

The Global Capital Stock

A Proxy for the Unobservable Global Market Portfolio

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If there was such a thing as a global index purist, that person would simply buy all outstanding assets in the world. This so-called global market portfolio will be composed of all risky assets in the world in proportion to their market capitalization. While being an appealing idea, the central problem is that not all risky assets that can be held by investors are investable and sometimes even measurable. Therefore, it is not surprising that, the academic literature on the computation of the global market portfolio has been limited so far (the rare references in the early years include Ibbotson and Fall (1979), Ibbotson and Siegel (1983). However, one of the most well-known model in finance, namely the Capital Asset Pricing Model, thereafter CAPM, relies on such unobservable variable. Roll (1977) and Fama-French (2004) even concluded that “the CAPM had never been tested and probably never will be because the market portfolio at the heart of the model is theoretically and empirically elusive”. While the Sharpe-Linter-Mossin CAPM homogeneous investor is intrinsically limited to a universe of publicly traded financial assets, it is not that clear which assets can legitimately be excluded from his market portfolio.

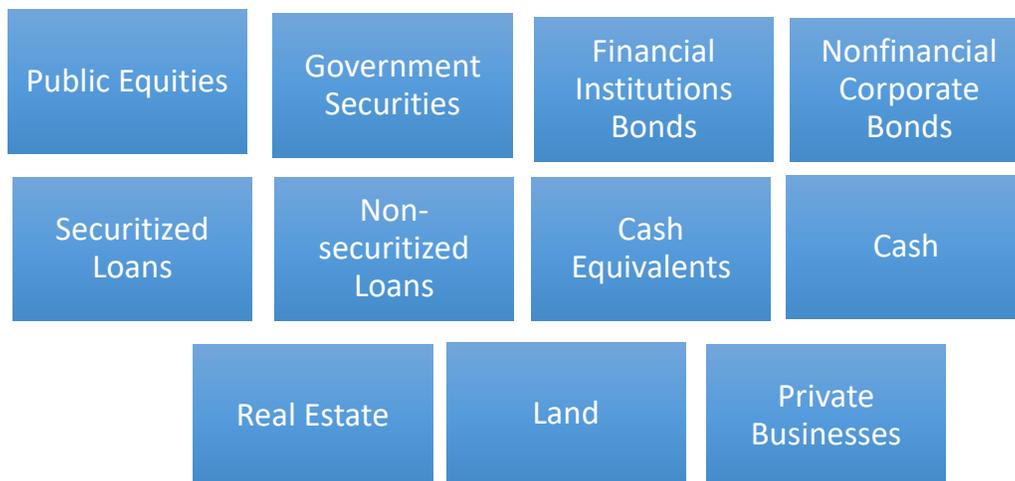
Meanwhile, institutional investors still miss a composite portfolio benchmark representing a broad spectrum of investments when they start their multi-asset investment process. Thirty years ago, Brinson, Diermeier and Schlarbaum (1986) offered the so-called Multiple Markets Index, composed of nine indices chosen among 80 asset classes and subclasses. However, the MMI and the bulk of the literature on global portfolio indexing that followed is based on mean-variance optimization, built most of the time on discretionary assumptions about risk and returns expectations, and thus cannot be seen as a realistic passive benchmark.

Nowadays, it is becoming easier to compute a global investable market portfolio thanks to the development of publically available financial databases. Recently, Roxburgh, Lund and Piotrowski (2011) built up a “map” of financial global assets. However, their coverage is limited to traditional financial assets only, omitting alternatives assets. Doeswijk, Lam and Swinkels (2014) went one step further considering a broader assets universe including notably real estate and private equity. Whilst it is the first attempt to include alternatives, their study only focuses on investable assets, with their portfolio’s weights given by the assets currently under management (AUM).

Our research takes a broader perspective. Our starting point is the definition of “Capital”. The SNA (2008) defines (physical) capital as non-financial assets having a dual role in an economy, being both a source of capital services in production and a storage of wealth. A broader definition extends the notion of storage of wealth to financial assets and assumes “Capital” as the stock of all assets held by private individuals, corporations and governments that can be traded in the market no matter whether these assets are being used or not (see Piketty, 2014). The latter definition which now refers to both physical and financial capital may then include assets like stocks, real estate, as well as more alternative assets such as art and jewelry collection.

In this article we propose a measure of the capital stock that involves measurable financial and non-financial assets. Thus, we include assets whose price information is not always readily available, but which can be derived from global institutional databases, and we exclude assets whose valuation depend on partial, non-transparent sources and assets whose measure is not observable or based on non-replicable methodologies. More precisely, we computed the market value of global assets included in the following 11 asset classes for the period 2005-2015¹ as our proxy for the global market portfolio.

¹When considering an extension of the time series pre 2005, the trade-off with regards to the quality and availability of data would have been too unfavorable.



One asset class which comes to mind as underweighted in the current representation of the global market, is real estate. Direct real estate investments is the primary asset of most households in the world. A global market portfolio aiming at including the major economic forces would need to take into account this weight accordingly, instead of only accounting for assets under management held by REITs. Likewise, the market value of privately held corporations and businesses exceed the total market value of traded equities. If privately held businesses have different risk characteristics than those of traded assets, investors ought to increase this entrepreneurial risk in their overall portfolio by investing directly or indirectly in privately held companies. As a matter of fact, the number of sophisticated investors, including endowments that allocate a significant portion of their capital to non-financial assets is continuously increasing. For instance, in 2015, the Yale endowment fund allocated more than 60% of its funds in private equity, real estate, and natural resources.

The rest of the paper is going into the details of the computation of the stock of financial and non-financial assets. The article takes the viewpoint of a US-based investor, all numbers are then expressed in US dollars. The global capital stock is then presented with its historical weights. Some limitations are presented and we conclude with future research avenues.

Data sources and Methodology

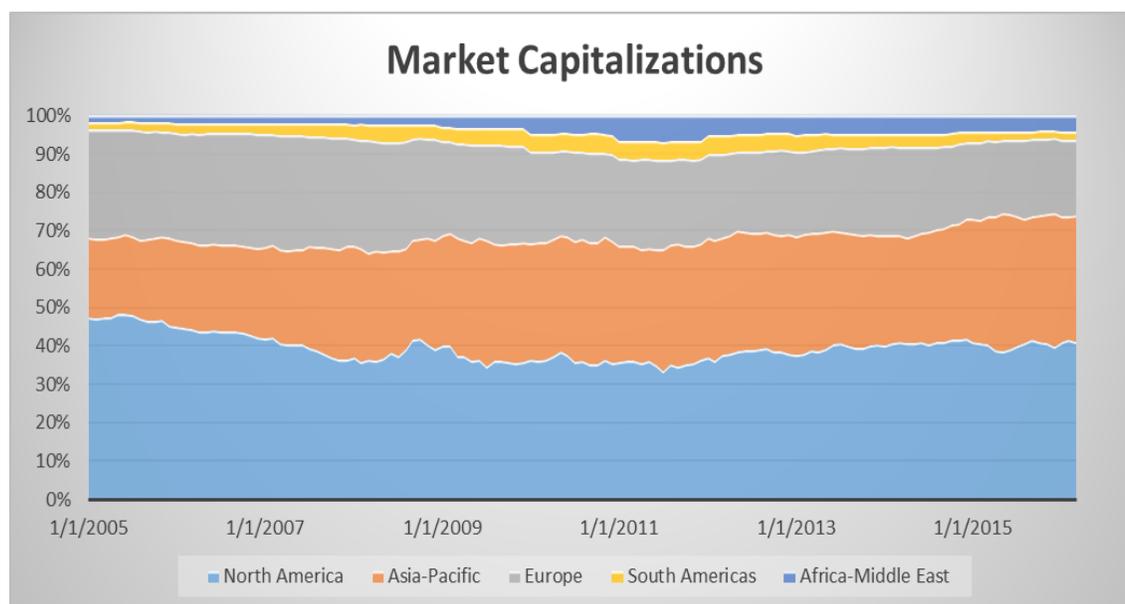
Public Equities

We start with equity markets and the valuation of publicly traded companies. We are faced with two choices: either market values (financial capital) or book values (physical capital). The Efficient Market Hypothesis (EMH) asserts that, the price of a security reflects all available information about its fundamental value (Samuelson, 1965). Thus, in theory, the market capitalization should be driven by arbitrage and accurately reflect the intrinsic value of companies. However, substantial financial fluctuations in market values may not reflect the growth and decline of physical capital (Lo, 2004). While we take no stance on the debate about the best measure of firms intrinsic values in this particular case, for consistency and reasonableness purposes, we choose to collect market values. We use the World Federation of Exchanges database, which gathers information about 77 regulated exchanges across the world, representing about 45,000 listed companies. The market capitalization figures cover the followings:

- 1) Shares of listed domestic companies
- 2) Shares of foreign companies which are exclusively listed on an exchange, i.e. the foreign company is not listed on any other exchange
- 3) Common and preferred shares of domestic companies
- 4) Shares without voting rights

The domestic market capitalization is computed as the total number of issued shares of domestic companies, including their several classes, multiplied by their respective prices at a given time period. This figure is then converted into dollars to reflect a comprehensive value of the market at that time. Figure 1 shows the evolution of the market capitalization by continents.

Figure 1: Public Equities by Continents



Source: WEF.

At the end of 2015, the US represented 38% of the global market capitalization, down from 42% a decade earlier, Europe decreasing from 28% to 19% and Asia expanding from 23% to 33%. Notably, the Chinese stock markets only account for 10%. This can be explained by the fact that China's stock market plays a smaller role in its economy than the U.S. stock market does for its own economy. Indeed, whilst U.S. companies are heavily dependent on equity financing, only five percent of total corporate financing in China is funded through the equity market.

Debt Securities

The debt market may be broadly defined as the market where fixed-income instruments of various types and characteristics are issued and traded. One big component is debt securities, which have some or all of the following quantitative characteristics: (1) an issue date; (2) an issue price; (3) a redemption price (or face value); (4) a maturity (or redemption date); (5) the coupon rate that the issuer pays to the holders; (6) the coupon dates; and (7) the currency of denomination and settlement (BIS *et al*, 2015).

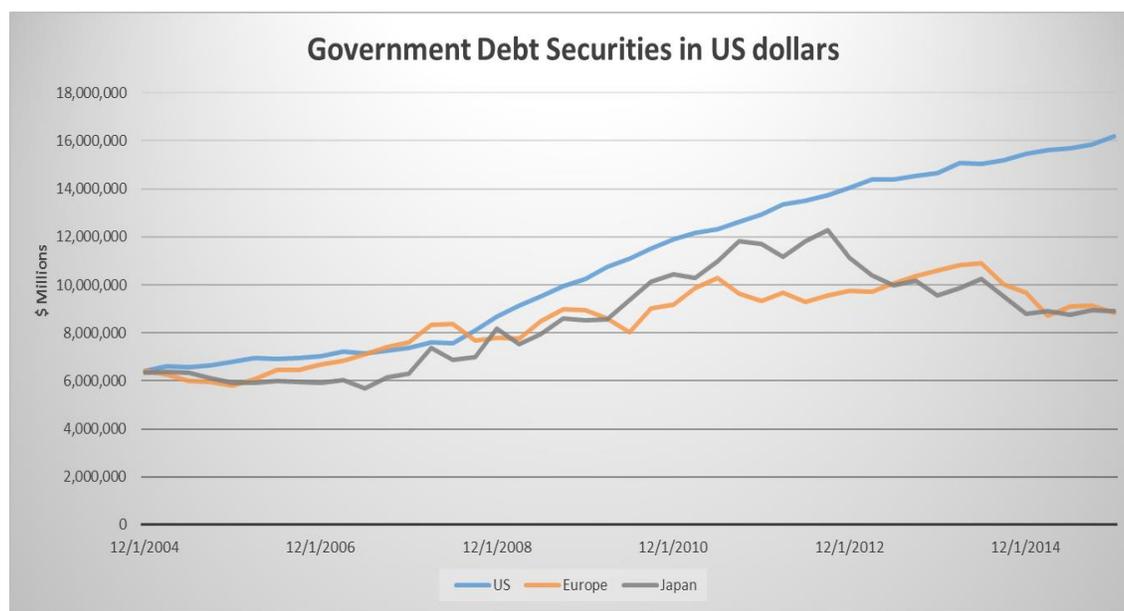
BIS *et al* (2015) also defines so-called institutional units and group them in five mutually exclusive institutional sectors on the basis of their principal functions, behavior, and objectives: nonfinancial corporations, financial corporation, general government, households and nonprofit institutions serving households (NPISHs). Together, the five sectors make up the total economy. However, following Roxburgh, Lund and Piotrowski (2011), we grouped data in these fewer categories: governments, financial corporations, non-financial sector.

We used the BIS database to get the whole aggregate values outstanding. The so-called Total Debt Securities –TDS- database is composed of the debt securities issued by residents in all markets, the sum of international (Eurobonds and foreign bonds) and domestic debt securities. The BIS gathered data on 40 countries on a quarterly basis with a 6 month lag.

Government Securities

Government securities outstanding is shown in Figure 2 for the three big zones, namely the US, Europe and Japan. The US show a continued increase in the nominal value of its debt while the downward trend in Japan and Eurozone is only a reflection of the appreciation the US dollar against the Euro and the Yen since 2012. As a matter of fact, the stock of government debt increased from 2012 to 2015 by 1.5% for the Eurozone, 4.7% for Japan and 17.8% for the US. In addition to the growing federal deficit, the bailouts of the government-sponsored enterprises, AIG and the auto industry propelled a 40 percentage point increase in US total public debt relative to GDP between 2007 and 2016. Meanwhile, the government debt in China has been multiplied by two in the last three years.

Figure 2: Government Debt



Source: BIS debt securities statistics.

Financial Corporate Bonds

Financial corporations consist of all resident corporations or quasi-corporations principally engaged in financial intermediation or in auxiliary financial activities, which are closely related to financial intermediation. In this section, we only take into account financial bonds issued. The advanced economies, namely, the US, Europe, UK and Japan represent 84% of the total value outstanding, with the US alone representing as much as 43% of the bonds outstanding at the end of 2015. As result of a drop in financial-sector leverage, the debt of the financial sectors decreased by 8% from its all-time high level in 2010, with the US and the UK accounting for the bulk of the deleveraging.

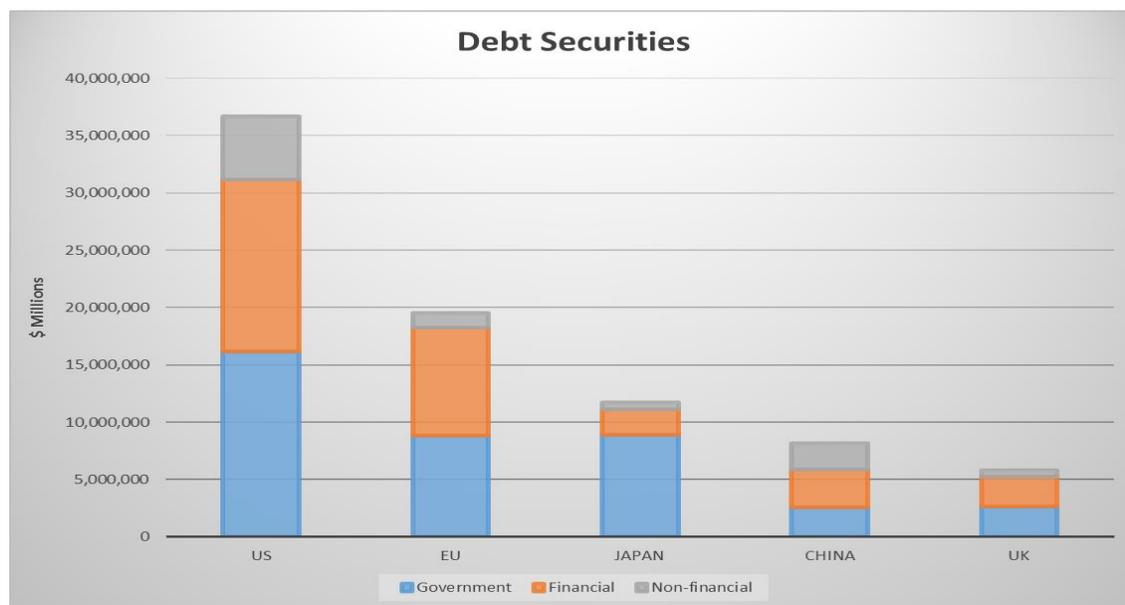
Non-financial Bonds

The term non-financial debt is used to refer to the aggregate debt owed by households, government agencies, non-profit organizations, or any corporation that is not in the financial sector. In this section, we only account for corporate bonds that these entities have issued to raise funds. Global nonfinancial corporate bonds outstanding have doubled in 10 years, with the US representing almost 50%. In the

emerging markets, corporate debt more than quadrupled between 2004 and 2016. Notably, the debt in the non-financial sector in China, which is most composed of state owned enterprises (SOE), has been multiplied by two in the last three years. However, the biggest year-on-year increase occurred in 2009, after the government responded to the global financial crisis by launching a fiscal stimulus of RMB 4 trillion (\$570 billion). The Chinese debt has been growing by double digits ever since. The composition of that debt has been shifting slightly away from loans toward bonds recently, but the former still accounts for 90% of emerging markets corporate financing in 2015.

Figure 3 below summarizes the current stock of debt securities for the major countries.

Figure 3: Summary of Debt Securities



Source: BIS debt securities statistics.

Non-Financial Sector Loans

We now turn to another form of external financing for economic agents, namely credit provided by financial institutions to all other sectors of the economy and nonresidents. In terms of financial instruments, loans can be then divided broadly speaking into securitized loans and non-securitized loans. For securitized loans, we gathered data from the SIFMA and AFME databases as well as central banks to compute the whole values outstanding. As for non-securitized loans, the BIS has constructed long series on credit to the private non-financial sector for 43 economies, that we use to estimate the total amount of loans outstanding measured at market value. For both databases, the series have quarterly frequency and capture the outstanding amount of credit at the end of the reference quarter.

Securitized loans

Securitization is the process of pooling together a large number of loans (such as mortgages, auto loans or SME loans) held on the balance sheet of a bank or other financial institution and selling them to a separate entity. The SIFMA and AFME databases cover historical issuance and outstanding values in Europe, US and Australia for the followings: asset-backed securities (ABS), collateralized debt obligations/collateralized loan obligations (CDOs/CLOs), commercial mortgage-backed securities (CMBS), and residential mortgage-back securities (RMBS). While several markets in Asia have established securitization frameworks over the years, securitization has remained an under-utilized tool. Some Asian markets that have seen increasing volumes of domestic securitizations in the years after 2008-09 include Korea and China, the latter being now the second biggest securitization market behind Japan. As of today, the three major regions concentrate the bulk of the volumes even if it is very likely that China's share will increase significantly over the near future.

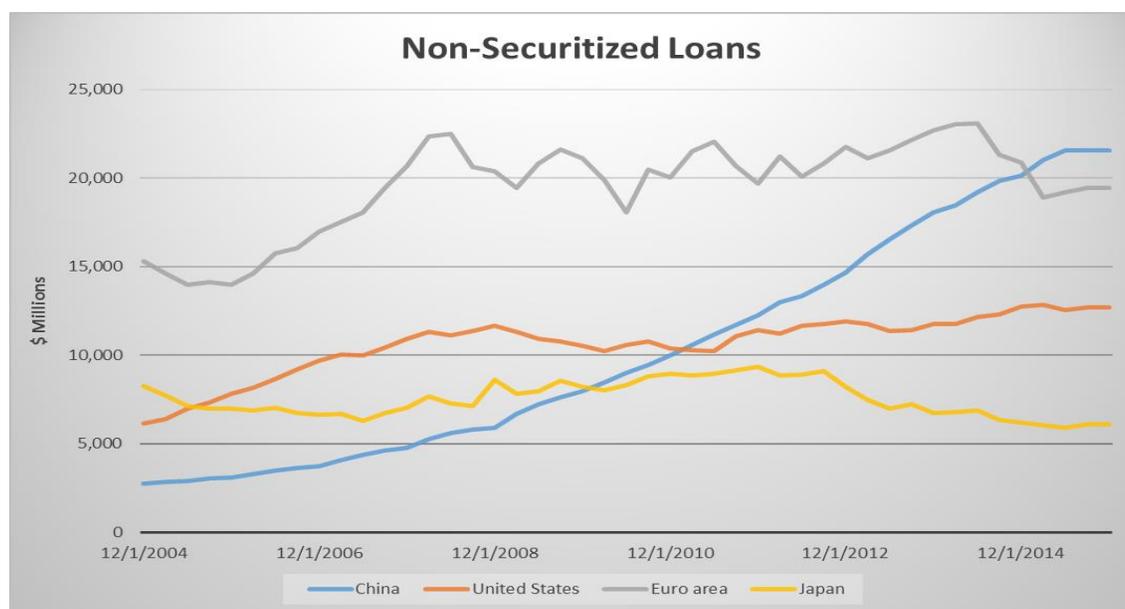
Non-securitized loans

The credit data gathered by the BIS covers loans and debt securities to private non-financial sector, which includes non-financial corporations (both private-owned and public-owned), general government sector, households, and non-profit institutions serving households². In order to capture the loan

² BIS data includes both loans from the financial and non-financial sectors. That's to say loans between same institutional units (e.g. households to households, intra-government lending...).

component, we subtract from the aggregate values the amount of debt securities issued by the non-financial sector as well as the securitized loans previously defined above. The total amount of loans left cover items like loans made to households in the form of mortgages, amounts owed on credit cards, or even commercial papers. The evolution of the two loans categories is shown in Figure 4 for the major economies³. The combination of both debt securities and loans provide a picture of the aggregated indebtedness of all global sectors.

Figure 4: Non-securitized Loans for selected countries



Source: BIS debt securities statistics, SIFMA, AFME.

³ In September 2015, the BIS has added a new data set, for credit to the general government sector, to the existing long series on credit to the private non-financial sector. The series on credit to the government sector cover the following borrowing subsectors: central, state and local governments and social security funds. This addition explains the difference between our values and the ones previously reported in the literature.

Cash and Cash Equivalents

The first financial assets reported in a typical balance sheet are the so-called “Deposits”⁴. We divided banks deposits into two sub-categories: the components of M1, which do not yield interest, i.e. currency in circulation and checkable deposits, which we label simply cash. The components of M2 only, i.e. time and saving deposits and money-market deposit accounts for individuals, which by definition generate interest, is labeled Cash Equivalents. While definitions of M2 vary from country to country we tried to minimize the gap by adjusting the measure when necessary. We excluded from our analysis M3 only components, i.e. money market funds, which typically invest in government securities⁵, certificates of deposit, commercial paper of companies, since these items were already taken into account previously. Figure 5 below shows the evolution of the two categories over time for our sample of the biggest 14 economies.

We must stress that the commercial bank deposits held in the central bank's reserves, which belong to the monetary base, are excluded from the analysis, as these assets are owned by the banks. Likewise, in our quest to avoid double counting assets, we must note that all the cash and cash equivalents owned by private and public corporations are technically already included in their valuation. Therefore, we subtracted this amount from the aggregate cash value in order to compute our final measure.

⁴ See for instance the US Fed categorization in the Flow of Funds data.

Figure 5: Cash and Cash equivalents worldwide



Source: Thomson Reuters Datastream

Non-financial Assets

Real Estate and Land

The physical real property market represents the largest market in the world, estimated between 30% and 40% of the value of the underlying physical capital (Fabozzi *et al*, 2010). The last Survey of Consumer Finances in 2010 showed that US non-financial assets represented about 62% of total assets, with housing wealth being the largest component of total family wealth. Primary residences accounted for 29.5 percent of total family assets, as much as direct and indirect stock holdings.

However, estimations of the value of the global stock of land are rare. One of the major difficulties in valuing land is that the valuation is often combined with the valuation of dwellings and other buildings and structures that exist on the land. Among the rare attempts, Larson (2015) calculates that US real estate land is worth 60% of the total value, while agricultural and forestry are both worth 8%. The author estimates that total land in the US was worth \$23 trillion in 2009. Observations are scarcer for the rest of the world though. The only partial database is provided by the OECD statistics, which gathered historical annual data on the gross total value of all types of land for a few countries including

Canada, Australia, Japan, Netherlands, Czech Republic, Korea, France and Finland. Our final sample of nine countries represents approximately 21% of the total land worldwide expressed in square kilometers. The values of land-per-skm within our sample change widely though, with values as low as 262 thousands USD in Australia, and as high as 55 million USD in Japan. Those values, among other factors, are impacted by the density of the population.

Ultimately, we adopted a weighted average price, and extrapolate this price in order to compute the worldwide figure. Then, we used Larson's (2015) estimate previously mentioned in order to separate the value of real estate land from other types of land.

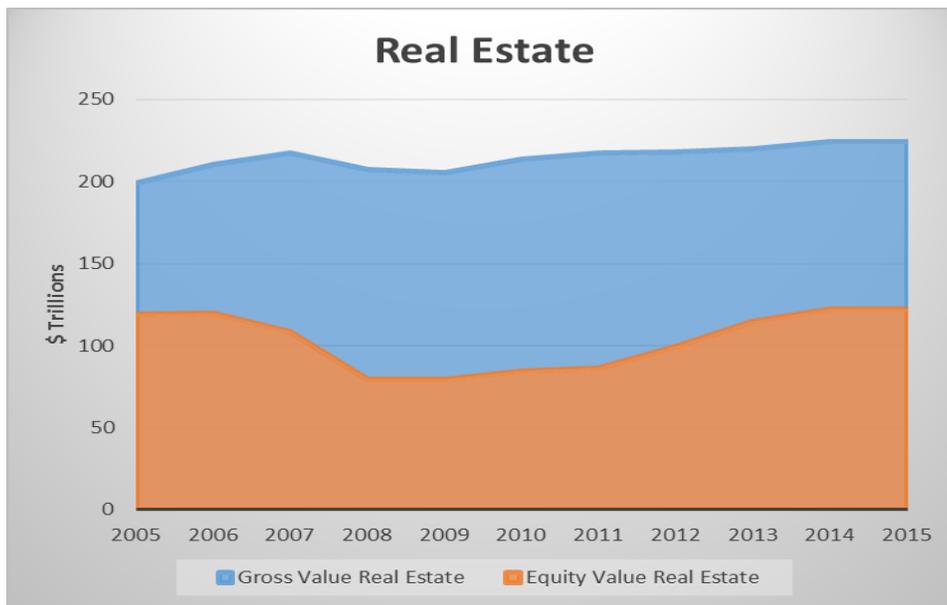
As for real estate, these previous estimates do not take into account the value of dwellings and other buildings. Using OECD statistics with our sample of countries, we estimate that the value of the dwellings and buildings represents 90% of the land value. Adding that number to real estate land, we derive the total value for real estate⁶.

We also computed the equity value of real estate and land, i.e. the difference between the fair market value and the outstanding balance of all mortgages on the property and/or land. Indeed, the later component has already been accounted for in the debt categories. We assume that Loan-To-Value ratios are similar for land and used the same value for both components, computed from the US Federal Reserve flow of funds data.

Moreover, we should again real estate and land owned by corporations are already included in their equity values. Using aggregated balance sheets data of corporations for a set of selected countries, we estimated that corporations' land and real estate is worth 45 \$ Tr. Our final estimation of real estate then discounts by another 20% the previous fair equity value.

⁶ We are aware of the several strong assumptions supporting this estimation, but this approach allowed us to overcome the lack of data and come close to estimation reported by consulting companies.

Figure 6: Gross versus equity real estate value



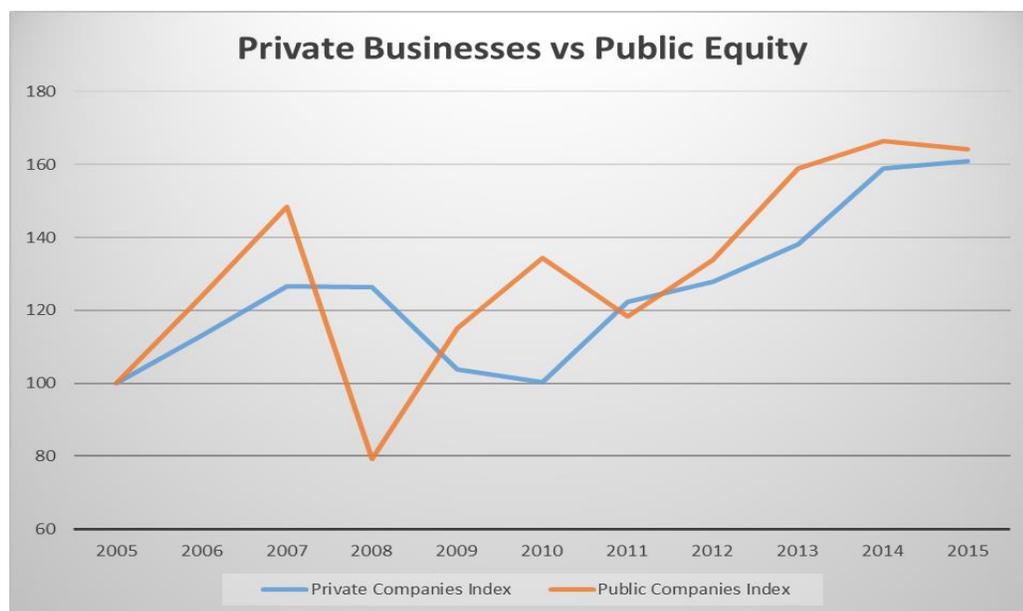
Private Businesses

The vast majority of businesses in the world are privately held, yet few academic articles aim at computing the market values of those firms. Physical capital is usually valued by the output it produces and not by the inputs needed in its production. Moreover, the process of valuing private companies should not be different from the process of valuing public companies. It means that one needs to estimate cash flows, attach a discount rate based upon the riskiness of the cash flows and compute a present value. However, for private companies there is no market value for equity as benchmark for intrinsic values. Moreover, among other cash flows issues, the financial statements for private firms are likely to go back fewer years, have less detail and have more holes in them (Damodaran, 2006).

Among some rare attempts, Anderson (2009) shows that private firms generate more income than their publicly held counterparts and uses a combination of tax earnings, net worth and tax filing status to derive the intrinsic values of US private firms. Given the lack of such data on a global scale, we had to use ratio analysis in order to estimate the market value of the private sector worldwide. Our first assumption was to consider small and middle enterprises (SME) as a good proxy for our universe of unlisted companies. The rationale is that the smallest listed companies have sizes (sales, employees) larger than the average SME. By contrast, we are aware that some large companies are privately

owned, therefore the match is not perfect. This assumption allows us to use the wealth of information available for European and American SMEs, including their gross value-added. With the help of the Eurostat annual reports on SMEs, we apply the average valued-added to GDP ratio to the world GDP in order to determine the gross profits of private businesses worldwide. Then, using trailing 12 month gross margin ratios from the MSCI world index, we derived each year the revenues generated by privately owned firms. Lastly, we apply historical MSCI world adjusted Price/Sales ratios to get our final numbers for the market value of the privately-owned companies. Interestingly, the public companies capitalizations and the privately held firms show similar growth over the last 10 years, however, the latter shows much lower volatility given that its main variations come from nominal GDP, more immune to market movements.

Figure 7: Private vs Public Market Capitalizations



Assets Excluded

As stated in the introduction, our objective is not to measure the wealth of nations, but rather to assess the measurable global capital stock, including both physical and financial capital. With regards to financial capital, our measure does not include all financial assets, and in particular we omit loans to the financial sector, which include for instance repos operations, federal funds, or interbank loans. These loans are usually collateralized, based on securities that we have already taken into account. Derivatives products are also not considered as they are based on notional amounts of underlyings already accounted for.

SNA (2008) distinguished physical capital between produced and non-produced assets. Produced assets are non-financial assets that have come into existence as outputs from production processes that fall within the production boundary of the SNA (2008). One may then wonder why some produced assets like housing, which are not always productive in use, is included in our measure while infrastructure, e.g. bridges, are not. One should recall that a produced asset is usually valued by the output it produces and not by the inputs needed in its production. The output generated by public infrastructure is usually unknown given the lack of markets transactions and its valuation is then impossible. Nonetheless, one must say that our measure takes into account private infrastructure as it is included in the equity valuation of both private and public companies.

Regarding non-produced assets, readers may also wonder why natural resources other than land are not included. For instance, commodities such as gold, which is widely used by investors to diversify risk, are not included. While flows data on commodities are public information, the estimation of the remaining stock of commodities on earth is rather uncertain. Meanwhile, the valuation of commodities-related private and public companies embeds by definition an exposure to commodities.

We are aware that the scope of our capital stock is somehow limited and readers may argue that our universe covers predominantly wealth or assets that generate income, rents, or dividends. But for consistency reasons, we took the stance of excluding assets whose stock measure is not observable or based on non-replicable methodologies. We now show the complete global portfolio components and their evolution over time.

The Global Capital Stock 2005-2015

Figures 8 and 9 depict the global financial stock per asset class during the last 10 years, expressed in Trillions of USD and as percentage respectively.

Figure 8: Global Capital Stock in \$ Trillion

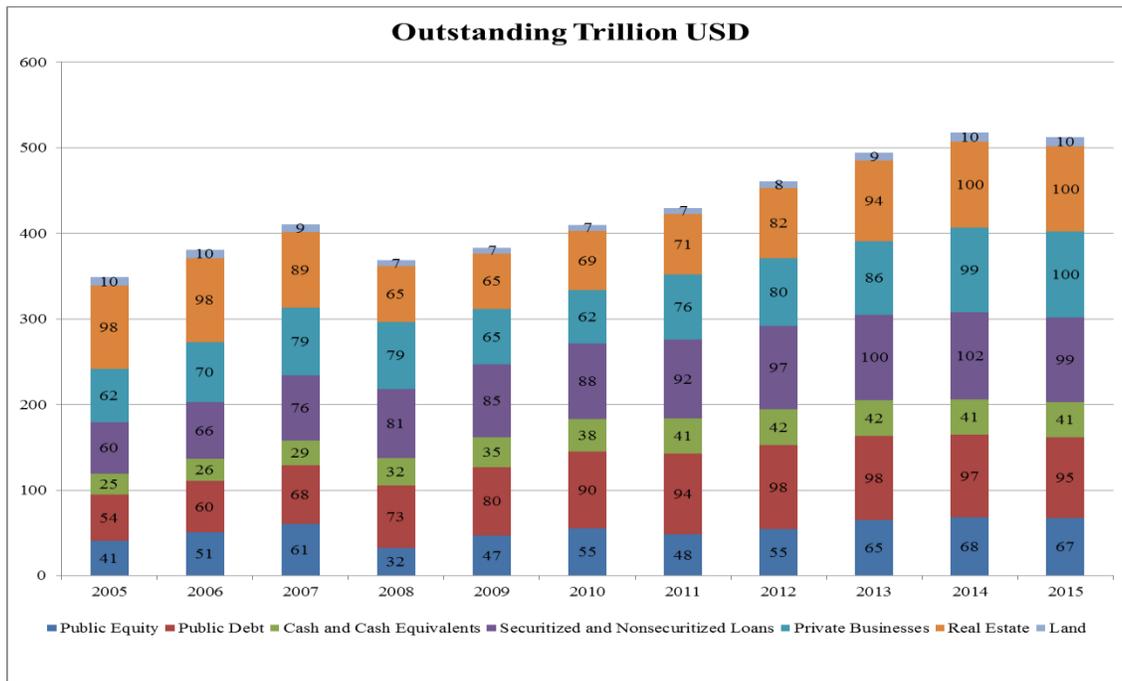
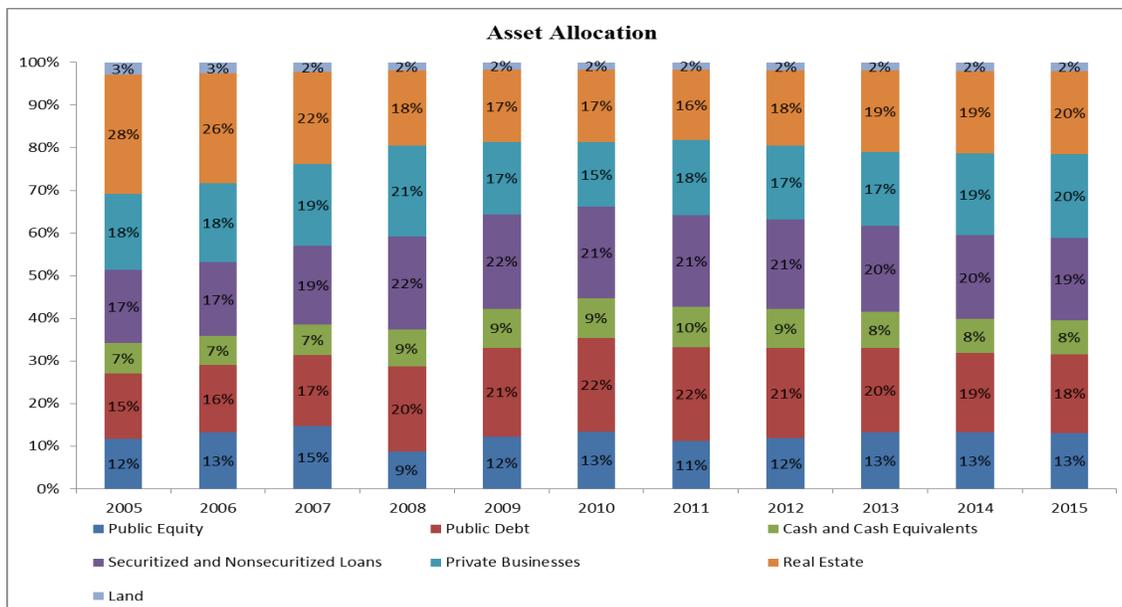


Figure 9: Global Capital Stock in percentage



The world's global capital stock reached \$512 trillion in 2015 down from \$517 trillion in 2014. The dominant asset class is real estate, expressed here as home equity value, with \$100 trillion in 2015, a value similar to the one during the peak of the real estate cycle in 2006. Accordingly though, its relative weight decreased from 28% to 20%, and this decline benefited the other asset classes equally. The stock of overall debt is the biggest component with \$194 trillion, loans growing without interruption until 2014 and non-financial corporate bond showing the biggest increase in 10 years. Private businesses amount to \$100 trillion in 2015. The stock of public debt stands at \$95 trillion, and has been relatively stable during the last 5 years, mainly due to an appreciation of the US dollar rather than a decrease in public borrowing as mentioned previously. Finally, equity holdings show an all-time high in 2015 with a stable weight over the last three years.

Conclusion

By comprehensively measuring the global capital stock, we see our research as a first important achievement towards reliably defining a natural benchmark for multi-asset portfolios. Some of the limitations of our research consist of an intrinsic margin of error in measuring the global capital stock given the lack of data for non-financial assets. However, we feel strongly optimistic about future development about data gap initiatives, which will further reduce the margin of error. We will continue our efforts on searching for better measures of the global capital stock.

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