

# **The Effect of Changes in Retirement Plans on Employee Savings and Retirement Age and the Financial Impact on Employers of Delayed Retirement**

**Sponsored by  
Society of Actuaries'  
Pension Section Research Committee**

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## **ABSTRACT**

There has been a significant increase in retirement plan savings in the U.S. over the past 20 years from the growth in 401(k) plans. Other countries such as the U.K. and Australia that adopted the defined contribution model had faster retirement asset growth than countries like Canada and Japan that remain primarily with defined benefit plans. Most of this increase in the U.S., which occurred on per participant inflation adjusted basis, is due to new companies adopting 401(k) plans and not replacement of defined benefit plans. This increase can be misleading since two thirds of 401(k) plan contributions come from the employee while most defined benefit plans are noncontributory. Traditional defined benefit plans in the private sector are being converted to cash balance plans or frozen and replaced with 401(k) plans. Under traditional defined benefit plans, long service employees have incentive to retire early and not to work past normal retirement. Under 401(k) plans, employees have incentive to work as long as possible and on average retire a couple of years later than those covered by defined benefit plans. According to some studies, older long service employees tend to have higher pay relative to productivity. The costs of benefits for these employees may also be higher. In some cases, delayed retirement can have a significant cost to the employer, if compensation is not adjusted to reflect reduced productivity. Another issue is that 401(k) plan participants tend to retire when the economy is strong and continue working during recessions when stock prices and account values are low. Defined benefit plans can offer early retirement windows to encourage older workers to leave voluntarily, which is more palatable than the alternatives when a reduction in workforce is required.

## **BACKGROUND**

The Society of Actuaries' Pension Section Research Committee commissioned<sup>1</sup> this study to examine reductions in retirement benefits from the decline in defined benefit plans and increases in defined contribution plans during the past 20 years and what effect this has on

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workforce management<sup>2</sup>. In particular how this change is affecting older workers' decisions to retire and what effect this could have on companies. An underlying assumption implicit in evaluating the benefit of retirement of older workers is that productivity declines in old age while pay does not, leading to a pay productivity gap that could have an adverse effect on the employer from delayed retirement. The validity of this assumption was also examined.

Even if productivity declines on average at old ages, this would not justify age discrimination against an individual. The pay productivity gap addressed here refers to long service employees whose salary rises to a higher level and whose productivity subsequently declines as they approach retirement. Not all individuals experience productivity decline as they age. In some cases individuals have valuable company specific knowledge that allows them to continue to function as a productive employee. For a discussion of the value of mature workers and other workforce management issues see "A Case for Workers Age 50+" [52].

## **METHODOLOGY**

A review of literature on the Internet was completed. Most of the studies were completed prior to the Pension Protection Act of 2006 and the financial crisis of 2008. These studies were updated using 5500 data from the Bureau of Labor Statistics. In the final section, the differences on retirement and workforce management in defined benefit and defined contribution plans are examined for a hypothetical firm to determine possible savings that can be achieved with a defined benefit plan by using the cost of employment and productivity data from empirical studies.

## **INTERNATIONAL COMPARISON OF RETIREMENT PLAN ASSETS**

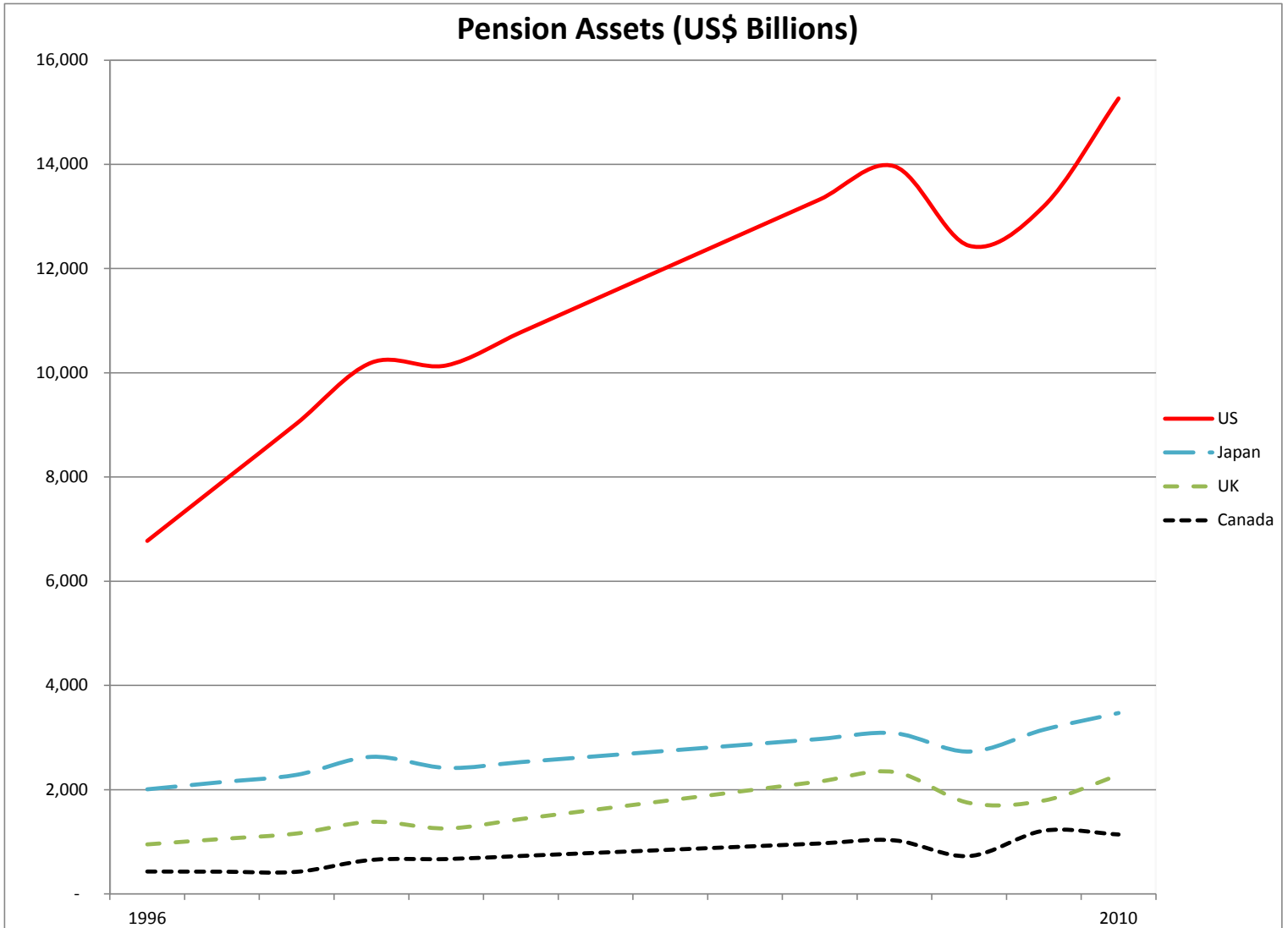
The following chart shows the growth in retirement plan savings since 1996 for the four countries with the highest level of retirement plan assets – U.S., Japan, U.K., and Canada. The

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<sup>2</sup> Periods of other than 20 years were used in this paper in some instances where data were not available for the past 20 years.

following tables will focus on the attributes and growth of retirement plan savings of these four countries.<sup>3</sup>

**Chart 1 -- International Comparison of Retirement Plan Assets**



<sup>3</sup> Data for this section is taken from Towers Watson / Watson Wyatt Worldwide studies [53, 54, 62, and 63]. Some of the data was checked against other sources [24] and deemed reasonably accurate for the purpose of this section. Plan assets include both defined benefit and defined contribution plans. Countries with larger GDPs such as Germany and France have lower pension assets, at 14% and 5% of GDP, respectively, due to reliance on unfunded social insurance plans. In 2010, Australia edged out Canada for 4th place in total pension assets due to the growth of defined contribution plan assets under a mandatory system.

In addition to the growth in absolute terms, retirement assets have been growing relative to GDP as shown in the following table:

**Table 1 – Retirement Plan Assets as a Percent of GDP<sup>4</sup>**

	<u>1996</u>	<u>2010</u>
US	87%	104%
Japan	43%	64%
UK	79%	101%
Canada	70%	73%
Australia	46%	103%

Asset allocation, in addition to demographic factors, can influence the rate of growth of retirement assets. As shown in Table 2 below, retirement assets in Japan have had the highest allocation to bonds, while retirement assets in the U.K. have had the highest allocation to stocks.

**Table 2 – Distribution of Retirement Plan Assets by Type of Investment**

	<u>1996</u>			<u>2010</u>		
	Stocks	Bonds	Other	Stocks	Bonds	Other
US	58%	33%	9%	49%	27%	24%
Japan	37%	48%	15%	37%	56%	7%
UK	76%	11%	13%	55%	35%	10%
Canada	55%	37%	8%	41%	36%	23%

Table 3 shows the breakdown between defined benefit (DB) and defined contribution (DC) plan assets. The data shows that DB plans have persisted in Japan and Canada. The U.S. has the highest proportion of retirement plan savings assets allocated to DC plans, while the U.K. has experienced the most rapid change from DB plans to DC plans during this time period<sup>5</sup>.

**Table 3 – Percent of Assets in Defined Benefit and Defined Contribution Plans**

	<u>1996</u>		<u>2010</u>	
	DB	DC	DB	DC
US	53%	47%	43%	57%
Japan	100%	0%	98%	2%
UK	96%	4%	60%	40%
Canada	90%	10%	95%	5%

<sup>4</sup> Australia was included in this chart because it surpassed Canada in 2010.

<sup>5</sup> This is based upon the total assets in both public and private retirement plans.

Finally the next table shows the breakdown between public and private plan assets in 2010. Both Japan and Canada have a majority of assets in public plans.

**Table 4 – Percent of Retirement Plan Assets in Public and Private Pension Plans**

	Public	Private
US	29%	71%
Japan	70%	30%
UK	10%	90%
Canada	62%	38%

From this data it appears that the highest level of retirement plan assets, measured as a percentage of GDP, exist in countries with private sector DC plans, ignoring individual savings outside of these retirement plans. For example, Japan’s Postal Savings Program had assets of almost US\$4 Trillion in 2008, exceeding retirement plan assets [25].

### **RETIREMENT PLANS IN THE UNITED STATES**

Public retirement plans in the U.S. can be further categorized into state, local, and federal plans. They often differ by type of employee – teachers and civil servants have different plans than police officers and firefighters. Likewise private sector plans can also be categorized into single employer or multi-employer arrangements. The public sector has generally retained defined benefit plans. The table below shows the percentage of workers, in 1975 compared to 2005, covered by defined benefit plans for those workers who have a retirement plan. During this period, about half of private sector employees were covered by a retirement plan [18, 23].

**Table 5 – Percent of workers covered by DB plans for those who have a retirement plan**

	1975	2005
State&Local	98%	92%
Private Sector	88%	33%

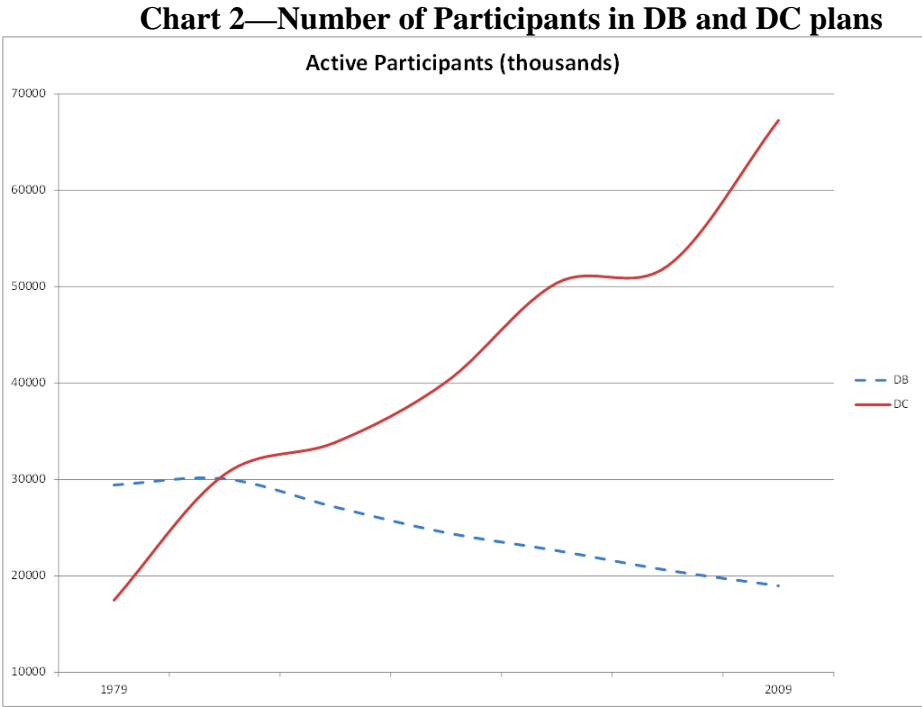
Public sector plans generally cover older, longer service employees in predominantly unionized environments. In addition, public sector plans are not subject to the same funding, regulatory, and accounting requirements of private sector plans. Regardless of these differences, the primary factor influencing public sector and private sector plans is the ongoing nature of governmental entities. According to the Haverstick [18] and Poterba [40] papers, the main cause of the replacement of DB plans by DC plans in the private sector is the decline of old companies

that had DB plans while new companies adopt DC plans. The Poterba paper contains estimates that 1% of DB plan participants per year have their DB coverage replaced by a DC plan. When a company with a DB plan adopts a DC plan, the future DB benefit accruals are usually lowered. It should be noted that both of these papers were written before the 2008 financial crisis; however, the Haverstick paper was written after the introduction of the Pension Protection Act of 2006 (PPA)<sup>6</sup> when DB plan freezes started to accelerate.

Multi-employer plans are typically DB plans that pay a monthly benefit based upon years of service and require a contribution from each employer based upon the hours employees work. They are negotiated with unions and have trustees jointly appointed by the unions and the employers. Member participation in multi-employer plans represents about 10% of the participants in all private sector pension plans. For these reasons they will not be considered further in this paper on workforce management.

**THE DECLINE OF SINGLE EMPLOYER DEFINED BENEFIT PLANS**

The following chart shows the decline in active participants in U.S. DB plans and the increase in the number of DC plan participants during the past 30 years<sup>7</sup>:

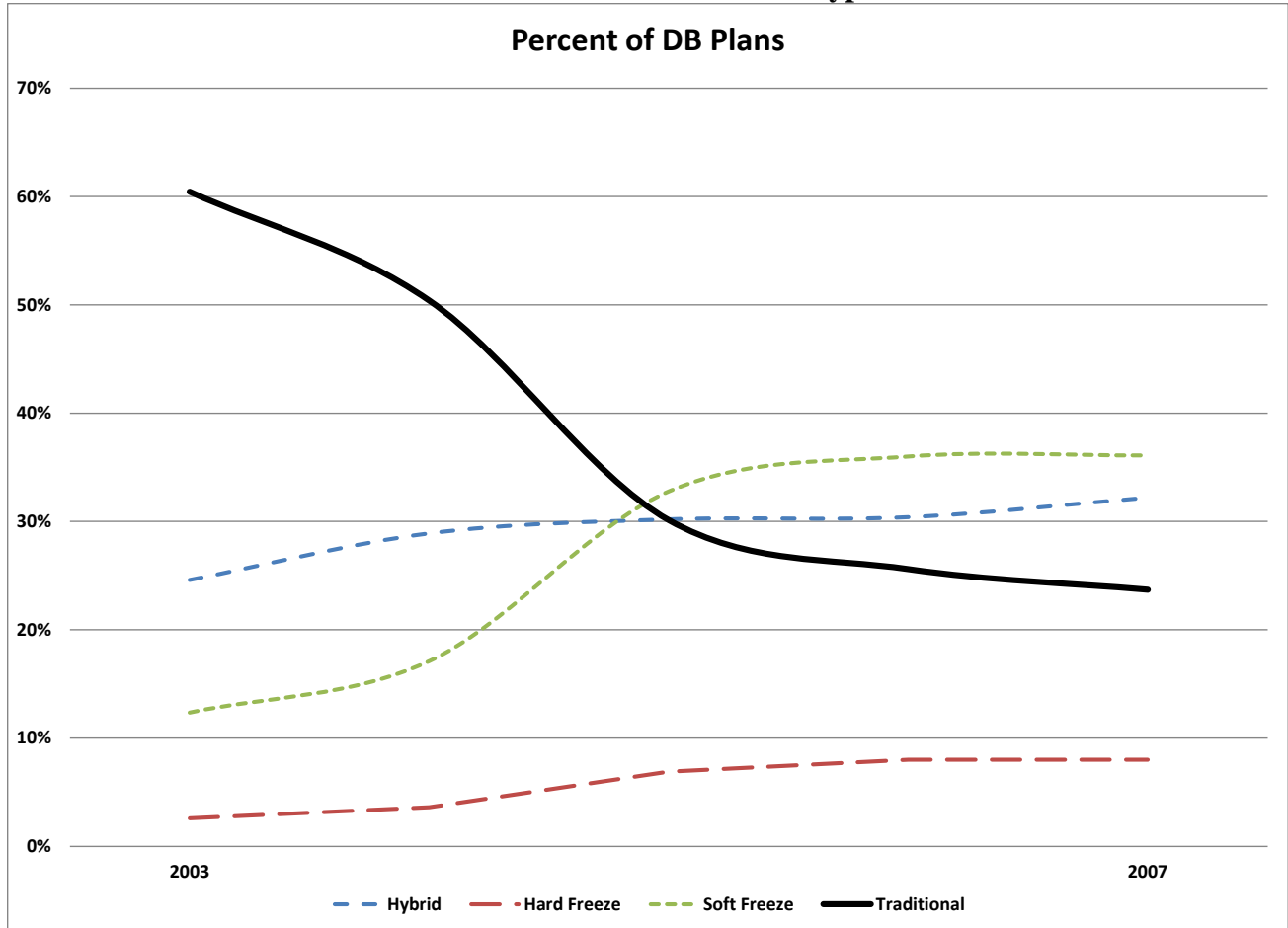


<sup>6</sup> Public Law Number 109-280 (HR 4)

<sup>7</sup> Sources of data for this section are US DOL [57] 5500 database.

The absolute decline in active participants in DB plans of over 10 million, or one-third of all 1979 participants, took place during a period when the labor force increased by over 50%. The decline in traditional DB plans is even greater than these figures would indicate when plan “freezes”, conversion to hybrid plans (primarily cash balance plans), and other design changes are taken into consideration. For example, typical DB plans pay a lifetime annuity to the participant and his spouse based upon final pay and service, whereas many of these DB plans are now offering lump sum options in lieu of annuities. The following chart shows the proportion of different types of DB plans excluding terminated plans based upon number of plans [38].

**Chart 3 -- Relative Percent of Different Types of DB Plans<sup>8</sup>**



The McKinsey study [31] projected that by 2012, up to 75% of defined benefit plans will be frozen due to PPA and SFAS 158<sup>9</sup>. However, recent data appears to show the rate of plan freezes to be stabilizing [30].

<sup>8</sup> Traditional Plans include career average plans. In a Hard Freeze no benefits are accruing under the plan while under a Soft Freeze some groups are accruing benefits (such as employees hired before a specified date). Most hybrid plans are cash balance plans where the employee’s benefit is expressed as a cash value that grows at a fixed interest rate.

<sup>9</sup> Financial Accounting Standards Board, “Statement of Financial Accounting Standards No. 158”



## COMPANY SPONSORED PENSION PLAN BENEFITS

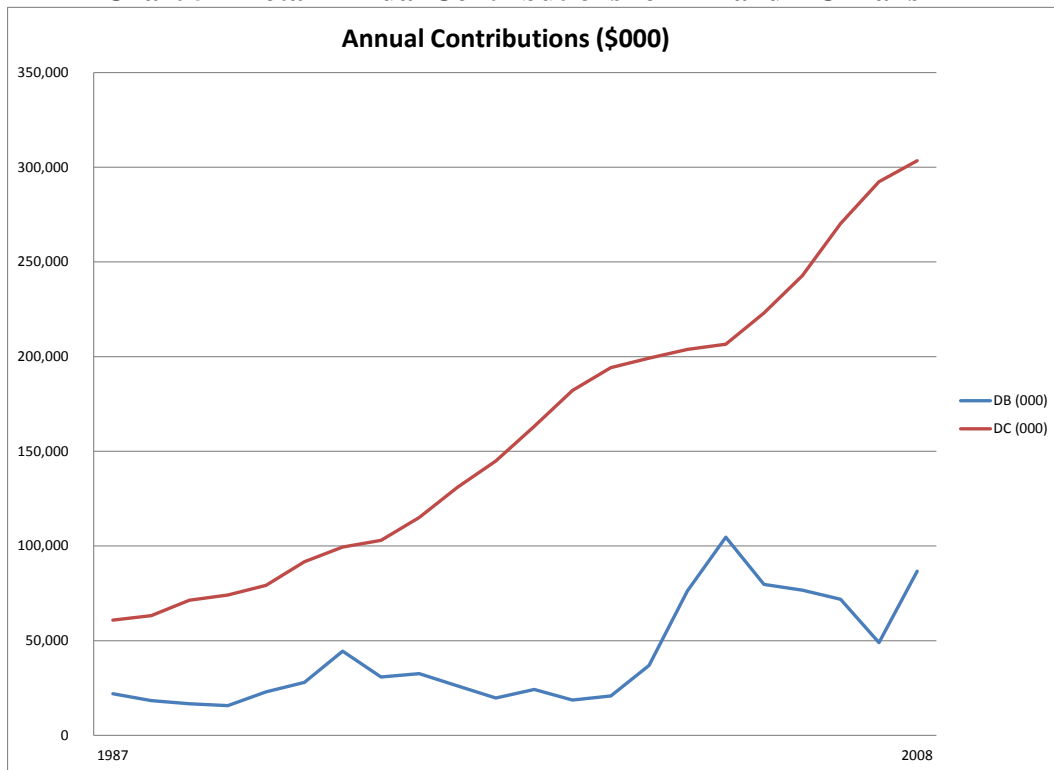
As Chart 1 demonstrates, retirement plan assets have been growing rapidly over the past 15 years, with a blip down in 2008 due to the financial crisis. This increase occurs regardless of how it is measured, as a percent of GDP, or per worker or participant<sup>10</sup>. Table 6 compares the assets per plan participant under DB Plans and DC Plans, measured in 1987 and in 2007. For comparison, the 2007 figures have been adjusted to 1987 levels by removing the effects of inflation.

**Table 6 – Assets per Participant in DB and DC Plans**

Private Sector Single Employer		
Assets Per Participant		
Year	DB	DC
1987	23,743	13,963
2007	66,654	43,941
2007deflated	40,570	26,745

Chart 5 and Chart 6 show how annual contributions to DB and DC Plans have increased from 1987 to 2008. Chart 5 shows the total annual contributions for all pension plans as reported by the Bureau of Labor Statistics [57] and Chart 6 shows the same information as an average per participant.

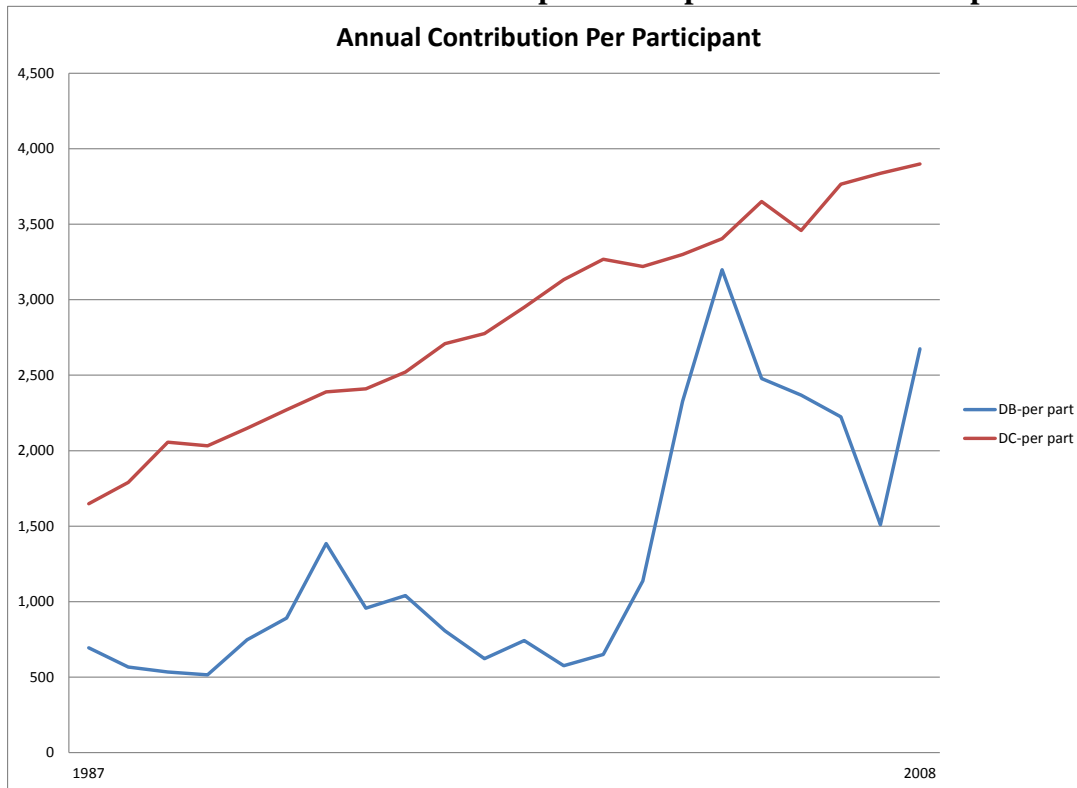
**Chart 5 – Total Annual Contributions for DB and DC Plans<sup>11</sup>**



<sup>10</sup> Assets from DOL BLS [57] GNP deflator from DOC BEA [56]

<sup>11</sup> Most DB plans in the private section are noncontributory while DC plans have substantial employee contributions.

**Chart 6 – Annual Contribution per Participant for DB and DC plans**



In looking at the almost doubling of the inflation adjusted per participant assets, a few facts should be considered before conclusions are drawn<sup>12</sup>. First, DB plans hold a significant portion of assets to support retiree payments, and increases in plan sponsor contributions would largely be required to fund deficits attributable to these retired participant liabilities. The number of active participants in DB plans declined from 73% in 1987 to 46% in 2007. The comparable figures for DC plans are 91% to 82% [57], since most participants take their DC account balances when leaving employment or retiring. DC plans are also subject to “leakage” from hardship withdrawals and loans. Unlike DC plans, DB plans do not need to be fully funded and funding ratios did decline between 1987 and 2007 [32]. The cost of annuitizing DC assets has increased by 34% between 1987 and 2007 for a male age 65 based upon PBGC rates due to lower interest rates and longer life expectancy<sup>13</sup>. Finally, DB plans are almost all noncontributory while most DC plans require employee contributions to obtain the matching employer contribution. In many cases the match may be only 50% of the employee contributions. In 1999, about two-thirds of 401(k) contributions were from employees based upon EBRI data [22]. When these factors and inflation are considered, company paid pension benefits at a macroeconomic level actually declined by over 15% during the period 1988 to 2008,

<sup>12</sup> Note that using 5500 data one individual could be counted more than once if covered by multiple plans. A participant with both DC and DB plans would be counted in each category.

<sup>13</sup> Sources are 29CFR4044, author’s calculation. DB plans are not required to be fully funded and so can pay higher benefits than supported by their assets. The decline in funding ratios implies more benefits are being provided by the assets. Leakage, while not affecting the amount of employer provided benefits, does reduce the ultimate retirement income of participants. Higher annuity costs mean that DC account balances produce less monthly income to be compared to DB plans.

despite apparent large increases in assets and contributions. Plan participants have contributed significantly to the growth of DC Plan assets.

Regardless of what is happening at the macro level, benefit reductions can take place at the company level. When a DB plan is frozen and replaced with a 401(k) plan or converted to a cash balance plan, older employees generally end up with lower benefits, even when the employer's contribution is not reduced. Some of the growth in 401(k) plans comes from companies with DB plans adding a supplemental 401(k) plan. Typically when a 401(k) plan is added, the future accruals under the DB plan are reduced to partially offset the benefits provided under the 401(k).

## **EMPLOYEE RETIREMENT SAVINGS**

Retirement income has traditionally come from three sources and has been described as a "three legged stool" consisting of Social Security, employer retirement plans and personal savings. Employer provided retirement plans were discussed in the previous section. This section will discuss briefly Social Security retirement benefits and employee retirement savings.

Social security retirement benefits provide a greater proportion of retirement income for low income participants. For example, Social Security retirement benefits replace approximately 69% of income for those earning \$20,000 per year, but only 36% of income for those making \$90,000 per year [2]. The current Social Security program is unsustainable<sup>14</sup>, and benefit cuts are possible. The last time concerns about the financial viability of Social Security programs was highlighted was in the 1980s. To alleviate concerns, the retirement age was gradually raised by 2 years and up to 85% of the benefits received were made taxable for those earning over a minimal amount (starting at \$25,000) [44]. However, no change in benefits under the current law has been assumed for those near retirement in the analysis in this paper.

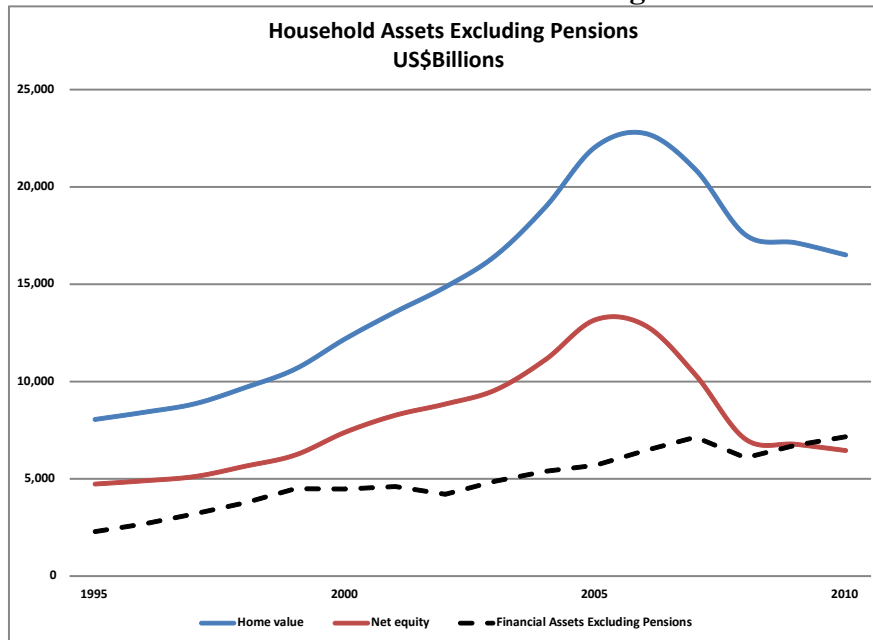
The third source of retirement income is employee retirement savings. Employee retirement savings includes financial assets such as stocks, bonds, annuity contracts in tax deferred or taxable accounts and home equity. Home equity is included here since it could be used to fund retirement by selling and moving to a smaller house and/or lower cost area or by a reverse mortgage. The amount of consumable net equity may be significantly less than total net equity [46]<sup>15</sup>. As the following chart shows, home equity peaked in 2005, a year before housing prices peaked as more loans were taken out on homes [4, 46].

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<sup>14</sup> The 2012 Annual Report of the Social Security Board of Trustees shows that under intermediate assumptions, the trust funds will be exhausted by 2033. <http://www.ssa.gov/oact/tr/2012/tr2012.pdf>

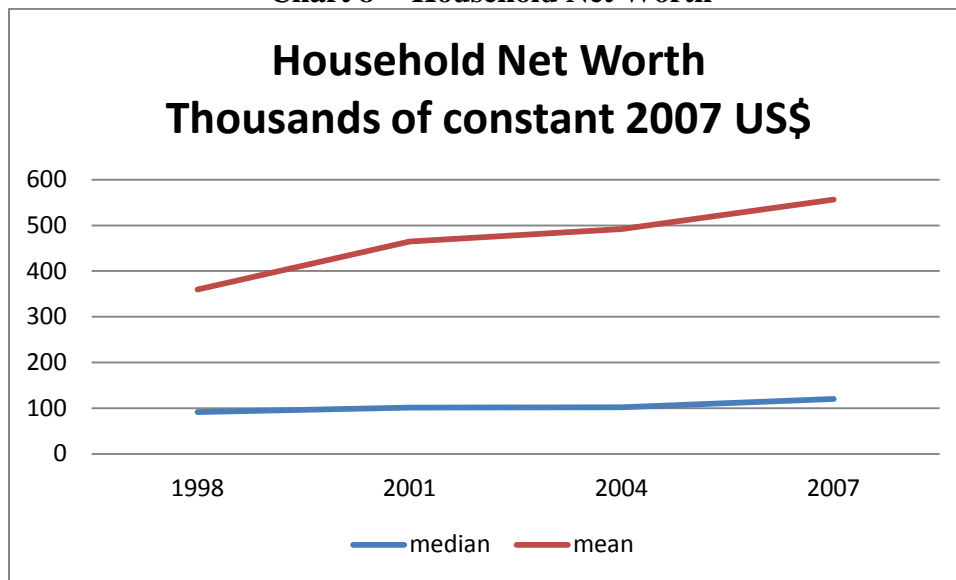
<sup>15</sup> Reverse mortgages generally require at least 50% equity in a house. <http://homeguides.sfgate.com/differences-between-reverse-mortgage-home-equity-loan-9400.html>. If a house is sold, the cost of replacement housing, expenses and possibly taxes will reduce equity available to support retirement.

**Chart 7 – Household Assets Excluding Pensions**



The following chart shows mean and median net worth of U.S. households adjusted for inflation [5].

**Chart 8 -- Household Net Worth**



There are several studies addressing the question of what percentage of employees will be ready for retirement, with significantly different conclusions. Many of the differences are due to different underlying assumptions in the various studies. Some studies assume retirement occurs at age 65, while others use Social Security Retirement Age (up to age 67). The replacement ratio, defined as the retirement income required divided by pre-retirement income,

in the various studies also differs. A study prepared by Aon [2], “The Replacement Ratio Study 2008”, provides rationale for replacement ratios that vary by income and other factors and includes lump sum equivalent dollar amounts necessary to support them. The Brady paper [6] argues that consumption, not income, needs to be replaced and that replacement ratios of 60% would be adequate for some individuals. Assumptions regarding earnings, savings rates, longevity/withdrawal rate, and effect of homeownership also differ. Another factor leading to different results is the date of the study. The Munnell study in 2007 [35] describes the National Retirement Risk Index (NRRI), where 45% of employees are at risk of having inadequate retirement benefits at age 65. The NRRI includes households of all ages based upon the 2004 Survey of Consumer Finances. Earlier studies showed that only 16% were at risk based on the Health and Retirement Study that covered those who were age 51 to 61 in 1992. Changes since 1992 such as the demise of defined benefit plans, cuts in Social Security benefits, lower interest rates and higher annuity costs could explain these differences.

The most recent study was completed in 2010 [10]. It contains a summary of recent literature on adequacy of retirement savings. This study produced median replacement ratios at age 62 of 66% to 75% depending on savings assumptions with little variation by gender or other demographic characteristic using data from the 2004 Survey of Income and Program Participation. This study also shows that if we assume a 1% savings rate and require an 81% replacement ratio; only 15% of workers are prepared to retire at age 62. However, if we assume a 15% savings rate and a 65% replacement ratio, 71% of workers are prepared for retirement at age 62. Another study [27] showed that 18% of households over the age of 55 in 2006 have less wealth than would be needed to generate income at 150 percent of the poverty-line during their expected future lifetimes.

For early retirement at age 55 even fewer workers would be ready to retire. Not only is there a longer period of retirement, which reduces income and increases expenditures, but Social Security benefits do not begin until age 62. Another factor to consider in being prepared to retire is the cost of health insurance for those retiring before age 65. Many companies have eliminated retiree health insurance so early retirees would need to pay for healthcare prior to eligibility for Medicare [14]. If healthcare reform goes into effect in 2014, the cost and availability of health insurance for these early retirees should be greatly improved [43]. The change to a do-it-yourself defined contribution retirement system will lead to more variability in retirement income. When defined benefit plans were common and many employees spent most of their career at one employer, most employees had adequate benefits at early retirement, whether they were spendthrifts or savers. Based on a review of the studies cited above, we can estimate that over a quarter of employees may not be prepared for normal retirement at age 65, and perhaps over a half may not be ready for early retirement at age 55.

## **EMPLOYEE DECISIONS TO RETIRE**

One of the best sources of data and studies on factors affecting employee decisions to retire is the National Institute on Aging/University of Michigan Health and Retirement Study that surveys more than 22,000 Americans over the age of 50 every two years. This is a longitudinal study of labor force participation and health transitions that individuals undergo

toward the end of their working lives. Chapter 2 of the Data Book from this study, “Work & Retirement,” [19] lists some conclusions such as:

- (1) The trend to earlier retirement may be ending as baby boomers plan to work longer;
- (2) Employees with DB plans retire 1.3 years earlier than those with only DC plans; and
- (3) Poor health is more important than financial factors in deciding early retirement<sup>16</sup>.

The Transamerica Center for Retirement Studies surveys [50, 51] are another source of data. According to this study, for many workers, their retirement plan is not to retire. The percentage of workers who plan to work to age 70 or not to retire is 39%, and 54% will continue to work after retirement with financial need being cited as the most common reason. Only 10% are very confident and 41% somewhat confident, that they will be able to retire comfortably.

Another source of factors influencing retirement decisions is the Society of Actuaries Risks and Process of Retirement Survey [48]. While only 11% of pre-retirees in the 2009 survey say that they plan to retire before age 60 and 59% plan to retire at 65 or later, of those actually retired, 51% retired prior to age 60 and only 18% retired at age 65 or later. It should be noted that half of the early retirees are working in second jobs either part or full time (about 20%). Also, 39% of retirees retired earlier than expected, with health and work related (layoff or firing) issues being the primary reasons for retirement. While two-thirds say they plan to work in retirement only about one-third of retirees are actually working. Not all those whose retirement plan is to keep working will be able to do so.

A study in Australia analyzes the following four factors in an employee’s choice of retirement age:

- (1) Financial Security;
- (2) Health;
- (3) Intrinsic (desire to keep working); and
- (4) Organizational (support at the firm to continue working).

A quantitative analysis shows Financial Security as the most important factor influencing an employee’s decision to retire, followed closely by Health factors. Organizational and Intrinsic factors were close together in that order but lower than the first two factors [7]. While social insurance (including health insurance) is different in Australia, the concept of Financial Security should be similar to that in the U.S.

Some of the papers reviewed discussed the wealth effect of the stock market on retirement. The first paper determined that each \$1,000 increase in unexpected capital gain raises the probability of retirement by about 0.04 percentage points [45]. A second paper [17] indicated that the stock market crash in 2008 resulted in only a few months of delayed retirement. The previously cited Transamerica survey showed 75% of respondents were confident they would have a comfortable retirement in 2006 compared to 51% in 2011. When the economy is booming and stock market is high, employees with 401(k) plans are more apt to

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<sup>16</sup> For employees retiring before age 65 without retiree health insurance, the cost of healthcare is a significant financial consideration [43].

retire than when the economy is poor and the stock market falling. Retirement under a defined benefit plan is not directly affected by the stock market.

One paper [28] described mathematical models of retirement. Unlike DB plans where benefits can be projected, there are too many variables such as investment returns and future annuitization rates, so models used for DB plan retirements do not work well for DC plans. Finally, there are papers dealing with psychological and behavioral finance aspects of retirement [3, 13]. We are currently in a perfect storm negatively affecting retirement decisions under DC plans – falling home prices, volatile stock prices, extremely low interest rates, uncertainty regarding Social Security and Medicare, increasing longevity, and rising inflation.

### **PAY/PRODUCTIVITY GAP AT OLDER AGES**

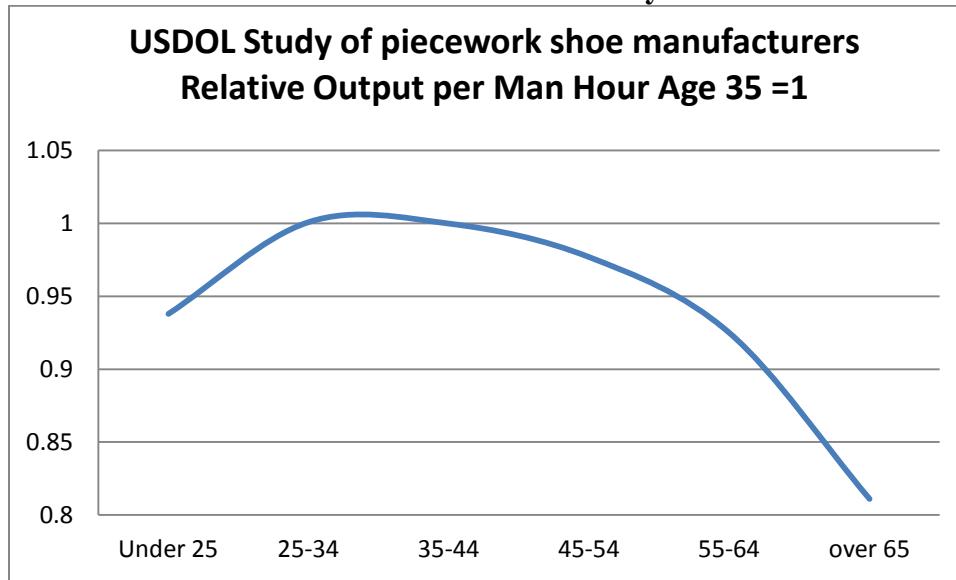
Some jobs, such as professional athletes, combat soldiers, police officers, and firefighters would not be expected to provide employment to age 70. However, most jobs in the modern economy do not depend upon physical strength or agility. The question for these jobs is whether conventional wisdom that productivity declines after age 50 is correct. Since most firms do not cut wages, productivity declines can result in pay exceeding productivity for long service employees. This is compounded by the cost of benefit packages offered by most large employers that escalate with age and service. Even if true that, on average, productivity declines in old age, there may be some 70 year olds that are more productive than some 40 year olds.

A comprehensive review of age and productivity studies in advanced economies including the U.S. and Canada was published in Europe [47]. While these studies show that productivity peaks between ages 30 and 50, wages continue to rise with age, and so older workers are overpaid relative to their productivity. For technical work in fields that are changing rapidly, peak productivity occurs in the 30s. A cause of this decline in productivity is that cognitive abilities decline with age.

The second paper reviewed is a study of how Dutch companies address the pay/productivity gap for older workers. The underlying basis for this gap is that human capital, like physical capital, depreciates over time and has to be renewed. Older workers may suffer cognitive decline, may not keep up with new developments, or their knowledge may become outdated. The study shows that 53% of Dutch employers tolerate this pay/productivity gap, 11% address this issue by retraining, and 10% either demote or dismiss unproductive older workers [59].

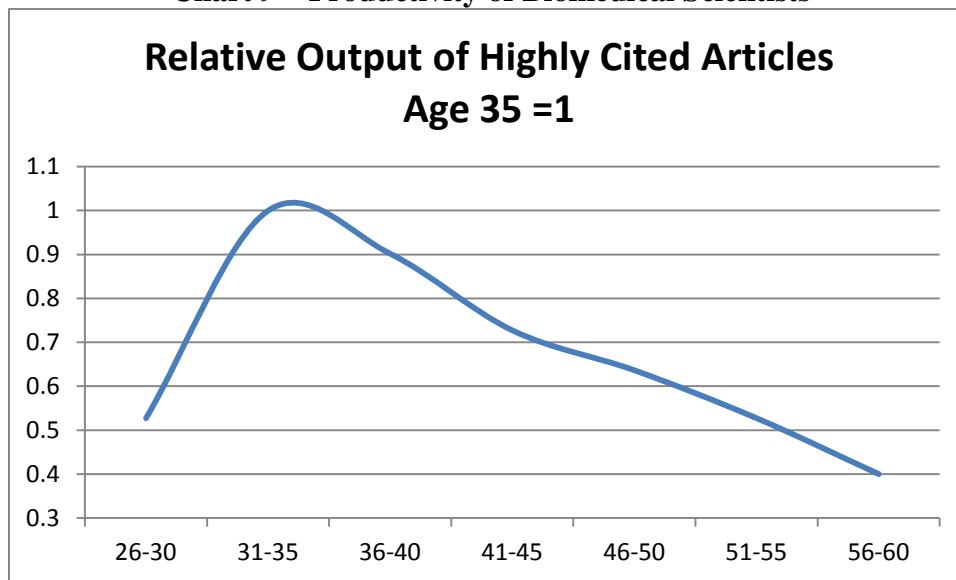
One of the early studies of age and productivity in the U.S. was conducted by the DOL in 1957 of footwear manufacturers. The data from the study, when plotted in Chart 8, shows the concave nature of productivity curves [58]. While dated, and since the time of the study most of these jobs have been automated and/or moved to China, it is a measure of output by age of employees, at a time when early retirement was uncommon.

**Chart 8 -- USDOL Study**



A study of papers published by economists show a decline in the number of papers as they age. For every paper published by economists age 36 to 50, those under 36 published 1.7 papers while those over 50 published 0.2 papers [36]. A study of biomedical scientists came to similar conclusions [12]. The following Chart 9 shows the productivity of biomedical scientists from age 21 to 60 based on the number of "Top 5" most highly cited articles produced by age, from a sample of 300 biomedical scientists.

**Chart 9 – Productivity of Biomedical Scientists**



Most of the recent studies on the pay/productivity gap use large matched employer/employee data sets where statistical inference is used to extract wages, productivity by



age and other variables. Many of these studies show a pay/productivity gap starting at age 50 or later.

Conversely, some studies do not show any significant pay/productivity gap for those in their 50s. Many of these studies, particularly in Europe, have sparse data beyond the late 50s because of retirements. As workers age, those few remaining in the workforce are a select group who are able to continue productive work. If all workers continued employment to age 70, the results of these studies might be different.

In some cases pay also declines with productivity at older ages. This most likely reflects hiring at later ages at pay reflecting lower productivity rather than demotion and pay cuts for long service employees.

A study completed in 2010 [60] in Europe supports the view that there is no significant pay/productivity gap for employees in their 50s. This study also contains a summary of the studies completed to date in Europe and North America. The study has 10-year age intervals starting at age 25 and ending at age 55. Those over age 56 are lumped together, reflecting the paucity of data at the older ages due to retirements highlighting the select nature of the group remaining. Some of the occupations examined by the study, such as retail store clerk, that are neither mentally nor physically challenging, could be performed as well by healthy 50 year olds as those in their 40s. Even in these jobs, productivity may eventually decline at age 60 or 70<sup>17</sup>.

Another study in Europe in 2011 [8] supports the conclusion, “that young workers are paid below their marginal productivity while older workers appear to be overpaid and lends empirical support to theories of deferred compensation over the life-cycle.” A study completed in the U.S. in 2004 [21] concluded: “wage profile is steeper than the relative productivity profile, consistent with models of deferred wages.” This study used the long-form respondents to the 1990 Decennial Census of Population matched to data on employers from the Longitudinal Research Database. A study in Canada in 2006 [11] states “We find evidence that wages of men with at least an undergraduate degree aged 35 and less are lower than their productivity while the reverse is true for men aged 55 and more, a pattern coherent with deferred compensation models.”

A study was published in 1988 based upon earnings histories for over 300,000 office workers in a large U.S. corporation covering the period 1969 to 1983 [26]. This study contains both pay and productivity by age and shows a large drop in productivity near retirement.

## **WORKFORCE MANAGEMENT**

While both DB and DC plans can be used to attract and retain employees, DB plans can also be used to encourage older, long service employees to retire. DC contributions are typically a constant percentage of salary and continue as long as the employee is working. An employee participating in a typical final pay DB plan accrues increasingly valuable benefits up to qualification for early retirement, after which the value of accruals decreases until they may be reduced or cease. While future income from a DC plan is dependent on account balances that

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<sup>17</sup> This is the author’s conclusion.

rise and fall with the financial markets and annuity rates, income from a DB plan is known and not variable. When there is a recession and need to reduce staff, older employees under DC plans will not want to retire because their account balances are likely lower due to declines in investment markets. Employers who provide a DB plan can offer an early retirement window of enhanced benefits to encourage older employees to retire during recessionary times.

In order to illustrate workforce management savings, a simple model was constructed comparing a DB plan to a DC plan for an employer. Some of the assumptions used in this model follow. The two plans have roughly the same cost. Under the DC plan, the employee would contribute 8% of salary while the employer provides a DB plan paying 1% of final salary multiplied by years of service (up to a maximum of 40 years). We have assumed the DC plan balances earn 3% per annum, while the DB fund earns 4% per annum, reflecting higher returns due to institutional investment management and a longer time horizon. Under the DB plan, an actuarially equivalent pension is available on early retirement at age 55. Annuity purchases by the DC plan are priced using the 1994GAR, assuming a 3% per annum discount rate. The cost of health insurance was included by using individual health insurance premiums<sup>18</sup>. The employee is assumed to have no other sources of retirement income other than the company pension plan and Social Security.

**Table 7 – Actuarial Assumptions**

	DB Plan	DC Plan
Interest	4%	3%
Mortality	1994 GAR	

A number of other simplifying assumptions were made, which include the following. Employees were assumed to start working at age 25 and retire at age 65. Obviously employees enter and leave at various ages. The purpose here is to test the effects of pension plans on the retirement of long service employees. An employer would not hire an employee at a compensation level in excess of expected productivity and so the pay/productivity gap should not be applicable for employees hired at later ages. Total compensation and productivity at age 66 was assumed to be the same as at age 65.

Three scenarios were prepared to illustrate the effectiveness of a DB plan or DC plan to enable workforce management and used Pay/Productivity scales from three of the studies reviewed in the previous section for this model. The first scenario is based on the Kotlikoff study [26]. This study estimates productivity using the lifetime earnings of 300,000 office employees of a large U.S. corporation from 1969 to 1983. While dated, it was chosen because it was the most recent large scale study with data for wage and productivity by age. It shows a significant wage productivity gap at older ages for long service employees. The second scenario was based on the Dostie study [11]. This study uses wage and productivity data based on linked employer-employee Canadian data from the Workplace and Employee Survey 1999-2003 covering 71,000 employees in 5,500 companies. Statistical inference was used to determine relative pay and productivity in three age groups. The third scenario, which showed no wage productivity gap at older ages, was based on a study by van Ours and Stoeldraijer [60]. It also used matched data covering over one million manufacturing employees in 13,000 companies in

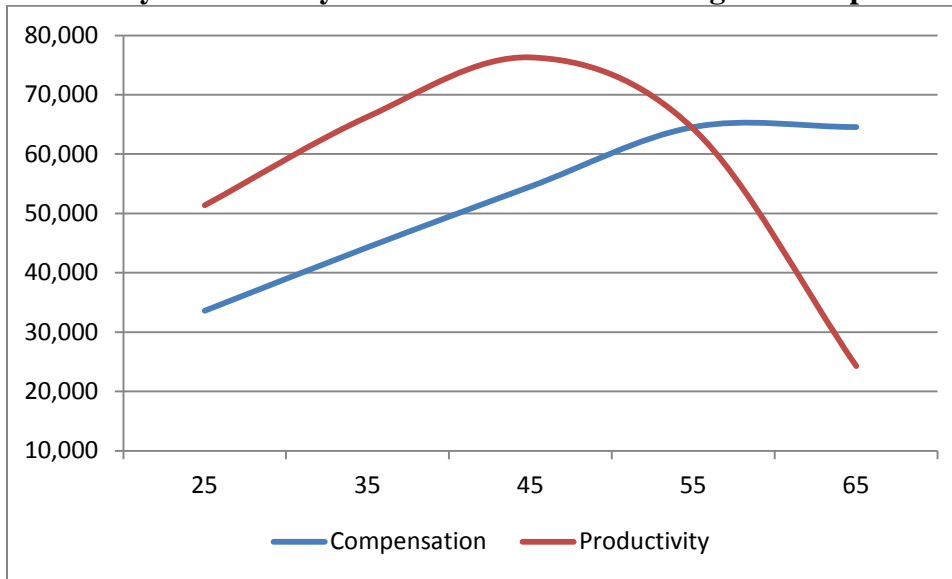
<sup>18</sup> Health reform may change individual health insurance premiums after 2014, but would not affect employers who self-insure.

the Netherlands from 2000 to 2005. Statistical inference was used to determine relative pay and productivity in eight age groupings.

**Scenario 1 – Kotlikoff Study**

The data in the Kotlikoff study was adjusted to current dollars using the GDP deflator and smoothed to take out the effects of the plan’s early retirement subsidies in the compensation. Pay was held constant after peaking at age 55 to allow the modeling of the DB plan benefit. The Pay/Productivity data is shown for this study in Chart 10.

**Chart 10 – Pay/Productivity of Office Workers of a Large US Corporation**



Based on this model and the Scenario 1 pay/productivity data, a summary of pay, production, profit and pension benefits is shown in Table 8 for the five employees of this company. As of the current date, the comparison looks like this:

**Table 8 – Pay/Productivity Model**

Age	Pay <sup>19</sup>	Health Insurance Premium	Total Employee Compensation	Production (Revenue Generated)	Profit	DB Annual Pension at 65	DC Account Balance	DC Annual Annuity
25	33,612	1,429	35,041	51,389	16,348	336	2,689	
35	44,302	2,104	46,406	66,299	19,894	4,430	39,367	
45	54,535	2,888	57,423	76,305	18,881	10,907	98,306	
55	64,549	4,127	68,676	64,272	-4,404	19,365	186,828	
65	64,549	5,755	70,304	24,293	-46,011	25,820	310,280	21,972
Total Profit					4,708			

<sup>19</sup> Includes pension cost of 8% of pay.

The lower annuity value for the DC plan benefit reflects its lower earnings rate and the benefit of survivorship (no death benefit) under the DB plan<sup>20</sup>. The total profit contribution from these employees in the current year is \$4,708. The 65 year old participating in the DB plan has a benefit, that when combined with Social Security benefits of \$29,000, should allow him to retire with about 85% of his pre-retirement income. In considering whether to retire at 65, the “DB plan” employee would lose \$25,820 in company pension benefits not paid and \$29,000 in Social Security benefits not paid. The “DC plan” employee receives a contribution of \$5,164 (i.e., \$64,549 earnings multiplied by the 8% contribution rate) toward his account balance, which along with lower annuity costs and higher Social Security benefits would increase his replacement ratio from 79% at age 65 to over 85% at age 66.

Assuming the “DC plan” employee who is currently age 65 continues to work one more year, while the “DB plan” employee who is currently age 65 retires and is replaced with a 25 year old new participant, the following would result.

**Table 9 – One Year Later**  
**DC Plan – 65 Year Old Continues in Employment**  
**DB Plan – 65 Year Old Retires/Replaced by New Employee Age 25**

DC Plan				DB Plan			
Age	Total Comp	Production	Profit	Age	Total Comp	Production	Profit
26	36,276	52,715	16,439	25	35,041	51,389	16,348
36	47,336	68,010	20,674	26	36,276	52,715	16,439
46	58,877	76,256	17,380	36	47,336	68,010	20,674
56	69,444	61,477	-7,967	46	58,877	76,256	17,380
66	70,304	24,293	-46,011	56	69,444	61,477	-7,967
		Total	515			Total	62,874

Note that under this simplified model, the company profit falls with a DC plan in place, while it increases with a DB plan.

Considering an extreme example, a recession results in a 30% drop in DC Plan account balances, while interest rates fall and annuity prices increase 30%. Furthermore, reduced economic activity requires the firm to layoff two employees. The 65 year old DC plan participant’s account balance is reduced to \$217,196 and the retirement annuity he can purchase is reduced to \$11,831. His replacement ratio falls to 63% on retirement at age 65 and he may no longer be able to afford retirement. The home equity that he could have used for retirement is gone and he can no longer afford to retire<sup>21</sup>. On the other hand, the DB plan participant’s replacement ratio remains unchanged at 85%, and his ability to retire is unchanged. The DB plan may experience losses and higher future contributions in these circumstances until the market recovers. The company with a DB plan can also offer the 55 year old participant an early retirement window pension – increasing service credit and eliminating the early retirement

<sup>20</sup> Benefit of survivorship for the DB plans refers to the fact that single employees who die prior to retirement receive no death benefit while under the DC plan the account balance is paid to their beneficiary. For married participants the spouse in the DB plan would qualify for 50% survivor benefit, which would be less valuable.

<sup>21</sup> Home equity was not considered in this model. Tapping home equity may be a back-up source of retirement funds which could also be decimated in a recession.

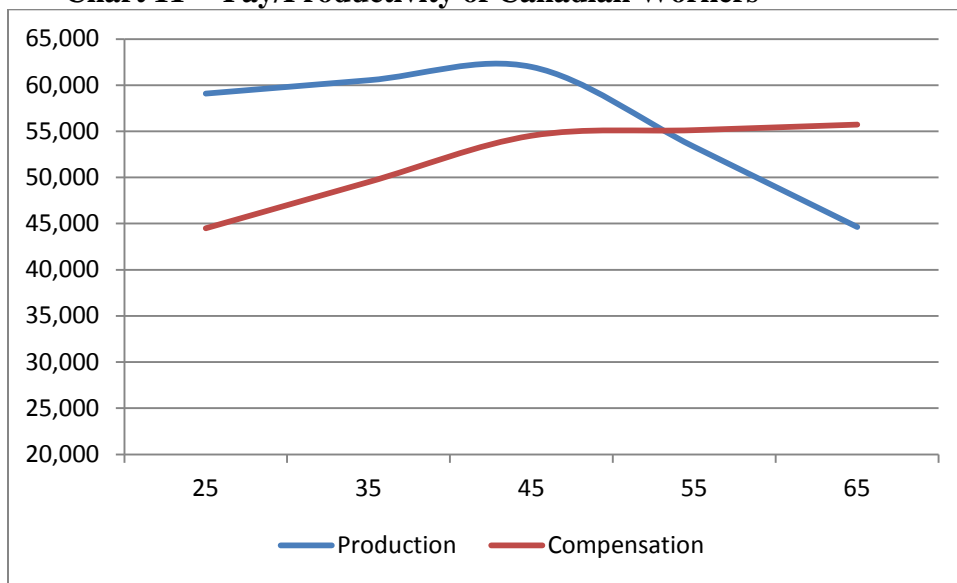
reduction – to encourage him to retire. Alternatives in these circumstances that the company with a DC plan may consider in workforce management includes layoffs or firing the older, higher paid workers or to offer severance packages such as a week’s pay for each year of service to encourage the longer service employees to leave voluntarily. Taking the first action will increase the risks of litigation with respect to age discrimination with its associated expenses and reputational risk, while the second action could be potentially costly.

**Scenario 2 – Dostie Study**

The pay/productivity data used for Scenario 2 has three age groups – younger than 35, 35 to 55 and over 55. In this model, ages 25, 45, and 65 respectively were used to represent these age groups and linear interpolation was used to determine intermediate values. This assumption may have led to overstatement of values at age 25 or age 65, depending on the actual distribution of data. The pay/productivity amounts in Scenario 1 were used at age 45 to develop dollar amounts for the relative values in this study. Then the productivity was adjusted so the total profit from employees was equal to that of Scenario 1. Health insurance costs were also added to make the study comparable, even though Canada has a different health insurance system, to achieve the purpose of comparing the relative costs of delayed retirement using different pay/productivity curves.

The Pay/Productivity data used for Scenario 2 is shown in Chart 11.

**Chart 11 -- Pay/Productivity of Canadian Workers**



Based on this model and the Scenario 2 pay/productivity data, a summary of pay, production, profit and pension benefits is shown in Table 10 for the five employees of this company. As of the current date, the comparison looks like this:

**Table 10 – Baseline Pay/ Productivity Model**

Age	Pay	Health Ins	Total	Production	Profit
25	44,510	1,429	45,939	59,283	13,344
35	49,523	2,104	51,627	60,734	9,107
45	54,535	2,888	57,423	62,185	4,762
55	55,136	4,127	59,263	53,479	-5,785
65	55,738	5,755	61,493	44,773	-16,720

Total Profit 4,708

Rerunning Table 9 to demonstrate the effect of the 65 year old employee continuing one more year of work under the defined contribution plan:

**Table 11 – One Year Later**  
**DC Plan – 65 Year Old Continues in Employment**  
**DB Plan – 65 Year Old Retires/Replaced by New Employee Age 25**

DC Plan				DB Plan			
Age	Compensation	Production	Profit	Age	Compensation	Production	Profit
26	47,077	59,573	12,496	25	45,939	59,283	13,344
36	52,786	61,024	8,238	26	47,077	59,573	12,496
46	57,791	60,444	2,653	36	52,786	61,024	8,238
56	59,709	51,738	-7,972	46	57,791	60,444	2,653
66	61,493	44,773	-16,720	56	59,709	51,738	-7,972
		Total	-1,305			Total	28,759

Here the savings under the defined benefit plan is \$30,064 compared to \$62,359 in Scenario 1 since the productivity decline is less under this scenario. Regardless, this figure represents about 10% of compensation costs.

### **Scenario 3 – van Ours and Stoeldraijer Study**

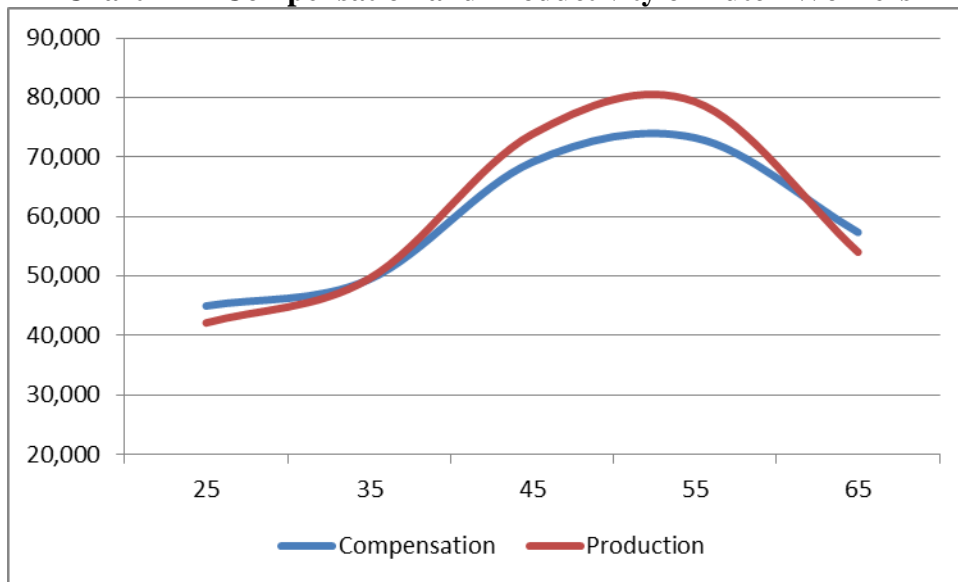
If there is no pay/productivity gap at the older ages – the relationship of pay and productivity is constant – the employer should be indifferent to the age composition of the workforce. An older workforce would result in higher healthcare costs, as evidenced by the individual healthcare premiums. For those retiring before age 65, either the employer would have to provide retiree health benefits or the employee would need more funds to purchase an individual policy. However for those aged 65 to 70, the employer would need to pay health insurance claims of employees while the retiree would receive Medicare. This can be a significant cost – approaching 10% of pay in the above example – that would give employers who provide health insurance incentive to retire these workers, other things being equal.

To illustrate the effects of no pay/productivity gap at older ages, Scenario 3 uses a Dutch study that concluded that there was no significant pay productivity gap after age 50.[58] The oldest age group in this study is 57+ and we have assumed that productivity and pay continue at this level through age 66. This study also has only relative values of pay and productivity, although it has 5-year age groupings starting at age 25. The pay/productivity amounts in

Scenario 1 were used at age 35 to develop dollar amounts for the relative values in this study. Then the productivity was adjusted so the total profit from employees equals that of Scenario 1. Health insurance costs were also added to make the study comparable, even though the Netherlands has a different health insurance system, to achieve the purpose of comparing the relative costs of delayed retirement using different pay/productivity curves.

The Pay/Productivity data used for Scenario 3 is shown in Chart 12 which shows declining compensation after age 55. The reason for this could be due to new hires at that age or hours worked since these are manufacturing companies. Dutch employers generally do not demote long service employees whose productivity has declined [59].

**Chart 12 -- Compensation and Productivity of Dutch Workers**



Rerunning the numbers used in Table 8 using the Scenario 3 pay/productivity data, adjusted to produce the same net profit contribution from these employees of \$4,708, gives the following.

**Table 12 – Baseline Pay/ Productivity Model**

Age	Pay	Health Ins	Total	Production	Profit
25	43,547	1,429	44,976	42,128	-2,848
35	47,334	2,104	49,438	49,562	124
45	66,267	2,888	69,155	73,848	4,692
55	69,108	4,127	73,235	79,300	6,065
65	51,594	5,755	57,349	54,023	-3,326
Total Profit					4,708

Note that the negative profit numbers at age 25 are the result of requiring the total profit to equal the total profit in the previous two scenarios.

Rerunning Table 9 to demonstrate the effect of the 65 year old employee continuing one more year of work under the defined contribution plan:

**Table 13 – One Year Later**  
**DC Plan – 65 Year Old Continues in Employment**  
**DB Plan – 65 Year Old Retires/Replaced by New Employee Age 25**

DC Plan				DB Plan			
Age	Compensation	Production	Profit	Age	Compensation	Production	Profit
26	45,869	43,615	-2,254	25	44,976	42,128	-2,848
36	53,381	54,419	1,038	26	45,869	43,615	-2,254
46	69,971	74,938	4,967	36	53,381	54,419	1,038
56	70,057	74,244	4,187	46	69,971	74,938	4,967
66	57,349	54,023	-3,326	56	70,057	74,244	4,187
		Total	4,612			Total	5,090

Under this scenario, the company profit whether a DB plan or a DC plan is in place is almost identical. The slight advantage of the DB plan is more than accounted for by the difference in health insurance costs of \$4,326 between the 25 and 65 year old employees.

### CONCLUSIONS

Demographic changes – increased longevity, lower birth rates, and the aging of the baby boomers – along with the switch from defined benefit to defined contribution plans and the financial crisis of 2008 that led to falling 401(k) account values, home prices and interest rates are causing some employees to postpone retirement for financial reasons. If these employees’ productivity is declining with old age while their compensation (including cost of benefits) is not, the employer’s profitability could decline. In the example in tables 7 and 8, the contribution to profit from labor declines from 1.8% of payroll to 0.2% as a result of postponed retirement.

There has been a shift from employer funded DB retirement plans to primarily employee funded DC plans. Even though total retirement plan assets have increased significantly under DB and DC arrangements, DC plans generally have lower assets per participant (see Table 6) and may not allow some employees to afford retirement.

Historically, defined benefit plans had been used in the U.S. private sector for workforce management – to encourage older workers to retire and provide early retirement incentives when staff reductions were needed and for mandatory retirement of executives. While defined contribution plans have led to an increase in retirement plan assets, their voluntary nature and lack of benefit certainty make them less effective for workforce management. Other potentially expensive methods of workforce management will be needed. Adjusting compensation down in line with reduced productivity through demotion or dismissal has legal and reputational risks. Offering cash severance for layoffs may be more expensive on an after tax basis than offering benefits through a DB plan because of tax deferred accumulation of earnings in the DB plan.



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