

**An International Comparison of the
Financing of Occupational Pensions**

By

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E Philip Davis

Introduction

This paper analyses the varying scope of private funding of pensions, pension funds' investments and the risks and returns they obtained in the capital markets in twelve major industrial countries - the United States, United Kingdom, Germany, Japan, Canada, France, Italy, the Netherlands, Denmark, Sweden, Australia and Switzerland. The marked differences in national experience raise a number of economic issues, which this paper seeks to address. For example, it aims to consider the role of private funding in retirement financing relative to social security; the role of government regulation of pension funds' financing, and appropriate contribution rates to private pensions. There are clear links between these issues; for example, regulations may influence appropriate contribution rates (via asset returns), and may also be a feature influencing the scope of funding itself. The paper seeks to illustrate the varying choices made in this field by the countries concerned, their benefits and costs and their consequences for the scope and efficiency of the private funded sector. The paper is structured as follows; it first considers the arguments for and against private pension funding per se, before going on to outline the differences in the scope of funding between the major countries and their determinants. It then goes on to assess the differing regulation of pension fund financing and the performance of funds in capital markets; together these enable an assessment to be made of appropriate contribution rates.

Before commencing, we offer four key definitions. In a *funded* pension plan, pension commitments are covered in advance by accumulation of real or financial assets. In *pay-as-you-go* plans, in contrast, contributions of employers and current employees are relied on to pay pensions directly. Social security systems are pay-as-you-go in most countries, while private pension plans tend to be funded. In a *defined benefit* pension plan the pension formula is defined in advance by the sponsor, independently of the contributions and asset returns. In contrast, in *defined contribution* pension plans only contributions are fixed, and benefits therefore depend solely on the returns on the assets of the fund. The key difference between defined benefit and defined contribution plans is that with defined benefit plans there can be risk-

sharing between worker and company as well as between younger and older members¹. These risk sharing features are absent with defined contribution plans.

Why Fund Pensions?

The costs and benefits of funded occupational pensions per se can be shown in the context of the economic issues raised by the overall *choice between funding and pay-as-you-go*. Under the simplifying "steady state" assumptions of a constant population and population distribution, with pension contributions proportionate to salary, and benefits proportionate to contributions², the transfers received by a pensioner under pay-as-you-go relative to his contributions earlier in his working life depend on the growth of average earnings (which determines the growth in total contributions by the workforce). Meanwhile the corresponding growth of receipts under funding depends on the rate of return on the assets accumulated during the working life. In other words, the "rate of return" to pay-as-you-go is indicated by earnings growth, and that of funding by the return on physical and financial assets (Aaron 1966).³ The actual pension received per annum under pay-as-you-go also depends on the ratio of contributing workers to pensioners (the dependency ratio), while that received in the case of funding varies with the number of years of retirement relative to working age (the "passivity ratio").⁴ Allowing for population growth, the steady-state "rate of return" to pay-as-you-go increases to the growth rate of average earnings plus population growth (i.e. total earnings).

The reasoning above implies, *ceteris paribus*, that funding can offer higher total benefits to retirees for the same outlay if asset returns exceed the growth rate of average earnings (or, with constant factor shares,

¹In effect, younger members may accept occasional shortfalls in the coverage of their pension rights while the older workers continue to receive their pensions.

²The implicit assumption is that workers receive "actuarially fair" pensions proportionate to their contributions; in practice redistribution is common under pay-as-you-go.

³This discussion abstracts from distributional considerations. As noted below, private funding tends to benefit those who have a sufficiently high income to save during their working lives, whereas pay-as-you-go lends itself more readily to redistribution.

⁴Conceptually, the discussion in this section applies to benefits obtainable for "defined contributions", but for defined benefit schemes the reasoning is similar. "Defined benefit" contribution rates under pay-as-you-go for a given population, replacement rate (ie pension relative to final salary) and a pension indexed to wages depend only on the dependency ratio. Under full funding, the contribution rate to obtain a similar replacement rate depends on the difference between the growth rate of wages (which determines the pension needed for a given replacement rate) and the return on assets, as well as the passivity ratio. For a given population and population distribution, if the dependency ratio equals the passivity ratio, the schemes will be equivalent if the growth rate of wages equals the return on assets.

that of productivity and real GDP). Historical experience and economic theory⁵ suggest this will generally be the case. Data shown in Table 1 indeed suggest that in most of the countries studied, asset returns did over 1970-90 exceed growth in average earnings and hence underlying economic conditions favored funding even in a steady state, particularly if international diversification of investment is permitted where domestic returns are relatively low. Risk may be a partially offsetting factor favoring pay-as-you-go relative to funding, if asset returns are more volatile than growth in the wage bill and the dependency ratio. Risk is particularly important to defined contribution funds as there is no backup from the sponsor and pensions must typically be taken in a lump sum (to buy an annuity) at the precise point of retirement.

In practice, the calculations in Table 1 are excessively favorable to pay-as-you-go since the key assumption of the steady state - a fixed population distribution - will not be fulfilled in the coming decades. Slower population growth and ageing of the population will put increasing strain on pay-as-you-go systems. In terms of the analysis above, the dependency ratio is set to rise sharply relative to the passivity ratio, driving down the rate of return to pay-as-you-go relative to funding, other things being equal.⁶ In line with this, the OECD (1993) calculate that under pay-as-you-go, contribution ratios in the G-7 countries⁷ would have to rise to a peak of 4.4-11.9 percent of GDP to eliminate net liabilities of social security, whereas for funding it would have to rise 1.1-5.3 percent, and the overall cost would be lower to the extent that the return on financial assets exceeds the growth of average earnings. Such problems are leading governments to seek to reduce social security promises, thus also showing the "political risks" to which social security is vulnerable when labor market conditions are unfavorable. However, if there were to be crises in the capital market equivalent to this "crisis in the labor market", funded plans could equally be disadvantaged.⁸

There are also differences in the implications of the alternative approaches for economic efficiency. If pay-as-you-go social security contributions are seen as taxes they will distort the labor supply decision, which is particularly likely if the rates of contribution are high and there is a great deal of redistribution; this does not occur with funding to such an extent. Again, pay-as-you-go may discourage saving and hence capital formation, notably for the first generation of recipients, which in turn by making labor relatively abundant in

⁵An interest rate in excess of the economic growth rate is a prediction of most theories of economic growth, given a positive rate of time preference (ie that consumers require compensation for postponing consumption).

⁶In practice, average earnings growth may increase and the rate of return to capital fall during the process of population ageing, thus constituting a partial offset.

⁷That is, the United States, the United Kingdom, Canada, France, Italy, Germany and Japan.

⁸This risk is less important for defined benefit funds, as long as profitability of firms is unaffected. Investment risk *plus* a collapse of profitability are needed to threaten occupational defined benefit funds.

relation to capital may reduce the wage and raise the interest rate, thus reducing the welfare of future generations (Kotlikoff 1992). In the context of an ageing population, if contribution rates under pay-as-you-go are not adjusted sufficiently to allow for benefits, fiscal deficits will be engendered, which may lead to crowding out of private investment. Even if deficits do not occur, pay-as-you-go with an ageing population implies net unfunded government liabilities, which could again have crowding out effects on investment. Meanwhile, funding tends under certain plausible conditions to increase saving, thus lowering the interest rate and raising the capital stock and hence future output for both workers and pensioners. Indeed, as noted by James (1994), the conditions under which funding will have a positive effect on saving, namely myopia, credit rationing and lack of credibility of the pension plan, are precisely those whose absence will lead pay-as-you-go to reduce saving. So a switch from pay-as-you-go to funding is *unambiguously* likely to raise saving. If higher saving engenders capital investment which itself raises productivity (e.g. by introducing new working methods) the overall economic growth rate may be endogenously boosted (Romer 1986). Funding can also benefit the capital markets via the composition of saving (in long term instruments such as equities and bonds), notably if asset allocation is decentralized, as is the case for private pension funds.

There are nevertheless some arguments against funding. Funded plans may be vulnerable to confiscatory taxation or diversion of investment to unprofitable projects or asset categories for political reasons. Funding may adversely influence the exchange rate and the current account if ex-ante domestic investment is less than the increase in saving. The increase in saving may over the very long term depress the domestic rate of return to capital; in other words the return on assets may be affected by the scope of funding⁹, reducing its advantage relative to pay-as-you-go, although international investment in countries with a younger population can in principle offset this problem.¹⁰

A transition from pay-as-you-go to funding can be difficult, as one generation has to "pay twice", once for existing pensioners via pay-as-you-go, and once for their own pensions via funding. Also, in a closed economy, and abstracting from the increase in saving that funding may induce, the problem of competition over domestic resources raised by the intergenerational transfers inherent in pay-as-you-go is not entirely removed by funding. Instead it is switched from pensioners seeking a share of labor income (via taxation) to

⁹In line with this suggestion, Blanchard (1993) has observed a decline in the premium on equity relative to debt, and attributes this to institutionalisation.

¹⁰There remains a possibility that a switch to funding at a global scale could depress the world rate of return.

claims over the returns on the capital stock (Vittas 1992).¹¹ But again, international investment can mitigate this problem. Pay-as-you-go plans can offer immediate pensions, without waiting for assets to build up, and hence are more favorable to the first generation after their introduction than funded plans. They can remove inflation risk to pensioners by being able to link future benefits to wages (assuming a steady-state in the economy with positive population and productivity growth). Pay-as-you-go may be superior in terms of insurance of risks to labor and capital income ("factor share risk"), since in its absence workers tend to be wholly dependent on labor income and pensioners on capital income.¹²

From a welfare point of view (Pestieau 1992), funding may be objectionable for intergenerational equity, where some redistribution may be justified, e.g. if the growth rate is rapid and the young are much more productive and therefore have higher incomes than the elderly. This is because with funding no transfers are possible between generations, to compensate for a changing economic environment. With an actuarially fair funded plan, there can also be problems of equity within generations, whereby well paid workers and those who stay with one firm benefit disproportionately from the fiscal benefits offered, whereas groups with broken work histories may get an inadequate net income.¹³ Only social security is able to redistribute to offset poverty within generations.

As regards methods of funding, a social security trust fund may face particular problems (Thompson 1992), which makes private funding relatively attractive. A large trust fund may induce higher government consumption or even fiscal deficits, thus defeating the object of the exercise, and its management could be subject to political interference (although it could be privatized or devolved). Investment in government bonds, which is typical of such funds (e.g. in the United States, Japan and Singapore), has ambiguous consequences. As pointed out by Bodie and Merton (1992), it is not clear that governments' willingness to repay bonds (or at

¹¹Even in a closed economy, this point should not be exaggerated. At least ownership of the capital stock may be a more secure basis for retirement than the willingness of existing workers to pay pensions as in pay-as-you-go schemes. If, as suggested, funding raises saving relative to pay-as-you-go, then capital formation and growth will be higher with funding, and the national income from which pensions must be paid correspondingly boosted.

¹²In the model of Merton (1983), all uncertainty regarding a worker's marginal product derives from the aggregate production function, with no individual-specific effects. Labour income is assumed perfectly correlated across individuals. Workers save for retirement via individual saving (or defined contribution pension funds). Since human capital cannot be traded, there is economic inefficiency, as individuals hold too much human capital early in their lives relative to physical capital, while at retirement all wealth is invested in physical capital. These rigidities prevent optimal sharing of factor share risk (ie relating to the division of GDP between wages and profits), which might, for example, derive from unforeseeable long term secular trends related to the degree of union militancy or technological developments. Merton shows that a pay-as-you-go social security scheme is welfare improving in this framework.

¹³This, in practice, depends on the benefit formula - it is not the case if benefits are based on career-average revalued earnings.

least, not to devalue them by a bout of inflation) should be any more reliable than the promise to pay pensions, unless the funds are used for productive capital investment, with revenues hypothecated to pay pensions. Even if used to fund investment, finance may be diverted to unprofitable projects for political reasons. Also lack of international investment, which is typical of such funds, leaves them dependent on the performance of the domestic economy. Investment performance of one such public trust fund, the ATP fund in Sweden, is examined below.

To summarize, these arguments suggest that funding is superior in terms of economic efficiency (eg lesser distortion of incentives to work and save), so a shift from pay-as-you-go to funding may raise work incentives and saving. Also the rate of return to funding tends to exceed that on pay-as-you-go. However, funding has some disadvantages, eg in terms of equity, that suggest a wholesale switch to funding would be inappropriate. Diversification reasons (the differing risks to which funded and pay-as-you-go plans are exposed), are also a point in favor of retention of pay-as-you-go. The ability of social security to redistribute suggests a role for pay-as-you-go in providing basic needs, while funding caters for transfer of saving to old age. And international investment may be needed to mitigate some of the difficulties that funding may entail with an ageing population. With this section as background, we go on to examine the actual determinants of private funding in 12 countries.

What Determines The Scale Of Private Pension Funding?

The data in Table 2 show pension fund assets in the twelve countries studied, first on a narrow definition of funded non-insured company plans and secondly on a broader definition including pension funds managed by life insurers and certain other funded plans. For each measure, a contrast is apparent between the role of pension funds in the Anglo-Saxon countries (the United Kingdom, the United States, Australia and Canada), the Netherlands, Denmark and Switzerland, where they account for a sizeable part of personal sector wealth and GDP, and those in other continental European countries such as Germany. Japan occupies an intermediate position, with sizeable total assets but low ratios to personal wealth or GDP. Note the Swedish data are for the funded earnings-related social security system (ATP); private funded plans exist, but their assets are relatively small.

Taking the asset/GDP ratio as an imperfect proxy for the size of the funded sector, what types of influences could account for the differences in the importance of funded sectors in the provision of pensions? The most crucial point is that private funded plans cannot usefully be viewed in isolation; the principal alternative to a private pension fund is the state social security pension system. Not surprisingly, the growth of private plans can be related to the *scale of social security pension provision*, which impose limits on private sector plans, particularly if there is generous provision for individuals at higher income levels. Second, where provision is voluntary, *taxation and regulatory provisions* make it more or less attractive for the firm to offer a pension fund. For example, exemption of funds from taxation, "prudent man" rules for asset management and flexible funding rules will increase funds' attractiveness. However, in some countries these factors may be overridden by imposition of *compulsory pension plans* on employers. Since accrued rights within occupational pension plans comprise assets of the *employee*, it is natural also to consider their motivations. For example, high marginal tax rates may increase the attraction to employees of tax deferral via pension funds. Employees will also be attracted by the quality of retirement income insurance that is on offer, which differs between defined benefit and defined contribution plans and varies with factors such as indexation of pensions to prices or wages (Bodie 1990). But note that regulations making funds attractive to employees, such as compulsory indexation and short vesting periods, may make them less attractive to employers. But not all funds are company based. *Personal pensions*, which are invariably defined-contribution, have grown in importance in a number of countries in recent years, the main aims being to provide the tax incentives of pension plans to those not in company plans, to enable company plans to be supplemented, and/or to offer greater portability than is available from company plans. A further factor influencing the size of pension funds is the *maturity* of the plans, i.e. whether they have a long-run ratio of contributing to benefiting members. *Coverage* is obviously also important (i.e. the proportion of employees covered by pension plans). However, this is a consequence of the economic features as discussed below, rather than a separate cause of growth in itself.

Accrual of pension rights in a defined contribution plan is synonymous with accumulation of assets - which will thus be larger, the higher the contribution rate, coverage of the workforce and rates of return. But a defined benefit plan is not necessarily synonymous with a fund; rather it is a way to collateralize the firm's benefit promise. In order for assets to be built up, it is essential for fiscal or regulatory provisions to encourage funding of defined benefits - otherwise defined benefit plans may be unfunded. Only if external funding is encouraged, as opposed to "booking" of pension liabilities on the balance sheet, will funds be available in the

form of assets of the capital market intermediated via pension funds. And only then one can one also assert for defined benefit funds that the more generous the benefits offered and the wider the coverage, the more financial assets funds will require.

Table 3 offers a summary of the way these various features stand in the 12 countries studied. To summarize, the influence on the development of private plans of the scale of social security, compulsion, the tax regime and maturity can be discerned in each country. Key regulatory features which may also influence funding, notably funding rules per se, are assessed in more detail in the next section.

As regards *social security*, replacement ratios are shown to be relatively low in Australia - which is a country which relies heavily on private pensions even for low earners - but comparable for those on low incomes in other countries. In such cases, the shape of the replacement ratio/final earnings relation is a crucial determinant of the scope of private funds; if social security provides high replacement ratios to high-earners, there will be little incentive to develop private funded plans at all. In line with this suggestion, the replacement ratio declines rapidly with earnings in Denmark, the Netherlands, the United States and the United Kingdom - countries with large funded sectors. Italy and Germany, by contrast, are notable for comparable replacement ratios to those retiring on earnings equivalent to \$20,000 and \$50,000. Their private funded sectors are much less important.

Turning to *taxation*, the Netherlands, the United Kingdom, Switzerland, the United States, and Canada offer generous treatment (exemption of contributions and asset returns from tax, while pensions in payment are taxed, denoted EET in the table). "Booking" is discouraged in these countries by withholding of tax privileges from reserve-funded plans (or outright bans, as in the United States and Canada). High general tax rates of up to 68 per cent, as in Denmark, can encourage private funding even if their fiscal treatment is less generous (a tax is imposed on real asset returns to pension funds above a certain level). In Germany and Japan, tax incentives to 'booking' of corporate pension liabilities and some tax disadvantages to pension funds have - at least until recently - accompanied smaller funded plans.

Compulsion is a feature of the Swedish public, Swiss and Australian private national funded systems, all of which are designed in the light of demographic concerns to provide a sizeable proportion of retirement benefits. Coverage is hence extremely high - only in the Netherlands do voluntary plans reach similar levels of coverage. Because the plans are compulsory, the tax regime is less important; in particular, the Australian fiscal treatment - of taxation of contributions, returns and benefits, would be unlikely to encourage voluntary

pension provision. The French supplementary plans are also compulsory, but pay-as-you-go financing is enforced.

Funded sectors differ in terms of *maturity*, which also influences the current and prospective asset/GDP ratio. In the United States, United Kingdom, Canada, Sweden and the Netherlands, defined benefit plans are largely mature and hence the asset/GDP ratio is near a peak, although personal and defined contribution funds could spur further growth in the United Kingdom, Canada and United States. In Denmark, Japan and Germany, immaturity of company plans indicates further growth is likely. In Australia and Switzerland the relatively recent introduction of mandatory pension funds means that a significant proportion of pension funds will again be immature.

A simple regression analysis was carried out to test the main influences on the 'broad' pension asset/GDP ratio, using as independent variables the key factors identified above, namely the scope of social security, the tax regime, whether the scheme is mandatory and maturity of the scheme. Of course, such a regression cannot *prove* causality. Subject to this caveat, the equation does indicate the importance of these factors in discriminating between countries with small and large private funded sectors. It suggests that every one percentage point increase in the difference between social security replacement ratios at \$20,000 and \$50,000 is associated with a 1.2% higher asset/GDP ratio; a deviation from favourable 'expenditure tax' treatment of pensions is related to 21% lower funding; countries where there is compulsion have a 23% higher ratio, *ceteris paribus*, and those with mature systems a 27% higher asset/GDP ratio. All variables were significant at the 95% level.

Detailed study of national funded sectors (Davis 1995) suggests that other important factors in the development of occupational pension funds are the ability of employees to opt out of earnings-related social security for an equivalent private pension (as in the United Kingdom and Japan), funding of civil service pensions (Netherlands), widening of coverage via encouragement of personal pensions (United Kingdom, Canada, United States, Switzerland) and encouragement of supplementary defined contribution plans (United States). On the other hand development can be stopped by simply banning company based externally funded plans, as in France¹⁴. And funding of social security in Sweden ensures private funds remain small.

A striking feature of this analysis of the determinants of private funding is that it appears to be tenuously related to the underlying fundamentals which were outlined above. This is unsurprising, as in most

¹⁴Source; Wyatt (1993).

countries social security and private provision have evolved piecemeal, without coordination. Only in Australia (and Chile) does social security provide solely for basic needs. There is little correlation between the wage-interest differential and the size of funded sectors, nor, as yet, to the future ageing of the population in the different countries. These should predispose countries such as France, Italy, Japan and Germany to extend the scope of funding. Progress in reform has nonetheless been marked in Japan, with a reduction in social security promises, partial funding of social security¹⁵ and reduction of tax benefits to "booking", even if it is not yet apparent in the data, but elsewhere it has been slow. Taxation costs and transition problems, as well as preference for the "social solidarity" of comprehensive pay-as-you-go are among the reasons.

What Are The Principal Pension Regulations Affecting Financing?

A final factor that may influence the size of the funded sector, by requiring external funding of benefits per se and/or affecting the attractiveness of provision of funds to companies, is regulation. This section assesses the main regulations affecting pension fund financing, namely regulations of funding and portfolio regulations, and considers their influence, together with other factors, on the portfolio distribution, returns and hence the cost of providing a given level of benefits. In terms of the framework set out in the first section, funding rules can be seen as ensuring that assets actually are accumulated to cover benefit promises under funding, while portfolio regulations seek to influence the nature of the return to funding. The basic regulations are summarised in Table 4.

Regulation of the funding of benefits is a key aspect of the regulatory framework for defined benefit pension funds. Note that by definition, a defined contribution plan is always fully funded, as assets equal liabilities, whereas as noted with defined benefit plans there is a distinction between the pension plan (setting out contractual rights to the parties) and the fund (a pool of assets to provide collateral for the promised benefits). When the fund is worth less than the present value of promised benefits there is underfunding; when the opposite is the case, there is overfunding. Calculation of appropriate funding levels requires a number of actuarial assumptions, in particular the assumed return on assets, projected future wage growth (for final salary plans) and future inflation (if there is indexing of pensions), as well as estimates of death rates and the expected evolution of the relative number of contributors and beneficiaries over time. Minimum funding limits

¹⁵However, note that the trust fund invests solely in government bonds, which has ambiguous consequences for benefit security.

set by regulation seek to protect security of benefits against default risk by the company, given unfunded benefits are liabilities on the books of the firm, and therefore risk is concentrated and pensioners (or pension insurers) may have no better claim in case of bankruptcy than any other creditor.¹⁶ Funding offers a diversified and hence less risky alternative backup for the benefit promise, as well as offering the possibility of unplanned benefit increases if the plan is in surplus. Extra protection against creditors of a bankrupt firm is afforded when the pension fund is independent of the firm and when self investment is banned or severely restricted, as is the case in most countries except Germany and Japan. There are usually also upper limits on funding, to prevent abuse of tax privileges (overfunding). Bodie (1990) suggests that the three main reasons why firms fund, besides regulations *per se*, are the tax incentives, provision of financial slack (when there is a surplus) that can be used in case of financial difficulty, and because pension benefit insurance may not cover the highest-paid employees.

Certain definitions are useful as background to a discussion of funding rules. The 'wind-up' definition of liabilities, the 'solvency' level at which the firm can meet all its current obligations¹⁷ absent any projections of salary, is known as the *accumulated benefit obligation* (ABO). The assumption that rights will continue to accrue, and be indexed up to retirement, as is normal in a final salary plan, gives the *projected benefit obligation* (PBO).¹⁸ The *indexed benefit obligation* (IBO) assumes indexation after retirement.¹⁹ An important argument in favor of the PBO/IBO over the ABO is that it ensures advance provision for the burden of maturity of the plan, when there are many pensioners and fewer workers, by spreading costs over the life of the plan²⁰ (Frijns and Petersen 1992). This may be better for the financial stability of the sponsor.

In the *United States* the ABO must be funded; unfunded plans are forbidden. Together with absence of obligatory indexation, this has an important influence on portfolio distributions, since underfunding ("shortfall risk") can be avoided, and tax benefits to the firm maximised, by holding bonds, or at least by portfolio insurance strategies; unhedged equities are only suitable for overfunded plans. The United States Pension Benefit Guaranty Corporation (PBGC) guarantees (up to a limit) benefits of defined benefit funds in default,

¹⁶Adequate provision of unfunded pensions is likely to be particularly difficult for declining industries, as the worker/pensioner ratio falls.

¹⁷Projections of inflation will be needed when benefit indexation is a contractual or legal obligation.

¹⁸This is guaranteed in the UK and the Netherlands.

¹⁹This is a legal obligation in Germany and Sweden and will soon be in the UK; it is generally provided in Switzerland and the Netherlands.

²⁰The facility with which funds of declining industries in the UK funded on a PBO/IBO basis (such as coal mining and railways) coped with maturity are a case in point.

funded by contributions from all defined benefit plans; the funding requirement can be seen partly as a protection for PBGC. Higher PBGC insurance premia are charged to underfunded plans.

The United States illustrates the interaction of funding rules with accounting standards and tax law in influencing funding. Under the United States accounting standard FASB 87, if pension assets fall below the ABO, the unfunded liability must be reported in the firm's balance sheet, and since they are senior debt, they act as a major problem for the firm in raising funds. However, a surplus cannot be included on the balance sheet, although it can be implicitly recouped via a reduction in contributions, as discussed below. The accounting standard requires presentation of the PBO, as well as the ABO, thus ensuring at least partial focus on future liabilities. Again, overfunding in the United States has since 1987 been limited by tax law to 150 percent of the ABO. This implies a rise in interest rates could prevent further funding, leaving the plan underfunded when interest rates fall. This would not have been the case for a PBO definition, taking projected rises in benefits into account, as long as the Fisher effect holds, i.e. interest rates rise with expected inflation.

Other countries show similar interactions. In *Germany*, various laws or court decisions have enforced minimum standards of funding for pension funds (while leaving open the choice of a book reserve system) and what amounts to inflation indexing of pensions. These provisions were felt to be particularly burdensome, and have helped blunt the growth rate of externally funded private pension plans as opposed to "booked" benefits (Deutsche Bundesbank 1984). In both Germany and *Switzerland*, accounting conventions have an impact on funding decisions, as shortfalls (defined at the lower of cost and market value of assets) are included in the company accounts (Hepp 1992). It is suggested that this helps to account for conservative investment strategies, independently of portfolio regulations discussed below. Rules forcing employers in Switzerland to credit at least four percent to pension accounts annually may have a similar effect. In *Japan*, the traditional means of provision of retirement benefits was via booked benefits, with a special reserve account on the balance sheet as benefits accrue. Externally funded plans must be funded only up to the ABO, and there is reportedly very little overfunding, partly because contributions which would raise funding levels above the ABO are taxed. In *Canada* plans must be funded as going concerns, including projections of salary rises (i.e. the PBO); unfunded plans are forbidden and any unfunded liabilities must be paid off in 15 years.

In the *United Kingdom*, plans which contract out of earnings-related social security must fund sufficiently to provide an equivalent 'guaranteed minimum pension' (GMP), but this is far below actual benefit promises. Funding above this level is not legally required - although trustees are bound by their duty of care to

ensure funding is in place - nor is there a requirement to include deficits in company balance sheets. In practice a continuance basis such as the PBO or IBO tends to be used, on which overfunding is limited to five percent. A crucial difference from other countries is that adequacy of funding is judged by current and projected cash flows from assets and not current market values; this allows volatile assets such as equities to be heavily used. This is reflected in accounting standard SSAP24, which also bases fund valuation on such actuarial valuations and long run smoothing. Historically, this has not conflicted with the need to cover obligations if the fund were wound up, since the PBO has tended to exceed the ABO. But compulsory indexation, currently being introduced²¹ will increase the ABO and could put the system under threat (Riley 1993). Meanwhile, although the government guarantees to pay the GMP if a plan fails, there has to date been no system to guarantee non-GMP pension benefits in the United Kingdom - partly for this reason regulations have historically been less strict than elsewhere, and managers could adopt a high return/ high risk portfolio strategy. However, the Goode Committee on UK pension law - set up to report on regulatory shortcomings in the wake of the Maxwell scandal, and which reported in 1993 - has recommended a minimum funding rule based on the ABO, with only a three-month grace period to top-up the fund, albeit with a 10% shortfall being permitted without the immediate need to top-up. Insurance against fraud was also recommended. The government launched a bill in mid-1994 approving these proposals, although funding rules will be less strict for immature funds. This raises similar issues to those outlined above for the US, and might alter quite significantly the asset mix of UK funds, towards less volatile but also less profitable assets.

The importance of the choice of discount rate in funding calculations is shown by a 1993 United States Department of Labor estimate that a one percent fall in the bond yield would raise pension liabilities by 10 percent for the average fund.²² Feldstein and Morck (1983) report that many underfunded plans in the United States tended to use a high rate to discount fund liabilities. One answer to these problems is to take a long run view of asset returns, or possibly, where inflation is low and stable, a fixed benchmark discount rate. The latter is the case in the *Netherlands*, where funding of the PBO is compulsory, and the government sets a maximum real interest rate assumption of four percent, as well as an assumption for wage growth. Since in practice Dutch funds have been able to earn over this level, surpluses estimated at 30 percent were present by 1990; a special tax levy is planned. In the *United States*, in the light of the tendencies noted above, the SEC

²¹ Given the cost of this measure, a decline of the company pension fund sector is predicted, but there is little evidence of this to date.

²² Note that only long maturity bonds will increase in price so as precisely to offset the increase in liabilities.

have insisted that interest rate assumptions follow actual bond yields closely. In *Japan* contributions are set assuming a five percent nominal rate of return on fund assets. In *Canada* a nominal return of 8.5 percent and 5.75 percent wage growth are standard assumptions. In the *United Kingdom* the government accepts the (varying) judgement of the actuaries, and generally also allows for an assumption of wage growth.

Finally, since most *Danish* and *Australian* funds (as well as a proportion of funds in Switzerland and the Anglo-American countries) are defined contribution, the issue of funding does not arise. However, the issue of limiting tax privilege does arise, and is dealt with (in Australia) via contribution limits and (in both countries) taxation of returns.

Quantitative regulation of portfolio distributions is imposed in a number of countries, with the ostensible aim of protecting pension fund beneficiaries, or benefit insurers, although motives such as ensuring a steady demand for government bonds may also play a part. Limits are often imposed on holdings of assets with relatively volatile returns, such as equities and property, as well as foreign assets, even if their mean return is relatively high. There are also often limits on self investment²³, to protect against the associated concentration of risk regarding insolvency of the sponsor. Apart from the control of self investment, which is clearly necessary to ensure funds are not vulnerable to bankruptcy of the sponsor, the degree to which such regulations actually contribute to benefit security is open to doubt, since pension funds, unlike insurance companies, may face the risk of increasing liabilities as well as the risk of holding assets, and hence need to trade volatility with return. Moreover, appropriate diversification of assets can eliminate any idiosyncratic risk from holding an individual security or type of asset, thus minimising the increase in risk. Again, if national cycles and markets are imperfectly correlated, international investment will reduce otherwise undiversifiable or "systematic" risk (see Davis 1994 and Table 9). Portfolio limits may be particularly inappropriate for defined benefit pensions, given the addition "buffer" of the company guarantee and risk sharing between older and younger workers, and if benefits must be indexed. Clearly, in such cases, portfolio regulations may affect the attractiveness to companies of providing pension funds, if it constrains managers in their choice of risk and return, forcing them to hold low yielding assets and possibly *increasing* their risks by limiting their possibilities of diversification²⁴. It will also restrict the benefits to the capital markets from the development of

²³These limits do not, of course, apply to reserve funding systems such as those common in Germany and Japan.

²⁴Technically, portfolio restrictions are likely to prevent managers reaching the *frontier of efficient portfolios*, which indicates where return is maximised for a given risk.

pension funds; in particular, in the case of restrictions which explicitly or implicitly²⁵ oblige pension funds to invest in government bonds, which must themselves be repaid from taxation, there may be no benefit to capital formation and the "funded" plans may at a macroeconomic level be virtually equivalent to pay-as-you-go.

Japanese funds face ceilings on holdings of certain assets (such as 30 percent for foreign assets and for equities), which Tamura (1992) suggests "(inappropriately) imitate regulations devised for trust banking and life insurers". *German* pension funds, besides a 10 percent self investment limit, remain subject to the same panoply of regulation as life insurers (four percent limit on foreign asset holdings, 20 percent limit on equities, five percent on property). It is arguable that these are particularly inappropriate for German pension funds given the indexed nature of their liabilities.²⁶ Note that by offering tax privileges to 'booking', Germany and Japan effectively impose no limits on self investment of book reserves (although the Germans do insist on insurance of such reserves). *Swiss* limits are similarly structured, but since end-1992 have been much less restrictive than the Germans'; a 50 percent limit on shares, 50 percent for real estate and 30 percent on foreign assets (Meier 1993). Scandinavian limits are in many ways even tighter than the Germans', in that minima are also specified. The *Swedish* ATP, as well as private funds, have historically been obliged to hold the majority of their assets in domestic listed bonds, debentures and retroverse loans to contributors (although recent deregulations have permitted limited investment in property, equities and foreign assets, which some private plans have reportedly taken advantage of). Historically, restrictions on equity investments were justified on the additional ground that for ATP they would involve backdoor nationalisation and worker control. *Danish* funds have to hold 60 percent in domestic debt instruments, although since 1990 they have been allowed to hold 20 percent in foreign assets. Investment in the sponsor is forbidden. Mutual societies providing pensions in *France* (via group-insurance policies) must follow insurance regulations which insist that they invest at least 34 percent in state bonds, and a maximum of 40 percent in property and five percent in shares of foreign insurers.

Such limits are not, however, imposed in all the countries studied. For example, pension funds in the *United States* are subject to a 'prudent man rule' which requires managers to diversify portfolios²⁷; the primary

²⁵For example, by closing down all alternative investment strategies such as international diversification.

²⁶One way to avoid the regulations on equities and foreign investment is reportedly to invest via special security funds, whose investments are not subject to restriction.

²⁷The precise wording is that fund money must be invested "for the sole benefit of the beneficiaries" and investments must be made with "the care, skill, prudence and diligence under the circumstances then prevailing that a prudent man acting in a like capacity and familiar with such matters would use in the conduct of an enterprise of a like character and with like aims"

limit to portfolio distributions is a 10 percent limit on self investment for defined benefit funds and some defined contribution funds. *United Kingdom* pension funds are subject to trust law and implicitly²⁸ follow the 'prudent man' concept; as long as trust deeds are appropriately structured they are not constrained by regulation in their portfolio distribution except for limits on self-investment (five percent) and concentration. *Australian* funds' investment has been unrestricted since exchange controls were abolished in 1983 and public sector funds were deregulated in 1985, except for a 10 percent limit on exposure to the sponsor. *Dutch* private funds face no legal restrictions, except for a five percent limit on self investment, see Van Loo (1988). In contrast, the Dutch public service fund (ABP) faces strict limits, being able to invest only 10 percent abroad, and 20 percent in shares or real estate. Some countries have switched to prudent man rules; *Canadian* funds were strictly regulated until 1987 (when the prudent man concept was introduced) and have until recently faced limits on the share of external assets.

To conclude, funding and portfolio regulations differ quite significantly, with some countries using only accrued-benefit based funding and others projected benefits. The division for portfolio regulations, between countries with prudent man rules and regulations, is even more stark. In the next sections we probe the consequences of such rules for portfolios.

How Are Pension Assets Invested?

The portfolio distribution and the corresponding return and risk on the assets held are the key determinant of the cost to the company of providing a pension in a defined benefit plan and the replacement ratio obtainable via a defined contribution fund (and hence in each case the yield that can be obtained by funding relative to that of pay-as-you-go). This section seeks to trace the various influences on portfolio distributions, in particular those of the portfolio and funding regulations outlined above.

How might funds be invested in the absence of portfolio regulation? As shown by Black (1980), for both defined benefit and defined contribution funds, there is an incentive to maximise the tax advantage of pension funds by investing in assets with the highest possible spread between pre-tax and post-tax returns. In 1980 in the United States this was bonds, but some analysts suggest that since 1986 the relative tax advantage to equities has declined sharply, making them candidates for pension fund investment on this basis (Chen and

²⁸There is no explicit prudent man rule, but the duty of prudence to trustees can be interpreted as requiring diversification.

Reichenstein 1993).²⁹ Apart from this a defined contribution pension plan would seek to diversify, seeking to maximise return for a given risk, and shift to lower risk assets for older workers as they approach retirement.

More complex considerations arise for defined benefit funds. First, there is an incentive to overfund to maximise the tax benefits, as well as to provide a larger contingency fund, which as noted is usually counteracted by government-imposed limits on funding. Meanwhile, appropriate investment strategies will also depend on the nature of the obligation incurred. If it is the ABO and is purely nominal, with penalties for shortfalls, it will be appropriate in theory to match (or "immunize") the liabilities with bonds of the same duration to hedge the interest rate risk of these liabilities, or at least to hedge against the risk of shortfall when holding more volatile securities. With a projected benefit obligation target, an investment policy based on diversification may be most appropriate, in the belief that risk reduction depends on a maximum diversification of the pension fund relative to the firm's operating investments (Ambachtsheer 1988).³⁰ Moreover, if the projected liability includes an element of indexation, then fund managers and actuaries typically assume that may be appropriate to include a proportion of equities and property in the portfolio as well as bonds, to minimise the risk of longer term shortfall of assets relative to liabilities³¹ - implicitly diversifying between investment risk and liability risk (which are largely risks of inflation)³², see also Deakin (this volume).

An essential counterpart to such an approach is that regulators allow gradual amortisation of shortfalls, or even focus in solvency calculations on income from assets rather than market values, as in the United Kingdom. Allowing inflation indexation of pension to be discretionary, as is the case in most countries other than the United Kingdom and Germany, is another way to reduce the risk of shortfall - implicitly it is a form of risk-sharing between firm and workers. Maturity will also affect optimal portfolios; Blake (1994) suggests that given the varying duration of liabilities it is rational for immature defined benefit funds having "real" liabilities to invest mainly in equities (long duration), for mature funds to invest in a mix of equities and bonds, and funds which are winding-up mainly in bonds (short duration).

²⁹Their analysis has been criticised for assuming that individuals realise capital gains on equities each year, which seems unlikely to be the case.

³⁰This approach, while being fully consistent with a prudent man rule, highlights the high-risk nature of book reserve or pay-as-you-go provision for private firms.

³¹Whether holding equities does help in this sense is a matter of some controversy in the literature, see the discussion above.

³²Such insights are formalized in so-called asset-liability modelling exercises - an actuarial technique which involves comparison of forecasts of liabilities in coming years with asset returns under various scenarios, which shows both risks to the employer and possible changes to portfolio strategy that may be warranted (Blake 1992).

It is important to note that many financial economists disagree with the implicit assumptions which may underlie a strategy of equity investment, namely that equity is a hedge against inflation, and that raising the share of equity reduces costs, as opposed to merely raising expected returns, and offering benefits of diversification, see Bodie (1990). We do not seek to take sides in this debate in this chapter. Suffice to note here that Tepper (1992) suggests that the debate hinges on whether returns on equity are statistically independent from year to year. If they were, it is quite conceivable that a long series of bad returns could lead to significant real losses from equities even over a long time-horizon relevant to pension funds. But proponents of the view that equities outperform bonds over long time horizons would maintain that there are reversals in trends in returns to ensure owners of capital are compensated over the long term. They suggest that although underperformance of equities is quite common in the short term, long term underperformance would entail economic collapse, which governments would seek to resist. Also of interest in this context is the suggestion that the premium in returns of equities over bonds is more than can be explained by relative risk (Mehra and Prescott 1985), which if correct implies that risk-neutral investors such as pension funds can gain from holding equities.

The actual patterns of portfolio distributions over the past two decades are shown in Table 5. There are marked differences, for example in 1990 equity holdings varied from one percent in Sweden to 63 percent in the United Kingdom, and foreign assets from one percent in Denmark to 18 percent in the United Kingdom. As background, estimates of real total returns and their standard deviations for 1967-90 are shown in Table 6. Davis (1995) offers a detailed analysis of these patterns of portfolio distributions and their determinants. Here we offer an overview of certain key determinants, grouping by type of influence.

In line with the discussion above, *liabilities* are a major influence, for example on the share of bonds. In countries such as Canada, with a high share of bonds, only nominal returns have historically been promised after retirement, while in the United Kingdom, where bond holding is low, a degree of inflation protection both before and after retirement is expected. Similar indexation promises are made by the Swedish supplementary national plan, despite which the bond share is extremely high, suggesting an inefficient portfolio allocation.

Historically the higher *taxation* on bonds than equities made the former an attractive investment to tax-exempt investors such as pension funds, but as noted recent analyses suggest that equities are now less advantaged in the United States, and hence should be more attractive, and indeed bond shares in the United

States have declined somewhat. Often portfolio regulations force funds to hold tax-disadvantaged assets, as in Denmark, where funds must hold 60 percent fixed-interest assets, despite the real interest tax on such assets.

Asset returns, both absolute and relative to other assets, are a key influence on the structure of any portfolio. This is confirmed by econometric analysis of the portfolio distributions of pension funds, (Davis 1988) which shows they are strongly influenced by relative asset returns, particularly where there are few regulations governing portfolio distributions and low transactions costs, as in the United Kingdom and the United States. Adjustment to a change in such returns is generally rapid. Assuming adequate information and appropriate incentives to fund managers, this should imply an efficient allocation of funds and correct valuation of securities. In Davis' research, these results did not all hold where transactions costs are high and regulations are strict - eg, in Germany, Japan and Canada. In these countries adjustment to a change in returns is somewhat slower and allocation of funds less efficient. The results also contrast with those for

As noted, *international diversification* can offer a better risk/return tradeoff to fund managers, by reducing the systematic risk of investing in domestic markets arising from the cycle or medium term shifts in the profit share. In a longer-term context, international investment in countries with a relatively young population may be essential to prevent battles over resources between workers and pensioners in countries with an ageing population (Davis 1994). Table 5 shows that foreign asset holdings have grown sharply over the 1980s in the United Kingdom, Australia and Japan. In all three countries, this pattern followed abolition of exchange controls, at a time particularly in the United Kingdom and Japan when the economies were generating current account surpluses and overseas investment returns looked attractive. In Japan, portfolio restrictions on overseas investment were also progressively eased over the 1980s. Meanwhile Dutch funds have long held a significant proportion of assets abroad, partly due to the large volume of pension fund assets compared with domestic security and real estate markets. Growth has been much less marked in the other countries; in Germany, Switzerland, Denmark, Sweden and Canada this is partly due to portfolio restrictions.

Risk aversion of trustees or managers may limit portfolio distributions, and at times appears directly counter productive. In the Netherlands equity holding remains low - 20 percent - despite absence of portfolio restrictions. Van Loo (1988) suggests that this may relate to risk aversion of pension fund trustees.³³ Partly reflecting portfolio regulations, although probably also due to conservatism of managers (since the limits do not currently bind) the equity share in countries such as Sweden and Denmark is exceptionally low, despite the Danish tax on real returns to debt instruments, which encourages substitution of equities for bonds. Risk aversion may also play a role in many countries in limiting international investment, whereas it actually *reduces* risk over a time horizon relevant for pension funds (Table 10). Risk aversion appears particularly marked for defined contribution funds; this is partly rational, given the lack of risk sharing, and workers nearing retirement will be anxious for low risk assets to be held.³⁴ But this risk aversion may be excessive. Indeed, United States evidence (Rappaport 1992) suggests that when employees have control over investment - as is often the case for defined contribution funds - the vast majority goes into fixed interest bonds; when equities are held and their value declines, dissatisfaction is often expressed. Even for defined benefit funds, pressures to hold low-risk assets may be sizeable with an ageing membership and employee trustees. But such

³³Also according to Wyatt (1993) there are unofficial tolerance limits for equity exposure of 30%, imposed by the supervisors.

³⁴This point indicates the inflexibility of company-based defined-contribution pans seeking to cater both for risk-seeking young workers and risk-averse older ones. Some funds, such as BT in Australia, overcome this by offering four separate funds at different levels of risk.

pressures also seem to occur when the fund is composed of younger workers.³⁵ Again, for personal pensions, there is anecdotal evidence in the United Kingdom that persons free to choose their asset backing often select highly cautious combinations of assets. In the United States only 25 percent of 401(k) plan assets, where individuals are free to choose their portfolio allocations, are invested in equity (Frijns and Petersen 1992). Mitchell (1994) expresses concern that as a consequence of conservative approaches to investment, future retirees may find their pensions inadequate.

Portfolio regulations have a clear and widespread influence on portfolios, a number of which have already been mentioned. Bonds constitute over two thirds of pension fund assets in Sweden and Denmark; this is largely due to portfolio regulations and the nature of the domestic financial markets, which require 60 percent of Danish assets to be invested in domestic debt instruments, while the majority of Swedish assets are to be in listed bonds, debentures and retroverse loans. Investment of a fifth of the Swedish quasi-public funds' assets in government bonds casts some doubt on their efficacy as a means to protect against future risks to social security, given the bonds are to be repaid by the taxpayer in the same way as they would to finance future social security burdens via pay-as-you-go. Similar comments can be made about the Dutch civil servants' pension fund (ABP), which is subject to severe portfolio restrictions, such that at end-1991 it held 48 percent of its assets in the form of public sector bonds and loans. The decline in public bond holding in Australia parallels the removal of portfolio requirements that formerly required the majority of assets to be held in government securities. As regards equities, it was noted above that German funds are limited to a maximum of 20 percent by regulation and Japanese to 30 percent - hence at 18 percent and 27 percent respectively in 1990, the German and Japanese ceilings were almost binding. Unlike other sectors, which have decreased holdings of property in recent years, Swiss funds retain around a fifth of their assets in property; one of the few assets that were relatively under their pre-1993 portfolio restrictions. This focus may drive up the price of land, does not contribute to capital formation, and funds may face decreasing returns on (domestic) property in the future, as the population declines.

Funding rules also have an effect. In the United States, where minimum funding regulations make it optimal to hold a large proportion of bonds to protect against shortfall risk, despite their weakness as an inflation hedge, bonds form around 40 percent of pension funds' portfolios. Bodie (1991) suggests that given such funding rules, it is a paradox that United States defined benefit funds invest in equities, since a drop in

³⁵Research by Mitchell (1994) suggests that employees representation reduces returns even for *defined benefit* funds, although in principle the employer is bearing the risk.

market values can cause underfunding which has to be reflected in the employer's profit and loss account. He suggests it occurs because management sees a plan as a trust for employees, and manages assets as if it were a defined contribution plan (i.e. for employee welfare), with a guaranteed floor given by the benefit formula. Swiss bonds offer low returns, but given the low target yield of four percent nominal, fund managers there historically saw little need to diversify into riskier assets.

As regards *accounting standards*, in Japan, assets are held at book value, and a fixed return on the fund (based on interest and capital gains) is targeted for every year. This gives perverse incentives to sell well-performing equities as general share prices fall and retain those showing price declines, as well as to hold more bonds than portfolio optimisation would imply (Tamura 1992). In Germany and Switzerland, Hepp (1990,1992) suggests that application of strict accounting principles, which are more appropriate to banks than pension funds, restrains equity holdings by funded plans independently of the portfolio regulations (evidenced, in Switzerland, by the fact that funds' equity holdings are far below the ceilings permitted). These conventions, for example, insist on positive net worth of the fund at all times, carry equities on the balance sheet at the lower of book value and market value and calculate returns net of unrealized capital gains. In contrast, the United Kingdom accounting standard permits long-run smoothing and focuses on dividends rather than market values, and hence enables funds to accept the volatility of equity returns. The concern of some commentators in the United Kingdom is rather whether equity holdings are *too high* given the risks; however, note that 18 percent of the 63 percent equity share in 1990 was actually in foreign equities, thus reducing risk somewhat. In 1992 the equity share was 80 percent, of which 58 percent were domestic and 22 percent foreign. No other country has anything comparable to this portfolio share of equities. And as noted, new legal proposals may lead funds to reduce their equity shares.

The structure of *fund management* in countries such as Japan has had counter productive effects, according to some commentators. There the share of loans has fallen sharply, although these medium-term floating-rate yen loans to firms were consistently the most profitable investment in Japan in the 1970s. It can be argued that this highlights a general point, that protection of fund managers from external competition (as was the case in Japan until recently) may lead to a sub-optimal investment strategy from the point of view of plan beneficiaries.

Finally there is *administrative fiat*. Much of the past growth of Japanese funds' bond holdings may reflect the high share of public bonds purchased under government pressure, a practice that has now been abandoned.

Funds' Performance

It is evident from the discussion above that a wide variety of often-extraneous influences impinge on pension funds' portfolios, which may in turn restrict funds from portfolio optimisation, reduce return and raise risk relative to feasible alternative investment strategies. We suggest that a useful means of judging the cost of these regulations and market imperfections - as well as in devising appropriate contribution rates - is to assess pension funds' performance both relative to that in other countries and to that of artificial portfolios. The patterns of portfolio distributions (Table 5) and risks and returns on assets can be used to derive estimates of the returns and risks on portfolios (Table 6³⁶), and hence the cost to the firm of providing a given level of pension benefits (for a defined benefit fund), or the return to the member (for a defined contribution fund). The estimates suggest that pension funds in the United Kingdom obtained the highest real return over the period 1967-90, those in Sweden, Switzerland, Canada and the United States³⁷ the lowest. The result of course partly reflects risk and the share of equity and property, the United Kingdom having the highest standard deviation of returns (together with Denmark), and by far the highest share of real assets. Meanwhile, Swedish, Swiss, United States and Canadian funds held high proportions of bonds, which performed poorly over this period. Note that United States funds are also high-risk in real terms despite relatively conservative portfolios; this is mainly due to unanticipated inflation in the 1970s, but it may also relate to funding rules and tax incentives. Interestingly, portfolios in Germany and the Netherlands had a high real return and low volatility, despite their focus on bonds and loans. This relates to relatively high returns on fixed-rate instruments in those countries. However, as discussed below, Table 9 shows that real returns for German and Dutch funds could have been boosted significantly by an increased share of equities. Investment in international equities would ensure that the associated increase in risk was mitigated.

³⁶Annual holding period returns on marketable fixed - rate instruments are used, as in Table 6, instead of redemption yields. In our view, the holding period returns are the more relevant measure for an ongoing portfolio, since they take full account of losses or gains due to interest rate changes (although other assumptions regarding holding periods could also be made).

³⁷The return in the US and Canada is considerably higher if the sample begins in 1971 (4.0% and 2.7% respectively).

Several observations can be made regarding these results. The publicly sponsored Swedish fund does poorly. The low-return Swedish and Swiss - and latterly the Australian system - are also compulsory, thus in principle reducing competitive pressures. In the case of Australian and Danish funds, occupational defined contribution funds imply that those who select the managers - companies themselves - do not bear the high level of portfolio risk. The Japanese, Swiss and Germans have generally had little competition in fund management (Davis 1995), and suffer from inappropriate accounting standards. But as shown by the results for Germany, good economic performance - or international diversification - can overcome a number of handicaps. Comparison, in Table 6, of the results with (nominally) risk free yields suggests that the funds generally outperformed government bonds, albeit only narrowly in Denmark. However, in Canada and Sweden the portfolio return is below that on market paper (it is open to doubt whether the markets were deep enough to absorb pension funds' size, of course). Returns are generally below those on equities, but at a benefit of much lower risk.

The most crucial test is ability of a fund to outperform real average earnings, given that liabilities of defined benefit plans are basically indexed to them. Similarly the replacement ratio a defined contribution fund can offer will depend on asset returns relative to earnings growth. Following the discussion in the first section, it also indicates whether in practice the return to funding (the asset return) exceeds that on pay-as-you-go in a steady state (the growth rate of average earnings). The margin is sizeable (over two percent pa) in the United States and United Kingdom, and between one percent and two percent in Germany and the Netherlands. Except for Germany, all of these countries have "prudent man" rules. It remains positive in Denmark and (barely) in Australia. But in Sweden, Japan, Canada and Switzerland, it is actually negative, implying that the returns on assets need to be constantly topped up to meet their target. It was noted above that this may relate to inefficient asset allocations, often arising from portfolio restrictions. Taking the results at face value, and disregarding demographic issues, pay-as-you-go would have offered a higher rate of return than funding over this time period in these countries.

Risk (measured crudely as the standard deviation of the annual real return) should not be disregarded; as noted, it is quite high in a number of countries. But defined benefit pension funds are well-placed to accept a degree of volatility, as there can be risk-sharing between worker and company as well as between younger and older members. Risk is more important for defined contribution funds as there is no backup from the sponsor and pensions must typically be taken in a lump sum (to buy an annuity) at the precise point of

retirement. In contrast, annuities from defined benefit funds typically come from the fund itself, or at least the rate is guaranteed. In the light of this, the high levels of risk in Denmark and Australia, where funds are mainly defined contribution, are of potential concern.³⁸

The data for the United Kingdom and United States allow a further comparison of effects of ownership and management methods to be made, this time in the same markets, in that portfolios of public (local government) fund data can be identified separately from those of private-sector funds. Estimates of the respective returns are shown in Table 7. In each case, local government funds obtain lower returns than private funds. This can be related to more conservative portfolio distributions and in some cases portfolio regulations. United Kingdom local authority funds held an average of 52 percent equity over the sample, while private funds held 56 percent. For United States funds the difference is more dramatic; 25 percent and 53 percent, according to the Federal Reserve Flow-of-Funds data. Interestingly, the risks in real terms were higher for the local government funds, partly as a consequence of the volatility of real returns on bonds, see Table 6. In this context, Mitchell (1994) analysed returns and funding ratios on a sample of United States state and local government pension funds and found, consistent with the discussion of risk aversion and of portfolio regulations above, that both returns and funding were lower when retirees and employees were on the board, and when "social investment" (i.e. a proportion of the portfolio invested in local companies) was required.

In order to estimate the benefits/contributions tradeoff, Table 8 shows the results of illustrative calculations on the relation between costs of providing pensions, average earnings and real returns (provided in Vittas 1992). The table shows the replacement rate that would be attainable given the real returns attained by funds in each country and the corresponding growth rates of wages shown in Table 6, assuming indexed pensions, a 10 percent "defined" contribution rate, 40 years of contributions and 20 years retirement. Abstracting from risk, the table illustrates clearly the benefits of a higher return relative to real earnings; assuming pensions are indexed to prices, United Kingdom funds can obtain a replacement ratio of 60 percent, Canadians only 25 percent. Conversely, to obtain a pension equal to 40 percent of average earnings, United Kingdom funds need a contribution rate of 6.7 percent, and Swiss funds of 16 percent.

Of course, in practice contribution rates are sometimes higher than 10 percent, implying higher potential benefits; for example the Australian government mandates a minimum of 12 percent beginning in 2000.

³⁸ Knox (1993b) shows that returns on a fund based on 12% contributions with 45 years of payment invested, similarly to current Australian pension funds, will obtain an average replacement rate of 61%, but the range of statistical probability of returns based on asset volatility in the past is between 35% and 96%.

Danish contributions tend to be around 10-15 percent, despite there being no ceiling imposed by taxation. Such ceilings are standard practice elsewhere, for example, in the United Kingdom, total contributions are limited to 17.5 percent of the employee's salary, and the maximum employee contribution is 15 percent of salary. Typically, employees contribute 5.5 percent and employers the remainder. However, in the United Kingdom, employers do not contribute on behalf of those opting out of company plans in favor of personal pensions, which reduces typical contributions to six percent. United States employers typically do contribute to employees' 401(k) plans, although these have many of the characteristics of United Kingdom personal pensions. In Sweden, contributions are 13 percent. In countries such as Germany, where private pension plans have limited 'supplementary' objectives, contributions are typically much lower, around 3.5 percent of salary. In Japan, contributions to funds remaining in social security (TQPPs) are limited to 3.2 percent of salary regardless of the condition of the fund. Funds replacing social security (EPFs) are more flexible - contributions are set to obtain the promised benefit given an assumed nominal return of 5.5 percent. The distribution of contributions between employer and employee varies widely, although it need not have significant economic implications if employers reduce salaries to offset their contributions. The proportion paid by the employer is around 100 percent in Japan and Sweden, 89 percent in Germany³⁹, 87 percent in the United States (100 percent for most private defined benefit funds), 70-75 percent in the United Kingdom, Canada and the Netherlands, 66 percent in Denmark and 58 percent in Switzerland.

As a further experiment, Table 9 shows the returns on artificial diversified portfolios holding 50 percent equity and 50 percent bonds between 1967 and 1990, implicitly assuming quantitative portfolio restrictions are replaced by prudent man rules. As noted, equity holdings are generally below 50 percent (Table 5). Compared with Table 6, the results confirm that returns may be boosted by raising the share of equity, at some cost in terms of risk, although the estimates suggest that risk is mitigated by international diversification⁴⁰. Only for the United Kingdom are returns consistently below those actually obtained; for the United States there is little difference, since the portfolio approximates that actually held by United States funds (Table 5). Several of the countries which fell below a satisfactory return on assets relative to average earnings (such as Japan, Australia, Denmark and Sweden) would have found provision of funded pensions less costly - of itself and

³⁹Employees may not contribute to book reserves or support funds.

⁴⁰The table only shows international diversification up to 20% of the portfolio, holding bonds and equities for the "rest of the world" in proportion to global portfolio weights in the 1980s. A full "global portfolio", where domestic holdings are reduced to their weight in the global index, would imply 95% international investment for the small countries, and over 50% even for the US. Similar calculations for such a strategy (not shown in detail), with again 50% bonds and 50% equities, again shows lower risk, although the change in return may be in either direction.

relative to pay-as-you-go - if they had followed such a rule. German funds would also have boosted their headroom considerably.

Summarizing this section, it is suggested that support is given to a prudent man rule, backed by flexible accounting and funding standards (perhaps, as in the United Kingdom, focusing on income rather than market value) to permit holding of a proportion, varying with the maturity of the fund, of high-return but volatile assets (it is not, of course, implied that 100 percent equity portfolio would be anything but *imprudent*). Since foreign investment is shown invariably to reduce risk, albeit often with a slight reduction in return, limits on such holding are suggested to be particularly counter productive. Meanwhile, decentralized fund management may be superior to centralized, if the poor performance of the Swedish ATP fund can be generalized.

Conclusion

The diversity of experience in the external funding of private pensions has been shown to be influenced particularly strongly by social security and fiscal regulations, as well as funding regulations per se. A generous and compulsory social security system across a broad range of incomes can effectively "crowd out" private pensions, while discriminatory tax treatment can discourage external funding. Such structures are suggested to be counter productive in the light of the higher return to funding relative to pay-as-you-go both in a steady state and in the light of the ageing of the population and the more adverse side effects of pay-as-you-go on economic efficiency, as well as the greater risk and danger of inefficient investment from "booking". An optimal system would probably include only a minimal pay-as-you-go sector catering for basic needs and for alleviation of poverty, with the bulk of earnings replacement being provided by private externally-funded plans. Only Australia (and Chile) approximate to this at present.

Meanwhile the efficiency with which pension funds provide pensions is shown to be influenced by regulations such as those of minimum funding and of portfolios, as well as features such as taxation, accounting standards and the competitiveness of fund management. In effect, these prevent the fund from reaching an optimal tradeoff between risk and return. It is suggested that streamlining of such regulations so as to allow prudent man rules and flexible funding limits may increase coverage of private pensions by increasing their attractiveness to the sponsor or member, or in the case of compulsory provision, reduce the cost of providing a given level of private pensions in terms of competitiveness. Other issues which arise in this context

include the appropriate degree of risk for defined contribution funds as opposed to defined benefit funds, and, conversely, the potential for excessively conservative investment strategies when employees are influential in fund management. Given the existing size and importance of pension funds in the countries studied, as well as buoyant prospects for development of occupational funded pensions in both European Union and Developing countries, these issues are of considerable importance.

REFERENCES

Aaron, Harry J. 1966, "The Social Insurance Paradox", *Canadian Journal of Economic and Political Science*, 32, 371-77.

Ambachtsheer, Keith. 1988, "Integrating Business Planning With Pension Fund Planning", in eds, R Arnott and F Fabozzi *Asset Allocation; A Handbook*, Probus, Chicago.

Black, Fischer. 1980, "The Tax Consequences Of Long-Run Pension Policy", *Financial Analysts Journal*, September-October, 17-23.

Blake, David. 1992, *Issues In Pension Funding*, Routledge, London.

Blake, David. 1994, "Pension Schemes As Options On Pension Fund Assets; Implications For Pension Fund Asset Management", mimeo, Birkbeck College, London.

Blanchard, Olivier J. 1993, "The Vanishing Equity Premium", in ed R O'Brien, *Finance And The International Economy* 7, Oxford University Press.

Bodie, Zvi. 1990, "Pensions As Retirement Income Insurance", *Journal of Economic Literature*, Vol 28, 28-49.

Bodie, Zvi. 1991, "Shortfall Risk And Pension Fund Asset Management", *Financial Analysts Journal*, May/June 1991.

Bodie, Zvi and Merton, Robert C. 1992, "Pension Benefit Guarantees In The US; A Functional Analysis", in ed. R Schmitt *The future of pensions in the US*, University of Pennsylvania Press.

Chen Andrew H and Reichenstein William. 1993, "Taxes And Pension Fund Asset Allocation", *The Journal of Portfolio Management*, Summer 1992, 24-27.

Davis, E Philip. 1988, "Financial Market Activity Of Life Insurance Companies And Pension Funds", Economic Paper No. 21, Bank for International Settlements, Basle.

Davis, E Philip. 1995, *Pension Funds, Retirement-Income Security And Capital Markets, An International Perspective*, forthcoming, Oxford University Press.

Davis, E Philip. 1994, "International Investment Of Pension Funds In Europe; Scope And Implications For International Financial Stability", Paper presented at a conference on "Pensions Privatisation", Santiago, Chile, 26-27 January 1994.

Deutsche Bundesbank. 1984, "Company Pension Schemes In The Federal Republic Of Germany", *Deutsche Bundesbank Monthly Report*, August, 30-37.

Feldstein, Martin and Morck Randall. 1983. "Pension Funding Decisions, Interest Rate Assumptions And Share Prices", in eds. Bodie, Zvi and Shoven, John *Financial Aspects Of The US Pension System*, University of Chicago Press.

- Frijns, Jan and Petersen, Carel. 1992. "Financing, Administration And Portfolio Management; How Secure Is The Pension Promise?", in *Private Pensions And Public Policy*, Organisation for Economic Cooperation and Development, Paris.
- Hepp, Stefan. 1990. *The Swiss Pension Funds*, Paul-Haupt, Berne.
- Hepp, Stefan. 1992. "Comparison Of Investment Behaviour Of Pension Plans In Europe - Implications For Europe's Capital Markets.", in ed. Mortensen Jurgen, *The Future Of Pensions In The European Community*, published by Brassey's, London, for the Centre for European Policy Studies, Brussels.
- James, Estelle. 1994. *Income Security In Old Age*, forthcoming, The World Bank, Washington DC.
- Knox, David M. 1993. "An Analysis Of The Equity Investments Of Australian Superannuation Funds", Research Paper No. 6, Centre for Actuarial Studies, University of Melbourne.
- Kotlikoff, Laurence J. 1992. "Social Security", *New Palgrave Dictionary of Money and Finance*, MacMillan, London.
- Mehra, Rajnish and Prescott, Edward. C. (1985), 'The equity premium; a puzzle', *Journal of Monetary Economics*, 15, 145-61
- Meier Peter. 1993. "Aus Der Praxis; Anlagestrategien Für Pensionskassen - Auswirkungen Der Neuen Anlagerichtlinien", *Finanzmarkt und Portfolio Management*, 7, 365-72.
- Merton, Robert C. 1983. "On The Role Of Social Security As A Means For Efficient Risk Sharing In An Economy Where Human Capital Is Not Tradeable", in eds Bodie, Zvi, Shoven, John and Wise, David, *Financial Aspects Of The US Pension System*, University of Chicago Press.
- Mitchell, Olivia S. 1994. "Public Pension Governance And Performance", Paper presented at a conference on "Pensions Privatisation", Santiago, Chile, 26-27 January 1994.
- OECD. 1993. "Pension Liabilities In The Seven Major Industrial Countries", mimeo for Working Party 1, Organisation for Economic Cooperation and Development, Paris.
- Pestieau, Pierre. 1992. "The Distribution Of Private Pension Benefits; How Fair Is It?", in *Private Pensions And Public Policy*, Organisation for Economic Cooperation and Development, Paris.
- Rappaport, Anna M. 1992. "Comment On Pensions And Labor Market Activity", in eds. Bodie, Zvi and Munnell, Alicia H, *Pensions And The Economy*, Pensions Research Council and University of Pennsylvania Press, Philadelphia.
- Riley, Barry. 1993. "Why Pension Funds Are Glum At The Bull Market", *Financial Times*, 6/12/93.
- Romer, Paul. 1986. "Increasing Returns And Long Run Growth", *Journal of Political Economy*.
- Tamura Matsuhiro. 1992. "Improving Japan's Employee Pension Fund System", *Nomura Research Institute Quarterly*, Summer 1992, 66-83.
- Thompson Lawrence H. 1992. "Social Security Surpluses", *New Palgrave Dictionary of Money and Finance*, MacMillan, London.
- Van Loo Peter D. 1988. "Portfolio Management Of Dutch Pension Funds", De Nederlandsche Bank, Reprint 197.
- Vittas, Dimitri. 1992. "The Simple(r) Algebra Of Pension Plans", Mimeo, The World Bank.
- Wyatt Data Services. 1993. *1993 Benefits Report Europe USA*, The Wyatt Company, Brussels.

Table 1: Indicators Of The Comparative Advantage Of Pay-As-You-Go Versus Funding

| Percent | Average population growth (1970-90) | Growth rate of real average earnings | Real return to pay as you go in steady state(1) | Real return on balanced portfolio(2) | Real return from pension funds(3) | Real return on equity(4) | Ratio of population over 65 to 15-65 in 1980 and 2050 |
|----------------|--|---|--|---|--|---------------------------------|--|
| United Kingdom | 0.1 | 2.6 | 2.7 | 3.7 | 5.8 | 8.1 | 23.1/30.4 |
| United States | 1.0 | 0.2 | 1.2 | 2.8 | 2.2 | 4.7 | 18.7/31.8 |
| Canada | 1.1 | 1.7 | 2.8 | 2.2 | 1.6 | 4.5 | 16.8/36.4 |
| Japan | 0.85 | 4.2 | 5.05 | 5.3 | 4.0 | 10.9 | 16.6/37.6 |
| Germany | -0.5 | 4.0 | 3.5 | 6.2 | 5.1 | 9.5 | 22.5/42.3 |
| Netherlands | 0.6 | 2.4 | 3.0 | 4.2 | 4.0 | 7.9 | 18.5/38.1 |
| Sweden | 0.15 | 1.5 | 1.65 | 3.7 | 0.2 | 8.4 | 27.4/35.8 |
| Denmark | 0.2 | 2.8 | 3.0 | 4.6 | 3.6 | 7.0 | 22.7/39.8 |
| Switzerland | 0.2 | 1.9 | 2.1 | 2.0 | 1.5 | 6.2 | 25.0/46.0 |
| Australia | 1.45 | 0.7 | 2.15 | 2.8 | 1.6 | 8.1 | 16.6/32.0 |
| France | 0.5 | 4.0 | 4.5 | 4.9 | n/a | 9.4 | 21.0/37.8 |
| Italy | 0.35 | 3.3 | 3.65 | 2.0 | n/a | 4.0 | 20.3/37.8 |
| Chile | 1.65 | 6.6 | 8.25 | n/a | n/a | n/a | n/a |
| Singapore | 1.3 | 3.6 | 4.9 | n/a | n/a | n/a | n/a |
| | | | | | | | |

(1) Sum of population growth and earnings growth.

(2) 40 percent domestic equities, 40 percent domestic bonds, 10 percent foreign equities, 10 percent foreign bonds.

(3) Average over 1967-90 (see Table 6).

(4) Average over 1967-90 (see Table 6).

Source; Davis (1995).

⁴¹**Table 2: Assets Of Pension Funds end-1991 (US\$ bn)**

| | Narrow definition ¹ | | | Broad definition ² | | |
|----------------|-------------------------------------|--------------------------------|-------------|-------------------------------------|--------------------------------|-------------|
| | Stock of assets (end-1991) \$ bn | % of personal sector assets | % of GDP | Stock of assets (end-1991) \$ bn | % of personal sector assets | % of GDP |
| United States | 2915 | 22 | 51 | 3780 | 29 | 66 |
| United Kingdom | 643 | 27 | 60 | 786 | 33 | 73 |
| Germany | 59 | 3 | 3 | 80(3) | 4 | 4 |
| Japan | 182 | 2 | 5 | 303(3) | 3 | 8 |
| Canada | 187 | 17 | 32 | 205 | 19 | 35 |
| Netherlands | 145 | 26 | 46 | 242 | 43 | 76 |
| Sweden | 87 | n/a | 33 | - | - | - |
| Denmark | 22 | n/a | 16 | 82 | n/a | 60 |
| Switzerland | 173 | n/a | 70 | - | - | - |
| Australia | 62 | 19 | 22 | 110 | 34 | 39 |

1. Includes only independent (private and public sector) funded pension schemes, except Sweden - public ATP scheme.
2. For the United States, Australia, Canada and Denmark includes data for pension reserves of life insurers; for the United Kingdom and Japan includes estimates of life insurance companies' pension fund reserves; for Denmark includes funds managed by banks; for the Netherlands includes the Civil Service Pension Fund (ABP).
3. In Germany and Japan there are large reserve funded (or "booked") pension plans with assets held directly on the sponsoring firm's balance sheet. The value of these in 1991 was \$150 billion in Germany and an estimated \$120 billion in Japan.

⁴¹ Source: Davis (1995)

Table 3: Determinants Of The Size Of Funded Sectors

| | Social security replacement rate (1992), based on final salary of \$20,000 and \$50,000 (1) | Form of taxation (2) | Coverage of funded schemes | Maturity of funded schemes |
|----------------|--|--|---|--|
| United States | 65% - 40% | EET - Contributions and asset returns tax free. Benefits taxed | 46% (voluntary) | Mature |
| United Kingdom | 50% - 26%(3) | EET - Contributions and asset returns tax free. Benefits taxed, except for tax free lump sum. | 50% (company) 25% (personal); (voluntary) | Mature |
| Germany | 70%-59% | TET - Employers' contributions taxed as wages; employees' contributions and asset returns tax free. Benefits taxed at low rate. (For booked benefits, employers contributions tax free, benefits taxed at normal rate) | 42% (voluntary) | Immature |
| Japan | 54%(4) | ETT - Contributions tax free. Tax on asset returns. Benefits taxed, except for tax free lump sum. (Partial tax exemption of contributions to booked benefits.) | 50% (voluntary) | Immature |
| Canada | 34%(4) | EET - Contributions and asset returns tax free. Benefits taxed. | 41% (voluntary) | Mature |
| Netherlands | 66% - 26% | EET - Contributions and asset returns tax free. Benefits taxed. | 83% (voluntary) | Mature |
| Sweden | 69% - 49% | ETT - Contributions to ATP tax free; contributions to ITP/STP subject to social security tax. Tax on asset returns of ITP/STP. Benefits taxed at low rate. | 90% (ATP compulsory; ITP/STP voluntary) | Mature |
| Denmark | 83% - 33% | ETT - Contributions tax free. Tax on real asset returns. Benefits taxed, including 40% of lump sum payments. | 50% (voluntary) | Mature |
| Switzerland | 82% - 47% | EET - Contributions and asset returns tax free. Benefits taxed. | 90% (compulsory) | Mature (pre- BVG) Immature (post - BVG) |
| Australia | 28%-11% | TTT - Contributions, asset returns and benefits taxed. | 92% (compulsory) | Immature |
| France | 67% - 45%(5) | E(E)T - Contributions to ARRCO/AGIRC tax free; separate funded schemes forbidden; insured pension contributions tax free. | 100% (compulsory) | Mature |
| Italy | 77% - 73% | EET - Contributions and asset returns tax free, benefits taxed | 5% (voluntary) | Immature |

(1) For married man; source Wyatt (1993). (2) The abbreviations refer to taxation of contributions, returns and benefits, hence EET means contributions and returns are exempt and benefits are taxed. (3) Includes state earnings related pension scheme (SERPS). For those contracted out, the ratios are 35% and 14% (4) Ratio to average earnings in 1986. (5) Includes ARRCO.
Source; Davis (1995)

Table 4: Summary Of Pension Asset Regulations

| | Portfolio regulations | Regulation of funding (1) |
|----------------|---|---|
| United States | Prudent man concept; 10% self investment limit for defined benefit funds | ABO must be funded. Maximum 50% overfund of the ABO. Higher insurance premia if underfunded. |
| United Kingdom | Prudent man concept; 5% self investment limit, concentration limit for defined contribution plans | Maximum 5% overfund of PBO or IBO. Funding only obligatory for contracted out part of social security |
| Germany | Guidelines; maximum 20% equity, 5% property, 4% foreign, 10% self investment limit | Funding obligatory up to PBO. Option of book-reserve funding. |
| Japan | Guidelines; maximum 30% equity, 20% property, 30% foreign, 10% in one country; minimum 50% in bonds. | Tax exempt up to ABO only. Option of book-reserve funding. |
| Canada | Prudent man, tax on foreign assets over 10%, 7% limit on property. | Maximum 5% overfund of PBO. Funding obligatory. |
| Netherlands | Prudent man concept, 5% self investment limit. | Funding obligatory for IBO or PBO. |
| Sweden | Majority to be in listed bonds, debentures and retroverse loans to contributors. | IBO is funded. Contribution rate adjusted 5-yearly to balance fund. |
| Denmark | Property, shares and investment trust holdings limited to 40%, foreign assets to 20%; 60% to be in domestic debt. No self investment. | Irrelevant as defined contribution; benefits must be funded externally. |
| Switzerland | 50% limit on domestic shares, 50% on property, 20% foreign currency assets. | Funding only obligatory for ABO; PBO usually funded. 4% to be credited to accounts annually. |
| Australia | Prudent man rule | Irrelevant as defined contribution; minimum contribution rate enforced.. |
| France | Assets of supplementary funds to be invested 50% in government bonds and less than 33% in loans to sponsors. | Funded company schemes forbidden; book reserve funding subject to tax discrimination. |
| Italy | No pension law | No pension law |

(1) ABO refers to the accrued benefit obligation; PBO the projected benefit obligation.

Source: Davis (1995)

Table 5: Pension Funds' Portfolio Distributions

| Percent | | Equities | Bonds | Loans and mortgages | Property | Liquidity and deposits | Of which(1): foreign assets |
|----------------|------|----------|-------|---------------------|----------|------------------------|-----------------------------|
| United Kingdom | 1970 | 49 | 32 | 0 | 10 | 4 | 2 |
| | 1980 | 52 | 24 | 0 | 18 | 5 | 9 |
| | 1990 | 63 | 14 | 0 | 9 | 7 | 18 |
| United States | 1970 | 45 | 45 | 6 | 0 | 1 | 0 |
| | 1980 | 41 | 41 | 2 | 0 | 8 | 1 |
| | 1990 | 46 | 36 | 2 | 0 | 9 | 4 |
| Germany | 1970 | 4 | 19 | 50 | 12 | 3 | 0 |
| | 1980 | 9 | 24 | 52 | 9 | 2 | 0 |
| | 1990 | 18 | 25 | 45 | 6 | 2 | 1 |
| Japan | 1970 | 6 | 12 | 52 | 27 | 2 | 0 |
| | 1980 | 9 | 51 | 33 | 6 | 2 | 1 |
| | 1990 | 27 | 47 | 14 | 2 | 3 | 7 |
| Canada | 1970 | 27 | 53 | 11 | 1 | 5 | 0 |
| | 1980 | 26 | 50 | 12 | 2 | 9 | 4 |
| | 1990 | 33 | 47 | 4 | 3 | 11 | 6 |
| Netherlands | 1970 | 11 | 15 | 54 | 16 | 3 | 7 |
| | 1980 | 5 | 10 | 69 | 14 | 2 | 4 |
| | 1990 | 20 | 23 | 43 | 11 | 3 | 15 |
| Sweden | 1970 | 0 | 76 | 22 | 0 | 1 | 0 |
| | 1980 | 0 | 74 | 26 | 0 | 1 | 0 |
| | 1990 | 1 | 84 | 10 | 1 | 3 | 0 |
| Switzerland | 1970 | 3 | 25 | 48 | 16 | 7 | 0 |
| | 1980 | 9 | 28 | 37 | 18 | 6 | 0 |
| | 1990 | 16 | 29 | 22 | 17 | 12 | 3 |
| Denmark | 1970 | 0 | 72 | 7 | 0 | 3 | 0 |
| | 1980 | 3 | 63 | 7 | 0 | 2 | 0 |
| | 1990 | 7 | 67 | 7 | 0 | 1 | 1 |
| Australia | 1970 | 15 | 51 | 0 | 2 | n/a | 0 |
| | 1980 | 15 | 33 | 0 | 13 | n/a | 0 |
| | 1990 | 27 | 20 | 0 | 16 | 23 | 13 |

(1) Foreign assets are included in the categories to the left.

Source: National flow-of-funds data

Table 6: Returns on Pension Funds' Portfolios 1967-90 (Mean (Standard deviation) of annual real total returns)

| Percent - domestic currency | United States | | United Kingdom | | Germany | | Japan | | Canada | | Netherlands | | Sweden | | Denmark | | Switzerland | | Australia | |
|---|------------------|--------|-------------------|--------|---------|--------|-------|--------|--------|--------|-------------|--------|--------|--------|---------|-------------|-------------|--------|-----------|--------|
| Estimated portfolio return (1) | 2.2 | (11.9) | 5.8 | (12.5) | 5.1 | (4.4) | 4.0 | (9.4) | 1.6 | (9.8) | 4.0 | (6.0) | 0.2 | (7.6) | 3.6 | (12.7) | 1.5 | (6.4) | 1.6 | (14.7) |
| Average earnings growth | 0.2 | (2.1) | 2.6 | (2.5) | 4.0 | (3.1) | 4.2 | (4.2) | 1.7 | (2.8) | 2.4 | (3.2) | 1.5 | (3.5) | 2.8 | (3.6) | 1.9 | (2.1) | 0.7 | (3.4) |
| Portfolio return less average earnings | 2.0 | | 3.2 | | 1.1 | | -0.2 | | -0.1 | | 1.6 | | -1.3 | | 0.8 | | -0.4 | | 0.9 | |
| Inflation (CPI) | 5.8 | (3.0) | 8.9 | (5.3) | 3.5 | (2.1) | 5.5 | (5.3) | 6.4 | (3.0) | 4.9 | (3.1) | 8.1 | (2.7) | 7.7 | (3.2) | 4.0 | (2.5) | 9.3 | (3.0) |
| Returns on: | | | | | | | | | | | | | | | | | | | | |
| Loans | 3.5 | (2.9) | 1.4 | (5.0) | 5.3 | (1.9) | 0.9 | (4.3) | 4.0 | (3.7) | 3.8 | (3.6) | 3.4 | (3.1) | 6.1 | (3.6) | 2.6 | (2.0) | 4.0 | (5.9) |
| Mortgages | 2.0 | (13.4) | 2.0 | (5.2) | 4.7 | (1.4) | 3.0 | (4.9) | 2.4 | (12.3) | 4.3 | (2.6) | 2.6 | (3.0) | 5.8 | (3.7) | 1.3 | (2.3) | 2.3 | (4.4) |
| Equities | 4.7 | (14.4) | 8.1 | (20.3) | 9.5 | (20.3) | 10.9 | (19.4) | 4.5 | (16.5) | 7.9 | (28.2) | 8.4 | (23.3) | 7.0 | (27.5) | 6.2 | (22.3) | 8.1 | (20.8) |
| Bonds | -0.5 | (14.3) | -0.5 | (13.0) | 2.7 | (14.9) | 0.2 | (12.8) | 0.0 | (12.1) | 1.0 | (13.1) | -0.9 | (8.5) | 3.4 | (16.1) | -2.2 | (17.6) | -2.7 | (14.7) |
| Short-term assets | 2.0 | (2.5) | 1.7 | (4.9) | 3.1 | (2.1) | -0.5 | (4.6) | 2.5 | (3.3) | 1.6 | (4.0) | 1.3 | (3.5) | 1.6 | (1.8) | 1.2 | (2.2) | 1.2 | (4.9) |
| Property | 3.4 | (6.4) | 6.7 | (11.4) | 4.5 | (2.9) | 7.2 | (6.8) | 4.6 | (6.2) | 4.6 | (15.0) | n/a | n/a | n/a | n/a | 3.7 | (8.9) | n/a | n/a |
| Foreign bonds | 1.6 | (14.9) | -0.1 | (15.0) | 3.0 | (11.2) | 1.3 | (14.6) | -1.7 | (12.7) | -0.7 | (11.2) | -0.2 | (12.6) | -2.0 | (11.6) | -1.7 | (12.6) | -0.2 | (16.0) |
| Foreign equities | 9.9 | (17.2) | 7.0 | (16.2) | 10.4 | (13.5) | 7.8 | (18.7) | 5.8 | (14.3) | 6.6 | (14.4) | 7.1 | (14.0) | 5.5 | (14.32) | 5.6 | (16.0) | 7.0 | (17.0) |
| Memo: portfolio return (2) | 3.9 | (7.6) | 6.3 | (10.7) | 5.5 | (3.0) | 2.9 | (5.7) | 4.1 | (5.0) | 4.3 | (5.5) | 2.8 | (2.9) | 5.8 | (3.0) | 2.2 | (2.8) | 4.2 | (8.2) |

(1) Using holding period returns on bonds (all countries) and on fixed-rate mortgages (United States and Canada) (2) Using redemption yields on fixed rate instruments.

Source: Davis (1995), using National Flow of Funds Data (for portfolio distributions - see Table 5) and BIS macroeconomic database (for asset returns)

Table 7: Local government and private pension fund returns (1967-90)*

Mean (standard deviation) of annual real total returns (domestic currency)

| | | | |
|-----------------|-----------------------|-----|--------|
| | | | |
| United Kingdom: | Local authority funds | 4.9 | (13.4) |
| | Private funds | 5.6 | (13.0) |
| | | | |
| United States: | State and local funds | 1.2 | (12.6) |
| | Private funds | 2.7 | (11.7) |

* 1967-1988 for the United Kingdom

Source: Davis (1995)

Table 8: Targeted replacement rates with indexed pensions

| Percent | Replacement ratio assuming indexation of pensions to prices | Percentage contribution rate for 40% replacement rate | Replacement ratio assuming indexation of pensions to wages |
|----------------|---|---|--|
| United States | 37 | 10.8 | 37 |
| United Kingdom | 60 | 6.7 | 50 |
| Germany | 39 | 10.3 | 27 |
| Japan | 29 | 13.8 | 20 |
| Canada | 25 | 16.0 | 20 |
| Netherlands | 44 | 9.1 | 37 |
| Sweden | 14 | 28.6 | 11 |
| Switzerland | 25 | 16.0 | 20 |
| Denmark | 36 | 11.1 | 27 |
| Australia | 30 | 13.3 | 27 |

Source: Vittas (1992) and estimates of average earnings, inflation and real returns on pension funds shown in Table 7.

Table 9: Artificial diversified portfolios (mean (standard deviation) of real total return), 1967-90

| Percent - domestic currency | Domestic(1) | | Domestic minus estimated portfolio return (Table 6) | Domestic & international (2) | | Domestic & international minus estimated portfolio return (Table 6) | Domestic and International Minus average earnings |
|--------------------------------|--------------------|--------|--|---|--------|--|--|
| United States | 2.1 | (12.9) | -0.1 | 2.8 | (12.5) | +0.6 | +2.6 |
| United Kingdom | 3.8 | (14.8) | -2.0 | 3.7 | (14.1) | -2.1 | +1.1 |
| Germany | 6.1 | (15.2) | +1.0 | 6.2 | (13.4) | +1.1 | +2.2 |
| Japan | 5.5 | (15.5) | +1.5 | 5.3 | (14.3) | +1.3 | +1.1 |
| Canada | 2.2 | (11.2) | +0.6 | 2.2 | (10.8) | +0.6 | +0.5 |
| Netherlands | 4.5 | (17.0) | +0.5 | 4.2 | (15.2) | +0.2 | +1.6 |
| Sweden | 3.8 | (13.5) | +3.6 | 3.7 | (15.2) | +3.5 | +2.2 |
| Switzerland | 2.0 | (15.4) | +0.5 | 2.0 | (12.3) | +0.5 | +0.1 |
| Denmark | 5.3 | (18.9) | +1.7 | 4.6 | (13.4) | +1.0 | +1.8 |
| Australia | 2.7 | (16.1) | -1.1 | 2.8 | (15.1) | +1.2 | +2.1 |
| France | 5.2 | (18.0) | - | 4.9 | (15.9) | - | +0.9 |
| Italy | 1.9 | (22.1) | - | 2.0 | (18.7) | - | -1.1 |

(1) 50% domestic equity, 50% domestic bonds.

(2) 40% domestic equity, 40% domestic bonds,
10% foreign equity, 10% foreign bonds.

Source: Davis (1995)