Strategic Asset Allocation:
The Global Multi-Asset Market Portfolio 1959-2011

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November 2012

Abstract

The portfolio of the average investor contains important information for strategic asset allocation purposes. This portfolio shows the relative value of all assets according to the market crowd, which one could interpret as a benchmark or the optimal portfolio for the average investor. We determine the market values of equities, private equity, real estate, high yield bonds, emerging debt, non-government bonds, government bonds, inflation linked bonds, commodities, and hedge funds. For this range of assets, we estimate the invested global market portfolio for the period 1990-2011. For the main asset categories equities, real estate, non-government bonds and government bonds we extend the period to 1959-2011. To our understanding, we are the first to document the global multi-asset market portfolio at these levels of detail for such a long period of time.

JEL classification: G11, G12

Key words*: strategic asset allocation, optimal portfolio, global multi-asset market portfolio*

1. Introduction

In this paper, we contribute to the literature by documenting the invested global multi-asset market portfolio. This portfolio is the aggregate portfolio of all investors, where portfolio weights indicate the constitution of the average portfolio. It contains important information as it represents the views of the market crowd with respect to the pricing and value of each asset class. Hereby, it can serve as a benchmark for the strategic asset allocation of investors. It can also be used as a starting point for portfolio construction or as a sanity check to determine deviations of the investor's portfolio from the market portfolio. Also, practitioner's using the asset allocation framework of Black and Litterman (1992) need the market portfolio to derive the expected returns implicitly priced in by all market participants. In addition, investors employing tactical asset allocation strategies might use large deviations from long term average market portfolio weights as a valuation indicator. But, aside from these practical perspectives, the market portfolio is also interesting from a theoretical perspective.

Tobin (1958) assumes that all assets are traded on financial markets. From his model, Tobin (1958) concludes that investors should invest in a combination of the market portfolio and a risk-free asset. With additional assumptions, this theory has lead to the development of the Capital Asset Pricing Model (CAPM), which has important implications. It states that each investor should invest in exactly the same portfolio of risky assets, the market portfolio. How much is invested in this market portfolio and how much in the risk-free asset depends on the amount of risk an investor is prepared to take. Thus, the existence of two mutual funds in the world is sufficient to meet the demand of all investors: one riskless money market fund and one fund that consists of the entire market of risky assets. For investors with liabilities, such as sovereign wealth funds or pension funds, the risk-free asset may be replaced by a "hedging asset" mimicking the liabilities, see Sharpe and Tint (1990).

The CAPM is frequently used in modern day finance to advocate passive index investing, see Goltz and Le Sourd (2011). Although thousands of passive index tracking funds are available these days, we have not been able to find one that aims to offer the global market portfolio. Investors who are willing to build this portfolio need to buy securities or funds from each of the asset classes separately and make allocations according to world market capitalizations. An important application of our study is to determine the strategic asset allocation weights of an investor who targets investing according to world market capitalizations.

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The validity of the CAPM has been tested extensively in the decade after it was developed. Roll (1977) criticizes empirical tests of the CAPM because many assets, such as human capital, are in reality non-tradable and hence cannot be part of the investable market portfolio.[1] But, Rosenberg (1981) and Stambaugh (1982) claim that different specifications of the market portfolio are unlikely to lead to different conclusions about the CAPM.[2] They recommend using the traded market portfolio in empirical applications. Moreover, Rudd and Rosenberg (1980) indicate that in an environment of investment management it is more useful to construct a market index that represents the opportunity set of the portfolio manager instead of a theoretical construct that is not observable in practice. For example, Brinson, Diermeier, and Schlarbaum (1986) first develop an invested market capitalization weighted benchmark for pension plans that contains nine asset classes: domestic large cap equities, domestic small cap equities, international equities, venture capital, domestic bonds, international dollar bonds, non-dollar bonds, real estate, and cash equivalents. In a second step, they improve upon the invested market capitalization benchmark by constructing a mean-variance efficient portfolio. Another example is Bekkers, Doeswijk, and Lam (2009) who distinguish a wide range of global asset classes simultaneously in a mean-variance analysis, a market portfolio approach, as well as a combination of both.

In our study we distinguish ten established asset classes: equities, private equity, listed and unlisted real estate, high yield bonds, emerging market debt, non-government bonds, government bonds, inflation-linked bonds, commodities and hedge funds.

We focus on the invested market portfolio. This is a subset of the investible portfolio. The investible portfolio refers to all assets that investors could and would invest in, if they would be available for them. The invested portfolio contains all assets that investors actually have invested in. So, for example, we exclude durable consumption goods, human capital, private housing, small private enterprises, government stakes in companies, or central bank holdings of gold. We focus on the invested portfolio because we try to assess the aggregate portfolio of all investors, which can serve as a reference for strategic asset allocation purposes. Then, it makes no sense to take assets into account that investors are not invested in. Our study differs from studies that include assets in which investors

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[1] Anthanasoulis and Shiller (2000) develop a theoretical model in which they show that making these non-traded assets tradable would increase social welfare.
[2] Brown and Brown (1987) document that ranking of mutual fund performance is not sensitive to different specifications of the market portfolio, but the estimation of out- or underperformance depends highly on the market index used.

are not invested like Ibbotson and Siegel (1983), Ibbotson, Siegel, and Love (1985) and Roxburgh, Lund and Piotrowski (2011).

In addition to providing an estimate of the world market portfolio for the end of 2011, we track the world market portfolio for these ten asset classes over the period 1990 to 2011. This is a non-trivial exercise, as invested market capitalizations are not readily available for each of these asset classes over this historical period. For the asset classes equities, real estate, non-government bonds and government bonds we even extend the period back to 1959. To our understanding, we are the first to document the global market portfolio at this level of detail for such a long period of time.

2. The global market portfolio 2011

In the appendix we describe our data sources and methodology in detail. Here, once again we stress that we focus on the invested market portfolio. This sums up to the opportunity set that is available to investors. We estimate the total market capitalization of the invested global multi-asset market portfolio at USD 83.5 trillion at the end of 2011. Equities represent the largest asset class with a market value of USD 29.0 trillion, or 34.7% of the total market capitalization of all asset classes. Government bonds follow closely with USD 25.0 trillion, which equals 30.0% of the market portfolio. Non-government bonds, primarily consisting of corporate bonds and mortgage backed securities, are worth USD 15.4 trillion or 18.4%. All other asset categories are relatively small compared to these three asset classes. They vary from USD 0.4 trillion (0.5%) for commodities to USD 3.7 trillion (4.4%) for real estate. The market capitalization of these seven relatively small asset categories adds up to USD 14.1 trillion (16.9%).

Figure 1. Global market portfolio ultimo 2011 (USD trillion and as %)
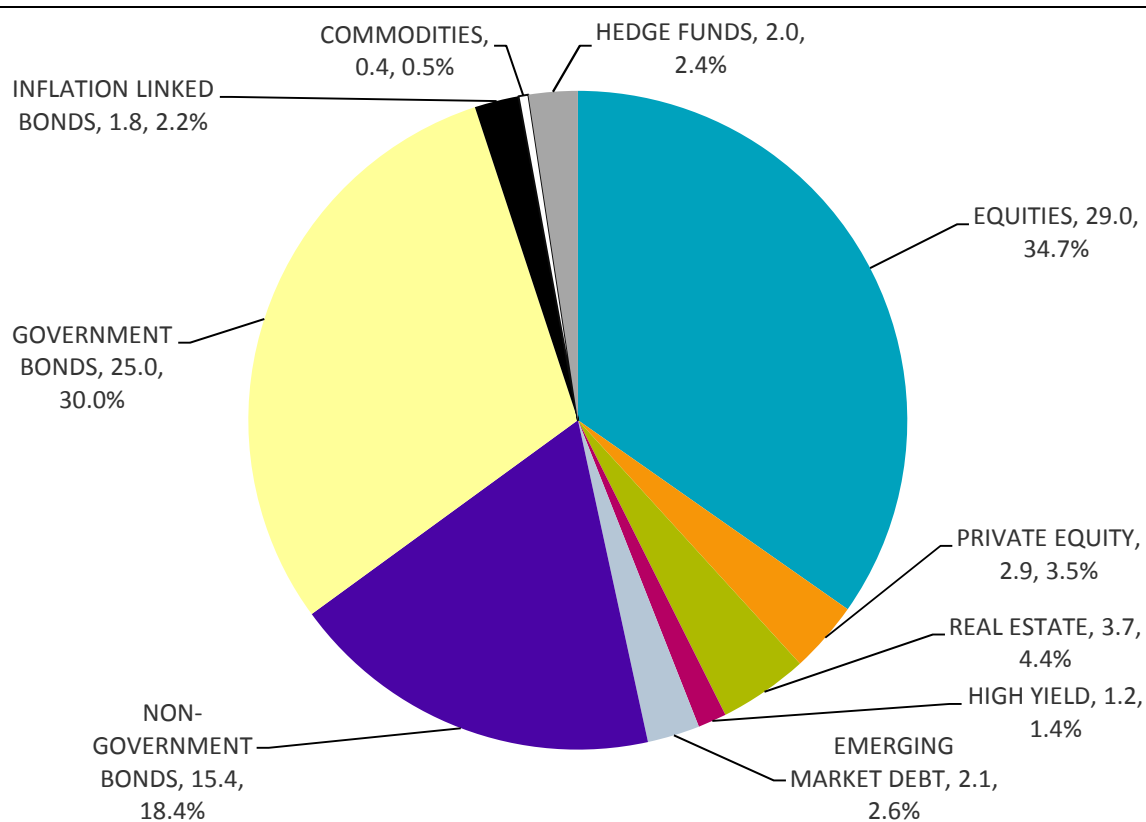
Our estimate for equities is in line with Idzorek, Barad and Meier (2006) from Ibbotson Associates. They estimate the market capitalization of equities to add up to USD 29.1 trillion in their market value

approach, which is in between our year end 2005 estimate of USD 28.4 trillion and the USD 33.7 trillion figure for 2006.[3] Roxburgh, Lund and Piotrowski (2011) estimate the global market capitalizations for equities and debt. Their estimated market values are substantially higher for equities and government bonds than our estimates. They do not document their methodology or their sources. As they add the value of government stakes in listed companies, they use investibility as a criterion, instead of the invested criterion that we use. For countries like China, this can make a substantial difference. To illustrate, they estimate the global stock market capitalization at USD 54 trillion at the end of 2010. For outstanding public debt securities they arrive at USD 41 trillion. For 2010, we estimate the market value of equities at USD 32 trillion, USD 22 trillion less than Roxburgh, Lund and Piotrowski (2011). Our 2010 estimate for the total value of government bonds, emerging debt and inflation linked bonds is USD 27 trillion. This is USD 14 trillion below the number for public debt of Roxburgh, Lund and Piotrowski (2011).

We now have a static estimate of the global multi-asset market portfolio. An estimate over a long period of time can provide insight into the dynamics of the market portfolio. These dynamics show the range and the volatility of historical asset class weights. Such a reference might be useful in determining investors' own strategic asset weights. Next, tactical asset allocation strategies might use large deviations from long term average market portfolio weights as a valuation indicator. In our next two sections we discuss the historical dynamics of the market portfolio. First, we document the market portfolio for a range of ten asset classes over the 22-year period 1990-2011. Then, we extend the analysis to the 53-year period 1959-2011 for four main asset classes.

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[3] Unfortunately, Idzorek, Barad, and Meier (2006) do not explicitly mention the date on which their estimate is based.

3. The global market portfolio 1990-2011

For the period 1990-2011 we have collected market capitalization data for ten asset classes. The further we go back in time, the less trivial it is to construct market capitalizations from standard data sources. A potential challenge is that several index providers did not cover as many assets historically as they do today. This could imply that the historical market portfolio weights are biased. On the other hand, the lower coverage of data providers in the past could also be related to the lower investibility of some of the asset classes. For this part, it would not bias our market portfolio weights. Our assumption, which we admit might be strong, is that the coverage of the data sources for all asset classes grows at the same rate.

As a kind of reality check on our data, we try to establish whether the portfolio weights obtained through our data sources and methodology leads to sensible outcomes. Therefore, we compare our estimated global market portfolio weights for the categories equities, real estate, government bonds and non-government bonds over the period 1985-2011 with the estimates of the US market portfolio by Ibbotson, Siegel, and Love (1985) for the period 1959-1984. This comparison supposes that market portfolio weights of these four main asset classes should resemble each other to some degree during two sub-periods of the 61 year sample period. At such a horizon one could argue this should be the case as (1) corporate balance sheets contain both debt and equity that are both available to investors, (2) the enterprise value of companies is related to the size of the economy, while the size of debt and the debt capacity of governments is related to the size of the economy and (3) the value of real estate is also connected to the size of the economy. At least, we would be very puzzled if this analysis would for example show that in the first sub-period all four main categories would on average have had roughly equal weights while the second sub-period would show major differences between asset class weights.

For the comparison, we prefer to use the US estimates of Ibbotson, Siegel, and Love (1985) for the period 1959-1984 estimates instead of their global estimates. This enables us to incorporate real estate in this reality check as they do not provide estimates for real estate outside the US. For this purpose, we have extended our estimates for these four categories back to 1985, as described in the appendix. A data extension before 1990 is also needed to compose data series for four main asset categories from 1959 to 2011 that we discuss in the next section.

Table 1. Weight of an asset class as a percentage of the total market value of four main asset classes (period averages)

	1959-1984 (US)	1985-2011 (global)
Stocks	61.0%	51.6%
Real estate	3.9%	4.3%
Non-government bonds	12.0%	14.5%
Government bonds	23.1%	29.6%
Real estate as % stocks	6.7%	5.3%
Non-government bonds as % government bonds	54.9%	57.2%

As Table 1 shows[4], our estimate for the average weight of global stocks in the period 1985-2011 (51.6%) is roughly 9% below the estimated weight of stocks in a US portfolio for the period 1959-1984 (61.0%). For each of the other three asset classes, our estimates are somewhat higher. The weight of real estate relative to stocks and the weight of non-government bonds relative to government bonds closely resemble each other. The value of global real estate equals 5.3% of global stocks in 1985-2011. For the US this is 6.7% for the period 1959-1984. Global non-government bonds are on average worth 57.2% of government bonds in the period 1985-2011 while this is 54.9% in the US from 1959 to 1984. Hence, a comparison of the weights of our global market portfolio with historical estimates on the US market suggests that our estimates make economic sense.

Figure 2 shows the global market portfolio from 1990 to 2011. The general picture is a declining weight for equities at the benefit of other asset classes, especially non-government bonds. Equities fall from a 51.4% weight at the end of 1990 to 34.7% in 2011. Non-government bonds rise from 11.4% 18.4%. Next, private equity and hedge funds grow 2.6%-point and 2.0%-point respectively to 3.5% and 2.4%. High yield bonds, emerging market debt and inflation linked bonds rise between 1.2% and 1.8% to end of period weights between 1.4% and 2.6%. Weights in other asset classes change less than

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[4] We divide the Ibbotson, Siegel, and Love (1985) estimate for the value of business real estate by four to arrive at a proxy for the equity component of invested real estate, see the appendix. Next, Ibbotson et al. (1985) label corporate issued bonds corporate bonds whereas we use the term non-government bonds for investment grade corporate bonds as this asset class also comprises mortgage backed securities, as well as a minor weight of other asset backed securities. We separately distinguish high yield bonds, which we add here to non-government bonds for comparison with Ibbotson et al. (1985) data. Here, we also add emerging debt and inflation linked bonds to government bonds.

1%-point. The total weight of the relatively small asset classes, everything outside stocks, non-government bonds and government bonds, rises from 6.6% to 16.9% throughout this 21 year period.

Figure 2. Global market portfolio over the period 1990-2011 (%)
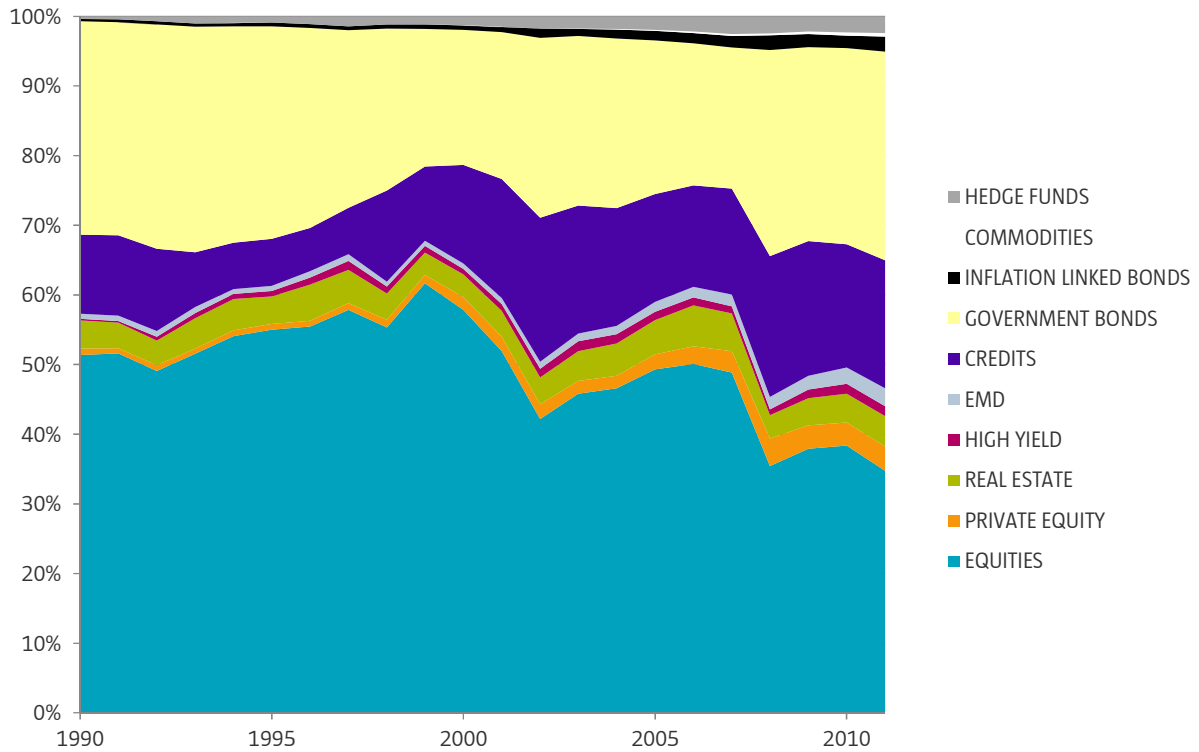

Figure 3 contains the estimated market values in absolute numbers in billions of US dollars. The global market portfolio in 1990 amounted to approximately USD 11 trillion, USD 39 trillion in 2000 and 84 USD trillion in 2011. These figures should be taken as a rough indication. Under the assumption that the coverage of the data sources for all market segments grows at the same rate, relative data are completely accurate. But, with increasing market coverage, absolute data underestimates the market capitalization in 1990 more than in the years afterwards. To illustrate, suppose market coverage for all asset classes has grown a percentage point a year from, for example, 77% to 98% during the 1990-2011 period. Then, the global market portfolio in 1990 would have been USD 14 trillion instead of USD 11 trillion.

Figure 3. Global market portfolio over the period 1990-2011 (USD billion)
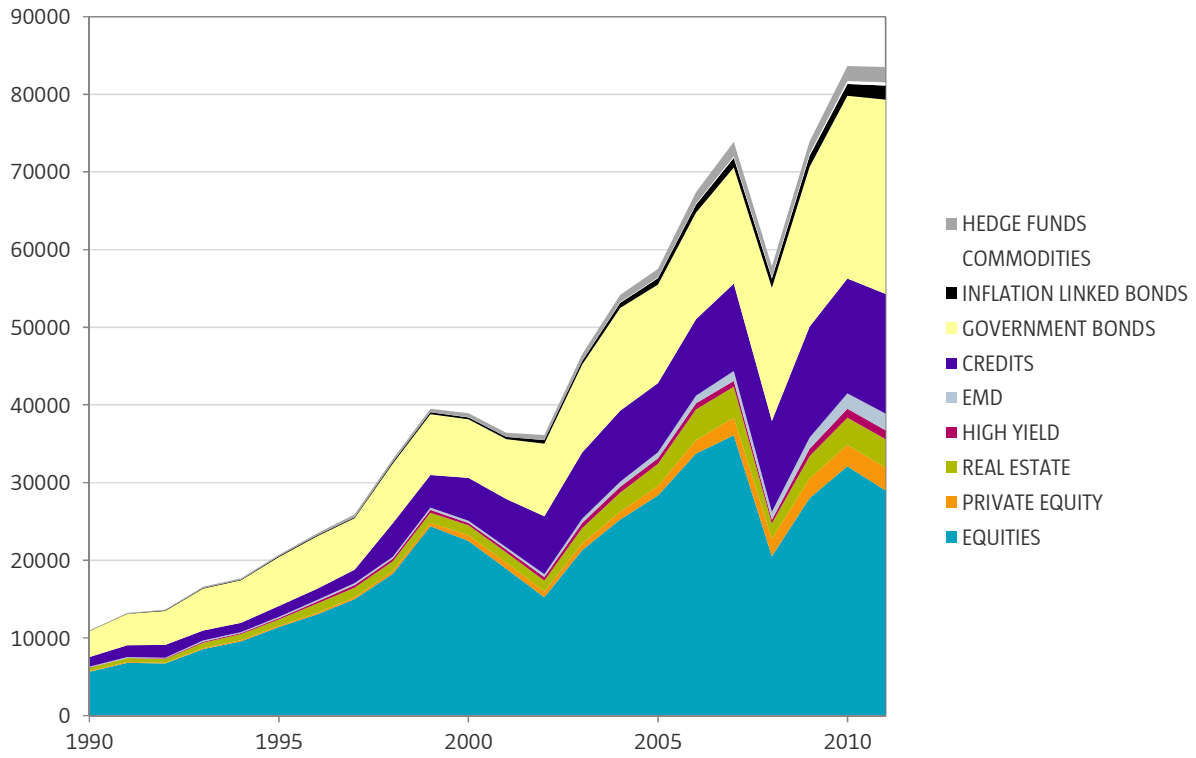
4. The global market portfolio 1959-2011

We determine the global market portfolio for the 53-year period 1959-2011 for the four main asset categories equities, real estate, non-government bonds and government bonds. Here, we broaden the definition for non-government bonds and government bonds. Now, we include high yield bonds in non-government bonds and we classify emerging debt and inflation linked bonds within government bonds. Private equity, commodities and hedge funds are not included in this analysis. We use the Ibbotson, Siegel, and Love (1985) world market capitalizations data as an indication how international financial markets have been developing from 1959 to 1984. As they do not provide data for real estate outside the US, we use their US estimates for business real estate to derive our global estimate of the market capitalization of invested commercial real estate.

Before we move on, we take a closer look at 1984, the year at which we stick the two datasets together. Table 2 shows the relative portfolio weights in 1984 for the world from Ibbotson, Siegel and Love (1985) and our global estimate[5]. Note that we cannot include real estate in this check. The data resemble each other, with differences in portfolio weights in 1984 for all three asset classes limited to a maximum of 2.5%-point.

Table 2. Global asset class portfolio weights in 1984

	Ibbotson ea. (1985)	Our data
Stocks	46.5%	49.1%
Non-government bonds	14.4%	13.6%
Government bonds	39.1%	37.3%
Total	100.0%	100.0%

To examine the weight of real estate in 1984 we compare asset class weights in the US of Ibbotson, Siegel, and Love (1985) to our global weights, as we backfill real estate before 1984 with US data. Ibbotson, Siegel, and Love (1985) end their US dataset at a 4.3% weight for real estate, while our global dataset starts with at 2.2% weight in 1984. So, by backfilling the global data sample for real estate with US data before 1984, we might underestimate the weight of real estate as the year that we initiate our backfilling seems to have a low starting value.

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[5] Please, note again that here we sum emerging debt, inflation linked bonds and government bonds for the period 1984-2011 to arrive at an estimated weight for (broader defined) government bonds in the market portfolio. See our earlier remarks.

Figure 4 shows the weightings of asset classes in the global market portfolio from 1959 to 2011. During this period, the weight of stocks declines 14.1%-point from 51.2% to 37.1%, as illustrated in Table 3. The weight of equities in 2011 is at a record low. The maximum weight for equities has been 64.1% in 1968. The weight in 1999 of 63.2% comes close to this maximum. The period average for equities is 52.3%. In 2011, at the end of the sample period, the weighting of 37.1% is 15.1%-point below this average. In 2011, for the first time in our 1959-2011 sample period, equities no longer outweigh government bonds.

On balance, the other three main asset categories have a smaller change in portfolio weight during the sample period than equities have had. Also, their current weightings are closer to the period average than for equities. During the sample period, government bonds' weighting rises 7.5%-point from 29.6% to 37.1%, close to their 37.3% high in 1982. In 2011 their weight is 7.6%-point above the period average of 29.5%. Non-government bonds see their weight increase 3.4%-point from 17.8% in 1959 to 21.2% in 2011. At the end of the sample period their weight is 6.1%-point ahead of their period average of 15.0%. Finally, the weight of real estate rises from 1.4% to 4.7% through the sample period, while the 4.7% weight in 2011 is 1.5% above the period average. However, as we have indicated before, we might underestimate the weight of real estate before 1984. Therefore, the weight in 2011 could well be closer to its average than these data suggest.

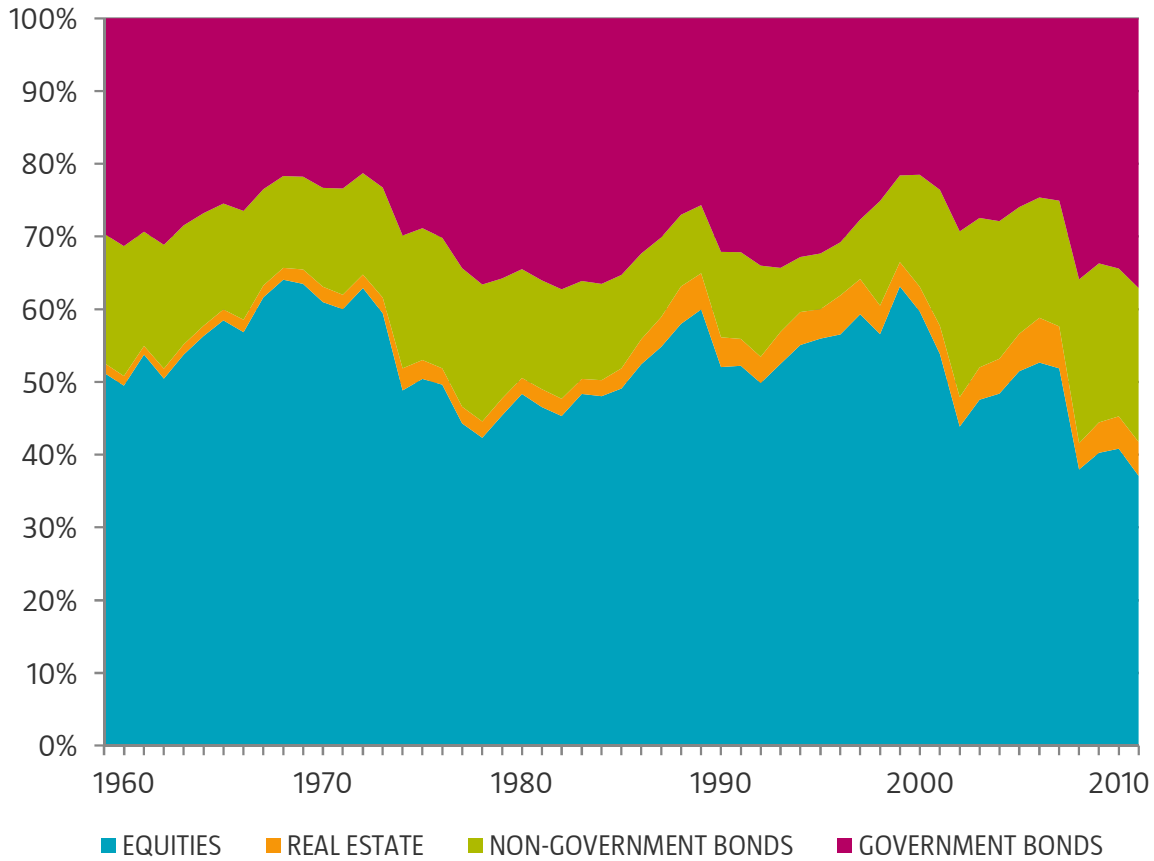**Figure 4. Global market portfolio over the period 1959-2011 (%)**

Table 3. Data characteristics for four main asset categories 1959-2011

	1959	2011	Minimum	Maximum	Average	2011-/-avg.
Equities	51.2%	37.1%	37.1%	64.1%	52.3%	-15.2%
Real estate	1.4%	4.7%	1.2%	6.2%	3.2%	1.5%
Non-government bonds	17.8%	21.2%	7.3%	22.8%	15.0%	6.1%
Government bonds	29.6%	37.1%	21.3%	37.3%	29.5%	7.6%

5. Summary

The invested market portfolio represents the views of the market crowd with respect to the pricing and value of all asset classes. Hereby, it can serve as a benchmark for the strategic asset allocation of investors. We focus on the invested global multi-asset market portfolio representative for investors. For the period 1990-2011 we determine the market capitalizations of ten asset classes: equities, real estate, high yield bonds, emerging debt, non-government bonds, government bonds, inflation-linked bonds, commodities, private equity, and hedge funds. At the end of 2011, we estimate the total market capitalization of the invested global multi-asset market portfolio at USD 83.5 trillion. Equities (34.7%) represent the largest asset class. Government bonds (30.0%) follow closely, while non-government bonds (18.4%) are also a major asset class. The market capitalization of the other seven asset categories (16.9%) is relatively small. But, the total weight of the relatively small asset classes has been on the rise with an increase from 6.6% to 16.9% throughout the 21 year period.

For the four main asset categories equities, real estate, non-government bonds (now broader defined and including high yield bonds as well) and government bonds (now also including inflation linked bonds and emerging debt) we compile data series for the period 1959-2011. At the end of 2011, the market portfolio weights for these four main categories are 37.1%, 4.7%, 21.2% and 37.1% respectively, with 53-year period averages at 52.3%, 3.2%, 15.0% and 29.5% respectively. In 2011, for the first time in our 1959-2011 sample period, equities no longer outweigh government bonds.

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Appendix: data sources and methodology

We derive the global multi-asset market portfolio from a variety of sources that we consider to be good in providing an assessment of the market size of an asset class. Below we discuss our data sources and the methodology that we use to arrive at our estimates. We provide year end estimates in US dollars.

Equities

For stocks we use the market capitalization of the MSCI All Countries Index. We sum the market values of the standard index, which contains large and mid caps, and the small cap index. We then subtract the weight of REITs as they are part of the real estate asset class in this study.

Before 1987, there is no MSCI AC World Index data available. Therefore, we use the annual percentage change in the market capitalization MSCI World index, which only contains developed markets, to backfill the market value of the standard index to 1984.

Before 2004, there is no market capitalization data of the MSCI AC World small cap index available. We proxy the market capitalization by the following formula

(1) $Mktcap_t^S = k_t \times Mktcap_t^L$

where asset S is the MSCI AC World small cap index and asset L the MSCI AC World large and midcap index. The multiplication factor k is known for 2004 as both market capitalizations are available. Before 2004, we determine k by the relative price performance of both assets over the subsequent period as we backfill the data. We use the following formula

(2) $k_{t-1} = k_t \times Price\ Return_t^L / Price\ Return_t^S$

where *t* starts in 2004 which is the first year to calculate *k* for the period 1994-2003. With these estimates we derive the market value of small caps by multiplying these weights by the market value of large and mid caps. This is the methodology displayed in Equations (1) and (2). Subsequently, for the period 1988-2003 we use the relative performance of the Russell 2000 to the Russell 1000 index to estimate the weight of small caps relative to large and mid caps, for the period 1984-1987 we use the

SMB-factor from the online data library of Kenneth French[6] to do this. Again, we derive the market value of small caps by multiplying these weights by the market value of large and mid caps.

As a final correction, we subtract the market value of REITs from the total estimated market value of equities. We use the market value of the MSCI industry REITs, which is available for the standard index from 2006 and for small caps from 2007. To backfill 2006 for small caps, we suppose that the percentage change from the 2006 to 2007 market cap equals the change in the standard index. Then, for both the standard index and the small cap index, we backfill the REITs series for the period 1994-2005 with the percentage changes in the market value of the industry group real estate of the MSCI AC World Index. For the period 1986-2003 we use the MSCI World Index for real estate to do the same for that period. Finally, for 1984 and 1985, we use the percentage change in the price index of the MSCI World Index for real estate for backfilling, as market capitalization data are not available prior to 1986.

Private equity

For the period 2000-2011 we use data from Preqin. Their 2011 estimate is not a year end figure but a mid year number. For the period 1990-1999 we use Thomson Reuters data as published in Leitner, Mansour and Naylor (2007).

Real estate

Within the real estate market, a distinction should be made when it comes to commercial and residential real estate. The residential market would be much bigger than the commercial market, were it not for the fact that a large portion of this market is the property of the occupiers or residents. Hordijk and Ahlqvist (2004), as an extreme example, estimate that only five percent of all residential real estate in the UK is available to investors. Added to investability constraints, most individual investors already have an exposure to residential real estate that exceeds the money they have available for investments, simply because they own their homes.

This study focuses on commercial real estate only. The commercial real estate market is valued by using data from RREEF Real Estate Research, see Hobbs and Chin (2007). RREEF divides the market

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[6] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

estimate of real estate into the four quadrants of public equity, private equity, public debt and private debt. At the end of 2006, they estimate the investable and invested markets at USD 16.0 and 9.8 trillion respectively. The 9.8 trillion estimate is the total market and includes both equity and debt. The equity component of invested real estate, which is the universe suitable for comparison in this framework, is USD 4.0 trillion. Public equity represents by far the largest part with roughly 85%, leaving 15% to private equity. The USD 4.0 trillion estimate is close to the figure given by Idzorek, Barad, and Meier (2006), who estimates this measure of the global real-estate market at USD 4.6 trillion. Real estate debt, such as MBS, can be considered as part of the fixed income asset class and is in fact largely captured by the estimate for credits.

We use the market capitalization of the GPR General PSI Global index to backfill the period 1984-2005, as well as to fill the period 2007-2011. Here, we use the 2006 estimate of USD 4.0 bln as a starting point. Subsequently, we use percentage changes in the market capitalization series to arrive at estimates for all other years.

High yield bonds

For high yield we use the market capitalization of the Barclays Capital Global Corporate High Yield Index, available from 2000 onwards. For the period 1990-1999, we base our estimates on the Barclays Capital Global High Yield Index. This index also includes sovereign high yield from emerging markets that we prefer to classify as emerging debt. To correct, we first calculate the weight of the Barclays Capital Global Corporate High Yield Index relative to the Barclays Capital Global High Yield Index for the period 2000-2011. It appears that the relative weight has on average grown 2% a year over that period. Subsequently, we suppose the 2% growth rate also applies to the 1990-1999 period. Our methodology here still uses Equations (1) and (2), but the multiplication factor k is now a constant, as represented by Equation (3):

$$(3)\ k_{t-1} = \frac{k_t}{1+c}$$

where the constant c = 2% for this asset class.

Before 1990 we suppose that the market capitalization of high yield as a percentage of the (estimated) market capitalization Barclays Capital Global Treasury Index grows 8% a year, in line with the 1990-2011 growth rate. Subsequently, we multiply this percentage with the market capitalization of the

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(estimated) market capitalization of the Barclays Capital Global Treasury Index. We use the Barclays Capital Global Treasury Index as a reference index because it has the longest dating history of market capitalizations available. Hence, we employ Equation (3) with $c = 8\%$.

Emerging debt

For emerging market debt we sum the JP Morgan Government Bond Index Emerging Markets Global Composite for external (hard currency) debt, JP Morgan EMBI Global Composite for local currency debt, the JP Morgan Corporate Emerging Markets Bond Index for USD denominated emerging market corporate bonds and the Barclays Capital Emerging Markets Government Inflation-Linked Index for inflation linked bonds.

The external debt data start in 1993. Before that period we assume that the growth rate equals the growth in the market capitalization of global treasury bonds. The data for the period 1993-2011 suggest that the growth of external emerging market debt on balance roughly matches the growth of global treasury bonds. For local currency debt, data start in 2002. Before that period, we suppose that the growth rate relative to the market capitalization of external debt equals the 13% compounded growth rate of the period 2002-2011. The corporate emerging debt data start in 2001. Prior to that date we suppose that the growth relative to external debt equals the 6% compounded growth rate in the estimated market capitalization of external debt over the period 2002-2011. Hence, we employ Equation (3) with $c = 13\%$ and $c = 6\%$ for local currency emerging debt and corporate emerging debt, respectively. For inflation linked bonds the data series start in 2003. Before, we use data from Swinkels (2012).

For the period 1984-1989 we assume that the market capitalization of emerging debt has grown in line with our estimate for (developed markets) government bonds.

Non-government bonds

Non-government bonds primarily consist of corporate debt and mortgage backed securities. We estimate the market capitalization of investment grade non-government bonds by subtracting the (estimated) market capitalization of the Barclays Capital Multiverse Government and the Barclays Capital Global High Yield indices from the (estimated) Barclays Capital Multiverse Index.

Government Bonds

We use the market capitalization of the Barclays Capital Multiverse Government Index as a proxy for the government bonds market. These data are available from 2005 on. Before, we suppose that this index has grown in line with the market capitalization of the Barclays Capital Global Treasury Bond Index, which has data from 1987 on. For the period 1984-1986, we use the growth rate of the market capitalization of the Barclays Capital US Treasury Index to backfill our estimates for the market capitalization of global government bonds. We have limited double counting as some emerging markets qualify for the Barclays Capital Global Treasury Bond Index. However, emerging sovereign debt is small compared to sovereign debt in developed markets. Therefore, the double counting will result in just a marginal bias.

Inflation linked bonds

For inflation linked bonds we use the market capitalization of the Barclays Capital Global Aggregate Inflation-Linked Index, available from 2000 on. For the period 1997-1999 we suppose that the market capitalization develops in line with the market combined market capitalization of the US and UK inflation linked market. For 1996 we use the market capitalization of the UK inflation linked market. We derive these country data from Barclays Capital indices. Finally, for the period 1984 to 1995 we suppose that the market capitalization of inflation linked bonds as a percentage of the (estimated) market capitalization Barclays Capital Global Treasury Bond Index grows 9% a year, in line with the 1996-2011 growth rate. Here, c in Equation (3) becomes 9%. Subsequently, we multiply this percentage with the market capitalization of the (estimated) market capitalization of the Barclays Capital Global Treasury Bond Index.

Commodities

We use estimates of the assets under management in commodities from the commodity research department of Barclays Capital over the period 1990-2011. Cooper et al. (2012) contains their most recent update.

Hedge funds

For hedge funds, we use the Hedge Fund Research estimates of (unleveraged) assets under management. Obviously, double counting takes place here, as hedge funds also invest in assets described in this section, next to derivatives that we neglect (with the exception being commodities, where Barclays also takes index swaps into account). One could even argue that hedge funds are no asset class but active trading strategies employed by (perceived) skillful portfolio managers. Nevertheless, we include hedge funds as a separate asset class. But, we cannot correct for double counting as we have no detailed data available. As hedge funds are a relatively small asset class, this only introduces a small bias in our estimates.