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**MACROECONOMIC ASPECTS OF
PRIVATE RETIREMENT PROGRAMS**

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Macroeconomic Aspects of Private Retirement Programs

Abstract

The decline of importance of private defined benefit plans in relation to defined contribution plans in the United States is a major issue of interest to pension actuaries. This decline is undeniable, and has been attributed to numerous factors: costs of government regulation, societal and cultural changes, changed attitudes of employers, and employees' lack of understanding of defined benefit plans. It has also caused some to proclaim the end of a private defined benefit plan. This work analyzes possible macroeconomic factors contributing to the crisis of defined benefit plans, and proposes an alternative hypothesis for the cause of the crisis: the decline of relative attractiveness of defined benefit plans in relation to defined contribution plans due to the shift in the way relative returns to macroeconomic factors of production, i.e., capital and labor, are allocated in the national economy.

Possibilities of improvement of the position of defined benefit plans are also discussed.

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Introduction: Are Defined Benefit Pension Plans an Endangered Species?

For more than two decades, traditional defined benefit (DB) plans in the United States have been declining in relative importance. As indicated by the United States Department of Labor (1997), in the period 1975-1993, the number of defined benefit plans in the United States has fallen at an average annual rate of 1.1%, while the number of defined contribution (DC) plans has grown in the same period at an annual rate of 5.91%. In the same period, total defined benefit plan assets have grown at a nominal annual rate of 10.54%, while total defined contribution plan assets have grown at a nominal annual rate of 15.08%. In 1975, total contributions to defined benefit plans were \$24.2 billion, nearly twice the amount of the \$12.8 billion total contributions to defined contribution plans in the same year. In 1993, total contributions to defined benefit plans amounted to \$52.1 billion, about half of the \$101.5 billion total 1993 contributions to defined contribution plans. One should note that contributions to DB plans were in a steady decline in nominal dollars from 1984 through 1990, and increases in such contributions have occurred only in the period 1991-1993. Finally, the total amount of benefits paid by defined benefit plans in 1975 was again about double that for defined contribution plans (\$12.9 billion versus \$6.2 billion), but in 1993 benefits paid by both types of retirement plans were nearly at par with each other (\$79.1 billion for DB plans versus \$77.2 billion for DC plans). In 1993, total assets of defined benefit plans still comprised the majority (54%) of pension plan assets, but the trends indicated an imminent triumph of defined contribution plans. Of particular significance was the sizable increase in the assets of the 401(k) variety of DC plans (Poterba, Venti and Wise, 1994).

The following figures are based on the data of the U.S. Department of Labor (1997):

- Figure 1 shows the relative share of pension plan assets held by defined benefit plans;
- Figure 2 illustrates the portion of all new pension plan contributions which went into DB plans;
- Figure 3 shows the share of all pension benefits paid by defined benefit plans; and
- Figure 4 shows the number of DB plan participants as a portion of the number of all pension plan participants.

The figures clearly illustrate a strong shift towards defined contribution plans in the last two decades.

1. Why is this happening?

In a debate at a March 1988 Meeting of the Canadian Institute of Actuaries moderated by Bharmal (1988) the following resolution was proposed: "Defined benefit plans are not well suited to tomorrow's work force and should be replaced by defined contributions plans." Two of the participants in the debate, Tom Holmes and Daniel McCaw, argued in favor of the resolution, presenting a list of factors causing the demise of defined benefit plans. The list was indeed inclusive of what is commonly believed to be the causes of the shift to defined contribution plans. One should, however, note that, in contrast with the United States, defined benefit plans have not

Figure 1: Share of Pension Assets held in DB Plans

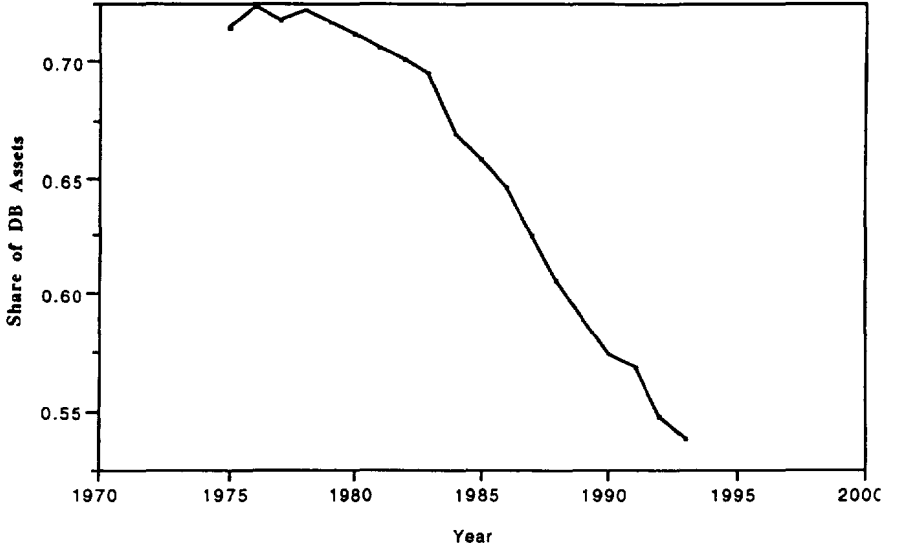


Figure 2: Share of DB Contributions in Pension Plan Contributions

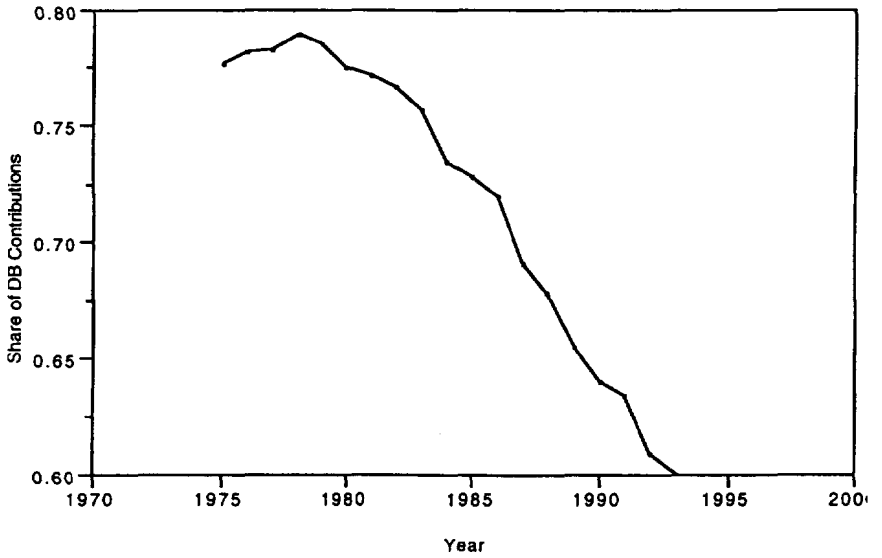


Figure 3: Share of Pension Benefits Paid by DB Plans

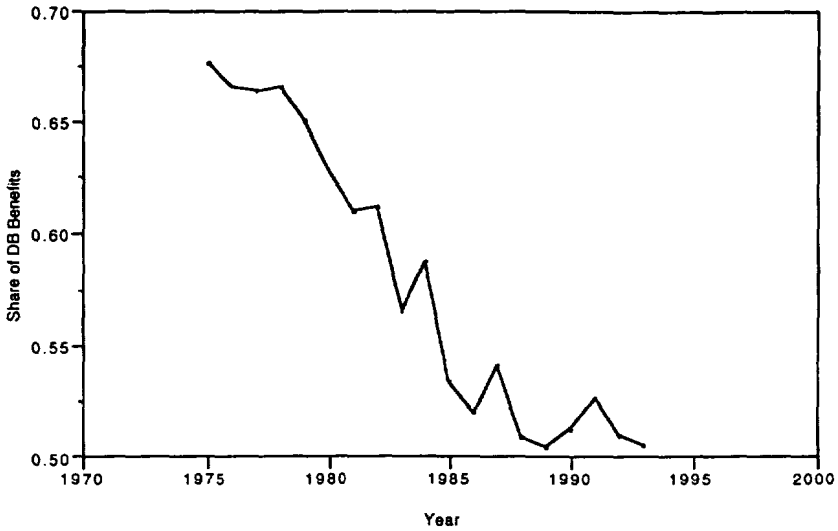
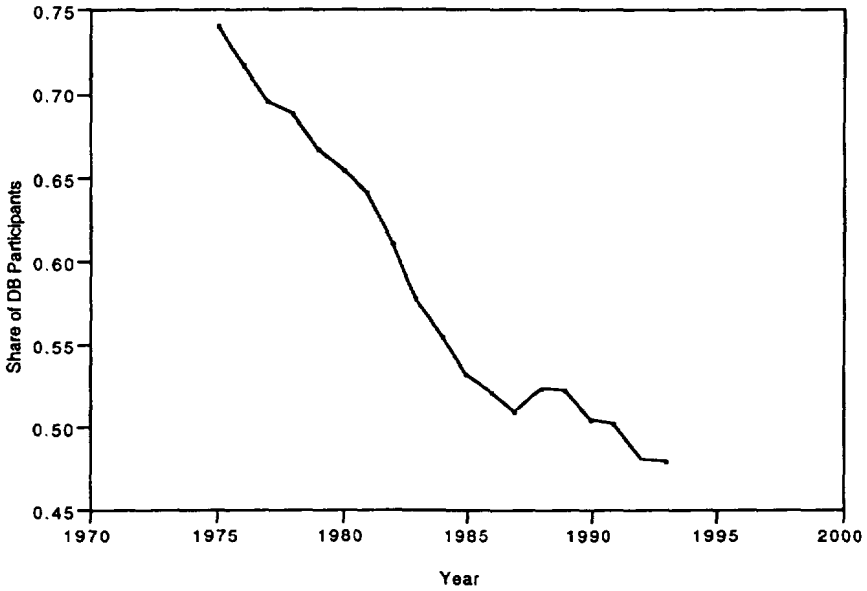


Figure 4: Share of Pension Plan Participants in DB Plans



declined significantly in relation to defined contribution plans in Canada. Nevertheless, the factors presented in the debate lead by Bharmal (1988) are exactly the ones commonly brought forth to explain changes in pensions structure in the United States, and for that reason are presented below:

- *Change in the relationship of the employer and employees.*

Today's workers are much less likely to retire from the same firm in which they began their careers, while firms are much less likely to view employees as lifetime workers. The result is that employees need direct ownership of their retirement accounts and full portability of them.

Furthermore, changes in culture, technology and education have caused employees to be more self-directed and independent, making defined contribution plans more desirable. This trend expresses itself both in the greater number of self-employed persons, and in the severing of the bond between employers and employees, both of these groups expressing more direct concern with their economic self-interest. Defined contribution plans offer an explicit and concrete measure of wealth, thus better matching the psychology of the new work place environment. Also, defined contribution plans tend to be more easily portable.

This idea will be termed the *New Economy Theory*.

- *New tax laws and funding regulations have decreased attractiveness of defined benefit plans.*

The passing of Employee Retirement and Income Security Act (ERISA) of 1974 began the process of imposition of stricter legal, funding and solvency requirements in the United States, including establishment of the Pension Benefit Guaranty Corporation (Marcus, 1987). Similar requirements in Canada were put in place by Pension Benefit Acts. Those stricter funding requirements were also accompanied by limiting access to surplus by employers. Accounting standards introduced by Financial Accounting Statement Board in the United States and the Canadian Institute of Chartered Accountants in Canada reduced flexibility of employers in accounting valuation of plans, and brought upon them the necessity to perform both accounting and statutory valuations for defined benefit plans, thus imposing additional costs. The rules are made additionally complicated and costly by tax laws concerning deductibility of employer contributions to pension plans. Finally, both Canada and the United States impose limitations of tax deductibility of contributions to other retirement accounts for workers participating in a defined benefit plan, which may reduce perceived attractiveness of DB plans, even though the restrictions apply equally to DC plans. In addition to the above, McCaw (Bharmal, 1988) points out that in Canada, legislators imposed mandatory inflation indexing on defined benefit plans, while making it voluntary for defined contribution plans. McCaw concludes that, in his opinion, legislators in Canada are moving often unwilling employers towards defined contribution plans.

The explanation of the historical shift from defined benefit plans to defined contribution plans as caused by government involvement appears to be the most popular among actuarial professionals. One of the main purposes of the present work is to challenge this explanation (even

though one must admit some of its merits). For the sake of simplicity, this set of ideas will be termed the *Excessive Regulation Theory*.

• *Distribution of risk between employer and employee.*

The last twenty years have been marked by unprecedented volatility in financial markets. This has caused the cost of funding retirement benefits to be less predictable. One could argue that under such circumstances employees should value protection from uncertainty and seek refuge in defined benefit plans. Indeed, such an argument is put forth in the Canadian Institute of Actuaries debate moderated by Bharmal (1988) by Patrick Longhurst, who stressed that defined contribution plan participants face the following flaws of their plans:

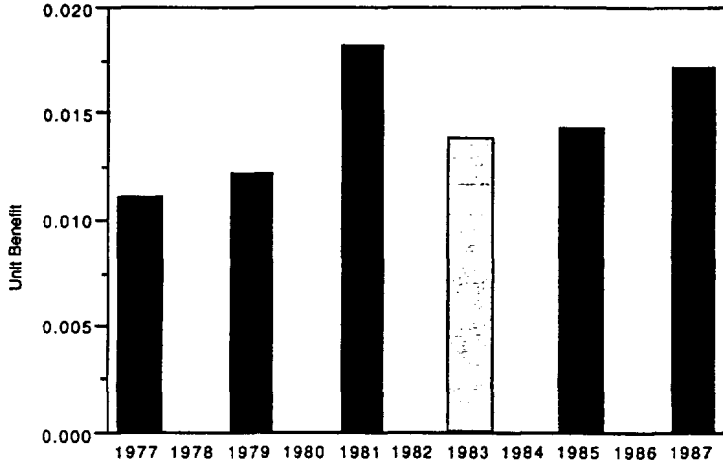
- Extreme volatility of benefit levels depending on investment performance;
- Significant impact of the choice of investment strategy;
- Inflexibility for employees hired at mid-career, who cannot be offered pension benefits beyond contribution limits;
- Difficulty in dealing with early retirement if sufficient assets have not been accumulated.

If, however, employers are fully aware of the risk distribution between DB and DC plans (while employees are less than fully informed), employers have become more risk averse, and employers have full control of the type of the pension plan adopted, then one would expect a shift to DC plans. We will term this the *Risk-Averse Employers Theory*.

As defined by Longhurst (Bharmal, 1988), unit benefit equals the pension as a percentage of salary at retirement, divided by the years of service, assuming a portfolio invested 50% in bonds and 50% in equities. The historical values of this index for selected years are shown in Figure 5. Unit benefit can serve as a measure of how much of a pension one can earn annually by investing in the benchmark portfolio.

One can see from this figure that funding retirement has become cheaper in this period (i.e., the values in Figure 5 are, generally speaking, trending upward), but also somewhat unpredictable. Given that there was a massive movement to defined contribution plans in the period, one can either argue that employers were uncomfortable with increased investment risk and preferred to shift it to employees, or that employees wanted to benefit from high returns available in capital markets. This work will return to the question of employees preferences, but let us note that these data put some doubt on the idea, presented above, that employers have been abandoning DB plans due to high expenses. Higher regulatory and legal expenses did indeed happen, but they coincided with higher returns available in the markets. In other words, pensions may have become more expensive because of having to pay actuaries and lawyers more, but they also have become cheaper because of higher returns. This also puts the *Excessive Regulation Theory* in a somewhat different light, making it less credible.

Figure 5: Unit Benefit as a Percentage of Salary at Retirement



What is suspiciously missing from all of the above theories of the relative decline of defined benefit plan importance is any economic motivation on the part of employees. Arguably, the *New Economy Theory* refers to the greater economic independence of individual workers (independence which may be wanted or unwanted, depending on the perspective), but it contains no reference to the rational self-interest of workers as economic decision makers. Such absence in actuarial literature is quite perplexing. This paper will endeavor to address it.

2. Economic Perspective on Pensions

From the perspective of financial economics, participation in a pension plan is just another capital asset, a security similar to a Treasury Bill, a share of stock, or a convertible bond. As in the case of any other security, plan participants give up today's cash flows (i.e., today's consumption) in return for future cash flows (i.e., future consumption). The major difference between DB pension plan participation and other securities is that the derivation of future cash flows of a DB plan participation is based on wages, not open market capital asset prices. A DB plan participant's forecasted value of plan participation is a function of length of service, salary, and other factors, e.g. vesting provisions. On the other hand, given the contributions level, the value of a DC plan participation is entirely a function of the performance of assets held by the participant.

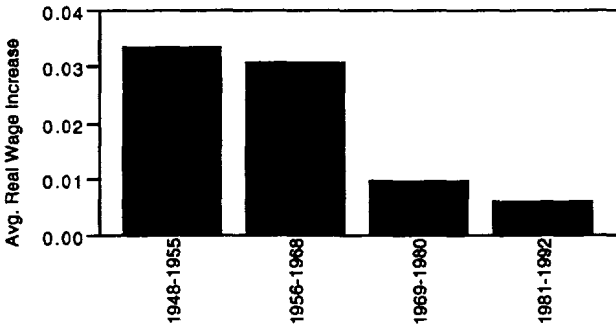
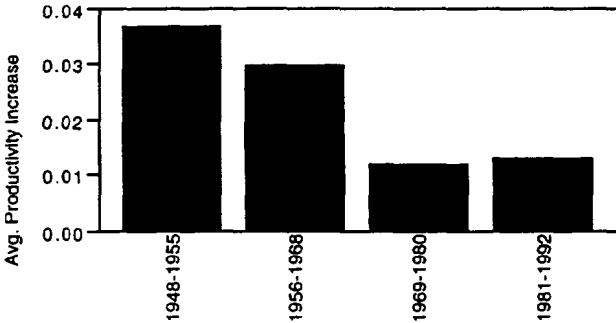
Gwartney and Stroup (1995) provide data about average productivity and real wage increases in the United States in a subset of the post World War II period, presented below in Figure 6. One sees a general downward trend in those quantities. Recall that the classical economic model of labor and capital as factors of production takes the production function as

$$Y = F(K, L, t) \quad (1)$$

where Y is the production, K is capital input, L is labor input, and t is time.

The function F is typically assumed to be homogeneous of degree one. It is also assumed that partial derivatives $\frac{\partial F}{\partial K}$ and $\frac{\partial F}{\partial L}$ are positive, while the second partials $\frac{\partial^2 F}{\partial K^2}$ and $\frac{\partial^2 F}{\partial L^2}$ are negative (Law of Diminishing Returns). Surrey (1976) provides a classical account of the problem of the distribution of the national income between capital and labor.

Figure 6: Productivity Increases and Real Wages Growth in the Post-World War II United States



Note that $\frac{\partial F}{\partial K}$ is termed the *marginal productivity of capital*, and $\frac{Y}{K}$ is the *average productivity* (or *average product*) of capital, similarly $\frac{\partial F}{\partial L}$ is the *marginal productivity of labor* and $\frac{Y}{L}$ is the *average productivity* (or *average product*) of labor.

The expressions

$$\frac{\frac{\partial F}{\partial K}}{\frac{Y}{K}} \quad \text{and} \quad \frac{\frac{\partial F}{\partial L}}{\frac{Y}{L}} \quad (2)$$

are termed *relative shares of capital and labor*, respectively, and represent portions of new output which are due to productivity increase of capital and labor, respectively. The most standard model of the production function is the Cobb-Douglas formula, where:

$$Y = AK^\alpha L^{1-\alpha}, \quad (3)$$

where A and α are constant parameters. In this case we have

$$\left(\frac{\frac{\partial F}{\partial K}}{\frac{Y}{K}} \right) = \alpha \quad \text{and} \quad \left(\frac{\frac{\partial F}{\partial L}}{\frac{Y}{L}} \right) = 1 - \alpha. \quad (4)$$

If a given level of output is sought for the minimum total cost of capital and labor, the well-known equilibrium condition is:

$$\frac{\text{Marginal Productivity of Labor}}{\text{Price of Labor}} = \frac{\text{Marginal Productivity of Capital}}{\text{Price of Capital}}. \quad (5)$$

In a perfectly competitive labor market the price of labor is equal to the marginal productivity of labor. One can find from historical data that these two quantities do follow each other reasonably closely (for a fascinating evidence of how closely this theoretical result follows the historical reality of wages in the United States, see Cooper and Borden, 1997). We also observe that productivity increases have slowed since the 1970s, resulting in a smaller rate of increase (or even in decreases) of real wages. Under the Cobb-Douglas function model of production, relative shares of labor and capital remain constant over time. The debate whether these do indeed remain constant is one of the central issues in classical economics. The last two decades in the United States have brought lower rates of increase in real wages while the real rates of return on capital have increased. The shares of the two factors of production appear to have changed their relationship.

Figure 7 below shows average real weekly wages (1996 dollars) in the United States in January of each year since 1964, based on the data provided by the United States Department of Labor. The data shows a slightly declining trend.

Figure 7: United States Real Weekly Wages (January)

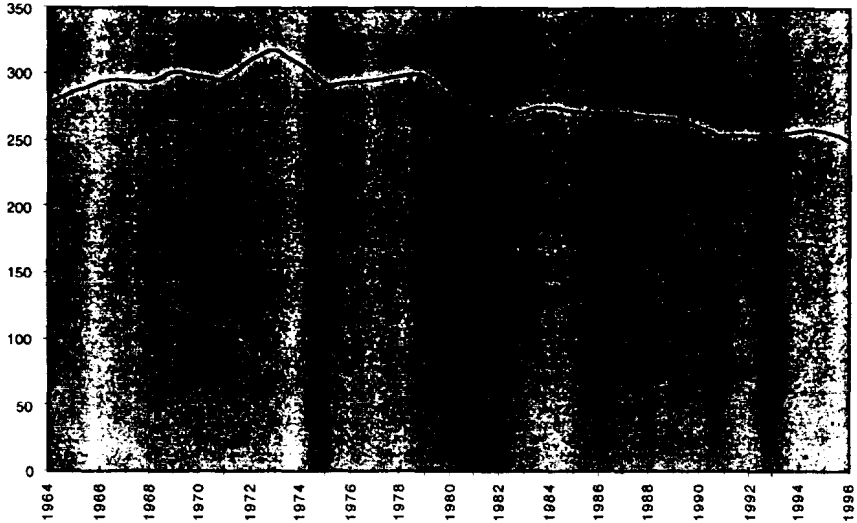
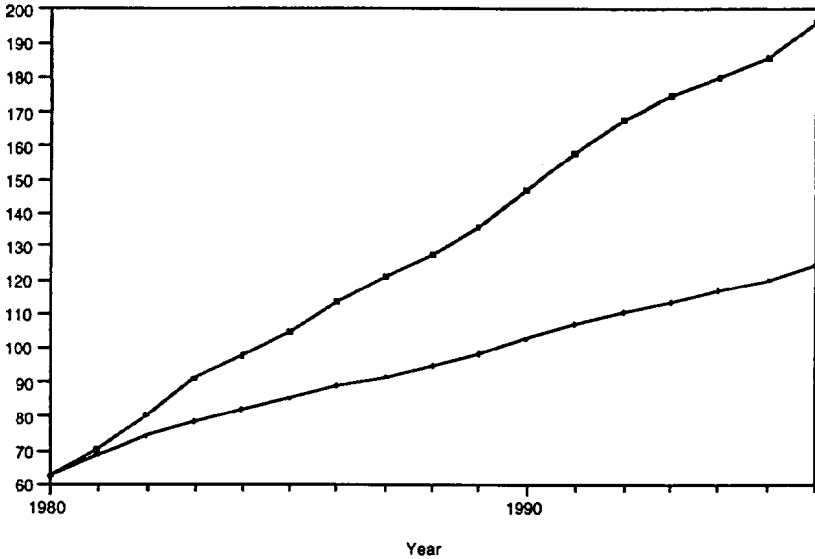


Figure 8 addresses another important issue. It shows the United States wages and salaries index, seasonally adjusted, as provided by the Department of Labor, nominal values, compared with nominal values of an amount equal to the initial value of the index invested in United States Treasury Bills (the upper graphs represents the amount invested in Treasury Bills). One sees that the rate of return on Treasury Bills has significantly exceeded the rate of growth of wages.

This means that over the last sixteen years investing in the wages and salaries index would have resulted, on the scale of national average, in about half of the amount accumulated when compared to investing in Treasury Bills. It is often argued that defined contribution plan participants take too little risk with their assets, often placing them in money market instruments, or Treasury Bill equivalents. Yet if the data is an indication of the existing macroeconomic patterns, participants may not be reducing their risk by purchasing those money market instruments, but actually improving their returns (in comparison to participation in DB plans). Of course the overall growth rate of wages is not the only determinant of an individual defined benefit pension level. There are other factors, such as individual performance, vesting provisions, and service with the company. But if these latter factors are held constant, and one compares defined benefit plan participation as a security to a defined contribution plan as a security, DC is merely a perfect conduit of underlying assets performance, while DB participation is a derivative security creating wage-dependent cash flows out of the underlying portfolio of capital assets.

Figure 8: Investing in Treasury Bills versus Investing in Wages Growth



In his analysis of social security systems (such as the United States OASDI, which can be considered a universal defined benefit plan) Samuelson (1958, see also 1975) developed a model in which a steady-state social security system delivers to its participants in the accumulation phase a nominal rate of return given by the compounding of population and labor productivity growth (assuming that labor productivity is fully reflected in taxable payroll, and assuming full compliance). The same reasoning naturally applies to defined benefit plans, if taken in aggregate. However in this case only labor productivity is translated into defined benefit participation security performance (social security systems have the advantage of compulsory participation with respect to entire population). The data in Figure 6 show that labor productivity has grown at real rates over 3% in the period 1948-1968, making DB participation an attractive security, while the last three decades witnessed a dramatic change in the rate of growth of labor productivity, dropping below 1% real.

As Robert C. Merton in his discussion of the work of Diamond and Mirrlees (1985) says: "In a world of full information and perfect markets, where all assets (including human capital) are freely tradable, private pensions provide nothing more than another way for individuals to save. With a full complement of risk-sharing securities available, the worker can fully offset or modify any particular form of payout prescribed by a pension plan." Why then did defined benefit plans develop in the first place, and why are we now witnessing such a large shift to defined contribution plans?

Some insights into the economic meaning of defined benefit plans are provided by analysis of market imperfections embedded in the labor market. The key issue is that human capital is not tradable. Young workers have large amounts of human capital, but cannot trade it for any other instruments. This forces such young workers to save more than optimal amount (as *any* savings on their part may be excessive, given large human capital position). Ideally they should seek ways to dissave, and by doing so pursue diversification of human capital and resulting reduction of nonsystematic risk (i.e., nonmarket risk of their own human capital). One way to dissave could be to accept lower wages, or lower pension contributions, in return for purchase of items of value to young workers.

Diamond and Mirrlees (1985) show that optimal labor contracts with nontradable human capital contain a portfolio of options, such as the worker's option to seek other employment. We can simplify this perspective by stating that young workers purchase their mobility by giving up some wages. This can be achieved more efficiently by allocating very small amounts to their pension contributions, instead of directly affecting their wages. One good way to achieve that purpose is through a promise of a defined benefit plan, but with slow vesting.

Bulow and Scholes (1983) provide yet another perspective on the defined benefit plans. They point out that the vesting option can be viewed as being traded between young employees, who purchase it, and elderly employees, who hold it and gradually resell it. This results in some compensation of young employees being allocated to vesting option purchase.

Thus under defined benefit plans, participants can be viewed as holding two types of securities:

- DB plan participation, whose performance is linked to labor productivity;
- Various options, including option to vest, retire early, etc.

On the other hand, defined contribution plan participants hold securities which are really the underlying capital assets. It is well-known that large amounts of defined contribution assets in the United States are held in low risk securities, i.e., money market instruments. Yet in the last two decades even those low risk securities outperformed the DB plan participation security, thus giving even very risk averse DC plan participants higher returns, for a comparable level of risk. Our main hypothesis is that the historical shift into defined benefit plans represents a lifetime investment portfolio readjustment on the part of participants. It leaves workers better off in terms of returns and it appears not to their detriment in terms of risk. Indeed, given greater uncertainty of employment (expressed, e.g., in downsizing by many large American corporations), one can venture a hypothesis that some improvement in their risk profile was achieved.

As is the case with all macroeconomic pronouncements, this one is not easy to prove empirically. Controlled experiments are not possible in the national economy. There are many factors which influence pension behavior of both employees and employers. One could argue that all pension-related decisions are made solely by employers. This work disagrees with that perspective, viewing it as too extreme. As pointed out in several analyses in the book edited by Wise (1985), especially in Wise's own overview and in Lazear (1985), defined benefit plan participation is strongly associated with union membership and with work in large corporations.

Union membership has been in decline in the last two decades, and this can be to a great degree attributed to employees' choices. Also, workers downsized from large corporations do not necessarily pursue employment in other large corporations. They often opt for self-employment and defined contribution plans. Recent introduction of SIMPLE defined contribution plans effective January 1, 1997 reflects the growing needs of that portion of the political constituency.

Therefore, we resolve that in the face of higher returns of capital assets in defined contribution plans, with the same or lower level of risk as the defined benefit plan participation derivative security, shift to defined contributions plans is a movement to a superior security, whose superiority is a function of the decline of importance of wages in the national income. This paper will now attempt to provide empirical justification for this hypothesis.

3. Testing the Hypothesis

It should be noted that given the macroeconomic nature of the data, and impossibility of performing controlled experiments, the power of statistics is limited when dealing with questions such as this one. Nevertheless, statistical relationship of returns to labor versus participation in defined benefit plans, if one exists, may shed some new light on the changes in the relative position of DB and DC plans in the recent history of the United States. To examine such a relationship, one must consider wages and DB plans in an aggregated perspective. If individual wages are not growing, but the share of national income to wages is unchanged, then maybe there are too many workers for significant increases in salaries to occur. But such a situation would typically be temporary. What is proposed here is that a meaningful measure of significance of wages growth is their growth in relation to national income, i.e., the share of national income flowing to wages. We design a test of the hypothesis of the causal relationship between falling relative importance of wages in national income and falling relative importance of defined benefit plans in pensions. We do so by comparing several series of data.

The first two data series which are compared are:

- Portion of all retirement plans assets (or new contributions, or benefits, etc.) in DB plans, and
- Portion of total GDP attributable to labor. This can be derived from National Income and Product Accounts data published in the *Statistical Abstracts of the United States* (1996/1997).

The National Income and Product Accounts express the Gross National Product of the United States from the income side, by providing information about total compensation of employees, including wages and salaries and nonwage compensation (including benefits and social insurance contributions), proprietors' income, and income from capital such as rents, dividends, interest, and corporate income. This national accounting procedure allows for an integrated view of sources of income for Americans, and, from the perspective of this work, is a valuable source of attribution of income to the factors of labor and capital. The hypothesis will be analyzed by regressing the portion of the national income flowing to labor on the portion of pension assets allocated to defined benefit plans, and, in the second analysis, on the portion of new pension contributions flowing to defined benefit plans.

This approach may not fully resolve the problem of the relationship of the two variables (DB pension contributions, or assets, and wages). As already pointed out, macroeconomic approach to pensions brings with it many other questions concerning factors contributing to the changes of the variables analyzed. However this type of analysis has been largely ignored in actuarial literature and it deserves at least some attention.

Figure 9 shows the portion of national income attributed to wages and salaries versus the portion of pension assets in defined benefit plans since 1973. One may argue that wages and salaries do not constitute all of employees' compensation. But from the perspective of this work it is more appropriate to analyze wages and salaries as labor's income, as other compensation does not necessarily affect current pension contributions and incentives of employees (especially for defined benefit plans). For further comparison, Figure 10 shows the portion of national income flowing to total compensation of employees, including proprietors' income (this would be by far the largest measure of income to labor, although it arguably includes items which could be attributable to capital).

Figure 9: The Share of National Income to Wages Versus the Share of Pension Assets to Defined Benefit Plans

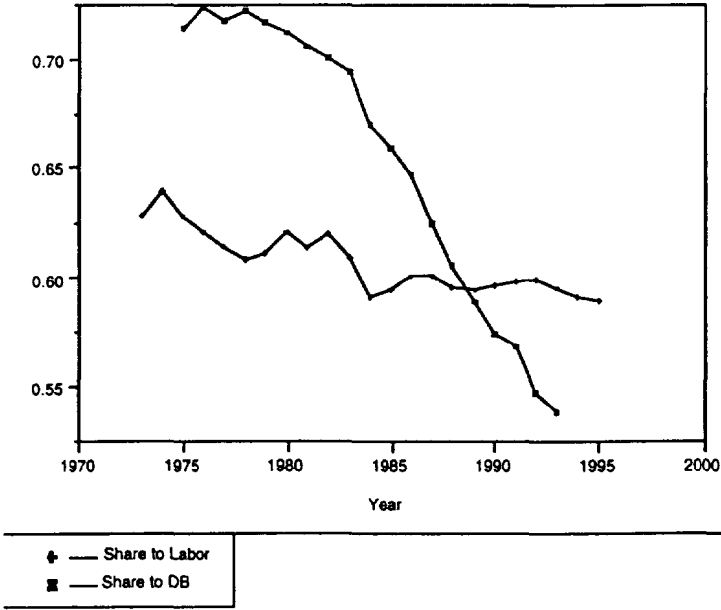


Figure 10: The Share of National Income to Total Employees' Compensation

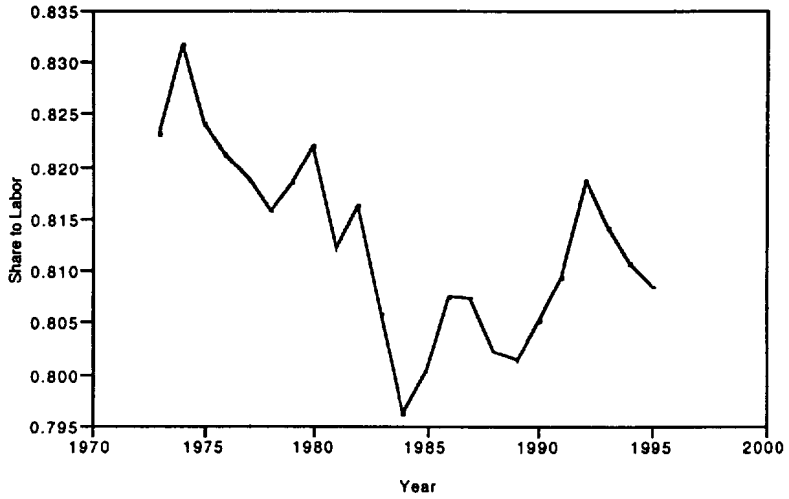
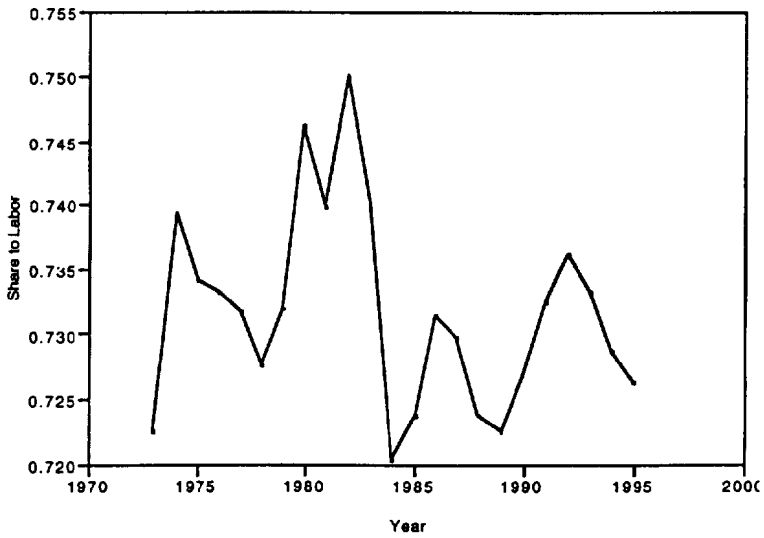


Figure 11: The Share of National Income to Total Employees' Compensation, Excluding Proprietors' Income



One striking difference between the first attribution of the share of national income flowing to labor (wages and salaries only) and the last two (wages and salaries plus benefits plus proprietors' income in Figure 10, and without proprietors' income in Figure 11) is that while wages and salaries have remained firmly in a downward trend established in the 1970s, the other two measures appear to have rebounded after the recession of the early 1980s and may be establishing an upward trend. Yet these measures are typically not included in the wage basis for the calculation of benefit in DB plans. The relative attractiveness of defined benefit plan participation as a security is determined by the growth of what can be termed *pensionable earnings*, and this is typically represented by wages and salaries.

One can see in Figure 9 that the share of national income flowing to wages and salaries appears to be correlated with the share of pension assets in defined benefit plans. Figure 12 shows statistical analysis of the relationship of those two quantities. Some of the results are:

- There is a very strong correlation of the two variables. The linear model is highly statistically significant (alpha level of 0.02%), with R^2 of 57.26%. Both parameters of linear regression are also highly statistically significant.
- Data come in two clusters, with the cluster of lower share to labor representing years 1984-1993. Figure 13 shows nonparametric bivariate kernel density estimates clearly indicating two clusters.
- The strength of the relationship is also illustrated by the bivariate normal ellipses shown in Figure 14 (99%, 95%, 90% and 50% ellipses). Virtually all data fit within the 90% confidence ellipse.
- The residuals of the linear fit are presented in Figure 15

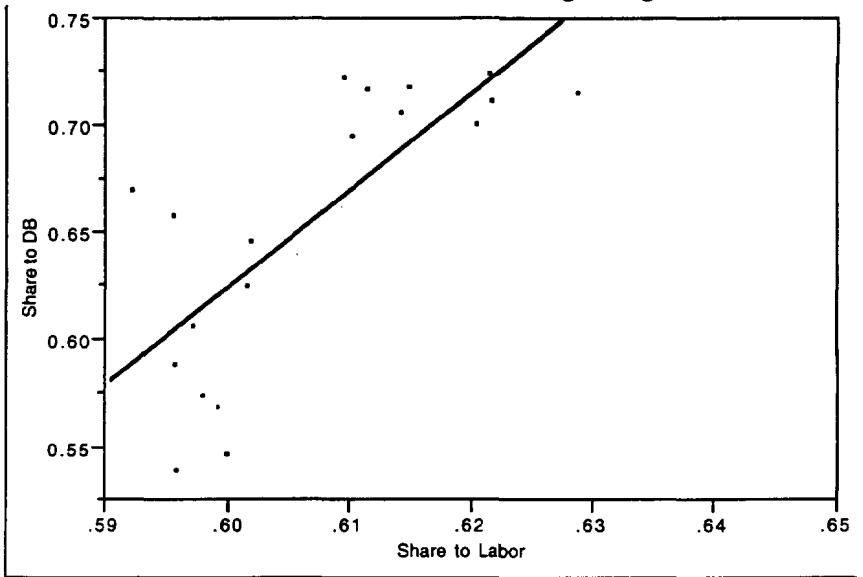
Although the residuals may benefit from more detailed research, it is quite clear that the share of national income flowing to wages and benefits provides some degree of explanatory power for the share of pension assets in defined benefit plans.

One may of course ask if one should not look at new money flowing into defined benefit plans instead of total assets. The response on the part of employees to the economic incentive is probably better represented by new contributions, but assets are an important part of the picture, too, as they represent the wealth of pension plan participants.

Figure 16 shows historical patterns of the share of national income flowing to wages and salaries and new contributions to defined benefit plans. This is followed by statistical analysis (linear regression) in Figure 17. Results indicate an even stronger statistical significance of the relationship, with similar values of R^2 and adjusted R^2 .

Residuals are plotted in Figure 18, while bivariate density plot is shown in Figure 19, and bivariate normal density ellipses (99%, 95%, 90% and 50%) are shown in Figure 20.

Figure 12: Analysis of the Share of Pension Assets in DB Plans versus the Share of National Income Flowing to Wages



— Linear Fit

Linear Fit

Share to DB = -2.0788 + 4.50491 Share to Labor

Summary of Fit

RSquare	0.572565
RSquare Adj	0.547421
Root Mean Square Error	0.044142
Mean of Response	0.654965
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.04437200	0.044372	22.7721
Error	17	0.03312494	0.001949	Prob>F
C Total	18	0.07749694		0.0002

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-2.078756	0.572955	-3.63	0.0021
Share to Labor	4.5049132	0.944028	4.77	0.0002

Figure 13: Nonparametric Bivariate Density Estimate for the Share of Pension Assets in DB Plans versus the Share of National Income Flowing to Wages

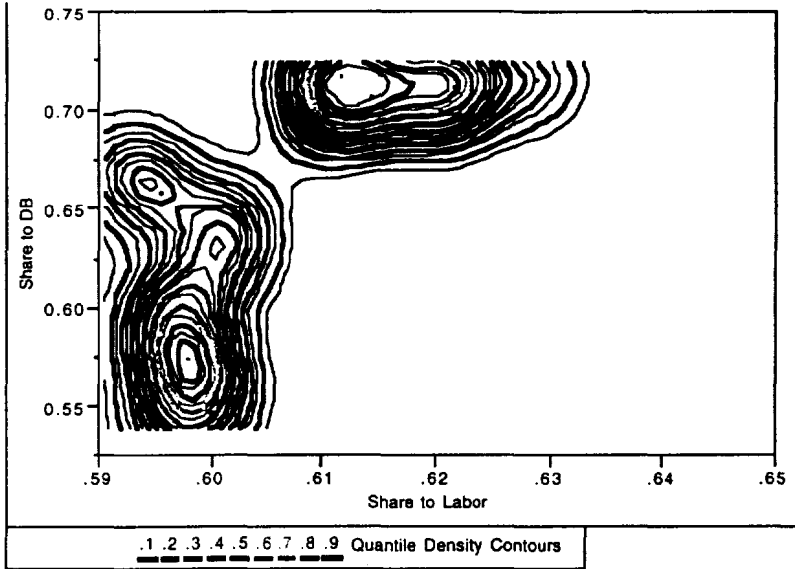


Figure 14: Bivariate Normal Ellipses for the Share of Pension Assets in DB Plans versus the Share of National Income Flowing to Wages

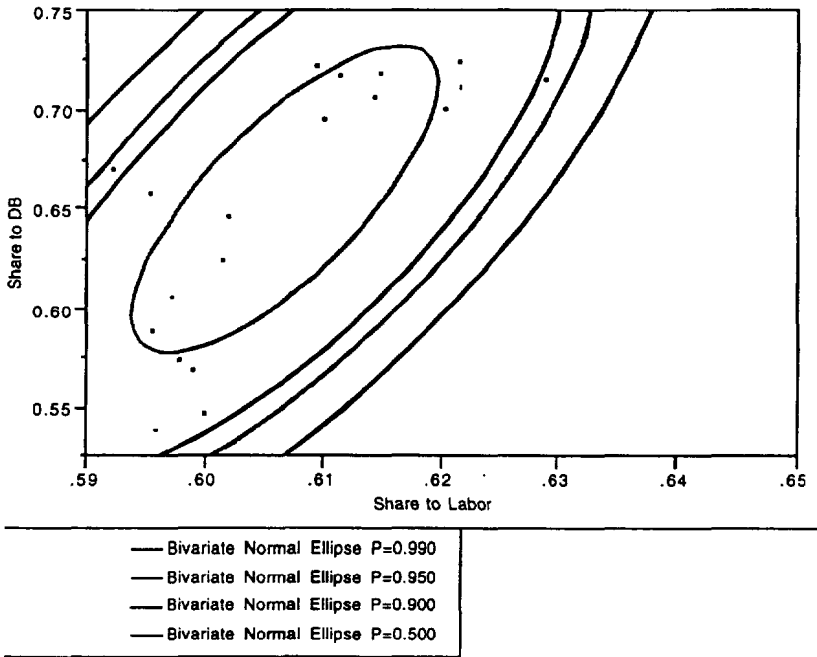


Figure 15: Residuals of the Model Relating the Share of Pension Assets in DB Plans to the Share of National Income Flowing to Wages

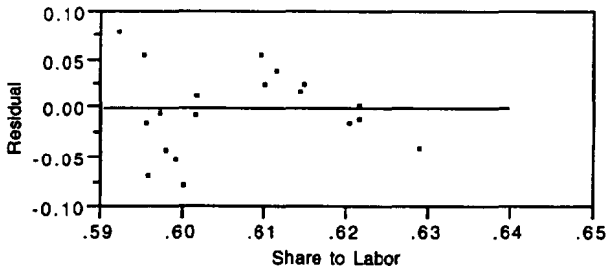
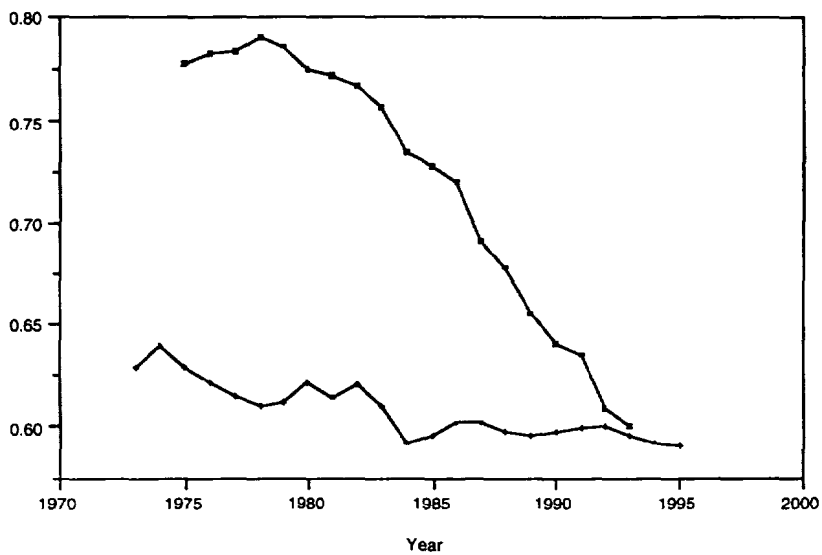
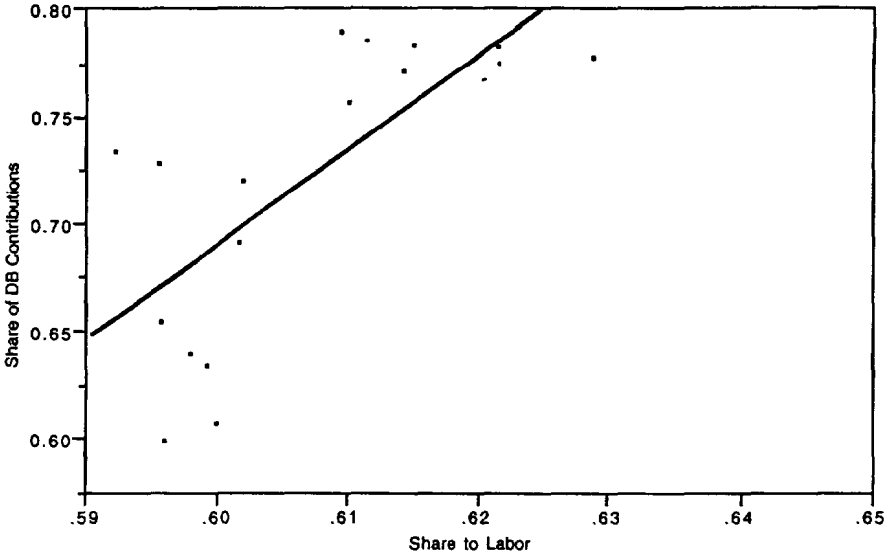


Figure 16: The Share of National Income to Wages versus the Share of Pension Plan Contributions to Defined Benefit Plans



◆ — Share to Labor
■ — Share of DB Contributions

Figure 17: Analysis of the Share of National Income to Wages versus the Share of Pension Plan Contributions to Defined Benefit Plans



— Linear Fit

Linear Fit

Share of DB Contributions = -1.9466 + 4.39519 Share to Labor

Summary of Fit

RSquare	0.545143
RSquare Adj	0.518386
Root Mean Square Error	0.045531
Mean of Response	0.720582
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.04223692	0.042237	20.3744
Error	17	0.03524173	0.002073	Prob>F
C Total	18	0.07747865		0.0003

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-1.946558	0.590979	-3.29	0.0043
Share to Labor	4.3951938	0.973724	4.51	0.0003

Figure 18: Residuals for the Analysis of the Share of National Income to Wages versus the Share of Pension Plan Contributions to Defined Benefit Plans

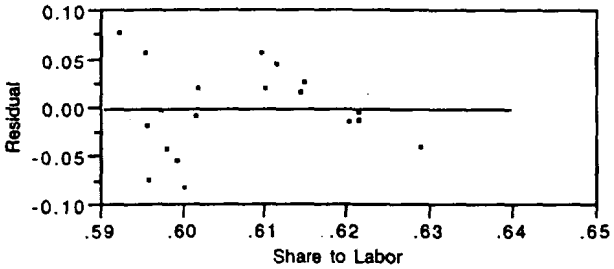
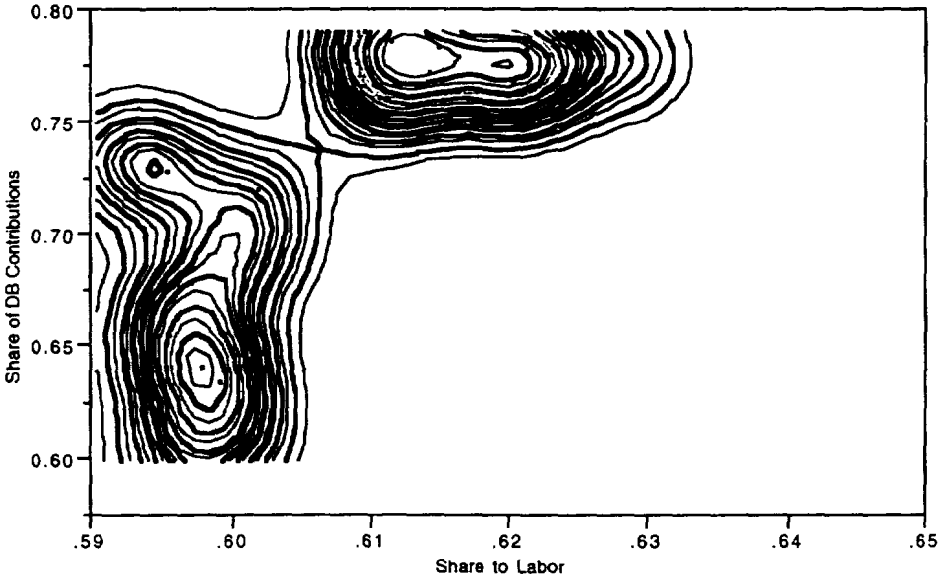
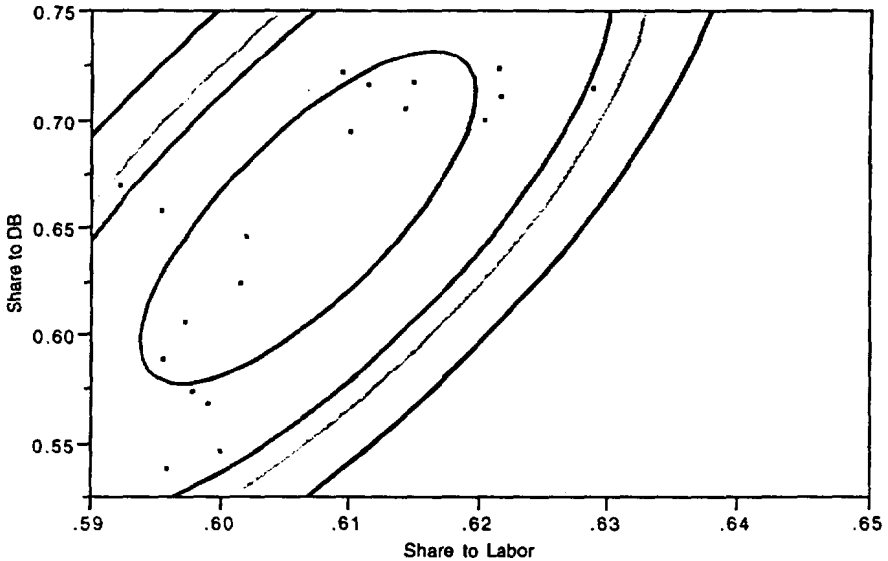


Figure 19: Nonparametric Bivariate Density Estimate for the Share of Pension Contributions to DB Plans versus the Share of National Income Flowing to Wages



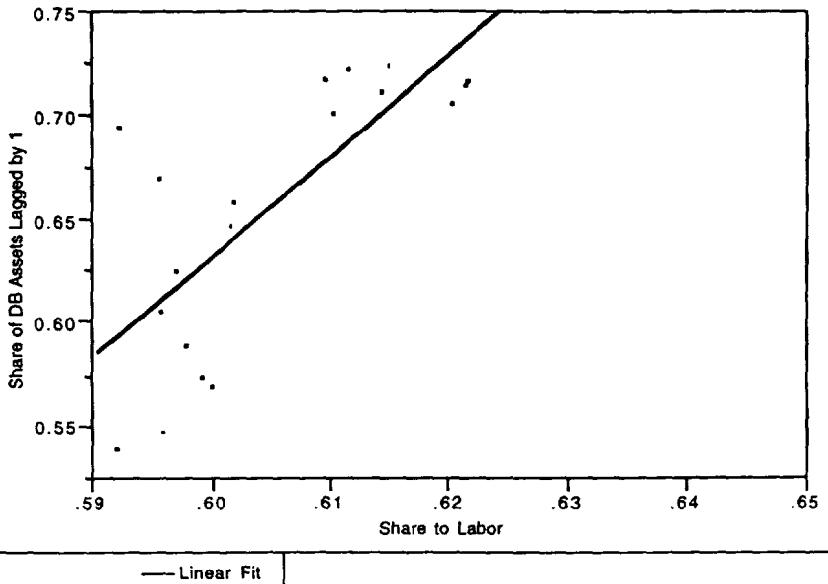
.1 .2 .3 .4 .5 .6 .7 .8 .9 Quantile Density Contours

Figure 20: Bivariate Normal Ellipses for the Share of Pension Contributions to DB Plans versus the Share of National Income Flowing to Wages



Finally, one may venture a hypothesis that people are not as quick to respond to economic incentives as to change their pension contributions, or their employment contract, or their job, as quickly as simultaneous analysis of the variables used would imply. This can be addressed by considering the relationship of the share of DB assets and contributions as a function of the previous year's share of national income flowing to wages, or the year before last, or even further. Analysis of the share of the national income flowing to labor versus DB assets and DB contributions lagged by one and two years in Figures 21, 22, 23, and 24 (let us clarify what is being compared here: defined benefit plans assets as a portion of all pension plan assets in any given year to the portion of national income flowing to wages and salaries in the previous year in the one year lag analysis, and the share to DB in a given year to the share to wages two years back in the two year lag analysis – this is precisely the relationship one would expect if decision makers reactions to economic incentives are delayed). Statistical significance does indeed improve, but only slightly. Since the processes involved here are long term macroeconomic phenomena, there may be lags, but they should not affect greatly the underlying economic trends, and in all cases, with or without lags, one can see statistical significance of the models.

Figure 21: Analysis of the Share of DB Assets in Pension Plan Assets versus the Previous Year's Share of National Income Flowing to Wages



Linear Fit

Share of DB Assets Lagged by 1 = -2.2625 + 4.82306 Share to Labor

Summary of Fit

RSquare	0.554562
RSquare Adj	0.52836
Root Mean Square Error	0.045062
Mean of Response	0.654965
Observations (or Sum Wgts)	19

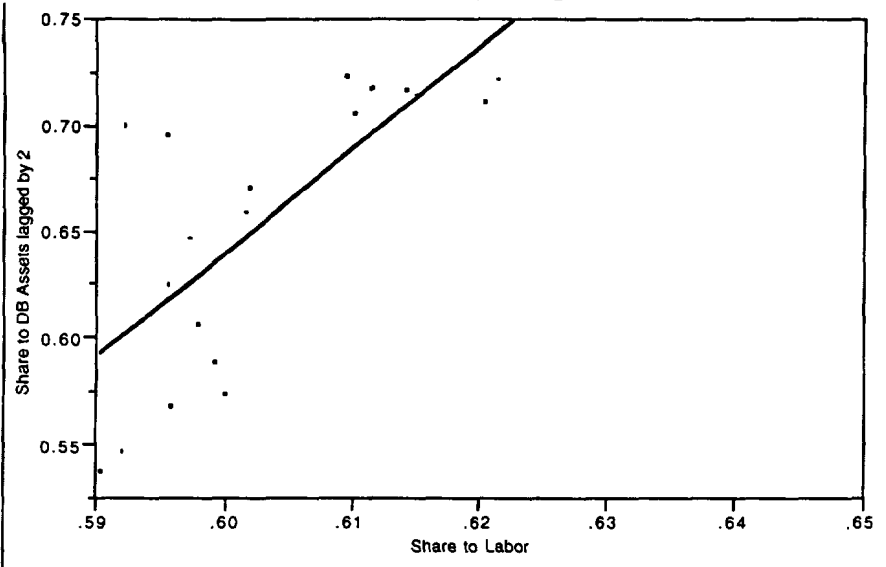
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.04297688	0.042977	21.1647
Error	17	0.03452006	0.002031	Prob>F
C Total	18	0.07749694		0.0003

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-2.262478	0.63424	-3.57	0.0024
Share to Labor	4.8230645	1.048376	4.60	0.0003

Figure 22: Analysis of the Share of DB Assets in Pension Plan Assets versus the Share of National Income Flowing to Wages Two Years Back



— Linear Fit

Linear Fit

Share to DB Assets lagged by 2 = -2.303 + 4.90327 Share to Labor

Summary of Fit

RSquare	0.535914
RSquare Adj	0.508815
Root Mean Square Error	0.045996
Mean of Response	0.654965
Observations (or Sum Wgts)	19

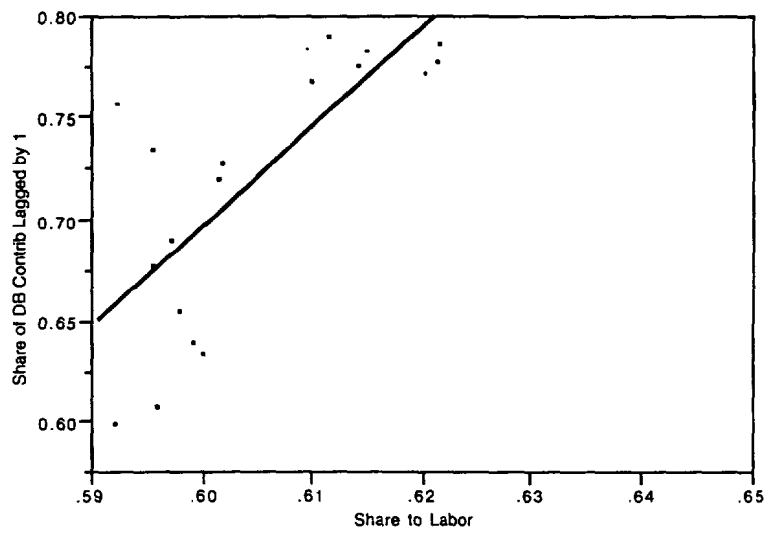
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.04153173	0.041532	19.6312
Error	17	0.03596521	0.002116	Prob>F
C Total	18	0.07749694		0.0004

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-2.303015	0.667692	-3.45	0.0031
Share to Labor	4.9032749	1.106657	4.43	0.0004

Figure 23: Analysis of the Share of DB Contributions in Pension Contributions versus the Previous Year's Share of National Income Flowing to Wages



— Linear Fit

Linear Fit

Share of DB Contrib Lagged by 1 = -2.1937 + 4.8179 Share to Labor

Summary of Fit

RSquare	0.553507
RSquare Adj	0.527243
Root Mean Square Error	0.04511
Mean of Response	0.720582
Observations (or Sum Wgts)	19

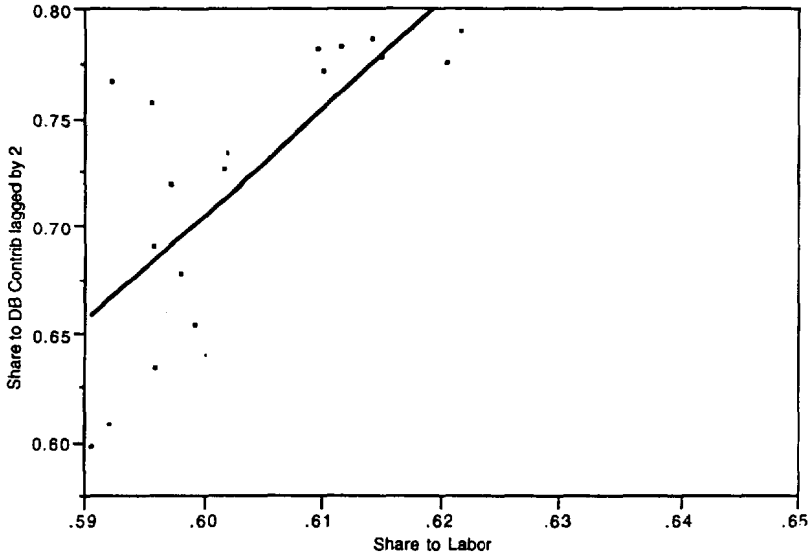
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.04288497	0.042885	21.0745
Error	17	0.03459368	0.002035	Prob>F
C Total	18	0.07747865		0.0003

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-2.193739	0.634916	-3.46	0.0030
Share to Labor	4.8179044	1.049493	4.59	0.0003

Figure 24: Analysis of the Share of DB Contributions in Pension Contributions versus the Share of National Income Flowing to Wages Two Years Back



— Linear Fit

Linear Fit

Share to DB Contrib lagged by 2 = -2.2344 + 4.89839 Share to Labor

Summary of Fit

RSquare	0.534973
RSquare Adj	0.507618
Root Mean Square Error	0.046037
Mean of Response	0.720582
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.04144896	0.041449	19.5570
Error	17	0.03602968	0.002119	Prob>F
C Total	18	0.07747865		0.0004

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-2.234449	0.66829	-3.34	0.0039
Share to Labor	4.8983868	1.107649	4.42	0.0004

Note also that:

- The share of defined benefit plan assets in all plans has a 99.98% correlation to the share of new pension contributions going to defined benefit plans. Even though there was a shift in the relationship of two plan types, contributions previously going to DB were not necessarily redirected to DC plans, but rather newly started plans were apparently mostly of the DC type.
- Share of participant number in defined benefit plans also had very high correlation with the share of total plan assets in DB plans, 89.02%.
- Share of benefits paid by DB plans had even higher correlation with total plan assets share than the share of participants, at 89.27%.

The implication of the above is that the shift away from defined benefit plans appears to have been a comprehensive process, and as this analysis points out, it is strongly correlated with the decline of the share of national income flowing to wages and salaries.

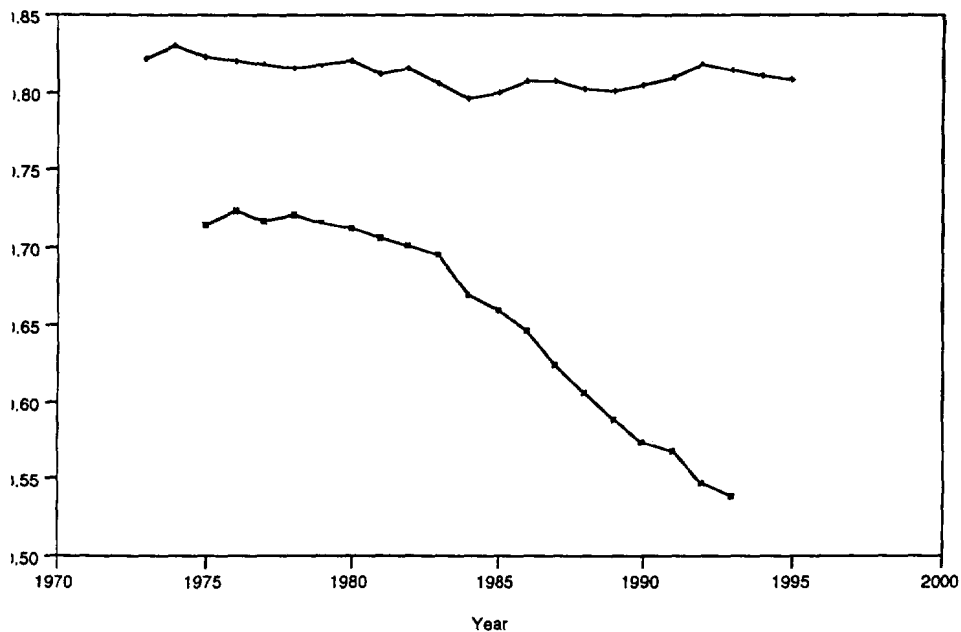
At this point, it seems appropriate to ask one more question: how did the shift out of defined benefit plans correlate with the share of national income flowing to the widely defined compensation of employees, i.e., the share of national income flowing to compensation (wages, salaries and benefits) and proprietors' income. The evolution of the share of national income flowing to total compensation and proprietors income is shown above in Figure 25, and the statistical analysis of these two variable appears in Figure 26.

It has been a long standing contention among some economists (Gwartney and Stroup, 1995, also Surrey, 1976) that the share of national income flowing to labor remains more or less constant over time (as it is in the Cobb-Douglas model discussed earlier in this work). We have seen from previously presented data that this has not been true of the share to wages and salaries. However, as we see in Figure 25, the share to total compensation including proprietors' income, has remained relatively stable in those tumultuous years of the last quarter of a century. In fact, a one-sided t-test of the mean of such a share rejects the null hypothesis of $\mu = 0.80$ in favor of $\mu > 0.80$, but does not reject the null hypothesis of $\mu = 0.81$.

Furthermore, as the statistical analysis in Figure 26 indicates, there is no statistically significant relationship between the portion of national income flowing to total compensation of labor and the portion of pension plan assets in defined benefit plans.

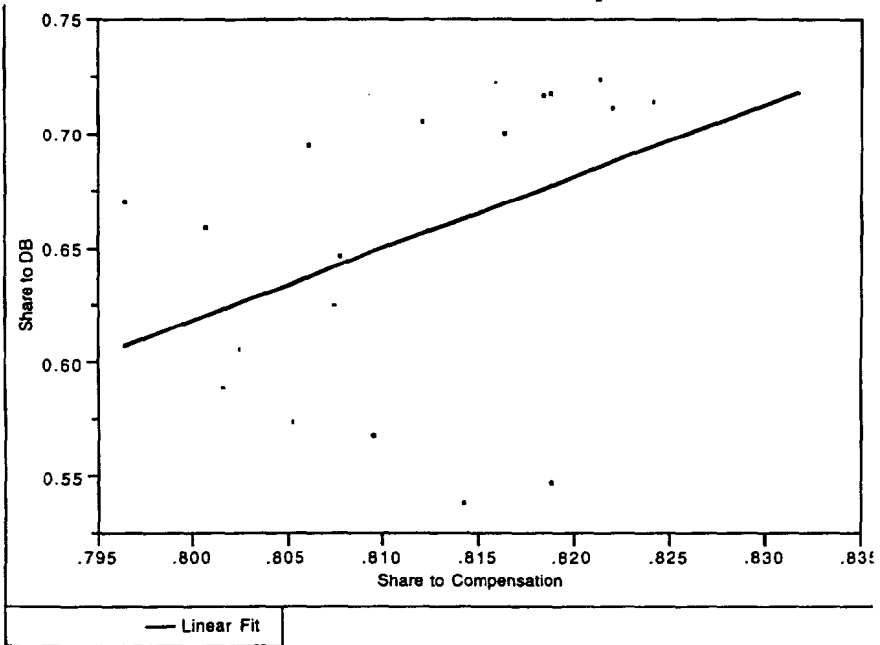
One must of course conclude that the last 25 years have brought about a change in the relationship between total compensation including proprietors' income and wages. Indeed, Figure 27 shows the increasing trend in the share of national income which belongs to total compensation of labor, but does not come from wages.

Figure 25: The Share of National Income to Total Compensation and the Share of Pension Assets in Defined Benefit Plans



+ — Share to Compensation
 x — Share to DB

Figure 26: Analysis of the Share of Pension Assets in Defined Benefit Plans versus the Share of National Income to Total Compensation of Labor



Linear Fit

Share to DB = -1.9 + 3.14821 Share to Compensation

Summary of Fit

RSquare	0.155427
RSquare Adj	0.105747
Root Mean Square Error	0.082049
Mean of Response	0.654965
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.01204515	0.012045	3.1285
Error	17	0.06545179	0.003850	Prob>F
C Total	18	0.07749694		0.0949

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-1.900022	1.444575	-1.32	0.2059
Share to Compensation	3.1482091	1.779893	1.77	0.0949

Figure 27: The Share of National Income which Belongs to Total Compensation of Labor but Is Not Derived from Wages



Conclusions

What is found in this work is that there exists a high degree of correlation between the shift away from defined benefit plans and nearly equally pronounced, but not as often mentioned, shift away from compensating labor in the form of wages. As the emerging forms of compensation do not lend themselves easily to be the basis for deriving a benefit in a DB plan, it would seem natural that different forms of pensions serve the workers who receive their compensation in a different form. It should be stressed, however, that the best we can do at this point is to derive correlations and hypothesize causations. When two random variables, say X and Y , are correlated, this can generally indicate one of the following three alternatives:

- X may cause Y ;
- Y may cause X ;
- Both X and Y may be caused by some third variable, or a combination of variables, which may or may not be included in the analysis.

Nevertheless, this work does point to the importance of wages as an index for defined benefit plans, and to the weakness of that wage index within national income coinciding with the weakness of defined benefit plans. Actuarial scholars and practitioners may benefit from this observation. This correlation may, as we would like to hope, mean causation. It may also mean that both wages and defined benefit plans have been affected by changes in the national economy, the evolving role of government, or changes in risk perception and distribution.

One could even view this analysis as a vindication of the *New Economy Theory*. The defined benefit plan participation derivative security created by DB plans is indexed to wages and salaries, which have declined in their relative importance in national income in this new economy, and have greatly underperformed securities available in the capital markets. This created an incentive to purchase other securities, and economic decision makers appear to have responded to that incentive. Also, workers seem to be paid differently in the new economy, not necessarily in direct wages, but in benefits, including ever more expensive health insurance and forms of participation in capitals, such as defined contribution plans, stock options, and of course income derived from self-employment in sole proprietors' businesses. This is, in fact, another way to express the *New Economy Theory* contention. Does this mean that the *Excessive Regulation Theory* is entirely false? One could answer that to the degree it focuses on some form of bad intentions or conspiracy, it is. However, to the degree that government activities create incentives for economic decision makers, we propose that regulators of pension plans who care about the future of defined benefit plans should take this analysis into consideration. Its implication seems to be that one possible key to the future of defined benefit plans is to make DB plan participation security indexation to wages and salaries attractive again, or to change the method of calculation of benefit to allow for inclusion of capital markets performance. The case for the *Risk Averse Employers Theory* is quite weak, given that even risk-free marketable securities (Treasury Bills) have provided higher growth of capital than wage index.

In any case, we must admit that we may not have a complete solution to the puzzle of the DB plans decline here, but merely a different perspective on this important issue.

Defined benefit pension plan have historically given a valuable safety net to American workers. It would be undesirable from the point of view of public policy to allow them to disappear without providing the workers with some form of substitute to meet their needs. Defined contribution pensions, as attractive as they appear now, have greater inherent uncertainty about the relationship of the pension and the final salary. Receiving insurance against that uncertainty is a benefit which one day may again be desired by many.

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