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The Global Multi-Asset Market Portfolio, 1959–2012

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The market portfolio contains important information for purposes of strategic asset allocation. One could consider it a natural benchmark for investors. The authors composed the invested global multi-asset market portfolio for 1990–2012 by estimating the market capitalization for equities, private equity, real estate, high-yield bonds, emerging-market debt, investment-grade credits, government bonds, and inflation-linked bonds. They also used an expanded period (1959–2012) for the main asset categories: equities, real estate, nongovernment bonds, and government bonds.

Our study contributes to the literature by documenting the invested global multi-asset market portfolio. This portfolio is the aggregate portfolio of all investors, in which portfolio weights indicate the constitution of the average portfolio. It contains important information because it represents the views of the global financial investment community with respect to the pricing of each asset class. Hence, it can serve as a benchmark for investors' strategic asset allocations. As Sharpe (2010) advocated, the market portfolio can also be used as a starting point for portfolio construction.

The asset allocation framework of Black and Litterman (1992) affords an important application of the global multi-asset market portfolio. Practitioners who use this framework need the market portfolio to derive the expected returns—implicitly priced in by all market participants—by reverse-engineering the mean–variance optimization problem. In the next step, investors can express their own views and corresponding uncertainty in determining their optimal asset allocations. In addition, investors who follow tactical asset allocation strategies might use large deviations from long-term average market portfolio weights as a valuation indicator. But aside from these practical considerations, the market portfolio is also interesting from a theoretical perspective.

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The capital asset pricing model (CAPM) states that each investor should invest in exactly the same portfolio of risky assets—the market portfolio. How much is invested in the market portfolio depends on the amount of risk an investor is prepared to take. The CAPM is frequently used in modern-day finance to advocate passive index investing (see Goltz and Le Sourd 2011). An important application of our study is to determine the strategic asset allocation weights of a CAPM investor who targets investing according to market capitalizations. As Rudd and Rosenberg (1980) showed, constructing an invested market index is useful in an asset management environment; indeed, that was the aim of our study, in which we documented the global invested multi-asset market portfolio.[1] None of this is to imply that the market portfolio has been the optimal portfolio in practice. Asness, Frazzini, and Pedersen (2012) demonstrated that, assuming leverage aversion, the tangency portfolio formed on the basis of risk parity between asset classes leads to a higher risk-adjusted return than does the market portfolio.

In our study, we used eight established asset classes: equities, private equity, listed and unlisted real estate, high-yield bonds, emerging-market debt, investment-grade credits, government bonds, and inflation-linked bonds.[2] Investors have easy access to these asset classes through mutual funds or index funds. In addition to estimating the world market portfolio for the end of 2012, we tracked the market portfolio for the eight asset classes over 1990–2012. For the four main asset classes—equities, real estate, nongovernment bonds, and government bonds—we expanded the period to 1959. To our knowledge, we are the first to have

documented the global market portfolio at these levels of detail over such a long period.

We focused on the *invested* market portfolio, which contains all assets in which financial investors have actually invested. So, for example, we excluded durable consumption goods, human capital, private housing, and family businesses. The presence of an asset in the benchmark of leading index providers is generally an important criterion. We focused on the invested portfolio because we tried to assess the aggregate portfolio of all financial investors, which can serve as a reference for purposes of strategic asset allocation. Our study differs from others (e.g., Ibbotson and Siegel 1983; Ibbotson, Siegel, and Love 1985; Roxburgh, Lund, and Piotrowski 2011) in that we included publicly available financial assets only.

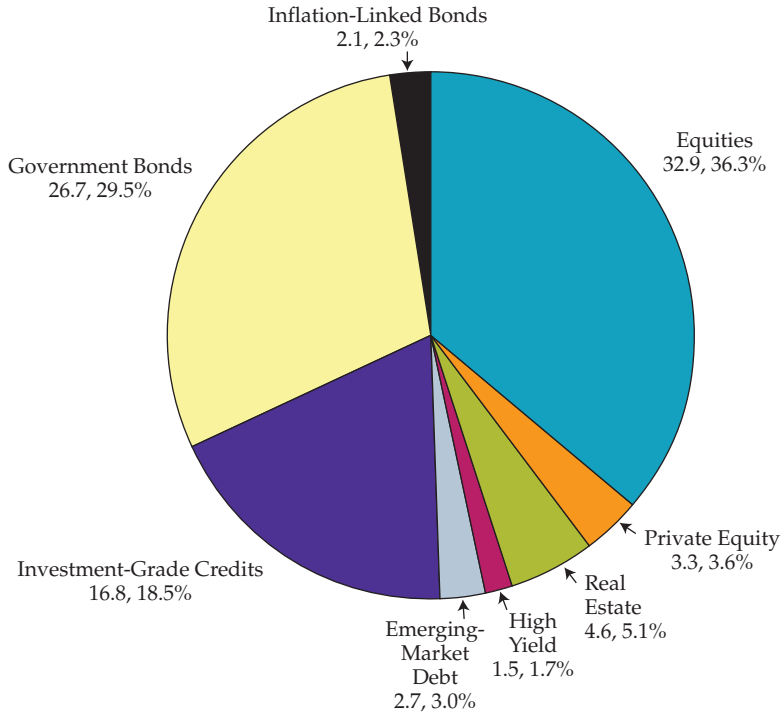
Composing the historical market portfolio is a nontrivial exercise because invested market capitalizations are not readily available for each of the asset classes over our historical period. In that regard, our experience is similar to that of Sharpe (2010, p. 57):

> First and foremost, more data will need to be made available about the market values of the securities in each of the benchmarks designed to represent major asset classes. . . . Recent and historical monthly *returns* for most popular indices may be difficult but not impossible to obtain from such providers. But obtaining data for the market *values* of the securities in an index is much harder.

Appendix A presents the outcome of our efforts to obtain these data and an explanation of the procedure used to obtain them. Where possible, we gathered our data from leading index providers, whose indices are often used as benchmarks for mutual funds or exchange-traded funds. Appendix B provides our annual historical estimates in tabular form so that practitioners and academics can easily use the historical data for applications or future research.

Although we are aware that our point estimates for the historical market portfolio are surrounded by uncertainty, we found indications that our data represent good estimates. We backfilled our data to 1984 and then appended our data to data from the study by Ibbotson et al. (1985) to get back to 1959. Our estimate for 1984 comes very close to theirs, suggesting that our backfilling produced a realistic estimate for 1984. Moreover, a comparison of the weights of our 1985–2012 global market portfolio with their 1959–84 estimates for the US market portfolio implies that our estimates make economic sense. Finally, Appendix C reports on our robustness

Figure 1. Estimated Market Values (US$ trillions) and Weights in the Global Market Portfolio at the End of 2012



check with data from alternative data providers, showing no material effect on our estimates.

The Global Market Portfolio, 2012

Appendix A provides our data sources and methodology in detail. We again stress that in our study, we focused on the *invested* market portfolio, which is the opportunity set available to financial investors.

Figure 1 depicts the global market portfolio at the end of 2012. Our estimate of the total market capitalization of the invested global multi-asset market portfolio is $90.6 trillion (all estimates in this article are in US dollars). Equities represent the largest asset class, with a market value of $32.9 trillion, or 36.3% of the total market capitalization of all asset classes. Government bonds follow, with $26.7 trillion, which equals 29.5% of the market portfolio. Investment-grade credits, primarily consisting of corporate bonds and mortgage-backed securities, are worth $16.8 trillion, or 18.5%. All other asset categories are relatively small compared with these three asset classes, ranging from $1.5 trillion (1.7%) for high-yield bonds to $4.6 trillion (5.1%) for real estate. The market capitalizations of these five relatively small asset categories add up to $14.1 trillion (15.6%).[3]

Our estimate for equities is in line with that of Idzorek, Barad, and Meier (2007). Using a market-value approach, they estimated the market capitalization of equities at $29.1 trillion, which is in between our 2005 year-end estimate of $28.4 trillion and the $33.7 trillion figure for 2006.[4] In addition, the MSCI data that we used closely resemble market-capitalization data from FTSE.[5]

Idzorek et al. (2007) estimated the combined market value of government bonds and investment-grade credits at $21.4 trillion, close to our 2005 and 2006 estimates of $21.6 trillion and $23.6 trillion, respectively. Our estimate for government bonds compares reasonably well with data from other index providers.[6] J.P. Morgan's 2012 global estimate of $23.1 trillion for Treasuries is in line with the $23.4 trillion estimate by Barclays Capital, which also estimated $26.7 trillion for government bonds, including bonds from agencies and local authorities. The 2012 estimate for government bonds by Bank of America Merrill Lynch is $24.7 trillion, which is somewhat below our $26.7 trillion estimate for government bonds, obtained from Barclays Capital. The Bank of America Merrill Lynch estimate for nonsovereign large-cap high-grade credits is $1.9 trillion greater than our $16.8 trillion estimate from Barclays Capital for investment-grade credits. Although these comparisons indicate that our estimates are robust for various index providers, there is some uncertainty associated with the point estimates that we report. Later in the article, we present two validity checks on our market portfolio.

We now have a static estimate of the global multi-asset market portfolio. An estimate over a long period can provide insight into the dynamics of the market portfolio. These dynamics show the range and volatility of historical asset-class weights. Such a reference might be useful in determining investors' own strategic asset weights. Tactical asset allocation strategies might then use large deviations from long-term average market portfolio weights as a valuation indicator. In our study, we examined the historical dynamics of the market portfolio. First, we documented the market portfolio for eight asset classes over the 23-year period 1990–2012. We then extended our analysis to the 54-year period 1959–2012 for the four main asset classes.

The Global Market Portfolio, 1990–2012

For 1990–2012, we collected market-cap data for all eight asset classes. The further we went back in time, the less trivial it was to construct market capitalizations from standard data sources. A potential challenge was that several index providers did not cover as many assets historically as they do today. On the one hand, the narrower coverage by data providers in the past could imply that the historical market portfolio weights are biased. On the other hand, it could be related to the lower investability of some of the asset classes. This situation would not bias our invested market portfolio weights if we assumed that the coverage by data sources grew at the same rate—admittedly, a strong assumption. However, because index providers tended to put more effort into covering the market as benchmarks gained importance during our sample period, it seemed reasonable for us to suppose that all asset classes were subject to increased coverage.

In a reality check on the quality of our data, we tried to establish whether the portfolio weights obtained from our data sources and methodology would lead to reasonable outcomes. Therefore, we compared our estimated global market portfolio weights for the four main categories—equities, real estate, government bonds, and nongovernment bonds—over 1985–2012 with the estimates for the US market portfolio over 1959–1984 by Ibbotson et al. (1985). In this comparison, we assumed that the market portfolio weights of the four main asset classes resembled each other to some degree

in two subperiods during the 54-year sample period. With such a horizon, one could argue that this assumption was reasonable because (1) the liabilities side of corporate balance sheets from listed companies usually contains data on bonds and shareholders' equity, which are both available to investors, and (2) the enterprise value of companies, the size of debt and the debt capacity of governments, and the value of real estate are all related to the size of the economy. For example, we would be puzzled if our analysis showed that all four main categories had roughly equal weights, on average, in the first subperiod yet had major weight differences in the second subperiod.

For the comparison, we chose to use the 1959–84 US estimates of Ibbotson et al. (1985) instead of their global estimates. This approach enabled us to incorporate real estate into the reality check because they did not provide estimates for real estate outside the United States. For that purpose, we extended our estimates for the four main categories back to 1985 (Appendix A). We also needed a data extension to before 1990 in order to compose data series for the four main asset categories over 1959–2012 (discussed later in the article).

As **Table 1** shows, our estimate of the average weight of global stocks over 1985–2012 (51.1%) is roughly 10 percentage points (pps) below the estimated weight of stocks in a US portfolio over 1959–1984 (61.0%).[7] For each of the three other asset classes, our estimates are somewhat higher. The weight of real estate relative to stocks and the weight of nongovernment bonds relative to government bonds closely resemble each other. The value of global real estate equals 8.7% of global stocks for 1985–2012; the US figure is 6.7% for 1959–1984. On average, the value of global nongovernment bonds relative to government bonds is 50.3% for 1985–2012; the US figure is 54.9% for 1959–1984. Hence, a comparison of the weights of our global market portfolio with historical estimates for the US market suggests that our estimates make economic sense.

Table 1. Weights (Period Averages) of the Four Main Asset Classes as a Percentage of Total Market Value

	1959–1984 (US)	1985–2012 (global)
Stocks	61.0%	51.1%
Real estate	3.9	4.4
Nongovernment bonds	12.0	14.7
Government bonds	23.1	29.8
Real estate relative to stocks	6.7%	8.7%
Nongovernment bonds relative to government bonds	54.9%	50.3%

Figure 2 shows the global market portfolio over 1990–2012. The general picture is of a declining weight for equities to the benefit of other asset classes, especially investment-grade credits. Equities fall from 51.6% at the end of 1990 to 36.3% in 2012. Investment-grade credits rise from 11.4% to 18.5%. Private equity grows 2.7 pps, to 3.6%. The weights of real estate, high-yield bonds, emerging-market debt, and inflation-linked bonds rise from between 1.0% and 2.2% to end-of-period weights between 1.7% and 5.1%. The total weight of the relatively small asset classes—anything other than stocks, investment-grade credits, and government bonds—rises from 6.2% to 15.6% over 1990–2012. As indicated earlier, we checked whether our estimated weights are robust with data from alternative data providers (Appendix C). The outcome of this check suggests that there is some uncertainty in the point estimates of the weights in the invested market portfolio, but using alternative sources results in only small deviations.

Figure 3 depicts the estimated market values in the global market portfolio over 1990–2012 in absolute numbers (in billions of US dollars). The portfolio in 1990 amounts to approximately $11 trillion; in 2000, $38 trillion; in 2012, $91 trillion. These figures should be taken as a rough approximation. Under the assumption that the coverage of all market segments by the data sources grows at the same rate, the relative data are completely accurate. But with increasing market coverage, absolute data underestimate the market capitalization in 1990 more than in the years thereafter. To illustrate: If we assume that market coverage for all asset classes grows 1 pp a year, from 76% in 1990 to 98% in 2012, then the global market portfolio in 1990 would be $14 trillion instead of $11 trillion.

The Global Market Portfolio, 1959–2012

We determined the global market portfolio over the 54-year period 1959–2012 for the four main asset categories: equities, real estate, nongovernment bonds, and government bonds. We included high-yield bonds and investment-grade credits in the category of nongovernment bonds; we classified emerging-market debt and inflation-linked bonds under government bonds. Private equity was not included in this analysis. We used the

Figure 2. Estimated Weights in the Global Market Portfolio, 1990–2012

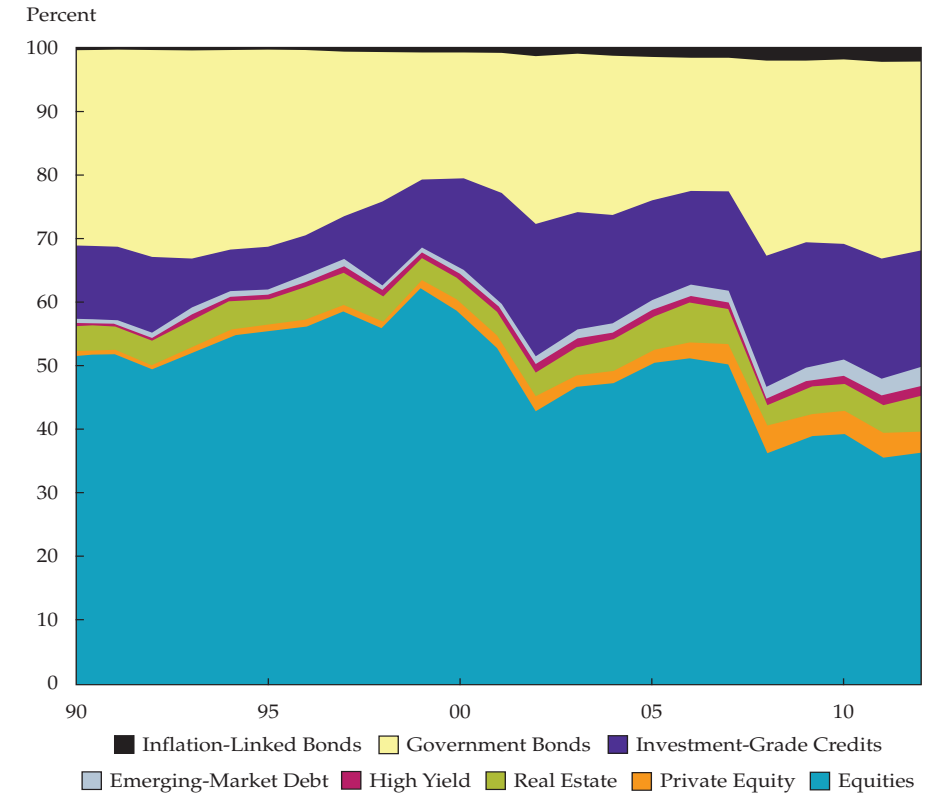
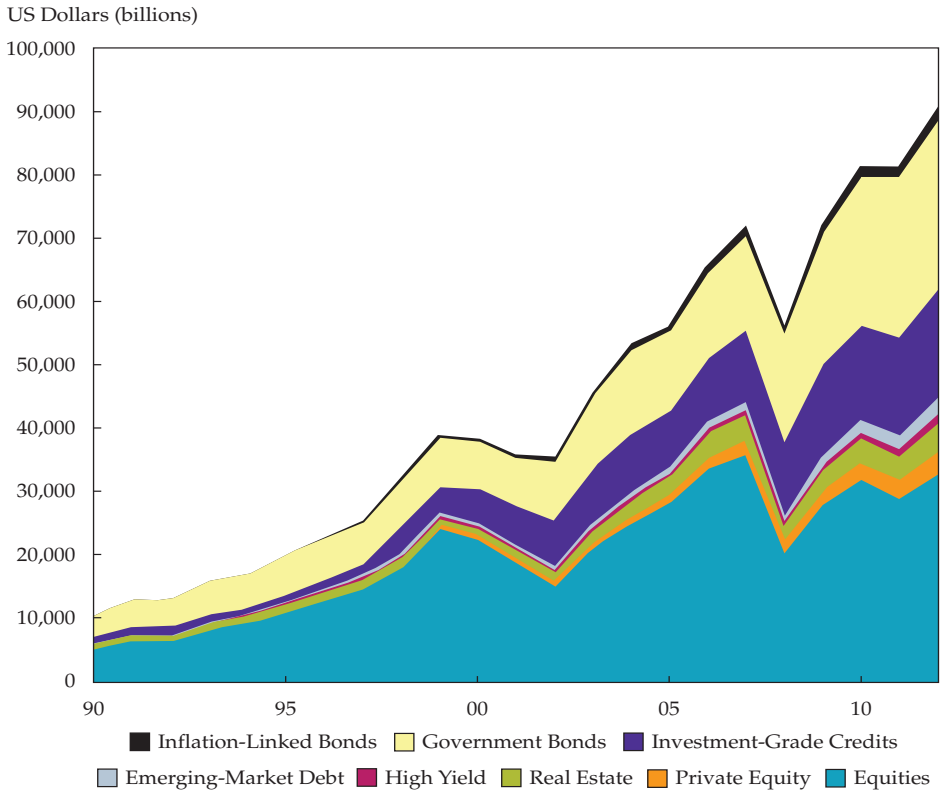


Figure 3. Estimated Market Values in the Global Market Portfolio, 1990–2012



world market-capitalization data in Ibbotson et al. (1985) to show how the international financial markets developed from 1959 to 1984. Because they provided no data for real estate outside the United States, we used their estimates for US business real estate to derive our estimate of the global market capitalization of invested commercial real estate.[8]

Let us take a closer look at 1984, when the two datasets merge. **Table 2** shows the relative global portfolio weights of stocks, nongovernment bonds, and government bonds in 1984 in Ibbotson et al. (1985) and our estimates.[9] Note that we were unable to include real estate in this check because they did not include estimates for real estate outside the United States. Their data and our data resemble each other, with the differences in portfolio weights in 1984 for all three asset classes limited to a maximum of 2.5 pps.

Table 2. Global Asset-Class Portfolio Weights, 1984

	Ibbotson et al. (1985)	Our Data
Stocks	46.5%	49.0%
Nongovernment bonds	14.4	13.5
Government bonds	39.1	37.4
Total	100.0%	100.0%

Note: Totals may not appear to sum to 100.0% owing to rounding.

Figure 4 shows the weights of asset classes in the global market portfolio over 1959–2012 (see Appendix B for the underlying data for this figure). We used the annual percentage change in the market-capitalization data in Ibbotson et al. (1985) to backfill our 1984 estimates. Over 1959–2012, the weight of stocks declined 13.5 pps, from 51.2% to 37.7%, as reported in **Table 3**. The weight of equities in 2012 is close to the record low of 37.1% in 2011. In 2011, for the first time in our sample period, equities no longer outweigh government bonds. The maximum weight of equities is 64.0%, in 1968. The weight of 63.2% in 1999 comes close to this maximum. The period average for equities is 52.0%. In 2012, at the end of our sample period, the weight of 37.7% is 14.3 pps below the period average.

On balance, the three other main asset categories are subject to a smaller change in portfolio weight than are equities over the sample period. Moreover, their 2012 weights are closer to the period average than is the 2012 weight of equities. Over the sample period, the weight of government bonds rises 6.4 pps, from 29.7% to 36.1%, close to their 37.4% high in 1982. In 2012, their weight is 6.4 pps above the average of 29.6%. The weight of nongovernment bonds increases 3.2 pps, from 17.7% in 1959 to 20.9% in 2012. At the end of the sample period, their weight is 5.8 pps above their period average of 15.1%. Finally, the weight of real estate rises from 1.4% to 5.3% over the sample period; the 5.3% weight in

Figure 4. Estimated Weights in the Global Market Portfolio, 1959–2012

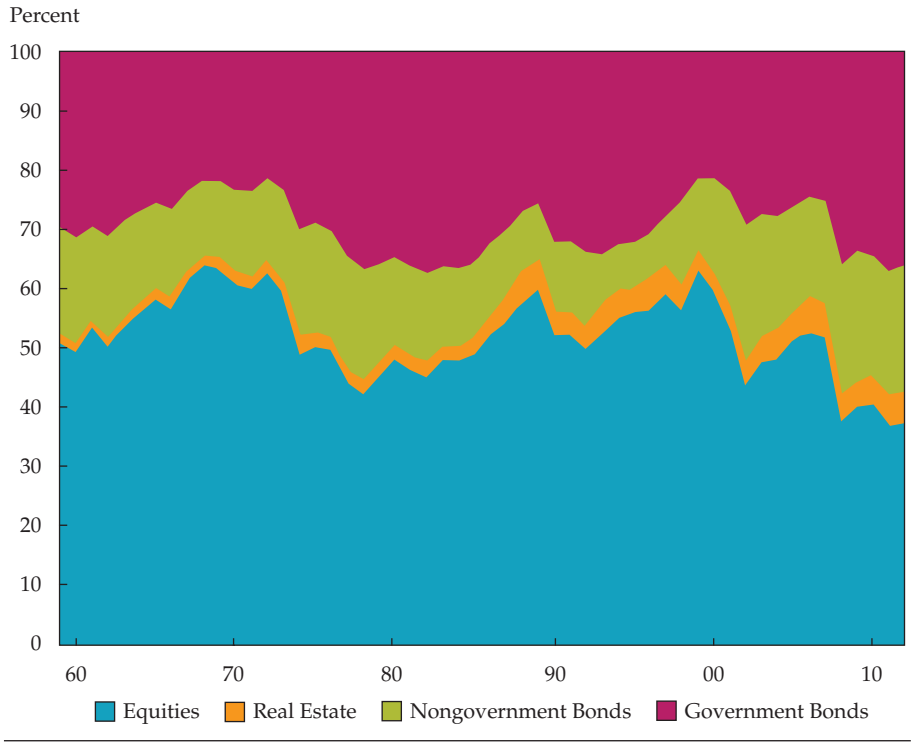


Table 3. Data Characteristics for the Four Main Asset Classes, 1959–2012

	1959	2012	Minimum	Maximum	Average	2012 – Average
Equities	51.2%	37.7%	37.1%	64.0%	52.0%	–14.3 pps
Real estate	1.4	5.3	1.2	6.2	3.2	2.1
Nongovernment bonds	17.7	20.9	7.3	22.8	15.1	5.8
Government bonds	29.7	36.1	21.4	37.4	29.6	6.4

2012 is 2.1 pps above the period average of 3.2%. As we indicated earlier, however, it is possible that we underestimated the weight of real estate before 1984. Therefore, the weight in 2012 could well be closer to its average than these data suggest.

Strategic Asset Allocations of Institutional Global Investors

In aggregate, all financial investors hold the market portfolio that we have described in the previous sections. At this point in our study, we analyzed the strategic asset allocations of several groups of investors and compared those allocations with the market portfolio's allocations. Because the classification of assets is not identical for all sources, it was an indicative analysis.

Table 4 shows that pension funds compose the largest group of institutional investors. In 2011, they had $21 trillion in assets under management (AUM). This amount equals 26% of the value of the total invested market portfolio. Panel A of Table 4 shows the asset allocations of pension funds in several large countries, as well as the global average, as estimated by the Organisation for Economic Co-operation and Development (OECD). We can see that the pension funds in Germany and Japan are typically underexposed to the equity markets,

Table 4. Strategic Asset Allocations of Institutional Global Investors

Institutional Investor	Source	Year	Equities (%)	Bonds (%)	Other[a] (%)	AUM (US$ billions)
A. Pension funds[b]						
Germany	OECD	2011	4	43	53	195
Japan	OECD	2011	9	41	50	1,470
United Kingdom	OECD	2011	45	41	14	2,130
United States	OECD	2011	48	28	24	10,584
World	OECD/Towers Watson	2011	41	39	20	20,719
B. Sovereign wealth funds[c]						
Abu Dhabi Investment Authority	SWFI	2012	55	22	23	627
Norwegian Pension Fund Global	SWFI	2012	60	35	5	716
China Investment Corporation	SWFI	2011	25	21	53	482
C. Endowments[d]						
United States	NACUBO	2012	31	11	58	406
D. Market portfolio						
		2010	39	53	8	81,337
		2011	36	56	8	81,239
		2012	36	55	9	90,568

[a]The category "Other" includes cash, loans, land and buildings, unallocated insurance contracts, hedge funds, private equity funds, structured products, other mutual funds (i.e., not invested in cash, bills and bonds, shares, or land and buildings), and other investments.
[b]We composed the pension funds in this table with data from the OECD study "Pension Markets in Focus No. 9" (September 2012), with the exception of world asset allocation, which we derived from Towers Watson's "Global Pension Assets Study—2012."
[c]We obtained these data from the Sovereign Wealth Fund Institute (SWFI; www.swfinstitute.org) in February 2013. The allocation data for the Abu Dhabi Investment Authority are the midpoint of a broad allocation range obtained from the fund's website (www.adia.ae/En/pr/Annual_Review_Website_2012.pdf).
[d]We obtained these data from a press release from the National Association of College and University Business Officers (NACUBO), "2012 NACUBO-Commonfund Study of Endowments" (1 February 2013): www.nacubo.org.

relative to the world market portfolio. They seem to be allocated more heavily to alternative assets or structured products ("Other"). Pension funds in the United Kingdom and the United States have 45% and 48% exposure to the equity markets, respectively, with the remaining portion invested in bonds or alternative assets. The global average allocation to equities is 41% for 2011, above but close to the weight of 36% in the market portfolio.[10] Bonds (broadly defined by the OECD but excluding investments in loans) represent 39% of the total assets of global pension funds, below the corresponding figure of 56% for the market portfolio. The allocation to bonds seems low compared with the market portfolio. However, pension funds may use fixed-income derivatives to increase that exposure—for example, for liability-hedging purposes. Our data did not include these exposures to derivatives because the total net position in derivatives was zero.

Panel B of Table 4 reports on three funds that are believed to be among the largest in the world, according to the Sovereign Wealth Fund Institute. Their allocations to equities tend to be higher than the average allocation of pension funds—at the expense of bonds. The China Investment Corporation has a relatively large position in the category "Other" owing to its "long-term investments," which do not seem to include public equities or public bonds because those are separate categories. Panels C and D show that the strategic asset allocation of all endowments together has substantially more alternative assets and fewer bonds than does the market portfolio. As we can see in the last column of Table 4, the AUM of sovereign wealth funds and endowments is relatively small compared with the size of the market portfolio.

Conclusion

The invested global multi-asset market portfolio is the aggregate portfolio of all investors, in which portfolio weights indicate the constitution of the average portfolio. The invested global multi-asset market portfolio contains important information because it represents the views of the global financial investment community with respect to the pricing of each asset class. Hence, it can serve as a benchmark for investors' strategic asset allocations. The market portfolio can also be used as a starting point for portfolio construction.

We focused on the invested global multi-asset market portfolio, which is relevant to financial investors. For 1990–2012, we determined the market capitalizations of eight asset classes: equities, private equity, real estate, high-yield bonds, emerging-market debt, investment-grade credits, government bonds, and inflation-linked bonds. At the end of 2012, we estimated the total market capitalization of the invested global multi-asset market portfolio at $90.6 trillion. Equities (36.3%) represent the largest asset class, followed by government bonds (29.5%). Investment-grade credits (18.5%) are also a major asset class. The total market capitalization of the five other asset categories (15.6%) is relatively small. But the total weight of the relatively small asset classes increased from 6.2% to 15.6% over 1990–2012.

For the four main asset categories—equities, real estate, nongovernment bonds (investment-grade credits and high-yield bonds), and government bonds (broadly defined and including inflation-linked bonds and emerging-market debt)—we compiled data series for 1959–2012; we did not take private equity into account. At the end of 2012, the market portfolio weights for these four main categories are 37.7%, 5.3%, 20.9%, and 36.1%, respectively, with 54-year averages of 52.0%, 3.2%, 15.1%, and 29.6%. The weight of equities in 2012 is close to the record low of 37.1% in 2011. In 2011, for the first time in our sample period, equities no longer outweigh government bonds.

We showed that pension funds' allocation to equities is a little above the market portfolio's allocation. The sovereign wealth funds in our sample tend to allocate more to equities and the endowments allocate more to alternative assets than is warranted by their weights in the market portfolio; their allocation to bonds falls short of the market portfolio's weight of bonds.

Our development of this new historical database on the global multi-asset market portfolio has important applications for the strategic asset allocations of practitioners. Moreover, our study might serve as a fruitful resource for future research in this field. We hope that this article will spark new applications, both theoretical and empirical.

We thank Dirk Hoozemans, Jesse de Klerk, and Maurice Meijers for their help; we thank Kristoffer Johansson, Lise Lindbäck, Roderick Molenaar, Chris van der Oord, Tapio Pekkala, and Tom Steenkamp for their constructive comments. The views expressed in this article are not necessarily shared by Robeco, Rabobank, Norges Bank Investment Management, or any of their subsidiaries.

This article qualifies for 1 CE credit.

Appendix A. Data Sources and Methodology

We derived the global multi-asset market portfolio from a variety of sources that we consider effective in providing assessments of the market

size of asset classes. In this appendix, we discuss our data sources and the methodology that we used to arrive at our estimates (in US dollars). **Table A1** contains the year-end estimates for 2012, together with (if applicable) the Thomson Reuters Datastream mnemonics, to facilitate replication and updating. The first time an index accessed through Thomson Reuters Datastream is

Table A1. Composition of the Global Market Portfolio by Asset Class at the End of 2012

Index Name or Source	Thomson Reuters Datastream Mnemonic	US$ (billions)	Mathematical Operation	US$ (billions)
Equities				32,920
MSCI AC World Index	MSACWF$	29,474	+	
MSCI AC World Small Cap Index	MSSAWF$	4,300	+	
MSCI AC World REITs Index	M3AFRL$	558	–	
MSCI AC World Small Cap REITs Index	C3AFRL$	296	–	
Private equity				3,270
Preqin[a]	—	3,270	+	
Real estate				4,612
GPR General PSI Global Index (2012)	GPRGLES	1,310		
GPR General PSI Global Index (2011)	GPRGLES	1,039	./.	
Real estate estimate (2011)		3,659	*	
High-yield bonds				1,523
Barclays Capital Global Corporate High Yield Index	LHGHYCO	1,523	+	
Emerging-market debt				2,681
J.P. Morgan Government Bond Index-Emerging Markets Global Composite	JGE$GCM	953	+	
J.P. Morgan Emerging Markets Bond Index Global Composite	JPMGTOT	579	+	
J.P. Morgan Corporate Emerging Markets Bond Index Broad[b]	—	620	+	
Barclays Capital Emerging Markets Government Inflation-Linked Index	BCEMALL	530	+	
Investment-grade credits				16,761
Barclays Capital Multiverse Index	LHMVALL	45,022	+	
Barclays Capital Multiverse Government Index	LHMVGVT	26,739	–	
Barclays Capital Global Corporate High Yield Index	LHGHYCO	1,523	–	
Government bonds				26,739
Barclays Capital Multiverse Government Index	LHMVGVT	26,739	+	
Inflation-linked bonds				2,062
Barclays Capital Global Aggregate Inflation-Linked Index	LHGREAL	2,062	+	
Global invested multi-asset market portfolio				90,568

Note: The symbols ./. and * indicate division and multiplication, respectively.
[a]Obtained from Preqin; not available from Thomson Reuters Datastream.
[b]Obtained from J.P. Morgan; not available from Thomson Reuters Datastream.

mentioned in the text, its mnemonics are next to it in parentheses.

Equities

For stocks, we used market-capitalization data from MSCI. First, we took the market value of the MSCI All Country World Index (MSACWF$), often referred to as MSCI AC World Index or MSCI ACWI—the standard index that contains large caps and midcaps. Second, we added the market value of the MSCI AC World Small Cap Index (MSSAWF$), which represents small caps. Both indices contain developed markets as well as emerging markets. They do not contain frontier markets, but the effect of inclusion would be small. According to MSCI, at the end of 2012, the market value of frontier markets was equal to only 0.4% of the market capitalization of the MSCI AC World Index.

Before 1987, no MSCI AC World Index data are available. Therefore, we used the annual percentage change in the market capitalization of the MSCI World Index (MSWRLD$), which contains only developed markets, to backfill the market values in the standard index to 1984. According to MSCI, at the beginning of 1988, the market value of emerging markets was equal to 0.8% of the market capitalization of the MSCI World Index.

Before 2004, no market-cap data are available in the MSCI AC World Small Cap Index. Using the following formula, we proxied the market-cap data:

$$Mktcap_t^S = k_t Mktcap_t^L, \tag{A1}$$

where asset S is the MSCI AC World Small Cap Index and asset L is the MSCI AC World Index that contains large caps and midcaps. The multiplication factor, k, is known for 2004 because both market caps are available. For pre-2004, we determined k from the relative price performance of both assets over the subsequent period as we backfilled the data. We used the following formula:

$$k_{t-1} = k_t \left(\frac{1 + \text{Price return}_t^L}{1 + \text{Price return}_t^S} \right), \tag{A2}$$

where t starts in 2004, which is the first year in which k is calculated for 1994–2003, and Price return$_t$ is the price return in year t. With the aid of these estimates, we derived the market value of small caps by multiplying these weights by the market value of large caps and midcaps. This methodology is displayed in Equation A1 and Equation A2. Subsequently, for 1988–2003, we used the performance of the Russell 2000 Index (FRUSSL2) relative to the performance of the Russell 1000 Index (FRUSSL1) to estimate the performance of small caps relative to large caps and midcaps; for 1984–1987, we used the SMB factor from the online data library of Kenneth French[11] to make these estimates. Again, we derived the market value of small caps by multiplying these weights by the market value of large caps and midcaps.

So, we had a complete time series of the market capitalization of equities, but we still made a final correction. We subtracted the market value of REITs from the total estimated market value of equities because they were part of the real estate asset class in our study. We used the market value of the MSCI All Country World Real Estate Investment Trusts Index (M3AFRL$), which is the standard REIT industry index from MSCI (it is available from 2006 on). Next, we used the MSCI All Country World Small Cap Real Estate Investment Trusts Index (C3AFRL$), which is a small-cap index for REITs with data availability from 2007 on. To backfill 2006 for the small-cap index, we assumed that the percentage change from the 2006 market cap to the 2007 market cap equaled the change in the market value of the standard index. Then, for both the standard index and the small-cap index, we backfilled the REIT series for 1994–2005 with the percentage changes in the market value of the real estate industry group of the MSCI AC World Index (M2AFR2$). For 1986–2003, we used the change in the market value of the MSCI Real Estate Index (MSREAL$), which represents real estate in developed markets, to do the same for that period. Finally, for 1984 and 1985, we used the percentage change in the price index of the MSCI Real Estate Index for backfilling because market-cap data are not available from the MSCI Real Estate Index prior to 1986.

Private Equity

The estimate for private equity reflects the value of companies in private equity portfolios and the sum of all uncalled commitments, the so-called dry powder. For 2000–2012, we used data from Preqin. To our knowledge, Preqin offers the largest coverage of the private equity market. Preqin has no pre-2000 data available. For 1990–1999, we used Thomson Reuters data, as published in Leitner, Mansour, and Naylor (2007). A comparison between their data and data from Preqin for 2000–2002 shows that market values from Preqin are, on average, 12% above the Thomson Reuters data. This comparison suggests that we may have somewhat underestimated the market value of private equity before 2000.

Real Estate

In the real estate market, a distinction should be made between commercial real estate 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 the residential market is the property of the residents. As an extreme example, Hordijk and Ahlqvist (2004) estimated that only 5% of all residential real estate in the United Kingdom is available to investors. In addition 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.

Our study focused 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).[12] RREEF divides the market estimate of real estate into the four quadrants of public equity, private equity, public debt, and private debt. At the end of 2006, RREEF estimated the investable market at $16.0 trillion. This figure includes owner-occupied real estate, which might become available to financial investors in the future. RREEF's proxy for the invested real estate market is $9.8 trillion. This figure is relevant to our study, but it includes both equity and debt. The equity component of invested real estate, which is the universe suitable for comparison in this framework, is $4.0 trillion, which equals a quarter of the combined value of invested and owner-occupied real estate. Private equity represents by far the largest part, with roughly 85%, leaving 15% for public equity. The $4.0 trillion estimate is reasonably close to the figure given by Idzorek et al. (2007), who estimated this measure of the global real estate market at $4.6 trillion. Real estate debt, such as mortgage-backed securities, can be considered part of the fixed-income asset class and is, in fact, largely captured by the estimate for credits.

We used the market capitalization of the GPR General PSI Global Index (GPRGLES) to backfill 1984–2005 and to fill 2007–2012. We used the 2006 estimate of $4.0 trillion as a starting point. Subsequently, we used percentage changes in the market-cap series to arrive at estimates for all other years.

High-Yield Bonds

For high-yield bonds, we used the market-cap data from the Barclays Capital Global Corporate High Yield Index (LHGHYCO), available from 2000 on. These data are in line with data from Bank of America Merrill Lynch. Although initially the market-cap figures from Barclays Capital are higher than those from Bank of America Merrill Lynch, this situation is reversed owing to index-inclusion rules that change over time. To illustrate, the largest deviations are for 2001 (8%) and 2012 (–11%). For 1990–1999, we based our estimates on the Barclays Capital Global High Yield Index (LHMGHYD), which also includes sovereign high-yield bonds from emerging markets that we chose to classify as emerging-market debt. To correct for this, we first calculated the weight of the Barclays Capital Global Corporate High Yield Index relative to the Barclays Capital Global High Yield Index for 2000–2012. It appears that the relative weight has, on average, grown 2% a year over that period. We assumed that the 2% growth rate also applied to 1990–1999. In our methodology here, we still use Equations A1 and A2, but the multiplication factor, k, is now divided by a constant, as follows:

$$k_{t-1} = \frac{k_t}{1+c}, \tag{A3}$$

where the constant, c, equals 2% for this asset class.

Before 1990, we assumed that the market cap of high-yield bonds as a percentage of the (estimated) market cap of the Barclays Capital Global Treasury Index (LHMGLOB) grew 8% a year, in line with the 1990–2012 growth rate. We multiplied this percentage by the (estimated) market cap of the Barclays Capital Global Treasury Index. We used the Barclays Capital Global Treasury Index as a reference index because it has the longest available history of market capitalizations. Hence, we used Equation A3 with c equal to 8%.

Emerging-Market Debt

For emerging-market debt, we summed the J.P. Morgan Government Bond Index-Emerging Markets Global Composite (JGE$GCM) for local currency debt, the J.P. Morgan Emerging Markets Bond Index Global Composite (JPMGTOT) for external (hard currency) debt, the J.P. Morgan Corporate Emerging Markets Bond Index Broad for US-dollar-denominated emerging-market corporate bonds, and the Barclays Capital Emerging Markets Government Inflation-Linked Index (BCEMALL) for inflation-linked bonds.

The external debt data start in 1993. Before then, we assumed that the growth rate equaled the growth in the market cap of global Treasury bonds. The data for 1993–2012 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 then, we assumed that the growth rate

relative to the market cap of external debt equaled the 10% compounded growth rate for 2002–2012. The corporate emerging-market debt data start in 2001. Prior to that date, we assumed that the growth rate relative to external debt equaled the 9% compounded growth rate in the estimated market cap of external debt over 2002–2012. Hence, we used Equation A3, with c equal to 10% and 9% for local currency emerging debt and corporate emerging debt, respectively. For inflation-linked bonds, the data series starts in 2003. Before that time, we used data from Swinkels (2012).

For 1984–1989, we assumed that the market cap of emerging-market debt grew in line with our estimate for (developed-market) government bonds.

Investment-Grade Credits

Investment-grade credits primarily consist of corporate debt and mortgage-backed securities. We estimated the market cap of investment-grade credits by subtracting the (estimated) market cap of the Barclays Capital Multiverse Government Index (LHMVGVT) and the Barclays Capital Global High Yield Index from the (estimated) market cap of the Barclays Capital Multiverse Index (LHMVALL).

Government Bonds

We used the market cap of the Barclays Capital Multiverse Government Index as a proxy for the government bonds market. These data are available from 2005 on. Before then, we assumed that this index grew in line with the market cap of the Barclays Capital Global Treasury Bond Index, which has data from 1987 on. For 1984–1986, we used the growth rate of the market cap of the Barclays Capital US Treasury Index (LHUSTRY) to backfill our estimates for the market cap of global government bonds. There is double counting because some emerging markets qualify for the Barclays Capital Global Treasury Bond Index. However, emerging sovereign debt is small compared with sovereign debt in developed markets. Therefore, double counting results in only a marginal bias.

Inflation-Linked Bonds

For inflation-linked bonds, we used the market capitalization of the Barclays Capital Global Aggregate Inflation-Linked Index (LHGREAL), available from 2000 on. For 1997–1999, we assumed that the market cap developed in line with the combined market cap of the United States (Barclays Capital Global Index-Linked US 1–10 Years [BCUS10L]) and the United Kingdom (Barclays Capital Sterling Index-Linked Overall All Maturities [BCSIFL0]), which we backfilled for 1996–1998 by using the percentage change in the market cap of the Barclays Capital Sterling Index-Linked Gilt Index (BCSGLAY). Before 1997, we estimated only the market cap of the UK inflation-linked market because it was the only major country with a developed inflation-linked bond market. To derive these estimates for the United Kingdom for 1984–1995, we assumed that the market cap of inflation-linked bonds grew in line with the (estimated) market cap of the Barclays Capital Global Treasury Bond Index. This last step in backfilling the data seems to be reasonably accurate according to data from the UK Debt Management Office. To illustrate: The nominal amount of outstanding inflation-linked debt was £8 billion ($9 billion) in 1984 (start year) and £18 billion ($34 billion) in 1990 (halfway between 1984 and 1995), whereas our backfilling rule estimates the market value of inflation-linked debt at $15 billion and $32 billion, respectively. The backfilling method before 2000 is of little relevance to the market portfolio. Inflation-linked bonds had only a 0.7% weight in the global market portfolio in 2000.

Appendix B. Asset-Class Weights in the Global Market Portfolio, 1959–2012

In this appendix, we provide our annual historical estimates in tabular form (**Table B1**) so that practitioners and academics can easily use the historical data for applications or future research. These data also appear in a Microsoft Excel spreadsheet as Supplemental Information with our article at www.cfapubs.org/toc/faj/2014/70/2. We expect to provide annual updates to this spreadsheet. Any users of these data should acknowledge us as the source.

Appendix C. Robustness of Our Estimates

As we have indicated, composing the historical market portfolio is a nontrivial exercise. Our point estimates of the asset-class weights in the historical market portfolio are surrounded by uncertainty. In the main text, we discussed evidence that suggests our estimates are accurate. For example, backfilling our data to 1984 resulted in estimated portfolio weights that come very close to the 1984 estimates of Ibbotson et al. (1985). Also, throughout the main text, we mentioned figures that we derived from other data providers for reasons of comparison.

Table B1. Global Market Portfolio Weights, 1959–2012

Year	Equities (%)	Real Estate (%)	Nongovernment Bonds (%)	Government Bonds (%)
1959	51.2	1.4	17.7	29.7
1960	49.4	1.3	17.9	31.4
1961	53.7	1.2	15.7	29.4
1962	50.4	1.4	17.0	31.2
1963	53.7	1.4	16.4	28.5
1964	56.2	1.4	15.5	26.9
1965	58.4	1.5	14.6	25.5
1966	56.8	1.7	15.0	26.5
1967	61.6	1.6	13.2	23.6
1968	64.0	1.6	12.6	21.8
1969	63.4	2.0	12.8	21.8
1970	60.9	2.1	13.6	23.4
1971	60.0	2.0	14.6	23.5
1972	62.9	1.8	13.9	21.4
1973	59.4	2.1	15.1	23.4
1974	48.8	3.1	18.2	30.0
1975	50.4	2.6	18.1	28.9
1976	49.6	2.2	17.9	30.3
1977	44.2	2.3	19.0	34.5
1978	42.2	2.3	18.8	36.7
1979	45.4	2.3	16.5	35.8
1980	48.3	2.2	14.9	34.6
1981	46.5	2.5	14.9	36.1
1982	45.2	2.4	15.0	37.4
1983	48.3	2.1	13.4	36.2
1984	48.0	2.2	13.2	36.6
1985	48.1	2.8	12.8	35.3
1986	52.4	3.5	11.7	32.4
1987	54.8	4.1	10.9	30.1
1988	58.0	5.2	9.8	27.1
1989	59.9	5.0	9.4	25.7
1990	52.0	4.1	11.7	32.1
1991	52.2	3.7	11.9	32.1
1992	49.9	3.6	12.6	33.9
1993	52.6	4.4	8.8	34.2
1994	55.2	4.6	7.6	32.7
1995	56.1	4.1	7.7	32.2
1996	56.7	5.3	7.3	30.6
1997	59.3	4.9	8.2	27.7
1998	56.6	3.9	14.4	25.1
1999	63.2	3.3	11.9	21.6
2000	59.7	3.4	15.4	21.5
2001	53.9	3.8	18.7	23.6
2002	43.9	4.0	22.8	29.3
2003	47.6	4.4	20.6	27.4
2004	48.4	4.8	18.9	27.9
2005	51.5	5.1	17.4	25.9
2006	52.7	6.2	16.5	24.6
2007	51.9	5.8	17.3	25.1
2008	38.0	3.6	22.5	35.9
2009	40.3	4.2	21.9	33.7
2010	40.8	4.4	20.3	34.4
2011	37.1	4.7	21.2	37.1
2012	37.7	5.3	20.9	36.1

In this appendix, we present the comparison of our data with similar time series of alternative data providers. We made this comparison for the three main asset classes—equities, government bonds, and investment-grade credits—as well as for high-yield and inflation-linked bonds because we had readily available data for these asset classes from alternative index providers.

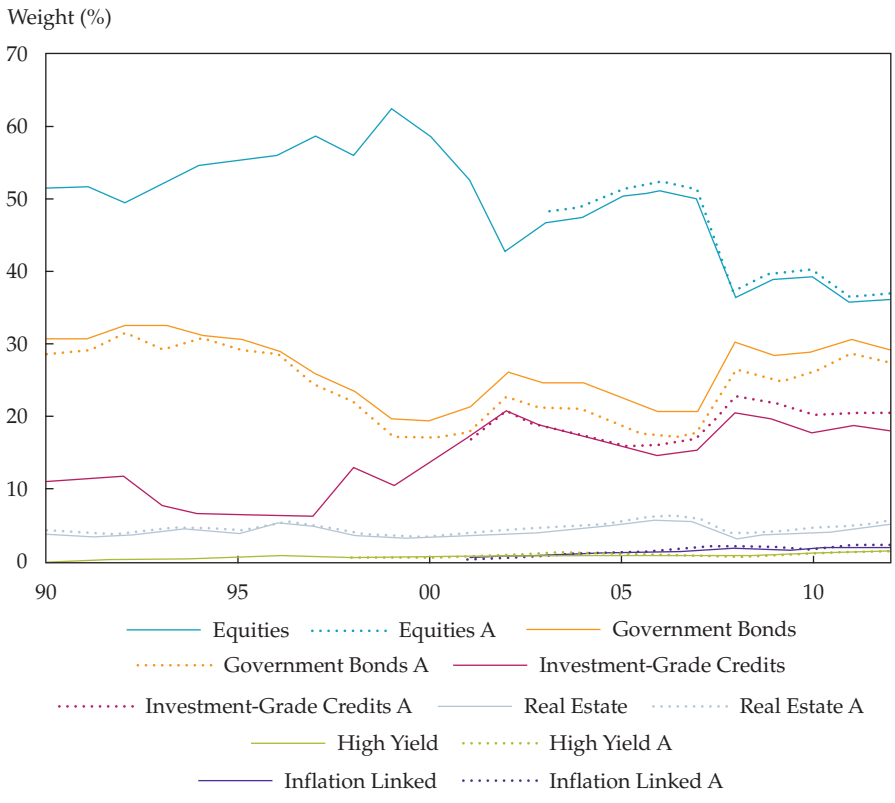
For equities, we compared our MSCI-based estimates with the market value of the FTSE Global All Cap Index. The alternative for our Barclays-based government bonds estimate was the Bank of America Merrill Lynch Global Government Index; for our Barclays-based investment-grade credits estimate, we used the Bank of America Merrill Lynch Global Largecap Non-Sovereign Index for the comparison. We compared our Barclays-based high-yield estimate with the Bank of America Merrill Lynch Global High Yield Index, and we compared our Barclays-based inflation-linked index with the Bank of America Merrill Lynch Global Government Inflation Linked Index.

To arrive at an alternative estimate for real estate, we followed another procedure for two reasons. First, because of the way we constructed our real estate estimate, the market portfolio weight was likely to be more sensitive for its base date estimate in 2006 than for an alternative time series of market-cap data. Therefore, we took the alternative estimate by Idzorek et al. (2007), who put the market size at $4.6 trillion instead of our $4.0 trillion, which we based on Hobbs and Chin (2007). Subsequently, we derived market-cap data for other years in the same way as described earlier. Second, we lacked alternative market-cap time series that went back a long time. For example, the FTSE EPRA/NAREIT Developed Index starts at the end of 1989 and is designed to track the performance of listed real estate companies and REITs worldwide. But it contains market-cap data only from 2005 on. The S&P Global Real Estate Investment Trusts Index has market-cap data from 2006 on.

With these alternative estimates for market-cap data, we calculated the weight for each of these six asset classes in the global multi-asset market portfolio that we documented for 1990–2012.[13] The inception date of the alternative weight depends on the start date of the data series.

As **Figure C1** shows, the differences in market portfolio weights between our estimates and the data from alternative sources tend to be rather small. For equities, the weights differ, on average, by 1.1 pps; for government bonds, the average difference is 2.4 pps; for investment-grade credits, the difference is 1.1 pps. For both high-yield and inflation-linked bonds, the portfolio weights, on average, do not differ.[14] The alternative estimate

Figure C1. Multi-Asset Market Portfolio Weights: Our Estimates and Those from an Alternative Source ("A"), 1990–2012



for real estate results in a market portfolio weight that is, on average, 0.5 pp higher.

This robustness check, as well as the other robustness checks we performed throughout our study, suggests that there is some uncertainty in the point estimates of the weights in the invested market portfolio but that using alternative sources results in only small deviations.

Notes

1. Although the CAPM assumes that the market portfolio consists of invested and noninvested assets, both Rosenberg (1981) and Stambaugh (1982) recommended using the invested market portfolio in empirical applications to test the CAPM. Nevertheless, Athanasoulis and Shiller (2000) developed a theoretical model in which they showed that making the nontraded assets tradable would increase social welfare.
2. Several other researchers have used the invested market portfolio as a starting point for strategic asset allocation. Brinson, Diermeier, and Schlarbaum (1986) were the first to develop an invested market-cap-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, nondollar bonds, real estate, and cash equivalents. In a second step, they improved upon the invested market-cap benchmark by constructing a mean–variance-efficient portfolio. Bekkers, Doeswijk, and Lam (2009) used a wide range of global asset classes simultaneously in a mean–variance analysis and in a market-portfolio approach, as well as a combination of both.
3. Note that we did not take hedge funds into account. One could argue that hedge funds are not an asset class but, rather, a group of active trading strategies. Moreover, double counting would occur because hedge funds invest in the kind of assets described in this section; we also disregarded derivatives since the net position in derivatives is zero by definition. To understand the size of hedge funds, we looked at data from Hedge Fund Research that show that (unlevered) assets under management (AUM) at the end of 2012 amounted to $2.3 trillion, or 2.5% of the total global market portfolio. We also left commodities out of the equation. A large part of commodity investing is done through futures. As mentioned previously, the net position in derivatives is zero. To the extent that long positions in futures are provided by commodity producers that fix their prices for future deliveries, these futures positions could be considered net long positions for financial investors. Following this reasoning, however, manufacturers that want to fix their commodities' input prices could provide short positions for investors. So, investors' true positions are hard to grasp. Cooper, Luo, Norrish, Corsi, and Staal (2013) estimated the AUM in commodities at $424 billion at the end of 2012 on the basis of the size of commodity-index swaps, exchange-traded products, and medium-term notes; this figure represents 0.5% of the total global market portfolio. Erb and Harvey (2013) estimated that investors (as defined by the World Gold Council) hold about $1.8 trillion in physical gold, or approximately 2% of the market portfolio.
4. Unfortunately, Idzorek et al. (2007) did not explicitly mention whether their estimate was based on year-end 2005, year-end 2006, or an intermediate date.
5. MSCI market-capitalization data for 2012 are 3% ($1.2 trillion) below the FTSE Global All Cap Index data after factoring in a correction for the presence of REITs, which we classified under real estate. We used MSCI data because they go back further in time.
6. All index providers impose certain investability requirements on bonds before they can be included. For example, there are minimum issue sizes, and in most cases, the bonds are required to have at least one credit rating, their remaining maturity must be more than one year, and they must be publicly issued.
7. We divided the Ibbotson et al. (1985) estimate of the value of business real estate by 4 to arrive at a proxy for the equity component of invested real estate (see Appendix A). Ibbotson et al. labeled corporate-issued bonds "corporate bonds," whereas we used the term "nongovernment bonds" for investment-grade corporate bonds because this asset class includes mortgage-backed securities as well as a minor weight of other asset-backed securities. We considered high-yield bonds separately and added them to nongovernment bonds for comparison with the data in Ibbotson et al. We added emerging-market debt and inflation-linked bonds to government bonds.
8. It is possible that we underestimated the weight of real estate. We estimated the global weight of real estate in 1984 at 2.2%, whereas Ibbotson et al. (1985) ended up with an estimated weight of 4.3% for US real estate in 1984. Although we are aware that backfilling global real estate data for 1959–1983 with US data might introduce a bias into our data, the US market was then the largest real estate market in the world. In addition, real estate is an asset class that has a small weight in the market portfolio. So, the impact of any bias would be limited for the total market portfolio.
9. Again, note that we summed emerging-market debt, inflation-linked bonds, and government bonds for 1984–2012 to arrive at an estimated weight for (more broadly defined) government bonds in the market portfolio.
10. We are referring to the weight we derived from the analysis with eight asset classes for our 1990–2012 sample period. Our analysis with the four main asset classes for 1959–2012 did not include private equity. Excluding private equity from the analysis, the weight of equities is 37.1% in 2011.
11. http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.
12. We thank Peter Hobbs for providing the detailed segmentation of the global real estate market that supplemented their study.
13. We left private equity and emerging-market debt out of our analysis because alternative data series for these asset classes were not readily available.
14. Alternative data for high-yield bonds start in 1997; for inflation-linked bonds, 2001. Because portfolio weights are hardly affected by the change in the alternative data sources, this fact cannot be seen in Figure C1.

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