1972 onwards. For our historical analysis we therefore rely on an index of democracy instead. Democratic governments are considered to be associated with lower country risk and larger capital inflows.

*Financial deepening:* The development of the domestic financial market is crucial for a government's ability to finance a budget deficit. In developed markets governments can more easily cover a deficit by the issuance of bonds and depend less on inflationary finance.

*Market capitalization:* An alternative measure of financial depth is provided by the size of the stock market relative to GDP. Large stock markets offer investment opportunities for foreign capital. This might also benefit the market for sovereign bonds.

*Financial center:* We control for financial centers by the inclusion of a dummy variable. Countries whose gross positions of external assets and liabilities relative to GDP are both larger than their respective mean plus their standard deviation in the cross-section, are considered to be financial centers.<sup>14</sup> Interestingly, the US is not identified as a financial center. To capture a broader notion of financial center, we additionally include countries listed as top ten in the Global Financial Centers Index, which evaluates the competitiveness of financial center cities. In particular, Hongkong, Japan, Switzerland, the UK and the US are coded as financial centers over the entire period.<sup>15</sup>

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<sup>14</sup>By way of example, in 2005 the following countries are identified as financial centers: Belgium, Hongkong, Ireland, the Netherlands, Singapore, Switzerland and the United Kingdom.

<sup>15</sup>While being in the top ten, Singapore's financial development is more recent. We therefore rely on the definition based on gross foreign assets and liabilities, according to which it has been a financial center since

While we first present a time-series approach, the main analysis is based on a panel data set. The time-series analysis is suitable to demonstrate the explanatory power of reserve demand. Thanks to easy financing, reserve currency countries might react differently to changes in the control variables. The panel data approach has the merit to assume constant impact coefficients across countries, which allows to isolate the effect of reserve status in the reserve demand variable.

We are aware that the global economy went through major changes during the considered 120 years. The process of financial integration, the move to more flexible exchange rates after the breakdown of the Bretton Woods system, the rising importance of emerging markets and China in particular as reserve holders and the introduction of the Euro are only some examples. We account for these effects by the inclusion of time effects in our regressions. We do not model these changes explicitly because we suspect that they do not change the fundamental determinants of the public budget balance. However, since we use the aggregate demand for reserves as a regressor we control implicitly for changes in reserve demand, e.g. periods of strong reserve growth and periods of declining reserve levels.

## 4.2 Time-series analysis

In a first step, we examine the determinants of the government budget balance for the US and the UK separately in a time series analysis. This analysis focuses on the question whether the demand for reserves is an important determinant of the budget balance in reserve currency countries. Importance is evaluated by the estimated magnitude of the effect and the marginal contribution of the reserve demand to R squared. To make use of the richest data set, we concentrate on the more recent period (1970-2009).

While the parsimonious model (columns 1-2 and 5-6) is estimated by OLS, the remaining columns are based on the instrumental variable approach using 2SLS. To control for potential endogeneity of interest rates, these are instrumented by the German interest rate, which is considered as a proxy for the world interest rate. Results are presented in Table 3. Because of the small number of observations, findings should be interpreted with caution.

[Table 3 about here.]

The results for the US (columns 1 to 4) show that besides unemployment the demand for dollar reserves by the rest of the world significantly lowers the government budget balance: If the rest of the world accumulates dollar reserves equal to 1% of US GDP, the US government

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1998.



budget balance relative to GDP decreases by 0.75 to 1.1 percentage points. The inclusion of the demand for reserves raises the R squared considerably.

Columns 5 to 8 show the results for the UK. Alike in the US, unemployment significantly lowers the government budget balance. When the rest of the world accumulates sterling reserves equal to 1% of UK GDP the UK government balance decreases between 1.0 and 1.3 percentage points. Consideration of reserve currency status positively affects the R squared; this effect is especially strong in the parsimonious specification (increase by more than 10%).

### 4.3 Panel data analysis

This section uses the panel data set to test whether the accumulation of reserve currency bonds in the rest of the world affects the government budget balance of reserve-providing countries. To this end, we regress the government budget balance relative to GDP on a set of standard determinants. To this setting, we add the demand for reserve-currency assets as an additional control variable. In particular, we estimate the following fixed-effects specification

$$\left(\frac{GovBudget}{GDP}\right)_{it} = \beta X_{it} + \gamma \left(\frac{\Delta R^d}{GDP}\right)_{it} + c_i + d_t + \epsilon_{it} \quad (4)$$

where  $GovBudget/GDP$  is the ratio of the government budget balance to GDP,  $X$  is a vector of control variables,  $\Delta R^d$  measures the change in the demand for reserve assets of country  $i$  by foreign central banks<sup>16</sup>,  $c$  is a fixed country effect,  $d$  a fixed time effect and  $\epsilon$  is the error term.  $i$  denotes a specific country and  $t$  represents the time period. The slope parameters, represented by the vectors  $\beta$  and  $\gamma$ , are assumed to be constant across countries and time. We use the fixed effects estimator with a cluster-robust variance estimator.<sup>17</sup>

To control for the endogeneity of interest rates, we use an instrumental variable approach. We provide results for two different instruments: the lagged value of interest rates on government bonds and the world policy rate. Since interest rates may be characterised by autocorrelation, the world policy rate is our preferred instrument. The world policy rate is defined as the policy rate set by the Bank of England (1890-1935) and the US FED (1948-2009). The switch from the UK to the US accounts of the changing dominance in international finance. It is empirically required because data on US policy rates is only available after the FED was founded in 1913. For the UK and US the world policy rate is set equal to the German policy rate when it would be their own rate.

One might suspect that the global demand for reserve itself is endogenous, that is, it is a function of the supply of safe assets in reserve currency countries. The literature on

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<sup>16</sup> $\Delta R^d$  is zero for all countries besides those enjoying reserve currency status.

<sup>17</sup>The Hausman test rejects a random effects specification.

the demand for reserves, however, identifies domestic variables (e.g. trade openness, financial openness, external debt, potential for capital flight) as well as policy variables (capital controls, exchange rate regime) as the determinants of reserve demand. These all are unrelated to deficit financing in reserve currency countries. A public deficit might induce foreign reserve demand if the deficit lowers the reserve country’s current account and if a fixed exchange rate system eliminates a nominal exchange rate adjustment. The evidence with respect to the twin deficit hypothesis, however, is mixed. Deficits might even increase the current account balance (see Kim and Roubini, 2008). We therefore opt not to instrument global reserve demand.<sup>18</sup>

I use two different estimators, the instrumental variable two-stage least squares (IV-2SLS) and the two-step efficient generalised methods of moments (GMM) estimators.<sup>19</sup> In the first step, both estimators create instruments by regressing interest rates on the instrumental variable. These instruments are then used to replace interest rates in the second-step regression.

### 4.3.1 Results spanning 120 years of history

The results for the entire time period (1890-2009) are presented in Table 4. While column 1 presents a parsimonious model only accounting for fundamental determinants of the budget balance (inflation, GDP growth and demographics), we add political and financial variables in subsequent columns.

[Table 4 about here.]

Regarding our control variables, the following effects are found: Wars significantly decrease the budget balance. Countries with deep financial markets are characterised by lower budget balances. While they are not significant across all specifications, inflation and real GDP growth affect the government budget balance in the hypothesised direction: The government budget is the lower, the higher the inflation rate. Real GDP growth positively affects the fiscal balance, which can be interpreted as evidence of countercyclical government spending. There is weak evidence that democratic governments are associated with larger government balances.

Columns (8) to (10) are estimated by IV-2SLS. Interest rates are instrumented by their lagged level (column 8) and by the world policy rate (columns 9 and 10). As expected higher

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<sup>18</sup>Endogeneity is present between global reserve demand and the current account balance of reserve currency countries.

<sup>19</sup>Results are reported for 2SLS; those obtained with GMM may be provided upon request.

interest rates and the existing level of government debt decrease the current government budget balance.

Across all specifications, the government balances of the UK and the US are significantly affected by the demand for sterling and dollar reserve assets, respectively. If the rest of the world accumulates dollar reserves equivalent to 1% of US GDP, the US government budget balance decreases by 0.7-1.4 percentage points relative to GDP. For the UK, these numbers are comparable in magnitude. An increase in global sterling reserves by 1% of UK GDP lowers the UK government budget balance relative to GDP by 0.8-1.3 percentage points. While these results are in line with our hypothesis that reserve demand lowers the government budget balance, the magnitude of the effects is surprising. Coefficients larger than one imply that the negative effect on public balances is stronger than what is directly financed by the official demand for reserve assets. The official demand for reserve assets seems to attract an additional private demand for government bonds. Hence, the effect of reserve demand is multiplied. Foreign central banks do not crowd-out private investors on the market for government bonds. On the contrary, private agents follow central banks' investment strategy and increase their holdings of government bonds when central banks accumulate reserve assets.

Apart from sterling and dollar demand we also include the change in globally held franc and mark reserves (see columns 3, 7-10). With respect to these secondary reserve currencies, we do not find significant effects.

While this analysis over an extended time period benefits from the included amount of information, it may be plagued by structural breaks. We therefore proceed by splitting our sample into two sub-periods, namely the period before and after World War II.

#### **4.3.2 UK during sterling dominance**

We replicate our fixed-effects regressions of Table 4 for the period from 1890 to 1935 excluding the period of World War I (1914-1919). The results in Table 5 show that most of the standard control variables do not significantly affect the government balance. We find some evidence that older societies are characterised by lower government balances. The demand for reserve assets, however, is significant: For the UK, sterling demand lowers the government budget balance albeit its effect is economically smaller compared to the entire period. An increase in global sterling reserves by 1% of UK GDP lowers its government balance by 0.6-1.1 percentage points. The demand for dollar assets significantly increases the US government balance. This unexpected result may be explained by various reasons: First, before World War I, the dollar was not yet used as global reserve currency. The empirical result for dollar assets is therefore based on the relatively short time period between 1920

and 1935. Second, relative to US GDP, dollar reserve demand was relatively low during this period (see Table 2). Hence, its effect on the government balance was economically small. Third, before World War II the US has actively promoted the rise of the dollar as reserve currency. This explains the positive coefficient implying that fiscal policy was more restrictive when dollar reserves were accumulated in the rest of the world. This is consistent with the observation that the US accumulated gold during that period.

[Table 5 about here.]

### 4.3.3 US during dollar dominance

For the dollar dominance since World War II (see Table 6) real GDP growth has a robust positive effect on the government balance confirming the tax- and consumption-smoothing hypothesis. Interest rates and government debt decrease the government balance significantly. For both UK and US the demand for reserve assets significantly lowers the respective government budget balances. This effect holds for the French franc in two out of four specifications, while the demand for mark reserves has the expected sign, but is only significant in one out of four specifications.

[Table 6 about here.]

For the most recent period beginning in 1970, data availability allows us to use a richer data set. In particular, besides the variables used before, we have data on the rate of unemployment, external shocks, military expenditures, government orientation and market capitalization. More importantly, we can make use of more precise data on the global demand for reserve assets. In its Annual Report the IMF provides data on the absolute change in official holdings of foreign exchange by currency, which are broken down in quantity and price changes. This allows us to identify reserve demand from active reserve policies (quantity change). We measure the change in the global demand for reserves by these quantities divided by GDP.

The results are presented in Table 7. For the following variables we find significant and robust results: Real GDP growth increases the balance, while it is negatively correlated with the rate of unemployment. When military expenditures exceed their country average, government balances are lower. Financial centers, characterised by easy access to private external financial resources, run lower government balances. Interest rates and government debt negatively affect the fiscal balance.

The demand for official reserves lowers the government budget balance. Across all specifications we find significant negative effects for the US and the UK. While the magnitude of

the effect in the US is comparable to that found in Tables 4 and 6, the estimated impact on the UK balances is now larger ranging between 1.9 and 4.6 percentage points. New is the finding of a robust and large effect of the demand for official franc reserves on the French government balance. This shows that France only recently used the reserve status to finance additional government spending.

[Table 7 about here.]

In sum, the demand for reserve assets affects the fiscal balance of the dominant reserve currency. When reserves are accumulated by the rest of the world, the government budget balance of the US and UK decreases. It increases when global reserve holdings are reduced.

#### 4.4 Robustness

In this section we check whether our results are robust with respect to an alternative sample of countries and to different measures for our main variables. Due to limited space, we do not include the tables of the robustness analysis but these may be provided upon request.

*Alternative sample:* Our sample is restricted to 24 industrialised countries, for which historical data before World War II is available. For the more recent period data can be obtained for a much broader set of countries. We check the robustness of our results for a sample of up to 125 nations, including industrialised, emerging and developing countries for the period 1970-2009. While the explanatory power of the regressions is low, a negative effect of the demand for dollars on the US government balance is confirmed.

*Means over 5-year-periods:* We replicate our analysis over the entire time period (1890-2009) from Table 4 using 5-year averages of the data. This allows to abstract from cyclical shifts in the government budget balance and to concentrate on structural effects. The negative effect of global reserve demand on national budget balances is confirmed.

*Data on public deficits:* Data on public budget balances are known to be imprecise, subject to revisions and may even be manipulated for political reasons. This might be even more true for historical data. We therefore repeat our analysis using Accominotti et al. (2011) as an alternative data source for historical values of our dependent variable. The main results are robust to this change.

## 5 Conclusions

Reserve currency status entails benefits and costs. It may affect decisions taken by individuals and the government of the reserve-providing country. While there exists a vast

literature examining the effects of reserve currency status on interest rates, this paper is the first to consider the impact on the government budget balance.

Reserve currency status eases the public budget constraint and enables the center country to run a lower government budget balance. Foreign central banks finance the budget deficit of the center's government by their purchase of reserves in the form of Treasury bonds. The government decision to run lower public budget balances is the optimal response to the increased demand for government bonds and their lower interest rate. As long as reserve status is retained, the higher level of debt is compatible with standard criteria of sustainability.

We provide empirical evidence that reserve currency status decreases the government budget balance of the center countries by 3 to 5 percentage points (relative to GDP). Any dollar of reserve assets purchased by official institutions in the rest of the world decreases the budget balance of the center by 0.7-1.5 dollars. These numbers are economically significant. Expressed in absolute terms they are outstanding.

Besides reserve status, we identify wars, high interest rates and the level of government debt as robust factors that have negatively affected the government budget balance over the last 120 years. For the more recent period since 1950, unemployment, deep financial markets and low GDP growth have contributed to low government balances.

This study distinguishes itself by covering 120 years of history and including two episodes of dominant reserve currencies: the sterling period until the interwar years and the dollar dominance since World War II. While we examine both periods separately, we derive surprisingly resembling results for the US and UK government budget balances. This provides further evidence in favour of our hypothesis: The lower government budget balance is not peculiar to a specific country. On the contrary, our study over a historical time span allows to conclude that lower government budget balances are a phenomenon akin to reserve currency countries, which persists independently of the time period, national policies or the provision of alternative reserve assets. More importantly, the presented facts may not be interpreted as evidence that the UK or US abuse their privilege as reserve currency country. The problem is a more fundamental one: It lies in the fact that a national currency is used as the global reserve currency. For secondary reserve currencies like the French Franc and the Deutsche Mark we do not find robust effects.

The flip side of this easy financing is an increasing level of sovereign (external) debt. Persistent government deficits may question the sustainability of public debt, which, in turn, undermines the stability of the reserve currency. The theoretical and empirical literature concurs that the probability of a sovereign debt crisis increases with the level of public debt (see Reinhart and Rogoff, 2011). In conjunction with a decreasing US share in global economic activity and rising alternative reserve currencies this process might prove to be

unsustainable in the long run. The US may be tempted to erode the real value of its debt by inflation (Aizenman and Marion, 2011).

The importance of these facts is highlighted by the ongoing sovereign debt crisis in European countries. While in the past sovereign debt crises have been mostly a feature of developing countries, the recent European crisis shows that advanced countries may be affected by a loss of confidence and capital outflows alike. When sovereign debt exceeds a sustainable threshold level a crisis may emerge. A loss of confidence in reserve currencies might cause central bank runs, characterised by central banks substituting alternative safe assets for their dollar reserves. An uncoordinated shift of reserve status to other currencies, however, would entail major global disruptions.

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## Appendix A: List of variables and data sources

| Variable                                    | Source  | Definition  |
|---|---|---|
| Government budget balance (relative to GDP) | WEO, GFS, WDI; complemented by Bordo et al. (2001)    | Data equals the variable general government net lending/borrowing provided in the WEO database, which is calculated as revenue minus total expenditure. Missing values are filled - where possible - by the variable <i>government cash surplus/deficit</i> of the GFS database (years from 1990 onwards) and <i>overall deficit/surplus of consolidated central government</i> from the historical GFS database (for years prior to 1989). Data are converted to dollars by end of period exchange rates and divided by current GDP. |
| Inflation                                   | WDI<br><br>Bordo et al. (2001)                        | Inflation is measured as the growth rate of the GDP implicit deflator (annual %)<br><br>Change in CPI   |
| Real GDP                                    | WDI<br><br>Comin and Hobijn (2009)                    | GDP is measured as gross domestic product in constant international dollars with the year 2005 as base. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States.   |
| Relative dependency ratio (old)             | WDI; Mitchell (2007); for US: US Census Bureau (2003) | Ratio of old (65+ years) to working (15-65 years) population measured as deviation from world average   |
| Wars  |   | Dummy that takes the value one between 1914-1919 and 1940-1944; 0 otherwise.  |
| Interest rate                               | Armingeon et al. (2011); Bordo et al. (2001)          | Long term (in most cases 10 years) interest rate on government bonds. Missings filled with data on government bonds as provided in the IFS if at least 10 data points could be added for a given country. Historical data (based on Bordo) use long-term interest rates, mostly for government securities or high grad bonds.   |
| Policy rate                                 | Center for Financial Stability, ECB                   | Interest rate set by the central bank   |
| Democracy                                   | Marshall and Jaggers (2011)                           | Democracy is measured by a score, which combines the information contained in indicators of democracy and autocracy (POLITY2 variable). It ranges from +10 (strongly democratic) to -10 (strongly autocratic).  |
| Financial deepening                         | WDI<br><br>Bordo et al. (2001)                        | Money and quasi money (M2) as a percentage of GDP. Complemented by data for the UK based on Bank of England (2012), Series LPMVWYH<br><br>Money as a percentage of GDP, where money is M1, M2 or M3 depending on the country and data availability.   |

## Appendix A (ctd.): List of variables and data sources

| Variable   | Source   | Definition  |
|--|--|---|
| Unemployment rate  | WDI  | Percentage of unemployed out of total labour force  |
| External shock   | WDI, own calculation   | Growth rate of terms of trade multiplied by trade openness  |
| Civil liberties  | Freedom House  | Index of civil liberties, which is based on ratings with respect to the freedom of expression, right of assembly, rule of law and individual rights. The ratings lie between 1 and 7 with 1 representing the highest degree of freedom.   |
| Military spending  | WDI  | Deviation of military expenditure (expressed as % of GDP) from its country-specific mean over the period under consideration.   |
| Financial center, dummy  | Own calculations based on Lane and Milesi-Ferretti (2007) and GFCI | The dummy takes on the value one in a country year where the country is identified as a financial center. A financial center is defined as having both a ratio of foreign assets to GDP and of foreign liabilities to GDP that exceed the mean plus one standard deviation of the respective variables in a given year over the whole sample. Based on information provided by the Global Financial Centres index the following countries are labeled financial centers over the whole period: Hong Kong, Japan, Switzerland, the United Kingdom and the United States. |
| Market capitalization  | Standard & Poor's and WDI  | Market capitalization is the market value (share price times the number of shares outstanding) of domestic companies listed on the country's stock exchanges. Investment companies, mutual funds or other collective investment vehicles are not included.  |
| Net change in Treasury bonds held by foreign official institutions | Federal Reserve  | Difference of Treasury securities held by non-US official institutions (Flow of Funds, Table L.107, line 11) between two consecutive years.   |
| World foreign exchange reserves                                    | IFS, Lindert (1969)  | Central banks' reserves of foreign exchange, converted in US\$  |
| World official gold reserves                                       | IFS, Lindert (1969)  | Total amount of gold at historical prices (35 US\$ per ounce) held at central banks   |

Sources: GFCI: Global Financial Centres Index provided by Z/Yen; GFS: Government Finance Statistics (online and historical database); IFS: International Financial Statistics; WEO: World Economic Outlook Database; WDI: World Development Indicators.

## Appendix B: Sample of countries

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|           |         |         |             |          |                |
|-----------|---------|---------|-------------|----------|----------------|
| Australia | Denmark | Greece  | Japan       | Norway   | Sweden         |
| Austria   | Finland | Iceland | Luxembourg  | Portugal | Switzerland    |
| Belgium   | France  | Ireland | Netherlands | Russia   | United Kingdom |
| Canada    | Germany | Italy   | New Zealand | Spain    | United States  |

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## Appendix C: Data sources: Shares of reserve currencies in total foreign exchange reserves

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|             |  |
|-------------|--|
| 1899 & 1913 | Lindert (1969)                                       |
| 1920-1936   | Eichengreen and Flandreau (2009) via Troutman (2010) |
| 1953-1994   | IMF Annual Report, various years                     |
| 1995-2010   | IMF, COFER Database                                  |

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Figure 1: Relative importance of foreign exchange reserves and US Treasuries

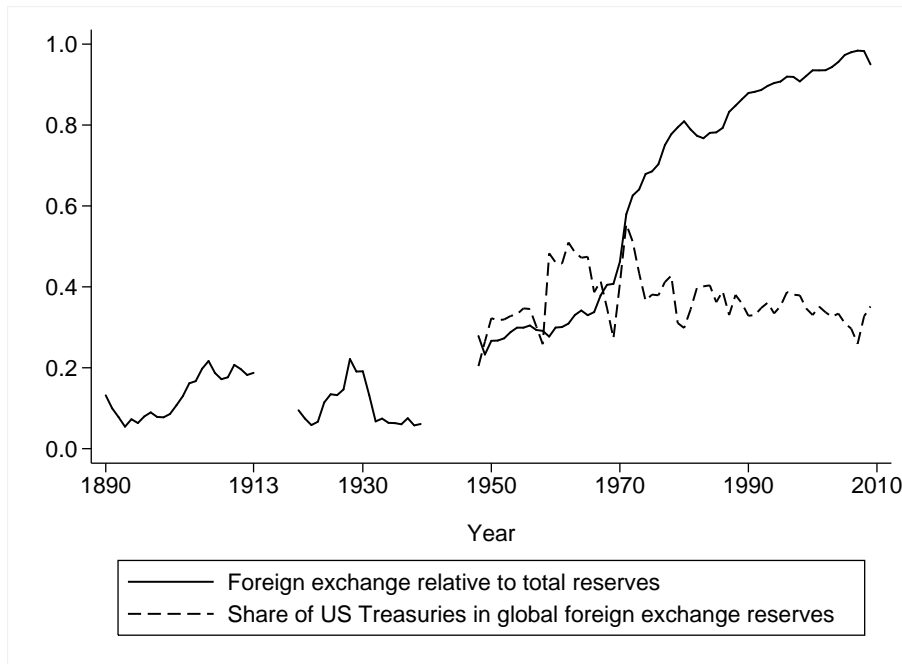
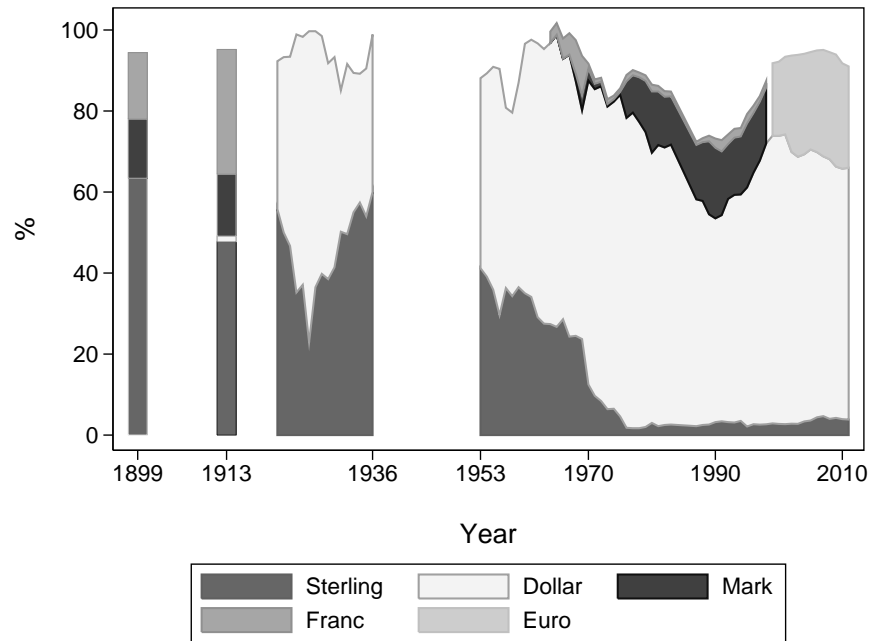
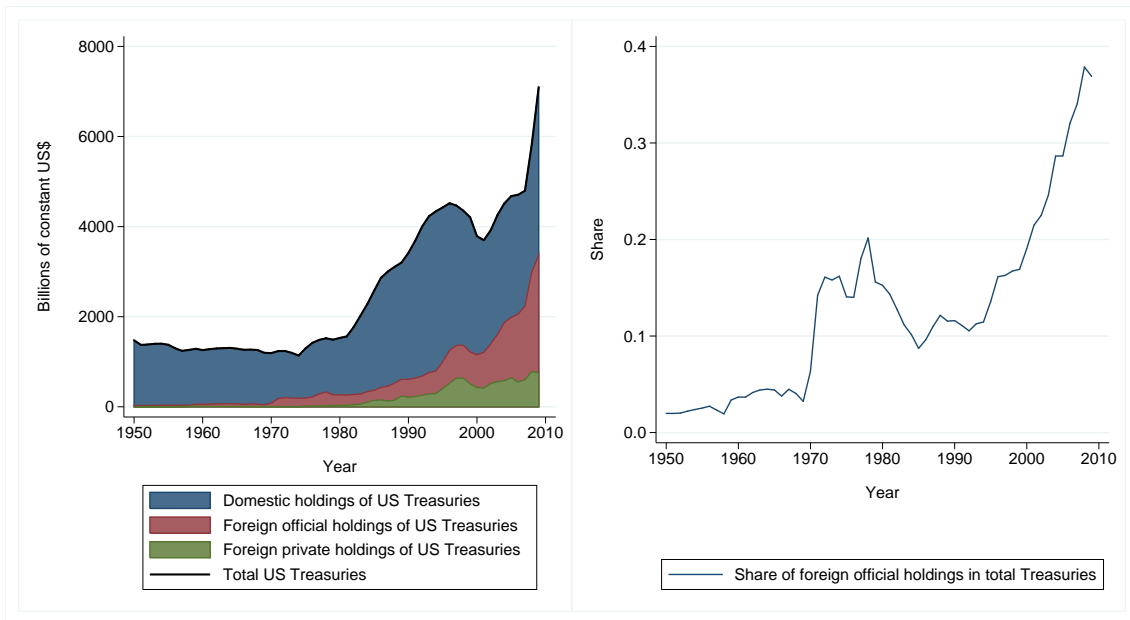


Figure 2: Shares of reserve currencies in total foreign exchange reserves



Note: This graphs shows the temporal evolution of the share of the major reserve currencies in total foreign exchange reserves. Prior to World War I, data is only available for 1899 and 1913.

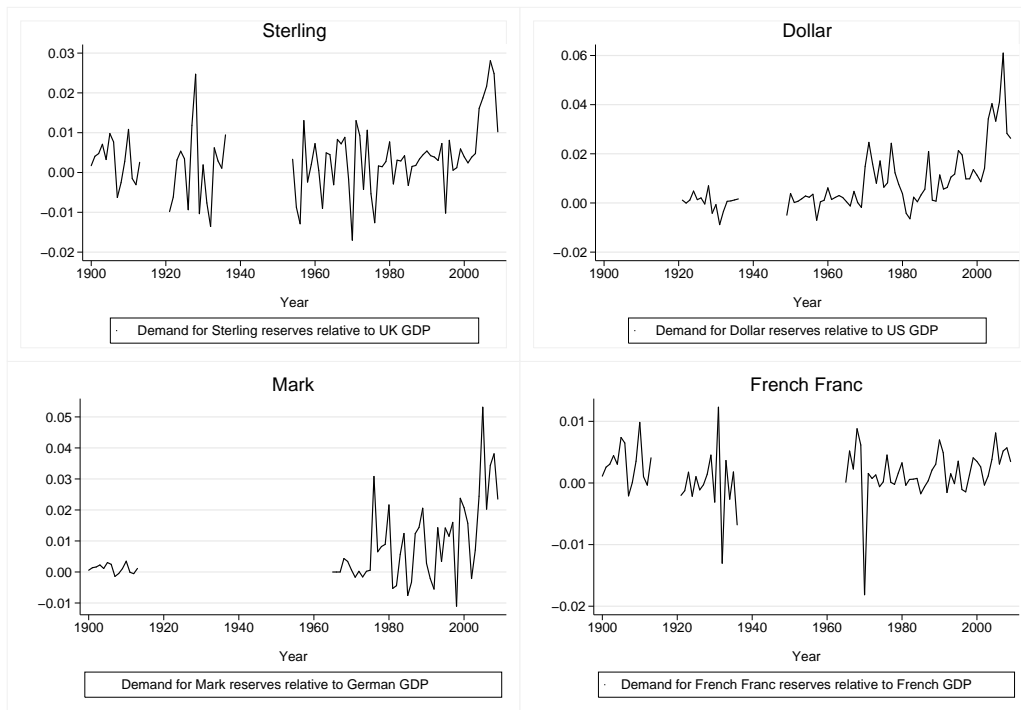
Figure 3: US Treasury debt



Notes: The left hand panel shows the distribution of outstanding Treasury securities by holder. Data are deflated by the US GDP deflator (base year 2005 = 1), which is provided by IMF (2011). The right hand panel depicts the proportion of US Treasury securities that are held by foreign official entities. Data source: Flow of Funds, Federal Reserve, Tables L.106 (line 11 and 12) and Table L.209 (line 1).



Figure 4: Change in global official holdings of major reserve currencies



Note: These graphs show the annual change in the level of globally held foreign exchange reserves denominated in four key currencies. The level of reserves denominated in the respective key currencies in a given year is computed as the global level of foreign exchange reserves multiplied by the share of the key currency in total foreign exchange reserves. To strip out the effect of exchange rate changes, reserves are converted in the respective currency before taking the difference.

Table 1: Share of government securities in total foreign assets held by central banks (in %)

|           | 1913 | 1920 | 1924 |
|-----------|------|------|------|
| Australia | n.a. | 72.5 | 73.7 |
| Denmark   | 34.5 | 7.6  | 0.4  |
| Finland   | 19.8 | 4.3  | 0.5  |
| Japan     | n.a. | 9.9  | n.a. |
| Italy     | 60.4 | 15.5 | 33.8 |
| Norway    | 18.0 | 6.9  | 8.1  |
| Portugal  | n.a. | 7.4  | 34.2 |
| Sweden    | 21.1 | 8.7  | 27.5 |

Notes: n.a. = not available

Data source: League of Nations (1925), p.150-159.

Table 2: Demand for reserves relative to GDP of issuing country (in %, mean over periods)

|           | Sterling | Dollar | Mark | French Franc |
|-----------|----------|--------|------|--------------|
| 1899-1913 | 0.29     | n.a.   | 0.11 | 0.32         |
| 1920-1936 | 0.08     | 0.03   | n.a. | -0.04        |
| 1948-1969 | 0.14     | 0.11   | 0.16 | 0.45         |
| 1970-1994 | 0.19     | 0.85   | 0.53 | 0.04         |
| 1995-2009 | 0.94     | 2.48   | 1.93 | 0.28         |

Notes: n.a. = not available

Table 3: Determinants of the government budget balance (1970-2009): Time series analysis

|                                    | (1)                   | United States         |                    |                      | (5)                  | United Kingdom        |                    | (8)                  |
|------------------------------------|-----------------------|-----------------------|--------------------|----------------------|----------------------|-----------------------|--------------------|----------------------|
|                                    |                       | (2)                   | (3)                | (4)                  |                      | (6)                   | (7)                |                      |
| Inflation                          | 0.0020<br>(0.53)      | 0.0007<br>(0.23)      | 0.0091<br>(0.97)   | 0.0048<br>(0.76)     | 0.0070**<br>(2.44)   | 0.0078***<br>(3.32)   | 0.0017<br>(0.07)   | -0.0090<br>(-0.59)   |
| GDP growth                         | 0.3311<br>(1.46)      | 0.2309<br>(1.05)      | 0.7451<br>(0.97)   | 0.4625<br>(0.92)     | 0.0637<br>(1.06)     | 0.0539<br>(0.87)      | 0.0516<br>(0.85)   | 0.0180<br>(0.34)     |
| Relative dependency<br>ratio (old) | 0.0075<br>(1.41)      | -0.0028<br>(-0.40)    | 0.0206<br>(1.03)   | 0.0015<br>(0.16)     | 0.0029<br>(0.21)     | -0.0097<br>(-0.76)    | -0.0057<br>(-0.15) | -0.0340<br>(-1.41)   |
| Unemployment                       | -0.0145***<br>(-4.50) | -0.0165***<br>(-6.13) | -0.0078<br>(-0.89) | -0.0130**<br>(-2.37) | -0.0069**<br>(-2.48) | -0.0081***<br>(-2.92) | -0.0098<br>(-0.73) | -0.0168**<br>(-2.07) |
| External shock                     | 0.4165<br>(0.69)      | 0.1440<br>(0.23)      | 0.5485<br>(0.78)   | 0.1125<br>(0.18)     | -0.8046<br>(-1.61)   | -0.8066<br>(-1.46)    | -0.5036<br>(-0.37) | 0.1407<br>(0.15)     |
| Interest rate                      |                       |                       | -0.0092<br>(-0.68) | -0.0061<br>(-0.63)   |                      |                       | 0.0066<br>(0.23)   | 0.0209<br>(1.14)     |
| $\Delta$ global dollar reserves    |                       | -0.7517**<br>(-2.43)  |                    | -1.0807*<br>(-1.95)  |                      |                       |                    |                      |
| $\Delta$ global sterling reserves  |                       |                       |                    |                      |                      | -1.2571*<br>(-1.97)   |                    | -0.9764*<br>(-1.65)  |
| Observations                       | 29                    | 29                    | 29                 | 29                   | 26                   | 26                    | 26                 | 26                   |
| R-squared                          | 0.66                  | 0.73                  | 0.38               | 0.65                 | 0.39                 | 0.47                  | 0.43               | 0.44                 |
| Estimation                         | OLS                   | OLS                   | 2SLS               | 2SLS                 | OLS                  | OLS                   | 2SLS               | 2SLS                 |

Notes: The dependent variable is the government budget balance to GDP ratio. Robust t-statistics are reported in parentheses. Standard errors are estimated robust to autocorrelation and heteroskedasticity. The symbols \*, \*\* and \*\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively. Interest rates are instrumented by the German rate in columns 3-4 and 7-8. The global change in reserves is measured relative to GDP.

Table 4: Government budget balance (1890-2009): Panel data analysis

|                                   | (1)                | (2)                   | (3)                   | (4)                   | (5)                   | (6)                    | (7)                   | (8)                   | (9)                   | (10)                  |
|-----------------------------------|--------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Inflation                         | -0.0001<br>(-0.78) | -0.0001<br>(-0.68)    | -0.0001<br>(-0.63)    | -0.0002<br>(-0.82)    | -0.0004**<br>(-2.22)  | -0.0003*<br>(-2.05)    | -0.0003*<br>(-2.03)   | -0.0005***<br>(-2.87) | -0.0005***<br>(-2.88) | -0.0005***<br>(-3.61) |
| Real GDP growth                   | 0.0570<br>(0.81)   | 0.1147***<br>(2.11)   | 0.1065*<br>(1.77)     | 0.1109*<br>(1.97)     | 0.0101<br>(0.21)      | -0.0176<br>(-0.45)     | -0.0257<br>(-0.62)    | -0.0476<br>(-0.58)    | -0.0473<br>(-0.58)    | -0.0392<br>(-0.60)    |
| Relative dependency ratio (old)   | -0.0010<br>(-0.71) | -0.0019<br>(-1.62)    | -0.0020*<br>(-1.71)   | -0.0016<br>(-1.25)    | -0.0014<br>(-1.00)    | -0.0008<br>(-0.81)     | -0.0009<br>(-0.97)    | -0.0012**<br>(-2.08)  | -0.0012**<br>(-2.10)  | -0.0000<br>(-0.01)    |
| Wars                              |                    |                       |                       | -0.1698*<br>(-2.02)   | -0.1110**<br>(-2.44)  | -0.11429***<br>(-3.81) | -0.1496***<br>(-3.76) | -0.1187***<br>(-5.01) | -0.1183***<br>(-4.99) | -0.1077***<br>(-4.59) |
| Democracy                         |                    |                       |                       |                       | -0.0001<br>(-0.11)    | 0.0003<br>(0.59)       | 0.0004<br>(0.68)      | 0.0013**<br>(2.51)    | 0.0013**<br>(2.50)    | 0.0013***<br>(2.60)   |
| Financial deepening               |                    |                       |                       |                       |                       | -0.0003*<br>(-1.88)    | -0.0003*<br>(-1.83)   | -0.0003***<br>(-3.48) | -0.0003***<br>(-3.48) | -0.0002***<br>(-3.44) |
| Interest rate                     |                    |                       |                       |                       |                       |                        |                       | -0.0020***<br>(-3.70) | -0.0021***<br>(-3.76) | -0.0022***<br>(-4.50) |
| Government debt                   |                    |                       |                       |                       |                       |                        |                       |                       |                       | -0.0002***<br>(-4.69) |
| $\Delta$ global dollar reserves   |                    | -1.3412***<br>(-4.50) | -1.3387***<br>(-4.46) | -1.2828***<br>(-3.87) | -1.2281***<br>(-3.44) | -1.0226***<br>(-4.68)  | -1.0200***<br>(-4.67) | -0.9892***<br>(-5.39) | -0.9887***<br>(-5.39) | -0.6988***<br>(-3.88) |
| * US dummy                        |                    |                       |                       |                       |                       |                        |                       |                       |                       |                       |
| $\Delta$ global sterling reserves |                    | -1.2537***<br>(-6.22) | -1.2638***<br>(-6.06) | -1.2433***<br>(-5.52) | -1.1828***<br>(-5.06) | -0.8314***<br>(-5.01)  | -0.8287***<br>(-5.15) | -0.8379***<br>(-2.72) | -0.8407***<br>(-2.73) | -1.1545***<br>(-2.99) |
| * UK dummy                        |                    |                       |                       |                       |                       |                        |                       |                       |                       |                       |
| $\Delta$ global mark reserves     |                    |                       | -0.1435<br>(-0.83)    |                       |                       |                        | 0.1367<br>(0.81)      | 0.0274<br>(0.11)      | 0.0296<br>(0.12)      | 0.0807<br>(0.33)      |
| * GER dummy                       |                    |                       |                       |                       |                       |                        |                       |                       |                       |                       |
| $\Delta$ global franc reserves    |                    |                       | -0.2421<br>(-0.72)    |                       |                       |                        | 0.3742<br>(0.90)      | 0.1193<br>(0.26)      | 0.1130<br>(0.25)      | 0.3102<br>(0.67)      |
| * FRA dummy                       |                    |                       |                       |                       |                       |                        |                       |                       |                       |                       |
| Observations                      | 1888               | 1821                  | 1757                  | 1716                  | 1650                  | 1436                   | 1373                  | 1164                  | 1168                  | 1146                  |
| R-squared                         | 0.39               | 0.38                  | 0.38                  | 0.38                  | 0.37                  | 0.43                   | 0.44                  | 0.43                  | 0.43                  | 0.47                  |
| Number of countries               | 24                 | 24                    | 24                    | 24                    | 22                    | 21                     | 21                    | 19                    | 19                    | 19                    |

Notes: The dependent variable is the government budget balance to GDP ratio. Regressions include fixed country effects and time dummies. Estimation by OLS except columns (8) to (10) where 2SLS is used because interest rates are instrumented. Robust t-statistics are reported in parentheses. Standard errors are estimated robust to intragroup correlations. The symbols \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively. The global change in reserves is measured relative to GDP.

Table 5: Government budget balance (1890-1935): Panel data analysis

|                                 | (1)                  | (2)                  | (3)                  | (4)                  | (5)                 | (6)                 | (7)                  | (8)                  | (9)                  |
|---------------------------------|----------------------|----------------------|----------------------|----------------------|---------------------|---------------------|----------------------|----------------------|----------------------|
| Inflation                       | -0.0004<br>(-0.83)   | -0.0004<br>(-0.77)   | -0.0004<br>(-0.83)   | -0.0005<br>(-0.95)   | -0.0006<br>(-1.15)  | -0.0006<br>(-1.03)  | -0.0005<br>(-0.94)   | -0.0008<br>(-1.39)   | -0.0003<br>(-0.55)   |
| Real GDP growth                 | 0.0336<br>(0.61)     | 0.0285<br>(0.45)     | 0.0336<br>(0.61)     | 0.0330<br>(0.59)     | 0.0320<br>(0.55)    | 0.0263<br>(0.39)    | 0.0252<br>(0.37)     | 0.0103<br>(0.20)     | 0.0351<br>(0.62)     |
| Relative dependency ratio (old) | -0.1527**<br>(-2.41) | -0.1120<br>(-1.38)   | -0.1527**<br>(-2.41) | -0.1678**<br>(-2.56) | -0.1350*<br>(-2.08) | -0.0966<br>(-1.15)  | -0.0891<br>(-1.05)   | -0.1007<br>(-1.19)   | -0.1324<br>(-1.64)   |
| Democracy                       |                      |                      |                      | -0.0003<br>(-0.47)   | -0.0000<br>(-0.07)  | 0.0004<br>(0.80)    | 0.0004<br>(0.83)     | 0.0004<br>(0.56)     | 0.0005<br>(0.80)     |
| Financial deepening             |                      |                      |                      |                      | -0.0002<br>(-1.42)  | -0.0001<br>(-0.55)  | -0.0001<br>(-0.55)   | -0.0001<br>(-0.56)   | -0.0002<br>(-0.96)   |
| Interest rate                   |                      |                      |                      |                      |                     |                     | 0.0061***<br>(5.50)  | -0.0105**<br>(-2.15) | 0.0115**<br>(2.83)   |
| Government debt                 |                      |                      |                      |                      |                     |                     |                      |                      | -0.0003<br>(-1.44)   |
| Δ global dollar reserves        | 1.5502***<br>(3.65)  | 1.4582***<br>(3.10)  | 1.5502***<br>(3.65)  | 1.5768***<br>(3.85)  | 1.6871***<br>(4.88) | 1.6625***<br>(4.69) | 1.7369***<br>(5.19)  | 1.2589<br>(1.26)     | 1.6025***<br>(5.35)  |
| * US dummy                      |                      |                      |                      |                      |                     |                     |                      |                      |                      |
| Δ global sterling reserves      | -0.5811**<br>(-2.50) | -0.5999**<br>(-2.36) | -0.5811**<br>(-2.50) | -0.5721**<br>(-2.30) | -0.5378*<br>(-2.16) | -0.5583*<br>(-2.07) | -0.6378**<br>(-2.33) | -0.6805<br>(-1.23)   | -1.1311**<br>(-2.30) |
| * UK dummy                      |                      |                      |                      |                      |                     |                     |                      |                      |                      |
| Δ global mark reserves          |                      | -0.2486<br>(-0.63)   |                      |                      |                     | -0.2247<br>(-0.50)  | -0.3311<br>(-0.65)   | -0.7944<br>(-0.53)   | -0.9623<br>(-1.46)   |
| * GER dummy                     |                      |                      |                      |                      |                     |                     |                      |                      |                      |
| Δ global franc reserves         |                      | 0.5279*<br>(1.92)    |                      |                      |                     | 0.6083*<br>(2.06)   | 0.5366<br>(1.71)     | 0.1987<br>(0.27)     | 0.8628<br>(1.33)     |
| * FRA dummy                     |                      |                      |                      |                      |                     |                     |                      |                      |                      |
| Observations                    | 426                  | 396                  | 426                  | 402                  | 374                 | 344                 | 344                  | 268                  | 332                  |
| R-squared                       | 0.31                 | 0.32                 | 0.31                 | 0.31                 | 0.33                | 0.33                | 0.35                 | 0.38                 | 0.40                 |
| Number of countries             | 14                   | 14                   | 14                   | 14                   | 13                  | 13                  | 13                   | 10                   | 13                   |

Table 6: Government budget balance (1950-2009): Panel data analysis

|                                 | (1)                   | (2)                   | (3)                   | (4)                   | (5)                   | (6)                   | (7)                   | (8)                   | (9)                   |
|---------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Inflation                       | 0.0000<br>(0.16)      | 0.0000<br>(0.33)      | -0.0002<br>(-0.48)    | -0.0001<br>(-0.13)    | -0.0006<br>(-1.07)    | -0.0005<br>(-0.89)    | 0.0006<br>(1.37)      | 0.0006<br>(1.36)      | 0.0007<br>(1.52)      |
| Real GDP growth                 | 0.1426**<br>(2.48)    | 0.1465**<br>(2.41)    | 0.1299**<br>(2.42)    | 0.1201**<br>(2.19)    | 0.0750*<br>(1.73)     | 0.0826*<br>(1.74)     | 0.0787<br>(1.63)      | 0.0749<br>(1.57)      | 0.0170<br>(0.37)      |
| Relative dependency ratio (old) | -0.0014<br>(-1.06)    | -0.0016<br>(-1.16)    | -0.0010<br>(-0.64)    | -0.0010<br>(-0.61)    | -0.0001<br>(-0.05)    | -0.0004<br>(-0.26)    | -0.0005<br>(-0.77)    | -0.0005<br>(-0.75)    | 0.0025***<br>(3.56)   |
| Democracy                       |                       |                       |                       | -0.0007<br>(-1.34)    | -0.0006<br>(-1.03)    | -0.0005<br>(-0.71)    | -0.0003<br>(-0.88)    | -0.0003<br>(-0.86)    | -0.0007**<br>(-2.06)  |
| Financial deepening             |                       |                       |                       |                       | -0.0002<br>(-1.15)    | -0.0001<br>(-0.87)    | -0.0001**<br>(-2.27)  | -0.0002**<br>(-2.32)  | -0.0002***<br>(-3.65) |
| Interest rate                   |                       |                       |                       |                       |                       |                       | -0.0014**<br>(-2.15)  | -0.0014**<br>(-2.18)  | -0.0022***<br>(-3.77) |
| Government debt                 |                       |                       |                       |                       |                       |                       |                       |                       | -0.0005***<br>(-6.74) |
| Δ global dollar reserves        | -1.1765***<br>(-4.16) | -1.1634***<br>(-4.03) | -1.0854***<br>(-3.23) | -1.1255***<br>(-3.16) | -0.8883***<br>(-4.39) | -0.8732***<br>(-4.36) | -0.8657***<br>(-5.04) | -0.8662***<br>(-5.04) | -0.5713***<br>(-3.49) |
| * US dummy                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| Δ global sterling reserves      | -1.3769***<br>(-5.40) | -1.3990***<br>(-5.39) | -1.3489***<br>(-4.62) | -1.3631***<br>(-4.48) | -1.0437***<br>(-5.30) | -1.0731***<br>(-5.57) | -0.9717***<br>(-2.62) | -0.9691***<br>(-2.62) | -1.2968***<br>(-2.71) |
| * UK dummy                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| Δ global mark reserves          |                       | -0.5142***<br>(-3.89) |                       |                       |                       | -0.1583<br>(-1.71)    | -0.1132<br>(-0.45)    | -0.1153<br>(-0.46)    | -0.1568<br>(-0.66)    |
| * GER dummy                     |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| Δ global franc reserves         |                       | -1.4356***<br>(-5.38) |                       |                       |                       | -0.2387**<br>(-2.60)  | -0.2707<br>(-0.47)    | -0.2668<br>(-0.46)    | -0.3516<br>(-0.47)    |
| * FRA dummy                     |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| Observations                    | 1225                  | 1195                  | 1120                  | 1092                  | 918                   | 888                   | 795                   | 798                   | 796                   |
| R-squared                       | 0.36                  | 0.37                  | 0.36                  | 0.36                  | 0.35                  | 0.37                  | 0.36                  | 0.36                  | 0.42                  |
| Number of countries             | 24                    | 24                    | 24                    | 22                    | 21                    | 21                    | 19                    | 19                    | 19                    |

Notes for Tables 5 and 6: The dependent variable is the government budget balance to GDP ratio. The global change in reserves is measured relative to GDP. Regressions include fixed country and time effects. Estimation by OLS. Instrumental variable 2SLS is used in specifications including the interest rate. Robust t-statistics are reported in parentheses. Standard errors are estimated robust to intragroup correlations. The symbols \*, \*\* and \*\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively.

Table 7: Government budget balance (1970-2009): Panel data analysis

|  | (1)                  | (2)                   | (3)                   | (4)                   | (5)                   | (6)                   | (7)                   | (8)                   | (9)                   | (10)                  | (11)                  | (12)                  |
|--|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Inflation                                  | -0.0000<br>(-0.40)   | -0.0009<br>(-0.98)    | -0.0009<br>(-0.97)    | -0.0012<br>(-0.52)    | -0.0013<br>(-0.57)    | 0.0030*<br>(1.81)     | -0.0015<br>(-0.83)    | -0.0016<br>(-0.83)    | -0.0010<br>(-0.49)    | 0.0051***<br>(4.60)   | 0.0051***<br>(4.62)   | 0.0049***<br>(4.36)   |
| Real GDP growth                            | 0.0777***<br>(4.82)  | 0.0533**<br>(2.33)    | 0.0528**<br>(2.31)    | 0.0650**<br>(2.65)    | 0.0657**<br>(2.65)    | 0.0498<br>(1.69)      | 0.0538**<br>(2.36)    | 0.0528**<br>(2.28)    | 0.0583**<br>(2.20)    | 0.0477**<br>(2.30)    | 0.0478**<br>(2.31)    | 0.0485**<br>(2.34)    |
| Relative dependency ratio (old)            | -0.0021<br>(-1.12)   | -0.0019<br>(-0.74)    | -0.0019<br>(-0.74)    | -0.0023<br>(-0.84)    | -0.0023<br>(-0.86)    | -0.0024**<br>(-2.47)  | -0.0025<br>(-0.96)    | -0.0025<br>(-0.95)    | -0.0017<br>(-0.64)    | -0.0029***<br>(-2.92) | -0.0029***<br>(-2.91) | -0.0007<br>(-0.47)    |
| Unemployment                               |                      | -0.0051***<br>(-4.03) | -0.0052***<br>(-4.02) | -0.0050***<br>(-3.05) | -0.0050***<br>(-3.10) | -0.0061*<br>(-2.17)   | -0.0048***<br>(-2.95) | -0.0048***<br>(-2.97) | -0.0050**<br>(-2.72)  | -0.0045***<br>(-5.65) | -0.0045***<br>(-5.65) | -0.0034***<br>(-4.19) |
| External shock                             |                      | 0.0487<br>(0.91)      | 0.0491<br>(0.92)      | 0.0972<br>(0.96)      | 0.0972<br>(1.02)      | -0.0257<br>(-0.35)    | 0.1020<br>(1.18)      | 0.1035<br>(1.19)      | 0.1104<br>(1.19)      | -0.1365**<br>(-2.07)  | -0.1356**<br>(-2.06)  | -0.1325*<br>(-1.93)   |
| Relative income                            |                      | -0.0087<br>(-0.53)    | -0.0094<br>(-0.57)    | -0.0252<br>(-1.20)    | -0.0263<br>(-1.25)    | 0.0012<br>(0.04)      | -0.0067<br>(-0.35)    | -0.0082<br>(-0.44)    | -0.0032<br>(-0.14)    | -0.0268***<br>(-2.64) | -0.0264***<br>(-2.65) | -0.0263***<br>(-2.65) |
| Military expenditure (deviation from mean) |                      |                       |                       | -0.0217*<br>(-1.90)   | -0.0218*<br>(-1.93)   | -0.0285**<br>(-2.62)  | -0.0212*<br>(-1.87)   | -0.0219*<br>(-1.92)   | -0.0168<br>(-1.55)    | -0.0262***<br>(-4.73) | -0.0262***<br>(-4.76) | -0.0275***<br>(-5.34) |
| Democracy                                  |                      |                       |                       | 0.0059<br>(1.26)      | 0.0059<br>(1.26)      |                       | 0.0066<br>(1.42)      | 0.0068<br>(1.47)      | 0.0049<br>(1.04)      | 0.0042<br>(1.42)      | 0.0042<br>(1.42)      | 0.0052*<br>(1.76)     |
| Left government                            |                      |                       |                       | -0.0000<br>(-0.41)    | -0.0000<br>(-0.41)    | -0.0002***<br>(-3.54) | -0.0000<br>(-0.30)    | -0.0000<br>(-0.30)    | -0.0000<br>(-0.27)    | -0.0000<br>(-0.42)    | -0.0000<br>(-0.44)    | -0.0000<br>(-0.26)    |
| Financial deepening                        |                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| Financial center (dummy)                   |                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| Market capitalization                      |                      |                       |                       |                       |                       |                       |                       |                       | 0.0002*<br>(1.74)     |                       |                       |                       |
| Interest rate                              |                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| Government debt                            |                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| $\Delta$ global dollar reserves            | -0.5885**<br>(-2.51) | -0.8376**<br>(-2.36)  | -0.8480**<br>(-2.38)  | -1.0095*<br>(-1.96)   | -1.0058*<br>(-1.96)   | -1.2034***<br>(-3.23) | -1.0834**<br>(-2.15)  | -1.1089**<br>(-2.19)  | -1.0183*<br>(-2.00)   | -1.1560***<br>(-2.79) | -1.1537***<br>(-2.79) | -0.9780**<br>(-2.41)  |
| * US dummy                                 |                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| $\Delta$ global sterling reserves          | -1.8884**<br>(-2.56) | -4.3179***<br>(-6.47) | -4.3487***<br>(-6.48) | -4.0872***<br>(-3.96) | -4.0204***<br>(-3.79) | -3.5399***<br>(-4.53) | -4.5092***<br>(-4.11) | -4.5706***<br>(-4.13) | -3.5632***<br>(-3.20) | -3.6421***<br>(-4.32) | -3.6445***<br>(-4.32) | -3.0483***<br>(-3.43) |
| * UK dummy                                 |                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| $\Delta$ global mark reserves              |                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| * GER dummy                                |                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| $\Delta$ global franc reserves             |                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| * FRA dummy                                |                      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| Observations                               | 785                  | 512                   | 512                   | 418                   | 418                   | 204                   | 418                   | 418                   | 411                   | 408                   | 409                   | 409                   |
| R-squared                                  | 0.39                 | 0.52                  | 0.52                  | 0.55                  | 0.55                  | 0.69                  | 0.57                  | 0.58                  | 0.57                  | 0.64                  | 0.64                  | 0.65                  |
| Number of countries                        | 22                   | 20                    | 20                    | 20                    | 20                    | 12                    | 20                    | 20                    | 20                    | 20                    | 20                    | 20                    |

The dependent variable is the government budget balance to GDP ratio. The global change in reserves is measured relative to GDP. Regressions include fixed country and time effects. Estimation by OLS except columns (10) to (12) where an instrumental variable approach is used (2SLS). Robust t-statistics are reported in parentheses. Standard errors are estimated robust to intragroup correlations. The symbols \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively.