"An International Perspective on Safe Withdrawal Rates from Retirement Savings: The Demise of the 4 Percent Rule?"

by

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Abstract

Numerous studies about sustainable withdrawal rates from retirement savings have been published, but they are overwhelmingly based on the same underlying data for US asset returns since 1926. From an international perspective, the United States enjoyed a particularly favorable climate for asset returns in the twentieth century, and to the extent that the US may experience mean reversion in the current century, sustainable withdrawal rates may be overstated in many studies. This paper explores the issue of sustainable withdrawal rates using 109 years of financial market data for 17 developed market countries in an attempt to provide a broader perspective about sustainable withdrawal rates, as financial planners and their clients must consider whether they will be comfortable basing decisions using the impressive and perhaps anomalous numbers found in the past US data. From an international perspective, a 4 percent real withdrawal rate is surprisingly risky. Even with some overly optimistic assumptions, it would have only provided "safety" in 4 of the 17 countries. A fixed asset allocation split evenly between stocks and bonds would have failed in all 17 countries.

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1. Introduction

For retirement savings that are not annuitized, an important and difficult question for retirees regards finding a safe withdrawal rate that will provide as much retirement income as possible without exhausting their savings while alive. Researchers have developed a variety of recommendations about sustainable withdrawal rates. One of the most famous and earliest in this regard is Bengen (1994), who famously motivated the 4 percent withdrawal rule using historical simulations. He would later coin the term "SAFEMAX" to describe the highest withdrawal rate, as a percentage of the account balance at retirement, that could be adjusted for inflation in each subsequent year and would allow for at least 30 years of withdrawals during all of the rolling historical periods in his dataset. Several years later, Cooley, Hubbard, and Walz (1998) use a Monte Carlo simulation based on the same data to determine that a 4 percent withdrawal rate with an underlying portfolio of 50 percent stocks and 50 percent bonds provides a 95 percent chance for success. While Scott, Sharpe, and Watson (2009) argue against the 4 percent withdrawal rule as being an expensive and inefficient means for achieving retirement spending goals, they first note how widely it has been adopted by the popular press and financial planners as an appropriate general rule of thumb for retirees.

Numerous studies about sustainable withdrawal rates have been published since 1994. To provide some idea of the numbers, Google Scholar indicates that 55 studies have cited the original Bengen (1994) article, and the author counts well over 30 articles on this topic in the pages of this journal. As the 4 percent rule became established as a baseline, a fair number of these studies were motivated by the search for ways to further increase the safe withdrawal rate. Bengen (2006a) considers some of the subsequent research advances, such as including more varied financial assets into the portfolio mix, requiring sustainable withdrawals for longer or shorter periods of time, changing withdrawal patterns such as withdrawing more during early or late retirement, making dynamic adjustments to the withdrawal rate in response to market conditions, and rebalancing the underlying portfolio at different time intervals. By including small company stocks in addition to the S&P 500 index, he finds that the safe withdrawal rate can be increased from 4.15 percent to 4.58 percent, and more generally he writes that the accumulated impacts of these modifications leave him comfortable recommending withdrawal rates much closer to 5 percent than to 4 percent. Bengen (2006b) provides a specific example of this revised recommendation, as a retiree who includes small-capitalization stocks, accepts a 6 percent chance

for failure, and rebalances the portfolio once every four years can enjoy a 5.1 percent real withdrawal rate.

It is widely acknowledged and understood that the applicability of these withdrawal rate studies depend on the future behaving with the same patterns as the past. But a potential problem with the findings of so many of the existing studies is that they are based on the same Ibbotson Associates' *Stocks, Bonds, Bills, and Inflation* (SBBI) monthly data on total returns for US financial markets since 1926. Either this data is used directly for historical simulations or bootstrapping approaches, or it is used to calculate parameters for Monte Carlo simulations. The problem is that the time period covered by this data may have been a particularly fortuitous one for the United States. If one thinks of the world as a Monte Carlo simulation, then the single simulated path observed in the twentieth-century United States may not represent the true underlying distribution of returns, and future returns are more likely to be lower.

This point is made forcefully in Dimson, Marsh, and Staunton (2004). They argue that looking only to past US data for future predictions will lead to "success bias" and sampling error. As the title of their article suggests, it is "irrational optimism." In the first case, they note that the US stock market capitalization grew from about 22 percent of world's total in 1900 to 54 percent in 2003, and such success cannot be extrapolated into the future. As for sampling error, the US data does not reach over a long enough time to be confident about its characteristics, as there are too few distinct periods. Examining asset returns for a larger selection of countries should provide a better idea about the range of possibilities for the future. Their hope was to eliminate the widespread belief that the stock market will always provide a positive real return over a 20 year period, as while this was true in the United States, it was also true only in 3 of the remaining 15 countries they investigate.

The argument in Dimson, Marsh, and Staunton (2004) was not based on any underlying factors in the US, but only on the unreliability of the small historical sample period. But an established literature also argues that the US should expect lower stock returns in the future due to underlying fundamental factors. Data available from Robert Shiller's homepage (http://www.econ.yale.edu/~shiller/data.htm) indicate that the dividend yield in June 2010 was 2.03 percent, compared to an average value since 1900 of 4.3 percent, and the cyclically adjusted price-earnings ratio in June 2010 was 19.79, compared to an average since 1900 of 16.27. Bogle (2009) is very skeptical about basing stock return expectations on their historical performance, arguing instead that they should be based on the fundamental sources: earnings growth and the dividend yield. If the current dividend yield is below its historical average, then future stock

returns will also be lower. Krugman (2005) argues that real stock returns of about 5 percent should be expected, and this can be determined either because the price-earnings ratio is above its historical average, or because of his combined expectations for earnings growth and the dividend yield. Altogether, the conclusions reached by studies using the SBBI data may provide overly optimistic estimates of future sustainable withdrawal rates, which could therefore jeopardize retirement spending at later ages.

One study in this literature acknowledging that past market conditions may not suitably represent what will happen in the future is Blanchett and Blanchett (2008). They note that based on the average expected forecast for future stock returns from a variety of sources, the future real return for a 60/40 portfolio of stocks and bonds can be expected to be between 1 and 2 percentage points less than historical averages. They use Monte Carlo simulations to consider how varying the returns and standard deviations of an investment portfolio will impact the sustainable real withdrawal rate for 30 year periods, which essentially allows the reader to choose their assumptions for these two portfolio parameters and see the probability of success for various withdrawal rates.

Our approach for obtaining a better idea about the implications of lower asset returns on sustainable withdrawal rates is to replicate the methodology of Bengen (2006a) using 109 years of financial market data for the 17 developed market economies described in Dimson, Marsh, and Staunton (2002). The author uses this multi-country data not because of a belief that the United States is directly comparable to the other countries, or because of a bearish outlook for the US, but rather as a way to consider sustainable withdrawal rates under different historical circumstances, acknowledging that asset returns in the US may simply be unable to continue the blazing path that past investors could enjoy. Though an acceptable interpretation of the results is also that they provide guidance to prospective retirees in 17 different countries, the intention is to apply them more as 17 actually possible scenarios for what a prospective retiree in the US may face in the future.

2. Methodology and Data

This paper primarily uses the Dimson, Marsh, and Staunton (DMS) dataset commercially available from Ibbotson Associates and Morningstar. For each of 17 developed market countries, annual data is available for stocks, bonds, bills, and inflation for the 109 years between 1900 and 2008. This data is compared to the findings based on the *Stock, Bonds, Bills, and Inflation* (SBBI) data that is commercially available from Ibbotson Associates for the United States on a monthly basis since 1926. While the SBBI data includes two series for stocks (large and small

capitalization stocks) and three series for bonds (intermediate-term government bonds (ITGB), long-term government bonds (LTGB), and long-term corporate bonds (LTCB)), the DMS data provides one series for each asset. Detailed definitions and sources for the DMS data are provided in Dimson, Marsh, and Staunton (2002). With this data, the paper uses a historical simulations approach, considering the perspective of individuals retiring in each year of the historical period. Because of the assumed retirement duration of 30 years and the data ends with 2008, retirements take place between 1900 and 1979. There are 80 retirement dates for each of 17 countries, or 1,360 retirement episodes.

For each country, we optimize across the three domestic financial assets, finding the fixed asset allocation that provides the highest sustainable withdrawal rate over the next 30 years. For each retirement episode, there are 5,151 possible asset allocations, which consist of all possible combinations where each asset is held as some multiple of one percentage point increments. This study includes several important assumptions, most of which can be easily modified in subsequent research. These assumptions include:

1. SAFEMAX: Bengen (2006a) describes his SAFEMAX as the highest withdrawal rate that would have provided a sustained real retirement income without being exhausted for the required number of years during every year of the historical period. In other words, it is the maximum sustainable withdrawal rate from the worst-case retirement year. This paper uses Bengen's SAFEMAX concept.

2. Perfect Foresight Assumption: Much of the analysis provides a best-case scenario for increasing the SAFEMAX by assuming in each year for each country that the new retiree has perfect foresight to choose the fixed asset allocation that would maximize the withdrawal rate for the subsequent 30 year period. Obviously the assumption is not realistic and artificially inflates the SAFEMAX, but we keep it because the traditional 4 percent withdrawal rule will still perform surprisingly poorly, and this assumption avoids accusations that we intentionally chose a poor-performing asset allocation to discredit the 4 percent rule. We relax this assumption at the end when we consider specific results for a portfolio mixed evenly between stocks and bonds.

3. Retirement duration: We assume a fixed retirement duration of 30 years, which would mean, for example, that a 65 year old retiree lives to age 95. This assumption is easy to change, and most studies find that sustainable withdrawal rates decrease as the retirement duration increases. 4. Portfolio Administrative fees: This assumption is rather vexing, but to be consistent with most studies (Ameriks, Veres, and Warshawsky (2001) and Pye (2001) are two notable exceptions), we assume that mutual fund companies and financial advisers do not deduct any fees from the

portfolio. We do this in order to make clear that the lower SAFEMAXs we find are due to factors other than such fees. To provide some idea about the potential impact of administrative fees, note that Bengen (2006a) finds a SAFEMAX of 4.15 percent for a portfolio with 50 percent large-company stocks and 50 percent intermediate-term government bonds. If we include average annual administrative fees of 1.6 percent for stock mutual funds and 1.2 percent for bond mutual funds (these are close to the averages found by Morningstar in 2008 - see http://news.morningstar.com/PDFs/Appendix_0409.pdf), which we deduct at the end of each year before rebalancing, the SAFEMAX for this portfolio is reduced to 3.49 percent. Looking to the future, index funds and ETFs do provide very low administrative fees, making it more reasonable to ignore them, but retirees who invest in costly mutual funds must realize the strong impact it will have on their sustainable withdrawal rate.

5. Portfolio rebalancing and taxes: Like much of the literature, we assume that the investment portfolio will be rebalanced at the end of each year to maintain the targeted asset allocation, and we do not attempt to collect taxes.

6. Withdrawal amounts and pattern of activities during the year: We assume the annual account withdrawal is set as a percentage of the accumulated portfolio at the retirement date. In each subsequent year, the withdrawal amount is adjusted by the previous year's inflation. Withdrawals are made at the start of each year. The remaining account balance, divided among the three assets, then grows or shrinks by that year's asset returns, and at the end of the year the portfolio is rebalanced to the target asset allocation. If the withdrawal pushes the account balance down to zero, the withdrawal rate was too high and the portfolio failed to be sustainable for 30 years.

3. Results

Tables 1 and 2 provide summary statistics for the 17 countries in the DMS dataset for the years 1900 to 2008, and for the US SBBI data for the years 1926 to 2009. These statistics are provided for the real returns after removing the effects of inflation. Before proceeding further, these tables already serve to illustrate how the United States enjoyed relatively favorable asset returns from an international perspective. For stocks, only 3 countries enjoyed a higher compounded return than the US's 6.01 in the DMS data and 6.6 in the SBBI data. Surprisingly as well, given the high returns, the United States could enjoy relatively low volatility for stock returns, as only 4 countries experienced standard deviations below the 20.43 percent of the United States. Australia boasts the distinction of being the only country with both a higher return (the highest of all) and lower volatility than the US. Another benefit for the United States was the low correlation between stocks and bonds, which will reduce the overall risk of portfolios that include

these assets. Only Canada and the Netherlands enjoyed correlations lower than the 0.17 experienced in the US.

// Table 1 About Here //

Table 2 provides the details of a similar success story for fixed income assets and inflation in the United States. First, for bonds, only 3 countries enjoyed higher compounded annual real bond returns than the United States. Of these, only Sweden experienced higher stock and bond returns than the US. Equally important, only two countries enjoyed less volatility for their bond returns. Switzerland is the one country with both higher returns and lower risks for its bonds. As for the SBBI data, all three bond series showed higher compounded returns than the US bonds in the DMS data, while two of the bond series also experienced less volatility. As for the real returns on bills, there were 6 countries with higher average returns, but the standard deviation for bills in the United States was the lowest of any country. And though inflation does not play a direct role in real asset returns, only two countries experienced lower average inflation than the 3.09 percent value in the US.

// Table 2 About Here //

These two tables show that conditions were quite favorable, relatively speaking, for the United States. The US consistently enjoyed among the highest returns and lowest volatilities for stocks, bonds, bills, and inflation. The SBBI data generally show even more favorable results than the US DMS data, but this is largely because the DMS data includes the years 1900 to 1925 as well. A check reveals less pronounced differences when comparing the same time periods from the two different datasets. Naturally, simulations using US data should subsequently provide for relatively high sustainable withdrawal rates from retirement savings.

// Figure 1 About Here //

Figure 1 provides a historical perspective on the maximum withdrawal rate that would have provided a sustainable inflation-adjusted return for a retirement duration of 30 years using DMS data for the United States. This figure provides a visual demonstration of the perfect foresight assumption, as the asset allocation for each retiree fluctuates from year to year. For instance, a new retiree in 1905 would have done best with an allocation of 95/1/4 for stocks/bonds/bills, while the next retiree one year later would find that 53/0/47 provides the highest sustainable withdrawal rate. The stock allocation fell to a low of 24 percent for the 1929 retiree, but in fact, 43 of the 80 retirees would choose stock allocations of 95 percent or higher to maximize their withdrawal rates. With this perfect foresight assumption, the SAFEMAX is 4.02 percent, which occurs in 1969 as the lowest maximum withdrawal rate. The asset allocation for

the SAFEMAX is 57/6/37 for stocks/bonds/bills. Though not particularly relevant, the 1949 retiree enjoyed the highest possible withdrawal rate of 12.47 percent.

// Table 3 About Here //

Table 3 summarizes the information provided in Figure 1 about sustainable withdrawal rates for each of the 17 countries. With perfect foresight and no administrative fees, the reported SAFEMAX values must really be thought of as best-case scenarios. Nevertheless, we find that the SAFEMAX exceeds 4 percent in only 4 of the 17 countries: Canada, Sweden, Denmark, and the United States. The US is ranked fourth, with the previously mentioned 4.02 percent occurring in 1969. The most unfortunate retiree of all was a Japanese person retiring in 1940, whose maximum sustainable withdrawal rate was a miserably low 0.47 percent. The tenth percentile column in the table shows the value of the withdrawal rate that would have failed in 10 percent of the 80 historical simulations. In other words, it can be thought of as the withdrawal rate providing a 90 percent chance for success. Still, only 9 of the 17 countries have values above 4 percent, and the US is ranked fifth with 4.7 percent. The next sets of columns show more about failures when using a fixed withdrawal rate of 4 or 5 percent, including the percentage of simulations that failed to provide 30 years of withdrawals, and the number of withdrawal years provided in the worst case. For the 4 percent withdrawal rate, 9 countries experienced failures in 5 percent or less of cases, but then a large jump occurs so that the best to be hoped for was failure in 25 percent of cases. In Italy, failures occurred in 62.5 percent of cases, and in Japan, withdrawals were sustainable for only 3 years in the worst-case scenario. Meanwhile, with a 5 percent withdrawal rate, Canada was the only country where failures occurred in less than 10 percent of cases. Failures in the United States happened 22.5 percent of the time, with the worst retirement year providing only 20 years of withdrawals.

Though an additional table about this situation is not shown, the "SAFEMAX Year" column in Table 3 shows that a number of countries experienced a bad start to the twentieth century, and if we reduce the period of investigation, the SAFEMAX values can increase. For example, if we only consider post-war retirees in 1946 and later, then 10 countries have a SAFEMAX of over 4 percent. Sweden enjoyed the highest with 4.84 percent, whereas the US value of 4.02 from 1969 is ranked 10 out of 17. Japan still experienced the lowest SAFEMAX, which was 1.56 percent in 1946.

// Figure 2 About Here //

Figure 2 provides a different perspective by showing the maximum sustainable withdrawal rates across the distribution of stock allocations for each country. This figure

maintains an aspect of the perfect foresight assumption, as for each stock allocation the breakdown between bonds and bills that provides the highest withdrawal rate is chosen. For each country's distribution, the highest withdrawal rates are marked (multiple points are marked for ties), and the US distribution is shown in blue. Occasionally, a country's maximums in the figure are slightly less than the SAFEMAXs shown in Table 3. This is because of the way the figure is constructed. First, for each stock allocation, the maximum sustainable withdrawal rate is found for each retirement year. The plotted point is then the minimum of these maximum sustainable withdrawal rates across the 80 retirement years. The plotted maximum will be smaller than in Table 3 in cases where the particular asset allocation that produced the SAFEMAX in Table 3 actually resulted in a lower sustainable withdrawal rate in some other retirement year (and was not the other year's SAFEMAX). This is particularly relevant for the cases of Sweden and Denmark, as in Figure 2 the US is shown to have the second highest maximum.

That being said, the differences are minor, and Figure 2 provides two very interesting results. First, for stock allocations between 30 and 90 percent, the United States enjoyed higher sustainable withdrawal rates than any country except for Canada. For the US case specifically, the maximum occurs at 57 to 60 percent stocks, but unlike many of the countries that show a much more pointed hump, the SAFEMAX is only slightly less for equity allocations between about 30 percent and 80 percent. Sweden and Denmark come close to the US only for a few specific asset allocations. With this figure we clearly see the relative dominance of the United States across the range of stock allocations.

The second interesting result from this figure relates to the stock allocations for each country's maximum. Switzerland, with 19 percent stocks, is the only country where the maximum occurs exclusively with a stock allocation under 48 percent. Meanwhile, 9 of the 17 countries experience stock allocations between 48 and 75 percent. As well, 7 countries have stock allocations that are exclusively 80 percent or higher. These include 100 percent stock allocations in South Africa, France, and Japan. Clearly, SAFEMAX does not obtain its safety from conservative asset allocations. But this point has an important *caveat*, because one inherent problem underlying the SAFEMAX approach is that the results are driven solely by the simulation year where the SAFEMAX occurred. The figure does suggest, though, from an international perspective, that stock allocations of at least 50 percent during retirement should be given careful consideration.

// Table 4 About Here //

We now eliminate the perfect foresight assumption by considering in further detail what happens for a specific asset allocation of 50/50 for stocks and bonds, a common choice for such studies. Table 4 shows the SAFEMAX and details about the failures associated with higher withdrawal rates for each country. These results are specifically shown for retirees between 1926 and 1979, which increases the SAFEMAX for some countries below the top 5, in order to make them consistent with the included SBBI results. This table overwhelmingly shows that a 4 percent withdrawal rate is not safe when using the SAFEMAX criteria for the DMS data with the 50/50 asset allocation. Indeed, the original Bengen (2006a) result, which is listed as "US SBBI ITGB," is the only case out of 20 with a SAFEMAX above 4 percent. Bengen (2006a) does acknowledge a lower performance when using long-term government or corporate bonds, and the table bears this out, showing a SAFEMAX of 3.62 and 3.72, respectively. For the DMS data, Canada's SAFEMAX of 3.94 is the highest, followed by the US and Denmark with 3.66. Even with a willingness to accept a 10 percent chance of failure, a withdrawal rate of over 4 percent was possible only in 4 countries using the DMS data. The United States just missed being one of these countries, as its 10th percentile value is 3.98. All three versions of the SBBI data, though, did allow for a withdrawal rate above 4 percent if the retiree accepts a 10 percent chance of failure.

With a 4 percent real withdrawal rate in the post-1926 period, among the top 7 countries, failure would have occurred in 13 percent of cases or less, but then there is a dramatic jump such that in the bottom 10 countries the lowest failure rate was quite large at 27.8 percent. The largest number of failures occurred in Spain. Retirees in the United States met failure in 11.1 percent of cases, with 4 percent being sustainable for only 24 years at one point. For another example, consider Italy, where a 4 percent withdrawal rate failed in 72.2 percent of the cases, and the worst retirement year yielded only 5 years of withdrawals. Both of these countries are further highlighted in Figure 3, which shows the distribution of sustainable withdrawal years (up to 30) across the entire retirement period between 1900 and 1979. For the United States, the failures were grouped together in the late 1960s, and the US did not experience any failures prior to 1926, while in Italy three major periods of low performance can be found.

// Figure 3 About Here //

Returning to Table 4, we see that a 5 percent withdrawal rate would have been risky from an international historical perspective as well. Bengen's original "US SBBI ITGB" scenario shows the most promising results, but still the strategy would have failed in 25.5 percent of the cases, and in the worst case it would have provided only 20 years of withdrawals. Only in the other SBBI scenarios and in Canada were the percentage of failures under 40 percent. The DMS

data shows the strategy failing in 40.7 percent of cases in the United States, and in Spain the strategy failed in 92.6 percent of cases.

4. Conclusions and Recommendations

The results have shown that from an international perspective, a 4 percent withdrawal rate has been anything but safe. With the perfect foresight assumption, only 4 of 17 countries could achieve it, while the 50/50 allocation for stocks and bonds shows no successes with the 17 countries in the DMS data. But what to make of these results? First, a few *caveats* are in order. For one thing, researchers have demonstrated that including more financial assets, using dynamic rules to adjust market portfolios, and changing rebalancing strategies can all serve to increase safe withdrawal rates, but these modifications have not been incorporated here. As well, some of the worst outcomes were connected with World Wars I and II, and investors who are confident that world war is a relic of the past may feel comfortable ignoring those cases, or may at least assume that enjoying a comfortable retirement would be the last thing on their minds. On the other hand, the paper does already provide two important advantages to increase the SAFEMAXs, namely the perfect foresight assumption and the lack of administrative fees.

These findings may be rather frightening. After all, who but the wealthiest could possibly save enough to live comfortably from a 0.47 percent withdrawal rate? The results assume that historical patterns in each country will prevail in the future, though from the perspective of a US retiree, the issue is whether the future US will experience the same asset return patterns as the past US, or whether Americans should expect some kind of mean reversion that could lower asset returns to levels more in line with what other countries have experienced. It may be tempting to hope that asset returns in the twenty-first century United States will continue to be as spectacular as in the last century, but Bogle (2009) cautions his readers, "Please, please please: *Don't count on it*" (page 60).

This leads to recommendations, as there are ways to help prepare for a world of lower sustainable withdrawal rates. First, for those who are not yet at the retirement stage, simply saving more or planning to work longer before retirement provide two options, however unsavory they may seem. Another approach advocated by Bodie and Clowes (2003) is to base one's retirement portfolio on Treasury Inflation-Protected Securities (TIPS). TIPS provide a certain real return at the time of purchase if held to maturity, and though the real return is less than people who focus on the SBBI data may be expecting from a balanced portfolio of stocks and bonds, it will at least help savers to develop reasonable and more certain expectations about what is possible for their retirements. Finally, assuming that providers are not driven out of business by

over-optimism, retirees may wish to consider annuities and other guaranteed products for part of their income in order to be less reliant on the sustainability of withdrawals from their accumulated savings. For more on potential strategies to achieve this, see Hogan (2007), Milevsky (2009), Pang and Warshawsky (2009), Guyton (2010), and Xiong, Idzorek, and Chen (2010). Though these strategies are more complicated, a more realistic attitude about sustainable withdrawal rates suggests that financial planners can provide value to their clients by helping them navigate through the various possibilities.

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Table 1

Summary Statistics for Real Equity Returns

	Geometric Mean	Arithmetic Mean	Standard Deviation	Correlation Between Stocks and Bonds
Australia	7.26	8.89	18.14	0.28
Sweden	7.23	9.59	22.93	0.18
South Africa	7.07	9.32	22.72	0.44
United States	6.01	8.05	20.43	0.17
Canada	5.87	7.25	17.03	0.16
United Kingdom	5.09	6.98	20.06	0.53
The Netherlands	4.65	6.79	21.75	0.08
Denmark	4.62	6.44	20.71	0.48
Switzerland	4.1	5.96	19.92	0.37
Japan	3.79	8.54	30.05	0.38
Norway	3.77	6.76	27.31	0.19
Ireland	3.54	6.2	23.17	0.5
Spain	3.53	5.77	22.17	0.35
France	3.17	5.72	23.33	0.38
Germany	2.8	7.94	32.5	0.44
Italy	1.89	6	29.21	0.4
Belgium	1.86	4.18	22.46	0.4
US SBBI S&P 500	6.60	8.64	20.51	
US SBBI Small-Cap	8.59	13.16	32.14	

Note: Red coloring indicates value is higher than the US DMS value for means, and lower for standard deviations and correlations.

Source: Own calculations from Dimson, Marsh, and Staunton (1900 - 2008) data and SBBI (1926 - 2009) data.

Table 2

Summary Statistics for Real Bonds and Bills, and for Inflation

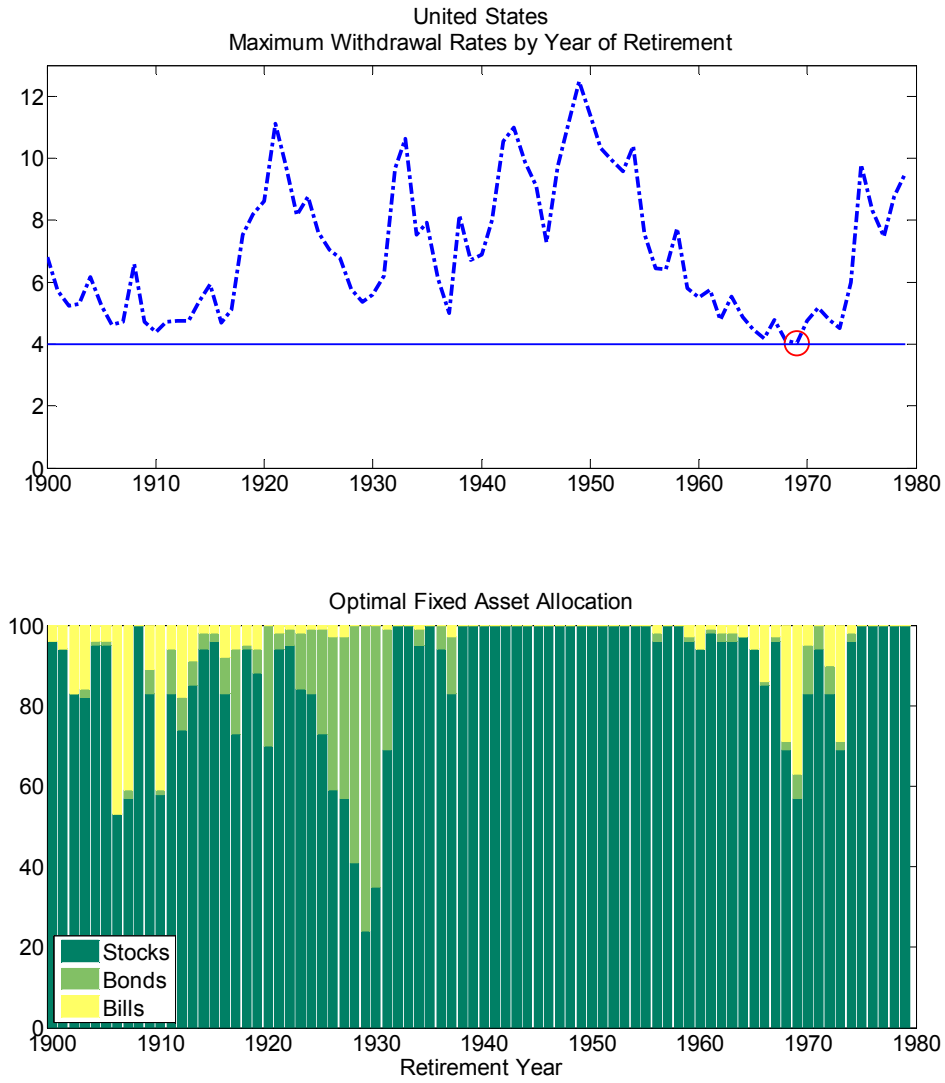
	Bonds			Bills		Inflation	
	Geometric Mean	Arithmetic Mean	Standard Deviation	Arithmetic Mean	Standard Deviation	Arithmetic Mean	Standard Deviation
Denmark	3.04	3.66	11.72	2.47	6.07	4.11	6.17
Switzerland	2.59	2.88	7.88	0.93	5.05	2.47	5.29
Sweden	2.51	3.23	12.48	2.17	6.85	3.85	7.33
United States	2.12	2.59	10.03	1.08	4.68	3.09	4.88
Canada	2.1	2.62	10.41	1.75	4.92	3.17	4.65
South Africa	1.77	2.3	10.44	1.21	6.3	5.18	7.58
Norway	1.69	2.43	12.29	1.44	7.25	4.02	7.4
Australia	1.52	2.36	13.26	0.82	5.47	4.02	5.3
United Kingdom	1.39	2.26	13.75	1.24	6.33	4.17	6.64
The Netherlands	1.37	1.79	9.46	0.85	5	3.06	4.8
Spain	1.36	2.04	11.82	0.54	5.92	6.12	6.95
Ireland	1.08	2.09	14.76	0.88	6.69	4.61	6.98
Belgium	-0.14	0.6	12.09	0.02	8.12	5.75	9.04
France	-0.2	0.73	13.12	-2.32	9.65	7.94	12.38
Japan	-1.19	1.55	20.28	-0.34	14.05	10.63	42.08
Germany	-1.62	0.73	15.49	0.31	10.15	5.67	15.21
Italy	-1.73	-0.43	14.17	-2.58	11.64	11.02	35.29
US SBBI ITGB	2.25	2.48	6.87	0.71	3.92	3.10	4.20
US SBBI LTGB	2.34	2.87	10.69				
US SBBI LTCB	2.76	3.18	9.51				

Note: Red coloring indicates value is higher than the US DMS value for means (except inflation), and lower for standard deviations. For Germany, inflation statistics are calculated after excluding two years of hyperinflation in 1921 and 1922. For the SBBI data, ITBG represents intermediate-term government bonds, LTGB represents long-term government bonds, and LTCB represents long-term corporate bonds.

Source: Own calculations from Dimson, Marsh, and Staunton (1900 - 2008) data and SBBI (1926 - 2009) data.

Figure 1

Maximum Sustainable Withdrawal Rates in the United States



Note: Assumptions include perfect foresight, a 30-year retirement duration, no administrative fees, annual inflation adjustments for withdrawals, and annual rebalancing.

Table 3

Sustainable Withdrawal Rates with Perfect Foresight Assumption

For Retirees, 1900 - 1979

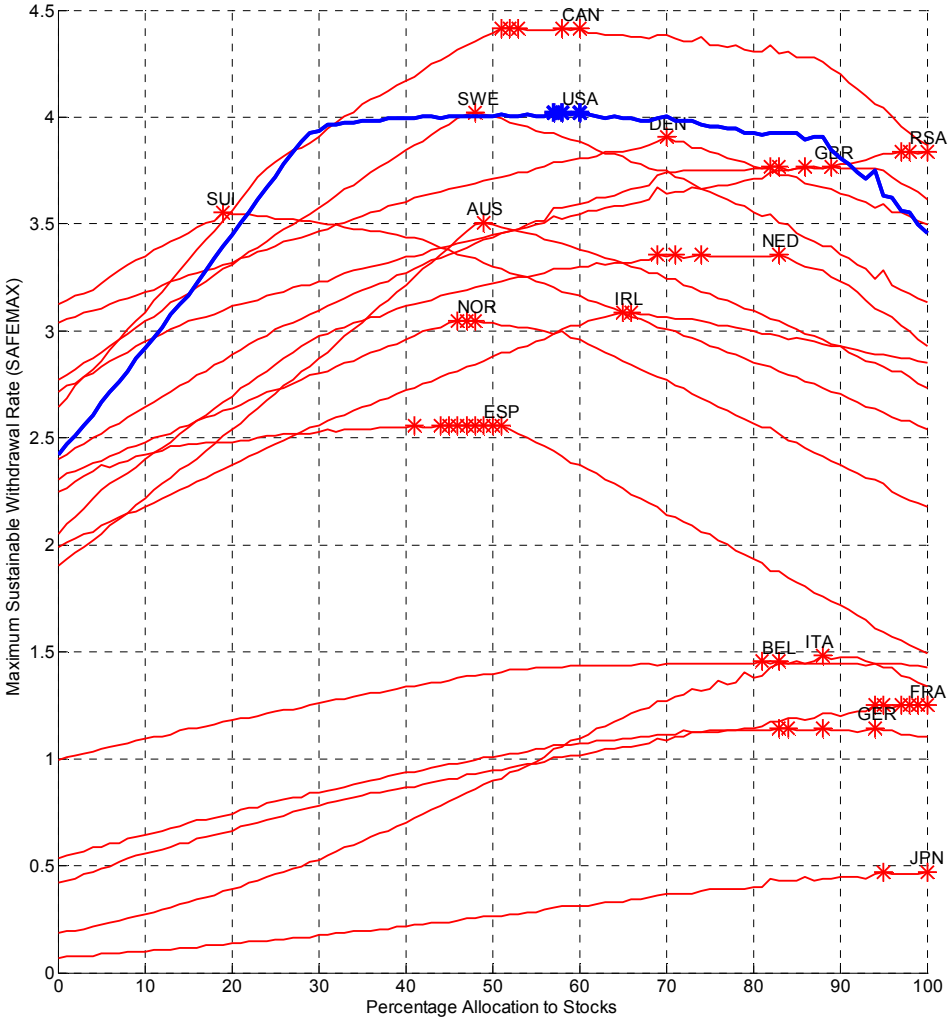
				Withdrawal Rate = 4%		Withdrawal Rate = 5%	
	SAFEMAX	SAFEMAX Year	10th Percentile	# Years in Worst Case	% Failures Within 30 Years	# Years in Worst Case	% Failures Within 30 Years
Canada	4.42	1969	5.04	30	0.0%	23	8.8%
Sweden	4.23	1914	4.92	30	0.0%	20	11.3%
Denmark	4.08	1937	4.6	30	0.0%	20	28.8%
United States	4.02	1969	4.7	30	0.0%	20	22.5%
South Africa	3.84	1937	4.88	27	1.3%	17	11.3%
United Kingdom	3.77	1900	4.17	26	3.8%	17	27.5%
Australia	3.68	1970	4.91	25	2.5%	18	10.0%
Switzerland	3.59	1962	4.08	26	5.0%	18	40.0%
The Netherlands	3.36	1941	4.14	22	2.5%	17	37.5%
Ireland	3.28	1911	3.41	21	25.0%	15	45.0%
Norway	3.13	1915	3.46	20	32.5%	13	61.3%
Spain	2.56	1957	3.07	19	36.3%	15	68.8%
Italy	1.56	1944	2.61	6	62.5%	5	76.3%
Belgium	1.46	1911	1.78	11	40.0%	9	68.8%
France	1.25	1943	2.62	7	42.5%	7	71.3%
Germany	1.14	1914	1.52	9	25.0%	8	41.3%
Japan	0.47	1940	0.54	3	37.5%	3	40.0%

Note: Assumptions include perfect foresight, a 30-year retirement duration, no administrative fees, annual inflation adjustments for withdrawals, and annual rebalancing.

Source: Own calculations from Dimson, Marsh, and Staunton (1900 - 2008) data.

Figure 2

Maximum Sustainable Withdrawal Rate for Various Equity Allocations



Note: Assumptions include perfect foresight for each stock allocation, a 30-year retirement duration, no administrative fees, annual inflation adjustments for withdrawals, and annual rebalancing.

Table 4

Sustainable Withdrawal Rates for 50% Stocks / 50% Bonds Fixed Allocation

For Retirees, 1926 - 1979

				Withdrawal Rate = 4%		Withdrawal Rate = 5%	
	SAFEMAX	SAFEMAX Year	10th Percentile	# Years in Worst Case	% Failures Within 30 Years	# Years in Worst Case	% Failures Within 30 Years
Canada	3.94	1965	4.34	29	1.9%	19	37.0%
United States	3.66	1966	3.98	24	11.1%	17	40.7%
Denmark	3.66	1939	3.95	26	13.0%	19	51.9%
Sweden	3.6	1939	4.33	25	3.7%	18	50.0%
South Africa	3.45	1937	3.99	24	9.3%	17	48.2%
United Kingdom	3.43	1937	4.01	23	9.3%	15	55.6%
Switzerland	3.36	1962	4.04	23	7.4%	17	42.6%
The Netherlands	3.22	1941	3.6	21	27.8%	16	53.7%
Norway	3.11	1950	3.31	22	50.0%	14	70.4%
Australia	2.89	1970	3.47	16	27.8%	12	61.1%
Ireland	2.87	1937	3.28	20	35.2%	14	70.4%
Spain	2.17	1973	2.54	10	75.9%	8	92.6%
Belgium	2.05	1942	2.75	12	44.4%	10	77.8%
Germany	1.3	1945	1.51	3	38.9%	3	57.4%
France	0.95	1943	1.5	7	44.4%	6	64.8%
Italy	0.89	1942	1.03	5	72.2%	4	77.8%
Japan	0.24	1937	0.26	3	38.9%	3	42.6%
US SBBI ITGB	4.15	1966	4.48	30	0.0%	20	25.5%
US SBBI LTGB	3.62	1966	4.01	23	9.1%	17	32.7%
US SBBI CB	3.72	1966	4.14	25	3.6%	17	30.9%

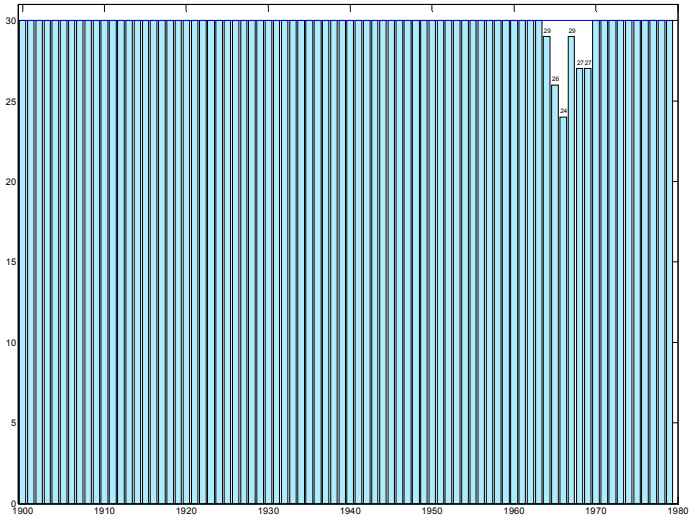
Note: These calculations are only for retirees since 1926 to make the two data sources more directly comparable. Assumptions include a 30-year retirement duration, no administrative fees, annual inflation adjustments for withdrawals, and annual rebalancing.

Source: Own calculations from Dimson, Marsh, and Staunton (1926 - 2008) data and SBBI (1926 - 2009) data.

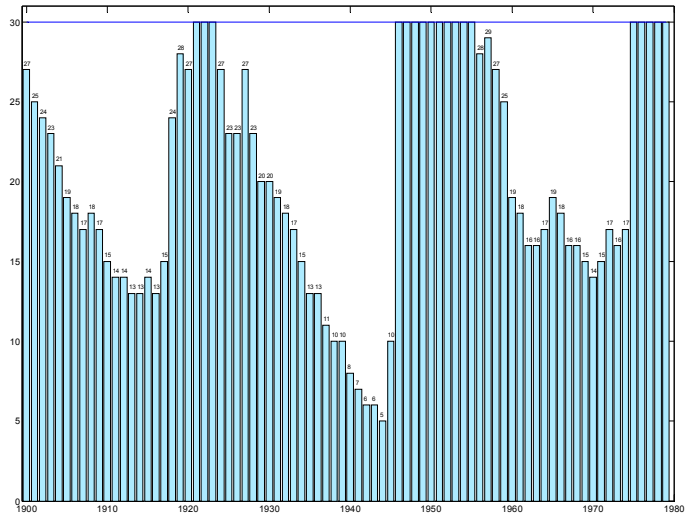
Figure 3

Years of Sustainability (up to 30) for a 4% Withdrawal Rate with a Fixed 50% Stocks / 50% Bonds Asset Allocation

United States



Italy



Note: Assumptions include no administrative fees, annual inflation adjustments for withdrawals, and annual rebalancing.