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ARE CANADIAN PENSION PLANS DISADVANTAGED BY THE CURRENT STRUCTURE OF PORTFOLIO REGULATION?

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Abstract:

We investigate the performance of Canadian pension funds relative to those from the UK and US, in the light of the ongoing quantitative asset restrictions that still apply in Canada, compared with the purer prudent person approach in the UK and US. We find that although Canadian funds often obtain better combinations of return and risk, returns are often less than could be obtained given financial market conditions, as shown by dummy portfolios split evenly between bonds and equities, or diversified into real estate, as well as mean-variance optimal portfolios. In contrast, UK and US funds typically outperform such benchmarks. Combined with criticisms of specific Canadian regulations in the light of finance theory and empirical evidence, the paper makes a case for removal of residual quantitative restrictions in Canada, and their replacement by sole prudent person regulations.

Key words: pension funds, regulation, prudent person rule, quantitative asset restriction, mean-variance optimisation, Canada

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1 Introduction

Since pension funds comprise pooled assets, which are aimed to support people's retirement, national governments have a particular concern about their investment performance and associated risk. Even if there is no explicit insurance of benefits, if pension funds are managed poorly, and unable to pay incomes to retirees in due time, governments may have no political choice, but to incur fiscal costs to meet up these losses (Clark and Hu 2005a). Hence, national governments focus closely on how to ensure pension funds are managed in an appropriate way. Besides solvency regulation per se, the most important investment regulation for pension funds is of portfolio composition. The basic choice for pension fund portfolio regulation is between quantitative asset restrictions (direct limits on holdings of specific assets) and prudent person rules (enjoining prudent investment procedures). This paper focuses on the situation in Canada.

Although Canadian funds are today subject to a prudent person portfolio regulation, there remain a number of vestiges of the quantitative regulations of the past (OECD 2007a). These limit holdings of real estate and Canadian resource properties, limit the proportion of voting shares of individual companies, and restrict concentration of portfolio investment in securities, stocks, bonds or notes of one issuer, as well as related party investment[2]. Until 2005, funds were subject to restrictions on international investment also (see Fried (2005), OECD (2005)).

The aim of this study is to assess the degree to which the quantitative restrictions on Canadian pension plans lead to a shortfall in returns and/or higher risk compared with funds in countries where there are no such restrictions. We also consider wider deleterious implications of such regulations for pension funds, the financial sector and the economy. We study two prudent-person countries in detail alongside Canada, namely the UK and US. The study is structured as follows. In the first section we assess determinants of investment for defined benefit (DB) funds as background for discussion of regulation. We then compare pension portfolio regulations in the three countries, before going on to trace the economic rationale for prudent-person and quantitative restrictions. We survey past studies that have looked at the effects of quantitative restrictions on fund performance. We give an overview of work relevant to evaluating the regulation of Canadian funds. In this context, we oppose the view that pension funds are best kept as passive investors, not influencing capital markets. Against this can be set inter alia the growing literature on net benefits of pension fund activism in corporate governance.

We then undertake empirical work on pension fund returns and risks in Canada, the UK and the US, to evaluate whether effects of quantitative restrictions in Canada can be detected empirically. This develops from existing work in Davis (2002a) and Hu (2007). First, we compare pension fund sector return data for the three countries, also with returns on synthetic portfolios allowing for domestic and international diversification opportunities in each market. The data period here is 1966-2006, but also 1990-2006 when financial market were less subject to structural change. We also compare national average returns with estimated returns on mean-variance optimal portfolios over 1978-2006. Second, using individual pension fund data for the three countries (for three large public sector funds in each country), we assess what index returns would be on their holdings and how the returns and risks differ across the three countries and relative to benchmarks. Third, we undertake an evaluation of

[2] Investment in related parties is investment in the administrator of the plan, or an employer who participates in the plan. Although in principle this is not allowed, there are certain exceptions, e.g. when the transaction is required for the operation, or the value is immaterial to the plan (OMERS 2007a).

comparative asset growth for a wider range of large pension funds, using data for the last few years on around 20 of the "world's largest funds" in each of the three countries.

2 Pension fund investment

2.1 Investment considerations for defined benefit funds

Essential background to any assessment of optimal portfolio regulation is how pension funds should invest optimally. The general trend of current occupational pension fund sector development is away from defined benefit (DB) to defined contribution (DC) pension plans, although the funds we investigate are largely still DB and accordingly we focus here on issues related to DB. One of the key differences between these two types of pension plan is the locus of investment risk (Clark and Hu 2005b and Blake 2007a).

For DB, pension benefits are defined, in that they are always a certain percentage of the employee's final or average salary, regardless of the fund management's performance. In this context, plan sponsors bear the investment risk. In contrast, for DC plans, the investment risk is transferred to the individual employees. Plan sponsors make payments to DC plan participants' accounts by matching employees' contributions.[3] There are technically no fixed liabilities in DC funds, and focus can justifiably be placed on assets.

For DC funds, fund managers might accordingly closely follow the simplest portfolio investment theory, i.e. the mean-variance approach, where the mean is the expected return from the various investment assets in the portfolio, e.g. bonds, equities, etc., while the variance is the corresponding risk. This approach holds that a DC pension fund should in principle maximise expected return for a given risk, so as to attain as high as possible a replacement ratio[4] at retirement. In practice, in order to find the optimal asset combination along the optimal frontier, it is essential first to determine the risk preference of investors, then, based on the risk level, to find out expected returns (Blake 2003). Meanwhile, the two-fund separation theory implies that the composition of the risky portfolio should be invariant to any shift in overall risk (Markowitz 1991).[5] Risk can be varied by shifting partly into a risk free asset. On the other hand, when there is inflation, a risk free asset is not always available unless there are index linked government bonds. This makes the simple application of the two-fund theorem more problematic.

As noted by Davis (2002a) DB plans are subject to a number of risks not present for DC plans, given they have fixed liabilities in a way DC plans do not:

- Real labour earnings will affect the replacement ratio that can be financed by the pension fund, and given there is usually a guarantee of a certain replacement rate, the fund is subject to risk from this source.
- Liabilities will also be influenced by interest rates at which future pension payments are discounted, and hence there are important interest rate risks.
- Mortality risks affect the cost of the annuities provided by the fund.
- Falling asset returns will affect asset/liability balance.
- There are also risks of changes in government regulation (such as those of indexation, portability, vesting and preservation as well as changes in asset regulations) that can

[3] However, although for DC plans, any investment risk falls on individuals, it is often argued that the risk is ultimately borne by the government. The underlying rationale is that, if there are bad investment returns and either DC or DB schemes cannot deliver sufficient supplementary income to avoid pensioner poverty and income inequality, any shortfall might have to be met by the state.

[4] The replacement ratio is defined as the ratio of pension income to the final salary.

[5] When all assets are invested in the risky assets, the composition of the (total and risky) portfolio varies.

vastly and unexpectedly change liabilities. The example of the UK, where such changes have been marked, is discussed in Davis (2001).

Because in DB plans, sponsors are not only responsible for making contributions to the plan, but are also obliged to guarantee a pre-determined retirement benefit, a strategy considering both assets and liabilities is more appropriate, which is also called the asset-liability management (ALM) approach (Blake 2007a; Blake and Inkmann 2004; Blome et al 2007). Broadly speaking, ALM is a risk management technique designed to match assets and liabilities by taking into account interest rates, cash flows etc.

In principle pension plans could adopt the simplest form of ALM, called immunisation. This is suitable if the plan sponsor seeks to fund the accumulated benefit obligation and the obligation is nominal, and entails investment in fixed interest bonds[6]. Or, if the sponsor agrees to make price or inflation indexed pension payments at retirement, as is the case in most countries, long-term inflation-protected bonds should be used.[7] However, as noted in OECD (2006), however, long-term bonds with price protection are not available in many countries. Even in those countries, like the UK and the US, where financial markets are deepest, total outstanding inflation-indexed government bonds were much less than aggregated pension fund assets. Furthermore, costs of pure bond investment can be very high; notably inflation-indexed bonds tend to provide lower returns and therefore require higher contributions from plan sponsors. Two alternatives forms of ALM to immunisation, based mainly on assets and mainly on liabilities, can be distinguished, as follows:

An asset-driven policy might argue that with an indexed accrued benefit obligation (ABO) or projected benefit obligation (PBO) target, an investment policy based on diversification might be 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). Moreover, owing to explicit or implicit indexation, fund managers and actuaries typically assume that it may be appropriate to include a significant proportion of real assets such as equities and property in the portfolio as well as bonds. By doing this, they implicitly diversify between investment risk and liability risk (which are largely risks of inflation), see also Daykin (1995). Such an approach as has historically been adopted by many DB plans, puts the main focus of investment on asset returns, although Ambachtsheer (2004) argues that due to poor governance structures, the shift to risky assets may have gone too far in many funds.

More recently, liability-focused investment has come to the fore. As noted by Blake (1997), minimum funding levels and limits on overfunding provide tolerance limits to the variation of assets around the value of liabilities. If the assets are selected in such a way that their risk, return and duration characteristics match those of liabilities, there is a "liability immunising portfolio". This protects the portfolio against risks of variation in interest rates, real earnings growth and inflation in the pension liabilities[8]. Such a strategy, which determines the overall

[6] Immunisation is the process of constructing a portfolio that has no interest rate risk, with the present value and duration of the future obligation of pension funds matching those of the portfolio, mainly fixed-income assets, e.g. bonds.

[7] Bodie (2001) is a strong proponent of the bonds-only investment strategy. He does not believe equities offer higher returns and inflation protection in the long run (which is correct if equity returns follow a random walk rather than mean reversion). According to this argument, unhedged equities will merely imply that such funds incur unnecessary risk (Bodie 1995), although as for insurance companies they may be useful to provide extra return on the surplus over and above the minimum funding level. In contrast, he suggests default-free and inflation protected government bonds are the most sensible investment instrument for retirement provision. Tax considerations also favour bond investment by pension funds. Consistent with this argument, the UK's Boots pension funds switched all assets into bonds in 2001.

[8] Note that this is distinct from classic immunisation, which relates to interest rate risk only.

asset allocation between broad classes of instrument, is an alternative form of ALM (see Peskin (1997), Blake (2000))[9]. There is growing interest in liability-driven investment in Canada (Tuer and Woodman 2005), with a focus of performance shifting from simple asset returns to returns relative to liabilities. This correlates with growing liabilities as the workforce ages.[10] It requires considerable flexibility in asset holdings that could be hindered by quantitative asset restrictions.

An important question for pension funds is whether they should hold international as well as domestic assets. Modern finance theory (Levy and Sarnat 1970; Solnik 1998) shows that as long as markets are not perfectly correlated, international investment in a portfolio offers better diversification, which implies scope for a lower risk for a given return, or a higher return for a given risk. Indeed, in the context of international investment, therefore, an appropriately constructed global portfolio[11] should in principle be able to eliminate any unsystematic risk. In fact the "home bias puzzle" as discussed in Davis (2005) is that institutional investors hold considerably more domestic assets than would be implied by risk minimisation of holding the global portfolio. Regulation is one reason for imperfect optimisation in many countries, including Canada till 2005 where foreign asset restrictions held.

Some have argued that for DB funds, if pension liabilities are denominated in the home currency, it is necessary to invest pension assets in that country's currency, since in this way pension liabilities and assets (both of which are denominated in the same home currency) could be closely matched (Queisser 1998). However, empirical studies find that including liabilities in the analysis of pension asset investment does not explain the home bias puzzle; for example, Yang (2003) used historic asset return data and found that even when liabilities are considered, US DB pension plans could still benefit from global investment. Meanwhile, by using UK data, Chaundy (1999) found only a marginal increase in the optimal allocation to domestic assets when pension liabilities are included in the mean-variance optimisation model.

2.2 Recent investment outturns and developments for Canadian funds

Tuer and Woodman (2005) conducted a study on recent trends of Canada's DB pension asset investment. Mainly relying on interviews with industry professionals, annual reports and publicly available data sources, they found that DB funds in Canada have shown an increasing interest in investing in alternative assets, e.g. property, hedge funds and commodities. Forces driving such changes in investment strategies include low long-term interest rates, pressure to beat the market and therefore earn alpha, and changes in accounting rules. In addition, it is argued that passive investment strategies are not able to generate returns sufficient to meet pension liabilities in the long run, therefore encouraging active investment; there is doubt

[9] Note that the ALM does not integrate the pension fund with the sponsor's balance sheet as may be warranted by its status as a collateral for the sponsor's guarantee, but treats it as an entirely separate financing vehicle. Davis et al (2007) show major links from sponsor's balance sheets to pension fund investment, consistent with the "integration" view.

[10] To minimise the cash flow gap between assets and liabilities over the life of DB plans, particularly those plans whose liabilities are linked to inflation and wage increases, major fund managers have introduced new financial products into the market. For example, in early 2005, SSGA (State Street Global Advisors) marketed PALMs (Pooled Asset Liability Matching Solution). The product involves the exploitation of the level of inflation-linked swap market, aiming to match pension assets and liabilities at a greater certainty. The period could range from a few years to 40 years, long enough to cover most pension funds' liabilities. These are however unlikely to be available in a sufficient volume to enable all funds to hedge in this manner.

[11] A global portfolio comprises weighted holdings of each global market. Weights could be market capitalisation or real GDP.

whether a sizeable excess return on equities over bonds can be relied upon. However, it is noted that their data sample, i.e. selection of their interviewees was biased towards mid to large sized pension funds, such as the Canada Pension Plan, which might distort the generality of the above findings.

Many DB pension plans in Canada have experienced sizeable solvency deficits over the past few years (Tamagno 2006). Although the extent of solvency deficits was alleviated after 2003, i.e. following recovery of the global and Canadian equity markets, funding deficits remained for a protracted period and shortfall risk is a major challenge faced by DB pension plans, as in other countries such as the UK (Davis 2004a) and the Netherlands (Davis et al 2007). For example, it was estimated that in Ontario, 75% of the plans overseen by the Financial Services Commission has a solvency deficit problem in mid-decade, and the median funding level was around 87% (FSCO 2006). As recently as June 2007, 50% of all the DB pension plans regulated by the Office of the Superintendent of Financial Institutes under federal jurisdiction was in solvency deficit (OSFI 2007). Against this background, traditional investment strategies may again not be sufficient to tackle such financial difficulties, which therefore prompt needs to alternative investment strategies, seeking high return asset classes, although perhaps at the price of higher risk for plan sponsors and beneficiaries (OECP 2007).

It will be seen below that the regulations applied to Canadian funds may hinder some of the strategies seen as desirable in these recent studies.

3 Pension fund investment regulation

Pension funds, as one form of large financial institutions, are subject to various regulations, although the structures of such regulations differ across countries (Srinivas et al 2000; OECD 2007a). Our focus here is on investment regulation. One can identify two forms of government policies on pension fund investment; one is the strict quantitative asset restrictions (QAR), where the government enforces specific regulations, typically limiting the holding of a particular class of assets and notably international assets. The other form of regulation is known as the prudent person rule (PPR). One helpful definition from the OECD (Galer 2002) states that under the principle of the prudent person rule “a fiduciary must discharge his or her duties with the care, skill, prudence and diligence that a prudent person acting in a like capacity would use in the conduct of an enterprise of like character and aims”. Accordingly, in the context of pension fund investment, the prudent person rule requires an investment strategy whereby pension assets are invested prudently as someone would do in the conduct of his or her own affairs.

The latest survey of regulations (OECD 2007a) shows Germany as an example of a country with QAR, whereby for Pensionskassen (a form of company pension fund structured as an insurance company), a maximum of 35% of pension fund assets could be invested in equities of listed firms and a maximum of 50% in bank deposits; as for foreign assets, the upper limit was 30% and there was also a 70% currency matching requirement. Most emerging market economies (EMEs), as well as advanced countries such as Sweden, Denmark, Spain and Portugal also have QAR. Among advanced countries implementing the PPR for pension fund investment are Australia, Canada, Ireland, Italy, Japan, the Netherlands, the UK and the US.

Comparing Canada, the UK and US, there remain differences in the application of PPR, as shown in the following tables, in that the Canadians have a number of residual quantitative restrictions. For example, a maximum of 10% of fund book value of assets can be invested in the securities, stocks, bonds and notes of one company. A maximum 5% of book value can be invested in a single item of real estate or resource property. In contrast, the UK and US have

requirements to diversify or concentration limits only for certain DC funds in the US. Second, there are quantitative restrictions on domestic assets in Canada, which are a 25% real estate and resource limit (15% for resource properties), again which is not considered necessary in the UK and US.

Each country restricts self-investment by the fund in the sponsor, with related party investment not permitted in Canada, limits of 10% for US DB funds, and 5% for UK funds. We note that the US does not restrict the self-investment for certain DC funds, which led to the losses in the Enron case. Ownership concentration rules apply in Canada unlike the US or UK, with a 30% limit on voting shares in one company (excluding special purpose corporations). Finally as regards foreign asset restrictions, none of these countries impose such restrictions on pension funds at present, although until 2005 Canadian funds were subject to a foreign assets maximum of 30% of the fund.

Table 1: Portfolio restrictions for pension funds in Canada, UK and US as of 2006

Country	Prudent person rule/diversification rules	Quantitative restrictions on domestic assets	Self investment and ownership concentration	Foreign asset restrictions
Canada	PPR, maximum 10% of pension fund assets in liabilities of one company, Maximum 5% of assets in a single item of real estate or single resource property.	Real estate and resource limit to 25%, and 15% for resource properties. Securities must be acquired on public exchange.	Related party investment not permitted; maximum 30% of voting shares of one company	None
United Kingdom	PPR, general requirement for diversification and suitability.	None	Self-investment is limited to 5%.	None
United States	PPR, general requirement for diversification except for some DC plans permitted to invest in employer securities or real estate.	None	Self-investment limited to 10% for DB and most DC funds. Limits on their investment in employer owned stocks, bonds and real estate, and lending to employer.	None

Source: OECD (2007a)

4 The case for pension fund portfolio regulation

The ongoing presence of QAR even in an ostensibly PPR country such as Canada, as well as their ubiquity elsewhere (OECD 2007a) raises the issue of why governments regulate pension fund portfolios and what the most appropriate method is.

4.1 Arguments for pension fund portfolio regulation in general

Pension funds are a distinct form of asset, in that they are collected and managed with the purpose of providing retirement income for retirees. It can be argued, explicitly or implicitly, that governments always stand behind pension systems (Clark and Hu 2005a). If retirees cannot receive enough income to live, the government has to incur fiscal costs to meet it, although pensioners might not receive the same amount of income as expected from their funds. In consequence, to mitigate the adverse impacts of excessive risk taken by fund managers, governments typically seek to restrict the investment behaviour of pension funds.

Market failure is another reason why the authorities might seek to regulate the pension fund industry (Davis 2001). There are three aspects of market failure, i.e. information asymmetry, externality and monopoly. Information asymmetry induces well-informed parties with private information to selectively contract with less-informed parties, thus exploiting the latter. Pension fund portfolios might become excessively risky if regulations are not applied, although a safeguard is employee trustees. Examples include the pension mis-selling and Maxwell scandals in the UK. However, the response need not be investment regulation. For example, given the concerns about pension funds' performance, partly following such information asymmetry, it was recommended in the UK Myners Review of Institutional Investment (2000) to rather enhance pension fund trustees' competence.[12]

Externalities arise when the behaviour of a particular group of people or firms have implications on others. Bank runs following the failure of a major financial institution in the market is one example here; nevertheless, whether such contagion could occur for pension funds is less clear. Nevertheless, partly in response to this risk, the Pension Benefit Guaranty Corporation (PBGC) was set up in the US, and the Pension Benefits Guarantee Fund (PBGF) in Ontario[13], while the Pension Protection Fund (PPF) was recently created in the UK; such a guarantee mechanism is conceptually similar to deposit insurance for banks (Hinz et al 1999). When such guarantees are available, the authorities may limit portfolio risk to prevent pension funds exploiting the government guarantee.

A third form of market failure relates to the degree of market power. In the context of pension funds, it means if the market is controlled by a small number of plan sponsors, these sponsors might pursue the interests of the management, but at the expense of plan members. They might for example invest pension monies in the sponsoring company as occurred in the Maxwell scandal in the UK (Davis 2001) and the case of Enron in the US, justifying regulation on self-investment.

Beyond these three main areas, governments may step in to widen market completeness, for example by issuance of inflation-linked bonds (e.g. in the UK) and recent policy recommendation on issuance of longevity bonds (Antolin and Blommestein 2007; Blake 2007b). Davis (2002a) suggests that pension regulation has the broad core objective of aiming to ensure that retirement income security for individuals is ensured. This is of particular importance where funded pension provision is compulsory at the national or company level.

Asset regulations are only a subset of the total range of regulations that apply. Table 2 shows that pension regulation is very wide ranging, notably on the liabilities side. Pension regulations include those of transferability, indexation and annuitisation. This in turn reflects the broader objective of pension regulation, including retirement income security rather than merely protecting against market failures in finance as highlighted above. The general issue arises of whether the wider range of pension regulations (notably on the liabilities side) makes portfolio controls more or less necessary. In our judgement they imply a premium on flexibility on the asset side. We now turn to a discussion of the different types of portfolio regulation.

[12] A recent survey also emphasises the growing responsibility, and thus the importance of competence and expertise of pension fund trustees (Clark et al 2006).

[13] See Nielson and Chan (2007) who show that funds covered by PBGF are less well funded than those not so covered, supporting the case that such guarantees generate moral hazard.

Table 2: Principal regulations of pension funds

Issue	Regulation	Which type?	Main economic issue
Are portfolios of pension funds adequately diversified and matched to liabilities?	Portfolio distributions	Both DB and DC (either PPR or QR)	Monopoly/ asymmetric information
Are there adequate funds to pay pension promises?	Funding/Solvency	DB	Monopoly/ asymmetric information
Who should benefit from assets accumulated in excess of guaranteed pension benefit promises?	Surpluses/reasonable expectations	DB	Fiscal/equity
Regulation of minimum levels of contributions or premia	Contributions, premia and commissions	DC	Monopoly/ Fiscal
Should individuals and companies be obliged to have private pension schemes?	Membership	Both DB and DC	Moral hazard/fiscal
Should annuities be inflation-indexed?	Indexation/ contract design	Both DB and DC	Monopoly
Should private pensions be an addition or partly a substitute for social security?	Integration	Both DB and DC	Fiscal
Should individuals be forced to take annuities, or are lump sums acceptable?	Annuities	Largely DC	Adverse selection
Should rights under or pension benefits be insured?	Insurance	Largely DB	Monopoly/ asymmetric information
Can losses on pension funds be avoided when individuals change job?	Portability	Largely DB	Monopoly/ economic efficiency
Should there be controls on the distribution of costs and benefits from pension schemes?	Benefits, contract conditions	Largely DB	Monopoly/equity/efficiency
How can one ensure adequate governance and member representation?	Trustees, fit and proper controls	Both DB and DC	Asymmetric information/ Monopoly
What information is essential for members to judge the soundness of pension plans?	Information/ consumer protection	Largely DC	Asymmetric information
How best to organise these various regulatory tasks?	Regulatory structures	Both DB and DC	Economic efficiency

Source: Davis (2002a)

4.2 Arguments favouring quantitative asset restrictions (QAR)

As discussed by Goodman (2000), the logic of the quantitative restriction or "prudent investment" approach is that prudence is equal to safety, where security of assets is measured instrument-by-instrument according to a fixed standard. The focus is placed on the investment itself. The overall risk of a pension portfolio must not go beyond a certain level, while allowing for the desire of pension fund sponsors to be as competitive or low-cost as possible. This leads to a quantitative view of prudence which is focused on the idea that the investment itself can be tested as to whether or not the decision was prudent at the time. The model effectively tests the investment category, the asset class and the outcome of the investment.

Such quantitative regulation of portfolio distributions entails limits on holdings of assets with relatively volatile nominal returns, low liquidity or high credit risk, such as equities, venture capital/unquoted shares and real estate, as well as foreign assets, even if their mean return is relatively high. The aim is to protect beneficiaries against insolvency of operators and

investment risks, by ensuring adequate diversification of assets. On the other hand, explicit allowance is by definition not made for potentially offsetting correlations between types of financial instrument. It thereby overrides free choice of investments and optimal diversification using combinations of risky assets. Meanwhile, if they reduce insolvencies[14], QAR may reduce the need for an insurance fund that might otherwise lead to moral hazard; and governments may, by use of asset restrictions, seek to avoid bearing the burden of bailing out individuals from losses following imprudent investments in products such as personal pensions, where the individual bears the risk.

Whereas such arguments could apply both in developing countries and advanced countries such as Canada, others are more relevant in developing countries with emerging securities markets. In such countries, fund managers as well as regulators are often highly inexperienced and the markets volatile and open to manipulation by insiders. Investors may need to be prevented from taking excessive risks. This point applies more generally where regulators have initial doubts about internal controls in institutions, as well as about the industry's capacity for self-regulation and related governance structures. If securities markets are not yet developed, there may be a need for initial investment in government bonds, corporate loans and corporate bonds. Also compliance with portfolio limits is more readily verified and monitored than for prudent person rules. Further issues arise in the context of capital outflow controls in EMEs (Fontaine 1997).[15] But none of these apply in advanced countries such as Canada.

QAR investment regulations have many sub-forms. But typically they specify holding limits according to five dimensions, i.e. asset class, concentration of ownership, issuer, security, and level of risk (Srinivas et al 2000; OECD 2007a). Limits by asset class and level of risk seek to prevent holdings of volatile assets thought to threaten solvency as discussed above. Holding limits by the issuer and/or security mean that pension fund's investment in a particular issuer/share, e.g. Microsoft, cannot exceed a specified percentage of the pension fund portfolio, e.g. 10%. The underlying logic is that an excessive investment exposure to a single firm entails high risk. Based on modern portfolio theory, holding a single firm has far higher risk than holding the whole market. This argument was proved by numerous real-world examples, e.g. the collapse of Enron and Worldcom. Even the seemingly healthiest firms might go into bankruptcy overnight, implying the risk of investing in one firm.

Limits to concentration of ownership restrict how much of a firm could be held by pension funds[16]. Here the issue is more linked to views of the authorities as to the appropriateness of pension funds exerting corporate governance influence or even taking control of firms, even small ones that are relatively trivial compared to the pension fund's portfolio. All five types of investment restrictions, i.e. by asset class, concentration of ownership, issuer, security, and level of risk, are similar to the prudential regulation techniques used in other financial

[14] In practice, there is little evidence from OECD countries that insolvencies of pension funds have been significantly higher with prudent person than with asset restrictions.

[15] Exchange controls have in the past been - justifiably - imposed during foreign exchange crises to deal with capital flight, to avoid a sharp and costly overshooting of the currency, but often kept in looser form once normal conditions were re-established. On the other hand, Bodie and Merton (2002) show that it would be feasible to gain the diversification benefits of international investment without risk of capital flight by use of appropriate swap contracts. Foreign investment may be seen as risky in the absence of appropriate derivatives markets for risk control; and some countries also argue that restrictions are needed to boost development of domestic capital markets – but openness to foreign investment may also achieve this objective, while permitting international investment by institutional investments reduces their exposure to diversifiable risk.

[16] Meanwhile, pension funds often have QAR on self-investment (e.g. assets are invested in the plan sponsor or the parties affiliated with the sponsor) (OECD 2007a).

institutions, e.g. banks (Hinz et al 1999). For example, the restriction by asset class is closely related to diversification and capital adequacy regulations for banks.

4.3 Arguments favouring the prudent person rule (PPR)

In contrast to QAR, Goodman (2000) notes that the prudent person rule is focused on the behaviour of the person concerned. Or, as noted by Galer (2002), the PPR is behaviourally oriented rather than outcome-focused. The process of making the investment is the key test of prudence. More specifically, the test in this case is of the behaviour of the asset manager, the institutional investor and the process of decision-making. It needs to be assessed whether, for example, there has been a thorough consideration of the issues, there is not blind reliance on experts and a form of "due diligence" investigation has been undertaken in formulating the strategic asset allocation. The institution would also be expected to have a coherent and explicit statement of investment principles.

In general terms, a prudent person approach is a standard that measures a course of conduct and not an investment outcome. The prudent person rule, in effect, allows the free market to operate throughout the investment process while ensuing, along with solvency regulations and appropriate decisions regarding contributions in the light of market conditions, that there is both adequacy of assets and appropriate levels of risk. Rather than the focus being on the external rules, the onus is rather on internal controls and governance structures in which the authorities may have confidence. The authorities correspondingly require information on these aspects rather than purely focusing on the composition of the asset portfolio, as is feasible with quantitative restrictions. Hence, a wider degree of transparency is needed for the institutions (including in particular identification of lines of responsibility for decisions and of detailed practices of asset management). Such monitoring may be delegated to self-regulatory bodies, which have incentives to maintain compliance in order to protect the reputation of the industry and if there are forms of mutual insurance against losses.

In this context, one major principle of the PPR is diversification, i.e. pension funds should be suitably diversified in order to avoid the unwarranted concentration of investment in particular asset classes. There is an implicit or explicit presumption that diversification of investments is a key indicator of prudence. Vittas (1998) highlights that under PPR pension funds could invest in private equity, for example. Indeed, as noted above, pension fund managers also in Canada have started to expand the traditional asset classes (e.g. bonds and equities) and explore new investment opportunities (e.g. real estate, foreign assets and hedge funds), which is mainly for the reason of maximising diversification benefits as well as aiming to achieve higher returns so as to meet rising pension liabilities. QAR would limit this.

4.4 Weighing up the arguments

On balance, economic arguments strongly support PPR. The general case against quantitative portfolio regulations is put succinctly by European Commission (1999), namely that they are "in the way of optimisation of the asset allocation and security selection process, and therefore may have led to sub-optimal return and risk taking". In more detail, drawing on the discussion above and Davis (2002a), they:

- prevent appropriate account being taken of the duration of the liabilities (which may differ sharply between sponsors and between funds, as well as over time), and related changes in risk aversion;

- render difficult or impossible the application of appropriate immunisation or ALM techniques for maturity matching, because such techniques may require sharp variations in the portfolio between equities to bonds, and use of derivatives;
- in terms of risk and return optimisation, they are likely to enforce holdings of a portfolio below the efficient frontier, because they typically insist on high proportions of bonds and domestic assets;
- they focus unduly on the risk and liquidity of individual assets and fail to take into account the fact that, at the level of the portfolio the default risk and price volatility can be reduced by diversification, while liquidity risk depends on the overall liquidity position of the investor and not the individual instruments;
- if portfolio regulations limit use of derivatives, abstracting from other operative limits, they will force the institution either to hold low-yielding assets or expose itself to unnecessary risks;
- they are inflexible and cannot be changed rapidly in response to changing conjunctural economic circumstances and movements in securities, currency and real estate markets; they also may find it difficult to adapt to structural changes in financial markets;
- if enforced strictly, they may give incentives to asset managers to hold proportions of risky assets which fall well short of the limits, to avoid breaching them when markets perform well and prices rise;
- they may encourage low levels of surplus assets, given the low returns on equity that they entail;
- they encourage strategies to be conducted so as to conform with legal restrictions rather than attaining good returns, reducing risk and other desirable objectives. Notably they may limit tactical asset allocation;
- they encourage national governments to treat pension funds as means to finance budgetary requirements, in a way that could not occur under a prudent person rule (this occurred disastrously in the case of the Argentine financial crisis, when the government forced funds to hold rapidly devaluing government bonds);
- they typically reduce the extent to which the diversification benefits of international investment may be attained, and can even be said to expose policy holders to currency risk, given that they will want to spend some of their income on foreign goods and services, and the domestic currency may depreciate;
- conversely, whereas regulations on domestic assets may seem appropriate in a small domestic market where there is high volatility and undiversifiable risk in equities, so as to ensure adequate diversification and portfolio liquidity, the widening and deepening of capital markets may make the regulations less necessary;
- limits on exposures to single borrowers are unnecessary for the most part, since diversification mandated by prudence would require small stakes in any case.

There may also be deleterious effects of portfolio regulations on the asset management industry and the economy as a whole:

- there might be less incentive for the institutional investor to nominate investment managers with skills to achieve higher return and lower risk;
- competition among asset managers is discouraged if their main function is to meet quantitative asset restrictions;
- the development of the industry per se is likely to be set back, especially if entry by foreign managers is restricted[17];

[17] The traditional lack of competitiveness of the Japanese asset management sector, low resultant asset returns, the consequences for the funding of pension funds, and the benefits of deregulation of entry and portfolio

- quantitative restrictions may lead to inefficient allocation of capital and hence hold back economic growth and employment;
- in particular, limits on unquoted shares and venture capital (including limits on the proportion of a firm's equity that can be held) can hinder the dynamic small firm sector, which generate the bulk of new employment;
- they increase costs for employers providing pensions, hindering job creation.

The case should not be overstated, however; as noted, even in OECD countries, limits on self-investment are appropriate to prevent concentration of risk. Meanwhile a difficulty with prudent person rules lies in the fact that court judgements (or desire to avoid litigation) may lead to narrow interpretations of risk and safety, see Del Guercio (1996)[18]. Of course, avoidance of individually high-risk assets that could improve the overall risk and return profile of the portfolio may actually be contrary to beneficiary protection, which was the intention of prudent person rules. Such interpretations may also encourage a focus on portfolio indexation. Indexing to narrow core market indices (such as the FTSE-100 and S and P 500) artificially drives up the value of the firms that are included and may increase the volatility of the investors' assets.

Portfolio limits would appear to be particularly inappropriate for DB funds, given the "buffer" of the sponsor guarantee for the beneficiaries and risk sharing between older and younger workers, and if benefits must be indexed. Clearly, in such cases, portfolio regulations may affect the cost to sponsors of providing pensions, if it constrains managers in their choice of risk and return, forcing them to hold low yielding assets, and possibly increasing their risks and costs by limiting their possibilities of diversification. Even solvency rules may not be essential if there is an appropriate actuarial and accounting framework[19].

5 Empirical research on pension fund portfolio regulations

Extant empirical work supports the beneficial role played by the PPR when compared to the QAR. For example, the European Federation for Retirement Provision conducted a study investigating whether the PPR is advantageous over the QAR. By using data for the period of 1984-1993, this study shows that pension funds from those European countries adopting the PPR achieved an average real rate of return of 9.5%, while this figure for those countries adopting the QAR was 6.9% (Queisser 1998). A similar finding was obtained by an OECD study (Galer 2002).

More recent research in this area was conducted by Davis (2002a). He investigated the benefits of international diversification in the context of pension fund investment. With a dataset covering 7 developed countries from 1980-1995, it was found that the hypothetical real return for pension funds in these countries on average was 7.8% with PPR, while it was 5.8% with QAR.

Research on EMEs is quite scanty; one exception is Davis (2005) who extended his earlier database and analysis to three EMEs (i.e. Chile, Singapore and Malaysia), in which a hypothetical shift to the PPR would impact positively on the pension fund returns for the latter two countries, but not for Chile. Meanwhile, Hu et al (2007) recently conducted a study with focus on the quantitative beneficial impact of pension fund investment liberalisation on

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regulations, are considered in Davis and Steil (2001). This situation developed under long standing QAR, that was only recently abolished.

[18] She found that bank managers subject to PPR in running trust accounts hold 31% of their equities in stocks of companies rated A+ by Standard and Poor's while the corresponding figure for bank run mutual funds is 15%.

[19] See the discussion of the pre-1995 regime in the UK in Davis (2001).

China's funded pension savings, including both mandatory individual accounts and voluntary occupational pensions. It was found that returns on the basic portfolio (which captures the actual restrictive pension portfolios in China) were consistently lower, and much lower in some cases, than those on the more diversified portfolios.[20]

Meanwhile, Hu (2007) looked at pension asset allocation in 39 countries, 17 emerging markets and 22 advanced countries. He found a beneficial impact of the regulatory move from the QAR to PPR, as highlighted by the positive values of the rate of change in the Sharpe ratios comparing mean variance optimal portfolios with foreign assets to those confined to domestic assets. This finding applies to pension funds in both OECD countries and EMEs, with a larger effect on the latter. Second, due to the different asset return characteristics, optimal pension fund portfolio compositions found varied markedly across countries. If higher risk aversion coefficients are specified, there is more investment in the risky portfolios, which is consistent with financial theory. These results were new to the literature (compare Reisen 1997; Davis 2002a, 2005), in incorporating risk aversion (at the national level) into the optimal analysis and also investigating a wide range of countries[21].

Hu (2007) also found a higher proportion of pension funds optimally allocated to foreign assets in EMEs than those in OECD countries. This might be mainly due to the lesser correlation between domestic markets in EMEs with foreign markets and the high volatility of EME domestic markets. The result is particularly important in the light of the prevalence of QAR regulations in EMEs. Furthermore, his statistics suggested the importance of property investment in pension fund portfolio optimisation, and the results were applicable to both OECD countries and EMEs. Such empirical findings support the arguments of Booth (2002), where property was frequently estimated to be included in the optimal portfolio regardless of maturity of the pension funds. Hu's overall results were in favour of the prudent person rule (PPR) investment approach and against the quantitative asset constraint (QAR) approach notably in terms of foreign investment. Therefore, his recommendation was liberalisation of pension fund global investment. Also, his findings highlighted the potential large benefit arising from international investment for pension funds in EMEs.

Another study was recently conducted by OECD (2007b), which looks at the extent to which different regulatory regimes impact on the performance of privately managed pension funds. By comparing actually observed returns with a set of different benchmark returns, it was found, albeit tentatively, that in all the sampled countries, including both selected developed and developing countries, pension funds underperform when compared to the hypothetical optimal portfolio, and investment restrictions have a damaging effect on performance. For example, actual returns achieved by pension funds in the US and UK underperformed than that of hypothetical optimal returns by 1.8% and 1.1%, respectively. It was found, however, that the Canadian pension funds outperformed the optimal portfolio by 2.2%, the results of which need to be viewed with caution, since its observation period is from 1990 to 2005, which therefore might not be able to capture the long-term nature of pension fund investments.

In addition, Davis (2002a) highlights that there are other influences on pension fund portfolios besides asset restrictions, which need, however, to be taken into account before conclusions are drawn from studies such as the above on the effects of the regulation. They are also relevant to the work presented in this paper. These include:

[20] The finding was robust even if two different observation periods (one in 1993-2006, the other is 1993 to 2004) were used, given the concern that high volatility of returns on stocks during 2005-06 might distort the empirical results.

[21] In Dutta et al (1999) 5 OECD countries were investigated.

- solvency and minimum funding rules and their interaction with associated accounting arrangements may play a crucial role in influencing portfolios of defined benefit funds, and may account for the non binding nature of the portfolio restrictions themselves. This is because they determine the size and volatility of the surplus, as well as defining the rules for dealing with a corresponding deficit. They hence influence the likelihood and cost[22] of any deficiency, and hence the importance for pension funds of maintaining a stable valuation of assets relative to liabilities, independent of portfolio limits.
- minimum rates of return set annually by regulation in some countries can constrain diversification even when quantitative limits are not stringent (OECD 2007a). This is because they limit holdings of volatile assets which could reduce returns below the limit in one year, even if they offer a high return in the long run;
- application of accounting principles which 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[23] and calculate returns net of unrealised capital gains may restrain equity holdings independently of portfolio regulations.
- liabilities have a major influence, for example on the share of bonds, in that (i) inflation sensitivity of liabilities will determine the demand for assets acting as inflation hedges such as index linked bonds, as well as assets whose return is unaffected by inflation such as real estate and equities; (ii) the need for cash flow will play an important role by determining the need for liquidity to meet (known or uncertain) cash flows, for example in the context of growing maturity of pension funds, and policy loans/early surrender for life insurers; (iii) duration of liabilities in combination with the strictness of minimum funding and solvency rules will set a benchmark for the duration of assets - or if they are not matched, to the scope of interest rate risk. Besides differing between countries, these factors will differ strongly between individual institutions;
- higher taxation on bonds than equities makes the former an attractive investment to tax-exempt investors such as pension funds;
- ownership and control of pension funds may influence portfolios, via the degree of risk aversion of those controlling the fund and the degree to which those holding residual risks can control asset distributions;
- concerning international diversification, in small countries the assets of institutional investors may exceed the entire domestic equity market, and hence simple liquidity considerations necessitate international investment, abstracting from risk/return considerations, if regulations permit;
- the structure of pension fund asset management markets and related levels of competition is likely to impact on the efficiency of investment, whereby protection of fund managers from external competition may lead to a sub optimal investment strategy from the point of view of beneficiaries;
- whereas in principle capital market activity should ensure that asset returns are equalised across countries, owing to international investment restrictions, exchange controls etc., this has not always been the case in the past, resulting in markedly different real returns on assets;
- financial structure more generally may have an important role to play. In traditionally bank-dominated economies where capital markets play a subordinate role, it is loans that often dominate the portfolios of long-term institutional investors.

[22] As an example, in the UK, the accounting rule FRS17 enforces mark to market, on balance sheet accounting for pension liabilities with no smoothing and use of a corporate bond yield discount rate. It is considered to be leading to widespread abandonment of defined benefit funds altogether (Davis 2001, 2004a).

23 These regulations were abolished in Germany after the impact on life insurers' solvency of asset price falls following the terrorist attacks on the US on September 11th 2001 became apparent.

6 The debate on QAR in Canada

In Canada there is a specific debate underlying the particular regulations that were highlighted in Section 3 above, which had been introduced in the Pension Benefits Standards Act of 1985. As noted by Fried (2005), the rules, like those recently abolished on foreign assets (FPRs), were based on the belief that government rules are necessary for the proper allocation of resources. He notes that experience has shown that the foreign asset restrictions were in fact a barrier to prudent management of pension plans, and basically were a tax on middle income earners. His estimates suggested a cost of between C$1.5 and 3 billion per annum, even when set at 30%; these comprise administrative costs, costs of reduced asset-manager competition and the limits imposed on diversification (Burgess and Fried 2004).

Fried expressed the view that the ongoing rules on property, company holdings etc as described in Section 3 also make "little if any sense especially given what has been learned in from the costly exercise with the Foreign Property Rule" and asserts that efficient markets and sponsors' fiduciary obligations are the best basis for fund investment. It is clear that the FPRs administrative costs, costs of reduced competition and the limits imposed on diversification may apply equally to these ongoing restrictions. Experience since the abolition of FPRs, with the national average pension fund holding of foreign assets rising to 31% of total assets in 2006, and OMERS and CPP rising to 32% (as shown in Table 3), suggests that the FPRs even at 30% up to 2005 had been a binding constraint. The vastly better performance of Canadian funds in the 1990-2006 period over 1966-89 (Table 5) in terms of both return and risk is suggestive of the benefits of FPR abolition, since progressive abolition took place in the later period.

Looking at specific current rules, the limits on real estate and resource properties as a proportion of the portfolio assume that real estate assets are more risky than other forms of asset; such rules hinder diversification and are redundant in the context of PPR. Furthermore, the use of book value as a measure of the portfolio exposure is inappropriate since market values are the relevant ones. Eichholz (1996) shows that cross border real estate investment offers considerable diversification benefit since national markets are not strongly correlated with one another, although Case, Goetzemann and Rouwenhorst (1999) highlight relatively high correlations in the recent period, and this is corroborated by Davis and Zhu (2004). A number of studies such as Hu (2007) and Booth (2002) have shown that (domestic) real estate is a highly appropriate asset for pension fund investment, and our results in Table 7 for mean-variance optimisation support this also, given its returns are rather uncorrelated with securities. This suggests the limits on real estate are potentially very costly, even though as shown in Table 3, Canadian funds' current holdings are well below the limit.

The so-called 30% rule, limiting the holdings of voting shares by companies, is based on the idea that pension funds should be passive investors, not influencing capital markets. OMERS (2007b) argues that this rule impedes ability to protect beneficiaries interests when investing in illiquid assets, may dissuade investors from investing in venture capital, limits use of risk management, and puts Canadian pension funds at a disadvantage in investing vis a vis hedge funds and pension funds from other PPR countries such as the UK and US.

The 30% rule is likely to limit pension fund investment in small firms, which is often seen as a weakness even in prudent person countries, but which will be aggravated in Canada. Sias (1996), for example, shows that for the United States total institutional holding of the largest

firms on average over 1977-91 was over 47% and for the smallest, only 8%.[24] The consequence of neglect of small firms by pension funds (assuming individual investors do not fill the gap) may be biases in the economy towards sectors with larger firms (for even if small firms can obtain bank loan finance, growth potential via debt is likely to be more restricted than with equity in addition). This may be contrary to the comparative advantage of the economy as a whole, not least given small firms' potential for innovation, growth and job creation is widely seen as crucial for economic growth.

Further economic background to the voting shares debate is that on pension funds and corporate governance, which suggests acting passively is not the best way to maximise returns, especially for a large fund. Shleifer and Vishny (1997) note that pension funds acting for future pensioners have scope to become important representatives of minority shareholder's interests, possibly electing independent board members as well as being able to access regulators and influence public opinion. As they are large investors, they may coordinate with other institutions so as to remove the free-rider problem which is normally a difficulty preventing action by minority shareholders. In this context, the "corporate governance movement" among pension funds in the US since 1990 reflects dissatisfaction among pension funds with costs of the take-over mechanism, and preference for direct influence as equity holders on incumbent management (Davis 1995, 2002b). It also links to indexation by large funds, which seek to improve the performance of firms they have to hold, as well as more generally the situation where pension fund holdings are so large that they cannot readily sell their participations without significant market movements against them.

There is a growing literature on the impact of corporate governance initiatives on company performance, albeit mainly focusing on the effects on share prices per se, which would benefit the pension funds involved. For example, Wahal (1996), in a sample of forty-three cases, found that efforts by institutional investors to promote organizational change via negotiation with management (as opposed to proxy proposals) are associated with gains in share prices. Strickland et al. (1996) report that firms that were targeted for pressure by the United Shareholders Association[25] experienced positive abnormal stock returns, although corporate governance proposals per se had no effect. Gillan and Starks (2000) show that shareholder activism by U.S. public pension funds has been successful in the 1990s, as measured by voting outcomes and stock market reaction. Smith (1996) reports favourably on the effects of CALPERS governance initiatives. Faccio and Lasfer (2000) show that the monitoring role of UK pension funds is concentrated among mature and low-performing firms and that in the long run, the firms in which pension funds have large stakes markedly improve their stock returns.

In a most recent study of Sweden, Giannetti and Laeven (2007) show that firm performance improves if large private funds or public funds take larger stakes in it. They show actual evidence of activism in that public pension funds are most likely to be represented on board nominating committees, and this has an independent positive effect on performance. Only large funds that are not linked to financial institutions or industrial groups have a positive effect on performance, though. Not all results are positive for corporate governance activism. Del Guercio and Hawkins (1999) found no evidence that activism had a significant effect on US stock returns over the three years following the proposals. Woitdke (2002) argues pension funds do not improve performance because of objectives that conflict with value maximisation.

[24] Note however, that besides limits on voting shares, such reticence may link to illiquidity or lack of marketability of shares, levels of risk which may be difficult to diversify away, difficulty and costs of researching firms without track records.

[25] Note that this is actually a coalition of small investors rather than a pension fund per se.

All of these studies are based on micro evidence. Davis (2002b) undertook macro work based on the share of equities held by pension funds and life insurers. The results are complementary to micro work if the view is taken that the effects of takeovers, institutional activism etc are not just apparent in the performance of targeted firms but also in the wider economy. This may be the case if managers of "unaffected" firms nonetheless change their behaviour in response to the threat of such action. Results were found which are consistent with a disciplining role of institutions in the Anglo Saxon countries, particularly life insurers and pension funds. The signs on their share of equity in the total are consistent with the view that they exert restraint of fixed investment (that can be wasteful if there is inadequate shareholder monitoring), and lead to a boost to dividends and to Total Factor Productivity. Furthermore, higher institutional holding is favourable to R and D (Davis 2004b).

Summarising, this section has shown that there are specific arguments against the form QAR has taken in Canada – notably that they limit holdings of the highly attractive asset real estate thus limiting optimisation, and that they limit corporate governance initiatives and holding of small firms that could hit the economy as well as the pension fund sector. As for FPR all of these ongoing restrictions entail heightened administrative costs, costs of reduced competition and limit diversification. These strengthen the general case against QAR put forward in Section 4 and the empirical work showing their deleterious effects summarised in Section 5.

7 Empirical work

As discussed above, there are two approaches to pension fund regulation, i.e. QAR and PPR. The evidence above suggests that the latter is more desirable than the former, notably in Advanced countries. In this section, we seek to analyse empirically whether this hypothesis is valid and if so, to what extent Canadian funds with more QAR elements are disadvantaged compared to the pension funds subject to "pure" PPR as in the UK and the US.

7.1 Data

We have constructed data on annual real returns on eight different classes of assets over 40 years from 1966-2006; those returns are short-term asset (ST) yields (money market interest rates), domestic corporate bond (CB) yields, domestic government bond (GB) yields, domestic equity returns (EQ), mortgage (MO) yields, domestic property (PR) yields, foreign asset (FA) returns, and yields on other residual asset classes (OA), see Appendix 1 for average real returns and risk. Inflation is deducted from nominal returns to obtain real returns. Bond, equity and property returns are all total returns, including both annual income and capital gain or loss. Foreign asset returns are also adjusted for exchange rate changes, and comprise market-capitalisation weighted returns on all of the major non-domestic markets, 50% bonds and 50% equities. "Other residual asset" yields are simply set equal to the average return on identified assets. Similar datasets were used in Davis (2005), Davis and Steil (2001) and Hu (2007), but all are with shorter time periods, i.e. 1967-1995, and 1967-2004.

All return data were collected from existing sources, i.e. Davis and Steil (2001), Datastream, Global Financial Data, IMF database, national central banks, the WDI (World Development Indicators) 2007, as well as Hu (2007). The pension fund sector portfolio distribution data at the national level for Canada are from Statistics Canada, that for the UK from the Office for National Statistics, UK, while that for the US from the Federal Reserve Board. The portfolio distribution data of the largest pension funds in the three sample countries was collected from the AP Information Services and the individual homepages, except for OMERS, in which case it was provided by OMERS directly. See Appendix 2 for details.

7.2 Simple real return comparison with benchmarks

In order to assess the effects of portfolio regulations, we first estimated the returns on pension funds' portfolios, using aggregate data for the respective sectors. This was done by weighting the various components of the asset portfolio by the annual total holding period returns obtained on the corresponding instruments in the market. The implicit assumption is that the institutions are holding the index portfolio in each instrument. Hence, no account is taken of possible benefits of active management in raising returns, while equally transactions and administrative costs, which would otherwise act to reduce returns, are also disregarded. Clearly, this involves a marked degree of estimation and conclusions should be drawn cautiously, but we maintain that it does highlight the impact of restrictions on assets better than other measures such as actual returns, which also incorporates effects of the quality of management. In effect, we are focusing on asset allocation's optimality (choice of instruments) and abstracting from that of security selection (choice of securities). No account is taken of the liability mix including pension fund maturity. Moreover, we note that the degree to which the (nominal or real) return and the standard deviation alone can be used to assess the optimality of portfolio choices is limited, given that the liabilities may justify some alternative approaches to investment (such as immunisation or shortfall risk minimisation) not focused on risk and return alone, see Borio et al (1997).

Direct cross country comparisons of absolute real returns and risks are problematic in that the returns that can be obtained in national markets often vary sharply[26]. Hence, it is also relevant to compare realised returns with various achievable benchmarks in national capital markets, These are:

- a 50-50 portfolio of domestic bonds and equities;
- a global portfolio of 50-50 international bonds and equities, distributed across the other markets with GDP weights;
- 20% and 40% international investment variants, again based on 50-50;
- a more diversified portfolio which is broadly in line with current practice, as shown in Table 3 below. This comprises 35% domestic equities, 10% domestic property, 25% domestic bonds and 30% foreign assets, split evenly between bonds and equities. This benchmark is useful in showing what historic returns could have been if current relatively liberalised portfolios were always held (notably, that the foreign asset restrictions that held till 1985 in Canada were not applicable, nor the limits on foreign assets in the UK before exchange controls were abolished in 1979).

7.3 Using the mean-variance approach and two-fund separation theorem

An alternative benchmark for portfolio optimisation is derived from the Markowitz (1959) and Sharpe (1990) two-fund separation theory. This seeks to calculate an optimal risky portfolio based on mean and variance of return. Then, all investors are hypothesised to make their investment choice between two funds, i.e. a risk-free asset or fund and a risky portfolio comprising risky assets (e.g. equities and bonds); in addition, this theorem argues that regardless of risk preferences, all investors will choose precisely the same risky portfolio, and difference in risk preferences among investors will determine the actual mix of the risk-free asset[27] and the risky portfolio in the investors' complete portfolios. Technical aspects of the calculation are shown in Appendix 3.

[26] Reasons include varying development of the capital market, interest rates, economic growth and exchange rate developments, and more generally imperfect capital market integration.

[27] However, strictly speaking, there is no risk-free asset notably when there is inflation.

Industry practice for pension funds as well as academic research shows it is indeed common to apply the mean-variance approach to find an optimal portfolio, or as a benchmark. The mean-variance approach can apply to both DC and DB plans. For both cases, some objective functions should be maximised, while the difference is that compared to the DC plan, pension liabilities are a more serious issue for the DB plan. For example, by incorporating liabilities into the analysis of optimal asset allocation, Yang (2003) seeks to quantify the gains from international diversification, and Blake and Inkmann (2004) identify the linkage between discount rates and asset allocation. Both studies are conducted under the mean-variance framework, which involves a maximisation of objective functions in the surplus of assets over liabilities in DB plans. In our work reported below, we use a simple optimisation model which is directly applicable to simple DC plans; partly owing to lack of information, our analysis does not allow for liabilities, unlike, e.g. Sharpe and Tin (1990), and Blake and Inkmann (2004).

7.4 Empirical results 1[28]: average pension funds in Canada, UK and US

We now go on to compare pension funds' national-average calculated returns with benchmarks using the asset return data described above and national sector-balance-sheet data. The balance sheet and asset return data cover 1966-2006. Table 3 below shows the evolution of national-average portfolios over this period. Long-term trends for Canadian funds have been a reduction in bonds and mortgages and a marked build-up in foreign assets. For UK funds, there has been similar trends, as well as a long-term decline in domestic equities and real estate. As regards US funds, there is a shift out of bonds, as well as a rise in foreign assets[29].

[28] Please note that in addition to this approach using national pension fund sector data, we also followed the same methodology using the largest three pension funds in Canada, UK and US. The results are given in Appendix 4.

[29] However, it is noted that due to lack of information on foreign investment by US pension funds at the national level, we estimated foreign asset allocation by the average of CALPERS, NY City and NY State funds for 1990-2006. Before 1990, the only information is in Ehrlich (1981) that US funds held 2% of assets abroad in 1980. We used this to give estimates from 1966-89 of gradual growth in international investment by US funds.

Table 3: Portfolios of pension fund sectors (value weighted average pension funds), in %

		Short term	Bonds	Equities	Mortgages	Property	Foreign assets	Other assets
Canada	**1970**	5	53	22	11	1	0	8
	1980	9	51	26	11	2	4	2
	1990	10	47	25	5	3	6	8
	2000	3	32	29	2	5	28	1
	2006	5	30	26	2	4	31	3
UK	**1970**	4	33	50	0	11	2	0
	1980	5	24	45	0	18	8	0
	1990	8	11	46	0	9	18	7
	2000	5	14	39	0	5	22	16
	2006	3	19	26	0	8	31	13
US private	**1970**	7	26	54	3	Na	1	9
	1980	13	24	45	1	Na	2	15
	1990	11	24	38	1	1	3	22
	2000	6	10	54	0	1	18	12
	2006	4	9	59	0	1	19	9
US public	**1970**	1	72	17	10	Na	1	0
	1980	2	68	22	6	Na	2	0
	1990	6	50	39	2	1	3	1
	2000	5	24	52	1	1	18	0
	2006	3	18	60	1	1	19	0

Sources: National Flow of Funds data (see Byrne and Davis 2003). Note: (1) All rows might not sum to 100 (%), duet to rounding; (2) Bonds equal to sum of corporate bonds and government bonds; (3) all asset classes (except Foreign assets) refer to domestic assets; (4) US fund foreign assets: see Footnote 28; (5) US private: US private pension funds; (6) US public: US state and local government employee retirement funds.

Table 4 shows the basic results for the sectors, which thus represent average pension fund portfolios (value weighted). It can be seen that Canadian funds on the face of it have varying combinations of real return and risk between sample periods. Their overall return over 1966-2006 was below the UK and the US state and local pension funds. Risks, however, are lowest in Canada; therefore, the trade-off shown by the Sharpe ratio[30] between return and risk is favourable to Canadian funds over this 40-year period.

Table 4: Comparing pension fund sector real returns and risks, in % (except Ratio)

		Canada	United Kingdom	United States – private funds	United States – state and local funds
66-06	Mean	5.4	7.7	5.6	5.7
	S. Dev	8.0	15.0	10.6	10.6
	Ratio	0.7	0.5	0.5	0.5
66-89	Mean	3.4	8.3	4.4	4.4
	S. Dev	8.1	18.0	10.9	10.9
	Ratio	0.4	0.5	0.4	0.4
90-06	Mean	8.3	7.0	7.2	7.7
	S. Dev	7.1	9.8	10.3	10.2
	Ratio	1.2	0.7	0.7	0.8

Source: authors' own calculations. S. Dev: standard deviation; (Sharpe) Ratio: mean/standard deviation.

One problem is that financial market conditions have changed considerably over this period, so we also split the period into the 1966-1989 and 1990-2006 periods. In the earlier period, the UK had a highest return and Canada had the lowest risk. In terms of the return and risk trade off ratio, UK still performed better than both Canada and US, which in turn witnessed

[30] The Sharpe ratio is defined as (nominal return – riskless return) / risk (i.e. standard deviation). In our study, since we used real returns, it could be assumed that riskless return in real terms is zero; therefore the above formula is reduced to real return/risk.

the same Sharpe ratio. In the later period, Canadian funds are estimated to have the highest return and the lowest risk, and thus the highest Sharpe ratio.

Table 5: Sector real returns and benchmarks, in % (except Ratio)

Canada		Actual portfolio	50-50 domestic	20% foreign	40% foreign	Global portfolio	Diversified portfolio
66-06	Mean	5.4	5.7	5.8	5.9	6.2	6.0
	S. Dev	8.0	9.9	9.4	9.3	11.6	8.6
	Ratio	0.7	0.6	0.6	0.6	0.5	0.7
66-89	Mean	3.4	3.2	3.8	4.4	6.2	4.6
	S. Dev	8.1	9.8	9.6	9.9	13.0	8.9
	Ratio	0.4	0.3	0.4	0.4	0.5	0.5
90-06	Mean	8.3	9.2	8.6	8.0	6.2	8.1
	S. Dev	7.1	9.3	8.6	8.3	9.6	8.1
	Ratio	1.2	1.0	1.0	1.0	0.6	1.0
United Kingdom							
66-06	Mean	7.7	7.2	6.8	6.4	5.2	6.9
	S. Dev	15.0	16.3	14.5	13.3	13.6	13.5
	Ratio	0.5	0.4	0.5	0.5	0.4	0.5
66-89	Mean	8.3	7.4	7.0	6.6	5.5	7.2
	S. Dev	18.0	20.1	17.6	15.7	15.0	16.0
	Ratio	0.5	0.4	0.4	0.4	0.4	0.4
90-06	Mean	7.0	7.0	6.6	6.1	4.8	6.5
	S. Dev	9.8	9.1	9.1	9.4	11.8	9.4
	Ratio	0.7	0.8	0.7	0.7	0.4	0.7
United States – private funds							
66-06	Mean	5.6	5.4	5.7	6.1	7.1	6.1
	S. Dev	10.6	11.8	10.8	10.7	15.4	10.0
	Ratio	0.5	0.5	0.5	0.6	0.5	0.6
66-89	Mean	4.4	3.8	4.8	5.8	8.8	5.7
	S. Dev	10.9	12.9	12.0	12.1	17.4	11.1
	Ratio	0.4	0.3	0.4	0.5	0.5	0.5
90-06	Mean	7.2	7.6	7.0	6.4	4.7	6.8
	S. Dev	10.3	10.1	9.0	8.7	12.0	8.6
	Ratio	0.7	0.8	0.8	0.7	0.4	0.8
US state and local funds							
66-06	Mean	5.7	5.4	5.7	6.1	7.1	6.1
	S. Dev	10.6	11.8	10.8	10.7	15.4	10.0
	Ratio	0.5	0.5	0.5	0.6	0.5	0.6
66-89	Mean	4.4	3.8	4.8	5.8	8.8	5.7
	S. Dev	10.9	12.9	12.0	12.1	17.4	11.1
	Ratio	0.4	0.3	0.4	0.5	0.5	0.5
90-06	Mean	7.7	7.6	7.0	6.4	4.7	6.8
	S. Dev	10.2	10.1	9.0	8.7	12.0	8.6
	Ratio	0.8	0.8	0.8	0.7	0.4	0.8

Source: authors' calculations. S. Dev: standard deviation; (Sharpe) Ratio: mean/standard deviation. Actual portfolio is that of pension fund sector, multiplied by returns by asset class. 50-50 domestic means 50% allocated to domestic equities and 50% to domestic bonds. 20% (40%) foreign means 20% (40%) allocated to global portfolio. Global portfolio is split evenly between foreign bonds and foreign equities with adjustment for foreign exchange rate changes. Diversified portfolio consists of 35% in equities, 25% in bonds, 30% in foreign assets and 10% in property.

The more telling comparison is with national benchmarks that take account of the differing asset returns and risks across countries. Table 5 shows the levels of the sector returns and benchmarks, and Table 6 the difference between them. The benchmarks are, as noted, a 50-50 domestic equity-domestic bond portfolio, a similar portfolio with 20% foreign, a 40% foreign portfolio and a global portfolio where domestic holdings are limited to global portfolio weights (which are particularly low for Canada and the UK), and finally a diversified portfolio where 35% in equities, 25% in bonds, 30% in foreign assets and 10% in property, comparable to 2006 portfolios in Table 3. Underperformance is shaded in grey. For Canada it is apparent that the returns often fall short of those that are feasible. For example, in 1966-

2006 the actual pension fund sector return is below any portfolio including foreign assets as well as the diversified portfolio, perhaps reflecting the foreign asset restrictions prevalent till 2005. This is also frequently true in 1966-89 and in 1990-2006. A redeeming feature is that risks on the fund sector portfolio tend to be lower, and hence the Sharpe ratio is generally higher. In contrast to Canada, in the UK the pension fund sector tends to outperform the benchmarks in terms of return, although the risks tend to be lower on the benchmarks. For US private funds, both the 1966-06 and 1966-89 periods tended to see underperformance relative to benchmarks, except the domestic 50-50 portfolio, while in the later 1990-2006 period, funds outperformed benchmarks other than the domestic 50-50 portfolio. Risks, however, are frequently lower than for the dummy portfolios; therefore Sharpe ratios vary between portfolios. For US state and local funds, the story is similar to the private funds except for 1990-06 where the fund returns outperform the benchmarks.

Table 6: Comparing sector real returns with benchmarks, in % (except Ratio)

	Actual portfolio less	**50-50 domestic**	**20% foreign**	**40% foreign**	**Global portfolio**	**Diversified portfolio**
Canada						
66-06	Mean	-0.3	-0.4	-0.5	-0.8	-0.6
	S. Dev	-2.0	-1.5	-1.4	-3.6	-0.7
	Ratio	0.1	0.1	0.0	0.1	0.0
66-89	Mean	0.2	-0.4	-1.0	-2.8	-1.1
	S. Dev	-1.7	-1.5	-1.8	-4.9	-0.8
	Ratio	0.1	0.0	0.0	-0.1	-0.1
90-06	Mean	-0.9	-0.3	0.3	2.0	0.1
	S. Dev	-2.2	-1.6	-1.2	-2.6	-1.0
	Ratio	0.2	0.2	0.2	0.5	0.2
United Kingdom						
66-06	Mean	0.5	0.9	1.3	2.5	0.8
	S. Dev	-1.3	0.4	1.7	1.4	1.4
	Ratio	0.1	0.0	0.0	0.1	0.0
66-89	Mean	0.9	1.3	1.6	2.7	1.1
	S. Dev	-2.1	0.4	2.3	3.0	2.0
	Ratio	0.1	0.1	0.0	0.1	0.0
90-06	Mean	-0.1	0.4	0.8	2.2	0.5
	S. Dev	0.7	0.7	0.3	-2.1	0.3
	Ratio	-0.1	0.0	0.1	0.3	0.0
United States – private funds						
66-06	Mean	0.2	-0.1	-0.5	-1.5	-0.6
	S. Dev	-1.2	-0.2	-0.1	-4.8	0.6
	Ratio	0.1	0.0	0.0	0.1	-0.1
66-89	Mean	0.6	-0.4	-1.4	-4.4	-1.3
	S. Dev	-2.0	-1.1	-1.2	-6.5	-0.2
	Ratio	0.1	0.0	-0.1	-0.1	-0.1
90-06	Mean	-0.4	0.2	0.8	2.6	0.5
	S. Dev	0.2	1.3	1.6	-1.8	1.7
	Ratio	-0.1	-0.1	0.0	0.3	-0.1
US state and local funds						
66-06	Mean	0.4	0.0	-0.3	-1.3	-0.4
	S. Dev	-1.2	-0.2	-0.1	-4.8	0.6
	Ratio	0.1	0.0	0.0	0.1	-0.1
66-89	Mean	0.5	-0.4	-1.4	-4.4	-1.3
	S. Dev	-2.0	-1.1	-1.3	-6.5	-0.2
	Ratio	0.1	0.0	-0.1	-0.1	-0.1
90-06	Mean	0.1	0.7	1.3	3.0	0.9
	S. Dev	0.1	1.2	1.5	-1.9	1.6
	Ratio	0.0	0.0	0.0	0.4	0.0

Key: see Table 5. Source: authors' calculations.

Consistent with the above findings, data in Table 6 also show that actual returns on the Canadian pension funds underperform than the benchmark returns, as indicated by the frequent negative values of the differentials (these are shaded to aid recognition). In contrast, UK pension funds outperform the benchmark in all cases except for the domestic bond-equity portfolio in 1990-2006. In the US case, private funds underperform internationally-diversified portfolios in the earlier period and domestic portfolio in the later one. In contrast, US state and local funds outperform all benchmarks over 1990-2006.

These results are consistent with the beneficial effects of an unrestricted portfolio composition under the prudent person rule in the UK and US, compared with the hybrid regulations in Canada.

In addition to the simple comparison with a set of benchmark returns, we also computed the optimal portfolios based on the mean-variance approach and the two-fund separation theorem. Results for 1978-2006 are given in Table 7.[31] Before going to details, it is necessary to explain some definitions. "Overall return/risk" means return/risk of the overall portfolio (i.e. risk free asset plus the risky portfolio), while "risky fraction" refers to the share of the risky portfolio relative to the overall portfolio. Our main panel has the five principal assets, equities, corporate bonds, government bonds, real estate and foreign assets.[32] We show three alternative approaches to investment, one with 100% risky assets, one with 5%, 10% and 20% in cash and another with lower risk consistent with a risk aversion coefficient of 0.5 and around 40% in the risky asset. The right hand columns in italics show the actual returns on pension funds over this period and the excess return is the difference actual less optimal.

The optimal portfolio distribution is worthy of note, as it has high shares of property for all three countries, suggesting that it is sub-optimal to restrict property holdings as is the case in Canada. The good performance of property in a mean variance portfolio is consistent with the work of Booth (2002) cited above. We suggest that it relates to the relatively idiosyncratic behaviour of property returns, as compared with more globally integrated and hence more closely correlated markets for bonds and equities.

Then, the key result is that Canadian pension funds underperform the optimal risky portfolio (panel 1) in terms of real returns, by 30 basis points per annum, while UK and US funds outperform by 60 and 30 basis points, respectively. The implication is that Canadian funds are investing sub-optimally, below the frontier of efficient portfolios, as they could obtain more return and less risk by investing in the optimal risky portfolio. This underperformance is even greater for the medium risk portfolios of panel 2 (i.e. excess return is always relatively greater for US and UK funds at each risk level) and low risk portfolio of panel 3 (i.e. only 3.1% excess return for Canadian funds as against 5.1% for the UK and 3.9% for the US ones).

[31] The optimisation package was unable to give consistent results for the 1990-2006 period, while results for the 1966-2006 period were not realistic.

[32] Meanwhile, two alternative optimal portfolios were calculated, i.e. one with the full set of assets, while the other one that excludes mortgages given this asset class's over-concentration in the former case. Results for the 1966-2006 period were also generated. These are available from the authors on request.

Table 7: Mean-variance optimisation results for hypothetical pension funds 1978-2006

(1) High risk mean variance portfolio (100% risky portfolio)

	Overall Return	**Overall Risk**	**Sharpe Ratio**	**Risky Portfolio**					***Fund Return***	***Fund Risk***	*Sharpe Ratio*	*Excess return on fund*
				CB	**GB**	**EQ**	**PR**	**FA**				
Canada	7.9	5.7	1.385	0.231	0.034	0.112	0.460	0.163	*7.6*	*7.8*	*1.0*	*-0.3*
UK	7.9	6.7	1.178	0.070	0.189	0.303	0.437	0.000	*8.5*	*8.9*	*0.9*	*0.6*
US	7.2	6.0	1.215	0.000	0.030	0.271	0.658	0.042	*7.5*	*9.9*	*0.8*	*0.3*

(2) Medium risk mean variance portfolios (80-95% risky portfolio)

	Overall Return	**Overall Risk**	**Sharpe Ratio**	**Risky Return**	**Risky Risk**	**Risk Fraction**	**Risky Portfolio**					***Fund Return***	***Fund Risk***	***Sharpe Ratio***	***Excess return on fund***
							CB	**GB**	**EQ**	**PR**	**FA**				
Canada	7.2	4.7	1.5	7.3	4.9	0.95	0.111	0.164	0.087	0.510	0.129	*7.6*	*7.8*	*1.0*	*0.4*
	7.0	4.5	1.6	7.3	4.9	0.9	0.111	0.164	0.087	0.510	0.129	*7.6*	*7.8*	*1.0*	*0.6*
	6.6	4.0	1.7	7.3	4.9	0.8	0.111	0.164	0.087	0.510	0.129	*7.6*	*7.8*	*1.0*	*1.0*
UK	6.9	5.5	1.3	7.1	5.7	0.95	0.018	0.378	0.183	0.421	0.000	*8.5*	*8.9*	*0.9*	*1.6*
	6.8	5.3	1.3	7.1	5.7	0.9	0.018	0.378	0.183	0.421	0.000	*8.5*	*8.9*	*0.9*	*1.7*
	6.4	4.8	1.3	7.1	5.7	0.8	0.018	0.378	0.183	0.421	0.000	*8.5*	*8.9*	*0.9*	*2.1*
US	6.1	4.6	1.3	6.3	4.7	0.95	0.198	0.000	0.122	0.667	0.013	*7.5*	*9.9*	*0.8*	*1.4*
	5.9	4.4	1.3	6.3	4.7	0.9	0.198	0.000	0.122	0.667	0.013	*7.5*	*9.9*	*0.8*	*1.6*
	5.5	4.0	1.4	6.3	4.7	0.8	0.198	0.000	0.122	0.667	0.013	*7.5*	*9.9*	*0.8*	*2.0*

(3) Low risk mean variance portfolio (risk aversion coefficient of 0.5)

	Overall Return	**Overall Risk**	**Sharpe Ratio1**	**Risky Return**	**Risky Risk**	**Risk Fraction**	**Risky Portfolio**					***Fund Return***	***Fund Risk***	*Sharpe Ratio2*	*Excess return on fund*
							CB	**GB**	**EQ**	**PR**	**FA**				
Canada	4.5	1.8	2.507	7.3	4.9	0.37	0.111	0.164	0.087	0.510	0.129	*7.6*	*7.8*	*1.0*	*3.1*
UK	3.4	2.0	1.701	7.1	5.7	0.35	0.018	0.378	0.183	0.421	0.000	*8.5*	*8.9*	*0.9*	*5.1*
US	3.6	2.1	1.714	6.3	4.7	0.44	0.198	0.000	0.122	0.667	0.013	*7.5*	*9.9*	*0.8*	*3.9*

Notes: (1) Risk aversion coef; risk aversion coefficient. (2) Overall return (risk): overall return (risk) of the whole portfolio which consists of risk-free asset and risky portfolio according to the two-fund separation theorem. (3) Sharpe ratio 1(2): Return divided by risk. (4) Risky return (risk): return (risk) of the risky portfolio. (5) Risk fraction: share of risky portfolio relative to the whole portfolio. (6) Fund return (risk): return (risk) of the actual pension funds. (7) Excess return on fund equals actual returns minus optimal. (8) The composition of the risky portfolio (and Risky return/risk) varies when the risk fraction is 1; the composition of the risky portfolio (and Risky return/risk) does not vary when the risk fraction is less than 1.

7.5 Empirical results 2: other large pension funds in Canada, UK and US

We collected data on around 20 funds for each of our 3 countries over the period 2000-2006, see Appendix 4, for the most part from fund websites. These data complement the more detailed and longer-term analysis of the 3x3 funds over 1990-2006 shown above. Note that for many funds returns have to be derived from the percent increase in asset values, which is distorted by contributions (although generally these are small relative to total asset values). These annual asset values are in fact the sole data available for most funds.

Table 8: Characteristics of top-20 individual fund real returns, 2000-2006

	2000-2006	2000-2006	2000	2001	2002	2003	2004	2005	2006
Canada	**average**	**SD**							
Mean fund return	**5.2**	7.9	5.0	-4.3	-7.2	9.2	10.7	11.5	11.7
Benchmark (40% foreign)	**6.4**	7.6	8.4	-10.0	4.6	12.0	10.1	9.9	9.6
Excess over benchmark	**-1.2**		-3.4	5.8	-11.9	-2.9	0.5	1.6	2.1
Standard deviation across funds	**4.0**		4.5	3.4	3.6	7.7	3.4	2.6	2.6
UK									
Mean fund return	**1.7**	9.9	-2.1	-11.6	-9.8	2.1	12.0	11.0	10.2
Benchmark (40% foreign)	**2.4**	7.5	-9.2	-6.0	0.2	9.1	6.8	8.1	8.1
Excess over benchmark	**-0.7**		7.1	-5.6	-10.0	-7.0	5.2	2.9	2.1
Standard deviation across funds	**11.1**		11.3	7.9	9.4	16.3	17.3	9.1	6.8
US									
Mean fund return	**0.7**	7.9	1.1	-10.8	-9.8	5.7	8.8	3.9	6.3
Benchmark (40% foreign)	**2.1**	8.0	-10.0	-6.2	0.6	12.5	6.8	2.9	8.3
Excess over benchmark	**-1.4**		11.2	-4.6	-10.4	-6.8	2.0	0.9	-2.0
Standard deviation across funds	**4.9**		8.7	2.3	3.0	8.7	4.7	3.7	3.4

Data source: Fund websites; in general Canadian data are actual returns while the returns for the UK and US are derived from changes in asset values. Benchmark is real return on 40% foreign portfolio allocated 50-50 between foreign bonds and foreign equities (the remaining 60% domestic portfolio is assumed to be allocated 50-50 between domestic bonds and domestic equities).

The period chosen was marked by the equity bear market, that led to negative returns for many funds in each of the three countries, as shown in Table 8. However, as shown by the benchmark, conditions were more benign in Canada than elsewhere, with a mean benchmark return of 6.4% compared to 2.4% in the UK and 2.1% in the US. As before, the most appropriate comparison is of funds' performance with feasible returns; in view of the development of portfolios highlighted above, we choose a 40% foreign portfolio as a benchmark. Here we see the UK funds markedly outperform the Canadians, with an underperformance of –0.7% compared to –1.2% in Canada and –1.4% in the US (these comparisons are approximate since we do not have portfolio data for this wider range of funds). This could be attributed to asset restrictions in Canada, while US are poorer in terms of asset allocation, possibly due to "home asset preference".[33]

[33] Note however that this result is sensitive to the choice of benchmark, with the Canadian funds doing relatively better against the "diversified portfolio" including property shown in Tables 5 and 9.

Meanwhile, Canadian funds' return was of similar volatility to US funds (standard deviation of 7.9% in each case compared with 9.9% in the UK). An interesting figure is the average of the yearly standard deviations of fund returns. This shows how dispersed as opposed to "herd-like" are funds in their investment behaviour. We see that the Canadian funds are the most comparable (average dispersion of 4% compared with 4.9% in the US and 11.1% for the UK). It can be argued that this is a sign of adopting common portfolios, which may partly reflect the similar liabilities and risk preferences associated with the Canadian and US pension schemes (i.e. largely DB mature pension funds), and also may be a consequence of the portfolio regulations highlighted in the paper.

Note in looking at these data that in terms of the ratio of returns the Canadian funds' performance is more impressive (i.e. the ratio of the mean return to the benchmark). We note also that the results could relate to the types of funds, where in both the US and Canadian sample there are a number of unsophisticated funds with potential governance problems, whereas the UK funds are all likely to be well run and with leading-edge investment approaches.

Summarising Section 7, we have found shortfalls in Canadian funds' performance relative to benchmarks at a number of levels; national data over 1966-2006, 1966-89 and 1990-2006 and with optimal portfolios over 1978-2006; for 3 large funds from each country over1990-2006; and for the top-20 funds over 2000-2006. Returns, in other words, are generally (albeit not universally) lower relative to the benchmark than those corresponding funds in the UK and (at times) the US. In each case, it is likely that quantitative asset restrictions contributed to underperformance by biasing the asset allocation away from the most appropriate one for the fund's liabilities (bearing in mind that the data are generally for DB or mainly-DB funds). Funds in Canada are not - or have not been - exploiting opportunities as widely as are their counterparts. This will have consequences for the cost of providing a given level of pensions. On the other hand, as noted in Section 5, it is acknowledged that there are other influences on pension fund portfolios besides such asset restrictions, so conclusions need to be drawn with caution.

8 Conclusions

In this paper, we reviewed the arguments relating to investment regulations of pension funds and then investigated the performance of Canadian pension funds relative to those from the UK and US, in the light of the ongoing quantitative asset restrictions that still apply in that country, compared to the "pure" prudent person approach in the UK and US. A summary of our findings is shown in Table 9. Overall, we found that although Canadian funds often obtain better returns and risks, these are often less than could be obtained given financial market conditions. In contrast, UK and US funds often outperform benchmarks. Although the differences we identify may seem small, they cumulate strongly over time. Over a 40-year period, scope for 0.5% higher investment returns gives rise to a 22.1% larger portfolio, and a 1% improvement raises the final pensionable sum by 48.9%. Combined with criticisms of specific Canadian regulations in the light of finance theory and empirical evidence, we contend that the paper makes a case for removal of outstanding quantitative restrictions in Canada, and their replacement by sole prudent person regulations. Notably, we found that the real estate limit in Canada, although not a binding constraint on individual funds, is inconsistent with the optimal portfolio generated by the mean variance calculation. This means Canadian funds are limited in the scope to minimise risk subject to return by the regulations. Although our results for the other regulations are less clear cut, this result plus the overall poorer performance than UK and US funds is evidence for their having a negative

effect on performance also. Nevertheless, we acknowledge that the results are imperfect and not all favour the hypothesis, so further research is needed.

Table 9: Summary of findings

Section	Finding
2: Pension fund investment	Many Canadian DB funds found themselves in deficit in 2007, which may require alternative investment strategies, seeking high return asset classes. Equally, the shift to liability driven investment requires flexibility in asset holdings. Both of these may be hindered by portfolio regulations.
3: Pension fund investment regulation	Canadian funds, although ostensibly subject to prudent person rules, are also constrained by a number of quantitative asset restrictions not present in the UK and US.
4: The case for pension fund portfolio regulation	Notably in advanced countries, it is hard to find economic arguments that favour quantitative asset restrictions over a prudent person approach. They are likely to lead to sub optimal return and risk taking, thus harming fund beneficiaries, as well as having adverse effects on the asset management industry and the economy as a whole.
5: Empirical research on pension fund portfolio regulations	Extant transnational studies show that prudent person rules play a beneficial role compared with quantitative asset restrictions. In both advanced and emerging market countries, quantitative asset restrictions lead to a marked underperformance of pension funds relative to feasible and/or optimal portfolio benchmarks. On the other hand, it is acknowledged that there are other influences on pension fund portfolios besides such asset restrictions, so conclusions need to be drawn with caution.
6: The debate on QAR in Canada	There are specific arguments against the form QAR has taken in Canada – notably that they limit holdings of the highly attractive asset real estate thus limiting optimisation, and that they limit corporate governance initiatives and holding of small firms that could benefit the economy as well as the pension fund sector. As for FPR all of these ongoing restrictions entail heightened administrative costs, costs of reduced competition and limit diversification.
7.4: Empirical results for average pension funds over 1966-2006	Canadian pension funds on average have achieved lower returns than were feasible, both over 1966-89 and 1966-2006. This is less the case for US funds, and not at all the case for UK funds, which have almost always outperformed their benchmarks. This underperformance can be attributed to portfolio regulations. Canadian funds also underperform optimal portfolios based on mean-variance optimisation, whereas UK and US funds outperform them. It is notable that such optimal portfolios recommend levels of property investment that are ruled out by current Canadian investment regulations.
7.5: Empirical results for other large pension funds over 2000-6	Large Canadian funds on average show a greater shortfall relative to a chosen benchmark over 2000-2006 than UK or US funds. They also show greater correlation of performance, that may reflect "herding" of asset managers. Both of these may be attributed to the influence of portfolio regulations.

REFERENCES

Ambachtsheer K (1988), "Integrating business planning with pension fund planning", in eds, R Arnott and F Fabozzi "Asset allocation; a handbook", Probus, Chicago.

Ambachtsheer K (2004), "Cleaning up the pensions mess, how it will take more than money", C.D. Howe Institute Backgrounder No. 78.

Antolin, P. and Blommestein, H. (2007), "Governments and the market for longevity-indexed bonds". OECD Working Paper on Insurance and Private Pensions No. 4. OECD, Paris.

Blake D (1997), "Pension funds and capital markets", Discussion Paper No PI-9706, The Pensions Institute, London.

Blake D (2000), "Does it matter what pension scheme you have?", Economic Journal, 110, F45-F81

Blake, D. (2003), "Financial system requirements for successful pension reform", UBS PRP Discussion Paper No. 13 (FMG 457). London School of Economics, London.

Blake, D. (2007a), “Its all back to front: critical issues in the design of defined contribution pension plans”. Presented at the annual conference of DNB/Netspar/IOPS on 22/3 March, Amsterdam.

Blake, D. (2007b), “Pension liability risk: manage or sell?” Presented at the IMF/DNB seminar on Ageing, Pension Risk Management and Financial Stability on 15 February, Washington.

Blake, D. and Inkmann, J. (2004), “Liability valuation and optimal asset allocation”, Discussion Paper No. 27. LSE-UBS Pension Research Programme, London.

Blome, S, Fachinger, K, Franzen, D, Scheuenstuhl, G. and Yermo, J. (2007), “Pension fund regulation and risk management”, OECD Working Papers on Insurance and Private Pensions, No 8. OECD, Paris.

Bodie Z (1995), “On the risk of stocks in the long run”, Financial Analysts Journal, 52, (March/April) 67-68

Bodie, Z. (2001), “Retirement investing: a new approach”, Working Paper 2001-03. Boston University School of Management, Boston.

Bodie Z, Kane A and Marcus A J (2003), "Investments", Irwin, Homewood, Illinois..

Bodie, Z., Merton, R. C. and Samuelson, W. F. (1992), “Labour supply flexibility and portfolio choice in a life cycle model”, Journal of Economic Dynamics and Control, 16, pp427-449.

Bodie, Z. and Merton, R. C. (2002), “International pension swaps”, Journal of Pension Economics and Finance, 1(1), pp77-83.

Booth, P.M. (2002), “Real estate investment in an asset/liability modelling context”, Journal of Real Estate Portfolio Management, 8(3), pp183-198.

Borio C V, Chincarini L and Tsatsaronis K (1997), “Institutional investors, asset management and financial markets”, mimeo, Bank for International Settlements, Basel.

Burgess D and Fried J (2004), “The FPR burden, a proposal for cutting government waste”, Canadian Investment Review, Summer 2004, 57-58

Byrne J and Davis E P (2003), “Financial Structure: An Investigation of Sectoral Balance Sheets in the G-7”, Cambridge University Press

Case Karl, William Goetzemann and K Geert Rouwenhorst (1999), “Global real estate markets – cycles and fundamentals”, Working Paper, Yale School of Management.

Chaundy, D. (1999), “Can domestic liabilities explain the home bias in UK investment portfolios”, Working Paper No. 116. ESRC Centre for Business Research, University of Cambridge.

Clark, G. L., Caerlewy-Smith, E. and Marshall, J. (2006), “Trustee decision-making in theory and practice”, Journal of Pension Economics and Finance, 5(1), pp91-110.

Clark, G. L. and Hu, Y. (2005a), “Re-writing pension fund capitalism 2: the UK pension crisis and trends in occupational pension plan benefits, 1950-2004”, WPG 0509, Economic Geography Working Paper. The University of Oxford, Oxford.

Clark, G. L. and Hu, Y. (2005b), “Re-writing pension fund capitalism 3 – defined contribution and defined benefit schemes with reference to demographic and financial flows”, WPG 0510, Economic Geography Working Paper. The University of Oxford, Oxford.

Davis, E. P. (1995), “Pension Funds, Retirement Income Security and Capital Markets”, Oxford University Press, Oxford.

Davis E P (2001), "Regulation of Private Pensions - A Case Study of the United Kingdom", Occasional Paper No OP15, Financial Services Authority, London

Davis, E. P. (2002a), “Prudent person rules or quantitative restrictions? The regulation of long term institutional investors’ portfolios”, Journal of Pension Economics and Finance, 1, pp157-191

Davis E P (2002b), "Institutional investors, corporate governance, and the performance of the corporate sector", Economic Systems, 26, 203-229

Davis E P (2004a), "Is there a pensions crisis in the UK?", Geneva Papers on Risk and Insurance

Davis, E. P. (2004b), “Financial development, institutional investors and economic performance” in C. A. E. Goodhart (ed.), “Financial Development and Economic Growth: Explaining the Links”, Palgrave-Macmillan, London.

Davis, E. P. (2005), “Pension fund management and international investment – a global perspective”, Pensions.

Davis E P, Grob S and De Haan L (2007), “Pension fund finance and sponsoring companies; empirical evidence”, Working Paper No. 158, De Nederlandsche Bank, Amsterdam.

Davis, E P and Steil, B. (2001), Institutional Investors. The MIT Press, Cambridge.

Davis, E. P. and Zhu, H. (2004), “Banking lending and commercial property cycles: some cross-country evidence”, BIS Working Papers No. 150. Bank for International Settlement, Basel.

Daykin C (1995), “Occupational pension provision in the United Kingdom”, in eds. Z Bodie, O S Mitchell and J Turner, “Securing employer-based pensions, an international perspective”, University of Pennsylvania Press.

Del Guercio D (1996), “The distorting effects of the prudent-man laws on institutional equity investments”, Journal of Financial Economics, 40, 31-62

Del Guercio, D and J. Hawkins. (1999), “The Motivation and Impact of Pension Fund Activism”, Journal of Financial Economics, Vol.52 (3), pp293-340

Dutta, J., Kapur, S. and Orszag, J. M. (2000), “A portfolio approach to the optimal funding of pensions”. Economic Letters, 69(2), pp201-206.

Eichholz P M A (1996), “Does international diversification work better for real estate than for stocks and bonds?”, Financial Analysts Journal, January-February, 56-62

European Commission (1999), “Rebuilding pensions, security, efficiency, affordability - recommendations for a code of best practice for Second Pillar Pension Funds”, prepared by Pragma Consulting for DG-XV, European Commission, Brussels

Faccio, M. and Lasfer (2001), “Institutional Shareholders and Corporate Governance: The Case of UK Pension Funds”, Working Paper No. 11/01. Centre for Research on Pensions and Welfare Policies, Turin.

Fontaine J A (1997), "Are there good macroeconomic reasons for limiting external investments by pension funds? The Chilean experience", in ed. Valdes-Prieto S The Economics of Pensions, Cambridge University Press.

Ehrlich, E. E. (1981), "International Diversification by United States Pension Funds," Federal Reserve Bank of New York Quarterly Review, vol. 6, no. 3 (Autumn), pp.1-14.

FSCO (Financial Services Commission of Ontario), (2006). “Funding defined benefit pension plans: risk-based supervision in Ontario”. Toronto.

Fried J (2005), “Elimination of the foreign property rule on tax deferred savings plans”, EPRI Working Paper 2005-5, University of Western Ontario.

Galer, R. (2002), “Prudent pension rule” standard for the investment of pension fund assets”, Financial Market Trends No. 83. OECD, Paris.

Gianetti M and Laeven L (2007), “Pension reform, ownership structure and corporate governance; evidence from Sweden”, CEPR Working Paper No 6489.

Gillan, S T and Starks, L T (2000), Corporate governance proposals and shareholder activism: the role of institutional investors; Journal of Financial Economics, Vol. 57(2), pp275-305.

Goodman R (2000), “The development of the prudent man concept in relation to pension funds”, Journal of Pensions Management, 6(3), 219-224

Hinz, R., Rocha, R. and Gutierrez, J. (1999), “Improving the regulation and supervision of pension funds: Are there lessons from the banking sector?”, Social Protection Discussion Paper No. 9929. The World Bank, Washington.

Hu, Yu-Wei (2007), “Pension fund investment and regulation”, in “Three essays on pension funds and pension reform”, Doctoral Dissertation, Brunel University, May 2007

Hu, Y., Stewart, F. and Yermo, J. (2007), “Pension fund investment and regulation: an international perspective and its implications for China’s pension reform”, OECD Insurance and Private Pensions Working Paper Series, forthcoming, Paris.

Levy, H. and Sarnat, M. (1970), “International diversification of investment portfolios”, American Economic Review, 60(4), pp668-675.

Markowitz, H. M. (1959), “Portfolio Selection: Efficient Diversification of Investment”, Yale University Press, New Haven.

Markowitz, H. M. (1991), “Foundations of portfolio theory”, Journal of Finance, 46(2), pp469-477.

Myners Review of Institutional Investors (2000),

http://www.hm-treasury.gov.uk/media/2/9/157.pdf

Nielson N L and Chan D K W (2007), "Private pensions and government guarantees, clues from Canada", Journal of Pension Economics and Finance, 6, 45-66.

OECD (2005), "Survey of Investment Regulation of Pension Funds 2005", Organisation for Economic Cooperation and Development, Paris

OECD (2006), "Pension markets in focus". October, Issue 3. OECD, Paris.

OECD (2007a), "Survey of Investment Regulation of Pension Funds, July 2007", Organisation for Economic Cooperation and Development, Paris

OECD (2007b), "Pension fund performance", committee meetings document, Working Party on Private Pensions, Paris.

OECP (Ontario Expert Commission on Pensions). (2007), "Reviewing Ontario's pension system: what are the issues?" A Discussion Paper for Interested Ontarians. February, Ontario.

OMERS (2007a), "Pension investment regulatory framework". Draft, May 18, 2007. Toronto.

OMERS (2007b), "OMERS submission to the Ontario Expert Commission on Pensions"; Closing the Gap: between pension regulation and best practices. October, Toronto.

OSFI (Office of the Superintendent of Financial Institutions) (2007), "PBSA Update 26 – Issue No. 26", December 2007, Ottawa.

http://www.osfi-bsif.gc.ca/osfi/index_e.aspx?ArticleID=2132#5

Peskin M W (1997), "Asset allocation and funding policy for corporate sponsored defined benefit pension funds", Journal of Portfolio Management, Winter 1997, 66-73.

Queisser, M. (2000), "Pension reform and international organisations: from conflict to convergence", International Social Security Review, 53(2).

Reisen, H. (1997), "Liberalizing foreign investments by pension funds: positive and normative aspects", World Development, 25 (7), pp1173-1182.

Samuelson, P. A. (1992), "At last a case for long-horizon risk tolerance and for asset allocation timing", in R. D. Arnott and F. J. Fabozzi (eds.). Active Asset Allocation. McGraw-Hill, Maidenhead

Sharpe, W. F. (1990), "Capital asset prices: with and without negative holdings", Nobel Lecture. December 7. Stockholm.

Sharpe, W. F. and Tint, L. G. (1990), "Liabilities – a new approach", Journal of Portfolio Management, 16(2), p5-11.

Shleifer, A. and Vishny, R. W. (1997), "A survey of corporate governance", The Journal of Finance, Vol. 52, No. 2, pp737-783.

Sias R W (1996), "Volatility and the institutional investor", Financial Analysts Journal, March/April, 13-20

Smith M P (1996), "Shareholder activism by institutional investors; evidence from CALPERS", Journal of Finance, 51, 227-252

Solnik, B. (1998), "International Investment", Addison-Wesley, Reading, Mass

Srinivas, P. S., Whitehouse, E. and Yermo, J. (2000), "Regulating private pension funds' structure, performance and investments: cross-country evidence", Social Protection Discussion Paper Series No. 0113. The World Bank, Washington.

Strickland, Deon, Kenneth W. Wiles, and Marc Zenner (1996), "A requiem for the USA: Is small shareholder monitoring effective?", Journal of Financial Economics 40: 319-338.

Tamagno, Ed (2006), "The management and regulation of occupational pension plans in Canada", December, Caledon Institute of Social Policy, Ontario.

Tuer E and E Woodman (2005), "Recent trends in Canadian defined-benefit pension sector investment and risk management", Bank of Canada Review, Toronto.

Vittas, D. (1998), "Regulatory controversies of private pension funds", Development Research Group. The World Bank, Washington.

Wahal, S. (1996), “Pension fund activism and firm performance”, The Journal of Financial and Quantitative Analysis, 31(1), pp. 1-23.

Woidtke, T, (2002), "Agents watching agents? Evidence from pension fund ownership and firm value", Journal of Financial Economics, 63, 99-131

Yang, T. (2003), “Defined benefit pension plan liabilities and international asset allocation”, Working Paper WP 2003-058. Michigan Retirement Research Centre.

Appendix 1: Statistical summary of asset returns in Canada, the UK and the US

			ST	CB	GB	EQ	MO	PR	FA	OA
Canada	**66-06**	**Mean, %**	2.9	6.5	4.6	6.8	5.2	6.5	6.2	5.5
		S. Dev, %	2.4	13.0	10.1	15.1	2.0	6.3	11.6	5.5
		Ratio	1.2	0.5	0.5	0.4	2.6	1.0	0.5	1.0
	66-89	**Mean, %**	3.0	1.1	2.5	3.9	5.1	6.9	6.2	4.1
		S. Dev, %	2.6	12.0	11.2	14.3	2.1	4.8	13.0	5.8
		Ratio	1.2	0.1	0.2	0.3	2.4	1.4	0.5	0.7
	90-06	**Mean, %**	2.8	14.2	7.5	10.8	5.5	6.0	6.2	7.6
		S. Dev, %	2.2	10.5	7.7	15.8	1.8	8.0	9.6	4.6
		Ratio	1.2	1.4	1.0	0.7	3.0	0.7	0.6	1.6
UK	**66-06**	**Mean, %**	1.4	3.5	3.4	11.1	4.0	6.0	5.2	4.9
		S. Dev, %	4.9	12.8	8.3	28.4	4.2	11.0	13.6	8.0
		Ratio	0.3	0.3	0.4	0.4	0.9	0.5	0.4	0.6
	66-89	**Mean, %**	0.1	0.6	1.9	12.8	3.2	5.5	5.5	4.2
		S. Dev, %	6.1	13.4	9.8	34.9	5.2	12.0	15.0	9.3
		Ratio	0.0	0.0	0.2	0.4	0.6	0.5	0.4	0.5
	90-06	**Mean, %**	3.3	7.5	5.4	8.7	5.0	6.7	4.8	5.9
		S. Dev, %	1.4	11.1	5.3	16.1	2.0	9.8	11.8	5.7
		Ratio	2.3	0.7	1.0	0.5	2.4	0.7	0.4	1.0
US	**66-06**	**Mean, %**	1.4	4.4	3.5	7.3	4.4	5.9	7.1	4.9
		S. Dev, %	2.1	9.3	11.6	16.8	2.6	5.1	15.4	5.9
		Ratio	0.7	0.5	0.3	0.4	1.7	1.2	0.5	0.8
	66-89	**Mean, %**	1.5	3.9	2.4	5.3	4.3	6.1	8.8	4.6
		S. Dev, %	2.5	11.3	13.2	16.9	3.3	2.3	17.4	6.9
		Ratio	0.6	0.3	0.2	0.3	1.3	2.6	0.5	0.7
	90-06	**Mean, %**	1.3	5.1	5.1	10.1	4.5	5.7	4.7	5.2
		S. Dev, %	1.5	5.8	9.0	16.8	0.9	7.5	12.0	4.4
		Ratio	0.9	0.9	0.6	0.6	4.8	0.8	0.4	1.2

Source: various sources, see Section 7.1 and Appendix 2 for details. ST: short-term assets; CB: domestic corporate bonds: GB: domestic government bonds; EQ: domestic equities; MO: mortgages; PR: property; FA: foreign assets; OA: other residual asset classes. All real returns are nominal returns less inflation. Note that bond, equity and property returns are based on total returns (capital gain plus income yield); foreign asset returns are based on non-domestic global portfolios split evenly between equities and bonds and adjusted for exchange rate changes, the other asset category is the simple average of the other returns.

Appendix 2: List of data sources

(1) Domestic asset returns	**ST**	**CB**	**GB**	**EQ**	**MO**	**PR**	**FA**	**OA**
Canada	BOC	BOC, DS, DAS	DS, GFD	DS, GFD	BOC	DAS, IPD	Panel 2	Authors
UK	BOE, DAS	WW, DS, DAS	DS, GFD	DS, GFD	BOE, DAS	DAS, IPD	Panel 2	Authors
US	GFD, FRB	DS, GFD	DS, GFD	DS, GFD	EFD, FRB	DAS, NCREIF	Panel 2	Authors
(2) Foreign asset returns	**Foreign bond**	**Foreign equity**	**(3) Portfolio distribution at the national level**		**(4) Portfolio distribution of the individual funds**			
Domestic return	DS, GFD	DS, GFD	**Canada**	Statistics Canada	**All countries**	AP Information Services, individual homepages and OMERS		
Weights	BIS	DS	**UK**	Office for National Statistics				
Exchange rate	WDI	WDI	**US**	Federal Reserve Board				

Keys for asset classes: see Appendix 1. BIS: Bank of International Settlement; BOC: Bank of Canada; BOE: Bank of England; DS Datastream; DAS: Davis and Steil (2001); GFD: Global Financial Data; FRB: US Federal Reserve Board; IPD: International Property Data; WDI: World Development Indicator; NCREIF, National Council of Real Estate Investment Fiduciaries.

Appendix 3: Calculation of the mean-variance optimal portfolio

Markowitz (1959) shows that the efficient set of feasible mean-variance opportunities can be found by either maximising portfolio returns for a given risk, or minimising portfolio risks for a given return. As a development of Markowitz's mean-variance model, the two-fund separation theorem has been widely accepted in the portfolio management studies with introduction of risk-free asset and particularly investors' risk aversion. The classic two-fund separation theorem states that all investors will make their investment choice between two funds, i.e. a risk-free asset or fund and a risky portfolio comprising risky assets (e.g. equities and bonds) (Sharpe 1990); in addition, this theorem argues that regardless of risk preferences, all investors will choose precisely the same risky portfolio, and difference in risk preferences among investors will determine the actual mix of the risk-free asset[34] and the risky portfolio in the investors' complete portfolios. In the context of the two-fund separation framework, the mean-variance approach needs to be followed to find the optimal weights in the portfolio. Basically there are two steps. The first is to find the tangency portfolio (i.e. the tangency point between the efficient frontier and the capital allocation line CAL, see below), while taking into account investors' risk preferences the second step involves moving the above-mentioned tangency portfolio along the CAL so as to find the optimal risk-adjusted portfolio (i.e. maximised utility), see Figure 1.

Specifically, the efficient set of feasible mean-variance opportunities should be first found by solving two standard optimisation problems, i.e. maximise portfolio returns for a given risk, or minimise portfolio risks for a given return as follows:

$$\text{Minimize } \sigma_W^2 = \mathbf{W^T V W} \text{ subject to: } (\mathbf{R} - R_f \mathbf{1})^{\mathbf{T}} \mathbf{W} = R_w - R_f \qquad (1)$$

[34] However, strictly speaking, there is no risk-free asset notably when there is inflation.

where:

$$\mathbf{W} = \begin{bmatrix} W_1 \\ \vdots \\ W_N \end{bmatrix} \text{(weights of risky assets in the risky portfolio)}$$

$$\mathbf{V} = \begin{bmatrix} \sigma_{11} & \cdots & \sigma_{1N} \\ \vdots & \ddots & \vdots \\ \sigma_{N1} & \cdots & \sigma_{NN} \end{bmatrix} \text{(variance of risky assets)}$$

$$\mathbf{R} = \begin{bmatrix} R_1 \\ \vdots \\ R_N \end{bmatrix} \text{(return of risky assets in the risky portfolio)}$$

T: matrix transposition;
1 : identity matrix;
σ_W^2 : variance of the risky portfolio;
R_W : return of the risk portfolio;
R_f ; return of the risk-free asset.

Equation 1 can be solved with the Lagrangian function as follows:

$$\mathrm{L}=\frac{1}{2}\mathbf{W}^{\mathbf{T}}\mathbf{V}\mathbf{W} + \kappa(R_W - R_f - (\mathbf{R} - R_f\,\mathbf{1})^{\mathbf{T}}\mathbf{W}) \quad (2)$$

To find the solution of the Markowitz problem, Equation 2 should be differentiated with respect to $\mathbf{W}$ and κ and the subsequent first derivatives are set to zero. As a result, the following 1st order conditions are found:

$$\frac{\partial L}{\partial \mathbf{W}} = \mathbf{V}\mathbf{W} - \kappa(\mathbf{R} - R_f\,\mathbf{1}) = 0 \quad (3)$$

$$\frac{\partial L}{\partial \kappa} = R_W - R_f - (\mathbf{R} - R_f\,\mathbf{1})^{\mathbf{T}}\mathbf{W} = 0 \quad (4)$$

Furthermore, the optimal weights for both risky portfolio and risk-free asset (corresponding to the tangency portfolio) can be obtained via the two equations below:

$$\mathbf{W} = \kappa\mathbf{V}^{-1}(\mathbf{R} - R_f\,\mathbf{1}) \quad (5)$$

$$W_f = 1 - \mathbf{1}^{\mathbf{T}}\mathbf{W} \quad (6)$$

Solutions to the above two equations will produce the weights we expect for an efficient frontier, which however is just the first step of the two-fund separation theorem. The second step of the theorem says that investors can adjust their individual optimal portfolio along the capital allocation line (CAL) according to their degree of risk aversion. In this context, the rational investors maximise their utility. Mathematically,

Maximize:

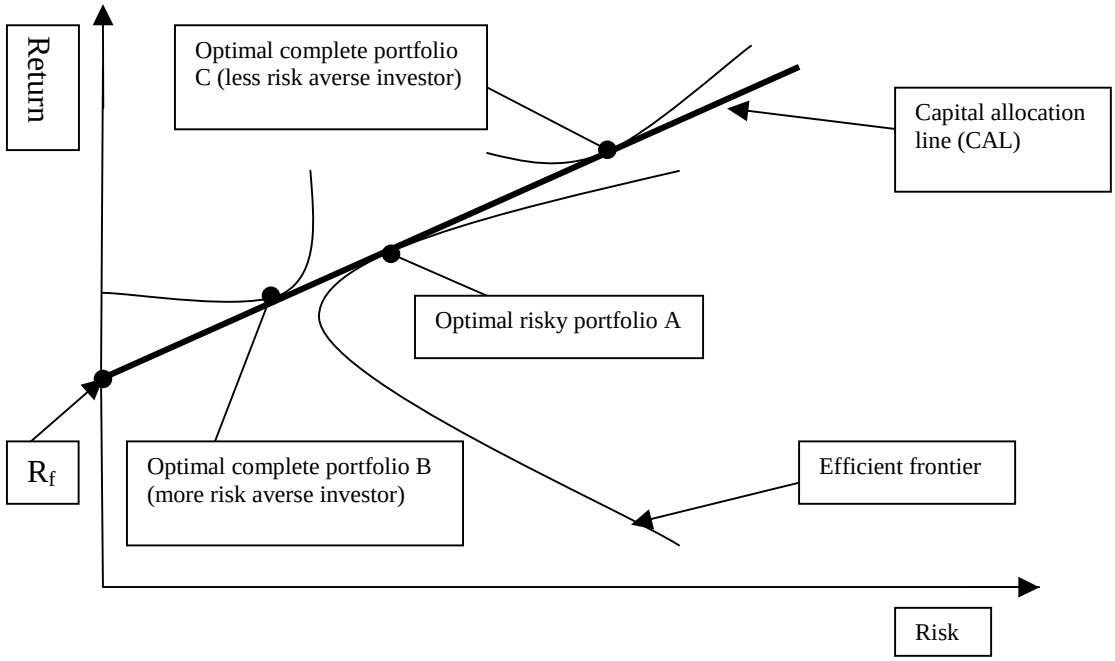
$$U = E(R_C) - \frac{\sigma_C^2}{RA}$$
$$= R_f + y[E(R_{W)}) - R_f] - \frac{y^2\sigma_W^2}{RA} \quad (7)$$

where:

$E(R_c)$: expected return of the complete portfolio
$E(R_W)$: expected return of the risky portfolio
σ_C^2: variance of the complete portfolio
σ_W^2: variance of the risky portfolio
y: proportion in the risky portfolio
RA: coefficient of risk aversion

Here, RA represents the investor's marginal rate of substation of variance for expected value. In this context, utility can be interpreted as dependent on a risk-adjusted return, as it is calculated by deducting a risky penalty factor (i.e. σ_C^2 / RA) from the expected return $E(R_c)$.

Figure 1: Optimal complete portfolio and risk aversion



Source: Hu (2007)

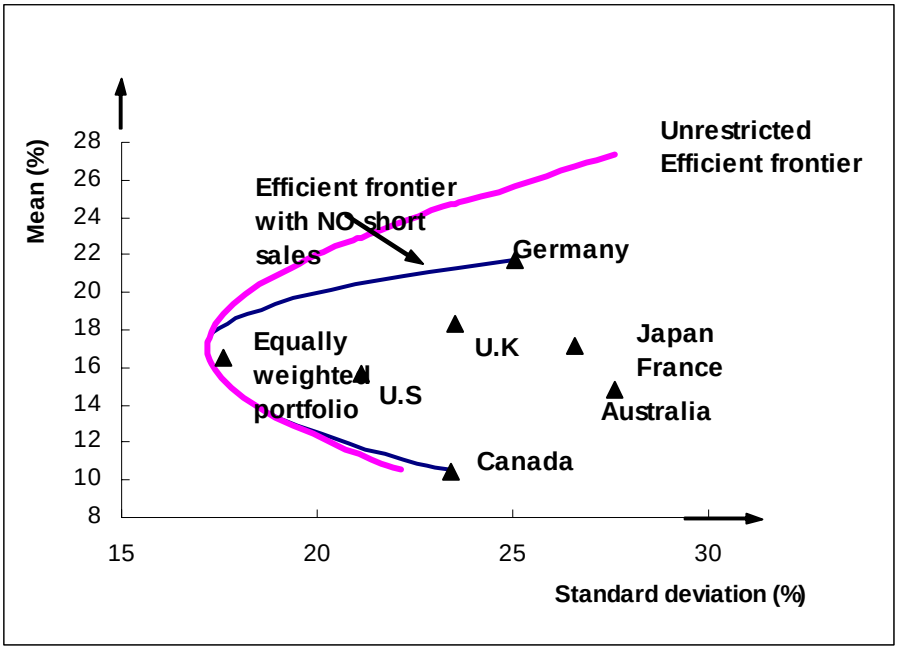
Graphically, as depicted in Figure 1, in order to find optimum portfolios, two steps (in line with the equations above) are involved. First, it is necessary to find the optimal risky portfolio A, which is also the tangency portfolio of the efficient frontier and the capital allocation line (CAL). As noted earlier, this optimal portfolio A is the same for all investors. Second, given difference in risk preferences among investors and ability to borrow and lend risk-free assets, investors could move their complete portfolios along the CAL to find their individual optimal complete portfolios (risk-free asset plus risky portfolio). For example, as shown in Figure 1, a more risk averse investor will lend his/her fund at the market rate and move his/her optimum portfolio combination to the point B, which is also the tangency portfolio of the CAL and the

indifference curve of this investor. In contrast, if the investor is less risk averse, he/she might borrow money at the market rate[35] and use the funds to invest in the risky portfolio, which corresponds to the optimal complete portfolio C (i.e. the point to the right of the optimal risky portfolio A). Based on the 2-fund separation theorem, the more risk averse investors are, the more funds are invested in the risk-free asset, and the less funds are invested in the risky portfolio. Meanwhile, the proportion of the individual asset class (bond, equity, etc) in the risky portfolio is the same regardless of how funds are allocated between the risk-free asset and risky portfolio.

Above we described the procedure for finding the optimal complete portfolios, under Markowitz's mean-variance approach as well as the two-fund separation theorem. Underlying this framework is the fact that portfolio risk is lower, if more assets are included in a portfolio, as long as they are not perfectly correlated with each other. This reasoning, addressing the old wisdom to "Never put all eggs in one basket", is particularly useful for portfolio management, since it lays out an appropriate theoretical foundation for portfolio investment, see also Section 2.

In view of the fact that markets across countries are not correlated, or move in one direction, Levy and Sarnat (1970) and Solnik (1998), among others, extend Markowitz's mean-variance framework into global investment. They believe that substantial advantages in risk reduction could be achieved by investing in foreign assets, as depicted in Figure 2. In this context, the total risk of a portfolio will depend not only on the number of securities, but also most importantly the riskiness of each security, and the extent to which these individual securities are correlated with each other. In other words, a portfolio selection strategy of choosing 10 shares from one country is almost certain to be less desirable than another strategy of choosing one share from 10 different countries.

Figure 2: Efficient frontiers with seven countries



Source: Bodie et al (2003)

[35] Note, however, that pension funds do not typically borrow, so the optimal complete portfolios are most likely to be between R_f and A in Figure 1.

Appendix 4. More analysis on the three large pension funds in Canada, the UK and US

In this section, by following the same methodology as in Section 7.4, we compare to what extent the performance of selected large pension funds in each country differs relative to a set of benchmark returns. The funds with the observation period from 1990-2006 are:

- For the UK, Bank of England (BoE), Universities Superannuation Scheme (USS), Strathclyde and British Telecommunications (BT)
- For the US, CALPERS, New York City Employees (NY City) and New York State Employees (NY State)
- For Canada, Ontario Municipal Employees Retirement System (OMERS), Ontario Teachers' Pension Plan (OTPP), and Canada Pension Plan (CPP).

Note that we are calculating index returns rather than the funds' actual returns, which may vary from the former due to investment skills in obtaining "alpha" and are in any case not available for the US and UK. In effect, as for sectors shown above, the outturns show funds' efficacy in asset allocation but not security selection. The funds' portfolios are shown in Table 4A. It is evident that there has been a degree of cross country convergence between 1990 and 2006 in foreign asset holdings, although other trends are more idiosyncratic, with Canadian funds decumulating bonds and building up mortgages and real estate and other asset holdings, UK funds building up bonds and reducing domestic equities and real estate; US funds have been relatively stable apart from the growth of foreign assets and reduction in real estate and mortgages.

Table 4A: Portfolios of major pension funds, 1990 and 2006 (percent of total)

		Short term assets	Bonds	Equities	Mortgages and Real estate	Foreign assets	Other assets
Canadian funds							
OMERS	1990	4	18	41	23	9	4
	2006	1	14	23	20	32	11
CPP	1990	0	99	0	0	0	1
	2006	11	31	21	5	32	0
OTPP	1990	0	93	3	0	4	0
	2006	0	20	16	14	31	20
UK Funds							
BT	1990	4	13	50	21	12	0
	2006	0	24	28	12	30	6
BoE	1990	4	2	60	4	30	0
	2006	3	36	31	5	24	0
Strathclyde	1990	7	7	53	11	22	0
	2006	0	12	40	10	33	11
USS	1990	6	5	48	15	14	11
	2006	2	4	37	7	50	0
US Funds							
CALPERS	1990	5	22	36	28	9	0
	2006	1	22	40	7	24	6
NY State	1990	3	40	47	8	0	2
	2006	6	22	42	4	16	10
NY City	1990	11	37	31	20	0	0
	2006	1	39	42	0	16	2

Sources: AP data and pension fund websites

Results of return calculations are given in Table 4B. For the three selected Canadian pension funds, in terms of the return on the actual portfolio OMERS performs better than CPP, but comparably with OTPP. For example, the average real return over 1990 and 2006 was 9.1% for OMERS and 9.2% for OTPP, while it was 8.9% for CPP. However, if risk is taken into account, the three funds almost performed the same, as indicated by the value of the Sharpe ratio ranging from 1.1 to 1.3. Note that CPP was severely restricted in its investments till 2001 and the CPP Investment Board did not begin investing until 1999, which helps account for poorer performance (see Table 4A).

When comparing returns on the largest Canadian funds with those in the UK and the US, statistics in Table 4B show that the former frequently outperformed the latter. For example, the mean return between 1990 and 2006 for UK funds was 7.4% (BT), 7.5% (BoE), 7.7% (Strathclyde) and 7.3% (USS), and for the US the calculated outturns were 6.7% (CALPERS), 7.6% (NY State), and 7.0% (NY City). When risk is taken into account, the Sharpe ratio still favours superior performance achieved by the Canadian funds, with US and UK funds having Sharpe ratios of 0.6-0.8.

Table 4B: Comparing individual fund real returns with benchmarks, 1990-2006, in %

Canada		Actual Portfolio	50-50	20% Foreign	40% Foreign	Global Portfolio	Diversified Portfolio
OMERS	**Mean**	9.1	9.2	8.6	8.0	6.2	8.1
	S. Dev	7.8	9.3	8.6	8.3	9.6	8.1
	Ratio	1.2	1.0	1.0	1.0	0.6	1.0
CPP	**Mean**	8.9	9.2	8.6	8.0	6.2	8.1
	S. Dev	7.7	9.3	8.6	8.3	9.6	8.1
	Ratio	1.1	1.0	1.0	1.0	0.6	1.0
OTPP	**Mean**	9.2	9.2	8.6	8.0	6.2	8.1
	S. Dev	7.1	9.3	8.6	8.3	9.6	8.1
	Ratio	1.3	1.0	1.0	1.0	0.6	1.0
UK							
BT	**Mean**	7.4	7.5	7.0	6.5	5.2	6.9
	S. Dev	10.8	9.0	9.0	9.3	11.6	9.4
	Ratio	0.7	0.8	0.8	0.7	0.4	0.7
BoE	**Mean**	7.5	7.5	7.0	6.5	5.2	6.9
	S. Dev	11.9	9.0	9.0	9.3	11.6	9.4
	Ratio	0.6	0.8	0.8	0.7	0.4	0.7
Strathclyde	**Mean**	7.7	7.5	7.0	6.5	5.2	6.9
	S. Dev	11.4	9.0	9.0	9.3	11.6	9.4
	Ratio	0.7	0.8	0.8	0.7	0.4	0.7
USS	**Mean**	7.3	7.5	7.0	6.5	5.2	6.9
	S. Dev	11.6	9.0	9.0	9.3	11.6	9.4
	Ratio	0.6	0.8	0.8	0.7	0.4	0.7
US							
CALPERS	**Mean**	6.7	7.6	7.0	6.4	4.7	6.8
	S. Dev	9.0	10.1	9.0	8.7	12.0	8.6
	Ratio	0.7	0.8	0.8	0.7	0.4	0.8
NY State	**Mean**	7.6	7.6	7.0	6.4	4.7	6.8
	S. Dev	9.7	10.1	9.0	8.7	12.0	8.6
	Ratio	0.8	0.8	0.8	0.7	0.4	0.8
NY City	**Mean**	7.0	7.6	7.0	6.4	4.7	6.8
	S. Dev	9.5	10.1	9.0	8.7	12.0	8.6
	Ratio	0.7	0.8	0.8	0.7	0.4	0.8

Source: authors' own calculations. S. Dev: standard deviation; Ratio: mean/standard deviation.

As for national data, the reason for different performance between funds might be due to the fact that the return on domestic assets during the period 1990 and 2006 was higher in Canada. For example Canadian equities returned 10.8%, while the corresponding returns for the UK were 8.7% and the US 10.1%, see Appendix 1. This difference is important given the large share of pension assets allocated to domestic equities in all selected pension funds. And this is shown when we compare the funds with realisable benchmarks in each country, which as argued above is a more appropriate comparison.

Looking at the Canadian funds, as for the national data, the three funds often underperform the domestic bond and equity portfolio (as shown in the grey cells). This is less common for the UK funds, with BoE and Strathclyde outperforming all the benchmarks, as also does the NY State fund in the US. However, Canadian funds tend to benefit from higher Sharpe ratios than the benchmarks, which is not the case for the UK and US funds.

Summarising, although the results are much more comparable than for the sectors as a whole and for longer periods, over 1990-2006 there is some evidence of underperformance of 3 large Canadian funds relative to the 50-50 domestic benchmark. This can be attributed to portfolio regulations, although it is also influenced by the quality of asset allocation decisions.

Appendix 5: Funds in the wider sample (2000-2006 or shorter)

Canada	**US**	**UK**
Ontario Teachers	California Public Employees	BT Group
Canada Pension	California State Teachers	Universities Superannuation
Ontario Municipal Employees	New York State Common	British Coal Pension Schemes
Hospitals of Ontario	Florida State Board	Royal Bank of Scotland Group
Quebec Pension	New York City Retirement	Barclays Bank U.K.
Public Service Pension Plan	Texas Teachers	Lloyds TSB Group
B.C. Municipal	Wisconsin Investment Board	National Grid
B.C. Public Service	General Electric	BAE Systems Pension Scheme
Ontario Pension Board	New Jersey	HSBC Bank
B.C. Teachers	Ohio Public Employees	Corus U.K.
OPSEU	Ohio State Teachers	Strathclyde Pension Fund
Canadian National Railways	Washington State Board	Greater Manchester Pension Fund
Canada Post	Michigan Retirement	BBC
Local Authorities Pension Board	Oregon Public Employees	ICI
Hydro-Quebec	Pennsylvania School Employees	West Midlands Metropolitan
	Virginia Retirement	CGNU
	Georgia Teachers	GlaxoSmithKline
		HBOS
		Rolls-Royce
		Marks & Spencer
		Prudential Staff
		Civil Aviation Authority

Source: see Appendix 2.