Real Interest Rates, Imbalances and the Curse of Regional Safe Asset Providers at the Zero Lower Bound*

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Abstract

The current environment is characterized by low real rates and by policy rates close to or at their lower bound in all major financial areas. We analyze these unusual economic conditions from a secular perspective and draw some implications for external imbalances, safe asset demand and the process of external adjustment. First, we decompose the fluctuations in the world consumption wealth ratio over long period of times and show that they anticipate movements of the real rate of interest. Second, our estimates suggest that the world real rate of interest is likely to remain low or negative for an extended period of time. In such a context we argue that there is a renewed Triffin dilemma where safe asset providers face a trade-off in terms of exposure (ex-post risk) and real appreciation of their currency. This tradeoff is particularly acute for smaller economies. This is the 'curse of the regional safe asset provider'. We discuss how this 'curse' is playing out for two prominent regional safe asset providers: core EMU and Switzerland.

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1 Introduction

The current macroeconomic environment remains a serious source of worry for policymakers. Global real and nominal interest rates are at historical lows across advanced economies, both at the short and long end of the term structure. Policy rates are close to or at their effective lower bound in all major financial areas.[1] Figures 1 and 2 report the nominal policy rates and long yields for the U.S., the Eurozone, the U.K. and Japan since 1980. Increasingly large amounts of wealth are invested at zero or negative yields.[2]

Yet economic activity in many parts of the advanced world remains quite anemic, or insufficiently vigorous to sustain a normalization of monetary policy, as evidenced by the repeated delays in the U.S. Federal Reserve's 'lift-off'. Figures 3 and 4 reports the output gap of many advanced economies, as calculated in the April 2016 IMF's World Economic Outlook database. While output gap calculations are always imprecise, the figures indicate that, with the exception of Germany and the U.K., most advanced economies remain significantly below their potential level of output.[3]

That despite the aggressive global monetary policy treatment administered levels of economic activity remain so weak across the advanced world strongly suggests that the *natural interest rate*, i.e. the real interest rate at which the global economy would be able to reach its potential output, remains substantially below *observed* real interest rates. Far from being overly accommodating, current levels of monetary stimulus may well be insufficiently aggressive because of the Zero Lower Bound constraint on policy rates.[4]

Understanding whether natural rates are indeed low, for how much longer, and the source of their decline has become a first-order macro-economic question. In a celebrated speech given at the IMF in 2013, five years after the onset of the Global Financial Crisis, Summers (2015) ventured that we may have entered and age of '*secular stagnation*', i.e. and era where output remains chronically below its potential, or equivalently real rates remain above their natural rate. Not coincidentally, the secular stagnation hypothesis was first voiced by Hansen (1939), ten years after the onset of

[1] This effective lower bound may well be negative. In this paper, and with a slight abuse of langage, we refer to the 'effective' lower bound as the 'Zero Lower Bound' (ZLB). It should be clear that there is no conceptual difference between a small positive and a small negative lower bound on policy rates.

[2] According to FitchRatings (2016), the total amount of fixed-rate sovereign debt trading at negative yields reached $9.9 trillion at the end of April 2016.

[3] Potential output data from other sources, such as AMECO or the OECD are broadly consistent.

[4] Most central banks also deployed nonconventional monetary policy mostly in the form of asset purchases, or forward guidance. While the evidence suggests these policies have contributed to stabilize the economy, they may not have been sufficient to raise the rate above actual real rates.

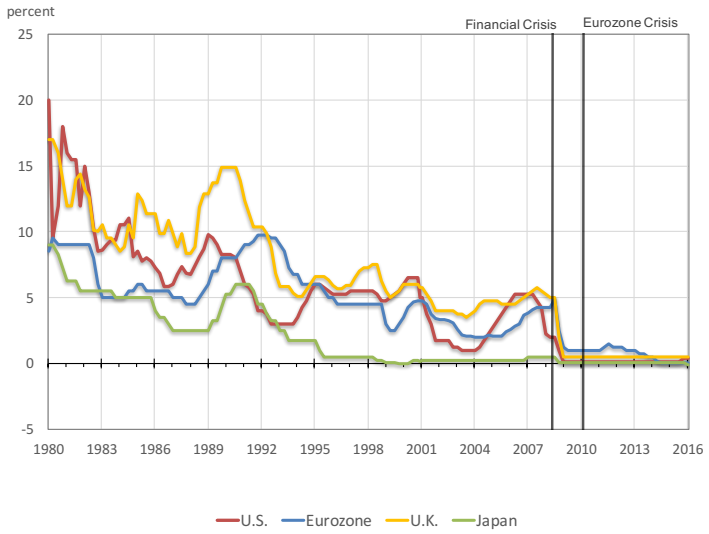

Figure 1: **Policy Rates, Eurozone, Japan, U.S. and U.K., 1980-2016**. Sources: U.S.: Federal Funds Official Target Rate; Eurozone: until Dec. 1998, Germany's Lombard Rate. After 1998, ECB Marginal Rate of Refinancing Operations; U.K.: Bank of England Base Lending Rate; Japan: Bank of Japan Target Call Rate. Data from Global Financial Database.

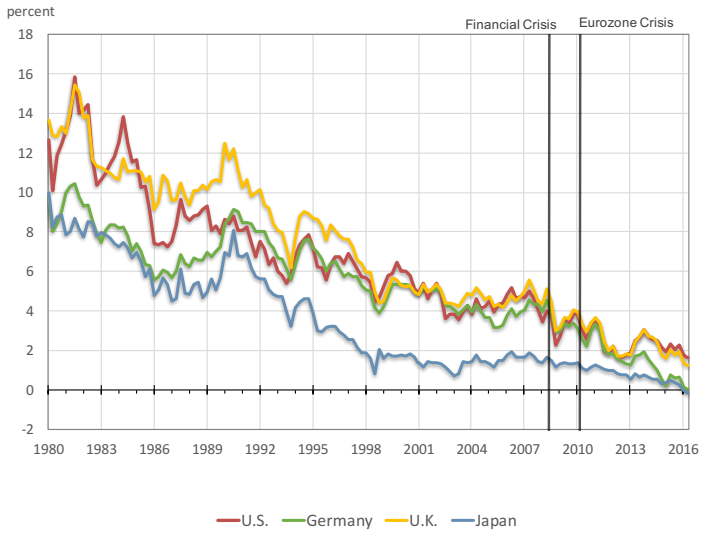

Figure 2: **Long yields, Germany, Japan, U.K. and U.S., 1980-2016**. Sources: U.S.: 10-year bond constant maturity rate; Germany: 10-year benchmark bond; U.K.: 10-year government bond yield; Japan: 10-year government bond yield. Data from Global Financial Database

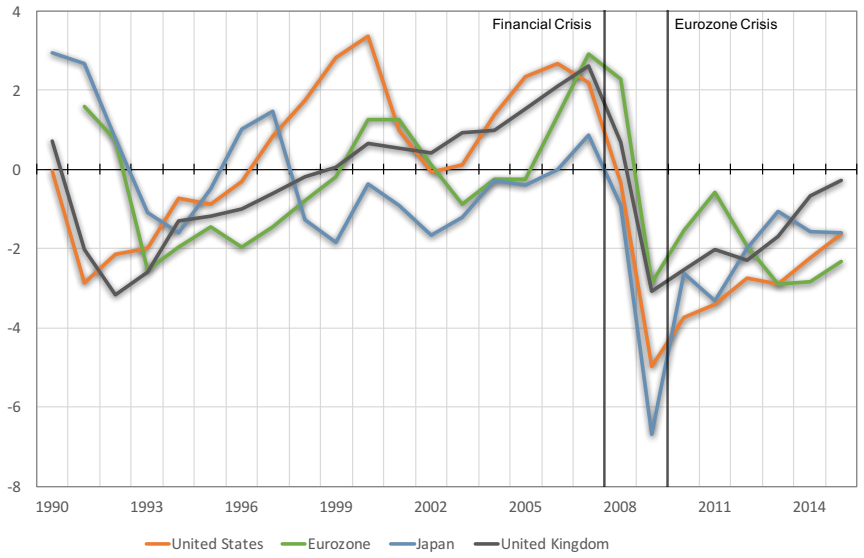

Figure 3: **Output Gap (percent of potential output), Eurozone, Japan, U.K. and U.S., 1990-2015**. Note: The graph shows the persistent decline in the output gap following the global financial crisis and European sovereign debt crises. Source: World Economic Outlook, April 2016.

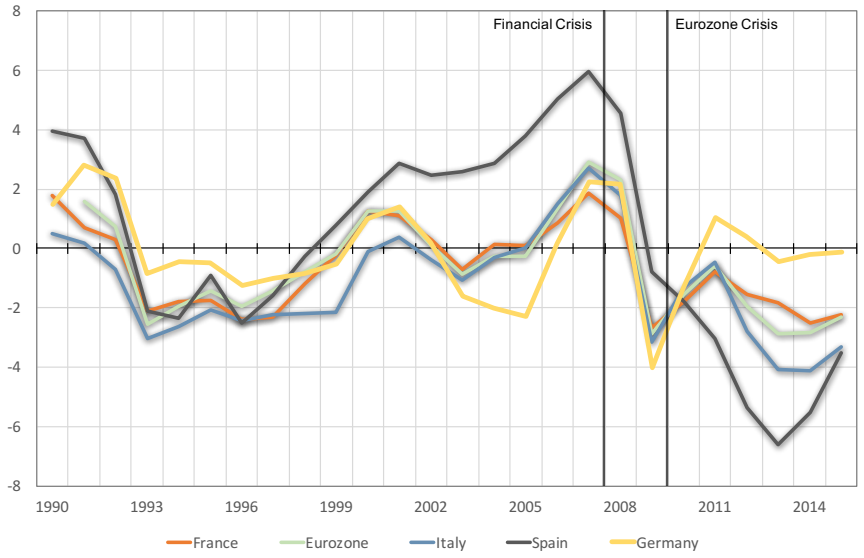

Figure 4: **Output Gap (percent of potential output), Eurozone, France, Germany, Italy and Spain, 1990-2015**. Note: The graph shows the persistent decline in the output gap following the global financial crisis and European sovereign debt crises. Source: World Economic Outlook, April 2016.

the Great Depression.

This paper contributes to this debate along three dimensions. We start by asking whether global real interest rates are likely to remain low for an extended period and why. Using a novel empirical approach to this question, we conclude that they will, for an extended period of time, and that global economic activity is likely to remain muted. We argue that, as in other historical periods, most notably in the 1930s, this is the likely outcome of an extended and on-going process of deleveraging that creates a '*scarcity of safe assets*.'

Next, we consider the question of global imbalances. Previous studies have emphasized that the global imbalances of the 1990s and 2000s originated from a combination of low levels of financial development and rapid economic growth of in emerging market economies.[5] If we enter an era of secular low growth, does it follow that the danger from global imbalances should recede? We answer this question in the negative: as argued in Caballero et al. (2015) and also in Eggertsson et al. (2015), global imbalances 'mutate' at the Zero Lower Bound from a benign phenomenon to a malign one.[6] At the ZLB, external surpluses propagate stagnation as countries attempt to grab a higher share of a depressed global aggregate demand via a more depressed currency, increasing the potential for negative spillovers and the prospect of currency wars.

The last part of our analysis focuses on safe assets providers. We argue that safe asset providers must, in equilibrium, either be more exposed to global risk with the incipient risk of large ex-post losses, or choose to let their currency appreciate with potentially adverse immediate real effects. Furthermore, we show that the terms of this trade-off worsen the smaller the safe asset provider is, a phenomenon we dub the '*curse of the regional safe asset provider*.' We document how this 'curse' has played out for two regional safe asset providers in recent years: Switzerland, and the core members of the European Monetary Union (EMU), most prominently Germany, but also the Netherlands, Belgium and France. Looping back to our initial global focus, we argue that the curse of these EMU safe asset providers contributes significantly to the headwinds faced by the global economy and to the current pattern of global imbalances. We conclude by outlining some potential solutions.

Our first part begins by analyzing the consumption-to-wealth ratio in four advanded economies:

[5] See Caballero et al. (2008), Mendoza et al. (2009) and Bernanke (2005).

[6] Of course, there may be reasons linked to financial stability for which large imbalances might constitute a risk even outside the ZLB.

the United States, the United Kingdom, France and Germany, for which we have data going back at least to 1920.[7] We show that, at any point in time over the last century, the aggregate consumption-to-wealth ratio contained a great deal of information about *future* short term real rates. According to our empirical analysis, actual and natural real interest rates are likely to remain low for an *extended period of time*: our point estimates suggest that real interest rates could remain between 0% and -2% for the next ten years, with natural rates likely to be even lower. Our findings provide a bleak assessment of the medium-run growth prospects in advanced economies, and how difficult the return to prosperity may be for most advanced economies: we may well be stuck at the ZLB for the foreseeable future.

Our approach requires minimal assumptions, likely to hold under very general circumstances. In effect, we extract the historical information encoded in households' decisions to consume out of wealth. The consumption-to-wealth ratio tends to be abnormally low following rapid increases in wealth, as is often the case during episodes of financial exuberance. In the aftermath of these booms, the return on wealth tends to be low or negative, and the consumption-to-wealth ratio reverts to equilibrium. Our empirical results indicate that this low return on wealth is traceable in large part to future low real risk-free rates, a finding consistent with the abundant body of empirical evidence documenting how many economic agents simultaneously attempt to delever in order to repair their balance sheet in the aftermath of financial crises (see e.g. Mian et al. (2013) for households).

We document two stark historical episodes where the consumption-wealth ratio was inordinately low. The first episode starts in 1929 and the Great Depression and lasts until the second World War. This is when Alvin Hansen first wrote about secular stagnation. The second episode starts in 1997 and is still on-going. It is during this period that Larry Summers revived the concept of secular stagnation.

What might cause a persistent decline in real interest rates? The literature emphasizes four candidate explanations (see Eichengreen (2015)): a slowdown in technological progress, demographic forces, a saving glut, and a decline in investment (possibly due to a decline in its relative price).

[7] Our measure of consumption consists of household's aggregate consumption expenditures. Our measure of wealth consists of households financial assets minus financial liabilities, plus housing and agricultural land. It does not include human wealth (the present discounted value of present and future non-financial income). Data for the United States goes back to 1870.

The first force is well understood: a slower rate of technological progress reduces the marginal product of capital. Demographic forces, especially a slowdown in fertility, or an increase in life expectancy, also have the potential to increase savings, depressing equilibrium rates of return. The 'saving glut' explanation originates from the combination of low levels of financial development in Emerging Market Economies and their rapid economic growth, relative to advanced economies (see Bernanke (2005) and Caballero et al. (2008)), or the increased demand for 'safe assets' (Caballero and Farhi (2015)). A faster decline in the price of investment goods can also reduce natural rates of interest, if the elasticity of the volume of investment to the real interest rate is not too high. Our empirical method does not allow us to separately test these four hypotheses. However it strongly suggests that the 'savings glut' explanation and deleveraging dynamics played a large role in the decline in real rates in both the 1930s and now, as in Eggertsson and Krugman (2012) or Guerrieri and Lorenzoni (2011). Our findings are thus consistent with the view that the main low-frequency drivers of global real interest rates are cyclical movements in the demand for safe assets, in a context of limited supply, i.e. an environment of '*safe asset scarcity*'.[8]

The second part of our paper considers more closely the implications of our findings for global imbalances. Since the Global Financial Crisis, global imbalances have diminished but have not disappeared altogether. Figure 5 reports current account surpluses and deficits for countries or regions, scaled by world output since 1980. While U.S. current account deficits have decreased, they remain sizable, at -0.66 percent of world GDP in 2015, representing around a third of all current account deficits. On the funding side, two developments are noticeable. First, the surpluses of oil producers have disappeared. Second, the Eurozone has become a major source of surpluses, with a current account surplus of 0.61% of world output in 2015. Figure 6 reports current account balances and surpluses for members of the Eurozone since 1993, as a fraction of Eurozone output.[9] It is quite startling to observe that, since 2014, all Eurozone countries are running current account surpluses or have a balanced position, and are projected to do so in years to come.

In Caballero et al. (2015) and Caballero et al. (2016), one of us argued that current account

[8]This terminology sometimes leads to some confusion. It should be clear that, in equilibrium, the supply of assets (safe or otherwise) always equals their demand. Instead 'scarcity of safe assets' refers to a situation where there is either an autonomous increase in the demand for safe assets, or an autonomous decline in their supply, leading to an endogenous adjustment in their price (outside the ZLB) or in output (at the ZLB) so as to restore equilibrium in these markets. See Caballero et al. (2016).

[9]In both graphs, the Eurozone consists of the 12 major members of the EMU for which we have consistent data over that period.

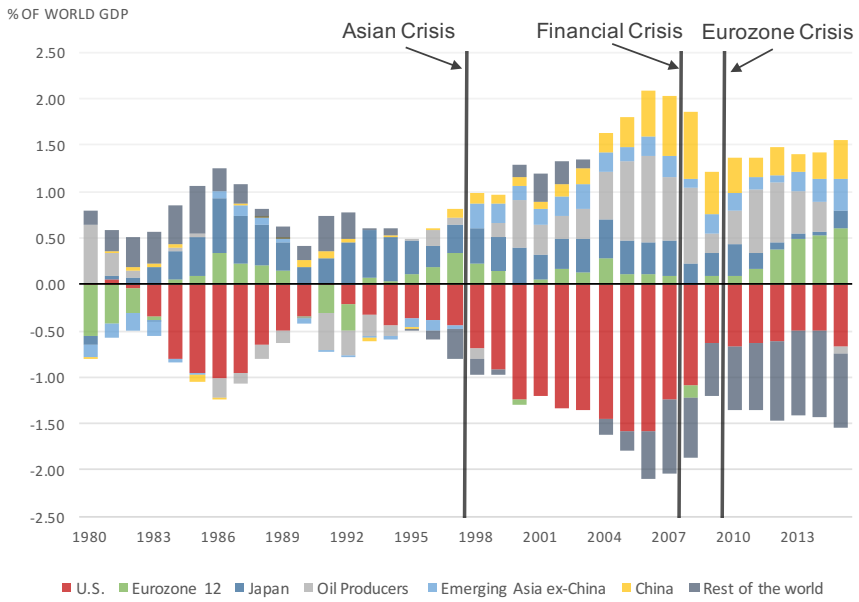

Figure 5: **Global Imbalances**, **1980-2015**. Note: The graph shows Current Account balances as a fraction of world GDP. Source: World Economic Outlook Database (April 2016), and Authors' calculations. WEO forecasts for 2015. Oil Producers: Bahrain, Canada, Iran, Iraq, Kuwait, Lybia, Mexico, Nigeria, Norway, Oman, Russia, Saudi Arabia, United Arab Emirates, Venezuela; Emerging Asia ex-China: India, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, Vietnam. Eurozone 12: Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain.

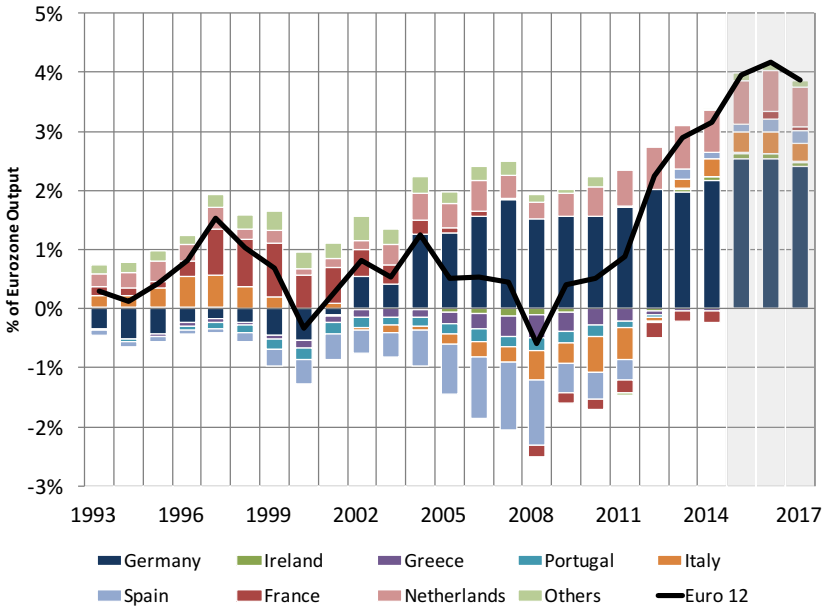

Figure 6: **Eurozone Imbalances**, **1993-2017**. Note: The graph shows the current account balances of Eurozone countries, relative to Eurozone output. Source: World Economic Outlook Database (April 2016) and Authors' calculations. WEO forecasts for 2015-2017. Euro 12: Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain.

imbalances mutate from benign to malign when the global economy hits the Zero Lower Bound. Excess savings of surplus countries cannot be accommodated any longer by a decline in global real interest rates. Instead, they push the global economy into a liquidity trap that depresses economic activity. Surplus countries *export* their recession, at the expense of deficit countries. Moreover, that paper argues that exchange rates become indeterminate at the Zero Lower Bound, yet play a key role in the adjustment process, by shifting relative demand for domestic and foreign goods. The analysis in that paper indicates a tight link between net foreign asset positions and exchange rates: countries or regions running current account surpluses have a more depreciated currency than under financial autarky, and correspondingly higher levels of activity, at the expense of foreign countries. A direct and immediate implication is that the exchange rate becomes a key variable to reallocate depressed global demand across countries, raising the prospect of 'currency wars'.[10] This analysis suggests that a period of secular stagnation does not necessarily imply that global imbalances should recede. Instead, imbalances at the ZLB have a greater potential to destabilize the global economy.

Indeed, Figure 7 illustrates that significant exchange rates movements have accompanied most major central bank attempts to stimulate their economy since 2008. The figure reports the cumulated rate of appreciation (+) or depreciation (-) of the euro against the US dollar, the Japanese yen and the Swiss franc since January 2007. The figure illustrates the large recent gyrations in exchange rates, especially in the dollar-euro rate after the implementation of the Federal Reserve's QE2 in October 2010 or the announcement of the ECB's public sector purchase program (PSPP) in January 2015; in the yen-euro rate following Abenomics in December 2013; or in the Swiss franc-euro rate after the Swiss National Bank decided to put a floor on the bilateral rate (September 2011) and to abandon it (January 2015). The figure also illustrates the significant depreciation of the Euro against the three other currencies since 2014, consistent with the surge in the Eurozone's current account surpluses.

In this context we ask how the growing demand for safe assets shapes external portfolios. Gourinchas et al. (2010) explored the implications for the United States' external portfolio of being a major safe asset producer. That paper argued that the structure of the U.S.'s external portfolio (gross assets and gross liabilities) would reflect its capacity to provide safe assets. With integrated

[10] See Eggertsson et al. (2015) for a similar argument.

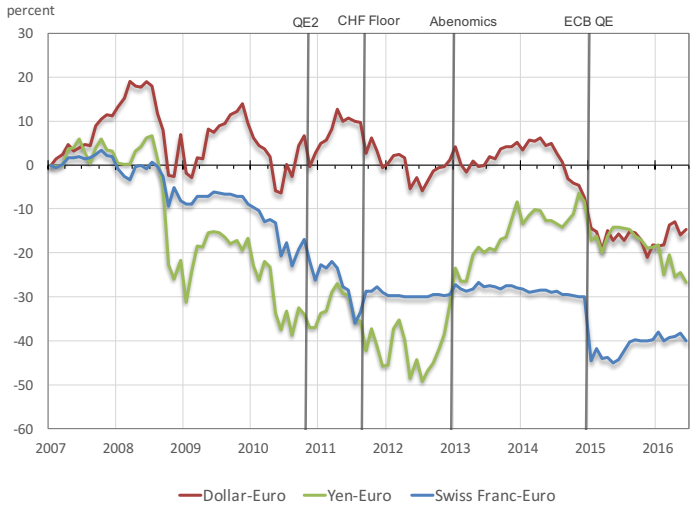

Figure 7: **Global Exchange Rates, 2007-2016**. Note: The graph shows the cumulated depreciation (+) or appreciation (-) of the dollar, the yen, and the Swiss Franc against the euro since January 2007. Source: Global Financial Database. The figure reports $\ln(E_{2007m1}/E)$ where E denotes the foreign currency value in euro.

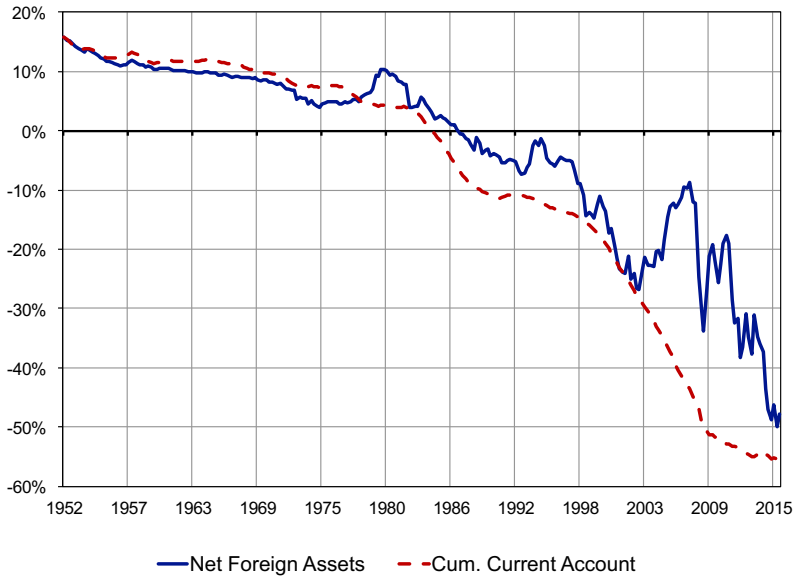

Figure 8: **United States Net Foreign Asset Position and Cumulated Current Account, 1952-2015**. Note: The graph shows the U.S. net foreign asset position as a fraction of U.S. output and the counterfactual obtained by cumulating current account balances since 1952Q1. Source: BEA, Flow of Funds and Author's calculations.

financial markets, asset prices and returns would adjust so that, in equilibrium, the U.S. provides safe assets to the rest of the world. This is reflected in the fact that (a) the U.S. holds a leveraged position long in risky assets and short in safe assets, relative to the rest of the world; (b) in normal times, the U.S. earns high returns on its gross assets relative to its gross liabilities (what is often referred to as the 'exorbitant privilege' of the United States); (c) the U.S. experiences large capital losses in times of financial stresses (which we dubbed the 'exorbitant duty'). This last point is especially relevant in recent years. Figure 8 reports updated estimates of the U.S. net foreign asset position since 1952. Between 2007Q4 and 2015Q3, the U.S. external valuation losses represent \$4.13trillion, or a staggering 22.9% of 2015 U.S. GDP.[11] Three episodes account for the bulk of these adjustments: in 2008Q4, following the collapse of Lehman Brothers; in 2011Q3 during the Eurozone crisis, and in 2014Q4 when the dollar appreciated substantially against the yen and the euro. As a result, most of the cumulated valuation gains, which reached 35% of US GDP in 2007, have dissipated.

An important message is that the status of safe asset issuer inevitably comes with increased exposure to global shocks. In this paper, we move away from the U.S. dollar and consider instead what the implications of our analysis are for *regional* safe asset providers. We argue that net safe asset providers face a variant of the old 'Triffin dilemma' (Triffin (1960)): faced with a surge in the demand for their (safe) assets, regional safe asset providers must choose between increasing their external exposure, or letting their currency appreciate. In the former case, the increased exposure can generate potentially large valuation losses in the event of a global crisis, as documented in the case of the U.S.. In the limit, as the exposure grows, it could even threaten the fiscal capacity of the regional safe asset provider, or the loss absorbing capacity of its central bank, leading to a run equilibrium.[12]

Alternatively, a regional safe asset provider may choose to limit its exposure, i.e. the supply of its safe assets. The surge in demand then translates into an appreciation of the domestic currency which may adversely impact the real economy, especially the tradable sector. The smaller the regional safe asset provider is, the less palatable either of these alternatives is likely to be, a

[11] In 2007Q4, the U.S. net foreign asset position was -\$1.28 trillion. By 2015Q3, it reached -\$9.03 trillion, a \$7.74 trillion decline, \$3.61 trillion of which represents cumulated current account deficits, and \$4.13 trillion ((22.9% of GDP)) valuation losses.

[12] See Maggiori et al. (2016) and Amador et al. (2015) for related analysis of the Triffin dilemma or the potential for 'reverse speculative attacks'. See also See also He et al. (2015) for a discussion of the issue of the determination of the status of reserve assets in a world with competing stores of value.

phenomenon we dub the '*curse of the regional safe asset provider.*'

In light of these considerations, we revisit the recent experience of two European safe asset providers: Switzerland, and core EMU, consisting of Germany, France, the Netherlands and Belgium. The case of Switzerland illustrates nicely the terms of the basic trade-off: After fixing its exchange rate against the euro in September 2011, the Swiss National Bank grew increasingly worried about its external exposure and the potential for future losses in the wake of the ECB's PSPP. In January 2015, in a surprise announcement, the Swiss National Bank chose to let the currency float, a move that was followed by a sharp appreciation of the Swiss currency (see figure 7).

The case of the core EMU is equally fascinating. In the run-up to the financial crisis, it acted as a safe asset provider, with an extra twist. As documented by Hale and Obstfeld (2016), core EMU countries invested in risky projects in peripheral Eurozone members, but also intermediated foreign capital from outside the Eurozone into these countries, thereby increasing further their exposure. Most of that increased exposure occured via an expansion in core EMU bank's balance sheet and leverage (Miranda-Agrippino and Rey (2015)) and cross-border loans instead of portfolio holdings. In this crisis, core EMU banks have borrowed globally and lent to peripheral Eurozone countries, earning small but positive excess returns in the process. Core EMU countries have not let their real exchange rate appreciate in response to a surge in the demand for safe assets. Instead, they have tended to absorb the increased exposure onto their national balance sheet. Some of that increase in financial sector exposure may well reflect risk shifting and expectations of bailouts using tax payers money. This emphasizes the need for a very careful monitoring of financial fragilities and imbalances, especially for EMU safe asset providers.

When the crisis materialized, as in the case of the U.S. and other safe asset providers, core EMU stood to realize substantial capital losses on its net external position, a combination of losses on its gross external assets and capital gains on its external liabilities. With an exposure structure similar to the U.S., a rough calculation indicates that the valuation losses could have reached a staggering 40% of output for Germany alone. Unlike the U.S., however, where the valuation losses were immediately realized via changes in asset prices and currency price movements, resulting in the sharp decline in the U.S. net foreign asset position documented in figure 8, the protracted resolution process of the European Sovereign Debt crisis mitigated the losses of the core EMU countries, but profoundly hampered the economic recovery of the Eurozone. Without a Eurozone debt resolution

mechanism for banks or sovereigns, and with the fear that markets might turn on them, most peripheral eurozone members followed multiple rounds of private and public deleveraging. The result has been a massive shift from current account balance in 2007, to a current account surplus of 0.5% of world GDP in 2014, predicted to rise to 0.6% in 2015, as illustrated on figures 5 and 6.[13] If the Eurozone were a closed economy, the resulting deflationary forces may well have proven self-defeating, just like attempts to deflate one's economy at the expense of one's trading partners were ultimately self-defeating during the Great Depression under the Gold Exchange Standard. At the global Zero Lower Bound, the shift towards external surpluses has lessened the burden of adjustment on the Eurozone, at the expense of the rest of the world.

In summary, our analysis suggests that core EMU countries have not performed their role as regional safe asset providers. They absorbed too many risks ex-ante, but pushed them back onto the rest of the Eurozone ex-post. Unlike the U.S. which saw its net foreign asset position deteriorate substantially during the crisis, as U.S. Treasuries appreciated while external assets plummeted in value, core EMU economies have not absorbed the banking losses that were on their balance sheet. Unrealized losses have been pushed back onto the peripheral countries public sector balance sheet, forcing them to delever aggressively. This aggregate delevering, and the corresponding surge in saving continues to have deleterious effects on the global economy. Given our finding that real interest rates will remain low for an extended period of time, we consider that it would be wise to steer away from policies that make us teeter on the edge of a global liquidity trap. Being a regional safe asset provider may prove to be a curse not only to the core EMU, but to the Eurozone at large, and to the global economy.

2 The Dynamics of Global Real Interest rates

As illustrated in Figures 1 and 2, both long and short rates have declined dramatically over the last thirty years. A growing literature has attempted to understand the source of this decline and concludes that the decline in global real rates is likely to be quite persistent.[14] In this paper, we

[13] Figure 6 demonstrates that the bulk of the increase in the Eurozone current account surpluses does not come from core EMU. Core EMU current account surpluses increased modestly from 2.3% to 2.6% of the region's output between 2007 and 2015. Over that period, the rest of the Eurozone's current account improved from -1.9% to 0.5%, representing 87% of the improvement in the Eurozone's current account.

[14] Barro and Sala-i Martin (1990) explores the converse question of why real interest rates were so high in the 1980. More recently, Laubach and Williams (2003, 2015) and Pescatori and Turunen (2015) attempt to measure the

borrow from Gourinchas and Rey (2016) and propose a novel approach based on the low frequency movements in the global consumption-to-wealth ratio.

2.1 The Global Budget Constraint: Some Elements of Theory

To fix ideas, denote beginning-of-period world private wealth W_t. W_t consists of financial wealth (assets minus liabilities) as well as nonfinancial assets such as housing, nonincorporated businesses, land etc...[15] The accumulation equation for the global economy is:

$$W_{t+1} = R_{t+1}(W_t - C_t), \tag{1}$$

where C_t denotes world private consumption expenditures and R_{t+1} is the gross return on wealth between t and $t+1$. In this equation, all variables are in real terms so R_{t+1} denotes the real return on total wealth. Equation (1) is simply an accounting identity: it has to hold exactly period by period. We add some structure on this equation by observing that, in most models of the economy, private agents aim to stabilize the ratio of their consumption to their wealth.[16] If the average propensity to consume out of wealth is stationary, equation (1) can be log-linearized around the steady state consumption-total wealth ratio $C/W \equiv 1-\rho_w$, where $\rho_w < 1$.[17] Denoting Δ the difference operator, $\mathbb{E}_t$ the expectation operator, $r_{t+1} = \ln R_{t+1}$ the continuously compounded real return on wealth and following some simple manipulations as in Campbell and Mankiw (1989), Lettau and Ludvigson

(unobserved) natural rate. Following Wicksell, they define the natural rate as "the real short-term rate consistent with the economy operating at its full potential once transitory shocks to aggregate supply or demand have abated" (Laubach and Williams (2015), p 2). Hamilton et al. (2015) adopts a similar definition but a different estimation method, relying on a bivariate error correction model for U.S. and world interest rates.

[15] In the following discussion, we ignore human wealth, i.e. the present value of current and future labor income. The appendix discusses how to incorporate human wealth in the analysis. We also focus on *private* consumption and wealth, as opposed to *national* consumption and wealth, which includes public consumption and net wealth. Our results are largely unchanged if we use either concept, except during wars where public consumption surges, while private consumption declines.

[16] For instance, if consumption decisions are taken by an infinitely lived representative household with logarithmic period utility $u(C) = \ln C$, then the consumption wealth ratio is constant and equal to the discount rate of the representative agent.

[17] In steady state, C/W satisfies the following relation: $\frac{\Gamma}{R} = (1 - \frac{C}{W}) \equiv \rho_w$, where Γ denotes the steady state growth rate of total wealth and R the steady state gross return.

(2001) and Gourinchas and Rey (2016) we can derive the following fundamental relationship:

$$\begin{aligned} c_t - w_t \backsimeq & \mathbb{E}_t \sum_{s=1}^{\infty} \rho_w^s r_{t+s}^f + \nu \mathbb{E}_t \sum_{s=1}^{\infty} \rho_w^s r p_{t+s} - \mathbb{E}_t \sum_{s=1}^{\infty} \rho_w^s \Delta \ln C_{t+s} \\ & \equiv cw_t^{rf} + cw_t^{rp} + cw_t^c, \end{aligned} \tag{2}$$

where c_t and w_t denote respectively (log) real consumption (resp. wealth) per capita, r_t^f is the real short term risk-free return, rp_t is the excess return between risky assets and the real short term risk-free return and ν is the steady state share of wealth invested in risky assets. Equation (2) states that today's aggregate consumption to wealth ratio (the left hand side) is high if either (a) expected future rates of return on wealth are high so that the denominator of C/W is expected to increase or (b) expected future *aggregate* consumption growth is low, so the numerator of C/W is expected to decline.

It is important to emphasize that the assumptions needed to derive this relation are minimal: we started from the law of motion of private wealth, which is simply an accounting identity. In particular, it holds with or without investment or production – these are simply factors that affect the return on wealth. We then performed a log-linearization under mild stationarity condition.[18] This simple equation conveys the message that today's average propensity to consume out of wealth encodes information about expected future consumption growth $\mathbb{E}_t \Delta \ln C_{t+s}$, expected future safe rates $\mathbb{E}_t r_{t+s}^f$, or future risk-premia $\mathbb{E}_t rp_{t+s}$. It also indicates how to construct the contributions of each component, cw_t^{rf}, cw_t^{rp} and cw_t^c as the expected present discounted value of each variable. Since it is well-known that aggregate consumption is close to a random walk, so that its growth rate $\Delta \ln C_{t+s}$ is unpredictable, and excess returns are also volatile and difficult to predict, we expect from equation (2) that the aggregate consumption to financial wealth ratio will provide us with significant informaiton about the expected path of future real risk free returns r_{t+s}^f.

2.2 Interpretation

Equation (2) does not provide a causal decomposition: in general, the risk free and risky returns as well as consumption growth are endogenous and interdependent. In Gourinchas and Rey (2016)

[18] We also impose a transversality condition that simply rules out paths where wealth grows without bounds in relation to consumption.

we discuss how different shocks are likely to impact the various terms on the right hand side of equation (2) and summarize this discussion here:

- **Productivity Shocks**: persistent negative productivity shocks decrease future aggregate consumption growth $\Delta \ln C_{t+s}$, which pushes up $c_t - w_t$ (direct effect). There is an indirect effect that goes in the opposite direction since lower productivity growth tends to reduce equilibrium real interest rates, which pushes $c_t - w_t$ down. The relative strength of the two effects depends on the intertemporal elasticity of substitution (IES). With a low IES, real rates respond more than consumption growth, hence the indirect effect is likely to dominate and $c_t - w_t$ will decline. If instead the IES is high, consumption growth responds more than real rates, the direct effect dominates and $c_t - w_t$ increases. More generally, we expect the return component cw_t^{rf} and the consumption growth components cw_t^c to have opposite signs if productivity shocks are a main source of fluctuations.

- **Demographics**: a slowdown in population growth has a direct effect on the consumption-wealth ratio via the decline in total consumption growth $\Delta \ln C_{t+s}$. This direct effect is the same as that of productivity and pushes up $c_t - w_t$. Population growth may also have an indirect effect on the consumption-wealth ratio via its effect on savings and global real returns. If the lower population growth induces higher saving rates among currently alive generations, the real interest rate will decline and this will tend to push down $c_t - w_t$. Similarly, increases in life expectancy that reduce the ratio of workers to retiree may stimulate savings, as households need to provide for a longer retirement life, pushing down real rates and reducing $c_t - w_t$. Again, we expect opposite movements in the return and the consumption growth components.

- **Deleveraging shock**: A deleveraging shock can be interpreted as an increase in the saving propensity (see Eggertsson and Krugman (2012); Guerrieri and Lorenzoni (2011)). There is ample evidence that saving propensities increase in the aftermath of financial crises, as households attempt to repair their balance sheets (see e.g. Mian et al. (2013)). In the global equilibrium this needs to be offset by a decline in the equilibrium real rate. The response of future total consumption depends on whether the economy operates outside the ZLB or not. Outside the ZLB, investment is likely to increase so while current consumption growth would be low initially, it would increase later as output increases. If the economy is at the

ZLB, aggregate demand may remains depressed, which keeps investment low and consumption growth muted. Most of the impact of financial shocks is therfore likely to be reflected in the return component cw_t^{rf} .

- **Demand for safe asset**: A surge in the demand for safe assets should lead to a decline in the real risk-free rate, and an increase in the risk premium, i.e. expected excess returns. The first effect tends to reduce $c_t - w_t$ while the second increases it. The overall effect on consumption growth is unclear. We therefore expect to see the impact of an increase in the demand for safe assets in a decline of the return component cw_t^{rf} and an opposite movement in the equity premium component.

We conclude that different primitive shocks have different effects on the various components on the right hand side of equation (2) which we will exploit to help us identify the source of the variation.

2.3 Empirical implementation

We implement our empirical strategy in two steps. In the first step, we construct estimates of the consumption-wealth ratio over long periods of time. We then evaluate the empirical validity of equation (2) by constructing the empirical counterparts of cw_t^{rf}, cw_t^{rp}, cw_t^{c} in that equation and testing whether they accurately capture movements in the consumption wealth ratio (i.e. whether $c_t - w_t = cw_t^{rf} + cw_t^{rp} + cw_t^{c}$). In a second step, we directly evaluate the forecasting performance of the consumption-wealth variable $c_t - w_t$ for future risk-free interest rates, risk premia, term premium and aggregate consumption growth.

For the first step, we use historical data on private wealth, population and private consumption for the period 1870-2011 for the United States, and 1920-2011 for the United Kingdom, Germany and France from Piketty and Zucman (2014a) and Jordà et al. (2016).[19] We identify the risk-free return with the ex-post real return on three-months Treasuries minus CPI inflation (both series obtained from Jordà et al. (2016)), and the real return on risky assets as the total equity return for each country minus CPI inflation (obtained from the Global Financial Database- see Appendix A for a detailed description of the data). Over the period considered, these four countries represent

[19]The wealth data prior to 1920 for these three countries is somewhat imprecise. There appears to be a strong break in data before the 1920s, most likely due to the first World War.

a substantial share of the world's wealth. Moreover London, New-York and to a lesser extent Frankfurt are major financial centers.

The dotted blue line in Figure 9 reports $c - w$ de-meaned for the United States from 1870 to 2011, while the dotted blue line in Figure 10 reports the same measure for our 4-country aggregate since 1920 (G4).[20] As expected, historical time-series on consumption and wealth show little long run trend but significant serial correlation.[21] These long swings in the consumption-wealth ratio justify the use of long time series.[22]

On both figures, we identify two periods during which the consumption-wealth ratio was significantly depressed: the first one spans the 1930s starting around the time of the Great Depression and ending at the beginning of the 1940s. Interestingly, it is in 1939 that Professor Alvin Hansen wrote his celebrated article about 'secular stagnation' (Hansen (1939)). The second episode of very low consumption-wealth ratio starts in the late 1990s with a pronounced downward peak in 2007 that is reversed during the financial crisis. As this paper is being written, the consumption-wealth ratio remains depressed, especially so for the G-4 aggregate. Not coincidentally, in the Fall 2013 at a conference at the International Monetary Fund, Larry Summers, revived the idea of secular stagnation, an idea which is still haunting us in 2016 (Summers (2015)). Periods of low consumption-wealth ratio can either be periods of low consumption, or periods of high wealth. In both cases, the consumption-wealth ratio decreases dramatically right before a financial crisis (in 1928-29, then in 2007-08) before rebounding during the crisis (1930 and 2009). This suggests that the movements in the consumption-wealth ratio are driven mostly by the dynamics of wealth during boom-busts episodes. We estimate each of the components on the right hand side of equation (2) using a reduced form Vector Auto Regression (VAR).[23]

[20] The appendix presents the raw data.

[21] A formal test of a unit root rejects the null of a unit root at conventional significance levels for the U.S. and the G4.

[22] Over shorter time periods, $c_t - w_t$ may exhibit a marked trend. For instance, over the 1970-2011 period, we observe a large decline in $c_t - w_t$.

[23] Note that we do not need to identify the various shocks driving the variables. Equation (2) only requires that we construct present discounted forecasts of real rates, excess returns and consumption growth. We do need to assume a discount rate and set $\rho_w = 0.96$. Recall that $\rho_w = 1 - C/\bar{W}$. This implies an average propensity to consume out of wealth of 4%. Our calculations also require an estimate of the share of financial wealth invested in risky assets $\hat{\nu}$. We estimate this share by regressing $c_t - w_t - \hat{cw}_t^{rf} - \hat{cw}_t^c$ on our estimate of $\mathbb{E}_t \sum_{s=1}^{\infty} \rho_w^s rp_{t+s}$. While this maximizes the overall fit of the decomposition, observe that it does not affect the risk-free and consumption growth contributions. See Gourinchas and Rey (2016) for details.

2.4 VAR Results

We report the long terms movements in the consumption-wealth ratio for the US on the 1870-2011 period and for our G4 world aggregate on the 1920-2011 period. Figure 9 shows that long term movements in consumption wealth ratio for the US as well as each of the terms of the right hand side of equation (2).

The results are striking. First, we note that the fit of the VAR is very good.[24] The grey line reports the predicted consumption-wealth ratio, i.e. the sum of the three components $cw_t^{rf} + cw_t^{rp} + cw_t^c$. We find that our empirical model is able to reproduce quite accurately the fluctuations in wealth over more than a century of data. This is quite striking since the right hand side of equation (2) is constructed only from the reduced form forecasts implied by the VAR estimation. Second, most of the movements in the consumption-wealth ratio reflect expected movements in the future risk-free rate, i.e. the cw_t^{rf} component. By contrast, the aggregate consumption growth cw_t^c and risk premia cw_t^{rp} components are often small, or non-significant. The interpretation is that the consumption-wealth ratio today contains significant information on future real rates, as encoded in equation (2). As discussed above, periods of low consumption-wealth ratios are mostly periods of rapid asset price increases. Our empirical results indicate that periods of rapid asset price increase are followed by periods of low (or negative) real risk-free interest rates. Moreover, we find only weak evidence for the view that productivity growth or demographic forces are the key secular drivers of the real risk free rates. Figure 10 presents a similar decomposition for the G4 group of countries.[25] It decomposes total consumption growth $\Delta \ln C_t$ into per capita consumption growth Δc_t and population growth Δn_t. If productivity or population growth were the main drivers of real interest rates, we would expect to find significantly negatively correlated direct contribution of each of these to the consumption wealth ratio. While we find a negatively correlated contribution, it is quantitatively negligible -and also not very robust.[26] Similarly, our estimates indicate that the consumption-wealth ratio contains little information about future equity risk premia. This is perhaps a more surprising result in light of Lettau and Ludvigson (2001)

[24] The lags of the VAR are selected by standard criteria.

[25] For the G4 group, we use a wealth-weighted average of the riskfree rate of the U.S. and the U.K. for the risk-free rate, and of the equity excess returns for the global excess return. Substantial price instability in the 1920s in Germany and France prevent us from using these countries' real returns.

[26] As discussed above, for the interest rate component to dominate the productivity or population growth terms would require very low intertemporal elasticity.

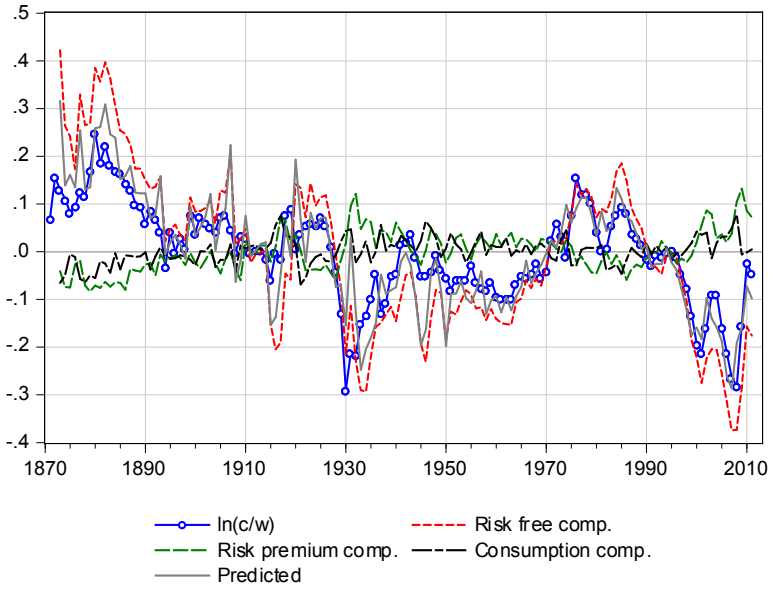

Figure 9: **Consumption Wealth, Real Risk-free rate, Equity Premium and Consumption Growth Components. United States, 1870-2011**. Note: The graph reports the (log, demeaned) private consumption-wealth ratio together with the riskfree, risk premium and consumption growth components. Estimates a VAR(3) with $\nu = 0.37$. Source: Private wealth from Piketty and Zucman (2014a). Consumption and short term interest rates from Jordà et al. (2016). Equity returns from Global Financial Database.

findings that a cointegration relation between aggregate consumption, wealth and labor income predicts reasonably well U.S. equity risk premia.[27]

Table 1 decomposes the variance of $c_t - w_t$ into components reflecting news about future real risk-free rates, future risk premia, and future consumption growth. It is immediate that the bulk of the variation in $c - w$ is accounted for by future movements in the real short term risk-free rate. The fact that total consumption growth contributes negatively is consistent with the fact that the productivity slowdown may play a role, especially for the G4, where the contribution of consumption growth per capita is also negative. However productivity growth or population growth are unlikely to be the main drivers of $c - w$ unless they have a disproportionate effect on real risk free returns.

[27] A number of factors may account for our result. First and foremost, $c_t - w_t$ appears stationary in our sample, hence we do not need to estimate a cointegrating vector or to incorporate labor income. Second, we consider a longer sample period, going back to 1870 for the U.S. Lastly, as argued above, our sample is dominated by two large financial crises and their aftermath, unlike theirs. Lastly, we view our analysis as picking up low frequency determinants of real risk-free rates while Lettau and Ludvigson (2001) seem to capture business cycle frequencies.

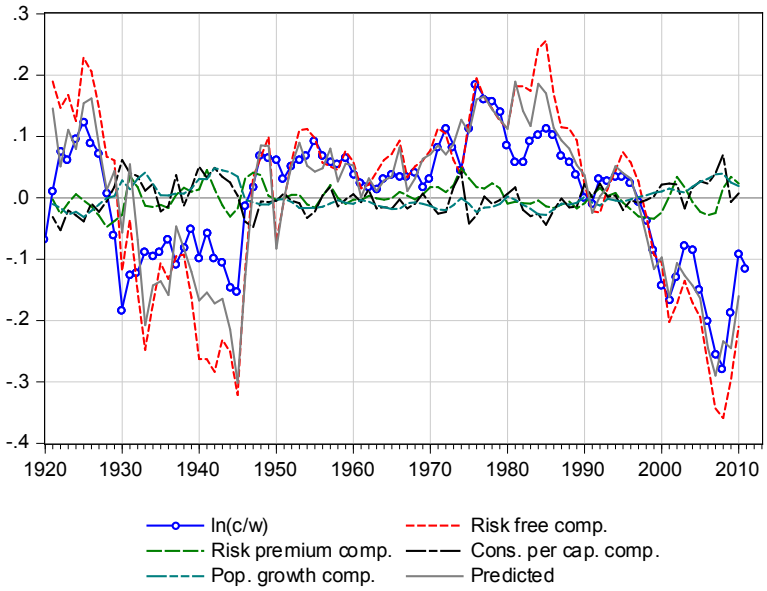

Figure 10: **Consumption Wealth: Real Risk-free rate, Equity Premium, Consumption per capita and Population Growth Components. United States, United Kingdom, Germany and France, 1920-2011**. Note: The graph reports the (log, demeaned) private consumption-wealth ratio together with the riskfree, risk premium, consumption per capita and population growth components. Estimates a VAR(2) with $\nu = 0.19$. Source: Private wealth from Piketty and Zucman (2014a). Consumption, population and short rates from Jordà et al. (2016). Equity returns from Global Financial Database.

#	percent	U.S.	G4
1	β_{rf}	1.364	1.406
2	β_{rp}	0.005	0.025
3	β_c	-0.329	-0.336
	of which:		
3	β_{cp}	0.056	-0.168
4	β_n	-0.386	-0.168
5	Total (lines 1+2+3)	1.041	1.094

Table 1: **Unconditional Variance Decomposition of $c_t - w_t$**

Note: β_{rf} (resp.β_{rp}, and β_c) represents the share of the unconditional variance of $c - w$ explained by future risk free returns (resp. future risk premia and future total consumption growth); β_{cp} (β_n) represents the share of the unconditional variance of $c - w$ explained by per capita consumption growth (population growth). The sum of coefficients $\beta_{cp} + \beta_n$ is not exactly equal to β_c due to numerical rounding in the VAR estimation. Sample: U.S: 1870-2011; G4: 1920:2011

2.5 Predictive regressions

Our decomposition exercise indicate that the consumption-wealth ratio contains information on future riskfree rates. We can evaluate directly the predictive power of cw_t by running regressions of the form:

$$y_{t+k} = \alpha + \beta cw_t + \epsilon_{t+k}$$

where y_{t+k} denotes the variable we're trying to forecast at horizon k and cw_t is the consumption-wealth ratio at the beginning of period t. We consider the following candidates for y: the average real risk free rate between t and $t+k$; the average one-year excess return between t and $t+k$; the average 10-year minus 3-month term premium between t and $t+k$; the average annual real consumption growth growth per capita between t and $t+k$; the average annual population growth between t and $t+k$.

Tables 2 presents the results for the U.S. and the G-4 aggregate respectively. We find that the consumption-wealth ratio always contains substantial information about future short term risk free rates (panel A). The coefficients are increasing with the horizon and become strongly significant. They also have the correct sign, according to our decomposition: a low $c-w$ strongly predicts a period of below average real risk-free rates. By contrast, the consumption-wealth ratio has almost no predictive power for the equity risk premium and very limited predictive power for consumption growth per capita. The regressions indicate some predictive power for population growth: a low $c-w$ predicts a low future population growth which suggests that the indirect effect (via changes in real riskfree rates) dominates the direct effect. Finally, there is also some predictive power for the term premium: a low $c-w$ predicts a high term premium, which is consistent with an increased demand for safe liquid assets.

Figure 11 reports our forecast of the risk free rate using the G-4 consumption-wealth ratio at 1, 2, 5 and 10 year horizon.[28] While the fit of the regression is quite poor at 1 year, it becomes very significant at 10-years. Our point estimates indicate that short term real risk free rates are expected to remain around -2% for the next ten years. Similar estimates using only the U.S. consumption-wealth ratio also indicate negative real risk free rates for the next ten years.

[28]The appendix provides similar graphs for the equity premium, consumption growth per capita and population growth.

United States				
Forecast Horizon (Years)				
	1	2	5	10
A. Short term interst rate				
$c_t - w_t$	**.12**	**.14**	**.16**	**.18**
	(.05)	(.05)	(.03)	(.03)
R^2	[.06]	[.10]	[.21]	[.34]
B. Consumption growth (per-capita)				
$c_t - w_t$	**.01**	**.01**	**-.02**	**-.04**
	(.04)	(.04)	(.02)	(.02)
R^2	[0]	[0]	[.01]	[.12]
C. Equity Premium				
$c_t - w_t$	**.05**	**.02**	**-.08**	**-.07**
	(.22)	(.16)	(.08)	(.08)
R^2	[0]	[0]	[.01]	[.02]
D. Population Growth				
$c_t - w_t$	**.03**	**.03**	**.03**	**.03**
	(.01)	(.01)	(.01)	(.01)
R^2	[.35]	[.38]	[.42]	[.36]
E. Term Premium				
$c_t - w_t$	**-.05**	**-.05**	**-.04**	**-.03**
	(.01)	(.01)	(.01)	(.01)
R^2	[.09]	[.13]	[.19]	[.17]

U.S., U.K., France and Germany				
Forecast Horizon (Years)				
	1	2	5	10
A. Short term interst rate				
$c_t - w_t$	**.07**	**.10**	**.19**	**.22**
	(.06)	(.06)	(.06)	(.04)
R^2	[.03]	[.07]	[.27]	[.43]
B. Consumption growth (per-capita)				
$c_t - w_t$	**.06**	**.05**	**.02**	**.01**
	(.04)	(.04)	(.02)	(.02)
R^2	[.06]	[.06]	[.02]	[.00]
C. Equity Premium				
$c_t - w_t$	**.27**	**.20**	**.01**	**-.06**
	(.25)	(.18)	(.11)	(.11)
R^2	[.02]	[.02]	[.00]	[.01]
D. Population Growth				
$c_t - w_t$	**.02**	**.02**	**.02**	**.02**
	(.01)	(.01)	(.01)	(.01)
R^2	[.07]	[.13]	[.18]	[.24]
E. Term Premium				
$c_t - w_t$	**-.05**	**-.06**	**-.06**	**-.03**
	(.02)	(.01)	(.01)	(.01)
R^2	[.14]	[.24]	[.40]	[.24]

Table 2: **Long Horizon Regressions**. Note: The table reports the point estimates, Newey-West corrected standard errors and the R^2 of the forecasting regression.

2.6 Interpretation.

Taken together, our results suggest that boom-bust financial cycles are a strong determinant of real short term interest rates. Wealth increases rapidly during the boom, faster then consumption. Increased leverage, financial exuberance, and risk appetite fuel asset prices, bringing down $c - w$. Two such historical episodes for the global economy are the roaring 1920s and the 2000s. In the subsequent bust, asset prices collapse, collateral constraints bind, and economic agents attempt to deleverage, as risk appetite wanes. The combined effect is an increase in saving that keeps future safe real interest rates low. Our estimates indicate that short term real risk free rates are expected to remain low or even negative for an extended period of time. Since current rates are constrained by the Zero Lower Bound, our estimation indicates that natural rates of interest might be even lower.

Our empirical results do not support directly the view that low real interest rates are the result of low expected future productivity –since we don't find much predictive or explanatory power for

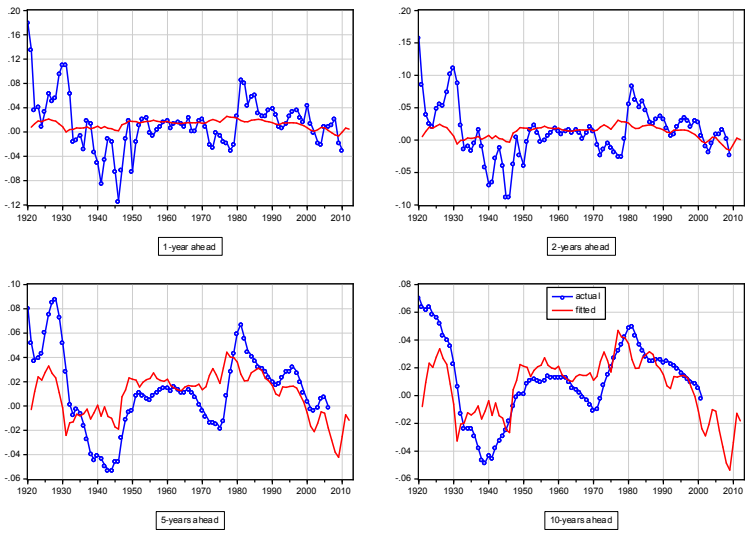

Figure 11: **Predictive Regressions: Risk Free Rate, 1920-2010.** . Note: The graph reports forecasts at 1, 2, 5 and 10 years of the annualized global real risk free rate from a regression on past $\ln(c/w)$.

future consumption growth- or demographic forces. Instead, it points us towards the global financial cycle boom/bust cycle, both in the 1930s and now. Under this interpretation, it is the increased in desired savings, and the move away from risky asset that drive real interest rate determination. Therefore, we view these empirical results very much in line with interpretations of recent events that emphasize the global financial cycle (Miranda-Agrippino and Rey (2015), as well as the scarcity of safe assets (Caballero and Farhi (2015)).

3 Imbalances and The Curse of the Regional Safe Asset Providers.

If the scarcity of safe assets can drive equilibrium real interest rates down -potentially into a global ZLB, their geographical distribution will determine the pattern of global imbalances. As described in Gourinchas et al. (2010), the country at the centre of the international monetary system acts as the world insurer and a liquidity provider. As such its external balance sheet is particularly remarkable, featuring large gross liquid liabilities and investment in mostly long term risky assets (see Figure 12).

This composition effect explains largely the excess returns that the US earns on its external position (see Gourinchas and Rey (2007)). But this *exorbitant privilege* comes with an *exorbitant duty*. In times of global stress the value of the external assets of the US, dominated by risky invest-

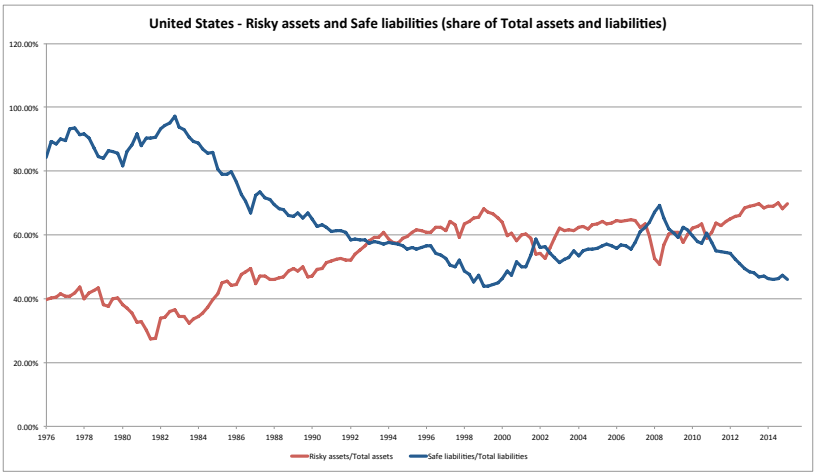

Figure 12: **US Share of risky assets (resp. liabilities) in total external assets (resp. liabilities), 1976Q1-2015Q3.**

ment, plummets while the value of its liabilities remain stable or even appreciate. As the centre country provides insurance to the rest of the world, its gross liabilities are large. The properties of the external balance sheet of the centre country therefore imply massive wealth transfers to the rest of the world in troubled times. Since at least the summer of 2007, financial markets have been in turmoil. The subprime crisis, followed by the near default or default of several investment banks, insurance companies and nation states has driven volatility to levels not seen in the last two decades. Inspection of the data on the net foreign asset position of the United States during the period of the recent crisis is very revealing. Figure 8 reports updated estimates of the U.S. net foreign asset position since 1952. We observe three dramatic collapses of the US international asset positions as a fraction of GDP during the crisis: between 2007Q4 and 2009Q1 as the US investment banking world sank, the net foreign asset position of the US declined by about 24% of GDP; it then bounced back but between 2011Q1 and 2012Q2 as the Eurozone crisis was unfolding, it declined again by 20.5% of GDP; finally between 2013Q3 and 2015Q3 it decreased by 19% of GDP as the dollar appreciated substantially against the yen and the euro, decreasing the dollar value of external assets. All in all, between 2007Q4 and 2015Q3, the U.S. valuation losses represent $4.13 trillion, or a staggering 22.9% of 2015 U.S. GDP.

Figure 13 reports the fluctuations in the US foreign asset position with the VIX[29] which is

[29]The VIX is s the ticker symbol for the Chicago Board Options Exchange (CBOE) Volatility Index, which shows the market's expectation of 30-day volatility. It is constructed using the implied volatilities of a wide range of S&P 500 index options.

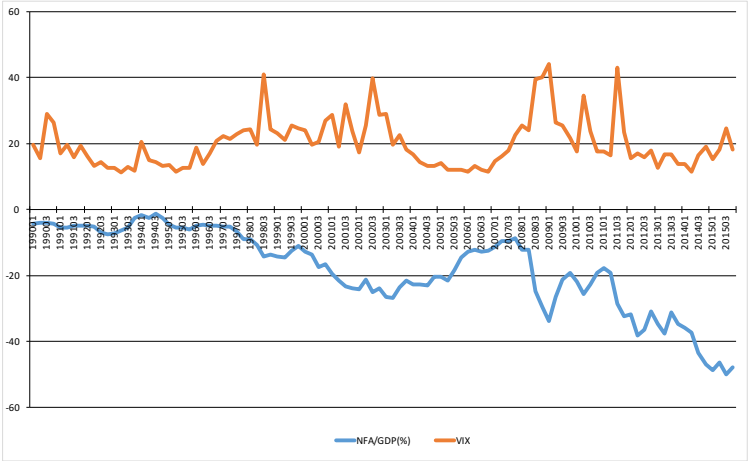

Figure 13: **US Net Foreign Asset Position and the VIX, 1990Q1-2015Q3.** Note: The graph reports the net foreign asset position of the US as a % of GDP and the VIX index.

an index widely interpreted as one of the main barometer of market sentiment, measuring both volatility and risk aversion of market participants. Positive spikes in the VIX indicate periods of high uncertainty and risk aversion. It is apparent that in period of financial stress (high VIX), we tend to see a deterioration of the US net foreign asset position. The correlation between the VIX and the US Net Foreign Asset Position is about -0.18 in quarterly data.

3.1 Scarcity of Safe Assets and the Exorbitant Duty

Periods of turmoil come with massive movements in the net foreign asset positions of the countries and in particular of the centre country who is providing insurance to the rest of the world. In the current configuration of the International Monetary System, the US is the main world insurer. There are however also a number of smaller or more regional safe asset providers such as Switzerland and Germany, - or more generally core euro economies. An important message of Gourinchas et al. (2010) is that the status of safe asset issuer inevitably comes with increased exposure to global shocks.

As pointed out in Section 2 of this paper, one plausible interpretation of the current very low real rates is that the world economy is characterized by a large demand for assets, driven in part by post crisis deleveraging. Indeed we showed that low consumption wealth ratios, symptomatic of periods of financial exuberance and quick wealth growth predicted low real rate of interest, as

agents deleveraged post financial crisis. This sequence of events occured at the time of the Great Depression as well as in the recent period.[30] We did not find strong evidence in favour of an expected TFP decline in the recent data as this should be associated with an expected decline in consumption growth, for which there is not much evidence according to our empirical analysis. Faced with a large demand for safe assets, *regional* asset issuers face a tradeoff. They can either choose to provide insurance elastically to the rest of the region and thus let their external balance sheet grow and their exposure to global risk increase. Or they can choose to limit their issuance of safe assets and let their currency appreciate thereby increasing the value of their limited supply of safe assets.[31] Hence, as described in Gourinchas et al. (2010), we argue that net safe asset providers face a variant of the old 'Triffin dilemma' (Triffin (1960)): on the one hand, limiting the supply of safe assets can have contractionary effects on the economy; on the other hand, the increased external exposure to macroeconomic risk can generate potentially large valuation losses in the event of a global crisis, as documented in the case of the U.S. In the limit, as the exposure grows, it could even threaten the fiscal capacity of the regional safe asset provider, or the loss absorbing capacity of its central bank, leading to a run equilibrium.[32] Building on Gourinchas et al. (2010) we show that the smaller the regional safe asset provider is, the less palatable either of these alternatives is likely to be, a phenomenon we dub the '*curse of the regional safe asset provider*.'

Let us imagine a world in which there is a surge in demand for safe assets, for instance because the probability of a major crisis goes up. In figure 14 we illustrate in that world the tradeoff between the real appreciation of the currency of the asset provider, versus the elastic provision of insurance to the region, which tends to increase massively the size of the external balance sheet for economies. Providing insurance to the region translates into high external debt liabilities of the safe asset issuer. We show how the extent of the tradeoff between exposure and real appreciation varies for countries with different sizes. For a large economy (corresponding to a relative size α= 0.75 of the world economy), there is a mild tradeoff between real appreciation and increases in net debt exposure as a proportion of GDP. The latter is never very high, even for a fixed exchange rate

[30] It is also possible that shifts in the composition of institutional investors and increased size of the asset management industry (pension funds for example) and/or changes in financial regulation play a role in fostering higher demand for assets and in particular safe assets.

[31] Another consequence is likely to be a large appreciation of the value of assets deemed safe in the economy, which may, in some cases extend to real estate

[32] Gourinchas and Rey (2007) already suggested the possibility of a run of international investors on the gross liabilities of the centre country in the case where its fiscal capacity would be put into question by international investors, stressing the parallel with old 'Triffin dilemma'.

and gets close to zero for real appreciations as low as 3%. But as the size of the safe asset provider gets smaller as a proportion to the world economy (we show the two cases α= 0.5 and α= 0.2) the tradeoff worsens in a very non linear way. When the size of the economy decreases from α= 0.5 to α= 0.2 and the real exchange rate is fixed, the net debt exposure increases from 34% to 187% of the country's GDP. In the case of a small safe asset provider (α= 0.2) even relatively small real appreciations of about 2% are enough to decrease the exposure sizably to around 100% of GDP. In contrast, for a large economy, it takes a huge real appreciation to decrease the size of the exposure (but the latter is much smaller as a proportion of GDP to start with). As a result of these very heterogenous terms of trade (reflected in the very different slopes of our three curves in figure 14) safe asset issuers will pick different 'habitats' on the tradeoff curve depending on their sizes. Large economies will probably be content with supplying the safe asset elastically and take the exposure, while small countries will let their real exchange rate appreciate at least to some extent in order to stay clear of the very high level of external exposures associated with fixed exchange rate. In figure 15, we illustrate these choices by portraying illustrative indifference curves (in red) for a large and a small economy: their points of tangence with the tradeoff curves (in blue) is their optimal point on the locus of real appreciation and external exposure. According to this analysis a small economy like Switzerland (point B) will tolerate a much higher real rate of appreciation than the US (point A) in exchange for staying clear of exposure levels close to multiples of its GDP (point C). Such high levels of exposure may eventually threaten the solvency of the country. For a small asset provider, it seems optimal to retain some flexibility in the real exchange rate. On the one hand, too large an exposure is a threat to solvency. On the other hand, too large an appreciation may lead to a recession. This is the *curse of the regional asset provider.*

3.2 European safe asset providers

In light of these considerations, we revisit the recent experience of two European safe asset providers: core EMU, which we will interpret here to mean Germany, and Switzerland. The case of Switzerland illustrates nicely the terms of the basic trade-off: after fixing its exchange rate against the euro in September 2011, the Swiss National Bank grew increasingly worried about its external exposure. Its reserves had grown from 39% of GDP to 90% of GDP during the period 2011Q2-2015Q1. The Swiss gross external risky assets (computed as portfolio equity and FDI assets) increased from 260%

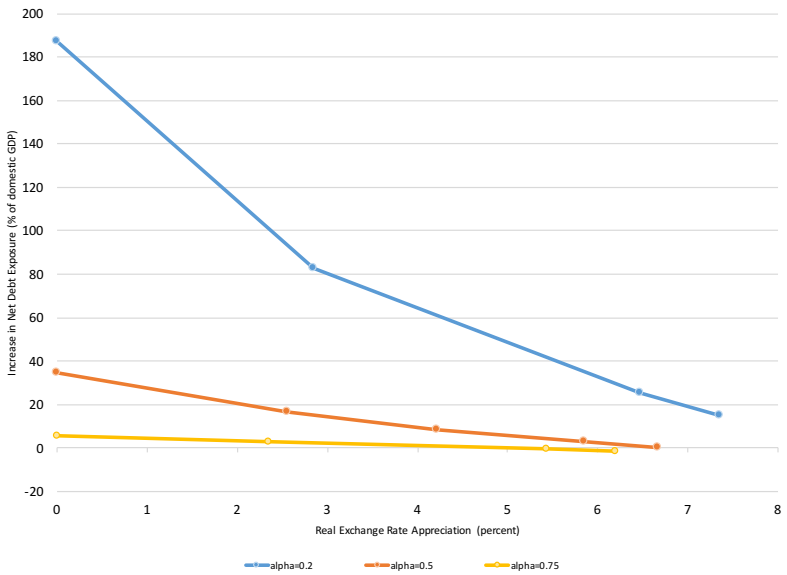

Figure 14: **Tradeoff between real appreciation and external balance sheet size for different size of countries.** Note: The graph reports the tradeoff between real appreciation of the exchange rate and the size of external exposure to risk for small (α= 0.2), median (α= 0.5) and large economies (α= 0.75). Source: simulations based on Gourinchas et al. (2010).

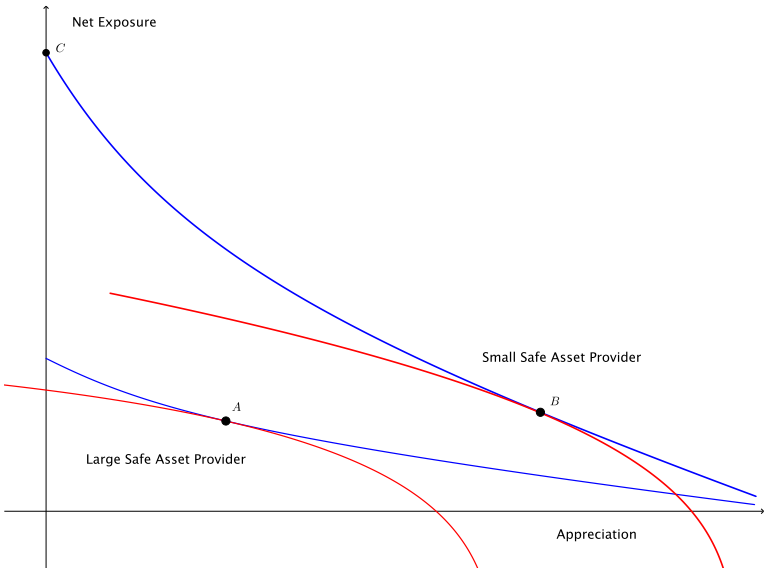

Figure 15: **Optimal "habitat" on the tradeoff line between real appreciation and external balance sheet exposures for large and small economies.** Note: Point Acorresponds to the optimal choice of exposure and RER appreciation for a large safe asset provider. Point B is the corresponding point for a small safe asset provider. A small safe asset provider under fixed exchange rates would end up at point C instead.

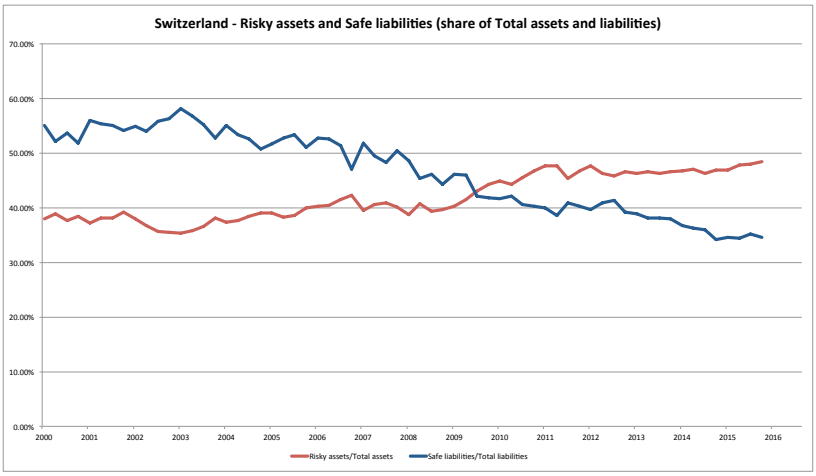

Figure 16: **Swiss Gross External Risky Assets and Safe Liabilities, 2000Q1-2015Q4.** Note: The graph reports the risky asset position of Switzerland (defined as FDI and portfolio equity assets) and its safe liabilities (defined as debt and bank liabilities), as a % of total external assets and liabilities respectively .

of GDP to 307% of GDP during the same period. The decline in the Swiss net external position between 2012Q3 and 2015Q1 was very large (from 143% of GDP to 84% of GDP). By the end of 2014, reserves had piled up to about 84% of GDP. In January 2015, in a surprise announcement, the central bank chose to let its currency float, a move that was followed by a sharp appreciation of the Swiss currency (see figure 7). In Figure 17 we show the rapid growth of the reserves and of the external risky assets of Switzerland (in particular FDI) after the beginning of the global financial crisis. At end 2015, FDI and equity external assets amount to about three times the Swiss GDP. On the liability side, banking deposits account for the lion's share of the Swiss external position as evidence in Figure 18. External debt liabilities are very small due to the lack of depth in the Swiss debt market, so that Swiss safe assets are effectively bank deposits. Bank deposits and trade credit (the "other liability" category of the balance of payment) reached almost 200% of Swiss GDP by end 2015. This is despite the fact that the Swiss Franc was allowed to appreciate substantially, suggesting that the increased exposure would have been substantially higher had the peg not be abandoned.

The case of core EMU is equally fascinating. In the run-up to the financial crisis, it acted as a safe asset provider, with an extra twist. As documented by Hale and Obstfeld (2016), Germany alongside other core EMU members such as France, Belgium and the Netherlands, invested in risky projects in peripheral Eurozone members, but also intermediated foreign capital into these

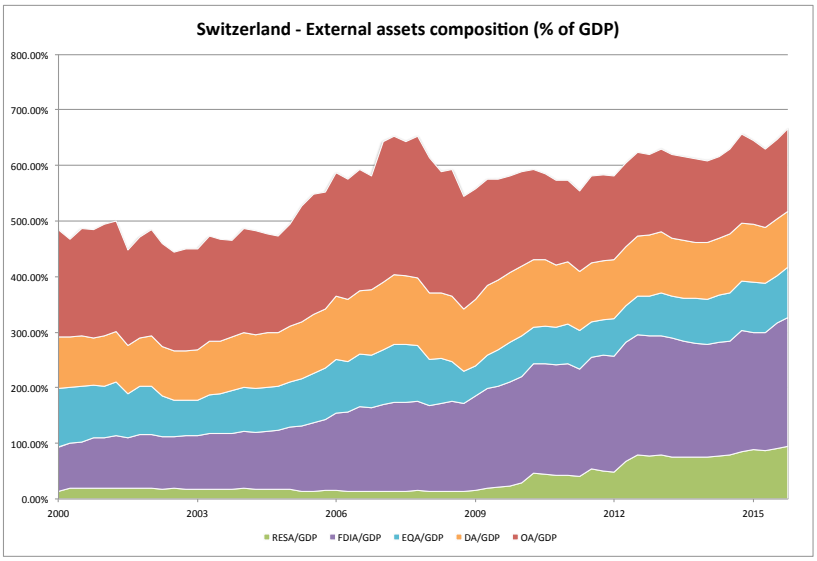

Figure 17: **Swiss Gross External Assets, 2000Q1-2015Q4.** Note: The graph reports the gross external asset position of Switzerland as a % of GDP .

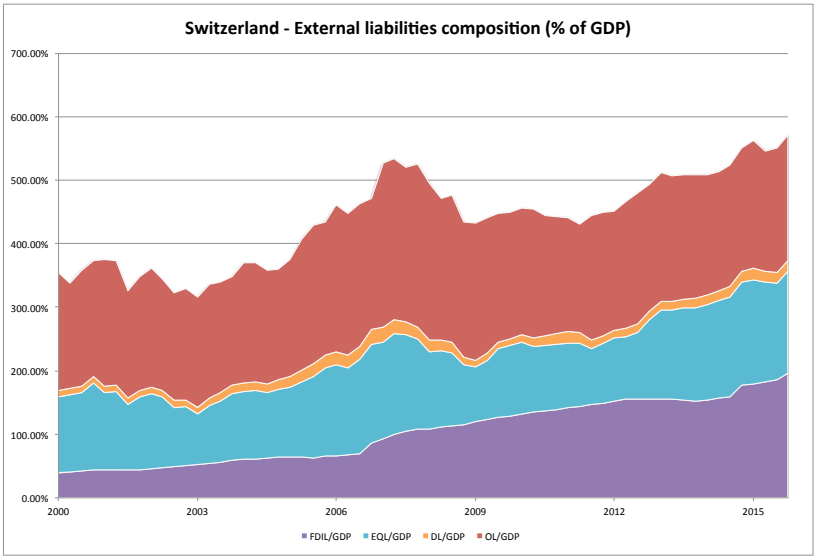

Figure 18: **Swiss Gross External Liabilities, 2000Q1-2015Q4.** Note: The graph reports the risky asset position of Switzerland (defined as FDI and portfolio equity assets) and its safe liabilities (defined as debt and bank liabilities), as a % of GDP .

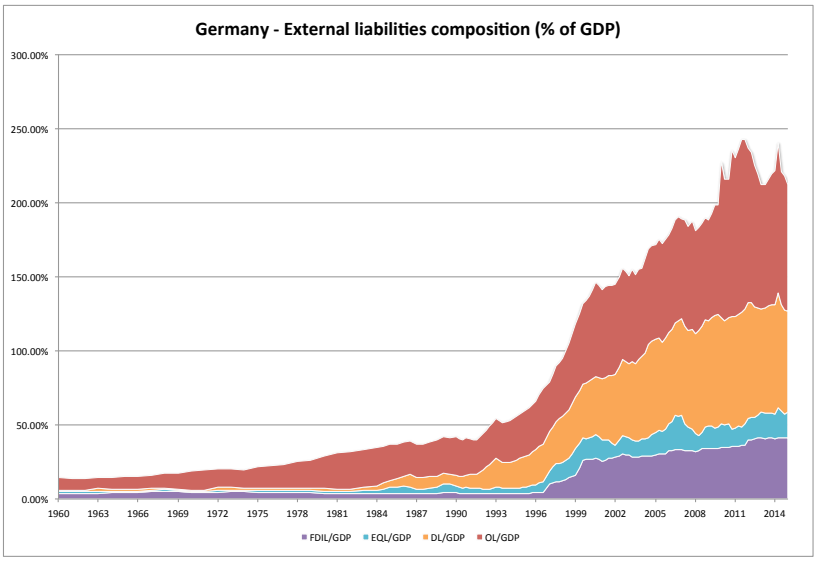

Figure 19: **German Gross External Liability Position, 1960Q1-2015Q4.** Note: The graph reports the gross external liability position of Germany disaggregated by asset classes, as a % of GDP. FDI: Foreign Direct Investment; O : bank loan and trade credit; D: Portfolio Debt; EQ : Portfolio Equity.

countries, thereby increasing further their exposure. Most of that increased exposure occured via an expansion in core EMU bank's balance sheet and leverage (Miranda-Agrippino and Rey (2015)) and cross border loans instead of portfolio holdings. In short, core EMU banks borrowed globally and lent to peripheral Eurozone countries, earning small but positive excess returns in the process. Importantly, because core EMU shares a common currency with the rest of the Eurozone, it cannot let its currency appreciate in response to a surge in the demand for safe assets. Instead, it has to absorb the increased exposure onto its national balance sheet. We illustrate how this trade-off has played out by considering in detail the external balance sheet of Germany.[33]

As can be seen from Figure 19, on the liability side the German external balance sheet has the definite characteristics of a safe asset provider with a very large share of its gross liabilities being either debt or bank liabilities (153% of GDP at end 2015). Over the period 1960-2015Q4, the share of safe liabilities in total liabilities is always above 60% and sometimes above 80% as can be seen in Figure 21. Portfolio equity and FDI account for a small share of liabilities. Interestingly the amount of safe assets held by foreigners has increased sizably with the euro area crisis in 2010. What is remarkable however is that on the asset side the portfolio is very symmetric in terms of asset classes, with the share of FDI and equity hovering around 20 and 30% in recent years. A

[33]Similar trade-offs are present for the other core EMU members. However, Germany plays a prominent role in that group.

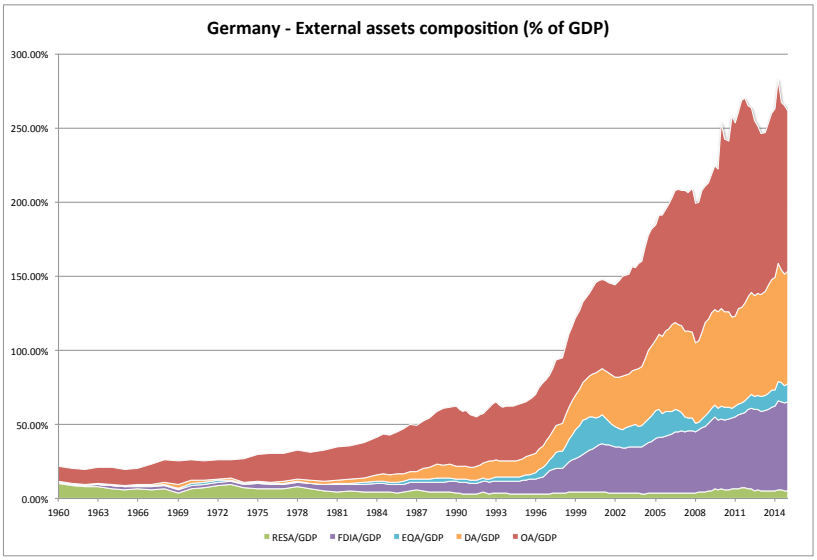

Figure 20: **German Gross External Asset Position, 1960Q1-2015Q4.** Note: The graph reports the gross external asset position of Germany disaggregated by asset classes, as a % of GDP. FDI: Foreign Direct Investment; O : bank loan and trade credit; D: Portfolio Debt; EQ : Portfolio Equity.

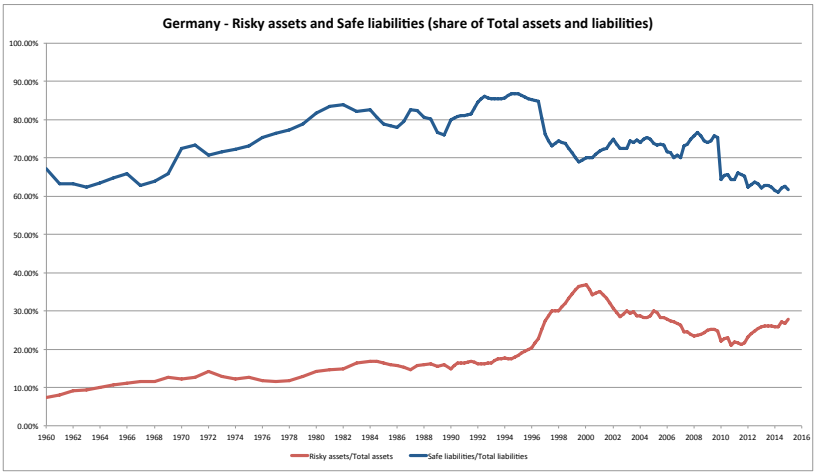

Figure 21: **German Gross External Risky Assets and Safe Liabilities, 2000Q1-2015Q4.** Note: The graph reports the risky asset position of Switzerland (defined as FDI and portfolio equity assets) and its safe liabilities (defined as debt and bank liabilities), as a % of total external assets and liabilities respectively .

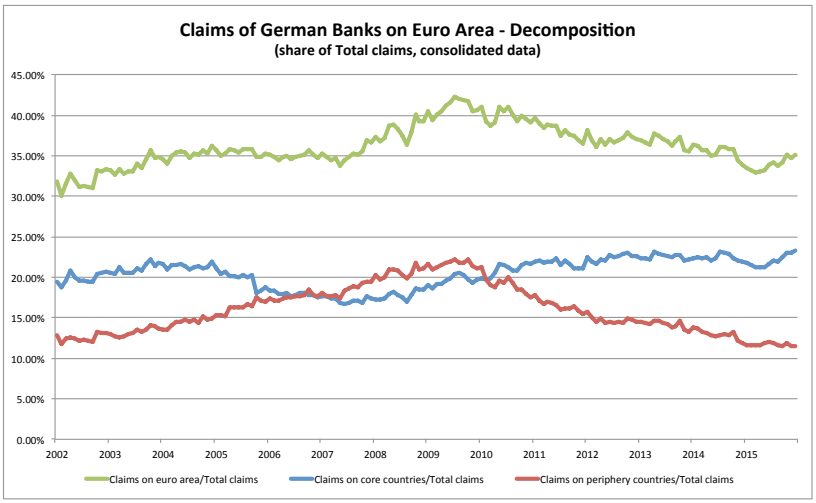

Figure 22: **Geographical composition of consolidated German MFIs external claims, 2002Q1-2015Q4.** Note: The graph reports the geographical composition of consolidated German MFI external claims on euro area countries. The core is defined as Austria, Belgium, Finland, France, Luxembourg, Netherlands. The periphery is defined as Cyprus, Estonia, Greece, Ireland, Italy, Latvia, Lithuania, Malta, Portugal, Slovak Republic, Slovenia, Spain.

very large proportion of German external assets are fixed income securities or bank loans. This is different from the US which is invested heavily in FDI and portfolio equity and exhibits a very asymmetric balance sheet structure in terms of asset classes. The riskiness of the bank loans and deposits may be very different on the two sides of the balance sheet however. Indeed, German banks have extended large amount of credits to the euro periphery. At end 2003, the consolidated claims of German banks on the euro area as a whole was about 92% of German GDP. By July 2007, they amounted to an impressive peak of 125% of GDP while the first warning shots of the global financial crisis were becoming more obvious with the BNP Paribas structured investment vehicles being in trouble.

In Figure 22 we look at the geographical composition of consolidated German MFIs external claims.[34] The share of German's external bank claims on the euro area kept on climbing by about 10 points (from a share fo 33% to a share of 42%) between July 2007 and september 2009. The share of claims onto the euro area periphery had been in constant rise from 2002 and up to 2009 while the share of the claims on the core euro area countries after dipping in 2005 and decreasing till

[34]We looked both at consolidated data and non-consolidated data. Non-consolidated data are consistent with the external investment position data which uses balance of payment (residency) definitions but do not cover the full exposure of Germany (based on a concept of ownership). A similar graph using non-consolidated data (data available since 1994) looks very similar however as far as the movements in shares are concerned. As expected levels of exposures of German banks to the euro area as a percentage of GDP are higher in the consolidated data.

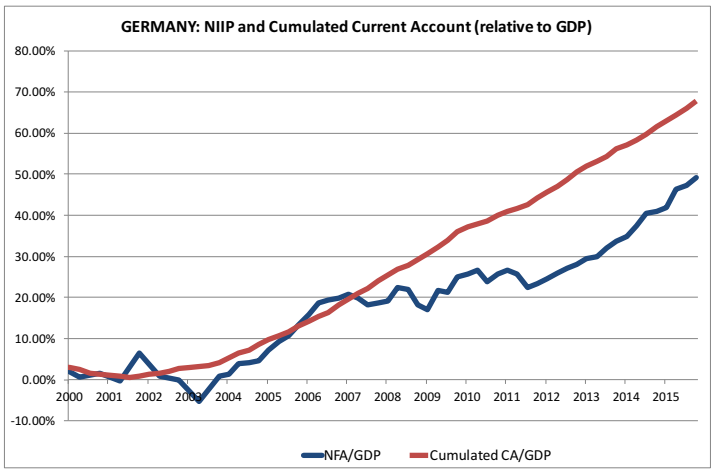

Figure 23: **Gap betweeen the Net International Investment Position of Germany and the cumulated current account surpluses, 2000Q1-2015Q4.**

2007 resumed its growth from 2007 onwards. The years 2009-2010 are turning points with German Banks decreasing massively their exposures to the periphery. German banks were therefore loading up exposures on the countries of the periphery of the euro area so that the riskiness of their banking assets and liabilities was very asymmetric. As a result, Germany was enjoying positive excess returns on its net foreign asset position for most of the period between 1995 and July 2007, since the net international investment position of Germany at market value exceeds the cumulation of currennt account surpluses or deficits. These excess returns appear to turn negative from the spring of 2007 onwards as risk started to be repriced in the global economy as shown on Figure 23.

The official statistics report a large gap of about 19% of GDP or about €492 bn between the international investment position and the cumulated current account deficit of Germany in 2015Q4. As pointed out by Busse and Gros (2016) however, there are reasons to doubt the accuracy of these numbers.[35] Using net investment income data, they estimate that returns on German external assets exceeded returns on German external liabilities even after the onset of the euro area crisis. When the crisis materialized and hit the periphery of the euro area, Germany (and core EMU) stood to make substantial capital losses on its net external position, a combination of losses on its gross external assets and capital gains on its external liabilities.

Unlike the U.S., however, where the valuation losses were immediately realized via changes in

[35]See also Schipper (2015) and Deutsche Bundesbank (2014).

asset prices and currency price movements, resulting in the sharp decline in the net foreign asset position (figure 8), these losses do not seem however to have materialized. With the crisis, risk was repriced throughout the periphery but there were no large realized losses.[36] Without a debt resolution mechanism for banks or sovereigns within the Eurozone, and with the fear that markets might turn on them, most peripheral eurozone members launched multiple rounds of private and public de-leveraging. The protracted resolution process of the European Sovereign Debt crisis profoundly hampered the recovery of the Eurozone.

Just for illustration purposes, we perform the folllowing simple thought experiment. Imagine that Germany had had the same external balance sheet structure of the US with a large share of risky claims (FDI and equity) on the rest of world. We ask: what would have been the order of magnitude of valuation losses that Germany would have incurred between 2007Q4 and 2015Q3? German external assets stood at about 200% of GDP in 2007 while US gross external assets amounted to about 115% of GDP, out of which about 80% were risky. Between 2007Q4 and 2015Q3, our estimates indicate that U.S. valuation losses represented approximately $4.13 trillion, or 22.9% of 2015 U.S. GDP. Assuming the appreciation of liabilities was similar in the US and in Germany (both countries benefitted form safe haven effects), German losses would have been of the order of 40% of GDP. Whatever one might think about the hypothetical negative returns on the German net foreign asset position, they are very far from 40% of GDP. According to the official statistics – which as mentioned above are probably biased upwards- German losses would be at most 19% of GDP. Three points are important here. First, some of these valuation losses can ultimately be reverted as the global economy recovers and safe asset providers –via their exposure– stand to gain disporportionately from the subsequent recovery. Second, our point here is not argue that Germany (or other core EMU countries) should have shouldered a staggering amount of losses. Rather, it is that the external portfolio structure of regional safe asset providers can entail very large levels of exposure. Third, this portfolio structure is an equilibrium phenomenon, emerging from market forces and expected returns. If German post crisis returns external returns are not very low, German pre-crisis external returns do not appear inordinately large either: the yield difference between core and periphery investment appeared surprisingly low in the run-up to the Eurozone crisis. This may have been the result of massive risk shifting on the part of core-EMU

[36] Except in Greece, but Greece was only a small share of German external exposure.

financial institutions. It also suggests that safe asset providers are disproportionately vulnerable to periods of excessive risk appetite. Ultimately, it contributes to extremely elevated exposure levels that made it very difficult to achieve a speedy resolution.

The result of the protracted deleveraging in the euro area has been a massive shift from current account balance, to a current account surplus of 0.7% of world GDP, as illustrated on figures 5 and 6. In terms of our earlier analysis, these deleveraging forces pushed the natural interest rate in the Eurozone far below the rest of the world. If the Eurozone were a closed economy, the resulting deflationary forces would have been self-defeating, just like attempts to deflate one's economy at the expense of one's trading partners were ultimately self-defeating during the Great Depression. At the Zero Lower Bound, instead, this shift towards surpluses has lessened the burden of adjustment on the Eurozone, at the expense of the rest of the world.

In summary, core EMU has not performed its role as a regional safe asset provider. Unlike the U.S. which saw its net foreign asset position deteriorate a great deal during the crisis, as U.S. Treasuries appreciated while external assets plummeted in value, core EMU has not absorbed the banking losses on its balance sheet. Unrealized losses have been pushed onto the peripheral countries public sector balance sheet, forcing them to delever aggressively. This aggregate delevering, and the corresponding surge in saving continues to have deleterious effects on the global economy. Given our finding that real interest rates will remain low for an extended period of time, we consider that it would be wise to steer away from policies that make us teeter on the verge of a global liquidity trap. Being a regional safe asset provider may prove to be a curse not only to core EMU, but to the EMU as a whole, and to the global economy.

4 Conclusion

Several policy implications can be derived from our analysis. First, we analyze the long run historical time series of consumption and wealth of four large economies accounting for much of international financial and economic activity between the end of the 19th century and today (the United States, the United Kindgom, France and Germany). We show that consumption wealth ratios tend to predict future movements in real rates. The strength of our analysis comes in particular from the fact that we do not superimpose any structural model on our data; all our results are obtained

using merely the intertemporal budget constraint of the word economy proxied by these four countries. Economic common sense and our budget constraint say that low consumption-wealth ratios today have to be an indication of future low returns on wealth or high future consumption growth. After decomposing the return on wealth in a real rate component, a term premium and an excess return component and constructing the relevant VARs, we obtain a first order result: consumption wealth ratios predict future real riskless rates. Furthermore, we identify two historical periods during which the consumption wealth ratios have been unsually low: those are the two "secular stagnation" periods (the 1930s and the current period). Both periods have been preceded by a period of "financial exuberance" (the 1920s and the 2000s) were wealth has grown quickly. Both periods have seen a major financial crisis followed by a period of deleveraging and low consumption. These deleveraging periods during which we observe low consumption to wealth ratios announce low future real rates. The bottom line is that our estimates indicate that the real rates should stay low for several more years. Such a long period of low real rates has consequences ranging from the sustainability of the business models of banks and insurance to the solvency of pension plans.

It also makes it more likely that several countries fall or stay in a liquidity trap. In a world where many countries flirt with the ZLB, it is the reallocation of demand across geographical areas that determines global imbalances as shown by Caballero et al. (2015) and Eggertsson et al. (2015). There is therefore a large risk that countries pursue non-cooperative policies. Another important message of our paper is that a world of low real rates also comes with unequal burdens. Safe asset providers and in particular regional or small safe asset providers face a large demand for their assets in times of turmoil. Building on Gourinchas et al. (2010), we show in section 3 of the paper that such countries face a tradeoff between letting their exposure to world risk increase or allowing their currency to appreciate in real terms. The tradeoff is starker for smaller economies (such as Switzerland or core EMU countries) than for the United States as their exposure can rapidly rise to several multiple of GDP. We dub this the '*curse of the regional safe asset providers*.' The recent experience of Switzerland comes to mind. Unlike the United States whose net foreign asset positions has massively declined since 2007 (as insurance has been provided to the rest of the world), core EMU countries have postponed or avoided losses on their external assets, forcing euro area economies to delever to make good on their external debt. Euro area periphery countries' deleveraging has translated into a large aggregate current account surplus of the euro

area, effectively exporting recession abroad.

What are the policy implications of our analysis? The issue of post-crisis deleveraging leading to low levels of the real interest rate is central to the difficulties of the world economy. Hence our econometric analysis supports the part of the "secular stagnation" literature which assigns the current economic weakness to the post financial crisis debt hangover and overhang. The policy prescriptions of this literature in terms of increased public spending in particular seem appropriate. But, our analysis also suggests a particular role for countries issuing safe assets. Overcoming the "curse of the regional asset provider" seems to be one of the most challenging issue. Several complementary steps could be taken.

First, it would be beneficial for the Eurozone to issue safe assets on a larger scale instead of relying only on Bunds or French OAT, or on Swiss deposits. This should give impetus to a number of initiatives aiming at developing euro-area safe assets, whether red/blue bonds (see Von Weizsäcker and Delpla (2010)); ESBies (see Brunnermeier et al. (2011)); or CDOs (see Corsetti et al. (2016)). Relying on a broader supply of safe assets, whose safety is not aligned with geographical boundaries but rather spans the entire euro area would avoid the destabilizing portfolio shifts occuring during periods of high risk. In periods of volatility, endogenous market segmentation increases, hindering the proper transmission of monetary policy and capital flows towards safe haven countries pushing them to either supply insurance and increase their risk exposure or to real appreciation with recessionary risk. Overcoming the curse of the regional asset provider can therefore be done by delinking the supply of safe asset from a particular economy.

Second, having a mechanism which allows orderly loss-taking within the euro area would be beneficial. When losses are not realized and deleveraging drags on, recession takes hold and becomes self-defeating in a closed economy. In an open economy, recession is exported abroad via current account surpluses. One can think of intitutionalising a sovereign debt restructuring mechanism within the euro area to make sure that the current situation does not reproduce itself in the future. By enabling an orderly write down of debts, a sovereign debt restructuring mechanism avoids lond periods of deleveraging and resolves the problem of debt overhang (see Corsetti et al. (2016) for a possible implementation). One should also pay particular attention to the treatment of non-performing loans (NPLs) in the portfolios of banks in order to avoid the well-known phenomenon of zombie lending. Both sovereign debt restructuring and NPLs write down should not lead to

financial instability and contagion across the area. It is therefore important that all the safeguards in terms of banking union (including deposit guarantees) be in place.

Third, developing the Capital Markets Union would allow a quicker write down of losses. Were risk to be shared through contingent assets -such as FDI and equity-we would not be facing the protracted current period of recession associated with a long and painful deleveraging of the periphery. In that respect much remain to be done and in particular some major rethinking of the legal infrastructure (bankruptcies).

Lastly core EMU banks and financial intermediaries should be carefully monitored. In this crisis, they have borrowed globally and lent to peripheral Eurozone countries, earning small but positive excess returns in the process. Core EMU countries have not let their real exchange rate appreciate in response to a surge in the demand for safe assets. Instead, they have tended to absorb the increased exposure onto their national balance sheet. Some of that increase in financial sector exposure may well reflect risk shifting and expectations of bailouts using tax payers money. This emphasizes the need for a very careful monitoring of financial fragilities and imbalances, especially for EMU safe asset providers.

References

Amador, M., J. Bianchi, L. Bocola, and F. Perri (2015). Reverse speculative attacks. mimeo University of Minnesota.

Barro, R. J. and X. Sala-i Martin (1990). World real interest rates. In *NBER Macroeconomics Annual 1990, Volume 5*, pp. 15–74. MIT Press.

Barro, R. J. and J. Ursúa (2010). Barro-ursua macroeconomic data. urlhttp://scholar.harvard.edu/barro/publications/barro-ursua-macroeconomic-data.

Bernanke, B. (2005, March). The global saving glut and the u.s. current account deficit. Sandridge lecture, virginia association of economics, richmond, virginia, Federal Reserve Board.

Brunnermeier, M. K., L. Garicano, P. R. Lane, M. Pagano, R. Reis, T. Santos, D. Thesmar, S. Van Nieuwerburgh, and D. Vayanos (2011). Esbies: A realistic reform of europe's financial architecture. *The Future of Banking*, 15.

Busse, M. and D. Gros (2016, April). Returns to german savings invested abroad. http://voxeu.org/article/returns-german-savings-invested-abroad.

Caballero, R. J. and E. Farhi (2015, February). The Safety Trap. NBER Working Papers 19927.

Caballero, R. J., E. Farhi, and P.-O. Gourinchas (2008, March). An equilibrium model of "global imbalances" and low interest rates. *American Economic Review 98*(1), 358–93.

Caballero, R. J., E. Farhi, and P.-O. Gourinchas (2015, October). Global Imbalances and Currency Wars at the ZLB. NBER Working Papers 21670, National Bureau of Economic Research, Inc.

Caballero, R. J., E. Farhi, and P.-O. Gourinchas (2016, February). Safe Asset Scarcity and Aggregate Demand. NBER Working Papers 22044, National Bureau of Economic Research, Inc.

Campbell, J. Y. and N. G. Mankiw (1989). Consumption, income and interest rates: Reinterpreting the time series evidence. In O. J. Blanchard and S. Fischer (Eds.), *N.B.E.R. Macroeconomics Annual*, pp. 185–215. Cambridge: MIT Press.

Corsetti, G., L. FELD, R. Koijen, L. Reichlin, R. Reis, H. Rey, and B. W. di Mauro (2016). Reinforcing the eurozone and protecting an open society. *Monitoring the Eurozone 2*.

Deutsche Bundesbank (2014, May). Discrepancy between changes in foreign assets and the cumulative financial account balance: unsuitable indicator of wealth losses. In *Monthly Report*.

Eggertsson, G. B. and P. Krugman (2012). Debt, deleveraging, and the liquidity trap: A fisher-minsky-koo approach. *The Quarterly Journal of Economics 127*(3), 1469–1513.

Eggertsson, G. B., N. R. Mehrotra, S. Singh, and L. H. Summers (2015). Contagious malady? global dimensions of secular stagnation. Working paper, Brown University.

Eichengreen, B. (2015, May). Secular Stagnation: The Long View. *American Economic Review 105*(5), 66–70.

FitchRatings (2016, May). Negative yielding sovereign debt (investors' cash flow squeezed). Technical report, FitchRatings.

Gourinchas, P.-O. and H. Rey (2007). From world banker to world venture capitalist: Us external adjustment and the exorbitant privilege. In R. Clarida (Ed.), *G-7 Current Account Imbalances: Sustainability and Adjustment*, Chicago, pp. 11–55. University of Chicago Press.

Gourinchas, P.-O. and H. Rey (2016, June). Global real rates: A long run approach. mimeo, UC Berkeley.

Gourinchas, P.-O., H. Rey, and N. Govillot (2010). Exorbitant privilege and exorbitant duty. mimeo, UC Berkeley.

Guerrieri, V. and G. Lorenzoni (2011, November). Credit crises, precautionary savings, and the liquidity trap. Working Paper 17583, National Bureau of Economic Research.

Hale, G. and M. Obstfeld (2016). The euro and the geography of international debt flows. *Journal of the European Economic Association 14*(1), 115–144.

Hamilton, J. D., E. S. Harris, J. Hatzius, and K. D. West (2015, August). The Equilibrium Real Funds Rate: Past, Present and Future. NBER Working Papers 21476, National Bureau of Economic Research, Inc.

Hansen, A. H. (1939). Economic progress and declining population growth. *The American Economic Review 29*(1), pp. 1–15.

He, Z., A. Krishnamurthy, and K. Milbradt (2015, June). A model of the reserve asset. Technical report, Stanford University, Graduate School of Business.

Jordà, O., M. Schularick, and A. M. Taylor (2016, April). Macrofinancial history and the new business cycle facts. forthcoming NBER Macroeconomics Annual 2016.

Laubach, T. and J. C. Williams (2003). Measuring the natural rate of interest. *Review of Economics and Statistics 85*(4), 1063–1070.

Laubach, T. and J. C. Williams (2015). Measuring the natural rate of interest redux. Federal Reserve Bank of San Francisco.

Lettau, M. and S. Ludvigson (2001). Consumption, aggregate wealth and expected stock returns. *Journal of Finance 56*(3), 815–49.

Maggiori, M., E. Farhi, et al. (2016). A model of the international monetary system. mimeo Harvard University.

Mendoza, E. G., V. Quadrini, and J.-V. Ríos-Rull (2009, 06). Financial integration, financial development, and global imbalances. *Journal of Political Economy 117*(3), 371–416.

Mian, A., K. Rao, and A. Sufi (2013). Household Balance Sheets, Consumption, and the Economic Slump. *The Quarterly Journal of Economics 128*(4), 1687–1726.

Miranda-Agrippino, S. and H. Rey (2015). World asset markets and the global financial cycle. Technical report, National Bureau of Economic Research.

Pescatori, A. and J. Turunen (2015). Lower for longer: Neutral rates in the united states.

Piketty, T. and G. Zucman (2014a). Capital is Back: Wealth-Income Ratios in Rich Countries 1700–2010. *The Quarterly Journal of Economics 129*(3), 1255–1310.

Piketty, T. and G. Zucman (2014b, July). Wealth and Inheritance in the Long Run. CEPR Discussion Papers 10072, C.E.P.R. Discussion Papers.

Schipper, U. (2015). Transaction and valuation effects on germany's international investment position (iip)–new statistical approaches and iip trends. In *IFC Satellite meeting at the ISI 60th WSC, Rio de Janeiro, July*, Volume 24.

Summers, L. H. (2015). Have we entered an age of secular stagnation? *IMF Economic Review 63*(1), 277–280.

Triffin, R. (1960). *Gold and the dollar crisis; the future of convertibility*. New Haven: Yale University Press.

Von Weizsäcker, J. and J. Delpla (2010, May). The blue bond proposal. Policy brief, Brueghel.

Appendix

A Data Description

The data used in Section 2 were obtained from the following sources:

1. **Consumption:**
   Real per-capita consumption going back to 1870 and covering the two world wars was taken from Jordà et al. (2016) who in turn took the data from Barro and Ursúa (2010). As this consumption series is an index rather than a level, we convert it to a level using the consumption data from Piketty and Zucman (2014a). To convert to a level we could use any year we have level data for but chose to use the year 2006 (the year that the index of consumption was 100). In addition, the consumption data was adjusted so that instead of being based on a 2006 consumption basket, it was based on a 2010 consumption basket to match the wealth data.

2. **Wealth:**
   Real per capita wealth data was taken from Piketty and Zucman (2014b). The wealth concept used here is private wealth. As such it does not include government assets but includes private holdings of government issued liabilities as an asset. Where possible, wealth data is measured at market value. Human wealth is not included. Private wealth is computed from the following components: "Non-financial assets" (includes housing and other tangible assets such as software, equipment and agricultural land), and net financial assets (includes equity, pensions, value of life insurance and bonds). Prior to 1954 for France, 1950 for Germany, 1920 for the UK and 1916 for the USA, wealth data is not available every year (see Piketty-Zucman's appendix for details on when data is available for each country or refer to Table 6f in the data spreadsheets for each country). When it is available is is based on the market value of land, housing, other domestic capital assets and net foreign assets less net government assets. For the remaining years the wealth data is imputed based on savings rate data and assumptions of the rate of capital gains of wealth (see the Piketty-Zucman appendix for details of the precise assumptions on capital gains for each country. The computations can be found in Table 5a in each of the data spreadsheets for each country).

3. **Short term interest rates:**
   These were taken from Jordà et al. (2016) and are the interest rate on 3-month treasuries.

4. **Long term interest rates:**
   These were taken from Jordà et al. (2016) and are the interest rate on 10 year treasuries.

5. **Return on Equity:**
   This data is the total return on equity series taken from the Global Financial Database.

6. **CPI:**
   CPI data is used to convert all returns into real rates and is taken from Jordà et al. (2016).

7. **Population:**
   These were taken from Jordà et al. (2016).

Figure 24 reports consumption per capita, wealth per capita, the consumption/wealth ratio as well as the short term real risk free rate for the U.S. between 1870 and 2011. Figure 25 reports the same variables for our G4 aggregate between 1920 and 2011.

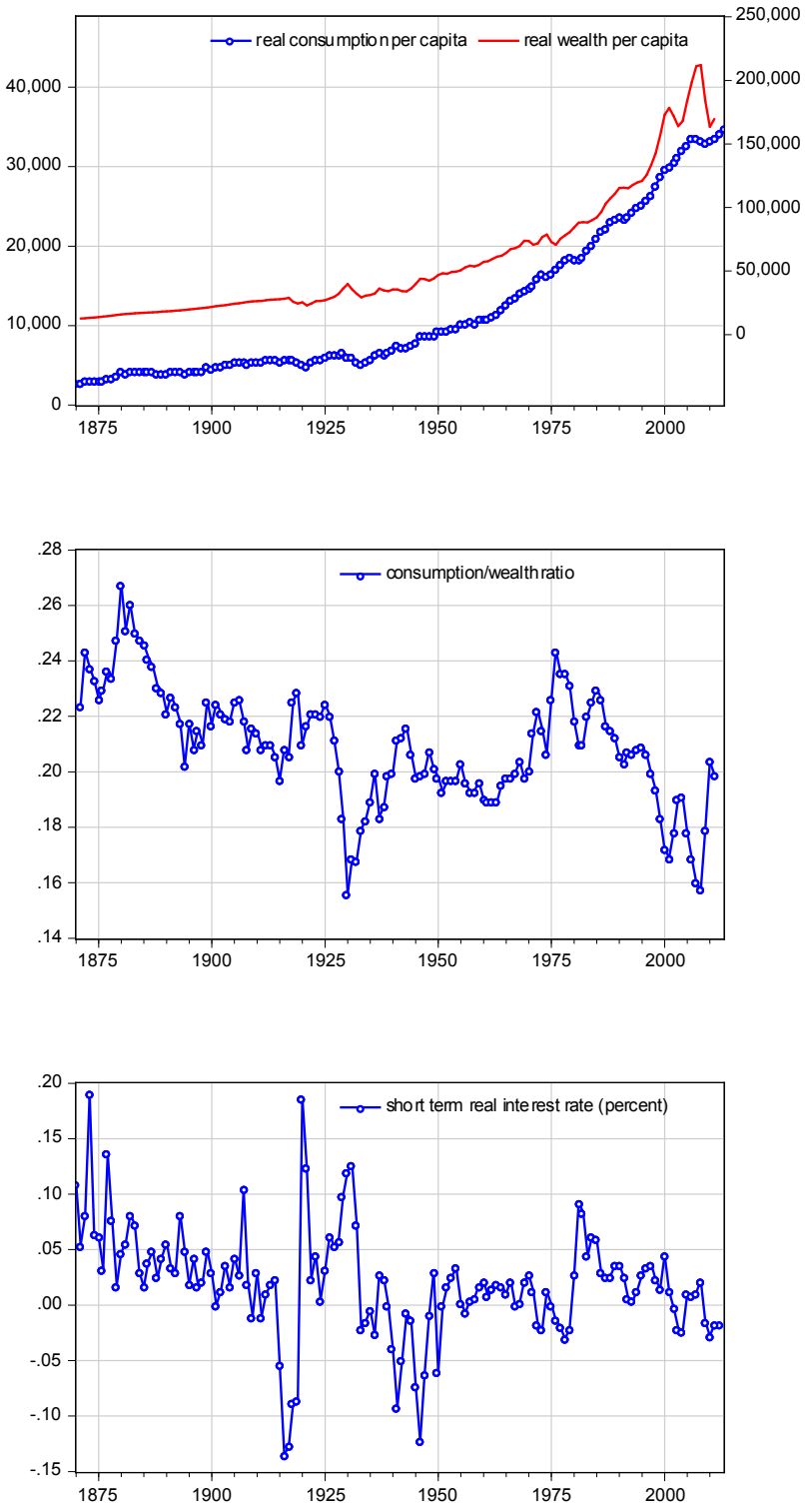

Figure 24: **Real Consumption and Wealth per capita (2010 USD), Consumption/Wealth Ratio and Short term real risk free interest rate, United States, 1870-2011.**

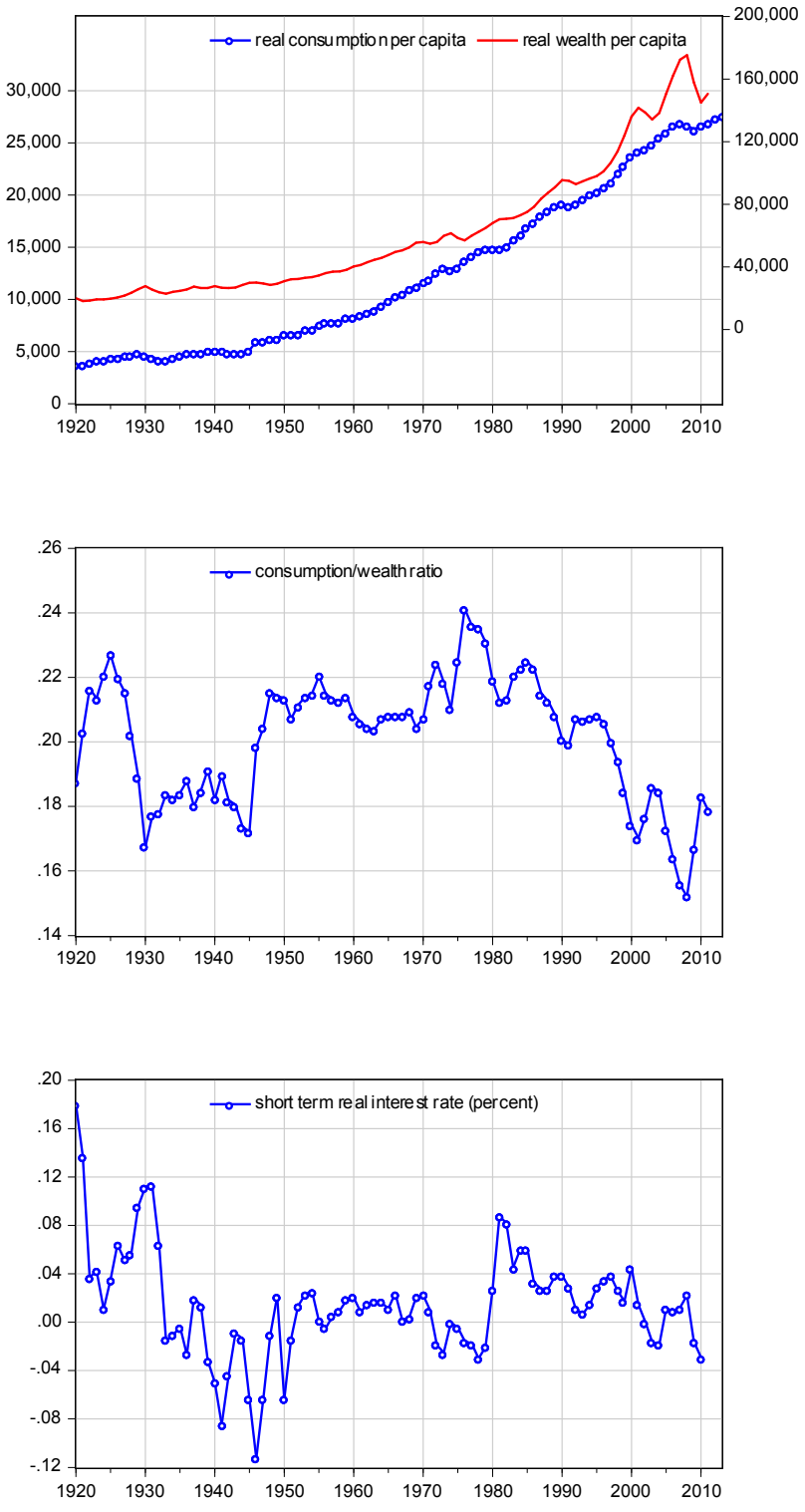

Figure 25: **Real Consumption and Wealth per capita (2010 USD), Consumption Wealth Ratio and Short term real risk free interest rate, U.S., U.K., Germany and France, 1920-2011.**