Pension fund finance and sponsoring companies: empirical evidence on theoretical hypotheses

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Abstract

This study presents empirical evidence on the influence of sponsoring companies on the funding and portfolio allocation of pension funds, an issue on which most extant literature is theoretical. We use a unique microdataset of 550 Dutch defined benefit company pension funds and 100 sponsoring firms over 1996-2005 to test the relevance of the main theoretical hypotheses, the first paper to do so in a comprehensive manner. We find that pension funds have lower cover ratios when (1) their sponsoring company is highly leveraged, (2) the fund's return on assets is relatively low, and (3) the sponsoring firm is small. Further, defined benefit pension funds are found to invest more in shares when their sponsoring companies are highly leveraged. These links in general suggest higher risk in the sponsor leads to correspondingly higher risk in the fund, and warrant close attention by regulators.

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1 Introduction

There is by now a significant volume of literature on the influence of the sponsoring company on funding and portfolio allocation decisions of its defined benefit pension fund. This literature is almost entirely theoretical. Depending on which angle is adopted, theory predicts whether or not it is beneficial to the sponsoring company when pension plans invest more in risky assets, or whether or not a sponsoring company has an incentive to underfund the pension fund by lowering its contributions to the fund.

Relative to the number of theoretical studies, empirical evidence on this particular subject is sparse, probably due to lack of data. One recent empirical contribution is Cocco and Volpin (2007) who assess whether the inclusion of insider-trustees (i.e. trustees that are also executive directors of the sponsoring company) in the board of UK defined benefit pension funds affects the share of equities in the fund's portfolio and the magnitude of the sponsor's contributions. They use cross section data on 90 UK pension funds for a single year, 2002.

We contribute to the empirical evidence on the relationship between pension finance and sponsoring using a rich set of data on Dutch company pension funds. To our knowledge, this is the first paper to test theoretical predictions in this area in a comprehensive manner. The main characteristics of Dutch funds are: dominance of defined benefit pension schemes, absence of any pension benefit insurance, absence of restrictive regulation concerning sponsoring companies' contributions, and a 50/50 representation of the pension fund's board by employer and employee. These characteristics make the Dutch system particularly interesting for the research problem at hand, as option theory is particularly relevant for defined benefit schemes, there is no benefit insurance with its concomitant moral hazard problems, and agency problems are imminent when employers are represented in the fund's board. The dataset is relatively rich, as it covers 500 to 600 company pension funds over a ten year period, 1996-2005. Hence, the difficult years 2000-2002, of low stock market sentiment and low interest rates, are included in the sample. Moreover, we use supervisory data on required technical provisions of individual pension funds, which allows a more accurate identification of underfunding or overfunding. Complementary to the data on company pension funds, we collected data for 100 sponsoring firms, half of which were listed on the stock exchange.

Our study is structured as follows. First we outline the institutional setting, including features of the Dutch pension system, regulatory aspects and recent trends in fund coverage. Then we give a brief sketch of the existing theoretical literature on the relationship between pension finance and sponsoring firms. Next, we outline the methodology and data used and present our empirical results for the capital structure, sponsor contributions, and portfolio allocation, respectively.

2 The institutional setting

In this section we describe the institutional setting during the period under investigation. We briefly sketch the Dutch pension system, regulation, and recent trends in pension funding.

2.1 The Dutch pension system

The Dutch pension system is remarkable for its high dependence on fully funded, defined benefit occupational pensions. The value of pension fund assets is well over 100% of GDP. The Dutch pension system has two main tiers, consisting of a flat rate public scheme and earnings-related, funded private schemes, mostly organised in pension funds. Most companies offer a pension scheme to their employees, either organized in a company pension fund or participating in an industry-wide pension fund.[1] If a pension scheme is offered, participation is mandatory for the employee, so that the system could be described as 'quasi-mandatory'. The result is a coverage ratio of 91% for all workers.

As a result of this high coverage, the Dutch pension fund industry is well developed. In 2005 Dutch pension funds' total assets were worth $ 780 billion, which accounts for more than half of all Euro area pension assets (OECD, 2006). In relative terms to its economy, the Netherlands has the worlds' largest pension fund industry (figure 1).

[Insert figure 1 about here]

The Dutch pension fund industry includes more than 800 pension funds, of which some 700 are company pension funds (the subject of this study) and about 100 are industry-wide funds.

Defined benefit schemes are still dominant in the Netherlands: 9 out of 10 workers have one. In recent years, many pension funds switched from final earnings-based to career average-based pension schemes. The typical Dutch pension scheme presently aims at building up a pension entitlement within 40 years, yielding a benefit ranging from 70 to 80 percent of the career average-wage (including the first pillar flat rate benefit). Most career average-based schemes apply wage inflation indexation, conditional on the fund's financial health.

2.2 Regulation

Each Dutch company pension fund has to be organised in a legal entity, which is separate and independent from the sponsoring companies. Most pension funds are organised in foundations. One half of the foundation's board is appointed by the employer, the other half by the employees. Nevertheless the board members are required to act independently and only in the fund's interest. In principle, a pension fund must be able to continue functioning for the benefit of all existing participants even if the sponsoring company ceases to exist.

In the Netherlands, there is no public pension benefit insurance of any sort, like there is in the US. The supervisory authority gives directions to individual funds concerning the minimum capital requirements and investment policy. The most important of these directions during the period under investigation were the following[2]:

(1) Liabilities of the fund (accumulated benefit obligations) are valued by a fixed discount rate with a maximum of 4%.

(2) Assets are valued in market prices, although in the earlier years of our sample period pension funds were also allowed to value bonds by their redemption value.

(3) Basically, there are no investment restrictions, only a directive that investments have to be 'solid'. This precludes, for instance, large financial interests of the pension fund in the sponsoring company.

(4) The value of assets has to be greater than that of the required technical reserve. Hence, there are no formal restrictions to premium holidays or even refunds of employer

[1] If there is an industry-wide pension scheme, employers are obliged to participate.

[2] Our data sample period covers 1996-2005, and hence falls before the year 2007 in which a new, risk based regulatory regime came into force.

contributions as long as the pension fund is in a healthy financial position. Furthermore, there is no additional reserve requirement for risky assets.[3]

2.3 Recent trends in pension fund coverage

Figure 2 shows the cover ratio of the median Dutch company pension fund. The cover ratio is defined as assets available to cover the technical provisions as a percentage of the required technical provision (excluding reinsurance). The availability of supervisory data on the required technical provisions of individual pension funds makes the Dutch dataset that we use unique, in that it allows identification of underfunded funds.

The cover ratio of our sample of Dutch funds deteriorated in 2000-2002 and recovered partially in the following years 2003-2005, the last years in our sample. The drop in the cover ratio reflected the fall in fund profitability, which was especially related to negative investment yields on equity. The crash in the stock market manifested itself globally and the development of the cover ratio of Dutch pension funds is representative of other countries' defined benefit pension fund sectors as well.[4]

[Insert Figure 2 about here]

Figure 3 shows the percentile distribution of the cover ratio in our sample. If we take a cover ratio of 100% as the minimum level, then no more than ten percent of the pension funds was underfunded and then in one single year only, 2002. Although the supervision framework considers nominal obligations – the indexation promises are not 'hard' promises in a legal sense – a cut-off point of 130% for the cover ratio is more appropriate as a measure of underfunding. This benchmark also reflects the Dutch pension funds' common practice to provide for a pension benefit in real terms. With an annual inflation rate of 2 percent (the inflation target of the ECB) a nominal cover ratio of approximately 130% would translate into a real cover ratio of 100%. Hence, in the empirical part we will consider a cover ratio below

[3] This changed in September 2002, when the supervisor strengthened the coverage requirements. Since then a minimum coverage of 105% was required. Furthermore an additional reserve for investment risk had to be formed. Basically these reserves had to be sufficiently great to ensure solvency in the case of a 40% equity price decline and a 10% bond price decline.

[4] See for example Davis (2004) on UK developments which parallel those in the Netherlands.

130% as a state of underfunding (the red horizontal line).[5] With a bench mark ratio of 130%, more than three quarters of all funds (the light blue line) went into a state of underfunding in the crisis year 2002, when the stock market collapsed. One half of all funds (the yellow line) of the sample went into underfunding already in 2001.

[Insert Figure 3 about here]

The drop in the cover ratio differed widely between funds. Figure 4 shows the frequency distribution of the change in the cover ratio between 1999 and 2002. Most funds' cover ratios fell by 10 to 50 percentage points. However, some funds saw their cover ratio fall by more than 50 percentage points, while a few saw their cover ratios increase.

[Insert Figure 4 about here]

3 Theory and hypotheses

Pension funds provide means for individuals to accumulate saving over their working life so as to finance their consumption needs in retirement. The key feature of a defined benefit pension fund, which is the dominant type of fund in the Netherlands, is that the pension plan contains embedded options. Treynor (1977) was one of the first to describe that a company sponsoring a defined benefit pension plan owns a put option. If the assets of the company and the fund fall short of the pension fund liabilities, the sponsoring company has a put option to give these assets to the pension beneficiaries as payment and liquidate the pension fund. Since the value of each option increases with the risk of the underlying assets, the sponsoring company may have an incentive to increase the risk of the assets (of the company and the fund) beyond what is optimal for the pension plan participants. This could explain why "employer corporations urge pension fund managers to invest pension funds in risky assets" (Treynor, 1977, p. 632).

Although pension funds are legally separated from the sponsoring firm in the Netherlands (see Section 2.2) - as they should be according to OECD principles and EU directives - in reality there is no watershed between the sponsor and its pension fund. Particularly in the case of

[5] Different hurdle ratios would not alter the qualitative conclusions of the empirical analysis, only their statistical significance.

funded defined benefit schemes, the dominant form in the Netherlands, recurrent occasions of overfunding and underfunding may lead to additional cash flows between the two parties. In case of a pension funding deficit, the sponsor may have the legal or moral obligation to increase contributions. In this respect, Kocken (2006) points out that defined benefit pension plans involve three embedded options including the one described by Treynor (1977).[6] First, defined benefit pension plans often involve employer guarantees to make additional payments in case the fund's cover ratio drops below some pre-specified level. This guarantee option is written by the employer and can be exercised by the pension plan participants if the cover ratio drops below the minimum. Second, there is an offsetting option for the employer to default on its pension payment promises, written by the plan participants (this is Treynor's option). Third, the employer can often exercise a conditional indexation option, by not granting inflation indexation. Usually, the employer will exercise the conditional indexation option before the pension plan exercises the employer guarantee option. Naturally, the option to default can not be exercised before the employer guarantee is. The exercise of all three types of options is triggered by various values of the fund's cover ratio, making the volatility of this ratio a key variable to the option values. The volatility of the cover ratio in turn will be determined by the fund's asset mix to a considerable extent. For example, a shift in asset mix from bonds to shares, by increasing the cover ratio's volatility, raises the value of both the guarantee option and the default option. Kocken also shows that a lower employer credit rating reduces the value of the guarantee option and increases the value of the default option. Finally, underfunding is demonstrated to increase the guarantee option.

As a result of the impact on relative option values, a pension fund should reduce risk taking for the benefit of its participants, by investing in less risky assets, if the sponsor has a high risk profile, which may be proxied by high leverage or low credit rating (Broeders, 2006).

From another perspective, that of optimal contract theory and capital market imperfections, Cooper and Ross (2002) argue that company pension funds may be underfunded in circumstances when their sponsoring company makes little or no profits, is not able to borrow (e.g. due to high leverage), and the investment yield of the pension fund's portfolio is lower than the yield on the financial markets.

[6] Our summary of Kocken (2006) draws heavily on Ambachtsheer (2007).

From yet another angle, i.e., contracting theory and risk sharing between employers and workers, Arnott and Gersovitz (1980) suggest that a risk-averse firm may have underfunded pension liabilities as a way to share risk with risk-averse workers. Webb (2007) proxies risk averseness by the inverse of a company's size. Hence, in case of underfunding, when corporate bonds are senior to pension claims, a small firm has more incentives to shift risk to the pension fund by raising its own leverage. Also Ippolito (1985) sees underfunding as a way to improve a firm's bargaining position with labour unions.

Webb (2007) suggests that pension plan liabilities are similar to long term debt. Accordingly, pension plan deficits that must be funded are a debt burden (whereas surpluses and unfunded deficits are sources of equity) to the sponsoring firm. The sponsoring company, according to Cocco and Volpin (2007) may thus have an incentive to favour shareholders by reducing contributions to the fund, thus minimizing funds payable to debt holders. Again, the incentive is greater in a highly leveraged firm. Also, they will contribute less to the fund per se, and will have a larger dividend payout (Webb, 2007).

The hypotheses that we are going to test empirically concern asset allocation decisions of pension funds and capital structure decisions, respectively:

Capital structure:

i. Pension funds have lower cover ratios/sponsor contributions when their sponsoring companies make little or no profits (Cooper and Ross, 2002);

ii. Pension funds have lower cover ratios/sponsor contributions when their sponsoring companies have high leverage (Arnott and Gersovitz, 1980; Cooper and Ross, 2002; Cocco and Volpin, 2007);

iii. Pension funds have lower cover ratios/sponsor contributions when their return on assets is relatively low (Cooper and Ross, 2002);

iv. Pension funds have lower cover ratios/sponsor contributions when the sponsoring firm is small (Arnott and Gersovitz, 1980).

Portfolio allocation:

v. Defined benefit pension funds invest more in shares than defined contribution pension funds (Treynor, 1977);

vi. Defined benefit pension funds invest more in shares when their sponsoring companies have high leverage (Cocco and Volpin, 2007);

vii. Defined benefit pension funds invest less in shares when their sponsoring companies have high leverage (Broeders, 2006).

Note that hypotheses *vi* and *vii* are diametrically opposed to each other.

4 Methodology and data

In view of the above mentioned hypotheses; we estimate models with as dependent variable, respectively: [7]

- The pension fund's cover ratio;
- The contributions of the sponsor over total contributions;
- The proportion of shares in the fund's asset portfolio.

In view of the above hypotheses, we test the following explanatory variables:

- Sponsoring company's leverage;
- Sponsoring company's profitability;[8]
- Pension fund's return on assets;
- Defined contribution dummy.

Furthermore, we add a set of control variables to account for all other factors determining capital structure and portfolio decisions. First, we add control variables that represent characteristics of the funds:

- Fund size. On the one hand, if a large fund is more likely to be rescued by the authorities, there may be more temptation for the sponsoring firm to underfund than in the case of a smaller fund. On the other hand, smaller firms may be tempted to underfund pension liabilities as a way to share risk with workers (Arnott and Gersovitz, 1980; Ippolito, 1985).

[7] Definitions of the variables are presented in Appendix A.
[8] Alternative variables could be the sponsoring company's beta or some other measure of share price volatility. However, this would restrict our dataset too much as only half of the sponsoring companies are listed.

- Maturity. A less mature fund which has less immediate obligations to pensioners may be less afraid of becoming underfunded than a mature fund which has a large proportion of pensioners, since risk aversion of the latter will presumably be greater.
- Reinsurance. The use of reinsurance is a way to decrease insurance risk and may also be used as a signalling device to signal financial soundness.
- Indexation. Indexation obligations demand additional funding efforts. We expect pension funds with conditional indexation or no indexation to have lower cover ratios than unconditional indexation funds.

Next, we add control variables for the sponsoring firms:

- Sponsoring company's size. A large size of the sponsoring company increases its ability to sponsor the pension fund and may reduce incentives to use underfunding for a bargaining counter with workers.
- Sponsoring company's size relative to fund size. The probability of underfunding may be expected to be greater if the pension fund is relatively large, not least for the impact additional contributions will make on the sponsoring company's profit and loss.

Finally, we add a year dummy for each sample year. This dummy variable captures the effects of macro-economic trends or structural breaks, which are common to all funds. To our knowledge, there have been no disruptive structural breaks in the supervisory framework during the sample period.

The dataset we employ for the pension funds are the individual fund data underlying the supervision data published in aggregated form in Tables 8.1 to 8.5 of the quarterly *Statistical Bulletin* of the Dutch central bank (De Nederlandsche Bank, DNB for short). This dataset comprises the entire population of Dutch company pension funds. The data for the sponsoring companies are taken from *Reach*.

We leave out 437 fund-year observations with a cover ratio higher than 300%. We drop 31 funds (111 fund-year observations) with a cover ratio of exactly 100% (these are pure DC funds). We drop the fully reinsured funds from the dataset. We 'winsorize' the dataset by dropping the 1^{st} and 99^{th} percentiles of each variable's distribution. This leaves us with a dataset containing between 5,200 and 7,000 observations for about 500 to 600 pension funds.

We selected data for all listed companies sponsoring a company pension fund. For the unlisted companies we selected companies with the largest pension funds, leaving out financial institutions (because of their incompatible balance sheet characteristics) and subsidiaries of foreign multinationals (because the link to Dutch pension funds is presumably weak). Hence, this selection procedure implies that the sub-sample including sponsor data is biased toward larger pension funds. This selection procedure helps to select those pension funds that have a significant impact on the financial position of the sponsoring companies.

Table 1 presents summary statistics for the samples of company pension funds and sponsoring companies.

[Insert Table 1 about here]

Table 2 gives the means and medians for sub-samples of pension funds, split by pension scheme and indexation mechanism for pensioners. As data on scheme and indexation are not available for all funds all the time this split-up entails a loss of observations. Most funds have defined benefit schemes and conditional indexation for pensioners. Defined benefit funds have higher reserves, receive more sponsor contributions, and are larger and more mature than defined contribution funds. Defined benefit funds do not invest relatively more in shares, as hypothesized on the basis of Treynor (1977). However, means and medians do not always tell the whole story, as they do not take account of the fact investment in shares may differ between two groups of funds just because of one or a few other variables influencing portfolio allocation. Therefore, the issue is taken up again in the multivariate analysis in the next section. The correlations indicate that funds with unconditional indexation have higher cover ratios, higher sponsor contributions, and higher reserves, are smaller in size, are more mature and invest less in shares than funds with conditional or no indexation.

[Insert Table 2 about here]

Table 3 gives the correlation matrix for our set of variables. It appears that larger funds invest more in shares. Funds using reinsurance have higher cover ratios. The correlations between variables of funds and their sponsors reveal no significant correlation between a sponsor's leverage and the fund's investment in shares. The correlation between the sponsor's leverage

and the fund's cover ratio is slightly negative. For the sponsor's profitability the correlation is positive. As correlations do not take into account the possibility that two variables may correlate just because they are both related to a third variable, we will perform a multivariate analyses in the next section.

[Insert Table 3 about here]

5 Results for capital structure

5.1 The cover ratio

We estimate a model relating the pension funds' cover ratios by a set of explanatory and control variables introduced in the previous section. We use GLS which unlike OLS allows for the presence of autocorrelation within panels and cross-sectional correlation and heteroskedasticity across panels. As capital structures are typically autocorrelated and heteroskedasticity is a common feature in panels, GLS is especially suitable to our purposes (e.g., Greene, 2003).

The first column of Table 4 shows the regression results before including the sponsoring variables. Except the conditional indexation dummy and an occasional year dummy, all variables are significant. Funds with more mature liabilities (i.e. with payments obligations closer in time) and more equity investments (i.e. with higher asset risk) hold more reserves, while funds without any indexation obligation (i.e. with lower inflation risk) hold lower reserves. Return on assets correlates positively with the cover ratio, which is in support of hypothesis *iii* that pension funds have lower cover ratios when their return on assets is relatively low. Funds that use more reinsurance have higher cover ratios, which may link to stipulations by reinsurers about levels of risk that are acceptable.

[Table 4 about here]

For easier interpretation of the economic significance of the explanatory variables, Figure 5 shows their contributions to the explanation of the cover ratio. Each bar represents the partial effect of one-standard deviation increase in a particular explanatory variable on the mean

predicted cover ratio. Maturity appears to be the most important determinant, followed by the proportion of shares in the asset portfolio.

[Figure 5 about here]

The second column of Table 4 presents the results when adding explanatory variables for the sponsoring company. As we collected data for about 100 sponsoring companies, the number of observations falls to one-fifth. Yet, the overall pattern of the regression still holds; most coefficients are robust. Only reinsurance and fund size lose their significance. As for the sponsoring company variables, the results suggest that a high leverage of the sponsoring company has a negative effect on the fund's cover ratio. This result supports hypothesis *ii*. A large size for the sponsoring company in absolute terms affects the cover ratio positively, consistent with hypothesis *iv* that small firms are more likely to use pension underfunding to influence wage bargaining. The profitability of the sponsoring company in a particular year does not have a significant contemporaneous effect on the fund's cover ratio, contrary to hypothesis *i*.

5.2 The probability of underfunding

In this subsection, we address the probability of underfunding. The dependent variable in the probit model is a dummy variable 'underfunding' with the following values:

underfunding = 0 if cover ratio > 130%
underfunding = 1 if cover ratio $\leq$ 130%

The choice for the 130% hurdle ratio was already discussed in Section 2.3. The frequency distribution of underfunding is given by year in Table 5. The year 2002 stands out as a crisis year with the most cases of underfunding, both in absolute and relative terms. [9]

[Insert Table 5 about here]

[9] The main results of the probit analysis proved to be not very sensitive to the choice of the hurdle rate. Lower hurdle rates gave less significant outcomes though, due to the fact that there remain too few observations in the underfunding group, which diminishes the discriminatory power of this type of model.

The probit approach is taken from the literature on corporate bankruptcy, being employed by e.g. Bunn and Redwood (2003). The probit model is to be preferred to the traditional discriminant analysis according to comparative work by e.g. Lennox (1999), who shows that the former can identify failing companies more accurately than the latter. We note that other work on company failures has recently employed the Merton (1974) model, which imposes assumptions about the value of firms' underlying assets and capital structure. Whether the firm defaults is determined by the market value of its assets in conjunction with the liability structure. However, the Merton model requires a share price to assess volatility and information on default probabilities. This information generally is not available for our sample of pension funds.

The results from the probit are shown in the first two columns of Table 6. The first column gives the results with the complete set of potentially explanatory fund variables introduced in the previous section. We have added the lagged reserves ratio. The reason is that we expect the probability of underfunding to be lower the higher the reserves are the year before. Indeed, the marginal effect for this variable is significant and negative. The second column gives the results omitting the insignificant variables. As expected, funds with sizable reserves and funds using reinsurance are less likely to run into a state of underfunding. This is also true of funds with high returns, which is consistent with hypothesis *iii* that relatively low returns give an incentive to underfund. Mature funds are less likely to be underfunded than immature funds. The coefficients of the year dummies are significant and indicate that macroeconomic developments increased the risk of underfunding for all funds, especially in the stock market crash years 2000-2002.

The fourth column gives the results when adding sponsoring company variables, if significant. As we collected data for 100 sponsoring companies, the number of observations falls by 75%. Yet, the fit of the regression still holds and the coefficients of reserves and reinsurance are robust. Maturity and return on assets lose their significance, which is due to the loss of observations; see the third column where model 2 is re-estimated using the sub-sample of model 4. As for the sponsoring company variables, the results in model 4 suggest that the relative size of the sponsoring company is an important determinant of the risk of underfunding of the pension fund. A large size for the sponsoring company relative to the pension fund's size, reduces the underfunding risk of the company pension fund. This is consistent with hypothesis *iv* that it is the small risk-averse firms that may seek underfunded

pension liabilities as a way to share risk with risk-averse workers. Large firms may seek to avoid underfunding due to reputation risk and to avoid repercussions on their credit rating.

[insert Table 6 about here]

6 Results for sponsor contributions

To the sponsoring company, the most direct way to influence the pension fund's cover ratio is to lower its contributions to the fund. In this section we test the hypotheses formulated for capital structure in terms of the sponsor's contributions. The dependent variable is the contributions from the sponsor over total contributions received by the pension fund. The set of explanatory variables is the same as before, though the lagged cover ratio has been added.

The first column of Table 7 presents the results without including the variables from the sponsor dataset. The cover ratio has a negative coefficient, which suggests that sponsors contribute more when their pension funds are lower on funding. This would be consistent with the exercise of guarantee options described by Kocken (2006). We further find that sponsor contributions are generally lower for larger pension funds. Maturity, equity investment, nor fund profitability are found to be significant for the level of sponsor contributions. Sponsor contributions are higher for funds using reinsurance, maybe because of stipulations of reinsurers. We do not find a significant coefficient for the defined contribution dummy. The year dummies reveal that sponsor contributions increased for most funds to a higher level since 2001, the episode where many pension funds had difficulties.

[Insert Table 7 about here]

The second column of Table 7 presents the results including the sponsor variables. Again, the sample shrinks to one-fifth due to the limited number of sponsoring companies in our dataset. Most coefficients are robust to this and keep their significance and sign. Only the two indexation dummy variables take over significance, and the year dummies loose significance except for the year 2002, which happens to be the hardest year for pension funds and sponsor contributions must have been very welcome. As for the sponsor variables, sponsor profitability is found to have a negative coefficient, which is inconsistent with hypothesis *i*

and contradicts our earlier finding for the cover ratio. The size of the sponsoring company has a positive effect on contributions, which supports hypothesis *iv* that small sponsoring firms are more likely to use pension underfunding to influence wage bargaining. This result confirms our earlier result for the cover ratio and underfunding.

7 Results for portfolio allocation

In this section we test the hypotheses formulated for the effect of the sponsor on the funds' portfolio allocation. The dependent variable is the proportion of shares in the pension fund's investment portfolio. The set of explanatory variables is the same as before.

Again, the first column of Table 8 presents the results before adding the sponsor variables. The defined contribution dummy has a negative coefficient, which implies that defined benefit funds invest more in shares than their defined contribution counterparts. This is consistent with hypothesis *v*. As for the control variables, we find a significantly positive relationship between a fund's cover ratio and its investment in shares. Further, we find that larger sized funds and less mature funds invest more in shares. This is to be expected, as large funds can better diversify risk in their portfolio and less mature funds have longer investment horizons. The results further suggest that more profitable funds and funds that use more reinsurance invest less in shares.

[Insert Table 8 about here]

The second column of Table 8 presents the results when including the sponsor variables. Again, despite the shrinkage of the sample size most coefficients keep their significance and sign. Only maturity and reinsurance lose their significance and the coefficient of the defined contribution dummy switches its sign from negative to positive. This means that hypothesis *v* no longer holds for the smaller sample. It should be kept in mind, however, that the small proportion of defined contribution funds in our sample (about 7%) may be the cause of this instability. As for the sponsor variables, we find a significantly positive effect of leverage, which is consistent with hypothesis *vi* and thus inconsistent with *vii*. We further find a positive effect of the relative size of the sponsor.

[Insert Table 9 about here]

8 Conclusion

This study presents empirical evidence on the influence of sponsoring companies on the funding and portfolio allocation decisions of their defined benefit pension funds. Several hypotheses taken from the theoretical literature are tested using a microdataset of around 550 Dutch company pension funds over the ten year period 1996-2005, combined with a microdataset on 100 of their sponsoring firms. The wide variation in funding levels over this period provides a natural experiment in the determinants of underfunding and portfolio composition.

Our empirical tests address the influence of sponsoring firms on pension funds' cover ratios, underfunding risks, as well as their decisions concerning the proportion of their investment portfolios that is allocated to shares. Moreover, we directly investigate the determinants of sponsor contributions to the pension fund. This is the first paper to address these theoretical issues in a comprehensive manner. Table 8 summarizes the evidence found for the seven hypotheses formulated in Section 3.

Summarizing unambiguous and significant evidence only, we find empirical support for the following hypotheses:

- Pension funds have lower cover ratios when their sponsoring companies have high leverage. This is consistent with the predictions of Arnott and Gersovitz (1980), Cooper and Ross (2002) and Cocco and Volpin (2007).
- Pension funds have lower cover ratios when their return on assets is relatively low. This supports Cooper and Ross (2002).
- Pension funds have lower cover ratios and receive lower sponsor contributions when their sponsoring firm is small. This is consistent with the predictions of Arnott and Gersovitz (1980).
- Defined benefit pension funds invest more in shares when their sponsoring companies have high leverage. This confirms Cocco and Volpin (2007) and contradicts the prediction of Broeders (2006).

These results provide strong empirical support for there being a consistent influence of sponsors' corporate financial structures on pension funding, largely in the direction of greater risk in the pension fund when there is more risk in the corporate balance sheet. The results may justify closer focus by pension regulators on the financial state of the sponsoring firm than has been the case hitherto. It is notable that such links apply consistently in the Netherlands despite the absence of pension benefit insurance that gives rise to moral hazard on the part of the sponsor vis-à-vis the insurer. Such patterns are likely to be even more marked when such insurance is present, as historically in the US and now in the UK also.

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Appendix A – Variable definitions

Conditional indexation dummy	= 1 if conditional indexation; = 0 if unconditional indexation or no indexation
Contributions received from the sponsor	Sponsoring company's contributions over total contributions
Cover ratio	Assets / Required technical provision
Defined contribution dummy	= 1 if defined contribution; = 0 if defined benefit
Fund size	Logarithm of number of fund participants
Investment yield	Yield on investment / Value of investments at the beginning of the year
Maturity	Inactive fund participants / Active fund participants
No indexation dummy	= 1 if no indexation; = 0 if indexation
Reinsurance	Reinsured / Technical provision
Fund reserves	Reserves / Total liabilities
Fund return on assets	Result / Total assets
Sponsoring company's size	Log(number of employees sponsoring company)
Sponsoring company's size / pension fund's size	Sponsoring company's balance sheet total / Pension fund's balance sheet total
Sponsoring company's leverage	Sponsoring company's debt to total assets ratio
Sponsoring company's profitability	Sponsoring company's return on total assets
Shares	Shares / Total investments
Underfunding	Dummy variable = 1 if cover ratio $\leq$ 130%; = 0 if cover ratio > 130%

Tables

Table 1 - Summary statistics 1996-2005				
	Mean (unweighted)	Median	Standard deviation	Number of observations
Pension Funds:				
Cover ratio	1.308	1.237	0.286	5211
Reserves	0.209	0.154	0.214	6731
Fund size	6.020	6.144	1.684	6119
Maturity	0.341	0.286	0.264	6242
Shares	0.227	0.230	0.191	7008
Return on assets	0.008	0.004	0.064	6986
Reinsurance	0.057	0.000	0.185	5583
Contributions from sponsor	0.801	0.844	0.269	6338
Sponsoring firms:				
Leverage	0.657	0.672	0.165	1053
Profitability	0.076	0.070	0.093	1052
Company size	8.322	8.211	1.617	1023
Relative size	11.244	3.003	27.222	1053
Explanatory note: Variable definitions are given in Appendix A.				

Table 2 – Summary statistics by pension scheme and indexation mechanism, 1996-2005

	Pension scheme		Indexation mechanism for pensioners		
	Defined benefit	Defined contribution	Unconditional	Conditional	No indexation
Cover ratio	1.282	.[a)]	1.431**	1.279	1.269
	1.215**	.[a)]	1.307	1.216	1.176
Reserves	0.191**	.[a)]	0.249**	0.179	0.215
	0.143**	.[a)]	0.165**	0.143	0.092
Fund size	6.154**	5.593	5.846**	6.254	5.196
	6.275**	5.983	6.157**	6.380	5.278
Maturity	0.348**	0.277	0.424**	0.336	0.425
	0.298**	0.145	0.370**	0.284	0.359
Shares	0.253	0.243	0.186**	0.267	0.175
	0.263	0.247	0.155**	0.279	0.084
Return on assets	0.003	0.006	0.011	0.003	0.003
	0.004**	0.000	0.009**	0.009	0.002
Reinsurance	0.048	0.029	0.035**	0.045	0.092
	0.000*	0.000	0.000*	0.000	0.000
Contributions from sponsor	0.815**	0.678	0.855**	0.813	0.763
	0.853**	0.676	1.000**	0.851	0.808
Number of observations	3,860	195	125	3,582	313

Explanatory note: The first and second rows in each cell give the mean and median, respectively. Statistical significance of differences between categories at 5% or 1% significance levels are indicated by * and **, respectively. Significance tests are based on t-tests or analysis of variance for differences in means by pension scheme and indexation mechanism, respectively, and on Pearson chi-square tests for differences in medians. Variable definitions are given in Appendix A.

a) Not applicable.

Table 3 – Correlation coefficients, 1996-2005

	Cover ratio	Reserves	Fund size	Maturity	Shares	Return on assets
Between funds:						
Cover ratio	1.000					
Reserves	0.792	1.000				
Fund size	-0.106	-0.034	1.000			
Maturity	0.165	0.193	-0.083	1.000		
Shares	0.125	0.229	0.314	-0.079	1.000	
Fund's return on assets	0.169	0.224	0.008	-0.039	0.006	1.000
Reinsurance	0.390	-0.042	-0.104	0.039	-0.079	-0.014
Contributions by sponsor	-0.072	-0.090	-0.126	-0.063	-0.072	0.021
Between funds and sponsors:						
Sponsor's leverage	-0.079	-0.086	0.090	-0.159	0.026	-0.053
Sponsor's profitability	0.147	0.181	-0.065	0.004	0.039	0.097
Sponsor's size	0.077	0.110	0.408	-0.046	0.179	0.026
Sponsor over fund size	-0.075	-0.139	-0.469	-0.206	-0.100	0.014
	Sponsor's leverage	Sponsor's profit-ability	Sponsor's size	Sponsor over fund size		
Between sponsors:						
Sponsor's leverage	1.000					
Sponsor's profitability	-0.119	1.000				
Sponsor's size	0.184	-0.068	1.000			
Sponsor over fund size	0.053	-0.015	0.113	1.000		

Explanatory note: Variable definitions are given in Appendix A.

Table 4 –GLS Regression results, 1996-2005

Dependent variable is the cover ratio

	Without sponsoring company variables (1)	With sponsoring company variables (2)
Fund size(t-1)	-0.003*	0.005
Maturity(t-1)	0.181**	0.144**
Shares(t-1)	0.179**	0.291**
Return on assets(t-1)	0.236**	0.200**
Reinsurance(t-1)	0.098**	-0.007
Conditional indexation	-0.049	-0.023
No indexation	-0.099**	-0.092*
Sponsoring company's leverage		-0.051*
Sponsoring company's profitability		0.046
Sponsoring company's size		0.016**
Sponsoring company's size / pension fund's size		-0.000
Year 1999	-0.006	0.044**
Year 2000	-0.096**	-0.085**
Year 2001	-0.201**	-0.215**
Year 2002	-0.320**	-0.373**
Year 2003	-0.279**	-0.308**
Year 2004	-0.270**	-0.303**
Year 2005	-0.232**	-0.251**
Intercept	1.403**	1.220**
Pseudo R^2	0.310	0.478
Number of observations	3207	640
Number of funds	544	106

Explanatory note: The feasible generalized least squares estimator has been used, which allows for the presence of AR(1) autocorrelation within panels and cross-sectional correlation and heteroskedasticity across panels. Suffixes * and ** indicate statistical significance at 5 and 1% levels, respectively. Variable definitions are given in Appendix A.

Table 5 – Frequency distribution of underfunding by year

	Underfunding = 0		Underfunding = 1		Total
	Observations	Percent	Observations	Percent	Observations
1996	265	55.7	211	44.3	476
1997	305	65.2	163	34.8	468
1998	334	66.0	172	34.0	506
1999	332	65.4	176	34.6	508
2000	307	52.7	275	47.3	582
2001	181	31.8	388	68.2	569
2002	67	12.3	478	87.7	545
2003	68	12.5	477	87.5	545
2004	89	17.1	432	82.9	521
2005	130	26.4	362	73.6	492
Total	2078	39.9	3134	60.1	5212

Explanatory note: Variable definitions are given in Appendix A.

Table 6 – Probit estimates, 1996-2005

Dependent variable is underfunding

	(1)	(2)	(3)	(4)
	Marginal effects			
Reserves(t-1)	-4.398**	-4.575**	-7.212**	-7.138**
Fund size(t-1)	0.003			
Maturity(t-1)	-0.166**	-0.158*	-0.139	-0.250
Shares(t-1)	-0.003			
Return on assets(t-1)	-0.643*	-0.696*	-0.237	-0.169
Reinsurance(t-1)	-1.351**	-1.433**	-1.163*	-1.144*
Sponsor size over fund size				-0.003*
	Fixed effects			
Conditional indexation	0.142			
No indexation	0.047			
Dummy 1999	0.139**	0.147**	0.002	
Dummy 2000	0.239**	0.263**	0.325**	0.288**
Dummy 2001	0.345**	0.372**	0.442**	0.425**
Dummy 2002	0.382**	0.412**	0.509**	0.497**
Dummy 2003	0.208**	0.234**		
Dummy 2004	0.205**	0.219**		
Dummy 2005	0.156**	0.175**		
Pseudo R^2	0.533	0.528	0.648	0.662
Number of obs.	3199	3724	764	764
Number of funds	618	670	123	123

Explanatory note: The reported marginal effects are changes in the probability that underfunding = 1 for an infinitesimal change in each independent, continuous variable. The reported fixed effects are changes in the probability that underfunding = 1 for a discrete change in each independent dummy variable from 0 to 1. Standard errors (not reported) are calculated using the Huber/White/sandwich estimator and allowing for correlation of observations for the same company. Suffixes * and ** indicate statistical significance of the effects at 5 and 1% levels, respectively. Variable definitions are given in Appendix A.

Table 7 –GLS Regression results, 1996-2005

Dependent variable is sponsor's contributions over total contributions

	(1)	(2)
Cover ratio(t-1)	-0.050**	-0.119**
Fund size(t-1)	-0.026**	-0.032**
Maturity(t-1)	-0.011	0.023
Shares(t-1)	0.012	0.072
Return on assets(t-1)	0.006	0.092
Reinsurance(t-1)	0.173**	0.362*
Defined contribution	0.020	-0.036
Conditional indexation	0.037	0.089*
No indexation	0.054*	0.093
Sponsoring company's leverage		-0.004
Sponsoring company's profitability		-0.135*
Sponsoring company's size		0.012*
Sponsor size over fund size		-0.000
Year 1999	0.007*	0.015
Year 2000	0.007	-0.012
Year 2001	0.023**	0.015
Year 2002	0.031**	0.040*
Year 2003	0.030**	0.037
Year 2004	0.028**	0.027
Year 2005	0.033**	0.018
Intercept	1.017	0.963
Pseudo R^2	0.062	0.072
Number of observations	3078	632
Number of funds	527	106

Explanatory note: The feasible generalized least squares estimator has been used, which allows for the presence of AR(1) autocorrelation within panels and cross-sectional correlation and heteroskedasticity across panels. Suffixes * and ** indicate statistical significance at 5 and 1% levels, respectively. Variable definitions are given in Appendix A.

Table 8 –GLS Regression results, 1996-2005

Dependent variable is the proportion of shares in the pension fund's investment portfolio

	(1)	(2)
Cover ratio(t-1)	0.103**	0.235**
Fund size(t-1)	0.025**	0.038**
Maturity(t-1)	-0.020*	0.012
Return on assets(t-1)	-0.067**	-0.227**
Reinsurance(t-1)	-0.226**	0.041
Defined contribution	-0.034**	0.116**
Conditional indexation	0.026	0.021
No indexation	0.000	0.032
Sponsoring company's leverage		0.049**
Sponsoring company's profitability		0.004
Sponsoring company's size		-0.004
Sponsor size over fund size		0.001**
Year 1999	0.047**	0.055**
Year 2000	0.027**	0.028**
Year 2001	0.034**	0.048**
Year 2002	-0.007	0.000
Year 2003	0.032**	0.054**
Year 2004	0.036**	0.070**
Year 2005	0.044**	0.081**
Intercept	-0.048*	-0.312**
Pseudo R^2	0.125	0.280
Number of observations	3216	637
Number of funds	551	106

Explanatory note: The feasible generalized least squares estimator has been used, which allows for the presence of AR(1) autocorrelation within panels and cross-sectional correlation and heteroskedasticity across panels. Suffixes * and ** indicate statistical significance at 5 and 1% levels, respectively. Variable definitions are given in Appendix A.

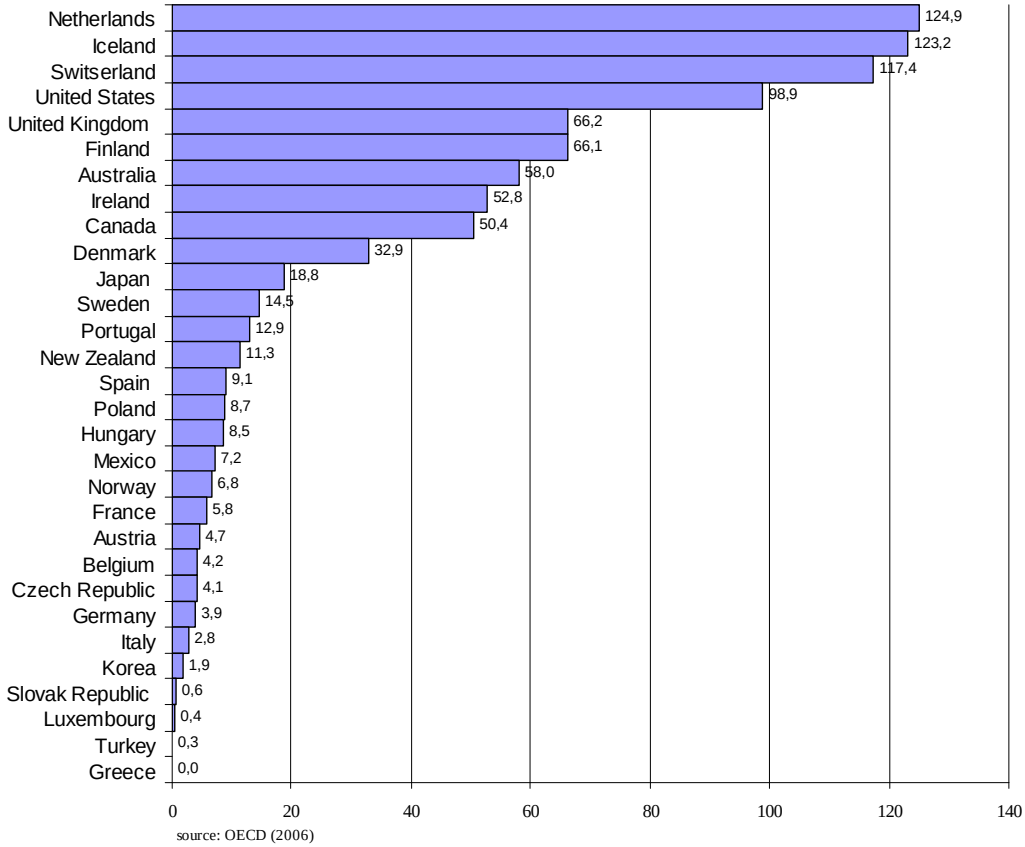
Table 9 – Summary of evidence on hypotheses

	Capital structure		Sponsor contributions	Portfolio allocation
	Cover ratio	Underfunding		
H_i	–	0	+	
H_{ii}	+	0	0	
H_{iii}	+	+	0	
H_{iv}	+	+	+	
H_v				±
H_{vi}				+
H_{vii}				–

Explanatory note: + or – indicates evidence in support or against a hypothesis. 0 indicates no significant result. Blank indicates that the hypothesis was not tested. $H_{\#}$ refers to the hypotheses and their numbers mentioned in Section 3.

Figures

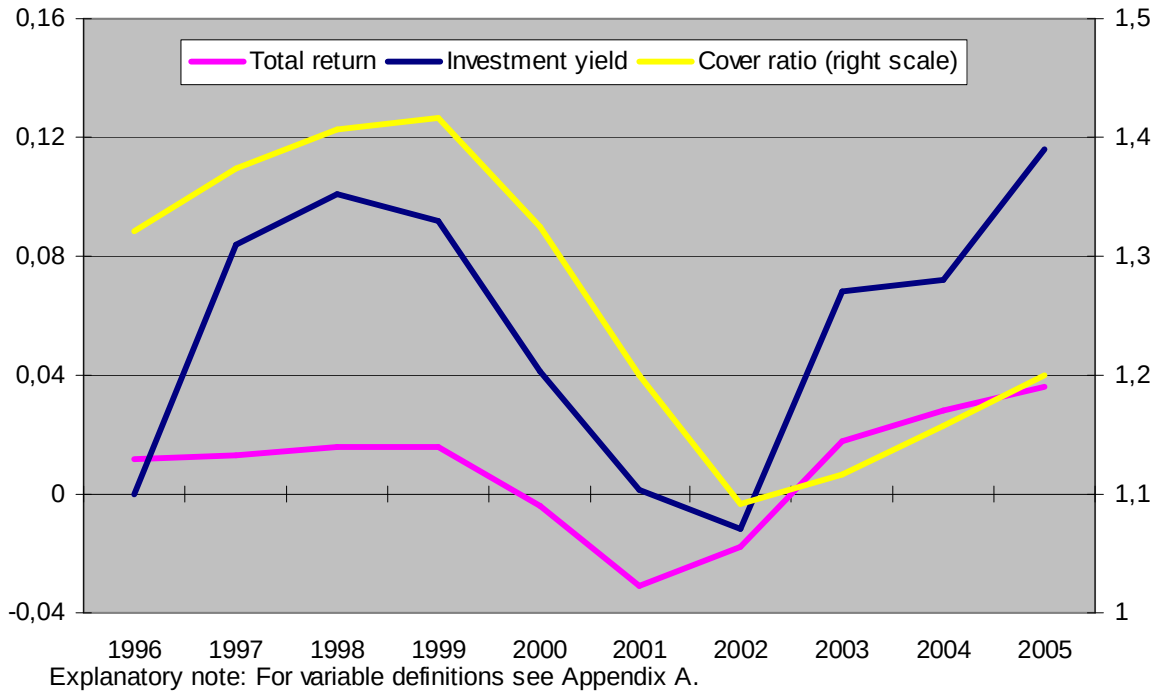
Figure 1: Importance of pension funds in OECD countries, 2005 (%gdp)



source: OECD (2006)

Figure 2 - Solvency and profitability

(Median company pension fund)



Explanatory note: For variable definitions see Appendix A.

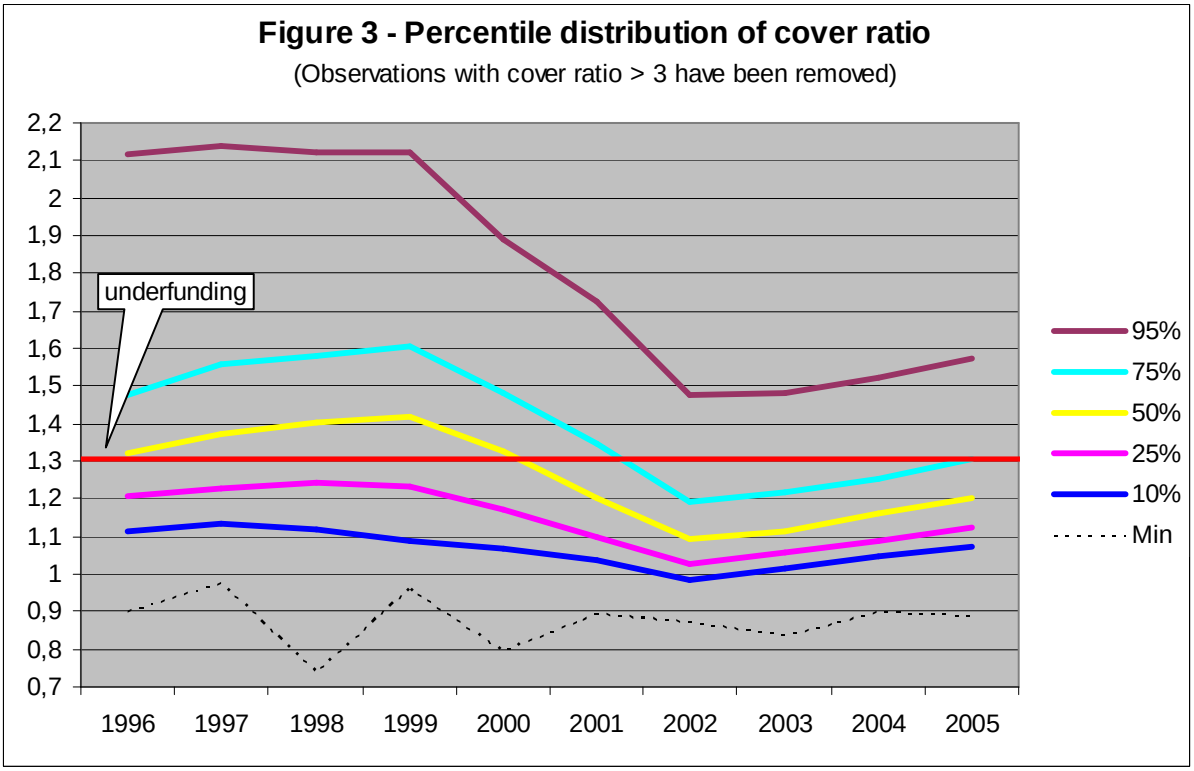


Figure 4 - Frequency distribution of change in cover ratio between 1999 and 2002

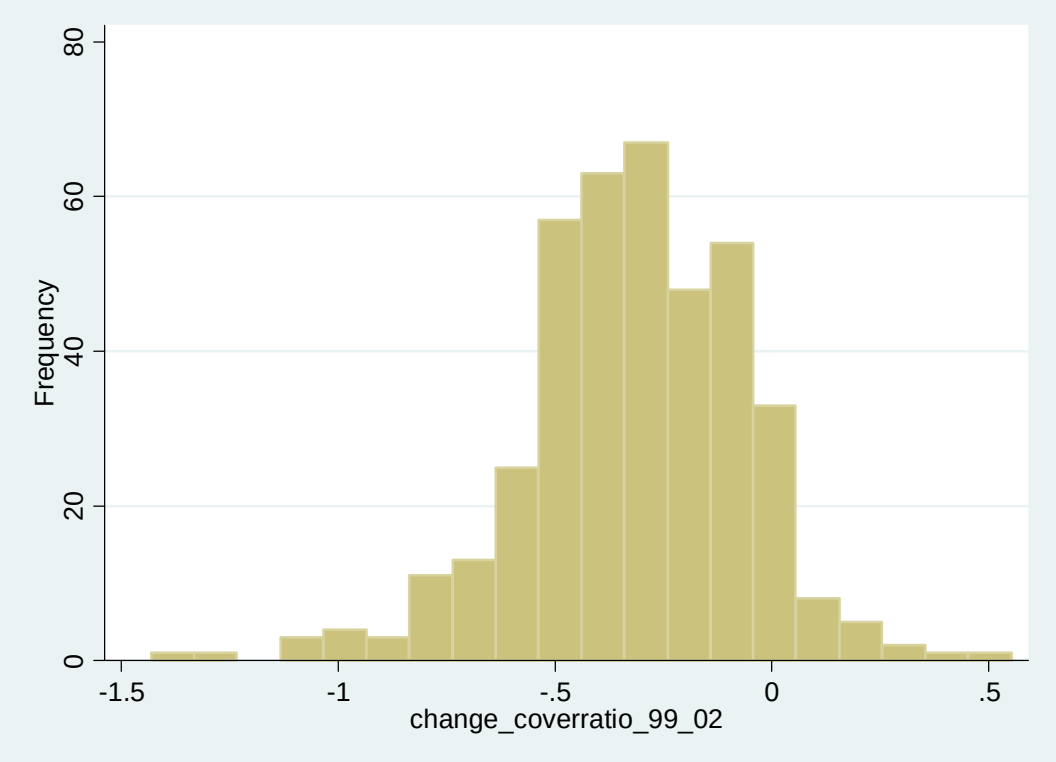


Figure 5 - Contribution of selected explanatory variables
(Partial effect of one-standard-deviation increase in explanatory variable on mean predicted cover ratio)