The Dollar and its Discontents*

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Abstract

Has the US dollar delivered the benefits that the rest of the world is expecting from international liquidity? US government debt has been liquid, safe and it has been supplied in sufficient quantity. But it has given a low return to the countries that accumulated the most reserves, especially when those returns are measured in terms of the countries' own consumption. I argue in this paper that the countries that accumulate the most reserves should expect a low return in terms of their own consumption (the "saver's curse"), and that there is little that international monetary reform can do to change that fact.

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1 Introduction

The international monetary system, viewed from a very high altitude, could be described as follows. There is a center and there is a periphery. The periphery uses assets of the center as reserves. There are three necessary conditions for the system to be viable (i.e., to deliver satisfactory outcomes for its participants):

(i) the center's assets must be liquid and safe;

(ii) they must be provided in sufficient quantity, and;

(iii) they must deliver an appropriate return.[1]

There are debates about whether the US dollar is meeting those conditions, and about its ability to satisfy them looking forward. First, the 2008 financial crisis has put in question the safety and liquidity of US assets. Second, it is not clear whether the US economy will be able to satisfy the ever-increasing demand for international liquidity (Fahri, Gourinchas and Rey (2011) and Obstfeld (2011)). And third, the central role of the US dollar in the current system has been criticized on the grounds that the return on the dollar is determined by the domestic objectives of the US authorities rather than a concern to provide a stable store of value for the rest of the world (Zhou (2009)). This has led to debates about whether the international monetary system should evolve toward a more multipolar arrangement with a greater role for the euro and perhaps (in the longer term), the renminbi, or the SDR (Eichengreen (2011)).

The purpose of this paper is to review those arguments, with special emphasis on the third one (the low return on dollar reserve assets). There is a link between the first two criteria, since whether the world runs short of dollar reserves depends on which US assets are deemed safe and liquid enough to be used as reserves. The crisis did not reduce the perceived safety and liquidity of US assets as a whole, but it certainly generated a sharper differentiation

[1] In addition, if there are fixed exchange rates, the monetary policy of the center must be acceptable to the periphery. With floating exchange rates this is not as important, although a minimum of stability is necessary to satisfy condition (i).

between the US assets that are viewed as safe and liquid (essentially US government debt) and those that have lost that quality to varying extent because of the banking and financial crisis. The crisis led to an increase in the supply of US government debt at the same time as it reduced the safety and liquidity of other types of US debt, with an ambiguous impact on the US effective supply of liquidity to the rest of the world. Looking forward, whether the US will provide sufficient liquidity to the rest of the world will depend less on supply than on demand—on how fast the rest of the world's demand for international liquidity will increase. A shortage of international dollar liquidity may be a constraining factor in the long run, but the international monetary system is likely to be changed by other forces before that constraint becomes binding.

Most of the paper focuses on the return that the rest of the world has received—and should expect to receive in the future—on its dollar assets. Those who complain about the low return on dollar assets often point to the fact that the US government pays a low interest rate on its debt because of the "exorbitant privilege" (and, in the more recent period, the US Fed zero-interest rate policy). The exorbitant privilege, however, is only one part of the picture, and may not be the main source of loss for the countries accumulating dollar reserves. If the countries that accumulate the most reserves tend to do so through trade surpluses (as the data suggest that they do), the appropriate metric from the point of view of domestic welfare is the real return that those countries have received on their dollar reserves *in terms of their own consumption*. And if one measures the return on dollar reserves in this way, it was indeed very low—by an order of magnitude lower than the exorbitant privilege suggests—and it is likely to continue being low in the future.

I illustrate this point first by measuring the consumption-based return on dollar assets for the four BRIC countries (Brazil, Russia, India and China), which are the four emerging market countries that accumulated the most international reserves in the 2000s. I find that the consumption-based cumulated return that these countries have received between 2000

and 2007 was negative for all four countries, equal to -27.8 percent for Brazil, -60.4 percent for Russia, -13.6 percent for India, and -4.9 percent for China. That is, by investing the equivalent of 100 units of Brazilian consumption in US Treasury bills at the beginning of 2000 and rolling over this position for eight years, the Brazilian authorities were left with enough dollars to buy 100-27.8=72.2 units of Brazilian consumption at the end of 2007.

Those low consumption-based returns are explained largely by the fact that the currencies of the BRIC countries have appreciated in real terms relative to the dollar. Those countries, thus, made a loss on the value of their dollar reserves in terms of their own consumption. For countries such as Brazil or Russia, this real exchange rate valuation effect dominates the loss stemming from the exorbitant privilege by an order of magnitude. China received a comparatively higher (although negative) return because its currency appreciated less than in the other BRIC countries. However, if one corrects for potential exchange rate misalignments using the fundamental equilibrium exchange rate estimates of Cline and Williamson (2008), the cumulated consumption-based return on dollar reserves was close to -30 percent for China between 2000 and 2007, about the same level as for Brazil and India.

Those findings are not due to the fact that 2000-2007 was a period in which the dollar depreciated against all currencies. Looking at a larger sample of 28 emerging market economies shows a wide variety of experiences, with a number of countries receiving a positive consumption-based return on their dollar reserves between 2000 and 2007. Furthermore, the data show an interesting fact: a negative cross-country correlation between the consumption-based return and the accumulation of reserves. That is, the emerging market countries that increased their international reserves the most also received a lower consumption-based return on their reserves. This is because the countries that accumulated more reserves also tended to have currencies that appreciated more relative to the dollar.

I then present a simple model that can explain this finding. The model considers a small open economy that produces and consumes a tradable good and a nontradable good. I

consider two reasons that the country might want to accumulate international reserves: (i) to resist the real appreciation of its currency, and (ii) to accumulate international liquidity in proportion with the growth in the domestic tradable good sector. In both cases, the country accumulates more reserves at the same time as its currency appreciates in real terms, which decreases the consumption-based return on the reserves. There is a kind of "saver's curse" in international finance: the countries that accumulate more net foreign assets also tend, in equilibrium, to have a lower consumption-based return on those assets.

The implications of those findings for the debate on reforming the international monetary system are discussed in the last section. The main point is that if the consumption-based return on dollar reserves is low for the reasons conjectured in this paper, it is not a problem that the international monetary system can or should try to solve. If reserves are accumulated primarily by countries that resist the appreciation of their currencies, or whose currency will appreciate because of the Balassa-Samuelson effect, then the consumption-based return on their reserves must be low in equilibrium.

The paper is structured as follows. Section 2 presents a review of the recent experience of the dollar as a reserve currency, with a special focus on the consumption-based return that it yielded to the countries that accumulated the most reserves. Section 3 takes a broader cross-country look at the data, establishes the saver's curse, and proposes a model to explain it. Section 4 concludes with a discussion of the policy implications.

2 The US dollar as a reserve currency

The dollar, with a share of about 60 percent of global reserves, remains the main reserve currency. The purpose of this section is to assess the performance of the dollar in the 2000s from the perspective of the three criteria stated in the introduction. Did dollar assets provide liquidity and safety? Were those assets supplied in sufficient quantity? And did they deliver an appropriate return? We consider each question in turn.

2.1 Safety and liquidity

There is little doubt that US financial markets have provided an abundance of liquid and safe assets to the rest of the world, at least until the crisis. This is especially true of US Treasury bonds, the main asset of investment for international reserves, and the US Treasury has benefited from this by paying a lower interest rate on its debt (Krishnamurthy and Vissing-Jorgensen (2010)).

Has this perception changed during the crisis? It has certainly changed for the asset classes that were most directly affected by the crisis such as asset-backed securities or corporate bonds. Foreign private and official investors, who had diversified their holdings of US securities in the decades preceding the crisis, rushed back to the safety of Treasury debt after 2008. Figure 1 shows the shares of foreign holdings of US debt securities invested in Treasury securities, Corporate bonds and Agency and GSE-backed securities between 1980 and 2010. More than 80 percent of the foreign holdings of US debt securities were invested in Treasury bills or bonds in 1980, a share that had been divided by two before the crisis. We observe, after 2008, a sharp increase in the share of Treasury debt, which goes back in 2010 to the level observed ten years earlier. This shift in investors' preferences was also observed in the relative prices of the different kinds of debt in the Fall of 2008, with a sharp increase in the spreads on US debt relative to Treasury debt.

The main impact of the crisis, thus, was not to reduce the perceived safety of US assets as a whole but rather to reintroduce more differentiation between assets that had been perceived as more and more substitutable before the crisis. US Treasury debt successfully served its function of "safe haven" and became again the first-choice asset during the crisis (McCauley and McGuire (2009)).

2.2 Triffin dilemma redux

Triffin (1960) famously pointed to an internal contradiction that was undermining the Bret-

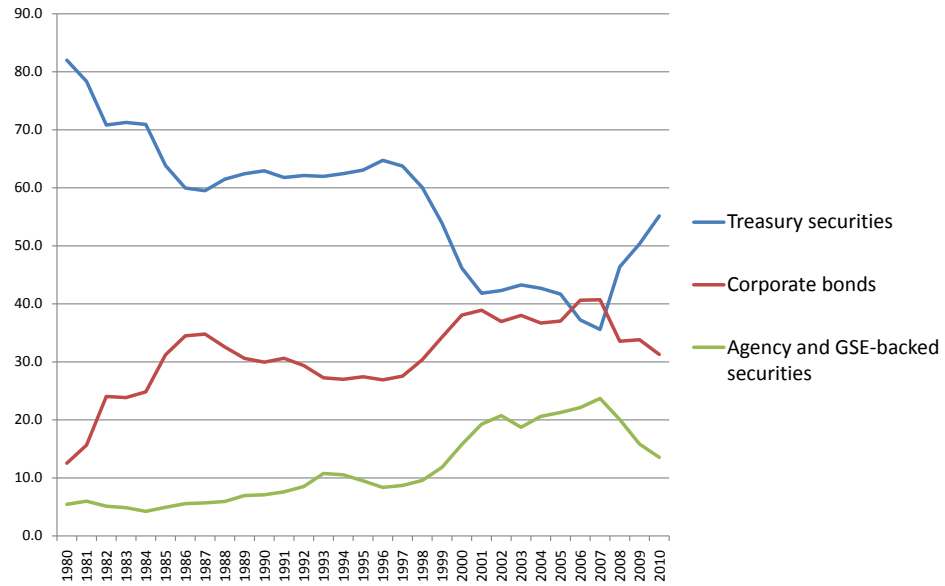

Figure 1: Shares of foreign holdings of US debt securities invested in Treasury securities, Corporate bonds, and Agency and GSE-backed securities (percent, 1980-2010). Source: Federal Reserve Flow of Funds Data.

ton Woods fixed exchange rate system. The quantity of dollars that the US needed to create in order to satisfy the rest of the world's demand for international liquidity grew at a faster rate than the US gold reserves, so that the fixed parity between the dollar and gold would be increasingly difficult to maintain without global deflation. Triffin's argument was mainly about the problem of maintaining a fixed peg to gold but it is now being updated and applied *mutatis mutandis* to today's system of floating exchange rates. A *fiscal* variation on the Triffin dilemma theme has been proposed by Fahri, Gourinchas and Rey (2011) and Obstfeld (2011). Those authors argue that as international reserves are primarily composed of US government debt, and the share of the US in the global economy is shrinking, the US progressively loses its fiscal capacity to satisfy the rest of the world's demand for international liquidity. Looking forward, the rest of the world might be faced with a shortage of US government debt.

One implication of the fiscal Triffin dilemma is that the rest of the world should hold an increasing share of the outstanding stock of US securities. Figure 2 shows that this is indeed

the case. Between 1980 and 2010, the share of foreign investors in the total outstanding stock of US debt securities increased from a little more than 10 percent to a little more than 30 percent.[2] This average masks interesting differences between different types of debt securities. The foreign share is larger for Treasury securities (where it exceeded 50 percent just before the crisis) than for corporate bonds and Agency and GSE-backed securities, although the latter's share increased a lot before the crisis. Between 1997 and 2007, the share of the foreign sector in US total debt securities or Treasury securities increased by about 15 percent. Extrapolating this trend (a 15 percent increase in the foreign sector's share every decade) implies that the foreign sector's share in US Treasury securities would exceed 100 percent before 2040.

However, those trends were reversed by the crisis. The share of US debt securities held by foreigners started to fall in 2008. This is especially striking for Agency and GSE-backed securities, an asset class out of which foreign investors divested during the crisis. The fall in the overall share, however, does not reflect a flight from US debt assets as a whole since foreigners continued to increase their total nominal holdings of US debt securities in 2009 and 2010. Rather, it reflects an increase in the total supply of US debt securities, especially of Treasury securities following the large fiscal deficits in 2009-11.

The crisis, thus, had two offsetting effects on the US supply of international liquidity. It increased the supply of liquid and safe US Treasury debt at the same time as it reduced the perceived liquidity and safety of other forms of debt, with an a priori ambiguous net impact on the effective supply of liquidity to the rest of the world. The fiscal deficits underpinning the increase in the supply of US Treasury debt are not sustainable in the long run, but looking forward the same offsetting effects should play in reverse. As the fiscal and financial situation of the US returns to normalcy, so should the perceived liquidity and safety of US debt securities issued by borrowers other than the Treasury.

[2]The data reported in Figure 2 include the holdings of foreign private investors.

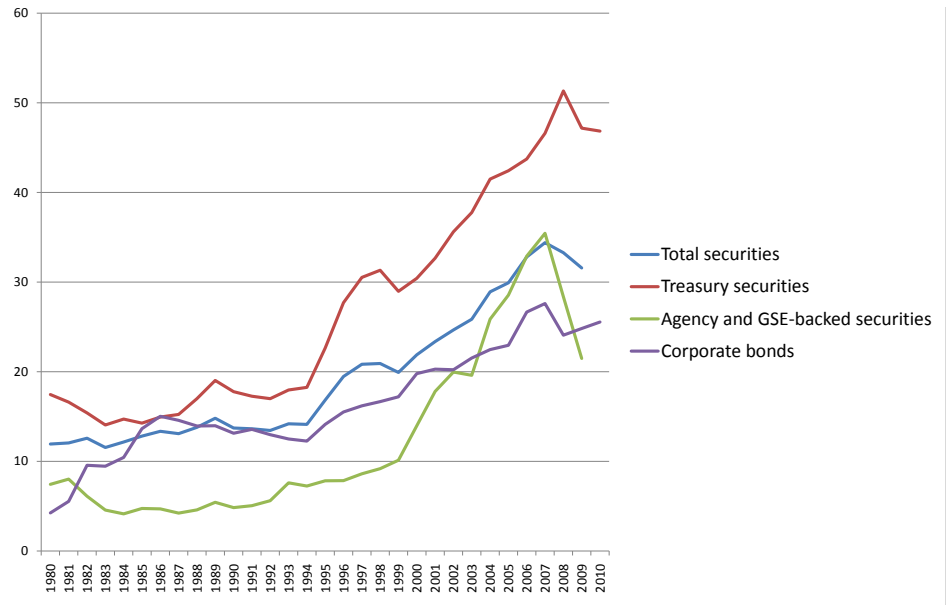

Figure 2: Share of foreign holdings in stocks of US debt securities (percent, 1980-2010). Source: Federal Reserve Flow of Funds Data.

What about, then, the view that the rest of the world is going to run short of safe and liquid US debt securities? To shed light on this question, Figure 3 shows global reserves as well as the outstanding stocks of US debt securities (total and Treasuries), expressed as shares of the rest of the world's (i.e., non-US) GDP. Several facts stand out.

First, global international reserves have exceeded the stock of US Treasury securities in every year after 2006, and the gap has shrunk in the recent period only because of US fiscal deficits that are unsustainable in the long run.[3] From this perspective, there seems to be some truth to the "fiscal Triffin dilemma" view that the supply of US government debt is becoming insufficient to provide the main basis for international liquidity.

Second, the picture is rather different if one compares the global stock of reserves with the *total* stock of US debt securities (including corporate bonds and Agency- and GSE-backed securities). The supply of US debt securities has remained close to 50 percent of the rest of

[3]There was no shortage of US Treasury securities because about 40 percent of international reserves are invested in currencies other than the dollar, and dollar reserves are not all invested in Treasury securities. According to the US flow of funds data, the foreign official sector's investment in US Agency and GSE-backed securities amounted to more than 54 percent of its investment in US Treasury securities.

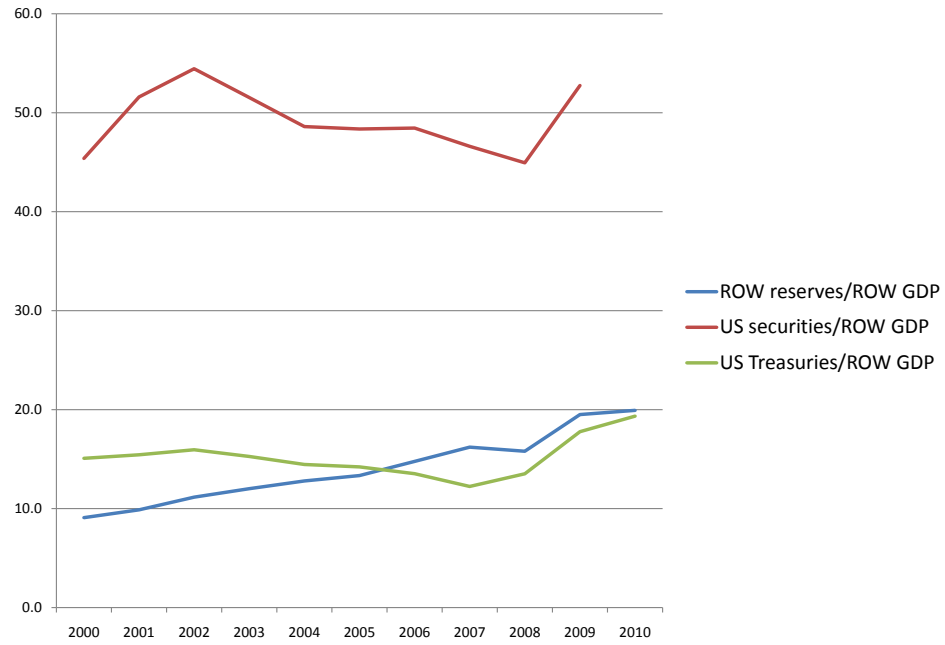

Figure 3: Global reserves, US debt securities and US Treasury securities as shares of the rest of the world's GDP (percent, 2000-2010). Source: Federal Reserve Flow of Funds Data and IMF World Economic Outlook.

the world's GDP, well in excess of the global stock of reserves. Looking forward, one can well imagine that foreign investors will view US Treasury securities and other US debt securities as more and more substitutable again. If US non-Treasury debt is deemed safe and liquid enough to be held as international reserves, a lot more room is left before the global demand for dollar liquidity hits a supply constraint.

Another lesson from Figure 3 is that the increase in the foreign sector's share of US debt securities is due to an increase in demand rather than to a decrease in supply. The stock of US debt securities has been roughly constant as a share of the rest of the world's GDP, but the stock of international reserves doubled between 2000 and 2010, from about 10 percent to about 20 percent. Thus, the looming dollar shortage (if any) comes from an increase in the rest of the world's demand for reserves relative to its own GDP, not from the fact that the US economy is producing less debt or that its economy is shrinking relative to the rest of the world.

Clearly, extrapolating this trend—assuming that the rest of the world will continue raising its reserves-to-GDP ratio by 10 percent every decade as it did in the 2000s—will sooner or later result in a dollar shortage. It is not clear, however, why the rest of the world would accumulate international reserves at such a pace. There is no historical precedent for such a trend, and no convincing theoretical explanation for why it should continue. To the extent that emerging market economies "graduate" and start looking more like advanced economies, they should lower rather than increase their reserve holdings as a share of their GDP.

It is not even clear that the increase in global reserves observed in the 2000s reflects mostly a larger demand for international liquidity. The countries with an authentic need for international liquidity are the emerging market economies that have an open capital account and are exposed to capital flow volatility and sudden stops. But those economies account for a relatively small share of reserve accumulation. A large fraction of the reserves were accumulated by oil-exporting countries and by China for reasons that seem to have little to do with liquidity per se. Oil-exporting countries save oil revenue for future generations. China accumulates reserves for reasons that are debated, but most likely to resist the appreciation of its currency. [4] It is in the interest of those countries to diversify their publicly-held foreign assets, as indeed they have started to do, in a limited way, with their sovereign wealth funds.

Overall, then, it does not seem that a shortage of US debt securities is likely to become a binding constraint soon. This does not mean, however, that individual countries will not feel at times constrained in their access to international liquidity, as they did for example at the time of the Lehman crisis in the Fall of 2008. The provision of swaps by the US Fed was important, at that time, to restore a measure of confidence in the global banking system (Aizenman, Jinjarak and Park (2011)). The fact that those swaps were perceived to restore confidence even in countries that had a comfortable buffer stock of reserves raises

[4] As argued in Jeanne (2011), the Chinese authorities do not need *liquid* foreign assets for that purpose—illiquid foreign assets would do too. In addition, China does not really need international liquidity to deal with capital flow volatility and the risk of sudden stops, given its relatively closed capital account.

important questions about the extent to which dollar reserves can provide a good substitute to international lending-in-last-resort in dollar. These question have been actively discussed in the debates about the "global financial safety nets". The problem revealed by the crisis, however, is not so much a shortage of international liquidity as the fact that in a world where the wholesale dollar funding market is a source of financing for non-US banks, there is a need for the US Fed to sometimes act as international lender of last resort.

2.3 Consumption-based returns

The third question is whether dollar reserves have provided an appropriate return to their holders. There is more to this question than meets the eye, and indeed I will spend the rest of the paper on it. Obviously, one way of answering the question is to measure the return on the dollar reserves expressed in terms of dollars. The return, then is determined by the yield on US debt securities during the period under consideration. According to that measure, the yield on dollar reserves should be the same for all reserve-accumulating countries (except for differences due to cross-country variations in their portfolio allocation across US debt securities).

This measure is too naive, however, if one wants to estimate the opportunity cost of holding reserves, and the impact of reserve accumulation on domestic welfare. For that, one needs to take into account how reserves are accumulated at the margin. Essentially, reserves can be accumulated in two ways: through the current account (with a trade surplus), or through the financial account (with capital inflows).

The most common approach in the literature is to assume (implicitly or explicitly) that reserves are accumulated through the financial account. For example, starting with Edwards (1985), the opportunity cost of reserves has often been measured as the differential between the interest rate that the country pays on its external debt and the return that it receives on

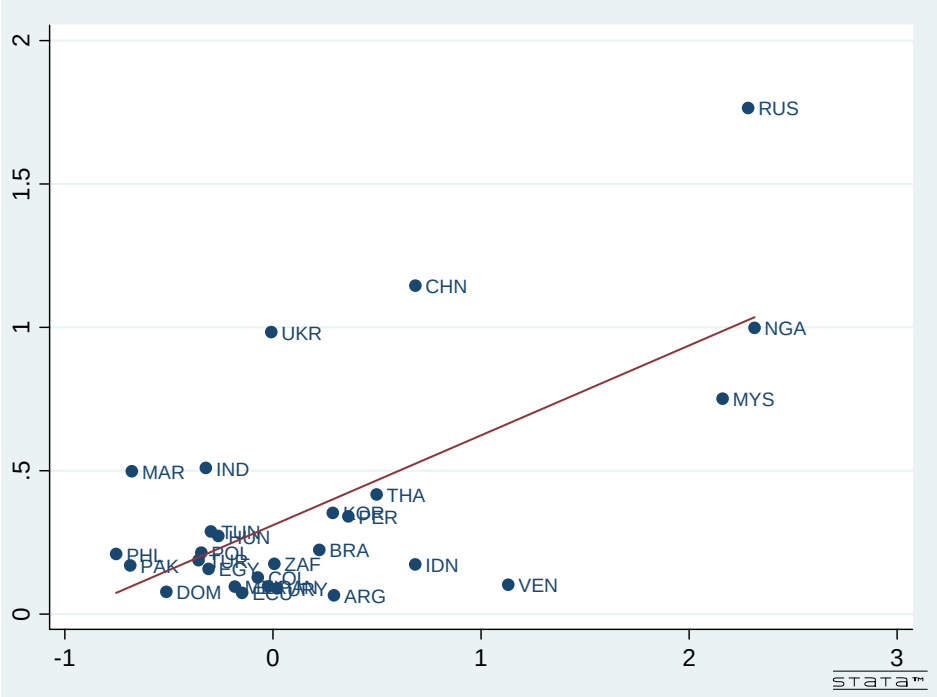

Figure 4: Cumulative trade balance (horizontal axis) and increase in international reserves (vertical axis) over 2000-07 normalized by 2000 GDP. Source: WDI.

its reserves.[5] The implicit assumption is that an additional dollar of reserves is financed, at the margin, by issuing one more dollar of external debt—i.e., though the financial account.

Looking at the data, it is not clear, however, that the financial account is the most relevant margin of adjustment. Figure 4 plots, for a sample of 28 emerging market countries, the accumulation of international reserves between 2000 and 2007 (vertical axis) against the trade balance cumulated over the same period (horizontal axis).[6] There is a a statistically and economically significant positive correlation between the two variables, suggesting that countries accumulate more reserves by having larger trade surpluses.[7]

If one assumes that reserves are financed through the current account (i.e., through

[5]See, for example, Rodrik (2006), Jeanne (2007), Jeanne and Rancière (2011).

[6]The countries are Argentina, Brazil, China, Colombia, Dominican Republic, Ecuador, Egypt, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Panama, Peru, the Philippines, Poland, Russia, South Africa, Thailand, Tunisia, Turkey, Ukraine, Uruguay and Venezuela.

[7]The correlation is statistically significant at the 1 percent level. This is not due to outliers. It remains statistically significant at that level if one removes China and Russia from the sample.

trade surpluses), then the decision to accumulate reserves should be viewed as, essentially, an intertemporal consumption-saving decision. Accumulating one more dollar of reserves means, for the country as a whole, saving this dollar by reducing domestic absorption. The dollar-accumulating country is essentially like an individual saver who postpones his consumption. It accumulates net foreign assets by postponing domestic spending, in the same way as an individual saver accumulates wealth by postponing his consumption.[8] For the same reason that individuals should determine their consumption and saving by looking at the real (rather than nominal) interest rate, the authorities of a country, when they accumulate net foreign assets on behalf of the domestic citizens, should care about the return on those assets expressed *in terms of domestic consumption*. From this perspective, it would make sense to estimate the return that dollar-accumulating countries receive in terms of their own consumption. This is what I will do in the rest of this section for the four BRIC countries (Brazil, Russia, India and China), which are also the four emerging market countries that have accumulated the most international reserves over the last decade.[9]

If a country invests 100 hundred units of domestic consumption in dollar bonds in January 2000, how many units of domestic consumption can the country purchase by selling those bonds at a later date? The answer is given in Figure 5 for the BRIC countries. For each country, the purchasing power of the dollar assets in terms of domestic consumption was computed by cumulating the country's own-consumption return on dollar bonds defined as,

$$r_t = i_{\$t} + \Delta s_{t+1} - \Delta p_{t+1}.$$

The consumption-based return on dollar bonds is equal to the dollar interest rate, plus the rate of nominal depreciation of the domestic currency relative to the dollar (which gives the

[8] Alternatively, the country could be reducing investment rather than increasing saving. The evidence in Gourinchas and Jeanne (2011), however, suggests that the margin of adjustment is saving rather than investment.

[9] China is the country that accumulated the most reserves by far ($2,710bn between 2000 and 2010). Russia came second, with $435bn of reserves accumulation. Brazil and India accumulated about the same amount of reserves (around $250bn).

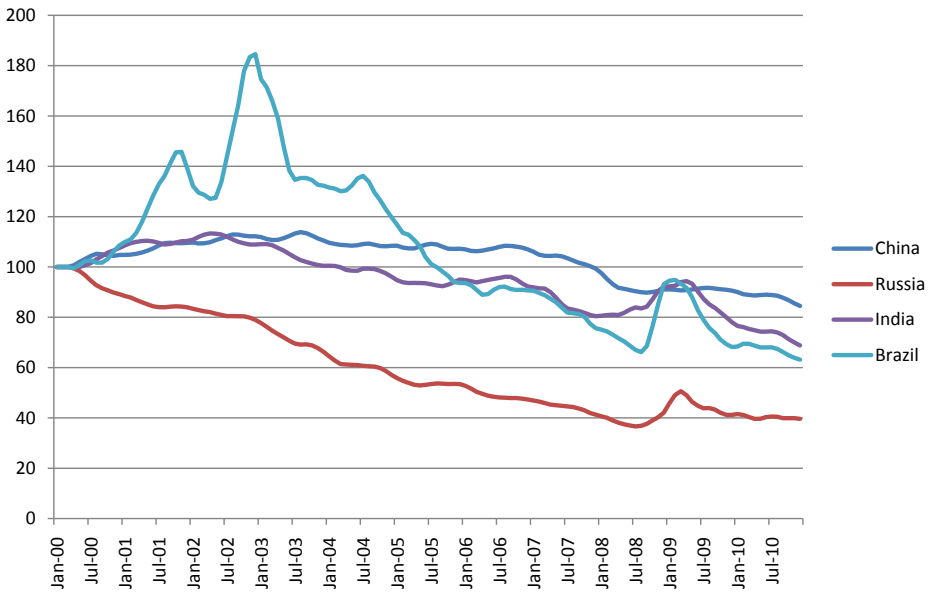

Figure 5: Consumption-based payoff on dollar reserves for the BRIC countries (2000:01-2010:12)

return on dollar bonds in terms of domestic currency), minus the domestic CPI inflation rate (which gives the return on dollar bonds in terms of domestic consumption). It was computed using monthly data, and taking the three-month US Tbill interest rate for the dollar interest rate.[10] I started from a base of 100 in January 2000 for all four countries.

A country has a positive (negative) own-consumption return on its dollar bonds between January 2000 and a given month if the index is above (below) 100 in that month. For example, the fact that the index fell to 83.0 in December 2010 for China, means that investing 100 units of Chinese consumption in dollar bonds in January 2000 yielded the equivalent of 83 units of Chinese consumption at the end of the decade. As shown in Figure 5, all four countries had a negative consumption-based return on dollar bonds in 2010.

These results suggest that there is certainly something to the view that the dollar has not performed well as a store of value. In fact, the return on dollar reserves is worse than most people think if it is measured in terms of the countries' own consumption. Those low returns

[10]The investment was staggered over time, with one third of the foreign assets reinvested every month

are driven in part by the low level of US interest rates, but for the most part they reflect the fact that the currency of the BRIC countries appreciated in real terms relative to the dollar, implying that the dollars reserves have depreciated in terms of home consumption.[11]

The return is not as low for China than for the other BRIC countries because China has limited more the appreciation of its currency relative to the dollar. One problem with these return estimates, however, is that they do not take into account the real exchange rate adjustments that we may expect to take place in the future given the trade balances and net foreign asset positions that were observed during that period. For example, China may have a certain level of pent-up appreciation that was not observed in 2010 but is "in the pipeline" for the future.

Table 1. Consumption-based return on dollar reserves in the BRIC countries (2000:01-2007:12)

	Brazil	Russia	India	China
Observed	-27.8%	-60.4%	-21.4%	-4.9%
FEER-adjusted	-31.1%	-62.0%	-26.4%	-27.7%

One way of adjusting for such unrealized appreciation is to estimate the consumption-based returns on dollar reserves that would be observed if the real exchange rate were equal to its "fundamental equilibrium value". According to the fundamental equilibrium exchange rate estimates of Cline and Williamson (2008),[12] the Brazilian Real, the Russian Ruble, the Indian Rupiah and the Chinese Renminbi were undervalued by respectively 4.8 percent, 7.1 percent, 4.2 percent and 31.5 percent relative to the US dollar in February

[11] The Brazilian Real depreciated sharply relative to the dollar from 2000 to 20003 but appreciated after that.

[12] The concept of fundamental equilibrium exchange rate was developed by Williamson (1994). In a nutshell, the fundamental equilibrium exchange rate is the real exchange rate that one would observe if the current account balance satisfied a certain norm of sustainability. The estimates depend on the assumptions that are made about the norm for current account sustainability and the trade elasticities. See Cline and Williamson (2008) for details.

2008. Table 1 reports the consumption-based return on dollar reserves that were observed in the four countries between January 2000 and December 2007 (first row) as well as the counterfactual return that would have been observed if the exchange rates had been equal to their fundamental equilibrium levels as measured by Cline and Williamson (2008). The adjusted consumption-based return is now close to -30 percent for China.

The valuation losses that reserve-accumulating countries had or will have to incur because of the real appreciation of their currencies are significantly larger than the effect of the "exorbitant privilege".[13] The recent literature offers a range of estimates for the amount by which US interest rates are reduced by foreign demand for US debt securities. The regressions in Warnock and Warnock (2009) suggest that foreign official inflows reduced the 10-year Treasury yield by 50 basis points in 2005, but that the impact on short-term interest rates was significantly smaller. Krishnamurthy and Vissing-Jorgensen (2010) find that if the foreign official sector were to sell all its holdings of Treasury bonds in 2008, the short-term yield on those bonds would increase by 40 to 60 basis points relative to corporate bonds.

The size of the exorbitant privilege depends on how one defines the counterfactual—whether the counterfactual is that the foreign official sector does not increase its holdings of US debt securities (as in Warnock and Warnock (2009)) or reduces those holdings to zero (as in Krishnamurthy and Vissing-Jorgensen (2010)). Even in the second case, foreign official demand for Treasury bonds would lower the interest rate that the US Treasury pays on its short-term debt by about one half of a percentage point. If the exorbitant privilege reduced the US 3-month bill interest rate by 0.5 percent on average over 2000-07 (8 years), then it reduced the cumulated return on dollar assets by 8 times 0.5 percent, that is 4 percent. This is only a fraction of the valuation loss that the BRIC countries incurred on their dollar reserves because the appreciation of their currencies.

[13] By "exorbitant privilege' I mean the fact that the US government can pay lower interest rate on its debt because of the foreign demand for dollar reserve assets. The term is also used by Gourinchas and Rey (2007) in a slightly different sense, to denote the apparent excess return that U.S. investors earn on their foreign portfolios compared to what foreigners earn on their U.S. portfolios.

3 The saver's curse

This section takes a closer look at the consumption-based returns that emerging market economies have received on their dollar reserves. I show that the consumption-based return on dollar reserves between 2000 and 2007 is negative on average in a broad sample of emerging market countries, but that this masks a high degree of cross-country heterogeneity. Furthermore, the consumption-based return is negatively correlated with the accumulation of reserves—that is, the countries that accumulated more reserves tended to have a lower return. This is the "saver's curse" in the title of this section. I will then present a simple model that sheds light on this fact.

3.1 Empirics

First, I present a measure of the consumption-based real returns that is simple and consistent across countries. For a given country, the consumption-based real return on a dollar of reserves between time t and time t' is given by,

$$1 + r = \frac{(1 + i_{\$})S'/P'}{S/P}, \tag{1}$$

where S and S' are the nominal exchange rates (domestic currency per dollar), and P and P' are the domestic currency prices of domestic consumption, at respectively time t and t', and $i_{\$}$ is the nominal interest rate on the dollar cumulated between time t and time t'. The numerator is the number of units of domestic consumption that one dollar invested at t buys at time t' and the denominator is the number of units of domestic consumption that the same dollar buys at time t. This relationship is the equation that we have used in section 2.3 integrated between time t and time t'.

Defining the real exchange rate as the price of US consumption in terms of domestic

consumption, $Q = SP_{US}/P$, the consumption-based real return can also be written,

$$1 + r = (1 + r_{\$})\frac{Q'}{Q}, \tag{2}$$

where $1+r_{\$} = (1+i_{\$})P_{US}/P'_{US}$ is the US consumption-based real interest rate. The domestic consumption-based real return, thus, is the US real interest rate (in terms of its own consumption) plus the rate of real depreciation of the domestic currency relative to the US. A country that invests in dollar reserves benefits from a positive valuation effect if the value of a dollar increases in terms of its own consumption (and conversely, a country whose currency appreciates relative to the dollar suffers a valuation loss).

I measured the consumption-based real return on dollar reserves for the same sample of 28 emerging market countries as in Figure 4 by applying formula (2) between t =2000 and t'=2007. I focus on a period that ends before the global financial crisis, for which an equilibrium model without unemployment is more likely to apply. Taken together, the countries in my sample have accumulated $ 2,890 bn between 2000 and 2007, 60 percent of global reserve accumulation. The country that accumulated the most reserves was of course China, which accounts for 47 percent of the reserves accumulated by this group.

The US nominal cumulative interest factor was obtained by cumulating the average interest rate on 3-month Treasury bills between January 2000 and December 2007, which gives $1 + i_{\$} = 1.284$ and the result was then divided by the ratio of the US CPI in December 2007 to the US CPI in January 2000, $P'_{US}/P_{US} = 1.249$, which gives $1 + r_{\$} = 1.028$. The average US real interest rate was thus positive over the sample period, although quite small (0.36 percent per year on average). The changes in the real exchange rate with the US dollar between 2000 and 2007 were similarly computed using the countries' CPI indices and nominal exchange rates with the dollar. For the nominal exchange rate I used the average levels in 2000 and 2007 to smooth out high frequency noise.[14]

[14]The 3-month Treasury bill rate and US monthly CPI come from the US Fed FRED database and the other data from the World Bank's World Development Indicators. The WDI data are annual.

The cross-country unweighted average of the cumulated consumption-based return on dollar reserves was minus 5.0 percent between 2000 and 2007. The average return weighted by the countries' stocks of reserves in 2007 (i.e., the expected return on a dollar that is randomly selected in the total stock of reserves) is equal to minus 9.3 percent. It is lower than the unweighted average because the four countries that accumulated the most reserves after China had very low returns (-51 percent for Russia, -14 percent for India, -15 percent for Korea and -16 percent for Brazil).[15]

The difference between the weighted average and the unweighted average may suggest that the countries that accumulated more reserves also had a lower consumption-based return on their reserves. In order to see whether this is true, Figure 6 plots the unadjusted consumption-based return r measured in the previous section against the increase in international reserves $\log(R_{\$,20007}/R_{\$,2000})$ for our sample of emerging market countries. The correlation is negative and significant at the 5 percent level.[16] It is also economically significant. For example, it implies that an increase in the reserves-to-GDP ratio of the magnitude observed in China should be correlated with 24 percent fall in the cumulated consumption-based return on the dollar reserves.

Taken together, Figures 4 and 6 show the "saver's curse" in the title of this section. Figure 4 suggests that countries tend to accumulate international reserves by reducing their domestic absorption, and Figure 6 suggests that the countries that accumulate more reserves tend to receive a lower consumption-based return on those reserves. These are just correlations and the direction causality is uncertain. We now turn the attention to a model that can shed light on these findings.

[15]The estimated returns for the BRIC countries are not the same as in section 2.3 because the underlying data are different. Whereas in section 2.3 we were using monthly data for the exchange rates and CPI, we now use annual averages. China now has a positive return (3.8 percent), but as noted above, this does not reflect the valuation losses that China may have to incur when its currency appreciates.

[16]This result is driven in part by the extreme cases of Argentina, Russia and Ukraine. The correlation is still negative but no longer statistically significant if one excludes those countries.

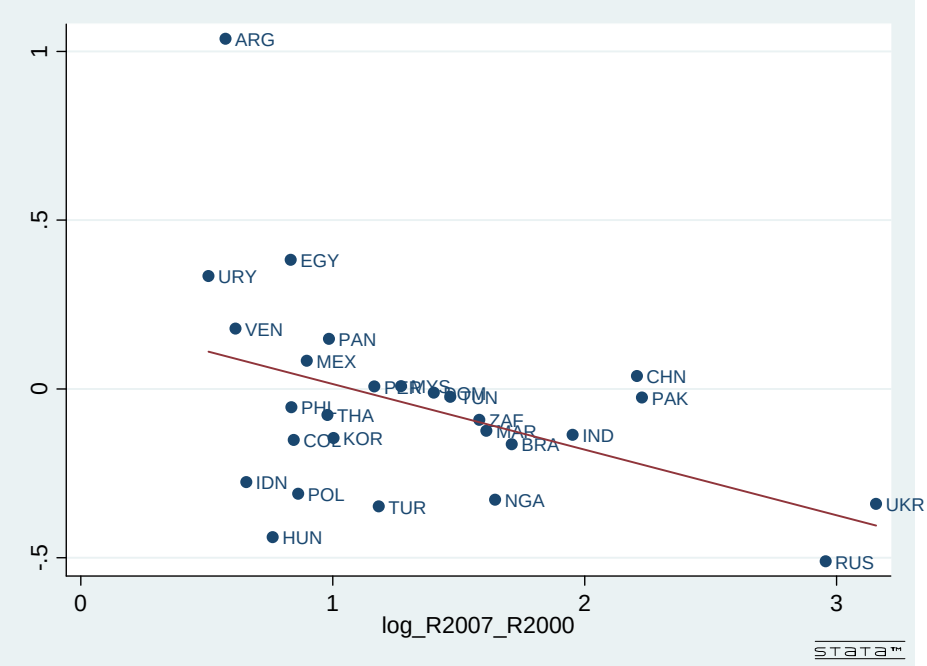

Figure 6: Consumption-based real return on dollar reserves (vertical axis) and reserve accumulation (horizontal axis) (2000-07)

3.2 Model

The model has two periods $t = 1, 2$ and focuses on a small open economy with a representative consumer who consumes a tradable good and a nontradable good. Domestic consumption is a Cobb-Douglas index of the consumptions of nontradable good and tradable good, $C = C_N^{1-\alpha} C_T^{\alpha}$. By an abuse of language that is common in the literature, I will call the tradable good "dollar" and the price of domestic consumption in terms of dollar the "real exchange rate". Denoting the real exchange rate by Q, the consumption-based real gross return on dollars is given by

$$1 + r = (1 + r_{\$}) \frac{Q_1}{Q_2}, \tag{3}$$

where $r_{\$}$ is the (exogenous) dollar return.

I consider an endowment economy: the consumer receives exogenous endowments of tradable and nontradable goods respectively denoted by Y_{Tt} and Y_{Nt} $(t = 1, 2)$. The endowment of nontradable good is constant $(Y_{N1} = Y_{N2} = Y_N)$ and the endowment of tradable good

grows at factor G ($Y_{T2} = GY_{T1}$).

An important variable of the model is the change in the real exchange rate varies between period 1 and period 2. The real exchange rate is proportional to $P_N^{1-\alpha}$, where P_N is the dollar price of the nontradable good. Since $P_N C_N$ is proportional to C_T (because of the Cobb-Douglas preferences) and $C_N = Y_N$ is constant, P_N varies proportionally with C_T. Therefore, the real exchange rate Q is proportional to $C_T^{1-\alpha}$. It then follows from (3) that the consumption-based real return can be written,

$$1 + r = (1 + r_\$) \left(\frac{C_{T1}}{C_{T2}} \right)^{1-\alpha}. \tag{4}$$

Next, I assume that reserves are the only foreign assets in this simplified economy, and that reserves are accumulated through a trade surplus. The amount of reserves accumulated in period 1, thus, is the trade surplus

$$R = Y_{T1} - C_{T1}. \tag{5}$$

The target level of reserves is assumed to be proportional to the second-period level of tradable output,

$$R = \rho Y_{T2}. \tag{6}$$

This assumption is meant to capture the idea that countries have a larger increase in their tradable good sector and integrate themselves to the world trade system need more reserves.[17]

The consumption of tradable good in period 1 is equal to the tradable endowment minus reserves accumulation (equation (5)), which, using (6) and $Y_{T2} = GY_{T1}$, can be written

$$C_{T1} = (1 - \rho G) Y_{T1}. \tag{7}$$

[17] For the purpose of reserves adequacy the appropriate denominator could be another variable, such as short-term external debt or a monetary aggregate like M2 (Jeanne (2007)). The assumption that is made here is that those other variables are positively correlated with a development of the tradable good sector.

As for the consumption of tradable good in period 2, it is equal to the tradable endowment plus the reserves augmented by the interest payment

$$C_{T2} = Y_{T2} + (1 + r_\$)R = [G + \rho(1 + r_\$)]\, Y_{T1}. \tag{8}$$

The expressions for C_{T1} and C_{T2} can then used to substitute out the ratio C_{T1}/C_{T2} in equation (4), which gives

$$1 + r = (1 + r_\$) \left[\frac{1 - \rho G}{G + \rho(1 + r_\$)}\right]^{1-\alpha}. \tag{9}$$

This expression shows how the consumption-based return on the reserves varies with the the exogenous fundamentals. We observe that this return decreases with both the growth factor, G, and the reserve target ratio, ρ.

Proposition 1 *The consumption-based real rate of return on the foreign reserves is decreasing with: (i) the real growth rate G; and (ii) the target ratio of reserves to tradable GDP, ρ.*

The intuition behind this result involves two channels. The first channel involves the fact that reserves are accumulated through a trade surplus. Increasing the level of reserves implies a larger trade balance in period 1 and a lower trade balance in period 2. But the trade balance is related to the real exchange rate. Other things equal, the trade balance can increase in period 1 and decrease in period 2 only if the real exchange rate appreciates in period 1 and depreciates in period 2. This induces a real exchange rate appreciation between period 1 and period 2 that decreases the consumption-based return on the reserves.

The second channel is simply the Balassa-Samuelson effect.[18] Growth in the tradable sector tends to increase the price of the nontradable good in terms of tradable good and to appreciate the real exchange rate. This is the channel that one observes by setting $\rho = 0$ in

[18]The textbook Balassa-Samuelson effect involves an increase in labor productivity in the tradable sector that raises the wage level in the nontradable sector. Here the channel involves the relative demands for the two goods rather than the supply side.

equation (9).

Note that with free capital mobility (that is, if the consumer were free to lend or borrow abroad at interest rate $r_\$$), higher growth in the tradable good sector would induce the consumer to borrow more in period 1 rather than accumulate more foreign assets, which would lead to a real appreciation in period 1 rather than period 2. I have assumed that the country was doing the opposite because it wants to maintain a stock of reserves that is proportional to the level of tradable output, and reserves are accumulated through a trade surplus. The motive for reserve accumulation, however, could be to resist currency appreciation in period 1 rather than seeking liquidity per se, as argued by Aizenman and Lee (2007), or Dooley, Folkerts-Landau and Garber (2004). This would not change the properties stated in Proposition 1.

The model provides a simple explanation for the "saver's curse", i.e., the fact that the countries that tend to accumulate more reserves also tend to have a lower consumption-based return on those reserves. The level of reserve accumulation in period 1 is $R = \rho G Y_{T1}$. Given Y_{T1}, the countries that accumulate more reserves are those that have higher growth G or a higher target ratio ρ, or both. By Proposition 1, those countries also tend to have a lower return on their reserves.

Clearly, the model is extremely simple does not capture some causality relationships that might be important in the real world. For example, the causality could also flow from reserve accumulation and currency undervaluation to growth, as argued by Rodrik (2008). Furthermore, the fact that the model is consistent with some data does not prove that it is true: more research is needed to test the model against alternatives. This being said, I will now speculate about the implications of this model for the reform of the international monetary system.

4 Policy implications

I have reviewed the performance of the US dollar as a reserve currency according to the three criteria: (i) dollar debt assets must be liquid and safe; (ii) they must be provided in sufficient quantity, and; (iii) they must deliver an appropriate return. I found that the dollar performed relatively well according to the first two criteria, but rather dismally according to the third one. This is not so much because of the exorbitant privilege (which did reduce returns, but moderately) as because of the valuation loss that reserve-accumulating countries incur in terms of their own consumption due to the appreciation of their currencies. There is evidence, furthermore, that the countries that accumulate the most reserves also receive the lowest return on those reserves in terms of their own consumption. This is what one would expect to observe if those countries accumulated the reserves to resist the real appreciation of their currency, or to accumulate liquidity in proportion to the growth in their tradable sector.

It is not clear, however, how this problem can be fixed by reforming the international monetary system. Let us consider various proposals that have been made in the debate on reforming the international monetary system.

One approach is to expand the set of assets eligible to be accumulated as reserves. Reserve-accumulating countries could accumulate foreign debt assets denominated in currencies other than the dollar, or even non-debt assets such as equity or real assets such as natural resources.[19] Such diversification should dilute the exorbitant privilege now enjoyed by the dollar.

This is likely to help, but will not reduce the saver's curse to a great extent. The problem is that the consumption-based returns on dollar reserves are lowered primarily by real exchange rate valuation losses rather than low US interest rates. Those real exchange rate valuation losses may have much more to do with structural developments in reserve-accumulating

[19] As some countries have started to do with their sovereign wealth funds.

countries than with US economic policies or with the way that the international monetary system operates. We still have a lot to learn about the motivations for accumulating reserves and directions of causality involved in this mechanism, but simple theory suggests that the low-consumption based returns on international reserves might be an equilibrium phenomenon that cannot be undone by a reform of the international monetary system. If the countries that accumulate the most reserves are also countries whose currency tends to appreciate because of the Balassa-Samuelson effect, then those countries must have a low return on their reserves in terms of their own consumption.

This conclusion also applies to proposals that would use the SDR as a new reserve currency. If the SDR is simply a denomination unit for a basket of existing currencies in which countries can already invest their reserves, investing the reserves in SDR should not yield a higher return than investing in the underlying currencies. Governor Zhou seems to have had something more ambitious in mind when he proposed to enhance the role of the SDR in the international monetary system. First, he argued that "the basket of currencies forming the basis for SDR valuation should be expanded to include currencies of all major economies, and the GDP may also be included as a weight" (Zhou (2009)). This implies that the Chinese currency should enter the SDR basked with a significant weight. Second, he proposed that the IMF set up "an open-ended SDR-denominated fund based on the market practice, allowing subscription and redemption in the existing reserve currencies by various investors as desired". This implies that China could bring its dollar reserves to the Fund exchange them against reserves that would be in part denominated in its own currency, and thus limit the valuation loss coming from an appreciation of the renminbi.

The question with this proposal is who pays for the valuation loss that China would no longer be incurring. If China provides the IMF against with sufficient Yuan-denominated assets to avoid a currency mismatch in the IMF balance sheet, there would be no benefit to China. But if the IMF bears a currency risk, the insurance provided to China would have to

be backed by fiscal transfers from the other members of the IMF. This is why no agreement could be reached at the end of the 1970s about the proposal to create a "substitution account" at the IMF.[20] No country would be willing to provide such garantee, and indeed there would little rationale in terms of efficiency or equity to compensate China for the valuation losses that it would incur on its reserves because of the Balassa-Samuelson effect. The low consumption-based returns on dollar reserve assets are an equilibrium phenomenon and the objective of reforming the international monetary system cannot be to lean against equilibrium developments.

The only way that high-growth reserve-accumulating countries can avoid receiving low returns on their foreign assets is by not accumulating net foreign assets in the first place. This is not necessarily inconsistent with the prudential accumulation of reserves because the reserves could be accumulated through the financial account (by issuing long-term foreign liabilities) rather than through the current account (by maintaining trade surpluses).

The development of more effective global financial safety nets could also reduce the demand for international reserves. This is consistent with certain recent proposals to use the SDR as an input into global financial safety nets (see, e.g., Obstfeld (2011), Truman (2010)). This is true, however, only if one believes that reserves are accumulated primarily for precautionary (rather than mercantilist) reasons.

[20]The international community discussed in 1980 a proposal to establish a SDR-substitution account at the IMF. Countries would be able to convert dollar reserves into SDR-denominated assets in the account. But if subsequently the dollar depreciated against the SDR, who would suffer the exchange rate loss? No agreement was reached on that question and the SDR-substitution account was not created. Kenen (2010)'s analysis is sympathetic to the proposal but acknowledges that the cost might be significant for the United States if it had been the guarantor.

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