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## Pension Economics

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## Pension Economics

### Disciplines

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### Comments

The published version of this Working Paper may be found in the 2003 publication: [\*A History of Public Sector Pensions in the United States\*](#).

# **A History of Public Sector Pensions in the United States**

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Pension Research Council  
The Wharton School of the University of Pennsylvania

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## Chapter 2

# Pension Economics

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Formal economic analysis of the incentives that are embedded in pension plans began around 1970. Since that time, labor economists have increasingly turned their attention to explaining the human resource policies of firms and how those policies affect the behavior of workers. Over the past three decades, theoretical and empirical studies have shown that pension plans are an important part of compensation, and employers use pensions to attract, retain, motivate, and retire workers. The history of public sector pensions in the United States shows that government officials and public administrators have understood these aspects of pensions for over two hundred years. This chapter provides a brief, nontechnical review of the modern theory of pension economics. The theory is then used to examine the development of public pensions in the nineteenth century. The parallels between contemporary economic theory and the nineteenth-century application of pensions as a human resource tool are striking, and they provide numerous lessons for today's policy analysts.

There are two basic types of pension plans: defined benefit plans and defined contribution plans. Defined benefit plans promise workers a specified benefit at retirement based on years of service, annual earnings, and/or position in the organization. In defined contribution plans, the employer and/or the worker make periodic contributions to a pension account. Benefits are based on these contributions and the investment returns accrued during the work life.<sup>1</sup> Historically, most public and private pension plans have been defined benefit plans; however, in the last quarter of the twentieth century, there was a pronounced shift away from defined benefit plans and toward increasing utilization of defined contribution plans (Clark and McDermed 1990; Gustman and Steinmeier 1992; EBRI 1997). During the past decade, a number of large companies have converted traditional defined benefit plans into so-called "cash balance" or pension equity plans. [These hybrid plans have some of the characteristics of both defined benefit and defined contribution plans (Clark and Schieber 2002a, b), and they bear some resemblance to the early public sector plans, such as the Massachusetts state plan of 1911 (see above and Chapter 10).]

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The U.S. military pension plans examined in this volume were all defined benefit plans, as were most of the early state and local plans. The initial reliance on defined benefit plans reflects the work and retirement incentives associated with these plans and the limited financial markets that existed during much of the nineteenth century.

### **Defined Benefit Plans**

Today, most defined benefit plans specify a retirement benefit based on years of service with the organization and the worker's final average annual earnings during the last three or five years on the job. Some collectively bargained plans base benefits solely on years of service. Workers must remain with the organization for a sufficient period of time, typically five years, to become vested in the pension plan. Once vested, the worker has a legal claim on future retirement benefits and is entitled to a benefit at the retirement age specified in the plan.<sup>2</sup> This means that the worker can leave the firm prior to the specified retirement age and still receive a benefit in the future.

Most of the early public plans specified a retirement benefit based on the position or rank of the individual. Benefits were usually specified in terms of percentage of monthly pay. In order to receive a retirement benefit, the individual had to remain with the organization for many years, typically 20 to 25 years but often longer. Leaving prior to that time meant that the employee would not receive any benefits. The lack of vesting in these early plans provided a strong incentive for workers to remain on the job until they reached the age of retirement. Since discharged workers could not expect to receive any pension benefits, these plans also provided additional motivation for workers to perform at a high level so they would not be fired. Of course, there were some moral hazards built into the employer's side of these contracts, since employers had an incentive to dismiss workers as they approached retirement age and thus became eligible for pension benefits.

Employer-provided pension plans are a significant component of total employee compensation for covered workers. As such, the value of these plans helps employers to attract high-quality new workers. In addition, workers who have low discount rates will place a higher value on the promise of retirement benefits, and employees who are otherwise more likely to remain with the firm for longer periods of time will place a higher value on the pension plan (Ippolito 1997). Thus, employers can use pension plans to help sort workers based on their propensity to remain on the job. Companies that have relatively high costs of hiring and training workers will want to minimize turnover. These companies are more likely to establish retirement plans that provide incentives for workers to remain with their employer. Thus, pension plans can help firms attract the type of employees they prefer (Salop and Salop 1976).

A simple numerical example can illustrate this point. Suppose a worker is considering two job offers. The first pays only a monthly salary of \$1,000 while the second offers a salary of \$950 per month plus a pension plan of \$250 per month conditional on the worker remaining with the firm for 20 years. These two compensation policies are depicted in Figure 2.1. The present value of this future benefit depends on the interest and discount rates and the probability that the individual remains with the firm until retirement. Workers expecting to leave the firm after only a few years will prefer the first job while workers who expect to remain with the firm for at least 20 years will be more likely to consider accepting the second job offer. By deferring a part of labor compensation, the firm is less likely to attract workers with high probabilities of turnover and more likely to hire individuals who are willing to remain with the firm for a long period of time.

Once employed, workers evaluate the gain from remaining on the job versus moving to another employer or retiring. A key aspect of total compensation is the change in the present value of expected retirement benefits from working an additional year. This is called the benefit accrual. In a legal sense, accruals are zero until the individual becomes vested in the pension; that is, a worker who quits or is fired for nonperformance will not receive any benefit unless he has worked the minimum amount of time required for vesting. Once having been employed for the minimum number of years required to be eligible for a benefit, the worker can leave the firm and ultimately receive a pension. This pension will typically become larger the longer the person stays with the company. These benefit accruals represent a component of annual compensation and are an incentive for the worker to remain with the firm (Ippolito 1985; Kotlikoff and Wise 1989).

Workers may look ahead to the promise of future benefits and calculate the gain in those benefits conditional on remaining with the organization. One of the innovations of modern pension economics was to place these pension expectations within the context of implicit long-term employment contracts (Lazear 1979; Ippolito 1985). These models assume workers can calculate the value of future retirement benefits if they remain with the firm and the value if they quit. Again, this "quit" pension is zero if the worker is not vested. The difference between the pension conditional on remaining with the organization and the pension if the worker quits is the loss in pension wealth associated with changing jobs. The bigger this difference, the less likely workers are to quit (Allen, Clark, and McDermed 1993; Ippolito 1987; Mitchell 1982). For example, a study of federal workers in the last quarter of the twentieth century concludes that the very low turnover rate among federal employees is, at least partly, due to the unusually large pension penalties for leaving the civil service before the age of early retirement (Ippolito 1987).

Once again, a simple example can illustrate the importance of the pension incentive. Assume that a worker earns \$20,000 during the first 20 years

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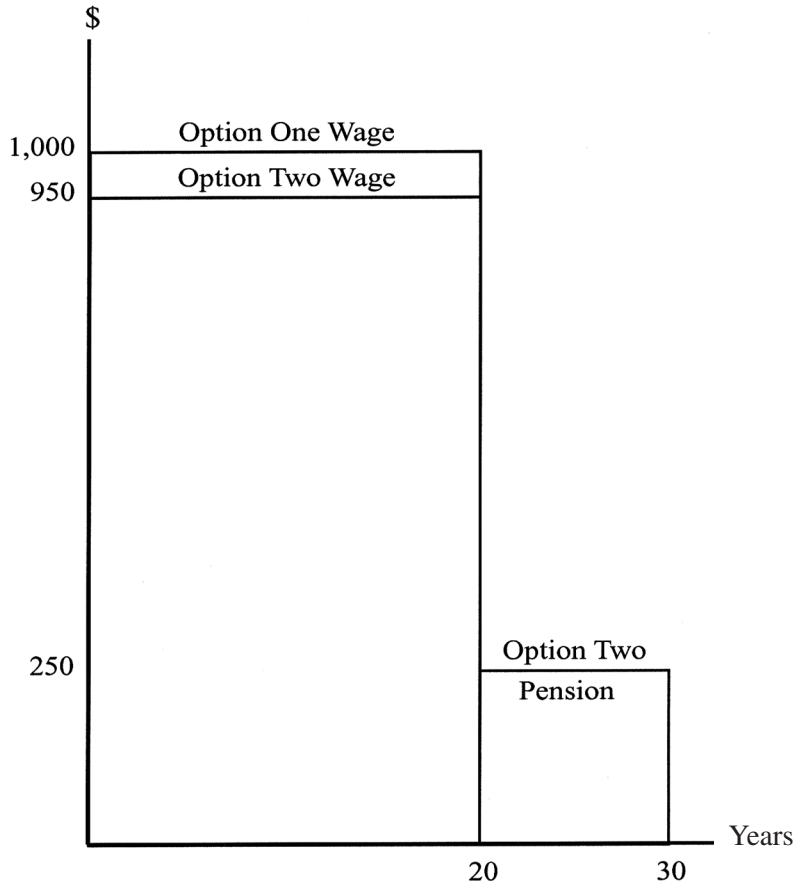


Figure 2.1. Compensation profiles with and without a pension. Two potential earnings profiles illustrate how a firm can use the promise of a pension to reduce turnover. The analysis is based on a 20-year worklife followed by 10 years in retirement, with an interest rate of 3 percent. Compensation option 1 provides a wage of \$1,000 per month; the present value of working for 20 years is \$178,800. Obviously, any worker expecting to leave the firm with less than 20 years of service would prefer option 1.

Option 2 provides \$950 per month plus a pension of \$250 per month conditional on the worker remaining with the firm for 20 years. The worker gives up \$50 per month in exchange for a retirement annuity of \$250. The present value of \$50 per month for 20 years is \$8,940; the present value (at the hire date) of \$250 per month commencing after 20 years and lasting for 10 years is \$14,177. Thus under option 2 the present value of total compensation is \$184,037.



of her working career and \$40,000 over the last 20 years of work. Further assume that her annual earnings will not be affected by changing jobs and all employers offer a defined benefit plan that provides a benefit that is equal to one percent of average earnings over the last five years of employment. A worker who spends all 40 years working for a single firm will have a retirement benefit of \$16,000 per year—that is, 40 years of service times \$40,000 per year in average earnings times 0.01. This last figure, 0.01, is sometimes referred to as the “generosity factor.”

If she changes jobs after 20 years of employment, she will receive two pensions, one from each firm that employed her for 20 years. The pension from the first job would be \$4,000 (20 years of service times \$20,000 times 0.01) and the pension from the second job would be \$8,000 (20 years of service times \$40,000 times 0.01). Thus, her total pension would be \$12,000. This example, which is depicted in Figure 2.2, shows that when earnings are unaffected by a job change and all companies have identical pension plans, a job change can have a significant impact on retirement benefits. It is this potential for loss in the lifetime values of pensions that reduces turnover among pension participants, holding other things constant, of course.

Both the gain in future benefits from continued employment and the loss in pension benefits associated with leaving influence worker behavior. These pension characteristics affect individual decisions concerning which job to accept and, once employed, whether to remain with the organization or seek new employment. Employers can alter the magnitude of these incentives by adopting certain pension provisions. In jobs with high training costs and other turnover costs, employers will want to have lower quit rates. Instituting a pension plan and selecting pension provisions that provide for higher benefit accruals and large losses in benefits if the worker leaves should result in a lower quit rate.

Pensions can also be used to motivate workers to perform at a higher level and to prevent shirking on the job (Becker and Stigler 1974; Lazear 1979). If, for example, a worker is caught shirking, is found to have stolen from the employer, or has a high absence rate, he could be discharged and thus lose retirement benefits. Thus, the same incentives that encourage workers not to quit will provide an incentive to perform at a high level to avoid discharge (Dorsey 1995). Therefore, we would expect lower quit and layoff (discharge) rates in organizations that have adopted defined benefit pension plans, a finding confirmed by much research (Allen, Clark, and McDermed 1993; Cornwell, Dorsey, and Mehrzad 1991; Lazear and Moore 1988). Since firms with lower turnover rates can afford to invest more heavily in the human capital of their employees, *ceteris paribus*, we would expect to see these firms pay higher wages, which is what one finds in practice (Becker 1964; Dorsey and Macpherson 1997; Dorsey, Cornwell, and Macpherson 1998).

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Defined benefit pensions can also alter the incentive to retire at particular ages by providing income to those who have retired and by altering the annual benefit accrual. Today's pensions, as well as many of those in the past, sharply reduce the benefit accrual once the individual has reached the age of eligibility to begin receiving a benefit. Virtually all modern pensions specify both an early and a normal retirement age. The normal retirement age is the age at which workers can retire and receive a benefit based on the regular benefit formula; this is called an "unreduced" benefit. The early retirement age is the earliest age at which a person can receive a benefit.

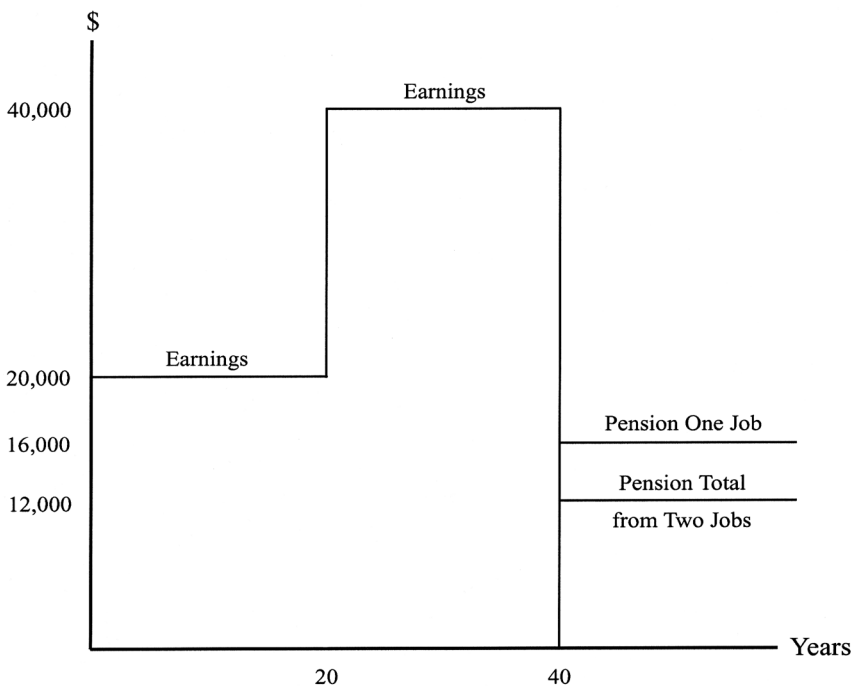


Figure 2.2. Impact of changing jobs on pension benefits. The figure shows annual earnings for a worker who earns \$20,000 per year for the first twenty years of employment and \$40,000 per year for the next 20 years. All employers have a defined benefit pension plan with a benefit formula of 1.0 percent per year of service  $\times$  salary average over the past 5 years.

Total earnings are the same whether the worker remains with the same employer for the full period or changes jobs. The worker who stays with the same employer will have an annual pension benefit of \$16,000 ( $0.01 \times 40 \text{ years} \times \$40,000$ ). The worker who changes jobs after 20 years will receive two pensions totaling \$12,000 annually—\$4,000 from job 1 ( $0.01 \times 20 \text{ years} \times \$20,000$ ) plus \$8,000 from job 2 ( $0.01 \times 20 \text{ years} \times \$40,000$ ). Thus changing jobs once lowers the annual retirement benefit by \$4,000.

Workers retiring at or after the early retirement age but before the normal retirement age receive a reduced benefit. The reduction in the annual benefit is applied because an individual who starts receiving benefits at an earlier age can be expected to receive benefits for a longer period of time than one who retires later. If benefits were actuarially reduced, the present value of the lifetime pension benefits would be the same regardless of the age at which the person retired.

Most pensions in the twenty-first century provide early retirement benefits that are reduced by a factor less than the “actuarial rate.” This means that early retirement is subsidized relative to retirement at the normal retirement age. In other words, the benefit is reduced by less than the amount that is consistent with life expectancy. As a result, these plans provide a strong incentive for workers to retire prior to the normal retirement age. Recent studies examined individual plans with characteristics that resulted in a substantial loss of pension wealth for those who continued to work after the age of early retirement. In some plans, employees lost up to half of the present value of their lifetime pension wealth by working past early retirement up to age 65 (Burkhauser 1979; Fields and Mitchell 1984).

The impact of continued employment on the present value of pension benefits could also be illustrated with a simple numerical example. Consider a pension plan with a normal retirement age of 65 and a benefit formula that specifies that a maximum of 30 years of service can be used to calculate benefits. Benefits are determined as one percent per year of service times the average of the last three years of earnings. A worker reaches age 65 having worked for the company for 30 years. She has been earning \$25,000 per year for the past five years and expects to continue to earn \$25,000 per year if she remains with the firm. This worker expects to die at age 80.

If she retires at age 65, the worker would receive \$7,500 per year for each of the next 15 years before she dies at age 80; however, if she works one more year and then retires at age 66, she would receive the same \$7,500 per year for the next 14 years. Thus, by continuing to work, the employee gives up \$7,500 per year. In a real sense, her total compensation for working at age 65 is not \$25,000 but \$17,500 (i.e., \$25,000 in earnings minus the \$7,500 in pension income forgone). While this example (depicted in Figure 2.3) ignores the potential for future benefits to rise with additional years of service and higher average earnings, it does illustrate the potential for a substantial loss in pension wealth with continued employment. The magnitude of this pension loss depends on various pension characteristics. Firms seeking to provide retirement incentives can adopt plan characteristics that increase the size of the loss in pension wealth with continued employment and can determine the age at which the loss begins.

The decline in pension wealth follows from a dramatic decline in the annual benefit accrual. Benefit accruals prior to reaching the age of early retirement can represent a large component of total compensation. After

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qualifying for early retirement benefits, benefit accruals drop sharply and can become negative (Kotlikoff and Wise 1987, 1989). This drop in total compensation and immediate access to retirement benefits provide strong incentives for employees to retire. Numerous empirical studies have shown that age-specific retirement rates are much higher at these

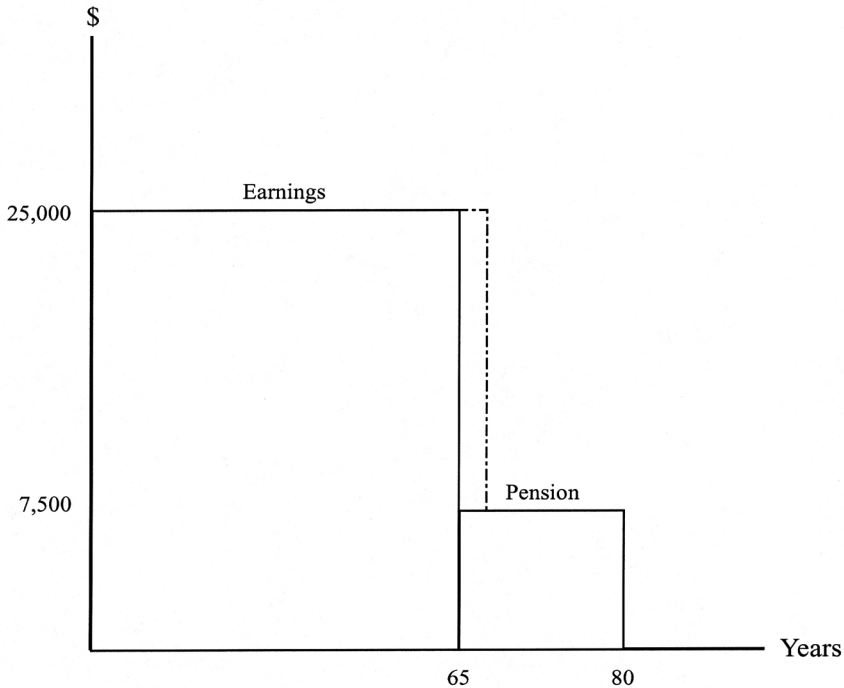


Figure 2.3. Impact of continued employment on pension wealth. A worker is employed at a company with a defined benefit pension plan using a benefit formula of 1.0 percent per year of service  $\times$  salary average over the past 3 years. The plan specifies that a maximum of 30 years can be used in determining retirement benefits, the normal retirement age is 65, and the pension doesn't have an early retirement age. Assume that the worker at age 65 has 30 years of service, has been earning \$25,000 per year for the past 5 years, and expects to earn \$25,000 per year until retirement. The worker expects to die at age 80 regardless of the age of retirement. If retirement occurs at age 65, the worker will receive a pension of \$7,500 per year for 15 years ( $0.01 \times 30 \text{ years} \times \$25,000$ ). If retirement is delayed for 1 year, the worker will receive the same \$7,500, but only for the 14 years of remaining life.

Prior to reaching the normal retirement age, the worker receives \$25,000 in case; moreover, future pension benefits are increasing because of the additional years of service. After the worker passes the normal retirement age, total compensation is now \$25,000 in case minus the \$7,500 in pension benefits forgone. Thus passing the normal retirement age results in a substantial decline in total compensation and presents a strong economic incentive for the worker to retire.

times (Lumsdaine, Stock, and Wise 1994; Kotlikoff and Wise 1989; Quinn, Burkhauser, and Myers 1990). Firms can determine the age at which these incentives become effective, and the size of the incentive, by setting the age of early and normal retirement, the magnitude of the reduction factor, and other pension characteristics. Thus, pensions can be an important human resource management tool for employers seeking to influence the age of retirement of their workforce.

Prior to the middle of the twentieth century, relatively few firms included early retirement provisions in their pension plans (Schieber 2002). Instead, these plans merely specified a normal retirement age and required workers to meet certain age and service qualifications. In these early defined benefit plans, the retirement incentives described above would occur, or “kick in,” at the normal retirement age. In addition, many public employers adopted mandatory retirement policies as part of their early pension plans. The mandatory retirement age was typically age 65, the same age as the normal retirement in their pension plan. Both the army and navy of the United States adopted mandatory retirement during the Civil War period in an effort to purge the officer corps of elderly, senior officers.<sup>3</sup> Of course, these veterans with many years of military service were provided a pension. Thus, the federal government achieved the desired retirement patterns while providing a continuing source of income for its retirees.

Taken together, the development of modern pension economics has demonstrated the financial incentives associated with defined benefit pension plans. Economic theory has been used to indicate the value of future pension benefits and to show how these benefits change with continued employment. Empirical studies indicate that pension-covered workers have lower quit and layoff rates compared to similar workers whose employers do not provide a pension plan. Furthermore, this review of the contemporary literature on pensions suggests that they are optimal or efficient contracts between employers and workers. An optimal or efficient contract is one in which both parties are made better off from the adoption of a pension contract (Craig 1995). Obviously, government policymakers in the nineteenth century were not aware of these economic studies; however, their actions indicate that they understood many of these incentives. The early use of pensions in military organizations is consistent with modern theories of pension economics. Consider, for example that the military is particularly susceptible to the costs of turnover. The jobs are often highly specialized with few private-sector parallels, and a regiment in the field or ship at sea cannot easily replace many of its key personnel. The need to retain these individuals during times of conflict was extremely important to the nation. In addition, it was often necessary to recall discharged veterans to active duty when war broke out. Retirement pensions provided a form of compensation that men simply could not find in civilian employment in the nineteenth century. In addition, the U.S. military was a leader in providing disability

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benefits to its personnel. A man who was about to storm an enemy trench or board an enemy man-of-war could take some comfort in knowing he or his widow would be taken care of should he be wounded or killed in action.

### **Defined Contribution Plans**

Defined contribution plans do not specify an annual benefit at the normal retirement age. Instead, these plans are based on annual contributions to pension accounts, and retirement benefits are determined by the size of the account when the individual converts the account balance into an annuity. Contribution rates tend to be the same percentage of earnings throughout one's career. In general, these plans are more "age neutral" in their effect on worker behavior.

Coverage by a defined contribution plan clearly is an employee benefit with value for workers. These plans can help organizations attract and retain workers. However, defined contribution plans typically do not impose a loss in pension benefits on vested workers who leave the firm prior to early or normal retirement. As a result, organizations with this type of plan will have higher turnover rates compared to those with defined benefit plans. In addition, there are no magic retirement dates in defined contribution plans; so age-specific retirement rates are likely to increase more smoothly in firms with these types of plans.

Until the last quarter of the twentieth century, employers primarily relied on defined benefit pension plans; this is true of almost all the public plans examined in this volume. Over the last three decades, employers, both public and private, have increasingly turned to defined contribution plans. Reasons for this change include new government regulations that have increased the administrative cost of defined benefit plans relative to defined contribution plans (Clark and McDermed 1990), the introduction of new types of defined contribution plans such as 401(k) plans (Papke 1999), and changes in the structure of the U.S. economy. Workers, and perhaps employers too, in the twenty-first century seem to prefer pension plans with individual accounts that are more portable than the benefits in defined benefit plans.<sup>4</sup>

Because defined contribution plans create a fund into which the contributions are placed, they also require assets that can be purchased and placed in the fund. Limited access to immature financial markets is another reason that most nineteenth-century pension plans were defined benefit plans. It would not have been easy for the typical American in the 1800s to invest retirement funds in a timely manner in relatively secure accounts. Mutual funds did not exist, and the occupation of financial planner was unknown. There were fledgling securities markets in major port cities, but for an individual living inland from the East Coast or in rural areas, buying and selling securities would have been very difficult. Although financial

markets developed quickly in the post-revolutionary period, access to these markets remained quite limited for most of the population.

At the time of the Treaty of Paris in 1783, which ended the Revolutionary War, there were essentially no organized stock or bond markets in America. Shortly thereafter, organized financial markets did begin to develop in Philadelphia, New York, Boston, Baltimore, and Charleston. At the end of the war, there were various colonial debt instruments outstanding, such as Loan Office Certificates and Indents. The buying and selling of these instruments was ubiquitous. Alexander Hamilton consolidated the war debt during his term as the first secretary of treasury. This action created about \$60 million of marketable long-term bonds, which were held by the newly created state governments as well as approximately 14,000 individual investors. In other words, only about 0.25 percent of the population owned U.S. government securities. In 1791, the First Bank of the United States was chartered and its stock became actively traded, at least in the major cities. The U.S. bonds and stock of the First Bank were quite actively traded in all of the major markets as well as between markets. In addition, a large portion of U.S. assets was held in London and Amsterdam.

In addition to U.S. bonds and stocks, states eventually began to charter banks, and these new financial institutions sold stock to the public. There were also various canal, toll-bridge, and turnpike companies with outstanding shares of stock that could be purchased by interested investors. The New York Stock & Exchange was formed in 1817 to facilitate the trading of shares of stock. During this period, financial markets were typically limited to the shares of firms in the local area. Integration of these emerging markets took several decades accompanied by improvements in the transportation network and communication, thus reducing the time required for news to move from one market to another.

In 1790, the travel time between New York and Boston was about four days; it required one day to get from Philadelphia to New York and three days from Philadelphia to Baltimore. By 1810, travel time from New York to Boston had been reduced to three days and from New York to Philadelphia to less than 24 hours. Similarly, the time required for information to pass between the major cities continued to decline throughout the nineteenth century. By 1830, a traveler could go between New York and Boston in less than a day and travel time between Philadelphia and New York or Baltimore was less than twelve hours (Pred 1973). Of course, communication with European financial centers still required many days. Travel between Philadelphia and Europe in 1800 took just over two months. Between 1818 and 1832, required travel time fell to about 38 days. The advent of steamships in the middle of the century reduced sailing time to 13 to 22 days (Pred 1973; Officer 1996). Thus the primitive nature of financial markets and financial market information tended to work against the use of defined contribution pension plans.

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The primary or benchmark security in the early republic was federal debt; however, throughout much of this period, the federal government was redeeming its debt, thus further limiting investment options in this already thin financial market. Gradually over the nineteenth century, financial markets expanded with the growth of the American economy while communications and transportation improvements made it possible for economic news to spread more quickly from one market to the other. Financial markets at the end of the century were certainly more mature, integrated, and broader based than those in 1800. Financial innovations continued into the twentieth century, making it easier for workers and firms to adopt and manage defined contribution plans.

### **Early Public Sector Pension Plans**

Pension economics and the use of economic theory to explain the human resource policies of firms are relatively recent innovations. The ensuing chapters illustrate that nineteenth-century policy-makers understood many of the incentives associated with pension plans. Federal government officials developed plans and adopted specific characteristics that helped the military attract, retain, and motivate army and navy personnel and then to retire them in an orderly manner at desired ages. Similarly, leaders of large cities and then state governments began to offer retirement plans to important government workers such as personnel in fire and police departments and school teachers. Pension plans became important components of labor compensation in the public sector and the development of these plans illustrates that employers were aware of the economic incentives associated with pension plans.

As noted above, historically, public employers primarily selected defined benefit plans for their workers. Among these early defined benefit plans were the federal military plans and most of the early state and local pensions. This choice of defined benefit plans may have occurred because the early plan creators and managers recognized the greater quit, performance, and retirement incentives in defined benefit plans compared to defined contribution plans. Another possible explanation for the early use of defined benefit plans is that the typical worker had few if any financial assets and did not want to bear the investment risk associated with defined contribution plans. Furthermore, as noted, the financial markets of the United States in the nineteenth century were rather thin, were concentrated in the larger cities, and were notorious for their maltreatment of small investors. Thus, workers would have had relatively few investment options for their funds in their individual defined contribution accounts. As a result, defined benefit plans would seem to have been the optimal pension plan for nineteenth-century American workers. The review now turns to the history of these plans.



**Notes**

1. McGill et al. (1996) provide a detailed description of these two different types of plans, how they are funded, the rate of benefit accruals, and so forth.

2. Since 1974, the federal government has required minimum vesting standards for tax-qualified pension plans—that is, plans that qualify for the tax exemptions conveyed by federal tax law. Currently, qualified plans must provide for 100 percent vesting after five years of service or use a graded vesting formula that results in full vesting after seven years.

3. Mandatory retirement policies were widely used by large private firms until the last decade of the twentieth century. Mandatory retirement provisions also generally covered public sector jobs. Amendments to the Age Discrimination in Employment Act in 1986 effectively ended the use of mandatory retirement in most jobs.

4. Recently, many large employers have amended their defined benefit plans to include individual accounts and the potential for lump sum distributions (Clark and Schieber 2002 a, b). These hybrid plans have many of the characteristics of defined contribution plans; however, for administrative and funding purposes they are defined benefit plans.