

PUBLIC DEBT AND THE WORLD FINANCIAL MARKET

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World public debt has increased by 30% of world GDP between 2007 and 2017. During the same period, the real interest rate on public debt has fallen by roughly 200 basis points, whereas it should have increased by 100 basis points according to previous estimates. This reveals that demand for public debt has increased faster than supply. Where does the increase in savings come from? To answer this question, we construct the world financial market equilibrium to identify the country and agents across countries who increased their saving rate. Using the equality between the sum of private and public saving and investment at the world level, we observed four key phenomena. First, the world investment rate has been slightly increasing during the period, with an impressive shift of investment in China. The investment rate of China was 6% of world GDP in 2007. This jumps to 12% in 2017. Second, during the 2007-2017 period, the world experienced an impressive reduction of global imbalances. The Chinese saving rate increased less than Chinese investment, and the US saving rate increased more than US investment. Third, the increase in the world saving rate came from highly indebted countries before 2007, mostly from the US and southern Europe. The increase in the current accounts of Italy, Spain and Greece (from a negative territory) is the order of magnitude of the increase in the US current account. Fourth, there is no clear relationship between the household saving rate and national government borrowing, thus not confirming the Ricardian equivalence view. Finally, it seems that the factors generating a high net saving rate in China are temporary, whereas the deleveraging of US and southern Europe may be long-lasting. As a consequence, one can expect low interest rates for a long period of time.

Keywords: Incomplete markets, optimal policy, public debt.

1. Introduction

The world financial markets display two new trends after the 2008 crisis. The first is the increase in public debt. The amount of public debt in the advanced economies as a share of world GDP increased from 71% in 2007 to 104% in 2017 (IMF, Fiscal Monitor). During this period, total debt (both public and private) in these countries increased by 30%, to reach 225% of world GDP in 2017. This is the highest level since at least 1950.

The second trend is the falling real interest rate on public debt and on all assets. For instance, the US real interest rate on 10-year government bonds (inflation-indexed security) fell from 2.5% in 2007 to 0.5% in 2017. The average real lending rate computed by the IMF has also fallen from 5.86% in 2007 to 4% in 2017%. The cause and consequences of low interest rates are now debated around the world (Blanchard, 2019)¹.

These two facts are puzzling. Before the crisis, common wisdom held that an increase in public debt generates an increase in real interest rates to increase the remuneration of debt holders so as to induce them to accept the additional public debt. This has been confirmed by empirical estimates, which reached the conclusion that an increase in 1% of public debt over GDP among the advanced countries would increase the interest rate by 0.03% (Engen and Hubbard, 2005). Using such an estimate, the 30% increase in public debt over GDP in the advanced countries should have *increased* the real interest rate by 1% between 2007 and 2017, whereas it *decreased* by roughly 2%. Estimates of the neutral real rate all conclude that the fall in the world saving rate is a first-order world phenomenon (Rachel and Summers, 2019).

This raises the obvious question: Why has the demand for public debt increased much more than the huge supply of public debt by governments? Why are agents fighting to buy public debt around the world? These questions are important to understand the period but also to assess whether the current low real interest rates are a temporary phenomenon, likely to be reversed, or if we can expect to be in a world of low real interest rates for a long period of time. This has

1 The data are taken from <https://data.worldbank.org/indicator/FR.INR.RINR?locations=US> and ECB Economic Bulletin, Issue 2/2019: https://www.ecb.europa.eu/pub/economic-bulletin/focus/2019/html/ecb.ebbox201902_06_0c96ee6f7c.en.html indexbond return can be obtained from the Fred database US: <https://fred.stlouisfed.org/series/DFII10>

important implications for the conduct of economic policy. The aim of this article is to contribute to the resolution of this question by investigating the data.

On purpose, this effort is based on descriptive statistics using basic accounting equality to understand the change in the world financial market equilibrium during the period.

The basic idea is obvious: At the world level, it has to be the case that the sum of the world primary deficit is equal to the household saving rate plus the firm net saving rate (net of investment). As a consequence, the increase in the public deficit between 2007 and 2017 must be due either to an increase in saving rates or to a decrease in investment. Although this is true at the world level, this may not be true in each country, since changes in countries' current accounts could allow them to lend to each other.

We thus construct the world financial market equilibrium between 2007 and 2017 using various datasets to construct the public deficit in each country, as well as investment and firm and household saving rates, in order to understand who lent to the government during this period.

This investigation discriminates among various theories proposed in the literature to explain the increase in saving rates and the low interest rates on public debt. For instance, Ricardian equivalence states that households save more when public debt increases, because they anticipate higher taxes. As a consequence, the household saving rate should be correlated with the *increase* in public debt across countries: This can be looked at in the data. Another explanation insists on Quantitative Easing and the acquisition of public debt by central banks. This again can be investigated by constructing the consolidated government budget constraints. The first Section of the paper reviews six explanations often proposed (which are not mutually exclusive), ranging from *Ricardian equivalence*, the *saving glut* issue, to the secular stagnation hypothesis. We don't pretend to confirm one single explanation, but the empirical investigation clearly points in certain directions. We now present the main findings of this investigation:

1. **Investment:** The world investment rate slightly increases during the period, invalidating a "crowding out" effect of public investment, or a global Secular Stagnation associated with low investment. Nevertheless, this hides an impressive shift in the allocation of investment around the world. The investment rates of Europe and the USA were 5% of world GDP in

2017. This figure decreased to 4.5% in 2017. During the same time, the Chinese investment rate increased from 6% to 12% of world GDP. Capital accumulation has clearly moved to China.

2. **International capital flow:** During the period, the world experienced an impressive reduction of the divergence in current accounts, notably that between China and the US, which was called the “global imbalance” by Ben Bernanke. The US current account improved during the period, reaching 2.3% of US GDP. This rebalancing appears as an improvement in the US current account. Second, the Chinese current account decreased by more than 8% of Chinese GDP, whereas the US current account increased by 2.8% of US GDP. This rules out a “saving glut” type of explanation of the low interest rate: It is not a single country that is lending to the rest of the world.
3. **Private saving rate:** The increase in the world saving rate comes from countries that were highly indebted before 2007. The increase in the current accounts of Italy, Spain and Greece (from a negative territory) amounts to roughly 80% of the increase in the US current account. This comes from an increase in the private saving rate (Spain and Portugal), and mostly from a fall in the investment rate.
4. **Household saving rate:** There is no clear relationship between the household saving rate and national government borrowing, not confirming the Ricardian equivalence view.

From this analysis, our tentative conclusion is that we are either in a low investment trap in Europe and in the US (local secular stagnation), or in a period of deleveraging and rebalancing after a period of abnormal and low saving rates. Considering the capital overaccumulation in China, one can expect low real interest rates for a long period of time.

2. Why has world net demand for public debt increased so much: A review of explanations

We review below standard explanations of the increase in the demand for public debt between 2007 and 2017. Each of them has generated an important literature, and they are not mutually exclusive. First, to understand the relationship between the following explanations, it is useful to recall a simple world accounting equality. This one is formally derived in Section 3 below. At the world level and for each

year, it is always true that the sum of the primary deficits across countries is equal to the sum of the private saving of households and firms, minus investment. Formally,

$$\sum_{\text{all countries } i} \text{State primary deficit}_i = \sum_{\text{all countries } i} \text{Hous. saving}_i + \quad (1)$$

$$+ \sum_{\text{all countries } i} (\text{Firm saving} - \text{Investment})_i \quad (2)$$

The left-hand side increased a lot at the world level over the period, and the interest rate declined. As a consequence, elements of the right-hand side have increased: Either the households' saving or the firms' saving have increased. Investment may have decreased. In addition, this increase may have taken place in some countries but not in others. The various explanations concern each of the elements on the right-hand side. We identify six explanations in the literature. The first two relate to the household saving rate. Explanations 3 and 4 concern the private saving rate in some countries, like China. Explanation 5 is about the monetization of public debt. Explanation 6 is about low investment. We put in italics the implication of each explanation.

1. **Household saving rate:** An increase in the household saving rate could come from two channels. First, Ricardian equivalence, as popularized by Barro (1974), states that savings increase as public debt increases because households save to pay higher expected taxes. Second, the increase in the household saving rate could come from an increase in inequality, which changes the distribution of income in favor of richer households with higher saving rates. This explanation would imply that the household saving rate should increase with inequality. If one assumes that households consider the saving of the firms that they might own, then it is the total private saving rate that should be considered. *One should thus observe an increase in the private saving rate related to the increase in public debt.*
2. **Uncertainty and risk: looking for a safe haven, and precautionary saving:** There is global demand for a safe asset (Gorton, 2016), and in particular for public debt, which is not contaminated by sovereign risk. The increase in the demand for public debt could be the result of an increase in world risk aversion between 2007 and 2017. This argument should imply an increase in the world market price of risk. As explained above, the real lending rate for a wide class of credit types has decreased by almost 2% during the period. In addition, the risk premium doesn't exhibit a clear upward trend (Jorda, Knoll, Kuvshinov, Schularick, and Taylor, 2019, and also the discussion in Rachel

and Summers, 2019). As a consequence, a low real interest rate does not mainly reflect a shift in the world portfolio towards safer assets, but an increase in world desired net saving. As a consequence, we will leave aside this explanation, which is not backed up by the data.

3. **Saving glut and Twin Deficit Theory:** To explain the persistent US current account deficit, Ben Bernanke has explained the role of high-saving countries like China in growing world saving. It may be possible that the high demand for public debt comes from specific high-saving countries. In the same vein, countries could finance their public debt by borrowing from the rest of the world. *This would imply a decreasing current account in countries where public debt is growing.*
4. **Private Deleveraging:** The reduction of borrowing by the private sector in some countries generates an increase in the net household saving rate (which is saving minus borrowing). The increase in world public debt could only partly compensate a decrease in private borrowing (Guerrieri and Lorenzoni, 2017; Fornaro, 2018; Challe and Ragot, 2011). *We should then observe an increase in the household saving rate in countries with a highly indebted private sector.*
5. **Monetization and central bank quantitative easing:** Monetary policy during the crisis by standard and non-standard monetary policy generated a sharp increase in the demand for public debt by central banks (public debt monetization). This could generate a decrease in the interest rate on public debt (see Vissing-Jorgensen and Krishnamurthy, 2011; or Beck, Duca, and Stracca, 2019). As real interest rates have globally decreased over the period (See Point 2 above), the effect of public debt monetization should be a global increase in the net saving rate. There is a little bit of confusion in the literature about the net effect of public debt monetization and national saving rates. We shall delay with the implications of this explanation in the next Section, where we lay down accounting equalities to understand the effects.
6. **Low investment and secular stagnation:** The weak recovery after the 2008 crisis has stimulated a debate about a possible secular stagnation and low investment due to weak demand (Summers, 2016; or Le Garrec and Touzé, 2016). The net saving rate might have increased due to low investment. The increase in public debt would reflect the decrease in the demand for funds by firms. The dynamics of investment in each country can

be observed in the data. *We should observe a fall in the world investment rate.*

The previous list summarizes the main possible explanations for the relative increase in the demand for public debt, although the reader might have other explanations in mind. It should be clear that these explanations are not mutually exclusive. We now provide statistics about the world financial market to observe trends in the relevant variables. Anticipating, the data seem to favor private deleveraging and possibly low investment as important explanations.

3. Who financed the world's borrowing?

3.1. The increase in public debt (normalized by GDP)

First, the increase in public debt between 2007 and 2017 is impressive. The average increase in public debt is more than 20% in OECD countries. Figure 1 reports the increase for a selection of countries (with standard identifier), as a percentage of world GDP. Importantly, we normalize this increase by world GDP (and not the domestic GDP), to represent the evolution of the relative size of each country's public debt at the world level. Denote as $B_{i,t}$ the outstanding public debt of country i at the end of year t in current dollars. We thus

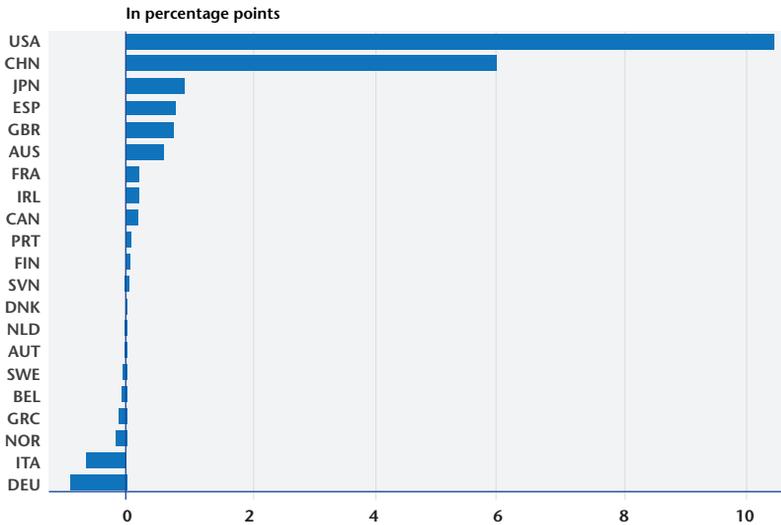
represent $\frac{B_{i,2017}}{Y_{2017}^{world}} - \frac{B_{i,2007}}{Y_{2007}^{world}}$ for each country i . To simplify the exposition,

we focus on some countries (not representing India, or oil exporting countries, for instance).

Figure 1 shows that the increase in world debt is driven mostly by the US, and by China and Japan to a smaller extent. The case of Italy is interesting. Italian public debt over Italian GDP increased from 104% to 134% from 2007 to 2017. But Italian GDP has actually fallen during the period, and world GDP has actually increased. As a consequence, Italian GDP has decreased from 3.8% of world GDP to 2.4%, and Italian public debt has actually *decreased* as a fraction of world GDP.

This Figure confirms the obvious fact of a generalized increase in public borrowing, and raises the motivating question: Who lent to governments around the world? To answer this question, we first perform a simple accounting decomposition. The evolution of public debt is the sum of the primary deficit denoted as $D_{i,t} = G_{i,t} - T_{i,t}$ and the net interest payment minus other possible sources of additional public income.

Figure 1. Change in public debt, 2007-2017, normalized by world GDP



Source: Authors' calculations. See Appendix A for data source.

The outstanding debt of a country i can be held by the private sector, by central banks or by foreigners. The total interest payment on the public debt in year $t - 1$ is denoted $r_{i,t-1} B_{i,t-1}$. The interest rate $r_{i,t-1}$ is thus the annualized average interest rate across the various maturities of public debt. Additional public income includes the profits of central banks rebated to the governments, which are mainly the interest payment paid to the central banks holding public debt: $r_{i,t-1} B_{t-1}^{CB}$. It also includes other sources of income denoted $E_{i,t}$ during year t . $E_{i,t}$ includes the profits of publicly owned firms and the returns from privatization, among others. The basic accounting equality is thus:

$$B_{i,t} - B_{i,t-1} = \underbrace{D_{i,t} + r_{i,t-1} B_{i,t-1}}_{\text{Total deficit}} - r_{i,t-1} B_{t-1}^{CB} - E_{i,t} \tag{3}$$

Then, from the definition of GDP, $Y_{i,t} = C_{i,t} + G_{i,t,t} + I_{i,t} + X_{i,t} - M_{i,t}$, one obtains the traditional equality between the current account and the excess of national savings over investment: $CA_{i,t} = S_{i,t}^{nat} - I_{i,t}$, where $CA_{i,t}$ is the current account of country i at the end of year t and $I_{i,t}$ is the private investment of country i during year t . Separating the investment rate by three institutional sectors (Government, Households and Firms), and noting that $D_{i,t}$ is the opposite of public saving), one finds $S_{i,t}^{nat} = -D_{i,t} + S_{i,t}^H + S_{i,t}^F$. One thus obtains:

$$D_{i,t} = S_{i,t}^H + S_{i,t}^F - I_{i,t} - CA_{i,t} \tag{4}$$

This well-known relationship states that the government borrowing in country i is financed either by the saving rate of households $S_{i,t}^H$, by the net saving of firms ($S_{i,t}^F - I_{i,t}$) and thus possibly a low investment—, or by the rest of the world, i.e. a negative current account, showing that government i is borrowing from the rest-of-the world².

The previous equality is an accounting equality and is “true” (notwithstanding some measurement issues). In addition, at the world level the sum of all current accounts should be 0 (no one is lending money to Earth). As a consequence, if we sum all countries, we have, for any year:

$$\sum_{\text{all countries } i} D_{i,t} = \sum_{\text{all countries } i} S_{i,t}^H + \sum_{\text{all countries } i} (S_{i,t}^F - I_{i,t}) \quad (5)$$

We can first use equations of equality (4) and (5) to provide insights about the financing of the world deficit.

3.2. Central banks and public debt: Monetization?

First, decomposition (4) can be used to discuss the monetization of public debt. The acquisition of public debt by central banks doesn’t appear in the expression (4), nor on the world financial market (5). Indeed, buying public debt and increasing the balance sheet of the central banks has no direct effect on the national saving rate. It substitutes public debt in the portfolio of some agents by money, for exactly the same value (as public debt is bought by central banks on the market at the market price). What is the gain for the government? The only gain is that the government substitutes an outstanding debt bearing a nominal interest rate $r_{i,t}$ against money, which is a central bank liability with a zero interest rate (by definition). The obvious conclusion is that monetization doesn’t in itself increase or decrease the national saving rate. Additional theories must be introduced to explain why agents holding money instead of public debt (for the net present value) would save more or less.

The gain of monetization is that it reduces the interest payment on public debt, thus reducing the volume of public debt, every thing else being constant, as seen from (3). This effect obviously depends on the nominal interest rate $r_{i,t-1}$, and it is exactly 0, when the nominal interest rate is 0.

² We actually denote as investment the total private investment (from households and firms), because we don’t have the data to separate the two. This will only affect the interpretation of the results.

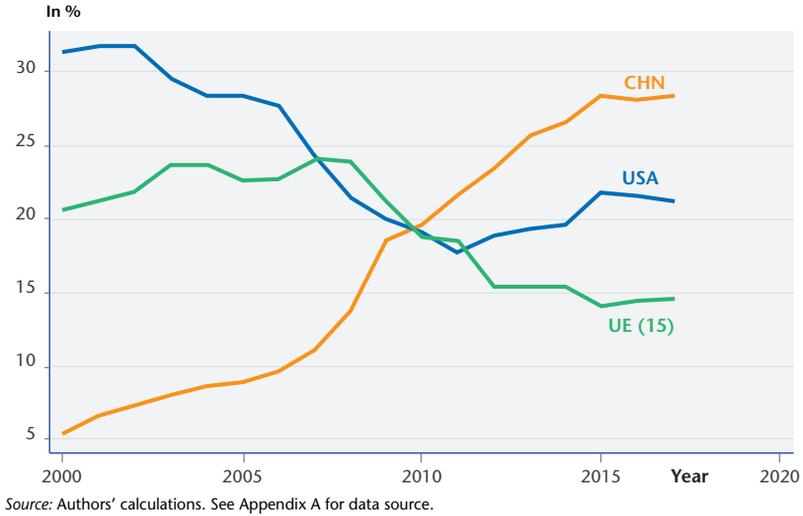
In addition to this fiscal view, the effect of debt monetization should thus be analysed by its effect on the risk structure and inflation. Indeed, the increase in the quantity of money may raise inflation expectations to a high level. This potential risk is likely to materialize in the coming years, as inflation is low or below target in many countries. Moreover, the link between central bank money and inflation is weak in a world of high precautionary savings. Finally, if inflation risk is small, domestic money might be seen as a safer asset than public debt in highly indebted countries. In this case, monetization would decrease perceived financial fragility. The link between central bank money, private credit, inflation and financial fragility is unfortunately outside the scope of the current paper. We recall here only that public debt monetization should first be seen as a swap between two assets, leaving the wealth of households unchanged, before considering the effect on the macroeconomic risk structure.

3.3. The big shift in investment

During the period, world investment stayed roughly constant. As a consequence, one cannot argue that the increase in world public debt has generated a global crowding-out of private investment by public debt. However, and importantly, as shown by Figure 2, the world has experienced a major shift of capital accumulation from Europe (EU15) and the USA to China. Investment increased rapidly in China after 2007, whereas it decreased in Europe and the US. This impressive shift reflects an obvious structural change at the world level. The investment rate in China (as a share of world total investment) has risen from 6% in 2007 to 28% in 2017, whereas the investment rate in the US and Europe (Euro area 15 countries) has sharply decreased over the same period. This trend in Chinese investment at the world level is the result of both an increase in the Chinese investment rate (relative to Chinese GDP, from 41.5% to 44.3%) and an increase in Chinese GDP relative to world GDP (from 16% to 28% from 2007 to 2017).

As noted by Holz (2019), the investment level in China is mostly a political outcome. The Chinese government directly promotes infrastructure projects, by channeling credit to government—supported investment projects. It also uses regulation to increase investment, for example in the residential real estate sector, or by using sectoral investment guidelines. Although globally China's capital output ratio is not very different from that in other countries, one can suspect an important overaccumulation of capital in China. Indeed, the high investment

Figure 2. Investment as a share of world total investment

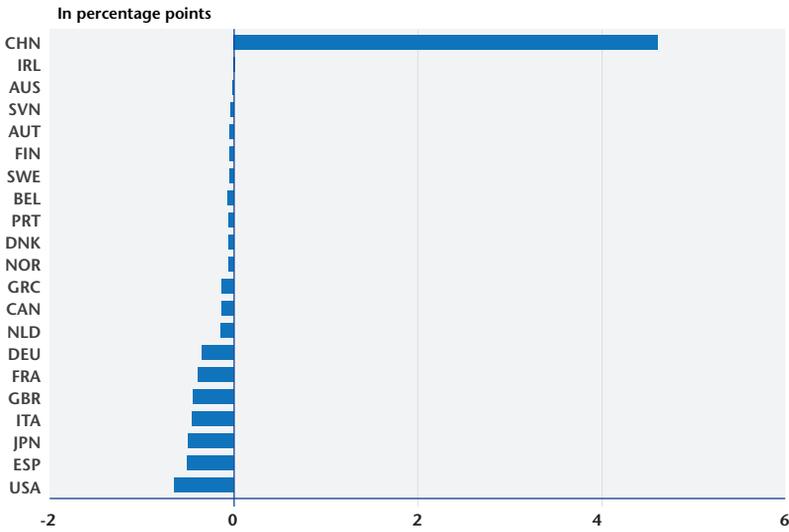


rate has led to a falling capacity utilization rate in many sectors. For instance, in the coal industry capacity utilization fell from 76% to 64% (Ju and Wang, 2017). For the steel industry, China represents roughly half of world production, and overcapacity (measured as the difference between capacity and normal production) has steadily increased from 16% in 2007 to 27% in 2015 (Brun, 2016). It is thus unlikely that investment in China will stay at such a high rate, without raising the issue of non-performing loans in the banking sector and other financial distortions. In other words, the increase in investment in China is the outcome of public policy, whereas the decrease in investment in the other areas is a market-based phenomenon.

Next, we represent the change in the investment rate at the world level between 2007 and 2017. More precisely, we represent, for each country i , the change $\frac{I_{i,2017}}{GDP_{2017}^{world}} - \frac{I_{i,2007}}{GDP_{2007}^{world}}$. Investment has fallen in all countries, except China, as can be seen in Figure 3.

The fall in investment is a major world issue. There can be two main explanations, with opposite policy conclusions. First, the fall in world investment is a correction of previous imbalances accumulated because of the debt and housing bubble: Households and firms believed that they were richer than they really were. As a consequence, they consumed and invested too much. The burst of the bubble in 2008 is a world correction, equivalent to a world negative wealth shock

Figure 3. Change in Investment, 2007-2017, normalized by world GDP



Source: Authors' calculations. See Appendix A for data source.

(i.e. a brutal downward revision of future income). In this first explanation, the fall in investment is a healthy adjustment.

The second explanation considers that the explosion of the bubble in 2008 generated a brutal fall in demand, which could not be corrected by monetary policy, due to a zero lower bound on the nominal interest rate. In addition, the fiscal space being limited at the world level, the world economy moved into another low-activity equilibrium with low inflation and low economic activity. This would be the secular stagnation trap (Summers, 2016; Le Garrec and Touzé, 2016, for a formal treatment). The discussion of the two main explanations is outside the scope of this paper. We insist here only on the world fall in investment, except in China, where the increase in investment is likely to be a policy outcome, and not a market phenomenon.

3.4. Current account: The end of global imbalances?

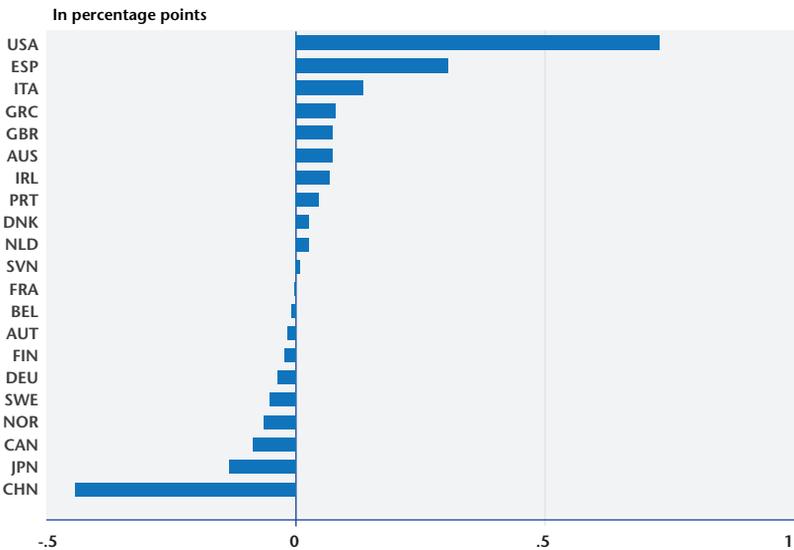
Next, we present the change in current accounts between 2007 and 2017, as a percent of world GDP. This is thus:

$$\Delta CA_i = \frac{CA_{2017}^i}{Y_{2017}^{world}} - \frac{CA_{2007}^i}{Y_{2007}^{world}}$$

for each country i . As the sum of the world current account is 0, the sum of countries is also 0, $\sum_{countries\ i} \Delta CA_i = 0$.

Figure 4 clearly shows the world rebalancing. The US current account was very negative in 2007, equal to -5.1% of US GDP. The US current account improved during the period, reaching -2.3% of US GDP. This rebalancing appears as an improvement of the US current account. Second, the Chinese current account was very positive in 2007, equal to +10.1% of GDP. It decreases to +1.3% of GDP in 2017. The sharp reduction appears as a negative change in the Chinese current account over the period. To a smaller extent, this is also the case for Japan. As a consequence, this graph should be read as a reduction of global imbalances, except possibly for Germany.

Figure 4. Change in current account, 2007-2017, normalized by world GDP



Source: Authors' calculations. See Appendix A for data source.

There are two implications from Figure 4. First, as the public debt of both the US and China increased during the crisis, this graph doesn't support a saving glut explanation for the demand for world public debt: one country isn't financing the rest of the world by a high current account surplus. Second, the increase in the current accounts of Italy, Spain and Greece (from a negative territory) is roughly 80% of the increase in the US current account. As a consequence, the world rebalancing of international saving should be seen as the global deleveraging (both public and private) of the US and the south of Europe. Globally, this increase in saving was compensated by the decrease in the (net) saving of China, Japan and Canada.

One must nuance this positive global picture. Although the world imbalance in current accounts has been reduced between the US and China, there are still long-lasting imbalances within the Euro area. Indeed, Germany and the Netherlands each still has a very high current account surplus. Germany's current account surplus is among the highest in the world in dollar value. As a consequence, there must be some countries borrowing to absorb these excess savings. This may reduce or even stop the deleveraging process in the south of Europe. The cause of these European imbalances is investigated in Le Moigne and Ragot (2015), who insist on nominal imbalances (and thus internal exchange rate misalignments) within the Euro area.

Summary data. To summarize the change between 2007 and 2017, Table 1 reports changes in key variables for various countries for the same period.

The first column is the annualized change in public debt over GDP in percent (roughly the cumulated change between 2017 and 2007 divided by 10, or the annual total public deficit)³. The increase in public debt is undoubtedly unprecedented in peace-time. The increase was 40% of GDP in the US and 30% in France and Italy, but stayed roughly constant in Germany. The second column is the change in the private saving rate, denoted as S^p . There is no clear pattern concerning the household saving rate. The correlation is actually slightly negative. As a consequence, one cannot easily conclude that Ricardian equivalence is valid and that the increase in public debt has been financed by an increase in domestic private saving, for all countries. Columns 3 and 4 decompose the private saving in household saving and firm saving. Column 5 is the change in the investment rate between 2017 and 2007. Finally, column 6 is the change in the current account. Again, one doesn't observe a significant relationship between a change in the public debt and a change in the current account. As explained before, both China and the US have experienced a sharp increase in public debt, but an increase in the current account in the US and a decrease in China.

Although no clear pattern appears across countries concerning household saving and the current account, there is a common trend concerning investment. This is clearly shown by the behavior of the average country. The last two lines of Table 1 indeed provide a country mean, with and without China, which appears as an exception

3 This normalization is provided to compare flows.

regarding its increase in investment. First, one can observe that the average country financed its yearly increase of 3.15% in public debt by a small increase in private saving (0.67), and an important decrease in investment (-3.39). This allows a reduction of the current account deficit (3.00). This average is not weighted by a country's GDP so as not to give too high a weight to the US. The US experiences a similar pattern with a higher increase in household private savings.

Table 1. Change in saving and investment behavior between 2007 and 2017
 S^P is private saving (percentage points)

Country	ΔB	ΔS^P	ΔS^H	ΔS^F	ΔI	ΔCA
AUS	3.11	2.15	0.98	1.17	-4.13	4.83
AUT	1.38	-1.47	-5.58	4.11	0.55	-1.88
BEL	1.64	-1.43	-5.4	3.97	0.123	-.77
CAN	2.29	-1.88	-0.38	-1.49	-3.62	-3.57
CHN	1.79	1.77	—	—	3.4	-8.59
DEU	0.19	-0.6	-0.37	-0.23	-0.66	1.22
DNK	0.79	4.45	9.05	-4.6	-3.67	6.45
ESP	6.29	3.71	0.14	3.57	-10.23	11.58
FIN	2.73	-1.9	-1.38	-0.52	-2.7	-4.37
FRA	3.27	-1.14	-0.96	-1.18	-0.71	-.19
GBR	4.58	-0.52	-4.43	3.9	-1.15	-.13
GRC	7.87	-10.94	-15.68	4.75	-14.62	12.36
IRL	4.46	19.01	7.57	11.44	-4.41	13.91
ITA	3.2	-0.33	-5.79	5.46	-4.53	4.22
JPN	6.22	-0.4	0.05	-0.45	-0.58	-.67
NLD	1.45	-0.56	7.24	-7.79	-2.68	4.55
NOR	-1.27	3.27	5.79	-2.51	0.85	-6.80
PRT	5.72	2.17	-3.32	5.49	-6.19	10.33
SVN	5.08	-1.58	-2.94	1.36	-11.53	11.33
SWE	0.27	-0.25	5.61	-5.85	0.92	-5.01
USA	4.04	1.55	3.02	-1.47	-2.01	2.61
Mean	3.10	0.72	—	—	-3.06	2.44
Mean (without CHN)	3.15	0.67	-0.34	1.01	-3.39	3.00

Source: Authors' calculations. See Appendix A for data source.

This analysis leads to an important conclusion. The increase in world public debt was financed mainly by the deleveraging of the US and the south of Europe and by a fall in investment. This has been compensated at the global level by an increase in investment in China, above the increase in private saving, which partly absorbed the excess

world saving. In other words, if investment had not grown so fast in China, the demand for funds would have been reduced and the real interest rate would have been even smaller.

The previous analysis considered changes in flows between the end of the period and the beginning of the period. We now investigate the world financial market, considering the cumulative change during the period.

4. The financing of the cumulative deficit

The goal of this Section is to understand the difference in public debt between 2017 and 2007. This difference has to be equal to the change in private saving minus investment, taking into account interest payment. Hence, to consider the cumulative change over the period, we sum the yearly balance (3) for the years between 2008 and 2017. The change in public debt between 2007 and 2017 is now the cumulative change in public borrowing, considering the contribution of interest payments:

$$B_{i,2017} - B_{i,2007} = \sum_{t=2008}^{2017} r_{i,t-1} (B_{i,t-1} - B_{i,t-1}^{CB}) + \sum_{t=2008}^{2017} (S_{i,t}^F - I_{i,t} + S_{i,t}^H - E_{i,t} - CA_{i,t})$$

The previous decomposition is a little misleading, as GDP is changing over the period. For this reason, we will actually report the following decomposition, normalized by the cumulated GDP over the period, focusing on the primary deficit:

$$\frac{\sum_{t=2008}^{2017} D_{i,t}}{\sum_{t=2008}^{2017} Y_{i,t}} = \frac{\sum_{t=2008}^{2017} (S_{i,t}^F - I_{i,t})}{\sum_{t=2008}^{2017} Y_{i,t}} + \frac{\sum_{t=2008}^{2017} S_{i,t}^H}{\sum_{t=2008}^{2017} Y_{i,t}} - \frac{\sum_{t=2008}^{2017} CA_{i,t}}{\sum_{t=2008}^{2017} Y_{i,t}} \quad (6)$$

The interest of this decomposition is that each term can be easily understood. The left-hand side is the cumulative change in the primary deficit over the total increase of GDP over the period. It can be roughly interpreted as the average yearly primary deficit as a percentage of

GDP. The first term on the right-hand side is $\frac{\sum_{t=2008}^{2017} (S_{i,t}^{Firm} - I_{i,t})}{\sum_{t=2008}^{2017} Y_{i,t}}$

which is the annual net saving of firms in country i over the period 2008-2017. The second term is the annualized household saving rate, and the last term is the opposite of the annualized current account.

We define the following quantities for each country (lowercase letters are used for ratios):

$$\begin{aligned}\sum_{2008}^{2017} d_i &\equiv \frac{\sum_{t=2008}^{2017} D_{i,t}}{\sum_{t=2008}^{2017} Y_{i,t}} \\ \sum_{2008}^{2017} s_i^F &\equiv \frac{\sum_{j=2008}^{2017} S_{i,t}^F}{\sum_{t=2008}^{2017} Y_{i,t}} \\ \sum_{2008}^{2017} i_i &\equiv \frac{\sum_{j=2008}^{2017} I_{i,t}}{\sum_{t=2008}^{2017} Y_{i,t}} \\ \sum_{2008}^{2017} s_i^H &\equiv \frac{\sum_{t=2008}^{2017} S_{i,t}^H}{\sum_{t=2008}^{2017} Y_{i,t}} \\ \sum_{2008}^{2017} ca_i &\equiv \frac{\sum_{t=2008}^{2017} CA_{i,t}}{\sum_{t=2008}^{2017} Y_{i,t}}\end{aligned}$$

such that for each country i , we have:

$$\sum_{2008}^{2017} d_i = \sum_{2008}^{2017} s_i^F - \sum_{2008}^{2017} i_i + \sum_{2008}^{2017} s_i^H - \sum_{2008}^{2017} ca_i. \quad (7)$$

This decomposition is the cumulative counterpart of the one in the previous Section. For each country, the increase in the primary deficit is financed either by an increase in domestic savings net of investment or by the rest of the world through a deterioration of the current account.

For some countries (China), we don't have the decomposition between the household and firm saving rates, but only the private saving rate. In this case, we define:

$$\sum_{2008}^{2017} s_i^P = \sum_{2008}^{2017} s_i^H + \sum_{2008}^{2017} s_i^F.$$

And the decomposition is now:

$$\sum_{2008}^{2017} d_i = \sum_{2008}^{2017} s_i^P - \sum_{2008}^{2017} i_i - \sum_{2008}^{2017} ca_i.$$

We plot some figures as a summary of the data.

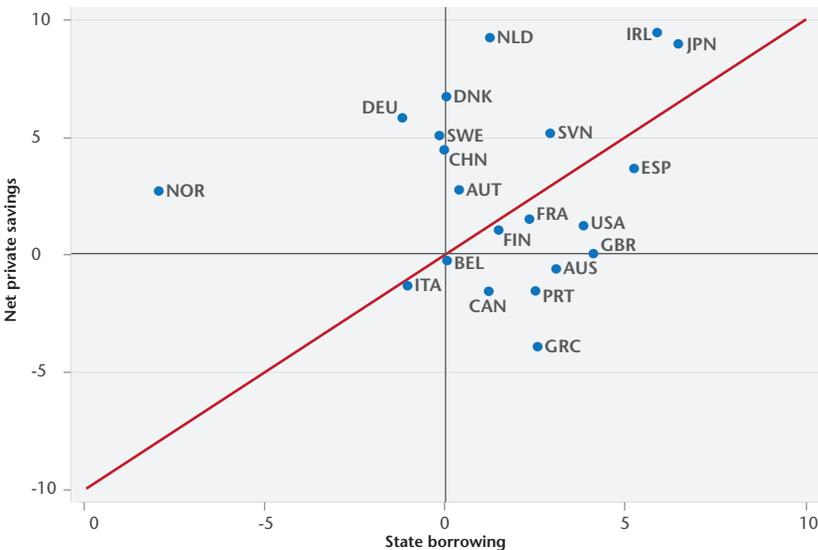
4.1. Change in primary state borrowing and net private saving

We first turn to the relationship between the increase in government borrowing and private saving. As explained above, Ricardian equivalence implies that private agents (both households and firms), anticipating an increase in taxes to finance interest payments on the

public debt, raise their savings by the same amount. In this case, the increase in saving would have been equal to the increase in public debt. To represent this graphically, we report the net of the interest increase in public debt and the increase in private saving, using the accounting equality of decomposition (6). We report the change in public debt $\sum_{2008}^{2017} d_i$ on the x-axis and the private saving rate $\sum_{2008}^{2017} s_i^P - i_i$ on the y-axis for each country. We also plot the 45-degree line, where both values are equal (perfect Ricardian equivalence).

One can observe that countries are on both sides of the 45-degree line. There are thus no clear patterns supporting Ricardian equivalence. Countries below the 45-degree line have financed their increase in public debt by a reduction in the current account. Countries above the 45-degree line have seen an increase in net private saving above the increase in public debt. At the world level, one should thus consider that countries above the 45-degree line generated excess saving (relative to government borrowing) to finance the deficit of saving of countries below the 45-degree line.

Figure 5. Normalized average saving rate of the private sector against normalized primary deficit (percent of domestic GDP)

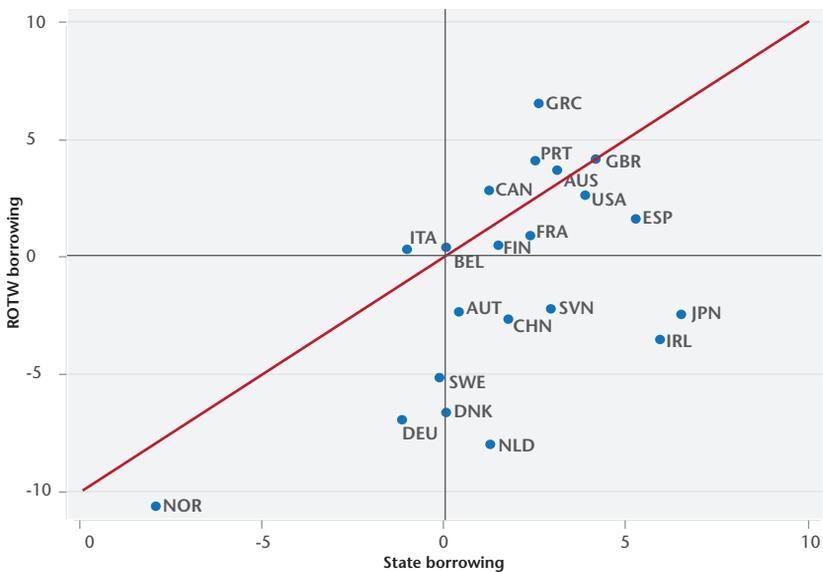


Source: Authors' calculations. See Appendix A for data source.

4.2. Twin-deficit theory

To further investigate the relationship between the increase in public debt and international borrowing, we examine the so-called twin deficit “theory.”⁴ We report $-\sum_{2008}^{2017} ca$ on the y-axis, as the cumulative domestic borrowing from the rest of the world, and $\sum_{2008}^{2017} b^p$ on the x-axis. We also plot the 45-degree line, where the correlation between the two values is exactly one.

Figure 6. Normalized average borrowing from the rest of the world against the normalized primary deficit (percent of domestic GDP)



Source: Author's calculations. See Appendix A for data source.

One can observe that most countries are below the 45-degree line, implying that the increase in public borrowing is financed mostly by domestic savings, which confirms the average finding of Table 1 discussed above. This is also consistent with the previous analysis showing that the increase in public debt occurred during a period of world rebalancing in external positions.

4 The twin-deficit “theory” could be seen as the exact “opposite” to Ricardian equivalence. It assumes that the behavior of private agents doesn’t change after an increase in public debt. As a consequence, the increase in public debt is financed one-for-one by a deficit in the current account: the government deficit and the external deficit move together.

Second, the pictures globally exhibit an increasing pattern. Countries lending more to the rest of the world (negative ROTW borrowing) are countries with the smaller cumulative deficit. The direction of the causality is an open question. Surplus countries (below the x-axis) with State borrowing (to the right of the y-axis) have experienced a net increase in private saving over domestic investment. The previous Section has shown that this was the result mainly of a fall in investment during the period.

4.3. The financing of the cumulative deficit

We now provide the full decomposition (6) for all relevant countries. As was discussed above, each number should be interpreted as the average rate over the period. For instance, Australia increased its public debt by 3.08% of GDP during the period 2007-2017, whereas the average saving rate of households is 7.06% over the period. Considering the change in the current account, the last column reports the average value of the current account. A positive number thus implies that the country relatively lent to the rest of the world, whereas a negative number states that the country borrowed from the rest of the world. For instance, although China's current account decreased over the period as discussed in Table 1, it stayed positive and equal to the average value of 2.67% of GDP over the period. Hence, China financed the rest of the world, but less and less.

The first column of Table 2 is the normalized primary deficit. Obviously, the total public deficit is the primary deficit plus the interest payment on public debt. For this reason, the sign of the value for Italy is negative, as most of the budget deficit is the interest payment on public debt. The Table clearly shows the huge increase in investment in China (46%) compared to other countries. The Chinese annualized investment rate is more than twice the average rate of other countries. Most countries have a private saving that is higher than investment. This is notably not the case for Italy, Portugal and Greece. It is likely that these countries with a high public debt and negative current account will experience an increase in saving to rebalance their external position.

The average country experienced a 2.8% annualized flow of savings net of investment (equal to 25.5% minus 22.7%), which was used to finance the increase in public debt (deficit) of 1.7% and an annualized current account of 1.1%.

Table 2. Cumulated financing of debt (% domestic GDP)

Country	$\sum_{2007}^{2017} d$	$\sum_{2007}^{2017} s^P$	$\sum_{2007}^{2017} s^H$	$\sum_{2007}^{2017} s^F$	$\sum_{2007}^{2017} i$	$\sum_{2007}^{2017} ca$
AUS	2.79	25.7	6.78	18.91	26.84	-3.94
AUT	0.29	26.66	8.92	17.75	23.88	2.48
BEL	-0.23	23.39	6.69	16.7	23.82	-0.19
CAN	0.93	22.38	3.65	18.71	23.97	-2.52
CHN	1.69	50.43	—	—	45.78	2.96
DEU	-1.25	25.98	9.75	16.23	20.28	6.95
DNK	-0.46	26.56	0.95	25.61	20.83	6.19
ESP	4.47	23.67	2.74	20.93	21.57	-2.37
FIN	0.9	24.16	0.53	23.63	23.33	-0.066
FRA	2.18	24.19	9.3	14.89	22.85	-0.83
GBR	3.84	16.76	3.68	13.08	16.99	-4.07
GRC	2.64	11.93	-9.09	21.01	16.64	-7.35
IRL	5.27	32.92	5.01	27.91	24.93	2.72
ITA	-1.13	17.62	4.57	13.05	19.17	-0.41
JPN	6.23	31.95	2.42	29.54	23.07	-0.41
NLD	1.02	29.37	7.25	22.12	20.54	7.81
NOR	-8.55	29.01	6.12	22.89	26.78	10.78
PRT	2.34	16.24	-1.17	17.4	18.54	-4.65
SVN	2.56	27.02	5.91	21.11	22.84	1.63
SWE	-0.47	29.11	13.61	15.5	24.15	5.44
USA	3.58	21.06	6.84	14.22	20.28	-2.8
Mean	1.36	25.53	4.72	19.56	23.19	0.97

Source: Authors' calculations. See Appendix A for data source.

5. Conclusion

As a global summary, our analysis shows that public debt was absorbed by an increase in the world saving rate net of investment. First, for most countries (except China), the fall in private investment explains a large part of the increase in net saving. Second, the smaller increase in private saving is mostly the outcome of deleveraging in the US and the south of Europe. Third, world investment stayed constant, mainly due to a sharp jump in investment in China. Fourth, deleveraging in the US and rising investment in China has contributed to a reduction in global imbalances. The descriptive statistics presented in

this paper did not confirm any simple explanation, such as the twin-deficit theory, or an implication of Ricardian equivalence. The low interest rate is mostly the outcome of low private investment in a period of reduction of global imbalances and of deleveraging. Obviously, the perspective of this paper was descriptive, and additional econometric estimations would be necessary to qualify this conclusion, with the usual caveats.

From these trends, we can infer some prospective implications for the evolution of the real interest rate. The deleveraging observed after the crisis is likely to be a permanent phenomenon, correcting the financial imbalances accumulated before the 2008 recession. The various investment plans in China are likely to have generated an over-accumulation of capital in China and may not be a permanent phenomenon. For this reason, it is most likely that the world investment rate will decrease, contributing to a further decrease in the world real interest rate.

This analysis did not put forward monetary policy and quantitative easing as a main driver of the increase in the world saving rate above investment. Indeed, the increase in the world net saving rate and the decrease in investment doesn't square well with a key role for monetary policy, which should have had the opposite effect.⁵ This doesn't mean that expansionary monetary policy did not contribute to limiting the fall in aggregate demand, but it shows that there are deep trends pushing toward a contraction in aggregate demand in a world of high public debts.

Finally, the analysis points toward the key issue of the decrease in world investment. This is currently hidden by the sharp increase in China, which is mostly the outcome of public policies. The "secular stagnation" hypothesis claims that a world deficit in aggregate demand is inefficient, which would necessitate additional expansionary fiscal policy. Another hypothesis is that this fall in investment is the market adjustment to the negative wealth shock resulting from the bursting of the world housing bubble. This contribution cannot pretend to answer this question but only to put it very high on the agenda.

5 There is currently a debate about the possibility that expansionary monetary policy could have generated some fall (and not an increase) in aggregate demand, due to an income effect. We leave this effect for future research, but this "reverse" effect is highly controversial, see Blot and Hubert, (2019).

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APPENDIX

A. Data source

The data used comes from various sources which are described below.

The saving rates come from the World Development Indicator data set, provided by the World Bank, and are described as GDP less final consumption expenditure (total consumption).

The investment rates come from the World Economic Outlook 2019 data set, provided by the International Monetary Fund, and are described in current local currency and GDP in current local currency. Investment or gross capital formation is measured by the total value of the gross fixed capital formation and changes in inventories and acquisitions less disposals of valuables for a unit or sector

The Household saving rate is provided by the OECD and is described as the subtraction of household consumption expenditure from household disposable income, plus the change in net equity of households in pension funds. Household saving is the main domestic source of funds to finance capital investment, a major impetus for long-term economic growth. This indicator is measured as a percentage of household disposable income.

Household consumption comes from the World Development Indicator data set, provided by the World Bank, and is defined as the final consumption expenditure of Households and NPISHs (% of GDP).

Government final consumption comes from the World Development Indicator data set, provided by the World Bank, and is defined as all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation.

Tax revenues come from the World Development Indicator data set, provided by the World Bank, and refer to compulsory transfers to the central government for public purposes. Certain compulsory transfers such as fines, penalties, and most social security contributions are excluded. Refunds and corrections of erroneously collected tax revenue are treated as negative revenue.

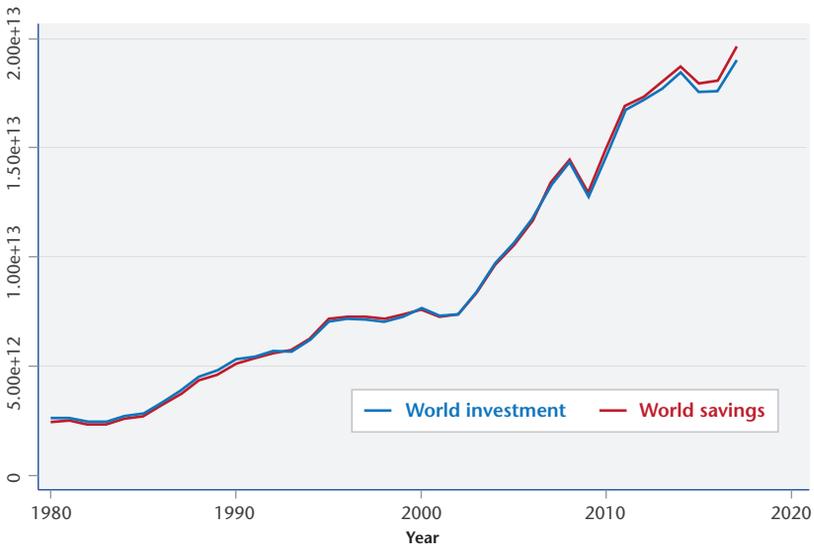
Public debt data comes from the IMF Global Debt Database and is defined as General Government debt as a % of GDP.

Nominal GDP comes from the World Development Indicator data set, provided by the World Bank, and is defined as GDP at purchaser's prices and is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for the depreciation of fabricated assets or for the depletion and degradation of natural resources. Data are in current U.S. dollars. Dollar figures for GDP are converted from domestic currencies using single year official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used.

The current accounts come from various sources: the International Monetary Fund (Balance of Payments Statistics Yearbook and data files), and World Bank and OECD GDP estimates.

As a summary of the quality of the data, the next figure reports the aggregate saving and investment rate at the world level in dollars for the period.

Figure Appendix. World saving and investment, in dollars



Source: Authors' calculations.

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