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Company Pension Plans, Stock Market Returns, and Labor Demand

Enrica Detragiache

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Prepared by Enrica Detragiache¹

Authorized for distribution by Robert Ford

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Abstract

The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

With asset values falling sharply in recent years, many companies around the world are under pressure to restore the solvency of their defined-benefit pension plans. Will this lead to higher contributions? Will higher contributions increase labor costs and reduce employment? Does this mechanism exacerbate economic downturns? What are the economic effects of pension fund regulation? This paper develops a theoretical model to address these questions. Although its scope is more general, the model captures the main institutional features of the pension system in the Netherlands, a country where the economic effects of the pension shock are widely debated.

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Author's E-Mail Address: edetragiache@imf.org

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I. INTRODUCTION

Employers compensate their workers through wages and a variety of nonwage benefits, including, importantly, retirement pensions. In some countries company pension plans (the so-called second-pillar pensions) are a substantial fraction of retirement income. From the point of view of the company, pensions are a contingent liability, which is usually financed upfront by contributing to a pension fund. In defined benefit plans, the company guarantees a payout to the pensioner, regardless of the future value of capitalized pension contributions.² In a number of countries, company pension funds have accumulated large amounts of assets over the years (see Table 1) and have become large players in international capital markets. With populations aging and less reliance on pay-as-you-go public pensions in many developed countries, the size of pension funds is expected to increase even further in the future.³

Table 1. Pension Fund Assets as a Percent of GDP in Selected European Countries, 2000	
(In percent)	
France	5
Spain	5
Portugal	12
Belgium	14
Germany	15
Italy	23
Norway	34
Finland	50
Ireland	54
United Kingdom	81
Sweden	96
Netherlands	110
Denmark	115
Switzerland	128
Source: UBS Asset Management.	

² An increasingly common alternative is the defined contribution plan, in which the pension payment depends on contributions and the actual rate of return earned on them. For a theory of the costs and benefits of different types of company pension plans, see Bodie (1990) and Gustman, Mitchell, and Steinmeier (1993).

³ Van Ewijk and others (2000) estimate that pension fund assets will reach 195 percent of GDP in the Netherlands by 2040.

In recent years, pension funds have increasingly invested in risky assets, particularly equity, to take advantage of higher long-run expected returns. While markets boomed in the 1990s, this strategy yielded high returns, the financial position of the funds improved, and funds were able to lower contributions by giving discounts to their members. With sharp declines in stock markets worldwide since 2000, though, the situation reversed, and coverage ratios eroded.⁴ In defined contribution plans, the employees and pensioners bear the losses, while in defined benefit plans the employer must cover the shortfalls. This is forcing companies worldwide to raise contributions or renegotiate pension plans. The former option means additional pressure on firms' balance sheets, which have already been hurt by asset price declines and the recession. Problems are particularly acute in the Netherlands, the United States, the United Kingdom, and Japan (IMF, 2003).

Shortfalls in corporate pension plans have raised several policy issues, such as the transparency of pension fund accounting, the protection of participants against the bankruptcy of the sponsoring company, the interest rate used to discount future pension liabilities, and others.⁵ A particularly interesting question, which has been widely debated in the Netherlands, is the macroeconomic effect of pension fund shortfalls. Will the need to cover pension fund shortfalls lead to higher contributions? Will this translate into higher labor costs and put further pressures on employment? Does this mechanism exacerbate the business cycle? Should regulators exercise forbearance to reduce pro-cyclicality?

The answers to these questions are not obvious. Increasing pension benefits, as with any other form of worker compensation, undoubtedly increases labor costs and lowers labor demand. The current problems at pension funds, however, do not arise from increases in pensions benefits, but from losses on the assets set aside to finance pension obligations already incurred. These losses are sunk costs that should not enter the calculation of the marginal cost of labor affect labor demand. Similarly, it seems intuitively wrong to treat increases in pension fund contributions to meet regulatory coverage ratios as higher labor costs, unless promised pension benefits also become more generous. Yet, regulations forcing firms to finance their pension liabilities in a particular way must have some economic cost.

To shed some light on these issues, this paper develops a theoretical model of a firm with a pension plan. The model is used to study the effects of pension fund solvency regulations and negative shocks to pension fund assets on the employment and investment decisions of the firm. As it turns out, in the case of large firms with individual pension plans, losses on accrued liabilities do not affect the marginal cost of labor. These losses are sunk

⁴ The coverage ratio is the ratio of the assets of the fund to the present discounted value of its liabilities.

⁵ Lynn Coronado and Sharpe (forthcoming) argue that analysts do not “see through the veil” of accounting rules allowing U.S. companies to smooth their pension earnings. As a result, the significant decline in such earnings following the stock market bust is being priced into U.S. equity values only gradually over time.

costs, unaffected by the current labor market behavior of the firm. However, the regulatory requirement that future pension liabilities be funded up front does introduce a distortion: the larger the difference between the internal rate of return of the firm and the expected future return on pension fund assets, the lower is labor demand. In the case of a small firm belonging to an industry-wide pension plan, on the other hand, losses on pension fund asset holdings that cause an increase in contributions indeed raise labor costs and lower labor demand, because these firms do not internalize the budget constraint of the pension fund.

These results suggest that empirical models that treat increases in pension fund contributions, to cover losses on preexisting obligations, as increases in the marginal cost of labor overstate the impact of the “pension shock” on growth and employment, and lead to excessive concerns about the pro-cyclicality of defined-benefit pension schemes.

This paper is organized as follows: after a brief overview of the Dutch pension system and the debate over the “pension shock” in the Netherlands in Section II, a benchmark model with no requirement to prefund pension obligations is presented in Section III; the case of a company with an individual funded pension plan is given in Section IV; and the model of a small firm belonging to an industry-wide pension fund is given in Section V. A brief discussion of the case of imperfect capital and labor markets follows in Section VI. Section VII concludes.

II. THE PENSION SHOCK IN THE NETHERLANDS

In the Netherlands, although employers are not obliged to offer a pension benefit, over 90 percent of workers are covered by occupational pension plans.⁶ This is partly the result of the administrative extension of branch-level collective wage agreements between the unions and employers’ organizations to all industry members. Second-pillar pensions account for about 40 percent of retirement income. First-pillar, public pensions account for another 40 percent, while the remaining 20 percent consists of private individual pensions (Carey, 2002).

Pension funds are legal entities separate from the companies that sponsor them and are often organized on a sectorwide basis.⁷ Individual company funds represent around 40 percent of private sector pension fund assets, with sectorwide funds accounting for the rest.⁸ Representatives of employers, workers, and pensioners sit on the board of directors.

⁶ For a comprehensive overview of the Dutch pension system, see Kremers (2002).

⁷ Thus, the accounts of company pension funds are completely separate from those of the sponsoring company. By contrast, in the United States and the United Kingdom, pension funds are typically part of the sponsoring company, and the accounts of the two entities are consolidated.

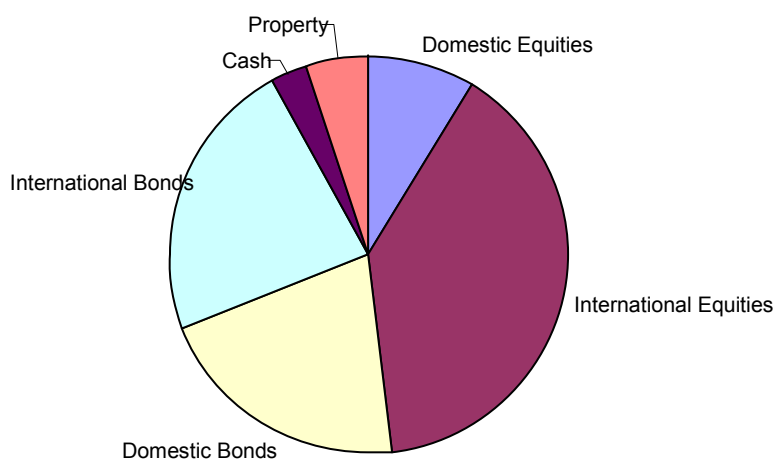
⁸ Civil servants and health care workers have their own pension funds, accounting for about 20 percent of second-pillar pension fund assets.

While this structure allows for risk-sharing within the sector, it virtually eliminates any potential competition among funds (van Ewijk and van de Ven, 2003).

Another important feature of Dutch second-pillar pensions is that 97 percent of the plans are of the defined benefit type.⁹ For a majority of workers (54.5 percent), benefits are based on the wage in the final year of work, while for 31.8 percent they are based on average pay. Pensions in payment are usually indexed to wages or, less often, to prices, but indexation is typically conditional on the financial health of the fund. Over the years, however, Dutch workers have come to expect full pension indexation. Pension contributions are, on average, 11 percent of gross wages, with employers typically paying two-thirds of the total.

By the end of the 1990s, Dutch pension fund had built up a substantial investment in equities, to take advantage of higher long-run returns (see Figure 1 below). After years of double-digit gains, returns turned negative in 2000, and have not recovered since. As a result, the average coverage ratio declined from a peak of over 130 percent in 1999 to around 105 percent in 2002, and a number of individual funds now fall short of 100 percent coverage (van Ewijk and van de Ven, 2003).

Figure 1. Asset Allocation of Dutch Pension Funds, End-2000



Source: UBS Asset Management.

⁹ By way of comparison, in the United States more than two-thirds of firms in the S&P 500 index have a defined benefit plan (Lynn Coronado and Sharpe, forthcoming). In the United Kingdom, about 85 percent of pension plans are of a defined benefit type (Association of British Insurers, 2000). In both countries the trend has been to switch to defined contribution plans.

To address the problem, funds began to increase contributions and considered limiting indexation. Concerned that this process was not sufficiently fast, the Dutch insurance and pension supervisor (PVK) clarified and strengthened coverage requirements in September 2002. Under these new rules, coverage must remain at or above 105 percent and additional buffers must be held—to ensure solvency in the case of a 40 percent decline in equity values relative to the peak in the previous 48 months, or a 10 percent decline from the lowest value in the last 12 months. A similar requirement applies to declines in bond values. To avoid abrupt increases in contributions, the PVK has given funds eight years to reach full compliance with the additional buffers. Nonetheless, employers reacted negatively to the new measures, pointing out that they would have large adverse effects on corporate balance sheets and labor costs, resulting in a further worsening of the competitiveness of Dutch producers.

More generally, the macroeconomic and fiscal impact of pension fund shortfalls has featured prominently in recent discussions on the Dutch economy. A serious concern is that pension funding costs will aggravate the current economic downturn and delay recovery. The Dutch central bank recently estimated that higher employer pension contributions would increase unit labor costs in the private sector by 0.8 percentage points in both 2003 and 2004, after having increased them by 0.7 percentage points in 2002 (DNB, 2002). The bank also stressed that higher employee contributions would reduce disposable income, resulting in lower consumption.

The Netherlands Bureau of Economic Policy Analysis (CPB), a government economic research institute, has also repeatedly pointed out that higher pension contributions will lower profits and disposable income and increase labor costs, resulting in lower economic growth. The Bureau estimates that to comply with the PVK buffers a coverage ratio of around 130 percent is needed. To reach such a coverage rate in the absence of pension reform, average contributions would have to rise from the current 11 percent of gross wages to 15 percent. This would result in higher labor costs, lower employment, and lower GDP (see Table 2). In addition, since contributions are tax exempt and, furthermore, the government needs to fund shortfalls in its own pension fund, tax revenues will be lower and outlays higher, resulting in a deterioration of the fiscal balance

Table 2. Economic Effects of the Pension Shock, 2002–07	
	Cumulative change in percentage points
Labor costs (private sector)	1.3
Employment (private sector)	-0.8
GDP	-1.2
General government balance	-1.3
Source: van Ewijk and van der Ven, 2003.	

The CPB has also raised the question of whether it would be desirable to limit equity investment by pension funds. With the current asset structure, contributions rise in periods of falling asset prices, which often coincide with economic downturns, thereby exacerbating the cycle. This also makes the tax and contribution wedge highly variable, contrary to principles of optimal taxation.

The next section explores the connection between pension fund losses and labor demand in a basic model of a competitive firm facing perfect capital and labor markets.

III. THE BENCHMARK MODEL

In the benchmark model the firm pays a portion of the worker's salary as deferred compensation, i.e. after the worker retires. The firm can precommit to pay the pension even if it later goes bankrupt. Hence, with full information and rationality, there is no reason to impose regulatory constraints on funding. As in conventional models, the firm is assumed to be perfectly competitive in product and factor markets. Also, implicit in this specification is that the firm has full access to capital markets and there are no information imperfections or other distortions, so that the production decisions of the firm are separate from the financial decisions.¹⁰

The production technology is represented by a standard neoclassical production function $f(k_t, l_t)$, where k_t is capital (assumed, for simplicity, to depreciate fully after one period) and l_t is labor. The firm maximizes the present discounted value of future profits by choosing the capital and labor input. The rental rate on capital is r_t , and the rate at which the firms discount future profits is $\beta < 1$. Employees receive a wage w_t when they work and a pension λw_t when they retire, so that λ is the replacement ratio. For simplicity, it is assumed that each worker spends one year in employment and one year in retirement, so that the entire labor force turns over each period.¹¹ The profit maximization problem is

$$\max_{\{k_t\}_{t=1}^{\infty}, \{l_t\}_{t=1}^{\infty}} \sum_{t=1}^{\infty} \beta^t [f(k_t, l_t) - r_t k_t - w_t l_t - \lambda w_{t-1} l_{t-1}] .$$

Let $V(l_{t-1})$ be the maximum profit at period t . Then, at any t , this value function must satisfy the following Bellman equation

$$V(l_{t-1}) = \max_{k_t, l_t} f(k_t, l_t) - r_t k_t - w_t l_t - \lambda w_{t-1} l_{t-1} + \beta V(l_t).$$

The necessary first-order conditions are

¹⁰ The case of imperfect capital markets is discussed in Section V.

¹¹ This model can be easily adapted to the case of uncertain survival. If h is the probability of surviving in the second period, then the expected pension is $h \lambda w_t$. Other factors that make the pension payment uncertain in practice—such as the fact that benefits depend on the wage in the last years before retirement rather than the current wage, that benefits may be only partially indexed to inflation, or may be indexed to wage developments over the retirement period—would be more complex to integrate into the model.

$$\begin{aligned}\partial f / \partial l_t &= w_t + \beta \frac{\partial V(l_t)}{\partial l_t} = w_t (1 + \beta \lambda), \\ \partial f / \partial k_t &= r_t.\end{aligned}$$

Thus, the marginal cost of labor is simply the current wage plus the (discounted) deferred compensation.

Result 1. With no regulation requiring prefunding of pensions, labor demand depends on the wage rate and the discounted value of the benefits promised to workers.

IV. A FUNDED COMPANY PENSION PLAN

Suppose now that the company cannot precommit to pay out pensions in case of bankruptcy. To protect pensioners, the regulator mandates that pension liabilities be funded up front.¹² In particular, the case of an autonomous fund financed by contributions from the firm is considered.¹³ The fund must abide by a regulatory solvency requirement stating that the market value of its assets A_t must be at least equal to x times the present discounted value of its liabilities. The parameter x is the coverage ratio, thus $x=1$ corresponds to a fully funded plan. The present discounted value of liabilities is computed using the actuarial discount rate $q < 1$.¹⁴ Each period, the pension fund administrators set the level of contributions c_t so that the solvency requirement is met.¹⁵ The fund resources are invested in a risky asset paying a gross return ρ_t every year. ρ_t is the realization of a first-order, Markov, stochastic process, such that $\rho_t \in P$ and $\Pr(\rho_t \leq \rho \mid \rho_{t-1} = \rho') = G(\rho, \rho')$. Under these assumptions, the present discounted value of the firm's profits is

¹² The funding requirement may be enforced by making it a necessary condition for the pension plan to receive favorable tax treatment.

¹³ In practice, workers may pay some of the contributions, but this is immaterial to the extent that the firm is a price-taker in the labor market. See Section V below for a discussion of imperfect labor markets.

¹⁴ In the Netherlands, the regulator mandates that the actuarial interest rate must not exceed 4 percent, hence q cannot be less than 0.96. In the United Kingdom, newly introduced accounting rules mandate the rate to be that on AA-rated corporate bonds, while in the United States it is the rate on the 30-year U.S. treasury bond.

¹⁵ In practice, Dutch pension funds are prohibited by their statutes from raising contributions by more than a given amount in each year, so that the return to the regulatory level of coverage may be gradual over time. Also, as discussed in Section II, the values of the funds often exceed the regulatory minimum, but this possibility is ignored here for simplicity.

$$E_o \sum_{t=0}^{\infty} \beta^t [f(k_t, l_t) - r_t k_t - (w_t + c_t) l_t] . \quad (1)$$

The dynamic of the pension fund assets is given by the following equation:

$$A_{t+1} = A_t \rho_t + c_t l_t - \lambda w_{t-1} l_{t-1}, \quad (2)$$

while the solvency constraint for the pension fund is

$$A_{t+1} = xq\lambda w_t l_t \forall \rho_t \in P \text{ and } \forall t.$$

Combining the last two equations, contributions to the pension fund are

$$c_t l_t = xq\lambda w_t l_t + \lambda w_{t-1} l_{t-1} (1 - xq\rho_t). \quad (3)$$

The first term is the amount needed to provision against new pension liabilities, while the second is the difference between what is paid to pensioners in the current period and the funding already set aside to cover that payment. The first term is a function of the current wage bill, while the second depends only on past hiring decisions. Naturally, contributions are decreasing in the realized return on the pension fund assets. Substituting (3) into (1), the profit maximization problem of the firm becomes

$$\max_{\{k_t\}_{t=1}^{\infty}, \{l_t\}_{t=1}^{\infty}} E_o \sum_{t=1}^{\infty} \beta^t [f(k_t, l_t) - r_t k_t - w_t l_t (1 + xq\lambda) - \lambda w_{t-1} l_{t-1} (1 - xq\rho_t)] ,$$

and the Bellman equation is

$$V(l_{t-1}, \rho_t) = \max_{k_t, l_t} f(k_t, l_t) - r_t k_t - w_t l_t (1 + xq\lambda) - \lambda w_{t-1} l_{t-1} (1 - xq\rho_t) + \beta E_t \max[0, V(l_t, \rho_{t+1})].$$

This expression explicitly recognizes the possibility that the firm may choose to close down rather than continue at time t .¹⁶ Let $\rho^r(l_{t-1})$ be the value of the financial shock for which the firm is exactly indifferent between staying in business or shutting down. Then, $P_t^r = \{ \rho \mid \rho \geq \rho^r(l_{t-1}) \}$ is the set of all realizations of the shock for which the firm chooses to remain in

¹⁶ In the Netherlands, workers have no recourse against the assets of the sponsoring firm in cases where the firm is bankrupt and the plan is underfunded. This contrasts with the United States, where benefits are, in part, guaranteed by the Pension Benefit Guarantee Corporation. The United Kingdom is considering introducing pension insurance.

business. Denoting a E_t^r expectation taken over this set, the necessary first-order conditions for profit maximization are¹⁷

$$\partial f / \partial l_t = w_t + xq\lambda w_t - \beta E_t^r \frac{\partial V(l_t, \rho_{t+1})}{\partial l_t} = w_t (1 + \beta\lambda) + xq\lambda w_t (1 - \beta E_t^r (\rho_{t+1})), \quad (4)$$

$$\partial f / \partial k_t = r_t. \quad (5)$$

These equations show that pension fund regulation and the financial performance of the fund do not affect the marginal cost of capital but may affect the marginal cost of labor. This is reflected by the second term in (4), which is the opportunity cost to the firm of setting aside resources in the pension fund. If the firm's discount rate was equal to the expected return on pension fund assets ($1/\beta = E_t^r \rho_{t+1}$), then the marginal cost of labor is just $(1 + \beta\lambda)w_t$, as in the benchmark model in Section III.¹⁸ When $1/\beta > E_t^r \rho_{t+1}$, however, hiring more workers means setting aside more funds in the pension fund, an inferior investment opportunity. This increases labor costs and reduces the demand for labor. This distortion, which could be called the “regulatory wedge,” is increasing in the regulatory coverage ratio x , the actuarial discount factor q , and the replacement rate λ . On the other hand, the higher the return on pension fund assets, the smaller is the wedge.

Comparing (4) with (3) also reveals that the marginal cost of labor is generally *not* equal to the wage rate plus the contribution to the pension fund ($w_t + c_t$). This is the case because the level of contribution reflects not only the additional pension liability that the firm incurs by hiring one additional worker, but also charges or discounts on liabilities related to pension rights already matured. The latter are sunk costs, and do not enter the labor demand decision of the firm.

Result 2. Regulation forcing firms to prefund pension obligations increases the marginal cost of labor if the expected returns on the pension fund assets is smaller than the internal rate of return for the firm. The marginal cost of labor is generally *not* the sum of the wage rate and the contribution to the pension fund

Labor demand and shocks to asset prices

A key implication of equation (4) is that if the stochastic process for the asset return is independently and identically distributed (i.i.d.), then the marginal cost of labor (and hence

¹⁷ The boundary of P_{t+1}^r is a function of l_t , but since $V(l_t, \rho_{t+1})=0$ for $\rho_{t+1} = \rho^r(l_t)$ this can be ignored in computing $\partial V / \partial l_t$.

¹⁸ On the interpretation of β in a general equilibrium framework, see, for instance, Blanchard and Fischer (1989), Chapter 6.

labor demand) is independent of ρ_t , the current realization of the pension fund return. This is the case even though a low asset return forces the firm to increase contributions to maintain the fund's solvency, creating the impression that labor costs have increased. On the other hand, if the shocks are not i.i.d., an adverse shock today would induce the firm to revise (presumably down) how much it expects to earn on the pension fund assets *next period*. This increases the regulatory wedge, and hence the marginal cost of labor. If the news also induces the firm to revise down its internal rate of return, however, the effect of a negative shock on pension fund returns may be small or nil.

Result 3. Losses on pension fund asset holdings do not affect labor demand. However, if low asset returns cause the firm to lower its expectation of future returns, then the opportunity cost of pension fund regulation increases, pushing up the marginal cost of labor.

Even when they do not change the *marginal* cost of labor and capital, financial losses or gains on pension fund assets do affect the *level* of profits. In terms of the model, the maximum level of profits $V(l_{t-1}, \rho_t)$ is indeed an increasing function of the current realization of the shock ρ_t . Indeed, if ρ_t is low enough $V(l_{t-1}, \rho_t)$ may be negative, and the firm may be better off closing down. If the pension fund happens to be underfunded in that period, pensioners will lose part of their pension.¹⁹ If these firms are a nonnegligible segment of the market, then aggregate labor demand may be negatively affected by financial losses on pension fund investments (and so will the aggregate demand for capital), even if the regulatory wedge does not change.

Result 4. Financial losses on pension funds may reduce *aggregate* factor demand because they may cause some firms to close down.

The effects of a higher coverage ratio

From (4), the effect of a higher regulatory coverage ratio on the marginal cost of labor is

$$\frac{dMCL_t}{dx} = q\lambda w_t (1 - \beta E_t^r(\rho_{t+1})), \quad (6)$$

which is positive in the realistic case in which the internal rate of return of the firm is higher than the expected return on pension fund assets ($1 > \beta E_t^r(\rho_{t+1})$). Accordingly, a higher coverage ratio reduces labor demand. However, the effect is smaller than the increase in the contribution rate necessary to comply with the higher coverage ratio. To see this, using equations (3) and (4), the increase in contributions is

¹⁹ This is why regulators may require pension funds to be over funded ($x > 1$). Of course, in practice, shocks other than pension fund returns affect a firm's profitability and, hence, its decision to stay in business.

$$\frac{dc_t}{dx} = q\lambda w_t - \frac{1}{(l_t)^2} w_{t-1} l_{t-1} (1 - xq\rho_t) \left(\frac{dl_t}{dx} \right). \quad (7)$$

In the realistic case in which $1 > \beta E_t^r(\rho_{t+1})$, dl_t/dx is negative, labor demand falls as the coverage ratio increases, and

$$\frac{\frac{dc_t}{dx}}{\frac{dMCL_t}{dx}} = \frac{q\lambda w_t - (1/l_t)^2 w_{t-1} l_{t-1} (1 - xq\rho_t) (dl_t/dx)}{q\lambda w_t [1 - \beta E_t^r \rho_{t+1}]} > \frac{1}{1 - \beta E_t^r \rho_{t+1}} > 1.$$

The difference between the increase in contributions and the marginal cost of labor can be quite substantial. Consider a case in which the firm's internal rate of return is 15 percent (so $\beta=0.87$) and the expected return on the pension fund assets is 5 percent. Then, $1 - \beta E_t^r(\rho_{t+1})=0.09$ and the increase in the marginal cost of labor is only 9 percent of the increase in contributions.

Result 5. If pension fund regulation is costly to the firm, an increase in the regulatory coverage ratio increases labor cost and reduces labor demand. The associated increase in the marginal cost of labor, however, is much smaller than the increase in pension fund contributions necessary to meet the higher coverage ratio.

V. A SMALL COMPANY IN A FUNDED INDUSTRY PENSION PLAN

For small companies, setting up individual pension plans can be very expensive because of high, fixed, administrative costs or because the size of the workforce may be too small to diversify survival and other risks. Thus, small and medium-size firms may choose to participate in sectorwide pension funds. To analyze this case, the extreme assumption is made that firms are atomistic. In addition, the pension fund is assumed to be subject to the same regulatory constraints as the individual company fund examined above, and to levy contributions proportional to the current wage bill of each member firm. Let the sector consist of a continuum of identical firms, indexed by i . $\mu(i): I \rightarrow [0, 1]$ is the measure of firms of type i , and $l_t(i)$ is labor demand of firm i , and similarly for capital. Finally, let total employment in the sector be defined as

$$L_t \equiv \int_I l_t(i) \mu(i) di.$$

Then, the dynamic of pension fund assets is described by

$$A_{t+1} = A_t \rho_t + c_t L_t - \lambda w_{t-1} L_{t-1} = xq\lambda w_t L_t \forall \rho_t \in P \text{ and } \forall t, \quad (8)$$

and the solvency constraint for the sector-wide pension fund is

$$A_{t+1} = xq\lambda w_t L_t \forall \rho_t \in P \text{ and } \forall t.$$

The contribution rate must satisfy

$$c_t \equiv c(L_{t-1}, L_t, \rho_t) = xq\lambda w_t + \lambda w_{t-1} (L_{t-1} / L_t) (1 - xq\rho_t), \quad (9)$$

while the cost of funding pension for the individual firm is

$$c_t l_t = xq\lambda w_t l_t + l_t \lambda w_{t-1} (L_{t-1} / L_t) (1 - xq\rho_t). \quad (10)$$

In contrast with the case of an individual company plan, cutting back on employment not only reduces what the firm has to contribute to the fund to cover new obligations, but it also reduces the transfers that the firm must make to offset losses on past obligations. The Bellman equation for the firm becomes

$$V(\rho_t) = \max_{k_t, l_t} f(k_t, l_t) - r_t k_t - [c(L_{t-1}, L_t, \rho_t) + w_t] l_t + \beta E_t \max[0, V(\rho_{t+1})].$$

The first order conditions for profit maximization are

$$\begin{aligned} \partial f / \partial l_t &= w_t + c(L_{t-1}, L_t, \rho_t) = w_t (1 + xq\lambda) + \lambda w_{t-1} (L_{t-1} / L_t) (1 - xq\rho_t) \\ \partial f / \partial k_t &= r_t. \end{aligned}$$

These equations show that the labor demand decision is affected by the performance of the pension fund in a very different manner than in the case of an individual company plan.

Result 6. For an atomistic firm belonging to a sectorwide pension fund, the marginal cost of labor is the sum of the current wage and the (exogenous) pension contribution rate. The latter is decreasing in the return on pension fund assets.

With a sectorwide pension fund, the firm does not internalize the link between the deferred wages it owes to its workers and pension fund contributions. Contributions depend on the hiring decisions of all the fund members, as well as on asset returns, and are therefore exogenous to the individual member. Thus, asset market returns directly affect labor demand decisions via required contributions to the pension plan. In addition, the contribution rate is influenced by the rate of growth of the total labor force belonging to the fund. In particular, if returns on the assets are low ($1 > xq\rho_t$), then contributions are higher in shrinking industries and lower in growing industries. This is because contributions levied on current workers must make up for losses on maturing obligations to old workers. By the same token, in

periods in which fund assets are overperforming, declining industries benefit, because the “financial windfall” per worker is higher.

The contrast between the case of an industry plan and a company plan is entirely due to the assumption (consistent with common practice in the Netherlands) that member companies are charged by the fund in proportion to their *current* wage bill. A two-part pricing scheme could restore equivalence between the two cases. To see this, suppose the fund charges each participant the following contribution:

$$tc_t = a(w_t l_t) + b(w_{t-1} l_{t-1}, \rho_t) = xq \lambda w_t l_t + \left(\lambda w_{t-1} l_{t-1} - \frac{w_{t-1} l_{t-1}}{w_{t-1} L_{t-1}} A_t \rho_t \right).$$

The first term, $a(w_t l_t)$, is the amount that the firm needs to contribute to cover new pension liabilities.²⁰ The second term, $b(w_{t-1} l_{t-1}, \rho_t)$, is the difference between what the fund pays out to workers of the firm and the value of the firm’s share in the fund at the beginning of the period (after current returns are realized but before new contributions are added). The share is calculated using the wage bill in the previous period. Using (6) to eliminate A_t yields

$$tc_t = xq \lambda w_t l_t + \lambda w_{t-1} l_{t-1} (1 - xq_{t-1}),$$

which is the same as the contributions in the case of the individual pension plan (see equation (3)).

Result 7. The labor demand decision of a small firm in a sectorwide pension fund would be the same as that of a company with an individual plan if contributions consisted of two parts, one to cover new pension liabilities and the other to reflect the capital gains or losses on accrued liabilities.

This two-part pricing scheme, although somewhat more complex than the standard one, would allow firms to better internalize the effects of its labor market decision on pension costs. In addition, a new firm joining the fund would not have to pay contributions reflecting capital gains or losses on past obligations (since $l_{t-1}=0$ for such a firm), but would pay only what is necessary to fund the pensions of its current workers. In spite of these advantages, however, it should be emphasized that because labor demand in the case of a large firm with an individual pension plan is not first-best, switching to this pricing scheme does not necessarily reduce distortions.

²⁰ This is sometimes referred to as the cost-covering level of contributions.

VI. MARKET IMPERFECTIONS

Imperfect capital markets

The models assume that firms have unrestricted access to capital markets. In practice, though, informational asymmetries and other contracting problems may create a wedge between the cost of internal and external finance, so that financing investment or working capital through retained earnings is cheaper than raising funds from the capital markets. This wedge, in turn, may become larger during downturns, when firms become more levered and face financial difficulties. In this case, losses on pension fund assets may increase the need to resort to costly external financing, inducing the firm to cut back on current production. An extreme case of this problem is that of a credit-constrained company. For such a company, the need to finance the pension shortfall would crowd out investment or working capital one-for-one.

Imperfect labor markets

Another important assumption is that the firm is a price-taker in the labor market, so that the compensation it promises workers (both immediate and delayed) is not affected by the profitability of the firm. If the labor market is not perfectly competitive, perhaps because workers are unionized, the firm has monopsonistic powers, or there are hiring and firing costs, then the firm no longer takes the wage as given. In particular, a financial loss on pension fund assets, by reducing current profitability, may induce the firm to strike a better bargain with its workers. This could result in an increase in employee contributions to the pension fund, which is not offset by a higher wage rate. Alternatively, there may be a reduction in the pension replacement ratio λ , for instance by forgoing indexation. Accordingly, with imperfect labor markets the effect of losses on pension fund assets on profitability and cashflow is likely more limited than in the perfectly competitive model, because workers end up sharing some of the losses. On the other hand, lower wages would reduce labor supply, which might curtail economic activity. If there is disequilibrium unemployment in the short run, however, a decline in labor supply may not have a sizable effect on growth.

VII. CONCLUSIONS

With asset values declining around the world for three years in a row, large holders of securities have realized substantial losses. Prominent among them, are occupational pension funds in a number of industrialized countries. With defined contribution pensions, the losses are borne by employees, who face the prospect of lower retirement income. Where pensions are mainly of the defined-benefit type, as in the Netherlands, employers must pay higher contributions to restore the solvency of the plan.

To gain insights into the possible macroeconomic repercussions of these large financial losses, this paper has developed a theoretical framework to study how firm behavior—in particular labor demand—changes when the firm sponsors a defined-benefit pension fund and the returns on the fund assets are uncertain. The model also sheds light on the economic costs of solvency regulation for pension funds.

In the case of large firms with individual pension plans, the marginal cost of labor, which determines labor demand, is equal to the sum of three components: the wage, the present discounted value of the pension benefit, and a “regulatory wedge,” that captures the opportunity cost of tying up assets in the pension fund. This marginal cost generally differs from the sum of the wage and the pension fund contribution. Thus, losses on accrued liabilities do not directly affect the marginal cost of labor, even if they result in higher contributions. The intuition is that shortfalls in pension fund coverage depend on past labor market decisions, not on the current ones, and are therefore a sunk cost. A low rate of return on pension fund assets, however, may make labor more expensive if it signals low returns in the future, because this would increase the regulatory wedge.

In the case of small firms belonging to industry-wide pension plans, on the contrary, the marginal cost of labor is equal to the sum of the wage and the pension fund contribution, because small firms take contribution rates as exogenous. Accordingly, as contributions rise and fall, reflecting losses or gains on pension fund assets, so does the marginal cost of labor, and labor demand from these firms tends to be more pro-cyclical.

In the case of both, large and small firms, losses on pension fund assets lower profits and cash-flows, which may make it more difficult for weak firms to access external capital markets, causing them to reduce activity. Firms and pension funds may also seek to negotiate concessions from workers on the level of pension benefits, for instance by increasing the retirement age or indexing the benefit to the average rather than to the last wage. Reducing the pension benefit, just like a reduction in the current wage, should increase labor demand by large firms, but it may curtail labor supply in the long run.

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