Second Draft

ASSET ACCUMULATION AND RETIREMENT INCOME UNDER INDIVIDUAL RETIREMENT ACCOUNTS: EVIDENCE FROM FIVE COUNTRIES

by

GARY BURTLESS*

July 14, 2003

The Brookings Institution
1775 Massachusetts Avenue, NW
Washington, D.C. 20036 USA

---

* An earlier and shorter version of this paper was presented at the American Economic Association meetings in Washington, D.C., 3-5, 2003, and published in the *American Economic Review, Papers and Proceedings* (May 2003). I am grateful to Claudia Sahm and Benjamin Keys for research help in preparing the paper. Financial support for this research was received under a grant from Japan's Economic and Social Research Institute (ESRI) to Brookings. The views are solely those of the author and should not be ascribed to ESRI or the Brookings Institution.

ASSET ACCUMULATION AND RETIREMENT INCOME UNDER INDIVIDUAL RETIREMENT ACCOUNTS: EVIDENCE FROM FIVE COUNTRIES

by

Gary Burtless

AS POPULATIONS IN RICH COUNTRIES grow older, the cost of paying for public pensions has risen, boosting tax burdens and placing increased pressure on government budgets. Only one of the seven largest industrial countries, the United Kingdom, has overhauled its public pensions in a way that is likely to hold down future pension spending so that it does not increase sharply relative to national income. The favorable outlook for public spending on British pensions is the result of policies that tightly restrain the growth of basic government pensions and encourage active workers to abandon the second-tier, earnings-related public program in favor of private pensions. Future retirees are expected to derive much more of their retirement income from privately managed and invested pension accounts than from publicly financed, pay-as-you-go pensions. Other leading industrial countries still face major challenges in paying for or fundamentally reforming their main public pension programs (Bosworth and Burtless, 1998).

Policymakers in several rich countries show interest in following the British example and replacing part of their public systems with private pensions organized around individual retirement accounts. In May 2001 the German government revised Germany's national pension system to curtail the future growth of publicly provided pensions and to subsidize the creation of new defined-contribution pensions based upon individual accounts. In June 2001 the upper house of the Japanese legislature gave final approval to the government's plan to offer workers tax-favored retirement saving plans modeled closely on 401(k) retirement accounts now available in the United States. The new retirement plan, like the one in Germany, is intended to

supplement pensions provided by the main public system. In both Germany and Japan, benefits under the main public system will be scaled back for workers retiring over the next several decades. The United States has long used tax incentives to promote private retirement systems, which now cover about half of the workforce. Many critics of traditional public pensions would like to go much further. A presidential commission recently outlined three reform plans to reduce benefits under the existing U.S. social security system and replace them with annuities financed out of voluntary retirement savings accounts (President's Commission to Strengthen Social Security, 2002).

This paper examines evidence on the likely success of individual retirement accounts in providing retirement incomes to typical workers. Historical and simulated data on financial market performance are used to evaluate the market risks facing contributors to a private system based on individual retirement accounts. The paper provides evidence on these risks by considering the hypothetical pensions that workers in five industrialized countries would have received based on financial market performance between 1927 and 2002 if they had accumulated retirement savings in individual accounts. The contributors to individual retirement accounts are assumed to have identical careers and to contribute a fixed percentage of their wages to private investment funds. When contributors reach retirement age, they convert their retirement savings into a level annuity. To make the calculations comparable across countries and across time, all contributors are assumed to have an identical career path of earnings and to face the same mortality risks after reaching retirement. Contributors differ only with respect to the level and timing of stock and bond returns, bond yields when they reach retirement, and price inflation. These differences occur because of the differing start and end dates of the workers' careers and

because workers reside in different countries and are assumed to restrict their investments to the stocks and bonds of their own countries.

The analysis demonstrates that the financial market risks of a funded private retirement system are empirically large in all of the industrialized countries. Although some of these risks are also present in a public retirement system, a public system, backed by the taxing and borrowing authority of the state, can spread risks over a much larger population of potential contributors and beneficiaries. This makes the risks more manageable for individual workers, many of whom have little ability to insure themselves privately against financial market risk.

Risk and return in an individual account system

The main goal of a pension system is to replace labor earnings that are lost as a result of old age, premature death, and invalidity. The usual way rich countries achieve this goal is through mandatory, publicly financed pensions. The typical public program is a defined-benefit program in which the pension is calculated on the basis of the worker's years of coverage under the system and average covered wages while the worker is contributing to the system (World Bank, 1994, esp. pp. 102-09). Benefits are largely financed out of current contributions of active workers and their employers. Only a few public systems have built up enough reserves to pay for a large percentage of future pension obligations. Excessive pension commitments and a growing ratio of retired to active workers have pushed many pay-as-you-go pension programs towards insolvency. Governments can restore solvency through higher taxes, reduced monthly pensions, or a delay in the age at which workers can claim benefits. Many industrialized countries, including the United States, have taken one or more of these steps, but their pension systems still face major funding shortfalls.

Private retirement accounts, in contrast, are usually operated as funded programs. Moreover, many advocates of reform believe that a new retirement system should be built around defined-contribution rather than defined-benefit pensions. The U.S. employer-sponsored pension system has already seen a major shift toward defined-contribution plans, which now cover two-thirds of the active participants and own more than 50% of the assets held by the private pension system (EBRI, 2002). Instead of contributing to a collective, pay-as-you-go retirement program, workers in defined-contribution plans build up retirement savings in individually owned and directed private accounts. Workers can withdraw their funds from the accounts when they become disabled or reach the retirement age, and their heirs can inherit any funds accumulated in the account if the worker dies before becoming disabled or reaching the retirement age. At the time a worker chooses to start receiving a pension, some or all of the funds in the worker's account are converted into an annuity that lasts until the worker dies. In most plans, workers are free to decide how their contributions are to be invested, at least within broad limits.

Private defined-contribution pension plans differ from public systems in two important ways. First, there is little or no redistribution of benefits from high-wage to low-wage workers. The ultimate retirement benefit depends on each worker's own contributions and the success of the worker's investment plan. Workers who make larger contributions receive bigger pensions, other things equal; workers whose investments earn high returns enjoy higher retirement incomes than workers whose savings earn poor returns.

Second, in a private system workers' pensions are paid out of accumulations of their own previous savings. In contrast, public pensions are financed mainly by the payroll taxes of active workers and their employers. This difference between the two kinds of system implies that the

savings accumulation in a private plan would be many times larger than the reserves needed in a pay-as-you-go public system. For this reason, existing pay-as-you-go systems cannot simply be scrapped in favor of an individual account system. Workers who are currently retired or near retirement have already made contributions that entitle them to future pensions. The pension liabilities of the old system must be financed out of future contributions, new taxes, or public borrowing, rather than out of funds that have already been accumulated. This represents a major hurdle to the introduction of a new funded retirement system. One or more generations of active workers will be required to pay for the liabilities of the existing system regardless of whether most of their own pensions will be financed out of that system.

This paper focuses on workers' returns on their contributions to individual retirement accounts rather than on their returns from the overall pension system. Readers should bear in mind, however, that returns obtained under the existing public system and under an individual retirement account are not strictly comparable. Contributions to existing public programs include a large implicit tax to pay for the unfunded liabilities that were accumulated in paying the benefits of deceased and already-retired workers who did not fully contribute to the system. Virtually all of this tax will have to be paid irrespective of whether the present public system is maintained or is replaced with a new system of private accounts. To make a meaningful comparison between the contribution rates to public and to individual-account systems, it is necessary either to subtract this implicit tax from the public pension contribution rate or to add it to the rate needed to fund the new private accounts.[1]

[1] In the United States, approximately 90% of current Social Security contributions are used immediately to pay for benefits to retired pensioners and their dependents. The contributions needed to finance these benefits must be collected whether the public retirement system is maintained or is replaced by a new system of individual accounts. It is thus incorrect to treat as equivalent the contribution rate to Social Security and to an individual retirement account. See Geanokoplos, Mitchell, and Zeldes (1998).

Financial risk

A defined-contribution system allocates risks in a very different way than a collective, defined-benefit system. Under most public pension systems, workers born in the same year who have similar earnings records and have the same number of dependents receive similar retirement benefits. Because of political constraints on legislators, the public pension formula changes very slowly and only after protracted political debate. Since this debate involves both contributors and beneficiaries, changes in contribution and benefit formulas tend to reflect a compromise between the interests of the two groups. The effects of unanticipated demographic, labor market, and financial market developments are rarely if ever borne by a single cohort. They are spread across a number of cohorts through gradual changes in contribution rates and benefit levels. In contrast, workers participating in a defined-contribution system bear many more of the risks associated with financial market fluctuations.

Workers enrolled in a defined-contribution pension plan face three kinds of financial market risk. They are exposed to the risk that the real return on their contributions will fall short of the historical average over the course of their working careers. If workers obtain unexpectedly low returns on their retirement savings, they will enter old age with too little savings to finance a comfortable retirement.

Second, at the point they retire workers may find it expensive to purchase annuities. Workers who want to ensure they will not outlive their assets will convert some or all of their retirement savings into an annuity around the time they retire. The market price they pay for annuities depends on four factors: their expected life span when they purchase annuities, the amount of adverse selection among the population buying annuities, the profit requirements needed to induce insurance companies to offer annuities, and the expected return on assets in

which insurance companies will invest their reserves. Even assuming that mortality risk among workers of the same age is identical, that adverse selection among potential annuity buyers is negligible, and that insurance companies will sell annuities at zero profit, workers will still pay widely varying prices for annuities over time because of fluctuations in expected returns on insurance company reserves.

Finally, workers who buy nominal annuities are subject to inflation risk. Inflation that occurs after a worker retires can have a dramatic impact on the purchasing power of a pension. If inflation turns out to be unexpectedly high, retired workers may reach advanced old age with a pension that has little purchasing power. This risk could be avoided if workers purchased price-indexed annuities rather than level nominal annuities. Indexed annuities are now available in the United Kingdom, though not in most other industrial countries (Brown et al., 2001). In countries where indexed annuities are not available, retired workers have no obvious way to assure stable consumption after retirement.

Historical returns in the United States

The risks just mentioned are relevant to considering whether an individual account pension system can deliver dependable income replacement in old age. One way to evaluate these risks is to calculate the real pensions workers would have obtained if they had contributed to a defined contribution plan in the past. To calculate such pensions it is necessary to define a standard career path of earnings and pension contributions, calculate the assets that would be accumulated under a chosen investment strategy, and estimate the real pension the worker could purchase with the assets accumulated at retirement. All the calculations that follow are based on the earnings profiles of workers who have a full, 40-year career that begins at age 22 and ends at 62. In the absence of economy-wide wage growth, workers are assumed to have a lifetime path

of real earnings that matches the age-earnings profile of employed U.S. men in 1995 (U.S. Census Bureau, 1996, p. 34). In 1995 the earnings of 22-year-old American males were roughly one-fourth those of 45-year-olds, while earnings of 60-year-olds were 17% less than those of 45-year-olds. The career path of earnings is also affected by the growth of real wages in the wider economy, which for purposes of this exercise is assumed to be 1.5% a year, approximately the growth rate of U.S. real wages since World War II.

I calculate the value of savings at retirement using two main assumptions. Workers contribute to their pension plans on the first day of every year, and they follow a consistent investment strategy over their careers. In particular, workers are assumed to invest their retirement savings in some desired combination of bonds and common stocks. All stock dividends during the year are reinvested in new stock purchases, and all bond interest payments are reinvested in a standard portfolio of long-term government bonds. If workers invest in a mixture of both stocks and bonds, they re-balance their portfolios at the end of each year to maintain the preferred allocation of stocks and bonds. The income flows from assets in the retirement savings account are assumed to be free of individual income taxes at the time they are reinvested. Unlike ordinary investors, who must pay trading fees and commissions when buying and selling most financial assets, workers are assumed to face no transaction costs in making these investments.

When workers attain age 62, they convert their accumulations into a single-life annuity that is fixed in nominal terms. The annuity seller bases its price on the expected mortality experience of American males who reached age 65 in 1995, using mortality projections of the Social Security Actuary (Board of Trustees, OASDI, 2001). The Actuary's projections take account of gradual improvements in mortality experience that Americans are expected to enjoy

over the next several decades. I assume the insurance company does not charge a load factor to cover its profit requirements or possible adverse selection among people seeking to buy annuities. Thus, retiring workers are assumed to purchase fair annuities.

In determining the sales price of an annuity, the insurance company assumes it will be able to invest the worker's funds at the long-term government bond yield prevailing when the annuity is purchased. Since the annual annuity payment is fixed in nominal terms, the insurance company uses the nominal bond yield in this calculation. Unlike most public pension programs, the insurance company does not adjust the nominal value of the annuity from year to year to reflect changes in the price level. Insurance companies in a few industrial countries can now offer indexed annuities, because they can purchase indexed government bonds. However, the historical experience with this kind of asset is too recent for us to calculate the price that would have been charged for real annuities in the past.

A common measure of the value of a pension is the replacement rate. Figure 1 shows replacement rates of hypothetical U.S. workers who retired after 40-year careers that ended on January 1st of the years indicated along the horizontal axis. The workers are assumed to contribute 7% of their wages to the retirement savings account. The dark, upper line shows replacement rates in successive years for workers who invest in a portfolio of common stocks that earns the same total return as the Standard and Poor's composite stock index. The lighter, middle lower line shows replacement rates for workers who invest in a portfolio consisting one-half of U.S. equities and one-half of long U.S. government bonds. The bottom line displays replacement rates obtained by workers who invest all of their retirement savings in long-maturity government bonds. The replacement rate is the worker's real annuity divided by his average real earnings between ages 54 and 58, when his lifetime earnings are at their peak. Replacement rates

are measured at age 62, when workers first retire. For example, the first point along the top line shows the replacement rate of a worker who entered employment in 1872, contributed 7% of his earnings to a retirement account invested in U.S. common stocks, and converted his retirement savings into a level annuity at the start of 1912.

For the 92 overlapping 40-year careers ending in 1912-2003, the average replacement rate based on a stock portfolio is slightly more than 70%, near the middle of the range recommended by financial planners as an income goal in retirement. However, the standard deviation of replacement rates is almost 34%, implying that the range of income replacement provided by stock-invested retirement savings plans is quite large. A worker who receives the ninth decile replacement rate would receive a pension that initially replaces 122% of his peak earnings, whereas a worker who receives the first decile replacement rate would collect a pension that replaces a little more than a quarter of this amount, just 33% of peak earnings. The range of replacement rates is reduced if workers steadily invest a higher percentage of their retirement savings in bonds or bills. This strategy substantially reduces the expected pension, but it may have only a slight positive impact on the first decile pension. For example, if 10% of retirement savings are invested in U.S. government bonds, the expected replacement rate falls 7 percentage points, from 71% to 64%, but the first decile replacement rate increases only 0.3 percentage points, from 33.4% to 33.7%. A larger allocation to bonds actually reduces the first decile replacement rate. For example, with a 50-50 allocation to stocks and bonds the first decile replacement rate falls to just 28.6%. If the goal of a conservative investment strategy is to protect workers' pensions in very poor financial markets, the strategy of investing steadily in either long government bonds or bills offers poor protection against the risk of obtaining a very small pension.

Another way to evaluate the range of investment outcomes shown in Figure 1 is to ask how high a worker's contribution rate must be to provide a 70% replacement rate at age 62. The median contribution rate needed to achieve this goal if all savings are invested in the U.S. stock market is 7.5%. The first and ninth decile contribution rates under this investment strategy are 4.0% and 14.7%, respectively. If workers steadily invest a fraction of retirement savings in bills or bonds, the wide range in required contribution rates can be cut, though of course the average required contribution would have to rise to offset the reduction in expected returns. For example, if workers maintained an investment portfolio in which half their savings are placed in U.S. stocks and half in long government bonds, the median required contribution rate would rise to 12.1%, and the first and ninth decile contribution rates would increase to 9.0% and 17.1%, respectively. If all retirement savings were invested in long government bonds, the required contribution rates would increase still further to 12.0% and 30.7%, respectively. The wide range of required contribution rates, even under very conservative investment strategies, implies that workers face great uncertainty in deciding how much of their annual earnings to set aside in investment accounts.

Workers who purchase nominal annuities also face uncertainty about the value of their pensions in the years after they retire. The Social Security Administration mortality projections imply that three-quarters of 62-year-old men will survive to their 72nd birthdays. The twentieth century record of U.S. inflation suggests that retirees should expect to receive real annuities at age 72 that are much smaller than the ones they received at age 62. We can use U.S. inflation experience between 1912 and 2002 to calculate the decline in real pensions workers would have experienced if they retired between 1912 and 1993. For workers investing 100% of retirement savings in stocks, the average real replacement rate measured at age 72 is 19 percentage points

(or one-fourth) lower than it is at age 62. In many cases the loss of purchasing power would have been much worse. Inflation in the 1970s and early 1980s was so high that the age-72 replacement rates of U.S. workers retiring between 1975 and 1983 were approximately the same as those of workers who retired in the Great Depression.

Cross-national results

Data on inflation and financial returns can be used to predict pensions for countries in addition to the United States. Consistent data on the total returns of stocks and long government bonds are available for France, Germany, Japan, the United Kingdom, and the United States for calendar years 1927-2002.[2] Table 1 shows real stock and bond returns in the five countries. Stock returns have substantially exceeded bond returns in all five countries. On average, the geometric mean equity return is 4.4 percentage points higher than the mean bond return, with the equity premium ranging from a low of 3.1% in Britain up to 5.2% in Japan. The standard deviation of real equity returns is approximately twice that of bond returns, implying that investors accept substantially more year-to-year risk when holding stocks rather than bonds. The risk of holding government bonds is far from trivial, however. For example, the standard deviation of annual returns on long Japanese bonds is approximately the same as the standard deviation of annual returns on U.S. equities. Japanese bonds are less risky than Japanese equities, but they are not notably less risky than U.S. equities.

[2] Data on consumer price inflation and on total nominal returns for stock and bond investments were obtained from Global Financial Data in March 2003 (www.globalfindata.com). Bond returns are measured for investments in government bonds with a remaining maturity of at least 7 years. Global Financial Data supplies financial information to financial planners, pension funds, and investment companies. Where possible, I checked the data against alternative estimates of inflation and stock and bond returns. The information for the United States corresponds very closely to inflation and return data independently derived in a previous paper. See Burtless (2003a).

Table 1 shows sizable differences in real returns across countries. U.S. investors have enjoyed the highest long-term returns on stocks, while Japanese investors have obtained the lowest returns (see also Dimson et al., 2002). One dollar invested in the U.S. stock market at the end of 1926 would have returned $151 by the end of 2002. One yen invested in the Japanese stock market at the end of 1926 would have returned just 8.9 yen at the end of 2002. Stock market performance in the three European countries, especially in Britain, has been closer to U.S. than to Japanese experience. Investors in all countries have experienced periods in which equity returns were persistently above- or below-average. The persistence of equity returns is especially notable in Japan. Japanese investors enjoyed an extraordinary 15% annualized rate of return on equities between 1948 and 1989, but this outstanding performance was counterbalanced by –12% annual returns between 1927 and 1947 and –9% returns after 1989. Japanese investors have also obtained relatively poor long-term returns on their bond investments, though these returns improved substantially after the mid-1970s. U.K. and U.S. investors have earned the highest returns on bond investments, primarily because their governments have not defaulted on the public debt through high inflation or major currency reform. Much of the variability in French, German, and Japanese bond returns can be traced to high inflation and currency reform in the immediate post-war period, when outstanding government bonds lost most of their value.

The large difference in average stock and bond returns means that workers who invest in stocks ordinarily accumulate more pension assets than workers who invest in bonds or in a combination of stocks and bonds. U.S. workers retiring after 40-year careers ending in 1967 through 2003, for example, would on average have accumulated almost 3 times more assets if they had invested exclusively in stocks compared with their accumulation if they invested

exclusively in bonds. In the same period Japanese workers would have accumulated 4 times more assets with stock investment than bond investment.

Stock market investments delivered widely varying accumulations over time, however. A Japanese worker who invested solely in stocks and retired at the beginning of 1973 would have accumulated almost 11 times as much retirement savings as a worker who followed the same investment strategy and retired at the beginning of 2003. The gap between the accumulation of the luckiest and the unluckiest saver is not as large in Europe or the United States, but in all five countries the gap is big enough so that it would produce dramatic differences in workers' initial replacement rates.

Interestingly, both stock and bond returns have tended to converge in the five countries, probably as a result of the closer integration of world capital markets. The gap between the highest and lowest government bond return was just 1.5 percentage points in 1974-2002, whereas it was more than 6 points in the early post-war period and 13 points in the period from 1927 to 1946. Similarly, the difference between the best and worst stock market performance narrowed dramatically. The cross-country gap between the best and worst annualized equity return was more than 15 percentage points in 1927-1946 but less than 5 percentage points in 1974-2002.

The observation period contains a total of 76 years, so it is straightforward to predict the pensions of 37 workers, namely, those who start their retirements at the beginning of successive years from 1967 to 2003. The pensions of these workers do not accurately reflect all the evidence on returns between 1927 and 2002, however, because annual returns at the beginning and the end of the 76-year period are reflected in the pensions of only one or two workers whereas returns in the middle of the 76 years are reflected in the pensions of essentially all of the

simulated workers. To give equal weight to each annual observation, I created a sequence of annual returns so that each of the 76 annual observations is used an equal number of times.[3]

Table 2 shows selected information about simulated pensions based on cross-national data on stock market returns. The table contains information about pensions derived from two different investment strategies. In the top panel, workers are assumed to invest solely in equities throughout their careers. The bottom panel shows results for an investment strategy in which 60% of savings is allocated to equities and 40% is allocated to long government bonds, with annual re-balancing to maintain the 60% / 40% portfolio allocation. For each country and each investment strategy I have calculated pensions under the assumption that the worker's contribution rate is just high enough so that the *median* worker will have an initial pension that replaces 70% of his peak career earnings. The contribution rates needed to achieve this goal are displayed in the top row of each panel in the table.[4] For example, French workers who invest all their retirement savings in equities must contribute 10.4% of their wages to retirement saving if they want to have a 50% chance of obtaining a 70% (gross) replacement rate. German workers who invest exclusively in German stocks must contribute 8.2% of their wages to reach the same target.

When all retirement savings is invested in equities, U.S. and U.K. workers face the lowest contribution rates while French and Japanese workers must make the largest

[3] In essence, observations are created for the years 2003-2041 based on observed returns for 1927-1966. Each annual observation of market returns between 1927-2002 is thus used exactly 40 times, once to reflect returns in the first year of a worker's career, once to reflect returns in the second year, and so on up through the last year of a 40-year career. An alternative approach is to predict pensions using Monte Carlo simulation, but this would require specification of the full time series correlation structure of stock and bond returns, a task that is beyond the scope of this paper.

[4] The results differ slightly from estimates reported in Burtless (2003b). The principal reason is that return data covering the period 1927-2002 rather than 1927-2001 are used to predict retirement pensions. Both stock and bond returns differed substantially from their historical average values in 2002. In

contributions. The explanation for this difference is the lower return that French and Japanese workers can expect to earn on their stock investments. The second row in each panel of Table 2 shows the average real internal rate of return that workers obtain on contributions to their retirement saving accounts.[5] When retirement savings is invested exclusively in stocks, the cross-national pattern of returns is similar to the cross-national distribution of equity returns shown in Table 1. Not surprisingly, expected returns are uniformly lower for workers who invest part of their retirement savings in government bonds. For example, the mean return on an American worker's contributions falls from 7.1% to 5.6% as the percentage of savings allocated to bonds rises from 0 to 40. The decline in returns is somewhat smaller in the other countries. In every country except France the variability of returns shrinks when government bonds are included in the investment portfolio.

The effect of saving allocation on the distribution of investment returns is highlighted in Figure 2. The top panel in the graph shows the range of investment returns when retirement savings is invested exclusively in equities. In the lower two panels the allocation to bonds is progressively increased, first to 40% and then to 80% of retirement savings. For each country and investment allocation I have calculated the median return on retirement savings as well as the first and ninth decile returns. Based on investment experience between 1927 and 2002, a Japanese worker who invests solely in Japanese equities can expect a median real return on his retirement savings of 5.6%, roughly midway between the first decile return (0.4%) and the ninth decile return (10.4%). The gap between the first and ninth decile returns is smaller in France

---

addition, the historical data on government bond yields were modified as a result of small revisions in the Global Financial Data files.

[5] Returns are calculated at age 62. Estimated returns would be smaller if they were calculated at the end of a worker's life, assuming that workers convert their retirement savings into an annuity. The expected return from purchasing a level annuity is the bond return, which is substantially lower than the expected equity return (see Table 1).

and Germany and dramatically narrower in the United States and the United Kingdom. Moreover, the median return on stock-invested savings is also higher in the U.S. and U.K. than it is in Japan.

Perhaps surprisingly, the gap between the first and ninth decile returns tends to grow as a worker's allocation to bond investment rises, and this pattern is repeated in all five countries. In Germany, for example, the gap between the first and ninth decile returns is 6.5 percentage points for workers who invest all retirement savings in equities, whereas it is 9.5 percentage points for workers who allocate 80% of their savings to government bonds. The gap increases because the first decile return falls steeply as more bonds are added to the investment portfolio. A larger allocation to bonds exposes workers to the risk that their retirement savings will be rapidly and permanently eroded as a result of unanticipated inflation or currency reform. Although equity investors are exposed to a similar risk, stock market shares represent an ownership claim on real assets. Even if the purchasing-power value of such claims falls in financial market crises, there is some prospect that the claims will regain some or all of their value when a crisis is over. The evidence of the past 76 years suggests that, compared with retirement savers who invest steadily in stocks, savers who invest in bonds are exposed to much greater risk of a very poor return. Furthermore, this risk is greater in France, Germany, and Japan than it is in Britain or the United States. If the post-World-War-II episodes of high inflation and currency reform are unlikely to be repeated, Figure 2 offers a misleading picture of the risks associated with bond investment.

Even when workers contribute the same percentage of their wages to retirement savings accounts and invest in the same portfolio of stocks and bonds, their pensions differ widely depending on the exact sequence of annual investment returns over their careers. This range is displayed at the bottom of each panel in Table 2, which shows selected replacement rates for the

five countries. The median replacement rate is identical across countries, because the contribution rate of each country was calibrated to ensure this result. The gap between the first and the ninth decile replacement rates differs widely across the five countries, however. When all retirement savings are invested in equities in the United States and United Kingdom, for example, the ratio of the ninth decile to the first decile pension ranges between 2.8 and 3.0. In France the ninth decile pension is 3.8 times the first decile pension, and in Japan the ratio is more than 10-to-1. Most workers would surely regard this range of uncertainty as excessive.

Strategies to deal with uncertain returns

As demonstrated in Figure 1, replacement rates can vary enormously over short periods of time, even when workers invest their pension savings in a fairly conservative portfolio of equities and bonds. For example, a U.S. worker who saved 7% of his salary and invested in a portfolio consisting of 50% stocks and 50% government bonds would have received a replacement rate of 87% if he retired in January 2000 but only 56% if he retired three years later in January 2003. The value of pensions funded out of defined-contribution accounts depends critically on the interval in which workers accumulate stocks and bonds and the exact year when they convert their investment portfolios into annuities.

Workers can follow a couple of strategies to reduce the uncertainty of individual-account pensions. They can invest a larger portion of their retirement savings in safer assets, such as bonds or bills, rather than stocks. Replacement rates in the top and bottom panels of Table 2 can be compared to see how much the riskiness of pensions is reduced when workers reduce their equity allocation from 100% to 60% of retirement savings. One measure of the variability of pensions is the ratio of the ninth decile replacement rate to the first decile replacement rate. For German workers this ratio is 4-to-1 if all savings are invested in equities, but falls to 2.4-to-1 if

40% of retirement savings are invested in long government bonds. The ninth decile / first decile replacement rate ratio falls from 10.3 to 7.6 in Japan, from 3.0 to 2.2 in the United Kingdom, and from 2.8 to 2.0 in the United States as the percentage of savings allocated to bonds rises to 40% of the worker's portfolio. In France, a larger allocation to bonds actually increases the variability of replacement rates. On the whole, however, a strategy of investing more savings in bonds usually reduces the volatility of the worker's replacement rate. The offsetting disadvantage is that it increases the contribution rate needed to achieve a given replacement rate. If workers invest all their pension savings in government bonds, the calculations in the this paper imply they will often obtain lower returns than those available under a fully mature pay-as-you-go pension system.

Note that many workers are likely to prefer a very conservative investment strategy. Evidence on the investment behavior of American workers implies that low-wage workers and workers with limited education tend to allocate their retirement savings to low-risk investment alternatives, including money market funds, bonds, and guaranteed income contracts (EBRI, 1996, and Ameriks and Zeldes, 1998). Thus, in comparison with workers earning above-average wages, low-wage workers may experience less fluctuation in the value of their retirement savings, but they would also tend to obtain below-average returns on their contributions and receive below-average pension replacement rates. The investment behavior of low-wage and low-education workers would thus tend to produce even greater proportional inequality in individual-account pensions than is observed in career wages.

Phased annuitization. Workers can follow another strategy to reduce the uncertainty of their individual account pensions. They can convert their retirement savings into annuities over several years rather than at a single point in time, as assumed in the earlier calculations. For

example, workers could convert their nest eggs into annuities in regular annual installments beginning several years before they retire. Under one plan, each worker would purchase five annuities rather than only one. The annuities would differ in size depending on stock and bond prices and interest rates at the moment of conversion. Since the conversion occurs in five successive years rather than only once, workers would not convert all their retirement savings into an annuity at a time when asset prices and interest rates make it particularly disadvantageous to do so.

Figure 3 shows replacement rates at age 62 under this annuitization strategy for U.S. workers reaching retirement age between 1912 and 2003. For purposes of comparison, I also show the replacement rates workers obtain when they convert their retirement savings to an annuity on their 62nd birthdays. Both sets of computations assume that 100% of pension contributions are invested in stocks.[6] The strategy of phased annuitization yields a distribution of replacement rates that has somewhat less variability, but the strategy also yields a lower average replacement rate. The standard deviation of replacement rates is 34% if the entire annuity conversion takes place at age 62, but it falls to 29% when annuitization is phased over five years. The average replacement rate also drops 5 percentage points, however, falling from 71% to 66% when workers adopt the phased annuitization strategy.

[6] Workers who purchase a simple annuity continue to hold all of their retirement savings as U.S. equity investments until they retire on their 62nd birthdays. Workers purchasing phased annuities purchase single-life annuities on five successive birthdays starting at age 58. At age 58 they use one-fifth of their savings to purchase an annuity; at age 59 they convert one-quarter of their savings (including the annuity payment from their first annuity; at age 60 they convert one-third of their savings (including the annuity payments from annuities purchased earlier); at age 61 they convert one-half of their savings (including payments from earlier annuities); and at age 62 they convert all remaining savings into a single-life annuity. The results are of course sensitive to the ratios of savings converted on successive birthdays, but strategies that involve larger conversions at earlier ages usually produce lower total pensions at age 62.

This decline in average replacement rates is hard to avoid. As noted earlier, when workers purchase an annuity they are exchanging stock market investments for a bond market return. By converting part of his pension accumulation to an annuity earlier than would be the case if a single annuity were purchased at retirement, the worker who follows a phased annuity strategy is exchanging stock returns for returns on a mixed portfolio of stocks and bonds. This reduces both the variance and the expected return of his retirement savings. For the period from 1912-2003, Figure 3 shows that the phased annuitization strategy would have done little to improve the worst replacement rates, which are very similar under the two annuitization strategies. Instead, it significantly reduced replacement rates for workers who retired near the end of stock market booms. If the goal of a conservative annuitization strategy is to help workers avoid low replacement rates, the strategy of phased annuitization would have performed poorly for U.S. workers over the 20th century.

Delayed retirement. Workers who reach age 62 and have accumulated too few assets to obtain a decent pension can delay their retirements. Suppose workers delay their retirements until they can buy an annuity that replaces at least 70% of their peak earnings. How long must workers delay their retirements to achieve this goal? Table 3 contains statistics on the distribution of retirement ages under two different retirement saving strategies. As in Table 2, the contribution rate for each country has been selected so that half of all workers can accumulate enough savings to attain the target replacement rate by age 62. Consequently, half the workers retire at age 62. Workers who delay their retirements after 62 make pension contributions for one or more additional years (though annual contributions decline slightly, since real earnings are assumed to fall 1% a year after age 62). In addition, the price of an annuity would typically decline, since the cost of annuities falls in line with a worker's

remaining life expectancy. For U.S. workers the overwhelming majority of retirements can occur by age 65 no matter which strategy is followed with regard to investment of retirement savings. If savings are invested solely in stocks, only 15% of retirements must be delayed until after age 65; if a 60% / 40% portfolio of stocks and bonds is maintained, just 17% of retirements must be postponed until after 65. Retirements in the United Kingdom are approximately as predictable as they are in the United States.

The variability of investment returns in Japan makes late retirement far more likely in that country. About one Japanese worker in seven fails to accumulate enough retirement savings by age 72 to achieve the target replacement rate, and this is true whether workers hold their savings in Japanese stocks or in a portfolio of 60% stocks and 40% bonds. Note that a worker who delays his retirement to age 72 must supply 25% more lifetime labor than a worker who retires at 62. In France and Germany the variability of retirement ages depends on the mix of stocks and bonds in the worker's portfolio. If German workers invest exclusively in stocks they face a greater risk of retirement delays than if they invest in a mixed portfolio of stocks and bonds. In contrast, French workers who select a mixed portfolio face an elevated risk of delayed retirement. In comparison with workers in the United Kingdom and the United States, French, German, and Japanese workers face some risk that their retirements will be significantly delayed to achieve a 70% replacement rate, and this is true regardless of the investment strategy selected.

Conclusions

Retirement benefits under a private, individual account system are financed solely with assets held in individual workers' investment accounts. The initial real value of a pension is determined by the current market value of assets held in the account as well as the interest rate at the time of conversion to an annuity. Although proponents of individual accounts are confident

that workers can purchase safe assets that will yield high rates of return, the experience of the leading industrial countries suggests that neither the value of financial assets nor their real return is assured. Workers in the same country who follow an identical investment strategy but who retire a few years apart can receive pensions that are startlingly unequal. Investment strategies that produce the highest expected returns and biggest pensions are also strategies that yield the widest swings in pension entitlement. The investment strategy that offers the most predictable pension can produce an expected rate of return that may be lower for many workers than the return available in a pay-as-you-go retirement system.

Even though workers on average can obtain good pensions under an individual account system, such a system generates wide variability in outcomes, even for workers who follow an identical investment strategy. Assuming workers deposit 7% of their annual pay into a retirement account that is invested in a conservative portfolio of 50% Japanese stocks and 50% Japanese government bonds, recent experience suggests their initial pensions could range from a low of 24% of their peak career earnings up to more than 103% of peak earnings. These are the actual replacement rates 62-year-old Japanese workers would have obtained in 1990 and 2003 if their careers and contribution patterns matched the assumptions of this paper. If an individual account system were established, the variability of actual outcomes is likely to be even wider than this, because risk-averse workers would choose safer investment portfolios while risk-loving workers would choose portfolios containing a bigger allocation to stocks.

The evidence in Figure 2 and Tables 1-3 provides one explanation for the wider acceptance of funded individual account pensions in Britain and the United States compared with France, Germany, and Japan. Financial market experience in the English-speaking countries offers workers greater assurance that individual account pensions will be able to provide initial

retirement benefits that are more affordable and in a narrower range than annuities that would be available in the other countries. Nonetheless, workers and policymakers may wonder whether the range of benefit uncertainty is small enough so that individual accounts could provide the foundation for old-age income security, even in Britain and the United States.

Workers who are offered plain-vanilla investment options can follow a couple of strategies to reduce the uncertainty of individual account pensions. They can gradually convert their retirement savings into annuity income by purchasing annuities at several points in time, reducing the risk that annuities will be purchased at particularly unfavorable prices. They can invest a portion of their retirement savings in bonds or bills, diversifying their investment portfolio. These strategies reduce the volatility of the worker's replacement rate, but they also reduce the expected value of the annuity. If workers invest all their pension savings in lower risk bills or government bonds, they may easily obtain lower returns than those available under a traditional pay-as-you-go pension system. Perhaps surprisingly, even if workers invest in a portfolio of 60% stocks and 40% bonds, there is a real possibility in some countries they will obtain a worse rate of return than the one in a pay-as-you-go system. Finally, risk-averse workers can purchase inflation-protected government bonds timed to mature around the expected age at retirement if such investment products are available.

The introduction of inflation-protected bonds should make it possible for financial intermediaries to offer investment products that assure retirement savers a low minimum real return while allowing savers to participate in some of the upside gains that are possible from equity investments (Bodie and Crane, 1999). So far, however, these investment products are not widely available to retirement savers. Some protections are available. Indexed annuities are offered in Great Britain and a few other industrial countries. Contributors to the new German

individual account system can purchase investment products carrying a money back guarantee. This guarantee assures investors of a zero percent nominal return rather than a minimum real return, however.

Financial market turbulence in the past three years (and over the past thirteen years in Japan) has reminded savers of the fact that even conservative saving plans offer little assurance workers will reach old age with enough assets to pay for a comfortable retirement. To some degree the risks can be reduced through improved financial education and the development of new investment products. Although proponents of individual accounts are confident that workers can purchase safe assets that will yield good rates of return, the experience of the leading industrial countries suggests that neither the value of financial assets nor their real return is assured. Workers in the same country who follow an identical investment strategy but who retire a few years apart can receive pensions that are startlingly unequal, a result that most public pension systems are designed to avoid.

To assure income security in old age it makes sense to preserve some components of existing public systems, especially the guarantee of indexed pensions to replace some minimum percentage of lifetime wages. The plans proposed by the U.S. Social Security reform commission included this kind of guarantee. However, for average-wage workers who choose to participate in the commission's plans the guaranteed portion of the pension will probably provide less than half of the replacement rate traditionally offered under the Social Security program. The remainder of retirement income will be derived from annuities or phased withdrawals from new individual retirement accounts (Bosworth and Burtless, 2002). Whether this arrangement can provide adequate income security for retired workers is a central question that divides American proponents and opponents of individual account pensions.

References

Ameriks, John, and Stephen P. Zeldes. 1998. "Empirical Evidence on Portfolio Choice: An Analysis of Longitudinal Data from TIAA-CREF," mimeo (New York: Columbia University Graduate School of Business).

Board of Trustees, Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds. 2001. *2001 Annual Report of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds.* (Washington: Social Security Administration).

Bosworth, Barry P., and Gary Burtless. 1998. "Population Aging and Economic Performance," in Barry P. Bosworth and Gary Burtless, eds., *Aging Societies: The Global Dimension* (Washington: The Brookings Institution).

_____. 2002. "Economic and Distributional Effects of the Proposals of President Bush's Social Security Commission." Boston College Center for Retirement Research conference paper. (Chestnut Hill, Ma.: Boston College Center for Retirement Research).

Brown, Jeffrey R., Olivia S. Mitchell, and James M. Poterba. 2002. "The Role of Real Annuities and Indexed Bonds in an Individual Accounts Retirement Program," in J.R. Brown, O.S. Mitchell, J.M. Poterba, and M.J. Warshawsky, eds., *The Role of Annuity Markets in Financing Retirement* (Cambridge: MIT Press), pp. 107-52.

Burtless, Gary. 2003a. "Social Security Privatization and Financial Market Risk: Lessons from U.S. Financial History," T. Ihori and T. Tachibanaki, eds., *Social Security Reform in Advanced Countries* (London and New York: Routledge).

_____. 2003b. "What Do We Know About the Risk of Individual Account Pensions? Evidence from Industrial Countries," *American Economic Review, Papers and Proceedings* 93(2), pp. 354-59.

Dimson, Elroy, Paul Marsh, and Mike Staunton. 2002. *Triumph of the Optimists: 101 Years of Global Investment Returns* (Princeton and Oxford: Princeton University Press).

Employee Benefit Research Institute (EBRI). 1996. *Worker Investment Decisions: An Analysis of Large 401(k) Plan Data,* EBRI Issue Brief No. 176 (Washington: EBRI).

_____. 2002. *An Evolving Pension System: Trends in Defined Benefit and Defined Contribution Plans*, EBRI Issue Brief No. 249 (Washington: EBRI).

Geanakopolos, John, Olivia Mitchell, and Stephen P. Zeldes. 1998. "Would a Privatized Social Security System Really Pay a Higher Rate of Return?" In R.D. Arnold, M.J. Graetz, and A.H. Munnell, eds., *Framing the Social Security Debate: Values, Politics, and Economics* (Washington: National Academy of Social Insurance / Brookings Institution).

Mitchell, Olivia S., James M. Poterba, and Mark J. Warshawsky. 1997. "New Evidence on the Money's Worth of Individual Annuities," NBER Working Paper No. 6002 (Cambridge, Ma.: National Bureau of Economic Research) .

President's Commission to Strengthen Social Security. 2002. *Strengthening Social Security and Creating Personal Wealth for All Americans* (Washington: President's Commission to Strengthen Social Security).

U.S. Census Bureau. 1996. *Money Income in the United States: 1995*, Series P60-193 (Washington: U.S. Government Printing Office).

_____. 1998. *Statistical Abstract of the United States, 1998* (Washington: U.S. Government Printing Office).

World Bank. 1994. *Averting the Old Age Crisis* (Oxford and New York: Oxford University Press).

Table 1. Annual Real Investment Returns in Five Industrial Countries, 1927-2002

Percent

Asset class	France	Germany	Japan	UK	USA
Stocks					
Geometric mean	4.2	5.0	2.9	5.9	6.8
Arithmetic mean	8.1	9.2	8.3	8.1	8.9
Standard deviation	31.0	29.4	31.9	21.7	20.8
Long government bonds					
Geometric mean	-0.9	1.1	-2.3	2.8	2.2
Arithmetic mean	0.5	3.7	0.6	3.1	2.6
Standard deviation	15.9	15.1	20.1	8.9	9.6

Source: Author's tabulations of total return and inflation statistics provided by Global Financial Data (updated March 2003).

Table 2. Real Returns and Replacement Rates under Individual Retirement Accounts with Alternative Allocations to Stocks and Bonds

Percent

	France	Germany	Japan	UK	USA
100% equities / 0% bonds					
Required contribution rate	10.4	8.2	9.4	7.4	6.9
Internal rate of return					
Average	4.6	5.4	4.2	6.1	7.1
Standard deviation	3.0	2.8	8.2	1.7	1.7
Replacement rate at age 62					
Average	83	77	115	75	77
Ninth decile	137	134	247	118	118
Median	70	70	70	70	70
First decile	35	33	24	40	42
60% equities / 40% bonds					
Required contribution rate	13.5	9.4	9.5	9.2	9.0
Internal rate of return					
Average	3.4	4.5	2.8	5.2	5.6
Standard deviation	3.9	2.5	7.7	1.6	1.6
Replacement rate at age 62					
Average	95	67	69	74	71
Ninth decile	176	90	123	104	96
Median	70	70	70	70	70
First decile	36	38	16	47	49

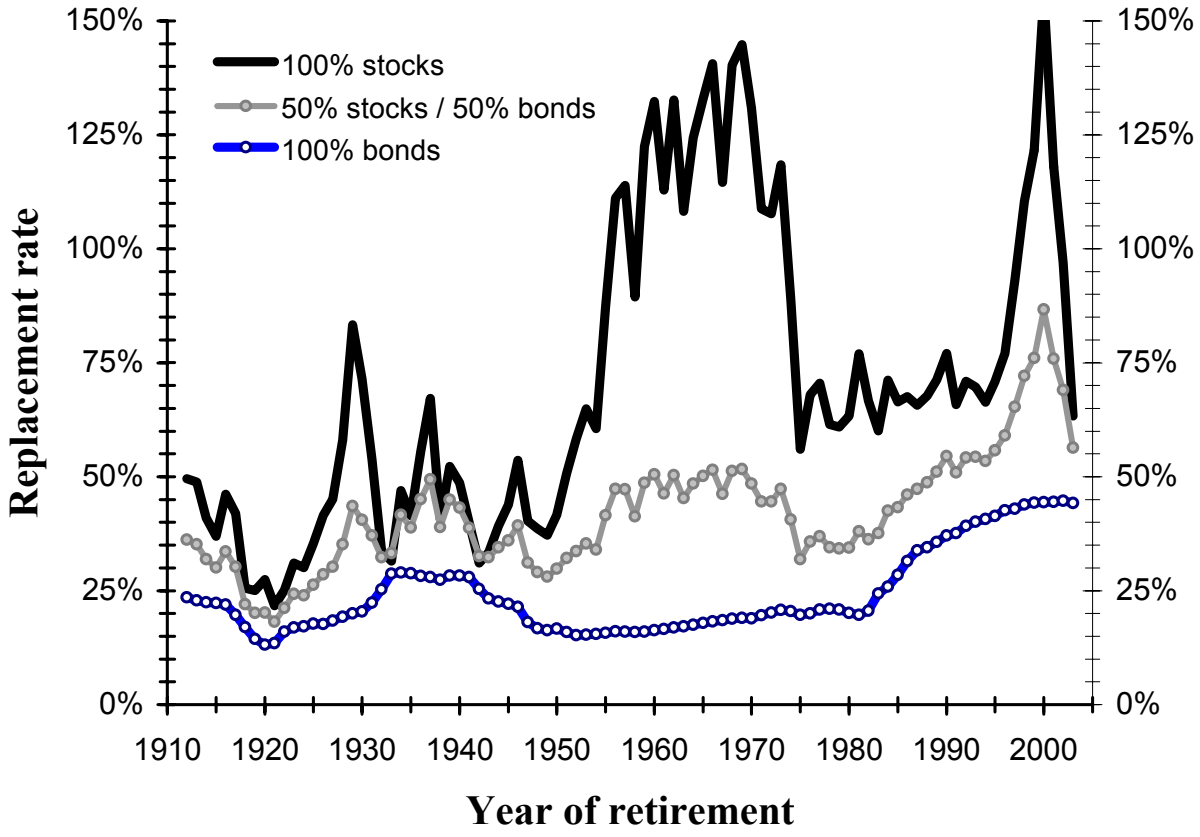
Source: Author's tabulations as explained in text.

Table 3. Distribution of Retirement Ages under Individual Retirement Accounts with Alternative Allocations to Stocks and Bonds

	France	Germany	Japan	UK	USA
100% equities / 0% bonds					
Retirement age (% frequency distribution)					
Age 62	50	50	50	50	50
Age 63	11	11	1	14	22
Age 64	11	4	1	8	8
Age 65	7	4	4	3	5
Ages 66 - 67	13	11	12	16	12
Ages 68 - 69	5	11	9	8	3
Ages 70 - 71	4	8	7	1	0
Age 72 or older	0	3	16	0	0
Average retirement age (in years)	63.8	64.4	65.5	63.7	63.2
60% equities / 40% bonds					
Retirement age (% frequency distribution)					
Age 62	50	50	50	50	50
Age 63	3	18	5	14	16
Age 64	4	13	3	13	13
Age 65	4	3	5	8	4
Ages 66 - 67	14	4	14	9	17
Ages 68 - 69	11	4	4	5	0
Ages 70 - 71	14	7	4	0	0
Age 72 or older	0	1	14	0	0
Average retirement age (in years)	64.8	63.7	65.1	63.4	63.3

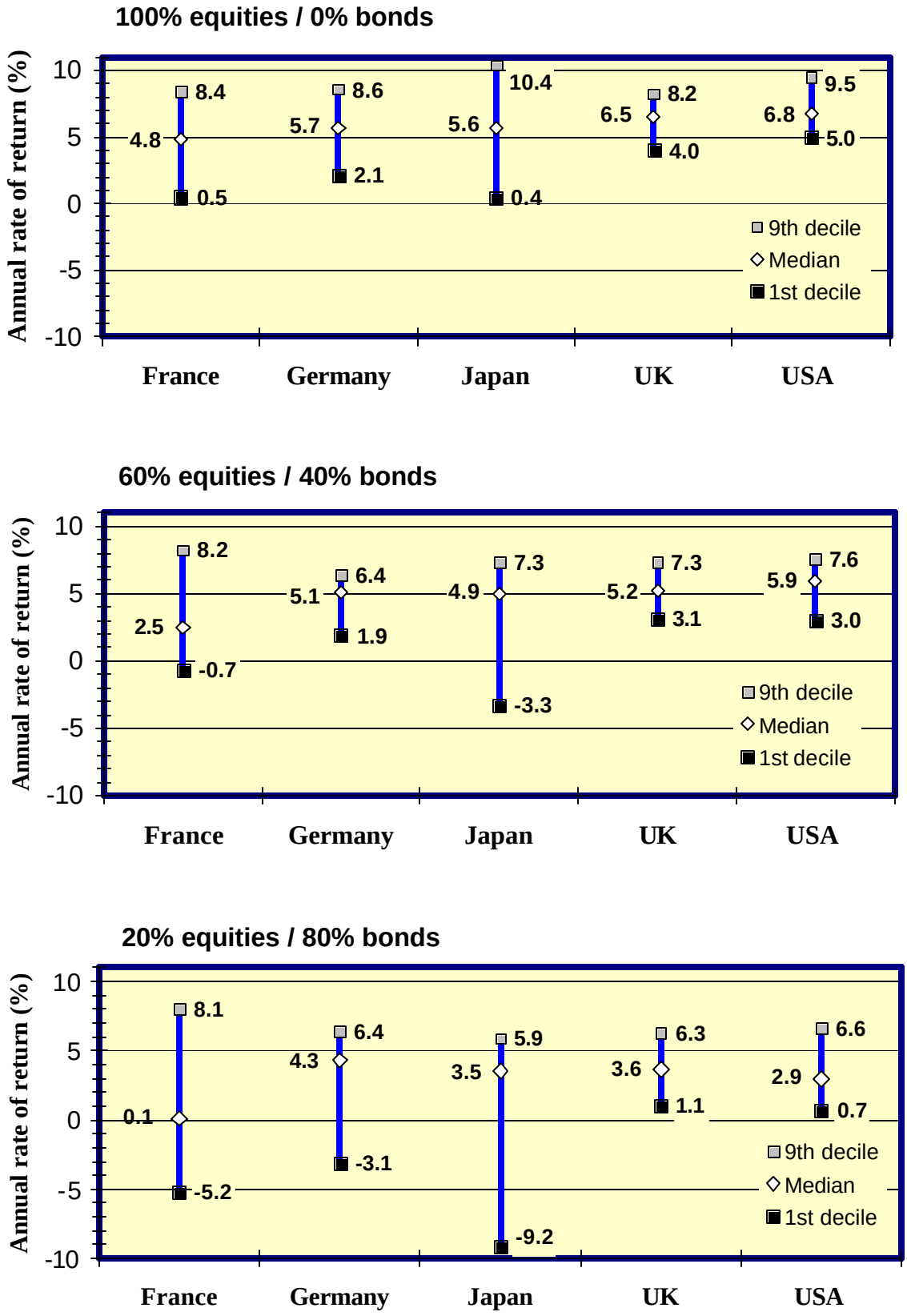
Source: Author's tabulations as explained in text.

Figure 1. Individual Retirement Account Replacement Rates for U.S. Workers under Alternative Investment Portfolios, 1912-2003



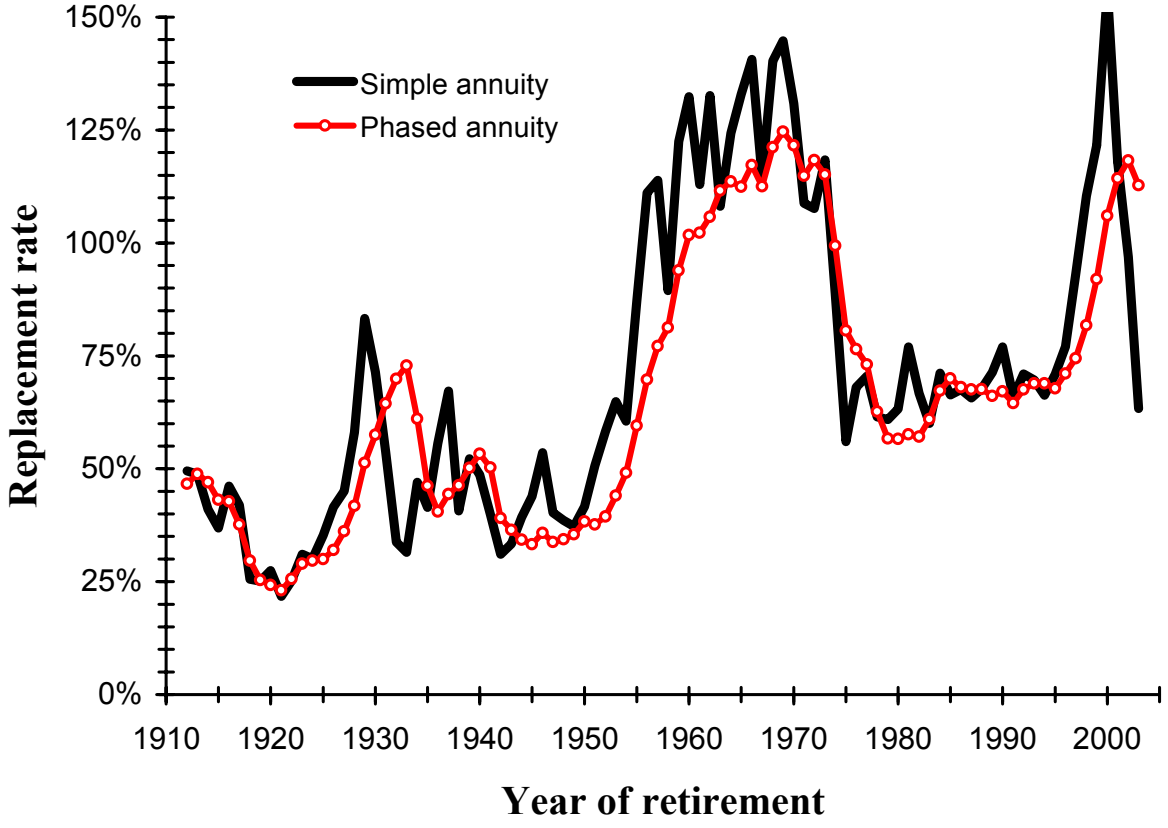
Note: Assumed contribution rate is 7% of wages. Author's tabulations of U.S. equity and bond return data supplied by Global Financial Data (March 2003).

Figure 2. Distribution of Real Returns on Pension Contributions under Alternative Investment Strategies



Source: Author's tabulations of inflation and equity and bond return data supplied by Global Financial Data (March 2003).

Figure 3. Individual Retirement Account Replacement Rates for U.S. Workers with Alternative Annuity Stragegies, 1912-2003



Note: Assumed contribution rate is 7% of wages. All retirement savings are invested in U.S. equities. Simple annuity is purchased at age 62; phased annuity is purchased in annual installments at ages 58-62.