Global Asset Allocation in Retirement: *Buffett's Advice and a Simple Twist*

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In his 2013 letter to Berkshire Hathaway shareholders, Warren Buffett discussed the very simple advice he gave to the trustee that will manage the bequest his wife will receive: Invest 90% of the cash in a very low-cost index fund tracking the S&P 500 and the remaining 10% in short-term government bonds. Although Buffett did not suggest that investors follow this strategy (he merely stated the recommendation he gave for his wife's bequest), his suggestion begs the question of why this specific asset allocation.

For the U.S. market, Estrada [2016a] explores the merits of a 90/10 stock/bond allocation relative to other static allocations. For 30-year retirement periods between 1900 and 2014, he finds that a 90/10 allocation had a very low failure rate (2.3%); he also finds that this strategy provided a middle ground between the higher upside potential of more aggressive strategies and the better downside protection of more conservative ones. One of the two goals of this article is to expand the scope of the inquiry to another 20 countries, thus evaluating the *global* performance of a 90/10 strategy relative to other static strategies.

The second goal is to evaluate the merits of a minor twist to the 90/10 allocation by exploring a simple dynamic strategy based on mean reversion. Essentially, this strategy, based on stock market performance, determines whether the annual withdrawal is made out of stocks or out of bonds, and whether or not the portfolio is rebalanced back to the 90/10 allocation.

The global evidence from 21 countries over a 115-year period discussed here ultimately suggests the following: In the average country, first, a 90/10 allocation has a much higher failure rate than it does in the United States; second, despite that, a 90/10 allocation does have a lower failure rate than most other static allocations; third, a 90/10 allocation provides better downside protection *and* higher upside potential than other strategies with a lower allocation to stocks; and fourth, the simple dynamic strategy explored here has a similar failure rate and provides slightly better downside protection and a somewhat higher upside potential than the 90/10 allocation.

The rest of the article is organized as follows: The first section discusses in more detail the issue at stake; the next section discusses the evidence, first by considering several static asset allocations, and then by considering a simple dynamic twist to the 90/10 allocation; finally, the last session provides an assessment. An appendix with tables concludes the article.

THE ISSUE

The savings rate, the withdrawal rate, and the portfolio asset allocation arguably are the three critical variables to consider when saving for retirement and spending during

retirement. All three variables, and particularly the last two, have received considerable attention from both academics and practitioners. Estrada [2016b] reviews the evidence on both the withdrawal rate and the portfolio asset allocation in some detail; of these two variables, the latter is the main focus of this article.

During both the accumulation and the retirement periods, a portfolio's asset allocation may be static or dynamic. Static allocations imply a constant proportion between stocks and bonds to which the portfolio is rebalanced periodically; they are easy to understand and implement and therefore have simplicity on their side. They also exhibit good performance relative to many other more complex strategies; see, for example, Blanchett [2007]. That said, given that, by definition, the stock/bond proportion is kept constant over time, it is critical for an investor to get the asset allocation right; if it is too conservative, he may fail to meet his goals, if it is too aggressive, he may be unable to tolerate short-term losses, and bail out.

Dynamic allocations, in turn, imply a time-varying proportion between stocks and bonds and often are more difficult to understand and implement. In some cases the asset allocation evolves according to a straightforward, predetermined rate; one such example is the "age-in-bonds" rule, which calls for increasing (reducing) the allocation to bonds (stocks) at the rate of one percentage point per year. However, in many other cases, the asset allocation evolves according to complex rules that depend on several variables and conditions; see, for example, Stout [2008].

Ultimately, this article explores two strategies for asset allocation. First, it examines the performance of a 90/10 asset allocation relative to other static allocations, taking a long-term (115 years), global (21 countries) perspective. And second, it examines the performance of a simple dynamic twist to the 90/10 static allocation, based on mean reversion, for which the evidence is pervasive; see, for example, the seminal articles by Fama and French [1988] and Poterba and Summers [1988].

Unlike other dynamic strategies, the one considered here is straightforward. The dynamic twist aims to avoid making annual withdrawals from stocks or selling stocks for rebalancing purposes in response to recent (the previous five years) poor performance in the stock market, and it requires only the calculation of short-term and long-term annualized returns. Given any point in time t, the former is the annualized return over the five years ending in t, and the latter is the annualized return over the

period between the beginning of the sample and t. The variable that determines where a withdrawal is made from and whether or not the portfolio is rebalanced is simply the difference between these two annualized returns.

This strategy is akin to a bucket approach, widely discussed by Morningstar's Christine Benz and originally proposed by financial planner Harold Evensky. In the simplest, two-bucket version of this approach, a portion of the nest egg is invested aggressively for long-term upside potential, and the other portion is invested conservatively (basically in cash) for shorter-term living expenses.

The number of years for which living expenses is set apart in cash is flexible. An investor who uses a 90/10 split between stocks (bucket 2) and short-term bonds (bucket 1) and who starts his retirement withdrawing 4% of the nest egg essentially starts out by setting apart and keeping in cash two-and-a-half years of living expenses; more aggressive (conservative) investors may want to have a smaller (bigger) bucket 1, thus keeping a smaller (larger) cash reserve.

EVIDENCE

This section discusses the global evidence based on 21 countries over the 115 years from 1900 through 2014. The first part discusses the data and methodology, the second part evaluates static asset allocations with a special focus on the 90/10 allocation highlighted by Buffett, and the third part evaluates a simple dynamic twist to the 90/10 allocation.

Data and Methodology

The sample considered in this article is the Dimson–Marsh–Staunton database, described in detail in Dimson, Marsh, and Staunton [2002, 2016]. The sample contains annual returns for stocks and government bonds over the 1900–2014 period for 21 countries; based on Buffett's advice, the bonds considered here are short-term government bonds (bills).[1] Returns are real (adjusted by each country's inflation rate), are denominated in local currency, and account for both capital gains/losses and cash flows (dividends or coupons). Exhibit A1 in the appendix summarizes some characteristics of all the series of stock and bond returns in the sample.

The analysis is based on a $1,000 nest egg at the beginning of retirement, annual withdrawals, and a 30-year retirement period. At the beginning of each year

the annual withdrawal is made, the portfolio is then rebalanced to the target asset allocation for the year, and then it compounds at the observed return of stocks and bonds for that year. This process is repeated at the beginning of each year during the 30-year retirement period, at the end of which the portfolio has a terminal wealth or bequest that may be positive or zero. The first 30-year retirement period considered is 1900 to 1929 and the last one is 1985 to 2014, for a total of 86 rolling (overlapping) periods.

The focus here is on a portfolio's asset allocation, not on its initial withdrawal rate (IWR), which is assumed to be 4%. For additional perspective, some results are reevaluated using a 3% IWR; results with IWRs higher than 4% are not reported simply because failure rates increase substantially for most asset allocations in most countries. (To highlight the obvious, everything else being equal, the higher the IWR, the higher the failure rate.) As is standard in the literature, the IWR indicates the proportion of the nest egg that is withdrawn in the first period, with subsequent annual withdrawals adjusted by inflation.[2]

Risk can be evaluated in many different ways, and the focus here is on two variables. The first variable is the failure rate, defined as the proportion of the 86 retirement periods considered in which the portfolio was depleted before 30 years. If history is any guide, this failure rate should be a good proxy for the expected probability of portfolio failure. The second variable is the bequest when tail risks strike, defined as the average terminal wealth in the lower $x\%$ of the distribution of terminal wealth.[3] In the framework considered here, this variable aims to assess downside protection as a retiree's bequest in particularly bad retirement periods.

Finally, upside potential is also assessed with variables estimated from the distribution of terminal wealth. These variables include mean and median terminal wealth, as well as the average terminal wealth in the upper $x\%$ of the distribution. In the framework considered here, this last variable aims to assess upside potential as a retiree's bequest in particularly good retirement periods.

Static Strategies

The first step of the analysis is to consider 10 static stock/bond allocations that can be compared to the 90/10 allocation highlighted by Buffett. Because Buffett did not intend to recommend this allocation to all investors, he did not discuss how it should evolve over time, or from which asset the periodic withdrawals for

consumption should be made; hence, a few assumptions need to be made.

It is assumed, first, that Buffett suggests maintaining the 90/10 allocation constant over time; second, that this is achieved by rebalancing the portfolio once a year at the beginning of each year; and third, that the annual withdrawal is made proportional to the asset allocation, which implies withdrawing 90% from stocks and 10% from bonds. These three assumptions—a constant asset allocation, annual rebalancing, and proportional withdrawals—are also applied to the other strategies considered in this section.

Exhibit 1 reports the results for eight static strategies with stock/bond allocations ranging from 100/0 to 30/70, in all cases rebalanced annually to the stated proportions.[4] Panels A and B are based on IWRs of 4% and 3%, the latter included for additional perspective. The results reported are averages across the 21 countries in the sample; Exhibit A2 in the appendix reports the same analysis on a country-by-country basis for a 4% IWR.

Panel A shows a tight, 27.8%–29.0% range of failure rates for strategies with stock allocations between 100% and 70%, and a 28.1% failure rate for the 90/10 allocation. To be sure, as Exhibit A2 shows, there is considerable variability across countries hiding behind these averages. To illustrate, in Canada and New Zealand, the 90/10 allocation never failed; in France and Italy it failed more than 58% and 66% of the time, respectively.[5,6] Both Exhibits 1 and A2 show that once the proportion of stocks falls below 60%, and even more so after it falls below 50%, failure rates increase considerably.

The standard deviation of the distribution of terminal wealth measures uncertainty about the bequest. Although seemingly plausible as a measure of risk, like any standard deviation it fails to distinguish between deviations above and below the mean, which is particularly important in this context, with highly positively skewed distributions. That said, this measure of risk increases steadily (and unsurprisingly) with the proportion of stocks in the portfolio, suggesting that the more aggressive the strategy, the higher the uncertainty a retiree has about his bequest.

However, a better way to assess risk in this context is to consider terminal wealth when tail risks strike. Both panels of Exhibit 1 show that terminal wealth in the 5% lower tail of the distribution (P5) is in a tight range for strategies with stock allocations between 100% and 70%, and peaks at the 90/10 strategy. Terminal wealth

EXHIBIT 1
Static Strategies: Cross-Sectional Averages

Stocks/Bonds →	100/0	90/10	80/20	70/30	60/40	50/50	40/60	30/70
Panel A: 4% IWR								
Failure	27.8	28.1	28.5	29.0	30.7	33.5	36.4	40.7
SD	3,473	2,879	2,367	1,924	1,543	1,217	941	711
P5	33	35	34	28	20	11	1	0
P10	87	83	70	52	33	22	8	1
P25	193	173	147	116	85	55	30	14
Mean	2,494	2,116	1,767	1,447	1,157	900	675	485
Median	1,281	1,116	947	760	581	426	300	188
P75	6,892	5,809	4,837	3,977	3,218	2,552	1,972	1,473
P90	10,586	8,872	7,364	6,027	4,860	3,851	2,985	2,250
P95	13,738	11,357	9,283	7,474	5,926	4,606	3,480	2,576
Panel B: 3% IWR								
Failure	14.9	15.1	14.8	15.2	16.2	17.6	19.5	21.8
SD	3,851	3,207	2,652	2,173	1,763	1,414	1,121	878
P5	262	263	250	232	205	162	113	60
P10	327	321	302	279	247	205	147	85
P25	499	471	434	392	344	288	224	155
Mean	3,269	2,834	2,427	2,050	1,704	1,391	1,112	866
Median	2,016	1,798	1,582	1,337	1,098	886	703	543
P75	8,252	7,048	5,960	4,989	4,127	3,365	2,695	2,114
P90	12,153	10,249	8,585	7,117	5,830	4,711	3,745	2,930
P95	15,494	12,886	10,625	8,644	6,931	5,473	4,264	3,267

This exhibit shows summary statistics for the average country (a cross-sectional average of the 21 countries in the sample) for eight static strategies evaluated over 86 rolling 30-year retirement periods, beginning with the period 1900–1929 and ending with the period 1985–2014. All strategies are based on a starting capital of $1,000, an initial withdrawal rate (IWR) of 4% in panel A and 3% in panel B, subsequent withdrawals annually adjusted by inflation, and annual rebalancing to the stock/bond allocations indicated in the first row. The failure rate (Failure) is the proportion of the 86 retirement periods in which the portfolio was depleted before 30 years. The statistics that describe the distribution of terminal wealth (bequest) across the 86 retirement periods considered include the mean; median; standard deviation (SD); average bequest in the 5% (P5), 10% (P10), and 25% (P25) lower tail; and average bequest in the 5% (P95), 10% (P90), and 25% (P75) upper tail. Returns over the 1900–2014 period are annual, real, in local currency, and account for capital gains/losses and cash flows. The data is described in Exhibit A1 in the appendix. All figures in units of local currency except for failure rates (in %).

in the 10% (P10) and 25% (P25) lower tail of the distribution, in turn, steadily decrease with the allocation to stocks.[7] Put differently, aggressive allocations provide better downside protection than conservative allocations simply because they enable higher bequests in particularly bad retirement periods.

These results suggest that in this context the standard deviation is a very poor measure of risk. For retirees, what ultimately matters is, first, how likely they are to outlive their savings, which can be assessed with the failure rate; and, second, if they do not outlive their savings, how much wealth they bequest in particularly bad retirement periods. Thus, aggressive strategies often labeled "risky" because of their high allocation to stocks are anything but. In fact, as Exhibits 1 and A2 show, aggressive

strategies tend to have the lowest failure rates and enable the highest bequests even when tail risks strike.

Finally, all the upside potential variables favor aggressive strategies; in fact, as both panels of Exhibit 1 show, the mean and median terminal wealth, as well as the terminal wealth in the 25% (P75), 10% (P90), and 5% (P95) upper tail of the distribution, all steadily decline with the proportion of stocks in the portfolio. As Exhibit A2 shows, with very marginal exceptions, the same results hold in each of the 21 countries in the sample.

A Simple Dynamic Twist

The results in the previous section show that the 90/10 allocation highlighted by Buffett performs very

well in terms of the probability of failure, downside protection, and upside potential. In fact, for the average country in the sample, it was outperformed only by a 100/0 allocation, which many (perhaps most) investors would find scary.[8] In this regard, the strategy highlighted by Buffett may enable retirees to obtain most of the benefits of an all-stock portfolio but at the same time sleep better, knowing that their short-term needs are covered even if the stock market falls substantially.

That said, the good performance of the strategy raises the question of whether a small dynamic twist can improve its performance. The simple modification to the 90/10 allocation considered here, based on the well-established evidence on mean reversion in stock markets, aims to avoid making annual withdrawals from stocks or selling stocks for rebalancing purposes in response to recent (the previous five years) poor stock market performance. The five-year time interval is one for which the evidence on mean reversion is strong.

More precisely, at any time t, the dynamic strategy proposed here compares the stock market's annualized return over the five years ending in t (GM_5) with the annualized return over the period from the beginning of the sample to t (GM_{LT}). When the difference between the former and the latter is positive ($GM_5 - GM_{LT} > 0$), the withdrawal is made from stocks, and the portfolio is subsequently rebalanced to its target proportion for the year; when this difference is negative ($GM_5 - GM_{LT} < 0$), the withdrawal is made from bonds and the portfolio is not rebalanced, thus giving stocks time to recover from their slump.[9]

Exhibit 2 compares the performance of this dynamic strategy (DS) to the 90/10 allocation highlighted by Buffett for IWRs of 4% (columns 1–2) and 3% (columns 3–4) for the average country in the sample; Exhibit A3 in the appendix reports a similar analysis on a country-by-country basis.

The dynamic strategy has a very marginally higher failure rate than the 90/10 allocation (0.5% in columns 1–2 and 0.3% in columns 3–4), although for all practical purposes these failure rates are essentially the same. In terms of downside protection when tail risks strike, the dynamic strategy slightly outperforms the 90/10 allocation, as revealed by the higher bequests in the 5%, 10%, and 25% lower tail of the distribution. In terms of risk, then, both the dynamic strategy and the 90/10 allocation provide retirees with fairly similar downside protection.

EXHIBIT 2
A Simple Dynamic Strategy: Cross-Sectional Averages

	4% IWR		3% IWR	
	90/10	DS	90/10	DS
Failure	28.1	28.6	15.1	15.4
SD	2,879	2,975	3,207	3,285
P5	35	42	263	272
P10	83	96	321	336
P25	173	196	471	495
Mean	2,116	2,219	2,834	2,928
Median	1,116	1,195	1,798	1,857
P75	5,809	6,030	7,048	7,237
P90	8,872	9,150	10,249	10,481
P95	11,357	11,746	12,886	13,189

This exhibit shows summary statistics for the average country (a cross-sectional average of the 21 countries in the sample) for two strategies evaluated over 86 rolling 30-year retirement periods, beginning with the period 1900–1929 and ending with 1985–2014. Both strategies are based on a starting capital of $1,000, an initial withdrawal rate (IWR) of 4% in the first two columns and 3% in the last two columns, subsequent withdrawals annually adjusted by inflation, and annual rebalancing. The static strategy is the same 90/10 allocation reported in Exhibit 1. The dynamic strategy (DS) calls for withdrawing from stocks when the annualized return of the previous five years is higher than the long-term annualized return, and from bonds otherwise (unless the amount in bonds is lower than the withdrawal, in which case it calls for withdrawing from stocks). The failure rate (Failure) is the proportion of the 86 retirement periods in which the portfolio was depleted before 30 years. The statistics that describe the distribution of terminal wealth (bequest) across the 86 retirement periods considered include the mean; median; standard deviation (SD); average bequest in the 5% (P5), 10% (P10), and 25% (P25) lower tail; and average bequest in the 5% (P95), 10% (P90), and 25% (P75) upper tail. Returns over the 1900–2014 period are annual, real, in local currency, and account for capital gains/losses and cash flows. The data is described in Exhibit A1 in the appendix. All figures in units of local currency except for failure rates (in %).

Regarding upside potential, however, the dynamic strategy clearly outperforms the 90/10 allocation in terms of mean and median bequest, as well as in terms of the bequest in particularly good retirement periods. This is the case for both 4% and 3% IWRs. Thus, the global evidence suggests that a minor tweak to the 90/10 allocation highlighted by Buffett may enable retirees to enjoy a higher upside potential at essentially the same (or even a slightly better) downside protection.

ASSESSMENT

Setting and maintaining an asset allocation for their nest egg is one of the most critical financial issues

that retirees have to deal with. If the asset allocation is too aggressive, a retiree may not be able to bear short-term losses and may bail out; if it is too conservative, the retiree may fail to achieve her goals. Striking the right balance between these two risks should be the beacon that guides the choice of asset allocation.

Warren Buffett, who has repeatedly advised individual investors to stick to a simple strategy consisting of broad diversification and low costs, has put his wife's money where his mouth is. He recommended the trustee that will manage his wife's bequest to implement a very simple portfolio, with 90% exposure to the stock market through a low-cost index fund, and 10% stashed away in short-term government bonds (cash). Many retirees may view this asset allocation as too risky, but is it?

The evidence discussed here shows that an aggressive allocation does not have to be necessarily risky; it all depends on how risk is defined. If it is defined as variability of the portfolio over time or as uncertainty about the bequest, then the more aggressive a strategy is (measured by the proportion of stocks in the portfolio), the higher is the risk borne by the retiree. And yet there are better ways to assess risk, particularly in the environment considered in this article.

If risk is viewed as the probability of outliving one's savings, or as the terminal wealth (bequest) when tail risks strike, then the 90/10 allocation is one of the best-performing strategies of those considered here.

If upside potential is brought into the assessment, then the allocation highlighted by Buffett is only outperformed by an all-stock portfolio, which most retirees would find hard to live with. Perhaps the shrewdness of Buffett's recommendation is that it preserves most of the benefits of a more aggressive portfolio, at the same time enabling a retiree to sleep well knowing that his short-term needs are covered even if the stock market falls substantially.

But can retirees do any better? The simple dynamic twist to the 90/10 allocation considered here suggests that this is indeed the case. Simply taking into account the performance of the stock market when deciding where to make the withdrawal from, and whether or not to rebalance the portfolio, should enable a retiree to enjoy essentially the same (or even a slightly better) downside protection, and at the same time a somewhat higher upside potential than with the 90/10 allocation highlighted by Buffett.

All in all, the evidence discussed here shows that, perhaps unsurprisingly, Buffett's advice is simple and sound. The allocation he highlighted outperforms most other static allocations in terms of both risk and return, and at the same time provides retirees with some peace of mind. Although such an aggressive strategy may not be for the faint of heart, those who feel comfortable with it may find that the simple dynamic twist suggested here may deliver an even better performance.

APPENDIX

EXHIBIT A1
Summary Statistics

	AM	GM	SD	SSD	Min	Max		AM	GM	SD	SSD	Min	Max
A: Stocks													
Australia	8.9	7.3	17.9	9.2	−42.5	51.5	Netherlands	7.1	5.0	21.4	10.3	−50.4	101.6
Austria	4.6	0.6	30.0	15.6	−60.1	127.1	New Zealand	7.8	6.1	19.4	9.0	−54.7	105.3
Belgium	5.4	2.7	23.7	13.0	−48.9	105.1	Norway	7.2	4.2	26.9	11.7	−53.6	166.9
Canada	7.2	5.8	16.9	8.4	−33.8	55.2	Portugal	8.4	3.4	34.4	15.3	−76.6	151.8
Denmark	7.2	5.3	20.7	8.9	−49.2	107.8	South Africa	9.5	7.4	22.1	9.0	−52.2	102.9
Finland	9.3	5.3	30.0	13.9	−60.8	161.7	Spain	5.9	3.7	21.9	11.0	−43.3	99.4
France	5.7	3.2	23.1	12.3	−41.5	66.1	Sweden	8.0	5.8	21.2	10.8	−42.5	67.5
Germany	8.2	3.2	31.7	14.7	−90.8	154.6	Switzerland	6.3	4.5	19.5	10.1	−37.8	59.4
Ireland	6.8	4.2	22.9	11.9	−65.4	68.4	U.K.	7.1	5.3	19.6	9.7	−57.1	96.7
Italy	5.9	1.9	28.5	15.6	−72.9	120.7	U.S.A.	8.5	6.5	20.0	10.4	−37.6	56.3
Japan	8.8	4.1	29.6	15.2	−85.5	121.1							

(continued)

EXHIBIT A1 (continued)
Summary Statistics

	AM	GM	SD	SSD	Min	Max		AM	GM	SD	SSD	Min	Max
B: Bills													
Australia	0.8	0.7	5.3	3.4	−15.5	18.5	Netherlands	0.7	0.6	4.9	3.0	−12.7	19.6
Austria	−3.9	−8.1	18.6	18.7	−94.2	12.6	New Zealand	1.8	1.7	4.6	2.0	−8.1	21.1
Belgium	0.6	−0.3	12.7	9.3	−46.6	69.0	Norway	1.4	1.1	7.0	4.3	−25.4	31.2
Canada	1.6	1.5	4.8	2.5	−12.5	27.1	Portugal	−0.5	−1.1	9.7	8.2	−41.6	23.8
Denmark	2.3	2.1	6.0	3.1	−15.8	25.1	South Africa	1.2	1.0	6.1	3.7	−27.8	27.3
Finland	0.5	−0.5	11.6	10.3	−69.2	19.9	Spain	0.5	0.3	5.7	4.3	−23.8	12.6
France	−2.3	−2.8	9.4	8.7	−38.5	29.7	Sweden	2.1	1.9	6.5	3.5	−23.2	42.7
Germany	−0.4	−2.3	13.0	11.9	−91.9	38.8	Switzerland	0.9	0.8	4.9	3.1	−16.5	25.8
Ireland	0.9	0.7	6.5	3.7	−15.5	42.2	U.K.	1.1	0.9	6.3	3.5	−15.7	43.0
Italy	−2.5	−3.5	11.3	11.1	−76.6	14.2	U.S.A	1.0	0.9	4.6	2.9	−15.1	20.0
Japan	−0.3	−1.9	13.6	12.2	−77.5	29.8							

This exhibit shows, for the series of annual returns over the 1900–2014 period, the arithmetic (AM) and geometric (GM) mean return, standard deviation (SD), semideviation for a 0% benchmark (SSD), lowest return (Min), and highest return (Max). All returns are real (adjusted by each country's inflation rate), in local currency, and account for capital gains/losses and cash flows (dividends or coupons). All figures in %.

EXHIBIT A2
Static Strategies: Individual Countries, 4% IWR

Stocks-Bonds →	100-0	90/10	80-20	70-30	60-40	50-50	40-60	30-70
Australia								
Failure	3.5	3.5	3.5	2.3	4.7	12.8	23.3	26.7
SD	3,991	3,054	2,347	1,823	1,438	1,146	913	729
P5	11	45	62	36	0	0	0	0
P10	284	278	227	146	37	0	0	0
P25	756	652	521	361	190	57	3	0
Mean	4,890	3,869	3,017	2,309	1,725	1,254	886	597
Median	3,809	2,977	2,354	1,830	1,389	963	631	341
P75	10,721	8,286	6,369	4,893	3,791	2,932	2,241	1,682
P90	12,892	9,937	7,644	5,890	4,542	3,546	2,855	2,309
P95	13,791	10,614	8,223	6,346	4,931	3,950	3,163	2,498
Austria								
Failure	52.3	52.3	53.5	55.8	60.5	62.8	62.8	62.8
SD	1,376	1,211	1,111	1,028	929	810	681	550
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	829	718	632	560	503	451	390	324
Median	0	0	0	0	0	0	0	0
P75	2,869	2,496	2,208	2,006	1,822	1,612	1,372	1,117
P90	4,195	3,705	3,424	3,185	2,865	2,516	2,125	1,716
P95	4,893	4,336	4,152	3,830	3,405	2,911	2,383	1,865

(*continued*)

Static Strategies: Individual Countries, 4% IWR

Stocks-Bonds →	100-0	90/10	80-20	70-30	60-40	50-50	40-60	30-70
Belgium								
Failure	50.0	50.0	50.0	50.0	50.0	48.8	48.8	47.7
SD	2,550	2,272	1,987	1,703	1,431	1,179	950	749
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	1,223	1,127	1,021	914	808	703	601	506
Median	11	5	5	13	47	64	97	122
P75	4,458	4,068	3,642	3,204	2,769	2,349	1,955	1,591
P90	8,071	7,200	6,295	5,399	4,536	3,725	2,993	2,344
P95	9,621	8,464	7,310	6,194	5,144	4,182	3,319	2,563
Canada								
Failure	1.2	0.0	0.0	0.0	0.0	1.2	2.3	8.1
SD	2,292	1,742	1,315	997	771	621	527	457
P5	173	234	301	333	285	200	23	0
P10	318	350	378	374	344	274	113	11
P25	614	616	593	550	486	381	252	137
Mean	2,795	2,345	1,945	1,588	1,273	997	759	563
Median	2,210	2,018	1,732	1,337	971	775	591	425
P75	6,035	4,818	3,808	3,001	2,357	1,885	1,542	1,249
P90	7,823	6,028	4,608	3,505	2,736	2,234	1,859	1,551
P95	8,886	6,759	5,098	3,888	3,148	2,561	2,079	1,702
Denmark								
Failure	3.5	1.2	2.3	2.3	4.7	7.0	8.1	9.3
SD	2,388	2,275	2,110	1,909	1,683	1,444	1,207	983
P5	15	19	41	9	0	0	0	0
P10	144	120	105	76	34	19	16	1
P25	353	317	277	234	193	151	101	53
Mean	1,898	1,796	1,666	1,510	1,337	1,154	967	782
Median	877	832	755	696	612	534	459	383
P75	5,104	4,875	4,553	4,152	3,694	3,207	2,716	2,235
P90	7,873	7,489	6,933	6,263	5,511	4,716	3,923	3,172
P95	9,706	9,147	8,386	7,480	6,488	5,468	4,466	3,560
Finland								
Failure	33.7	37.2	38.4	37.2	37.2	40.7	43.0	45.3
SD	6,102	5,436	4,720	3,985	3,265	2,587	1,973	1,439
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	3,771	3,379	2,943	2,487	2,033	1,601	1,207	863
Median	1,347	1,157	1,021	825	723	614	530	347
P75	12,002	10,800	9,449	8,030	6,593	5,217	3,950	2,836
P90	18,718	16,743	14,587	12,353	10,208	8,119	6,270	4,641
P95	24,113	21,100	17,884	14,682	11,944	9,511	7,255	5,271

(*continued*)

EXHIBIT A 2 (continued)
Static Strategies: Individual Countries, 4% IWR

Stocks-Bonds →	100-0	90/10	80-20	70-30	60-40	50-50	40-60	30-70
France								
Failure	53.5	58.1	64.0	65.1	68.6	72.1	74.4	81.4
SD	2,806	2,405	2,015	1,648	1,312	1,011	751	531
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	1,261	1,083	905	733	571	425	297	194
Median	0	0	0	0	0	0	0	0
P75	4,761	4,114	3,457	2,816	2,208	1,654	1,162	757
P90	8,598	7,442	6,285	5,164	4,118	3,189	2,364	1,656
P95	11,013	9,315	7,684	6,168	4,872	3,772	2,890	2,135
Germany								
Failure	54.7	54.7	55.8	53.5	54.7	53.5	54.7	55.8
SD	6,337	4,904	3,730	2,785	2,036	1,453	1,008	673
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	2,206	1,829	1,508	1,226	980	763	572	407
Median	0	0	0	0	0	0	0	0
P75	7,809	6,458	5,307	4,299	3,407	2,627	1,955	1,385
P90	14,066	11,249	8,897	6,888	5,218	3,849	2,739	1,874
P95	23,939	18,761	14,396	10,784	7,851	5,516	3,705	2,367
Ireland								
Failure	26.7	30.2	29.1	30.2	33.7	34.9	38.4	46.5
SD	3,672	3,135	2,624	2,154	1,730	1,358	1,039	773
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	2,204	1,974	1,720	1,450	1,177	914	673	463
Median	835	743	644	469	386	256	139	69
P75	6,676	5,978	5,191	4,377	3,578	2,816	2,124	1,532
P90	10,786	9,313	7,903	6,598	5,354	4,267	3,292	2,460
P95	14,634	12,422	10,339	8,471	6,740	5,192	3,860	2,878
Italy								
Failure	60.5	66.3	67.4	70.9	73.3	76.7	79.1	81.4
SD	1,086	918	788	662	540	423	314	217
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	518	414	334	277	223	172	125	81
Median	0	0	0	0	0	0	0	0
P75	1,884	1,547	1,288	1,076	871	672	487	315
P90	3,028	2,524	2,232	1,910	1,590	1,274	972	683
P95	4,130	3,676	3,176	2,653	2,128	1,664	1,228	830

(continued)

Static Strategies: Individual Countries, 4% IWR

Stocks-Bonds →	100-0	90/10	80-20	70-30	60-40	50-50	40-60	30-70
Japan								
Failure	37.2	36.0	36.0	36.0	36.0	36.0	37.2	37.2
SD	8,406	6,103	4,360	3,072	2,148	1,506	1,075	788
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	4,242	3,364	2,644	2,055	1,574	1,182	864	609
Median	1,183	1,243	1,197	987	837	717	552	299
P75	14,050	10,779	8,184	6,135	4,551	3,377	2,470	1,789
P90	24,909	18,202	13,035	9,210	6,556	4,657	3,269	2,419
P95	36,301	26,474	18,861	13,077	8,776	5,651	3,531	2,633
Netherlands								
Failure	19.8	19.8	17.4	18.6	17.4	20.9	25.6	32.6
SD	3,546	2,982	2,470	2,012	1,608	1,258	958	709
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	12	17	21	19	11	6	0	0
Mean	2,622	2,188	1,785	1,420	1,096	820	590	406
Median	1,146	926	852	690	463	305	181	83
P75	7,785	6,494	5,310	4,255	3,323	2,527	1,882	1,380
P90	11,258	9,626	8,061	6,605	5,285	4,119	3,112	2,262
P95	13,126	10,951	8,967	7,216	5,742	4,453	3,352	2,447
New Zealand								
Failure	0.0	0.0	0.0	0.0	1.2	8.1	15.1	31.4
SD	1,762	1,573	1,440	1,335	1,236	1,130	1,010	874
P5	285	266	211	125	35	0	0	0
P10	429	372	280	176	71	7	0	0
P25	629	552	444	326	202	91	16	0
Mean	2,563	2,251	1,949	1,657	1,376	1,112	872	663
Median	2,357	2,060	1,737	1,458	1,189	906	664	485
P75	5,014	4,464	3,966	3,490	3,072	2,664	2,249	1,842
P90	6,147	5,443	5,000	4,569	4,179	3,758	3,337	2,886
P95	6,880	6,020	5,696	5,438	5,065	4,554	3,943	3,273
Norway								
Failure	34.9	36.0	40.7	43.0	45.3	45.3	50.0	54.7
SD	3,272	3,058	2,780	2,457	2,106	1,746	1,396	1,070
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	1,605	1,529	1,419	1,279	1,117	943	766	596
Median	141	163	167	140	121	58	1	0
P75	5,487	5,226	4,847	4,370	3,846	3,265	2,667	2,091
P90	9,758	9,307	8,588	7,665	6,612	5,500	4,396	3,356
P95	13,490	12,613	11,417	9,998	8,456	6,885	5,371	3,984

(*continued*)

Static Strategies: Individual Countries, 4% IWR

Stocks-Bonds →	100-0	90/10	80-20	70-30	60-40	50-50	40-60	30-70
Portugal								
Failure	46.5	44.2	41.9	38.4	43.0	45.3	51.2	54.7
SD	2,940	2,636	2,327	2,011	1,692	1,371	1,059	769
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	1,888	1,692	1,486	1,265	1,030	800	587	400
Median	210	345	355	330	250	139	0	0
P75	6,116	5,383	4,642	3,971	3,319	2,677	2,062	1,484
P90	8,972	8,246	7,357	6,353	5,337	4,298	3,290	2,356
P95	11,017	10,107	9,074	7,906	6,607	5,269	3,976	2,819
South Africa								
Failure	2.3	2.3	2.3	4.7	8.1	15.1	18.6	20.9
SD	3,570	2,825	2,211	1,712	1,303	968	698	492
P5	181	124	43	0	0	0	0	0
P10	457	380	240	83	8	0	0	0
P25	1,044	821	598	391	227	123	59	12
Mean	4,698	3,786	2,989	2,301	1,721	1,243	855	542
Median	4,299	3,609	2,948	2,348	1,651	1,165	776	481
P75	9,479	7,517	5,868	4,509	3,395	2,500	1,783	1,211
P90	12,519	9,889	7,713	5,905	4,408	3,227	2,345	1,640
P95	15,446	12,254	9,554	7,297	5,435	3,921	2,713	1,809
Spain								
Failure	38.4	39.5	39.5	44.2	48.8	51.2	53.5	59.3
SD	3,515	3,026	2,548	2,095	1,680	1,309	988	717
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	1,311	1,141	971	813	666	532	412	307
Median	176	173	130	117	16	0	0	0
P75	4,766	4,135	3,522	2,953	2,433	1,956	1,528	1,153
P90	10,657	9,242	7,834	6,484	5,230	4,104	3,128	2,288
P95	14,696	12,553	10,478	8,534	6,769	5,212	3,875	2,760
Sweden								
Failure	24.4	19.8	17.4	16.3	15.1	14.0	14.0	14.0
SD	6,315	5,323	4,377	3,509	2,739	2,077	1,526	1,087
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	15	25	42	56	57	55	53	33
Mean	4,358	3,668	3,019	2,422	1,888	1,426	1,041	730
Median	2,004	1,725	1,464	1,201	895	626	418	259
P75	12,752	10,750	8,837	7,087	5,530	4,210	3,122	2,234
P90	19,942	16,893	13,967	11,292	8,868	6,757	4,992	3,536
P95	26,081	21,802	17,743	14,045	10,834	8,149	5,910	4,104

(*continued*)

EXHIBIT A2 (continued)
Static Strategies: Individual Countries, 4% IWR

Stocks-Bonds →	100-0	90/10	80-20	70-30	60-40	50-50	40-60	30-70
Switzerland								
Failure	31.4	30.2	30.2	29.1	25.6	32.6	34.9	40.7
SD	1,621	1,362	1,130	925	746	589	457	346
P5	0	0	0	0	0	0	0	0
P10	0	0	0	0	0	0	0	0
P25	0	0	0	0	0	0	0	0
Mean	1,581	1,331	1,096	878	679	506	358	238
Median	1,366	1,178	913	735	523	330	189	76
P75	3,888	3,249	2,675	2,169	1,727	1,348	1,018	737
P90	4,878	4,169	3,499	2,880	2,327	1,846	1,418	1,064
P95	5,395	4,597	3,843	3,200	2,617	2,090	1,626	1,290
U.K.								
Failure	5.8	7.0	7.0	9.3	17.4	23.3	25.6	31.4
SD	2,640	2,208	1,836	1,513	1,234	992	786	618
P5	0	0	0	0	0	0	0	0
P10	22	14	9	0	0	0	0	0
P25	195	162	116	65	28	4	0	0
Mean	2,684	2,307	1,935	1,582	1,256	964	707	488
Median	2,044	1,804	1,601	1,289	997	751	522	288
P75	6,113	5,195	4,357	3,605	2,947	2,353	1,836	1,394
P90	8,217	6,976	5,847	4,825	3,934	3,163	2,490	1,926
P95	10,470	8,707	7,144	5,806	4,659	3,666	2,815	2,106
U.S.A								
Failure	3.5	2.3	2.3	1.2	0.0	1.2	3.5	12.8
SD	2,747	2,022	1,476	1,073	786	589	456	352
P5	20	42	58	86	93	38	1	0
P10	182	219	236	241	204	152	36	0
P25	438	473	473	440	381	281	148	49
Mean	3,232	2,638	2,116	1,661	1,267	930	647	423
Median	2,881	2,485	2,005	1,494	1,129	746	557	282
P75	6,965	5,366	4,095	3,109	2,349	1,748	1,291	926
P90	8,997	6,695	4,930	3,620	2,647	2,007	1,507	1,104
P95	10,882	7,820	5,529	3,943	2,837	2,161	1,613	1,196

This exhibit shows summary statistics for eight static strategies evaluated over 86 rolling 30-year retirement periods, beginning with the period 1900–1929 and ending with the period 1985–2014 for the 21 countries in the sample. The strategies and notation are those described in Exhibit 1; the data are described in Exhibit A1. All figures in units of local currency except for failure rates (in %).

EXHIBIT A3
A Simple Dynamic Strategy: Individual Countries

	A: 4% IWR		B: 3% IWR			A: 4% IWR		B: 3% IWR	
	90/10	DS	90/10	DS		90/10	DS	90/10	DS
Australia					**Denmark**				
Failure	3.5	3.5	1.2	1.2	Failure	1.2	3.5	0.0	0.0
SD	3,054	3,255	3,408	3,585	SD	2,275	2,322	2,552	2,585
P5	45	81	530	564	P5	19	6	530	522
P10	278	340	880	953	P10	120	119	657	664
P25	652	743	1,336	1,451	P25	317	320	884	899
Mean	3,869	4,242	4,910	5,253	Mean	1,796	1,859	2,592	2,663
Median	2,977	3,414	3,767	4,210	Median	832	889	1,713	1,768
P75	8,286	8,936	9,887	10,484	P75	4,875	5,038	6,155	6,304
P90	9,937	10,580	11,467	12,033	P90	7,489	7,650	8,874	8,971
P95	10,614	11,324	12,132	12,691	P95	9,147	9,246	10,555	10,683
Austria					**Finland**				
Failure	52.3	54.7	39.5	40.7	Failure	37.2	36.0	22.1	22.1
SD	1,211	1,247	1,488	1,526	SD	5,436	5,604	6,427	6,561
P5	0	0	0	0	P5	0	0	0	0
P10	0	0	0	0	P10	0	0	0	0
P25	0	0	0	0	P25	0	0	15	15
Mean	718	729	1,102	1,121	Mean	3,379	3,477	4,310	4,396
Median	0	0	502	513	Median	1,157	1,167	1,825	1,875
P75	2,496	2,553	3,322	3,397	P75	10,800	11,116	13,133	13,383
P90	3,705	3,819	4,600	4,712	P90	16,743	17,243	20,010	20,398
P95	4,336	4,488	5,204	5,293	P95	21,100	21,813	25,124	25,641
Belgium					**France**				
Failure	50.0	52.3	22.1	23.3	Failure	58.1	57.0	27.9	25.6
SD	2,272	2,262	2,643	2,617	SD	2,405	2,424	2,780	2,785
P5	0	0	0	0	P5	0	0	0	0
P10	0	0	0	0	P10	0	0	0	0
P25	0	0	4	3	P25	0	0	0	0
Mean	1,127	1,118	1,637	1,622	Mean	1,083	1,104	1,528	1,552
Median	5	0	622	640	Median	0	0	272	297
P75	4,068	4,042	5,261	5,213	P75	4,114	4,181	5,312	5,351
P90	7,200	7,161	8,440	8,338	P90	7,442	7,479	8,656	8,682
P95	8,464	8,447	9,894	9,817	P95	9,315	9,382	10,637	10,645
Canada					**Germany**				
Failure	0.0	0.0	0.0	0.0	Failure	54.7	54.7	40.7	40.7
SD	1,742	1,879	1,859	1,972	SD	4,904	5,175	5,126	5,371
P5	234	283	983	1,023	P5	0	0	0	0
P10	350	381	1,058	1,094	P10	0	0	0	0
P25	616	650	1,355	1,410	P25	0	0	0	0
Mean	2,345	2,511	3,229	3,373	Mean	1,829	1,901	2,304	2,382
Median	2,018	2,097	2,720	2,793	Median	0	0	441	480
P75	4,818	5,178	5,877	6,185	P75	6,458	6,694	7,341	7,536
P90	6,028	6,522	7,176	7,589	P90	11,249	11,678	12,113	12,486
P95	6,759	7,334	7,960	8,430	P95	18,761	19,665	19,729	20,542

(continued)

A Simple Dynamic Strategy: Individual Countries

	A: 4% IWR		B: 3% IWR				A: 4% IWR		B: 3% IWR	
	90/10	DS	90/10	DS			90/10	DS	90/10	DS
Ireland						**New Zealand**				
Failure	30.2	30.2	3.5	3.5		Failure	0.0	0.0	0.0	0.0
SD	3,135	3,175	3,538	3,534		SD	1,573	1,653	1,743	1,813
P5	0	0	5	2		P5	266	303	816	889
P10	0	0	39	30		P10	372	439	940	1,032
P25	0	0	200	199		P25	552	651	1,201	1,327
Mean	1,974	1,995	2,751	2,747		Mean	2,251	2,450	3,078	3,287
Median	743	751	1,567	1,539		Median	2,060	2,211	2,747	2,943
P75	5,978	6,013	7,334	7,282		P75	4,464	4,766	5,554	5,854
P90	9,313	9,355	10,793	10,704		P90	5,443	5,756	6,556	6,928
P95	12,422	12,716	14,316	14,494		P95	6,020	6,474	7,345	7,785
Italy						**Norway**				
Failure	66.3	65.1	43.0	41.9		Failure	36.0	36.0	10.5	11.6
SD	918	1,012	1,110	1,188		SD	3,058	3,123	3,490	3,539
P5	0	0	0	0		P5	0	0	0	0
P10	0	0	0	0		P10	0	0	0	0
P25	0	0	0	0		P25	0	0	115	105
Mean	414	439	629	654		Mean	1,529	1,567	2,128	2,166
Median	0	0	125	148		Median	163	115	641	605
P75	1,547	1,651	2,056	2,159		P75	5,226	5,350	6,488	6,612
P90	2,524	2,775	3,180	3,384		P90	9,307	9,489	10,984	11,101
P95	3,676	4,094	4,448	4,795		P95	12,613	12,919	14,477	14,625
Japan						**Portugal**				
Failure	36.0	37.2	31.4	32.6		Failure	44.2	46.5	27.9	27.9
SD	6,103	6,364	6,556	6,828		SD	2,636	2,724	2,929	3,012
P5	0	0	0	0		P5	0	0	0	0
P10	0	0	0	0		P10	0	0	0	0
P25	0	0	0	0		P25	0	0	0	0
Mean	3,364	3,472	3,953	4,061		Mean	1,692	1,733	2,250	2,249
Median	1,243	1,269	1,816	1,792		Median	345	220	1,196	965
P75	10,779	11,153	12,134	12,511		P75	5,383	5,592	6,345	6,510
P90	18,202	18,871	19,829	20,604		P90	8,246	8,453	9,245	9,378
P95	26,474	27,529	28,155	29,142		P95	10,107	10,272	11,414	11,380
Netherlands						**South Africa**				
Failure	19.8	22.1	0.0	0.0		Failure	2.3	1.2	0.0	0.0
SD	2,982	2,960	3,342	3,309		SD	2,825	2,983	2,979	3,094
P5	0	0	156	68		P5	124	186	907	1,018
P10	0	0	200	126		P10	380	497	1,209	1,336
P25	17	11	371	311		P25	821	997	1,751	1,924
Mean	2,188	2,234	3,088	3,121		Mean	3,786	4,165	4,947	5,299
Median	926	1,013	1,770	1,908		Median	3,609	4,027	4,869	5,126
P75	6,494	6,529	7,998	7,982		P75	7,517	8,106	8,859	9,369
P90	9,626	9,516	11,025	10,847		P90	9,889	10,583	11,319	11,906
P95	10,951	10,895	12,664	12,635		P95	12,254	12,883	13,623	14,074

(*continued*)

EXHIBIT A3 (continued)
A Simple Dynamic Strategy: Individual Countries

	A: 4% IWR		B: 3% IWR				A: 4% IWR		B: 3% IWR	
	90/10	DS	90/10	DS			90/10	DS	90/10	DS
Spain						**U.K.**				
Failure	39.5	39.5	23.3	24.4		Failure	7.0	7.0	0.0	0.0
SD	3,026	3,038	3,358	3,367		SD	2,208	2,213	2,318	2,298
P5	0	0	0	0		P5	0	0	535	550
P10	0	0	0	0		P10	14	14	640	673
P25	0	0	0	1		P25	162	197	908	978
Mean	1,141	1,151	1,574	1,591		Mean	2,307	2,394	3,219	3,284
Median	173	184	569	589		Median	1,804	1,979	2,863	2,887
P75	4,135	4,165	5,098	5,142		P75	5,195	5,247	6,208	6,203
P90	9,242	9,291	10,656	10,698		P90	6,976	6,987	8,028	8,022
P95	12,553	12,590	13,934	13,978		P95	8,707	8,802	9,917	9,983
Sweden						**U.S.A**				
Failure	19.8	20.9	11.6	12.8		Failure	2.3	3.5	0.0	0.0
SD	5,323	5,400	5,951	6,016		SD	2,022	2,246	2,144	2,350
P5	0	0	0	0		P5	42	20	1,051	1,071
P10	0	0	0	0		P10	219	229	1,113	1,145
P25	25	45	232	229		P25	473	499	1,362	1,391
Mean	3,668	3,812	4,704	4,840		Mean	2,638	2,834	3,609	3,786
Median	1,725	1,849	2,742	2,858		Median	2,485	2,614	3,204	3,148
P75	10,750	11,077	12,948	13,237		P75	5,366	5,823	6,519	6,953
P90	16,893	17,152	19,128	19,357		P90	6,695	7,418	8,024	8,719
P95	21,802	22,099	24,281	24,479		P95	7,820	8,924	9,233	10,197
Switzerland										
Failure	30.2	29.1	11.6	15.1						
SD	1,362	1,419	1,597	1,637						
P5	0	0	0	0						
P10	0	0	0	0						
P25	0	0	153	141						
Mean	1,331	1,413	1,967	2,034						
Median	1,178	1,301	1,792	1,902						
P75	3,249	3,416	4,182	4,303						
P90	4,169	4,370	5,122	5,247						
P95	4,597	4,774	5,559	5,663						

This exhibit shows summary statistics for two strategies evaluated over 86 rolling 30-year retirement periods, beginning with the period 1900–1929 and ending with the period 1985–2014 for the 21 countries in the sample. The strategies and notation are those described in Exhibit 2; the data are described in Exhibit A1. All figures in units of local currency except for failure rates (in %).

ENDNOTES

[1]The choice of short-term bonds over long-term bonds is solely determined by Buffett's choice of the former. Estrada [2016b] also discusses the retirement glidepath and considers long-term bonds, but those results are not directly comparable to the results here due to both the consideration of different strategies and a slightly shorter (1900–2009) sample period.

[2]This implies that the purchasing power of the first year after retirement remains constant during the 30-year

retirement period. Both the 4% IWR and the subsequent annual inflation adjustments were originally suggested by Bengen [1994].

[3]This distribution results from aggregating the 86 wealth levels at the end of the 86 retirement periods considered. Estrada [2014a, 2014b] originally proposed this measure of risk and refers to it as lower-tail terminal wealth.

[4]Strategies with a lower proportion of stocks (20/80, 10/90, and 0/100) have substantially higher failure rates and are neither reported in the exhibit nor further considered in the analysis; they are, however, available from the author upon request.

[5]Explaining the difference in failure rates across countries is both far from trivial and beyond the scope of this article. A referee suggested that countries that have suffered no wars at home, such as Canada, New Zealand, and the United States, tend to have relatively lower failure rates, a hypothesis that is largely supported by the data. The reverse is also largely true; countries such as France, Germany, and Italy, which were highly affected by WWI and WWII, tend to have relatively higher failure rates. Another pattern suggested by the data is that failure rates seem to be lower in 30-year periods that finish (roughly) after 1978 than in 30-year periods that finish before then.

[6]A referee further suggested that failure rates may be also explained by the relationship between the IWR and the stock market yield (or the difference between the stock market yield and the bond yield) at the beginning of the retirement period. Although this relationship could be explored for the United States with data for the S&P 500, the DMS database used here does not contain multiples such as P/E and D/P.

[7]Estrada [2014a, 2014b] considers extreme events those in the 1%, 5%, and 10% lower tail of the distribution of terminal wealth. The reason for using 5%, 10%, and 25% here is that, in most countries and for most strategies, the average terminal wealth in the 1% lower tail of the distribution is zero (that is, the strategies failed). Hence, using a less extreme definition of tail risk provides more variability in the observed downside potential across strategies and across countries.

[8]As implied by the discussion in the previous section, this would be the case for all the wrong reasons. Strategies with high allocations to equity are "risky" only when risk is defined as variability or uncertainty. When risk is plausibly defined as discussed here, or as the probability of destroying purchasing power in the long term (see Estrada [2013]), then portfolios with high allocations to equity are in fact less risky than those with high allocations to bonds.

[9]If the funds available in bonds are not enough to make the required withdrawal, then the withdrawal is made from stocks.

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