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THE IMPACT OF AGGREGATE MORTALITY RISK ON DEFINED BENEFIT PENSION PLANS

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Annuities provide a means by which risk-averse households facing an uncertain lifespan can insure themselves against the risk of outliving their wealth. While few households purchase voluntary annuities, much household wealth is automatically annuitized through Social Security and defined benefit (DB) pensions offered by employers. Annuity providers — be they insurance companies, private and public sector employers offering DB pension plans, or taxpayers through Social Security and the Pension Benefit Guaranty Corporation — face two kinds of mortality risk: idiosyncratic risk, since any particular annuitant may live longer than expected, and aggregate mortality risk, since annuitants may on average live longer than expected. Idiosyncratic risk can be eliminated by increasing the size of the annuitant pool, but aggregate mortality risk cannot.

The vast majority of this aggregate risk is held by shareholders of companies providing DB plans to employees, by insurance companies providing deferred annuities to pension plans, and by taxpayers. Friedberg and Webb (2006) focus on the aggregate mortality risk faced by voluntary annuity providers. We extend the above research to consider the aggregate mortality risk faced by providers of DB pension plans. DB pension coverage has declined substantially in recent years in both the United States and United Kingdom, and aggregate mortality risk is one of the factors that has been explicitly blamed in the United Kingdom. To calculate the magnitude of this risk we use the Lee-Carter (1992) mortality model, which — according to Deaton and Paxson (2004) — has become the "leading statistical model of mortality in the demographic literature."

In the first part of this paper, we evaluate the potential impact of aggregate mortality risk on DB pension plan liabilities. We consider the possibility that plan providers use mortality forecasts that are biased upward, compared to putatively unbiased forecasts (i.e., Lee-Carter or Social Security Administration), and then the possibility that future improvements in mortality are greater than those predicted by these unbiased forecasts. In the last part of the paper, we investigate the potential cost of transferring such risk to broader financial markets.

Our inquiries and previous research both indicate that plan providers commonly base the estimates of pension liabilities that are reported in their financial statements on GAM83, a period mortality table reflecting mortality in the 1960s, projected to 1983 with a 10 percent margin for error. Very recently, there has been a shift toward RP2000, a period table reflecting mortality in the year 2000. Mortality rates have declined since both tables were compiled, and most forecasters project further declines. Our investigations indicate that only a minority of plans adjust GAM83 or RP2000 to reflect declining mortality rates, and that any adjustments are typically made only to a current date and not over the expected lifetimes of plan participants.

We calculate the effect of this apparent forecasting bias on plan providers' pension liabilities. For males, liabilities may be understated by as much as 16.2 percent, depending on the ages of the participants, if mortality rates decline at the intermediate rate predicted by the Social Security Administration. If mortality declines at the somewhat higher rates predicted by the Lee-Carter model, then the understatement could amount to as much as 25.2 percent. For females, the 10 percent conservative margin built into GAM83 comes closer to offsetting the smaller improvements in female mortality from 1983 to date. The resulting understatements are smaller but still sizable, at 6.1 percent, based on the SSA forecast, and 13.2 percent, based on Lee-Carter.

We then consider the magnitude of risk inherent in an unbiased forecast of mortality improvements. We assume that the Lee-Carter model provides an unbiased forecast and, importantly, captures the degree of uncertainty attached to that forecast. We calculate that there is, in any year, a 5 percent chance that an aggregate mortality shock could increase the provider's projected benefit obligation for male participants by 1.07 percent, and a 1 percent chance that a shock could increase it by 1.41 percent. We calculate that for a frozen pension plan, there is a 5 percent (1 percent) probability that reductions in aggregate mortality result in the present value of total future payments being at least 2.9 percent (4.2 percent) greater than expected. Since the riskiness of the liability is substantially higher when a lower interest rate is used to discount the payments, inflation-protected pensions expose a provider to substantially greater aggregate mortality risk than nominal pensions. Lastly, using data supplied by Credit Suisse First Boston, we conclude that the aggregate risk is not large relative to profits and stock market capitalization of the average S&P 500 company, but it is substantial for some of the companies, like General Motors.

Our results suggest a role for capital markets to reallocate aggregate mortality risk to those most willing to bear it. Longevity bonds serve as a mechanism to transfer aggregate mortality risk from annuity providers to the financial markets. The payments on such bonds would be based upon the survival rate of a reference population, for example American males aged 65 in 2006. Purchasing such bonds would insure an annuity provider against aggregate mortality risk to the extent that the provider's mortality experience mirrored that of the reference population.

Friedberg and Webb (2006) showed how such bonds can be priced using the Capital Asset Pricing Model (CAPM). Applying the CAPM, the mortality risk premium depends on the bond's beta — the correlation between market returns and the component of the bond's return related to aggregate mortality risk. Friedberg-Webb show that the historical correlation between the stock market and hypothetical longevity bonds available during the period 1959-1999 was extremely close to zero. Thus, the yield on such bonds should differ little from that on similar non-mortality related securities. Consequently, were the market to price aggregate mortality risk in accordance with the CAPM, then pension plan providers could purchase bonds to insure themselves at a quite low annual cost.

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