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# *"An International Perspective on Safe Withdrawal Rates from Retirement Savings: The Demise of the 4 Percent Rule?"*[1]

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, "safe" 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 safe 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 at some point in all 17 countries.

***JEL* Codes:** G11, G15, G17, C15

**Brief Biography:**
Wade Pfau, an Associate Professor at the National Graduate Institute for Policy Studies in Tokyo, Japan, holds a Ph.D. in Economics from Princeton University. His hometown is Des Moines, Iowa.

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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. The starting point for advice on this issue in the modern era is Bengen (1994), who famously motivated the 4 percent withdrawal rule using historical simulations. He later coined 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 on sustainable withdrawal rates with various tweaks and modifications followed this early research. For instance, 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 diversifying into more financial assets, requiring sustainable withdrawals for longer or shorter periods of time, changing withdrawal patterns to favor larger withdrawals either in 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, a time interval for which there are less than three nonoverlapping 30-year periods. 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 path observed in the twentieth-century United States may not represent its true underlying distribution of returns, and future returns are 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 though the US enjoyed remarkable growth and success in the twentieth century, with its stock market capitalization growing from about 22 percent of world's total in 1900 to 54 percent in 2003, such relative success would have been difficult to predict in 1900 and cannot be extrapolated into the future. As for sampling error, the US data does not reach over a long enough time interval to be confident about its characteristics, as there are too few nonoverlapping 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 (Norway has since been added to their dataset, increasing the total countries now available to 17). For their study with data from 1900 to 2002, the real compounded returns to the US stock market was 6.3 percent, compared to 5.4 percent for their index of developed-country stock markets.

The argument in Dimson, Marsh, and Staunton (2004) was not based on any underlying factors in the US. 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. Low dividend yields and a high price-multiple on earnings should both lead to

lower future stock returns on average. For this reason, Bogle (2009) is very skeptical about basing stock return expectations on their historical performance.

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). Basing an average forecast for future stock returns on a variety of sources, they find that the future real return for a 60/40 portfolio of stocks and bonds could 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 how the probability of success changes 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 17 developed market countries. 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 potential scenarios for what a prospective retiree in the US may face in the future. Though not all readers may accept the notion that the experiences of other countries are relevant to the United States, these findings do suggest that advisers and retirees should more critically consider the safety of the 4 percent withdrawal rule. Altogether, this paper argues that conclusions reached by studies using the SBBI data may be providing overly optimistic estimates of future sustainable withdrawal rates.

## 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. Results with this data are compared to those 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 the assumed retirement duration is 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 and in each retirement year, the paper optimizes across the three domestic financial assets, finding the fixed asset allocation that provides the highest sustainable withdrawal rate over the next 30 years. There are 5,151 possible asset allocations, which consist of all possible combinations of each asset in one percentage point increments. Other important assumptions include:

1. SAFEMAX: Bengen (2006a) describes 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 maximizes the withdrawal rate for the subsequent 30 years. Obviously the assumption is not realistic and artificially inflates the SAFEMAX, but even so, the traditional 4 percent withdrawal rule will still perform surprisingly poorly. This assumption avoids accusations that a poor-performing asset allocation was chosen to discredit the 4 percent rule. To provide some idea about this assumption, we will also include a brief discussion for how the results change for a specific portfolio mixed evenly between stocks and bonds.

3. 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 planners 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 by 0.66 percentage points 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 or who pay fees to financial planners must realize the strong impact it will have on their sustainable withdrawal rate.

4. 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. This assumption is appropriate for withdrawals from a Roth IRA, but must be considered as a pre-tax withdrawal rate for taxable accounts.

5. 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 drops the account balance to zero at any point before the 30$^{th}$ year, the withdrawal rate was too high and the portfolio failed to be sustainable.

**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 real return than the United States' 6.01 in the DMS data and 6.6 in the SBBI data. Surprisingly, given the high values, the US could also 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, while Canada enjoyed the lowest stock volatility

of any country. 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.

// 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 compounded real returns, but the standard deviation for bills in the United States was the lowest of any country. As well, only two countries experienced lower compounded average inflation than the 2.98 percent value in the US.

// Table 2 About Here //

These two tables showed that conditions were quite favorable, relatively speaking, for the United States. The country consistently enjoyed among the highest returns and lowest volatilities for stocks, bonds, bills, and inflation. As a consequence, simulations using US data should 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 sustained inflation-adjusted withdrawals for a retirement duration of 30 years using DMS data for the United States. It demonstrates the perfect foresight assumption visually, as the optimal fixed 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 more to maximize their withdrawal rates. With this perfect foresight assumption, the SAFEMAX is 4.02 percent, which occurred in 1969. The asset allocation for the SAFEMAX is 57/6/37 for stocks/bonds/bills.

// Table 3 About Here //

Table 3 summarizes the information about sustainable withdrawal rates provided in Figure 1 for each of the 17 countries. 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 SAFEMAX occurring in 1969. For the US, the remaining columns can be understood as follows. The 10th percentile column value of 4.7 percent means that for the 80 retirement years in the US, 4.7 percent would have worked 90 percent of the time, and a slightly larger withdrawal rate would have resulted in failures 10 percent of the time (8 of the 80 retirement years). The next columns reveal more about the situation for a retiree using a 4 percent withdrawal rate and a 5 percent withdrawal rate. In the US, the 4 percent withdrawal rate failed in zero percent of cases and always provided 30 years of withdrawals, while a 5 percent withdrawal rate would have led to failure in 22.5 percent of cases. In the worst-case scenario, the retiree's account would have been depleted after only 20 years with a 5 percent withdrawal rate.

As for the other countries in Table 3, the most unfortunate retiree of all was a Japanese person retiring in 1940, whose SAFEMAX was a miserably low 0.47 percent. Six countries experienced SAFEMAX values below 3 percent. With the 10th percentile column, retirees accepting a 10 percent chance for failure could enjoy a withdrawal rate above 4 percent in 9 countries, but 5 countries still found these withdrawal rates to be under 3 percent even with the allowed chance for failure. For the columns showing what happens specifically when a 4 percent withdrawal rate is used, 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.

// 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. The distribution for the United States is shown with a thick red line. Occasionally, because of the way the figure is constructed, a country's maximum is slightly less than its SAFEMAX in Table 3. The reason is that for each stock allocation, the maximum sustainable withdrawal rate is found for each retirement year. The plotted point is the minimum of these maximum sustainable withdrawal rates across the 80 retirement years. The plotted maximum will be smaller than the SAFEMAX in cases where the particular asset allocation that produced the SAFEMAX actually resulted in a lower sustainable withdrawal rate in some other retirement year (but was not the other year's SAFEMAX).

That being said, 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, the maximum occurs at 57 to 60 percent stocks, but unlike many of the countries that show a much more pointed hump, the maximum is only slightly less for stock allocations between about 30 and 80 percent. Maximums for Sweden and Denmark come close to the US only for a few specific asset allocations. The second interesting result from this figure relates to the stock allocations associated with 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 maximum withdrawal rates with stock allocations between 48 and 75 percent, and 7 countries have stock allocations that are exclusively 80 percent or higher. These include 100 percent stock allocations in South Africa, France, and Japan. SAFEMAX does not obtain its safety from conservative asset allocations, and the findings from this figure suggest that from an international perspective, stock allocations of at least 50 percent during retirement should be given careful consideration.

Finally, to provide insight about the role of the perfect foresight assumption, consider a specific asset allocation of 50/50 for stocks and bonds, a common choice for withdrawal rate studies. A table for this allocation is not shown, but a 4 percent withdrawal rate is not safe when using the SAFEMAX criterion for any country in the DMS data. Indeed, the original Bengen (2006a) result is the only case with a SAFEMAX above 4 percent. 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.

**4. Conclusions**

With the SAFEMAX criterion, and from an international perspective, the 4 percent real withdrawal rule has simply not been safe. With the perfect foresight assumption, only 4 of 17 countries had a SAFEMAX above 4 percent, while a 50/50 allocation for stocks and bonds led to zero successes for the 17 countries in the DMS data. Granted, researchers have demonstrated that including more financial assets, using dynamic rules to adjust withdrawals to market conditions, and changing rebalancing strategies can all serve to increase safe withdrawal rates, and these modifications have not been incorporated here. As well, some of the worst outcomes were connected with World Wars I and II, and we can hope that such devastating wars will never happen again. 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 and planner fees.

These findings may be rather frightening. After all, who but the wealthiest could possibly save enough to live comfortably from the global SAFEMAX withdrawal rate of 0.47 percent? 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 many 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).

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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**

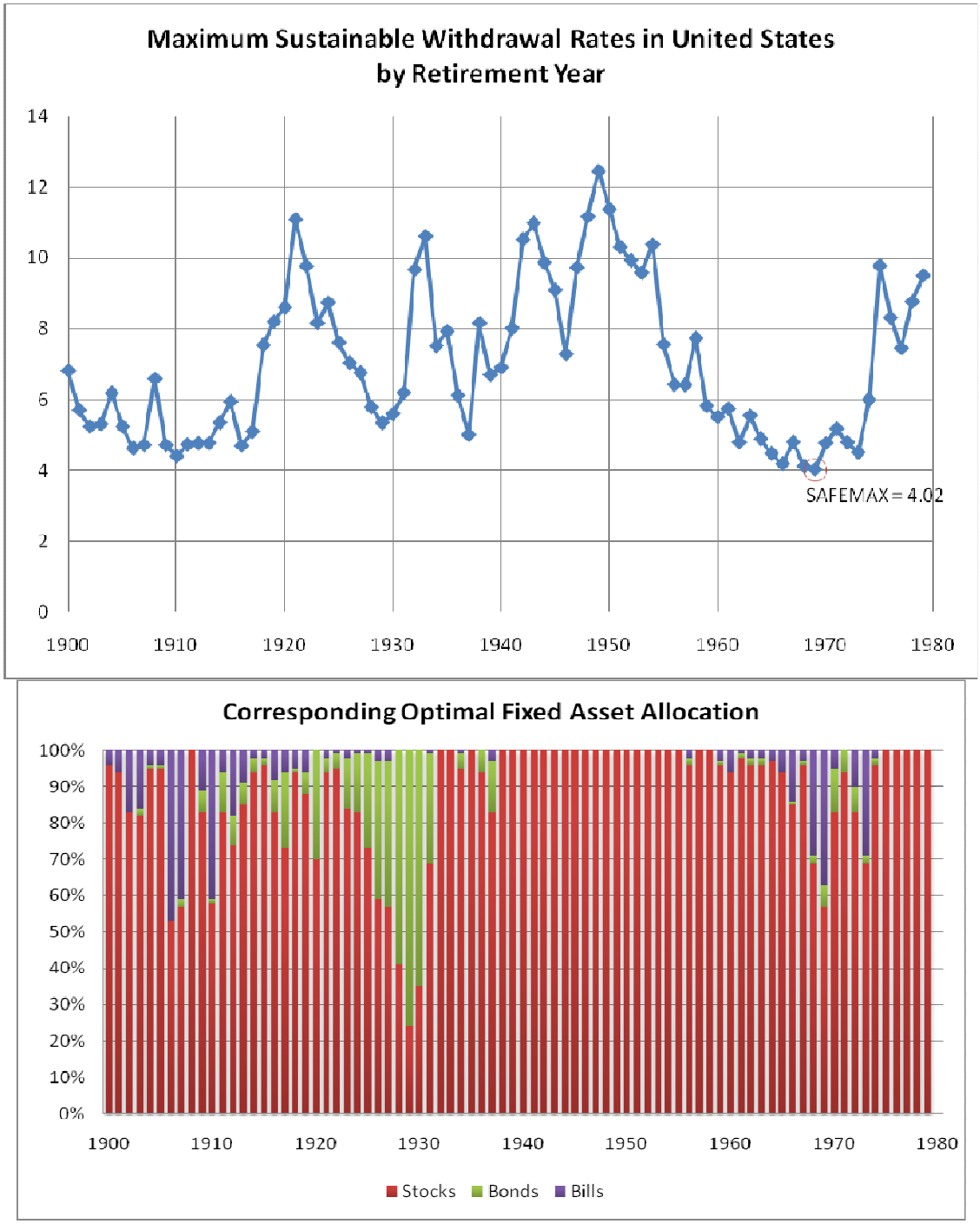
**Summary Statistics for Real Bonds and Bills, and for Inflation**

| | Real Bonds | | | Real Bills | | Inflation | |
|---|---|---|---|---|---|---|---|
| | Geometric Mean | Arithmetic Mean | Standard Deviation | Geometric Mean | Standard Deviation | Geometric Mean | Standard Deviation |
| Denmark | 3.04 | 3.66 | 11.72 | 2.29 | 6.07 | 3.93 | 6.17 |
| Switzerland | 2.59 | 2.88 | 7.88 | 0.8 | 5.05 | 2.34 | 5.29 |
| Sweden | 2.51 | 3.23 | 12.48 | 1.95 | 6.85 | 3.6 | 7.33 |
| United States | 2.12 | 2.59 | 10.03 | 0.97 | 4.68 | 2.98 | 4.88 |
| Canada | 2.1 | 2.62 | 10.41 | 1.64 | 4.92 | 3.07 | 4.65 |
| South Africa | 1.77 | 2.3 | 10.44 | 1.02 | 6.3 | 4.92 | 7.58 |
| Norway | 1.69 | 2.43 | 12.29 | 1.18 | 7.25 | 3.77 | 7.4 |
| Australia | 1.52 | 2.36 | 13.26 | 0.67 | 5.47 | 3.88 | 5.3 |
| United Kingdom | 1.39 | 2.26 | 13.75 | 1.05 | 6.33 | 3.95 | 6.64 |
| The Netherlands | 1.37 | 1.79 | 9.46 | 0.72 | 5 | 2.95 | 4.8 |
| Spain | 1.36 | 2.04 | 11.82 | 0.36 | 5.92 | 5.9 | 6.95 |
| Ireland | 1.08 | 2.09 | 14.76 | 0.67 | 6.69 | 4.37 | 6.98 |
| Belgium | -0.14 | 0.6 | 12.09 | -0.33 | 8.12 | 5.39 | 9.04 |
| France | -0.2 | 0.73 | 13.12 | -2.85 | 9.65 | 7.32 | 12.38 |
| Japan | -1.19 | 1.55 | 20.28 | -1.98 | 14.05 | 7.17 | 42.08 |
| Germany | -1.62 | 0.73 | 15.49 | -0.32 | 10.15 | 4.87 | 15.21 |
| Italy | -1.73 | -0.43 | 14.17 | -3.69 | 11.64 | 8.58 | 35.29 |
| | | | | | | | |
| US SBBI ITGB | 2.25 | 2.48 | 6.87 | 0.63 | 3.92 | 3.01 | 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**




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.

**Table 3**

**Sustainable Withdrawal Rates with Perfect Foresight Assumption**

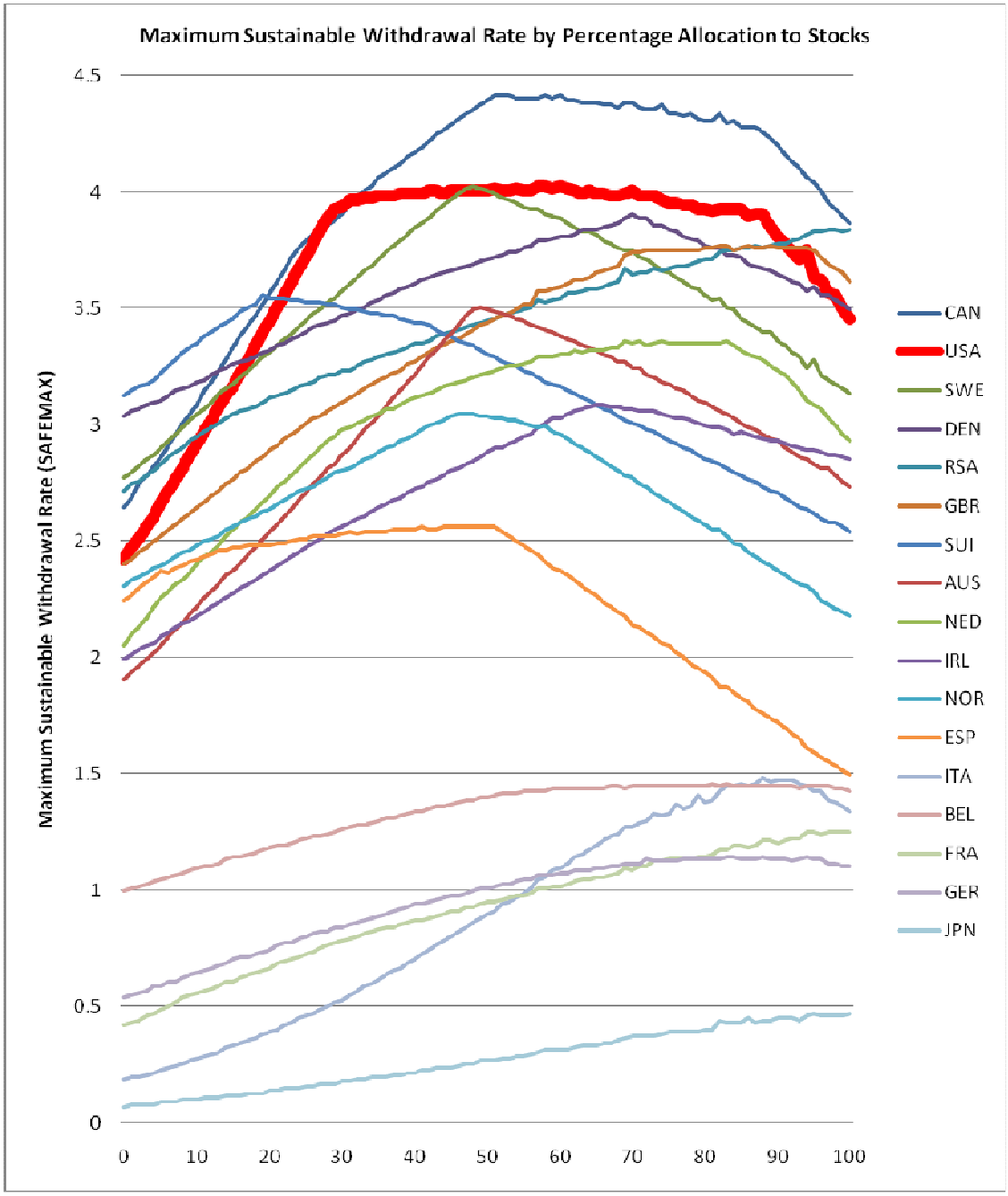
**For Retirees, 1900 - 1979**

| | | | | 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**




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.

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