Skin in the game, wealth and risk-taking: Evidence from private equity funds*

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Abstract

We investigate the incentive effects of "skin-in-the-game" compensation (delegated decision-makers owning stakes in the investment vehicle) in particular on risk-taking. We use the private equity industry where fund managers are typically required to co-invest their own money alongside the fund as our testing ground. We check the predictions of our model, namely that more skin in the game will lead to the acquisition of less risky, but more levered firms,in a unique sample of private equity investments in Norway. This data set allows us to compute the fund managers' skin in the game as we have information on their personal wealth. Consistent with the model, portfolio company risk decreases and leverage ratios increase with the co-investment fraction of the manager's wealth. Hence, our results clearly show that wealth effects are of first order importance when designing incentive compensation.

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1 Introduction

Looking back at the financial crises of 2008 it is not difficult to find a large number of voices that claim that compensation schemes in the financial industry played their part in causing the crises. Two types of criticsm were lobbed at boni schemes - a fundamental one that simply thinks that boni are inappropriate for employees in financial institutions (Taleb (2011)). A less extreme case of thinking takes aim at the structure of the bonus scheme, namley the large reliance on short term cash payments, the absence of long term incentives and the lack of “skin in the game” (Quinn (2009)). Politicians, particularly in the EU, have reacted and introduced limits to boni payments in 2013 in many types of financial instituions (European Commission (2013)). Currently large cash boni are forbidden and boni are paid out over a number of years. This deferrement of boni leads to a build up of equity (and wealth) in the firm and implictly relaxes the limit-liability constraint of the bonus recipient by accumulating “skin in the game”.

Unfortunately we know very little about the effect of “skin in the game” on incentives as data on such contracts is very hard to come by. In this paper we attempt to start to investigate “skin in the game”, or the link between risk taking, incentives and wealth. We do so by looking at particular setting in finance, namely private equity funds. Compensation in Private equity funds is on the one hand quite similar to contracts in other areas of financial intermediation. Private equity funds are raised and managed by a general partner (GP), who makes the investment decisions for the fund. GPs are compensated with a mix of fixed fees and a bonus . A typical compensation structure is a two percent annual management fee on the fund’s capital and a 20% carried interest on the profits above a certain threshold (Metrick and Yasuda, 2010).[1] On the other hand are GPs typically required to co-invest their own money in the portfolio companies alongside the private equity fund. This “skin in the game” forces the GP to participate in any losses incurred by the fund.[2] A typical GP in the US is required to invest 1% of the fund’s capital, corresponding to a $3.6 million investment (Robinson and Sensoy, 2015).[3] This setup makes provides us with an ideal testing ground

[1]The largest differences is a sense the fact that funds last for ten years, so compensation is set for a much longer period than in other areas.

[2]Edmans and Liu (2011) argue that inside debt provides an efficient solution to agency problems, since its payoff depends not only on the incidence of bankruptcy but also on firm value in bankruptcy.

[3]In the US, GPs must invest at least one percent of the fund’s capital in order for the carry to be taxed as capital gains (Gompers and Lerner, 2001).

to examine the impact of "skin in the game" on incentives for risk taking: while a large co-investment mitigates incentives for excessive risk taking, it may also make a risk-averse manager too conservative, foregoing valuable investment opportunities with high risk. In addition to exploring the relationship between "skin in the game" and risk taking incentives, our paper aims to contribute to the existing body of knowledge in two dimensions.

First, due to our data set we are able to control for the GP's wealth . Thereby, we can relate the co-investment of the GP to his own wealth. Hence, we can control for the well-documented fact of risk-preference being dependent of wealth (see e.g. Holt *et al.* (2002)). We find that controlling for wealth-effects matters a lot. While the absolute co-investment levels are unrelated to risk-taking of the GP, the relative, wealth-adjusted co-investment levels significantly affect risk-taking of the private equity fund. Our approach may hence also explain the absence of any effect of co-investment on fund performance (see e.g. (Robinson and Sensoy, 2015)).

Second, since we are using data on ex-ante designed contracts which are applicable to the investment in not only one, but many firms we are able to cope with the endogeneity concerns inherent in the relationship between incentive contracts and risk-taking. There is ample evidence on the relation between incentive compensation and risk-taking, e.g. on the relationship between compensation of corporate managers and corporate investments (see e.g. Guay (1999), Knopf *et al.* (2002) and Rajgopal and Shevlin (2002)) as well as between compensation and financial risk or leverage (see e. g. Tchistyi *et al.* (2011)) These studies suffer, however, potentially from endogeneity concerns. Value-maximizing shareholders may have an incentive to jointly determine the risk of the firm and the incentives schemes. This implies, for example, that shareholders aiming for more risk also aim to incentivize risk-averse corporate managers with steeper contracts to join the company. While there are some efforts to overcome these endogeneity concerns (see Chava and Purnanandam (2010) and Shue and Townsend (2013), but also Coles *et al.* (2012) on the difficulties with such approaches) we provide a new route to address this issue by investigating the impact of incentive contracts which are ex-ante designed and applicable to new investments into a number of portfolio firms.[4]

[4]To understand this point better, consider the following setup: GPs commit to a certain co-investment level during fundraising. The fund closes six months to a year later and then proceeds to acquire on average ten firms over the next five years. Many of these firms are bought through auctions. If one were for example concerned

We start by developing a simple theoretical model, in which the selection of a target firm and the decision on deal financing are made simultaneously. Fund managers can chose between firms with different risk and have to decide how much debt to use in the acquisition, the rest of the consideration being equity contributed from the fund. Firms with relatively high risk have higher expected cash flows, but also have a higher probability of default. For tractability, we assume that firm value is independent of the capital structure, ignoring potential benefits from debt tax shields and reduced agency costs (Jensen, 1986; Modigliani and Miller, 1958).

The fund manager is required to co-invest a fraction β of the equity in the firm and receives a performance based carried interest α on the cash flows above a certain threshold. Since firm value is independent of the capital structure, β has no direct effect on the leverage decision. However, because the GP is risk averse and derives negative utility from downside risk, β has direct implications for the choice of project risk. The fund manager selects investments by trading off the project's expected cash flows against the negative utility associated with higher risk. *Ceteris paribus*, managers with a higher co-investment will invest in less risky firms.

The incentive effect of α is more straightforward. Since leverage increases the payoff to equity in the good states, managers will chose more debt the higher is α. The optimal leverage depends, among other things, on the firm's debt capacity. High-risk firms have greater default risk and therefore higher expected bankruptcy costs. Because managers with a relatively high co-investment share prefer to invest in projects with less risk, the debt capacity and the marginal value of additional debt will be increasing in β. As a result, for a given α, funds with a higher co-investment share will finance their portfolio companies with more debt.

We then take the model predictions to the data, using a unique sample of 62 portfolio company investments made by 20 Nordic leveraged buyout funds between 2000 and 2010. We limit the analysis to firms in Norway, where the manager's taxable wealth is public information, as are the financial statements of firms after going private.[5] The wealth data allows us to estimate the incentives provided by the co-investment, not only in percent and dollar amount, but also as a fraction of the manager's total wealth. This is an important empirical contribution of this paper. As shown below, and consistent with a declining risk aversion in wealth, the effect

about reverse causality then the principal would need to anticpate all these decisions.

[5]Norway's tax system makes it attractive to have holding companies to be located in Norway, in contrast to Sweden or Denmark

of the co-investment becomes evident only after controlling for the fund manager's wealth.[6]

The required co-investment proportion varies substantially across the 20 funds, ranging from zero to 15% of the fund's equity investment, and with an average of 3.7% (median 1.5%). When measured as a fraction of the wealth at the time of the investment, the average GP personally invests 93% (median 48%) of his total wealth in the fund.

Our empirical tests confirm the model predictions. Funds with a higher co-investment requirement tend to acquire target firms with lower asset beta and use more leverage. That is, firms with stable cash flow that can safely operate with higher leverage without jeopardizing their ability to service the debt. Axelson *et al.* (2013) show that buyout leverage is determined primarily by economy-wide credit conditions. We add to their evidence by showing that the fund manager's personal co-investment also helps explain portfolio company leverage in the cross-section.[7]

We further each look at relationship between a target firm's equity beta and the GP's co-investment. The higher the equity beta, the higher overall risk as it corrects firm risk for leverage. We find a negative correlation between the equity beta and the co-investment, again suggesting that the overall effect of project risk dominates the leverage effect, showing that the manager's risk appetite is lower the more he has to invest of his own funds.

Finally, we investigate whether we can find effects at the portfolio level as well. We look at the relative size of deals and find that the higher the relative co-investment fraction, the smaller the relative size each individual deal. This finding suggests that the incentive effect of a higher co-investment is not limited to the deals itself but has a broader effect on the GP's decision-making process.

This finding may also shed light on one curious aspect of our analysis. We do not find that GPs with a high co-investment select firms with lower absolute risk. Rather these GPs seem to select firms with lower systematic risk. However, given that we find an diversification effect at the portfolio level, GPs still opt for more diversification, but the pattern is somewhat different from what we may suspect initially.

[6]Robinson and Sensoy (2015) fail to find any relationship between the fund-level net-of-fee performance and the GP co-investment, perhaps because they lack data on GP wealth. Becker (2006) shows that corporate boards in Sweden tend to provide higher variable incentives to wealthy CEOs.

[7]See also Colla and Wagner (2012), who find that buyout leverage increases with firm profitability and decreases with cash flow volatility.

Overall, our evidence suggests that limited partners effectively reduce fund managers' incentives to take risk by requiring them to co-invest in the portfolio companies. Whether this reduction in GP's risk appetite is optimal or not goes beyond the scope of this paper. Limited partners ultimately care for the risk-adjusted net-of-fee returns, something which we do not examine here.[8]

In our framework, we treat the co-investment fraction as exogenous. Obviously, fund managers may design a compensation structure at the outset—when raising the fund—that fits their own risk preferences. In such case, the co-investment fraction and the investment risk may simply both be a result of the fund manager's risk preferences. Thus, an alternative interpretation of our evidence is that limited partners could infer the GP's risk preferences from the co-investment fraction and pick funds with risk profiles that fit their investment strategy.

The paper proceeds as follows. Section 2 sets up and discusses our theoretical model and its predictions. Section 3 describes the data, while Section 4 presents the empirical results. Section 5 concludes.

2 Model

2.1 Model set-up

To analyze the incentive effects of the private equity manager's co investment, we propose a model that combines a project choice with a capital-structure decision. Specifically, we consider a buyout fund's selection of a target company and the amount of debt with which the acquisition is financed. In our model we take the structure of the incentive contract as a givens in an attempt to understand the implications of this type of arrangement.

There are three players in this model. The principal is the LP (which we also call investor), with the GP (or fund manager) being the agent. Banks constitute the third group. An implicit assumption is that investors and banks are diversified, while the GP is not.

The private equity fund manager can choose among a set of firms that vary in their degree of risk. Investing in a firm leads to three potential outcomes: high, medium and low. The cash

[8]For evidence on private equity fund returns, see, e.g., Kaplan and Schoar (2005), Phallipou and Gottschalg (2009), Groh and Gottschalg (2011), Driessen *et al.* (2012), Harris *et al.* (2014), Higson and Stucke (2012) and Phalippou (2012).

flows x in each outcome are, respectively, $R + \Delta$, R and $R - \rho$. The high and low outcomes arise with probability $0.5q$, while the probability of the medium outcome is $(1 - q)$. A higher q increases the likelihood of the high and the low outcome. Hence, q can be interpreted as a measure of firm risk. We assume that $\Delta > \rho$, a zero discount rate, and risk neutral investors, so the expected value of the firm $V(q) = R + 0.5q(\Delta - \rho)$ is increasing in the risk measure q.

Concurrent with the selection of a target firm, the fund manager has to decide on how to finance the investment I. This is tantamount to choosing a capital structure for the newly acquired firm. Specifically, the GP has to choose the amount of debt D, with the remainder of the purchase price $(I - D)$ being equity from the buyout fund.

Creditors receive the principal D plus a credit spread $D(1 + r)$ as long as the firm's cash flows exceed this amount. We let $R > D(1+r) > R - \rho$, so the firm defaults on its debt in the low state. In default, creditors receive $R - \rho$ and the equity is worth zero. For tractability, we ignore potential benefits from the tax shield of debt and reduced agency costs, so firm value V is independent of leverage.

2.2 The incentive scheme of the fund manager

In our model, the GP is compensated with the components typically observed for private equity funds. First, he receives a fixed management fee M from the limited partners. Since we ignore future fund raising efforts, this fixed fee has no impact on his investment decisions, as shown below.

Second, the GP receives a performance based payment equal to a fraction $\alpha \in (0, 1)$ of the cash flows to equity exceeding a normal return e. We assume that e is a non-risk adjusted return, with $e > r$. Letting e be exogenous maps industry practice, where the hurdle rate typically is set when the fund is raised, well before the fund manager starts selecting portfolio companies.

The carried interest thus pays the fund manager $\alpha(x - C) > 0$, where $x - C$ is the cash flow in excess of C, the payments to creditors and the hurdle return paid to limited partners:

$$C(D) = D(1 + r) + (I - D)(1 + e) = I(1 + e) - D(e - r). \tag{1}$$

For $C \leq x$, the carried interest is zero.

To make debt financing attractive, we assume that $\Delta + \rho - R > D(1 + e)$. That is, the sum of the cash flow upside and downside $\Delta + \rho$ exceeding the mean return is larger than the hurdle rate reduction due to debt financing. For simplicity, we also set the cash flow in the medium outcome equal to the hurdle equity return, $R = I(1 + e)$.[9] These assumptions ensure that the all-equity financed firm has a positive net present value (NPV).[10] They further imply that, in the medium state and with debt financing, $x - C = D(e - r) > 0$ and the GP receives a carry.

Third, in addition to the management fee and the carry, the GP is required to co-invest his own money alongside the fund. This co-investment relaxes the limited-liability constraint of the fund manager and forces him participate in the downside risk. Specifically, the GP contributes the fraction $\beta \in (0, 1)$ of the fund's equity investment and receives a fraction β of the realized equity value, where the value of the leveraged firm is:

$$V^D(q, D) = 0.5q[R + \Delta - D(1 + r)] + (1 - q)[R - D(1 + r)] \tag{2}$$

We allow creditors to observe firm risk q, depicting the notion that the demand for credit occurs after the target has been selected. The creditor charges a credit spread r that allows him to at least break even:

$$0.5qD(1 + r) + (1 - q)D(1 + r) + 0.5q(R - \rho) \geq D \tag{3}$$

With a competitive market for loans, the creditor's participation constraint in Eq. (3) is strictly binding. In our model, project risk and capital structure are decided simultaneously. Since creditors can observe the GP's selection of target firm, we assume that q is contractible and let creditors account for q in setting the loan contract terms. Using the binding participation constraint (Eq. (3)) of the creditor allows us to rewrite (Eq. (1)) to

$$C(D) = I(1 + e) - De + \frac{0.5qD}{1 - 0.5q} - \frac{0.5q(R - \rho)}{1 - 0.5q}. \tag{4}$$

[9]This assumption could be relaxed without changing the implications of the model.

[10]The NPV of the all-equity firm is $V(q) - I$. With $R = I(1 + e)$, $V - I = Ie + 0.5q(\Delta - \rho) > 0$ since $\Delta > \rho$.

While debt funding increases the equity returns in the high and medium states, it does not come without a cost to the GP. In case of default, the manager incurs a reputational loss. We let the personal bankruptcy costs B be increasing in the creditor losses and convex in the face value of debt. Furthermore, we rely on the notion that the failure of a risky firm causes less reputational losses than that of a more mature and stable firm. Hence, we let $B(q, D) = \lambda D^2/q$, where $\lambda \in (0, 1)$ is an exogenous liquidation cost.

We further assume that the private equity manager shows some degree of risk aversion and derives negative utility from downside risk. We depict this negative utility $k(q) = 0.5cq^2$, where $c \in (0, 1)$ captures the fund manager's sensitivity to risk or his degree of risk aversion. In our setting, k is more pronounced the higher the risk of the venture. Since the GP realizes downside risk only from his co-investment, this cost is assumed to be proportional to β (see Bolton *et al.* (2011) for a related approach). Moreover, in our empirical analysis below—and in line with much of the extant literature—we assume c to be decreasing in wealth w (i.e. $c(w)$ with $\partial c/\partial w < 0$), implying that wealthier fund managers are less risk averse.[11]

2.3 The analysis

Having outlined the incentive structure of the GP, we now derive the implications for his choice of project risk and leverage. The objective function of the fund manager is:[12]

$$\begin{aligned} V^{GP}(q, D) \quad &= \quad \beta(V^D(q, D) - (I - D)) + \alpha(V^D(q, D) - C(D)|x > C) \\ &\quad -0.5qB(q, D) - \beta k(q) + M. \end{aligned} \tag{5}$$

Inserting the binding creditor constraint from Eq.(3) into the function for the value of the leveraged firm and substituting for the functions of C, B and k, the GP's objective function

[11]See, for example, Rabin (2000).

[12]For tractability, we ignore the portion of the carry that the GP has to pay from his ownership stake β in the target firm. With $\alpha = 0.20$ and $\beta = 0.01$, this portion will be small in comparison with the other components of the GP's payoff and could safely be ignored without altering the results.

can be rewritten as:

$$\begin{aligned} V^{GP}(q,D) &= \beta(0.5q(R+\Delta)+(1-q)R+0.5q(R-\rho)-0.5cq^2-I)) \\ &\quad +\alpha[0.5q(R+\Delta-C+(1-q)(R-C)]-0.5\lambda D^2+M \end{aligned} \tag{6}$$

Furthermore, when choosing the level of project risk and debt financing, the GP faces two opposing effects that he has to trade off against each other. Higher q is associated with, on the one hand, larger expected cash flows and, on the other hand, greater negative utility k related to risk aversion. Similarly, higher leverage D is accompanied by higher expected carry as cheaper debt replaces more expensive equity, but also by greater expected costs of bankruptcy B.

Since, from Eq. (1), $\partial C/\partial D = -(e-r)$, the first-order condition of the GP's choice of debt is:

$$\frac{dV^{GP}}{dD} = -\lambda D + \alpha((1-0.5q)e - 0.5q) = 0 \tag{7}$$

and the first-order condition for his choice of risk is:

$$\frac{dV^{GP}}{dq} = \beta(0.5(\Delta-\rho)-cq) + 0.5\alpha(\Delta+\rho-D(1+e)-R) = 0. \tag{8}$$

Solving these two equations yields:

$$D(q,\alpha) = \frac{\alpha((1-0.5q)e-0.5q)}{\lambda} \tag{9}$$

and

$$q(D,\beta,\alpha) = \frac{(\Delta-\rho)}{2c} + \frac{\alpha(\Delta+\rho-D(1+e)-R)}{2c\beta}. \tag{10}$$

Note that leverage and project risk are complements to each other. That is, D is a function of q in Eq. (9) and q is a function of D in Eq. (10). Notice also that the two dimensions of risk, D and q, operate in opposite direction. Higher project risk leads the private equity manager to choose lower leverage and vice versa.[13] Our two choice variables are in this sense risk-substitutes. This tradeoff between project risk and leverage which can be already be seen

[13]This follows from $\frac{dD}{dq} = -\frac{\alpha e-1}{2\lambda} < 0$ and $\frac{dq}{dD} = -\frac{\alpha(1+e)}{2c\beta} < 0$.

in the first-order conditions is a key mechanism in our model.

An important consequence of this complementarity is that exogenous parameters may affect the choice of risk and leverage directly, via the respective first-order condition, as well as indirectly, through the other choice variable. For example, the carry α affects both D and q directly, and therefore also indirectly. In contrast, the co-investment share β has a direct effect solely on q and hence only an indirect effect on the leverage choice.

We derive the comparative static effects of the co-investment share by totally differentiating the first-order conditions. From Eqs. (7) and (8), we get:

$$\frac{dD}{d\beta} = \frac{(cq - 0.5(\Delta - \rho))(0.5(1+e))}{\Gamma} > 0 \tag{11}$$

and

$$\frac{dq}{d\beta} = \frac{-\lambda(cq - 0.5(\Delta - \rho))}{\Gamma} < 0, \tag{12}$$

where $\Gamma > 0$ is the determinant of the Hessian matrix of the two endogenous variables.[14]

Recall from above that we let $\Delta + \rho - R > D(1+e)$, so that debt financing increases the cash flow to equity in the good states. For the first-order condition with respect to q in Eq. (8) to be satisfied, it follows that $cq > 0.5(\Delta - \rho)$. Thus, at the optimum, the cost of a marginal increase in project risk is higher than the marginal benefit from the point of view of the risk-averse GP. Consequently, an increase in β has a negative effect on q and a positive effect on leverage. The economic intuition hence, is that co-investment makes the GP to own a higher fraction of the portfolio firm. Given the risk-aversion of the GP, this higher degree of ownership in the firm induces the GP to choose a lower risk firm, i.e. to reduce q. Since, our two choice variables are substitutes, the GP, in turn, decides to lever up the firm more.

In a second step, we analyze the wealth effects on our two risk dimensions. By taking the negative relation between c and w into account we find by totally differentiating Eqs. (7) and (8):

$$\frac{dD}{dw} = \frac{(0.5\beta q(1+e)(\partial c/\partial w)}{\Gamma} < 0 \tag{13}$$

[14] Γ is the determinant of the D-q matrix of the second derivatives stemming from Eqs. (11) and (12). Since Γ is the product of two second-order conditions that are negative, it must be positive. In our case, the non-zero cross derivatives imply that the direct effects dominate the indirect effects, which is a relatively standard assumption.

and

$$\frac{dq}{dw} = \frac{-\beta q \lambda (\partial c / \partial w)}{\Gamma} > 0, \tag{14}$$

Hence, an increase in wealth has just the opposite effect on the two risk measure. Wealthier GPs are less risk reverse and hence invest in riskier projects which they, however, lever up less.

To sum up, there are three main results of our model that will guide our empirical testing strategies below. First, the GP's incentives to invest in risky projects are declining in his required co-investment share. That is, a higher β induces the GP to be more conservative in his project choice. Second, having chosen a less risky project, a higher co-investment share induces the GP to use more debt financing. Third, wealth reduces the negative utility associated with risk, these effects are more pronounced the less wealthy the GP. A measure which relates the co-investment level to the wealth of the GP takes up both effects. We now turn to an empirical examination of these implications.

3 Sample selection and description

3.1 Sample selection

We start by manually assembling a list of all leveraged buyout transactions in Norway between 1991 and 2010. This list, provided by the Argentum Centre for Private Equity at NHH, is created by combining information from two sources: (i) the public websites of Nordic buyout funds, and (ii) the Argentum private equity market database.[15] We are able to identify a total of 142 buyout transactions targeting 134 unique Norwegian firms.

In Norway, all firms—public and private—are required to file their financial statements with the Norwegian corporate registry ("Brønnøysundregistrene").[16] By manually matching the target firm names to the corporate registry, we are able to identify the record in the year of the buyout transaction for 117 firms. We retrieve the annual financial statements and ownership information during the period 1997 to 2012 for these firms.

The fee structure of the private equity fund is generally confidential information, found in the fund's Investment Memorandum. We are able to get privileged fee information from a

[15] The Argentum market database can be accessed at http://www.argentum.no/en/Market-Database/.

[16] See Mjøs and Øksnes (2012) for information about this data.

large limited partner for 68 of the transactions. We are able to match 62 of these 68 firms with public firms and obtain an asset beta for each of these 62 firms. The appendix contains a comparison of the characteristics of the 62 firms we ultimately include in the sample with the 51 firms with missing fee data.[17]

As shown in the appendix, the average firm included in the sample has slightly larger total assets and is acquired by a fund of higher sequence number managed by a somewhat older private equity firm. However, other characteristics such as fund size, firm profitability, asset tangibility, industry, and market conditions, are not significantly different across the two groups so we are not concerned that our sample differs substantially from the firms we were unable to include. The information necessary for a transaction to be included in our sample is that we know the GP's co-investment fraction, fund age, and fund size. We have this information for twenty funds. We also receive information about the management fee, the percent carry, the hurdle rate and any clawbacks for fourteen funds.[18] The difference can be attributed to the fact that the limited partner in question declined to invest into some of the funds in our sample but retained the fund-raising prospectuses.

Norwegian corporate law prevents an acquiring firm from servicing the acquisition debt with the target firm's cash flows.[19] For this reason, buyout transactions are typically structured in two steps. First, the buyout fund levers up an empty holding company used as an acquisition vehicle. Second, as a generally accepted practice, the holding company merges with the portfolio company about 12 months after the acquisition.[20] To account for this practice, we consider the transaction leverage to be the total debt across the portfolio company and its holding company. We therefore track the ownership for each firm to the point where the ultimate parent is the buyout fund itself. In our sample, 32% of the firms are owned directly by the private equity fund, 31% of the firms have one holding company above them, while the remaining 27% have two or more levels of holding companies. We retrieve the balance

[17]As explained further down below, we have to exclude eight firms for which we have the GP's co-investment.

[18]Nordic funds often pay carry on a deal-by-deal basis as the fund exits its investments. If a fund that paid carry to its GP subsequently underperforms, the clawback requires the GP to return the excess carry paid out. Also, in contrast to the US, Nordic funds do not charge transaction and management fees from their portfolio companies.

[19]"Aksjeloven §8-10. Kreditt til erverv av aksjer mv".

[20]We are grateful to Tore Rynning-Nielsen at Herkules Capital for helping us understand the intricacies of Norwegian buyouts.

sheets for all holding companies registered in Norway to compute the total debt used in the transaction.

Finally, to retrieve data on the wealth of the general partners, we first identify all relevant partners and associates from the buyout funds' websites. We drop professionals that join the firm after the fund's investment phase and do Google searches for professionals that have left. For private equity firms with part of its deal team located outside Norway, we limit our analysis to the professionals living in Norway, for a total of 120 (out of 243 world-wide) individuals.[21]

We then obtain the historical tax records for all the professionals from the Norwegian tax authorities. The tax records disclose their taxable wealth. This information is used below to compute the required co-investment as a fraction of the GPs' total wealth. There are two caveats with this data. First, while most assets are marked-to-market, real estate is an exception and generally has a tax assessment below 30% of its market value. This prevents us from identifying the exact level effect of wealth on risk taking, but rather we examine differences in the cross-section. Second, since we are unable to identify the exact deal team, we assume that all professionals or partners in a private equity firm have equal responsibility for the fund's investments.[22] This assumption introduces noise in the wealth estimate that should work against us. Also, we winsorize the relative GP at five times wealth.

3.2 Sample description

The 62 portfolio companies in the sample are acquired by 20 different buyout funds raised between 2000 and 2010 by 11 unique Nordic private equity firms. All variables are defined in Tables 11 based on Table 12.

Insert Table 11 about here

Table 1 presents summary statistics for the 20 buyout funds. The fee structure (see Panel B) is quite standard with an average carry of 18% (median 20%), management fee of 2% (median 2.0%) and equity hurdle rate of 8% (median 8.0%). Data on these fees are missing for

[21]Private discussions with a limited partner suggest that the professionals residing in Norway are responsible for the local deals.

[22]Since the professionals' wealth largely depends on the success of earlier funds raised by the private equity firm, there is likely a relatively large correlation in the wealth of professionals within the same firm.

almost one-third of the funds. However, because there is virtually no cross-sectional variation, we ignore these fees in our empirical analysis below.

Insert Table 1 about here

The variable of particular interest to our study, the absolute (i.e. independent from wealth considerations) co-investment β, averages 3.1% of total fund size with a median of 1.5% of the consideration, ranging from zero to 15% across the different funds (see Panel B) . We assume that the proportion of the fund invested in Norway equals the fraction of the private equity firm's professionals that reside in Norway. With this assumption, the average absolute co-investment in Norway is $17.83 million (median $5.45 million) per fund. The average fund in the sample is managed by a private equity firm with 8 partners or 17 professionals. The mean wealth of these partners is $3.2 million (median $1.53 million) in the year of the investment (see Panel A). The corresponding number for all professionals is $1.92 million (median $1.31 million).

Compared to Robinson and Sensoy (2015) there is more dispersion in Norwegian GPs' co-investment. They find that on average buyout funds own 2.38% of their fund. This is somewhat lower than the 3.1% we report.

We then compute several measures for the co-investment relative to wealth. The first measure, *Relative co-investment all*, is the ratio of the dollar total co-investment for the fund and the combined wealth of all the fund's professionals averaged over three years prior to the investment.[23] We use the co-investment in the fund and not the individual target firm because the fund manager's risk aversion will be determined by his total co-investment amount. For the average firm, the professional has to invest 117% of his wealth (median 43%). We repeat this exercise using only partners who are responsible for the co-investment (*"Relative co-investment partners"*) with the mean at 113% and the median at 43%. The variable *Relative co-investment partners* is our main measure for the co-investment fraction of the GP's wealth, used in most of the empirical analysis below. Due to our winsorization procedure, the relative co-investment share range from zero to five.

The table also provides general information about the funds (see Panel A). Our sample

[23] We use the three-year average to smooth large variations in the taxable wealth.

includes on average 3.65 firms per fund. The funds in the sample are relatively large, with an average (median) size of $942 ($325) million. The typical fund is a follow-up fund and on average the fourth fund raised by the private equity firm.

Table 2 shows characteristics of the 62 sample firms. The portfolio company investments are from the period 2000 to 2010. At year-end of the transaction, leverage was on average 62% (median 64%). Total assets size is $120 million. The sample firms have relatively low profitability, with a return on assets of 3%. A substantial fraction of the firms (42%) are in the technology industry. We also display the macroeconomic conditions we use in our analysis. This reveals quite some variation in credit spread as well as of Nibor (the Norwegian correspondence to LIBOR) which ranges from slightly above two percent up to more than seven percent.

Insert Table 2 about here

Table 13 in the Appendix provides a comparison between the firms in our sample and those buyout deals for which we lack information about the GP's investment. The deals in our sample are somewhat more recent and the firms in our sample are somewhat larger (regressing time on size shows a trend towards larger deals in recent years).

As a measure of project risk, we estimate asset beta for the portfolio companies. To estimate this asset beta, we run a propensity score estimator that looks at all listed firms on the Oslo Stock Exchange in a particular year and finds the best fit to our buyout target. There are about 250 listed firms on the Oslo Stock Exchange in any given year.[24] We run yearly a regression were we match on the firms' profitability, return on assets, (log) size, fixed asset ratio and industry (at the one-digit level). We allow each control firm to be used across multiple deals. Including sales growth does not change our results.

We use nearest neighbor matching with replacement and assign five matches to each firm. For each matching firm, we estimate equity beta using monthly returns over an 24 month rolling window against the Oslo Main Index. We then delever these equity betas and compute the average asset beta by averaging over the individual asset betas of the five matching firms. Two treatments are not on common support but our results below do not change if we include

[24]Our return data are from NHHs Brsprosject.

these deals and hence we keep them in the sample. The average asset beta of our portfolio firms is 0.47 (median 0.46). This is consistent with the relatively low asset beta of 0.33 of buyout portfolio companies in the US found by Driessen *et al.* (2012).

Table 4 displays the correlation matrix of our main variables. Most importantly it reveals that while there is a very close relationship between our two relative co-investment measure, the correlation between the relative co-investment measure and the absolute co-investment percentage is almost zero. This already indicates that the absolute and relative co-investment measure capture something quite different.

Insert Table 4 about here

4 Empirical Analysis

We next set out to test our model. The two main implications to be tested are the effect of the co-investment fraction on leverage and project risk. We will then test what the combined effect of project risk and leverage risk predicts. Finally, we check the effect of the GP's co-investment on the deal size in order to see if GP's with a higher co-investment percentage reduce deal size. In order to take potentially enogeneity and omitted variable concerns into account we account in our multivariarate analysis for a number of factors which may determine our measures of risk-taking into account. More importantly, however, we argue that our research-design makes endogeneity concerns less likely. Since our contracts including the co-investment are determined ex-ante and are applicable to many firms, it is much less likely that unobserved variables (such as risk factors or preferences) may jointly determine the co-investment level as well as the risk of the investments. Even if risk preferences of GPs would determine the co-investment levels (which is rather unlikely this they are influenced heavily by LPs as well) this would even strengthen our hypotheses. This would call for more co-investment levels and higher risk of investment just running contrary opposite to our result. Hence, when we find evidence for our hypotheses these arguments would even strengthen our findings on the causal effects.

Table 3 gives a first impression by showing a univariate comparison of the co-investment-to-wealth measures across groups of firms double-sorted on asset beta and leverage. Our theory predicts that the co-investment fraction for the low beta/high leverage group should be higher than that of the high beta/low leverage group. The table supports this prediction. In the top panel, for example, using *Relative GP co-investment all*, β=0.444 for high beta/low leverage group vs. β=1.407 for the low beta/high leverage group, the difference being significant at the five percent level. The same pattern appears for the partners' co-investment-to-wealth measures in the table. There, the relative co-investment level differs almost to the same extent, namely between β=0.480 for high beta/low leverage group vs. β=1.431 for the low beta/high leverage group, the difference being significant at the five percent level. Given the dispersion of the relative co-investment variables (see Table 1), both differences are also economically quite pronounced.

Insert Table 3 about here

4.1 Project risk

Our model predicts that GP's with a higher co-investment fraction choose to invest in projects with less risk. We test this notion by regressing the GP co-investment on the portfolio company asset beta.

In table 5, we regress the firm's asset beta on the different definitions of the GP's relative co-investment fraction. We use *Relative co-investment partners* as a measure for the co-investment-to-wealth ratio. Standard errors are clustered by private equity fund. We also use robust standard errors but do not find any changes. The regression model contains additional variables that may affect the firm's risk. These variables include three broad categories of control variables: macro-economic, firm and GP specific characteristics. The firm-specific characteristics are firm size (log of total assets,), firm profitability measured by the firm's return on assets and fixed asset ratio. We also add a control for the firm's industry by including a dummy variable indicating NACE category 7. To control for the macro environment, we either include a dummy variable for the deal year or we directly control for Nibor and Credit Spread. We further control for fund characteristics, namely the fund size, the fund's sequence number (in our sample) and the private equity firm's age (GP Age).

Insert Table 5 about here

The variable *Relative co-investment partners* is negative and significant in all specifications. Consistent with our model, a higher co-investment fraction is associated with lower project risk, here measured as the firm's asset beta. In contrast, the absolute co-investment percent is unable to explain the cross-sectional variation in asset beta. Hence, it is essential to control for wealth in order for the GP's co-investment to explain his choice of project risk. That is, without controlling for the level of wealth, there is little information in the GP percentage itself regarding the fund manager's risk appetite.

To gauge the economic impact of this results we note that the average asset beta is 0.47, while the coefficient estimate is -0.049. A one standard deviation increase (1.73) in the relative co-investment fraction reduces asset beta from 0.47 to 0.39.

Overall, the regression suggests that the GP's co-investment relative to his wealth is a significant determinant for the choice of asset beta, while the absolute co-investment lacks any explanatory power.

4.2 Leverage

Our model predicts a positive relationship between leverage and the GP's co-investment percentage. In Table 6 we next regress the full model on leverage, using the different measures for the GP's co-investment-to-wealth ratio. Standard errors are clustered by private equity fund. We use the same set of controls as above. As shown in the table, all the various specifications (columns (1)-(4)) of the co-investment relative to wealth produce positive and significant coefficients.

That is, the higher the GP co-investment, the higher the portfolio company's leverage, as implied by our model. The debt ratio further tends to be higher for older private equity firms. Consistent with much of the extant literature, firm leverage is increasing in the proportion of tangible assets. Furthermore, firms of larger funds are more levered.

To gauge the economic impact of this results we note that the average leverage ratio is 0.62. Given our estimated coefficient of 0.088 one standard deviation increase (1.73) in the relative co-investment fraction would increase the leverage ratio from 0.62 to about 0.77.

In columns (5) to (8), we replace the relative GP co-investment with the absolute co-investment and the percentage co-investment, i.e. the fraction of the fund's investment that the general partner have to contribute. As shown in the table, both measures are consistently insignificant. That is, once again, without controlling for the level of wealth, there is little information in the GP percentage itself regarding the fund manager's risk appetite.

Overall, table 6 is consistent with the notion that that the GP co-investment relative to his wealth is a significant determinant for the choice of leverage, while the absolute co-investment lacks explanatory power.

Insert Table 6 about here

4.3 Total risk

Our analysis has so far shown that on the one hand, GPs with a higher relative co-investment select less risky firms. But on the other hand, these firms tend to be higher levered. What about the overall effect? We use each deal's equity beta to measure total risk for the deal. This measure comprises both of our risk factors and allows us to ask us about the overall effect of leverage on risk given that our findings so far point in opposite direction. While on the one hand a higher relative co-investment share reduces asset beta (and hence the overall firm risk), the opposite is true for leverage. Since these two effects have opposing impact on equity beta, investigating the effect of co-investment on equity beta allows us to look into the net effect.

Table 7 shows coefficient estimates for a regression of equity beta on the GP's relative co-investment. Standard error are clustered by private equity fund. We use once again the same controls as in our previous regression tables. As shown in the table, all the various specifications of the co-investment relative to wealth produce significant negative coefficients. The various estimates are not only robust with respect to the precise co-investment measure used but also with regard to the precise specification of the regression. It appears that overall risk is lower the higher the GP's relative co-investment in his fund. We consider this to be an important finding of our analysis: more "skin in the game" leads to a reduction in overall risk.

In columns (7) and (8), neither the absolute co-investment percent, nor the dollar amount has any significant impact on the leverage choice, consistent with the results on asset beta and leverage.

To allow for a better understanding of the economic impact of these results we note that the average leverage ratio is 0.69, while the coefficient estimate is -0.15. A one standard deviation increase (1.73) in the relative co-investment fraction would decrease the equity beta from 0.69 to about 0.43 implying quite a pronounced effect.

Insert Table 7 about here

4.4 Project Size

We now turn to a further aspect of the impact of co-investment shares on risk-taking by asking: Does a higher co-investment also lead to more diversification of the GP's wealth? GP's have various ways in order to achieve this aim. A simple way would be to reduce non-systematic risk by investing into projects with lower absolute volatility. As discussed in the introduction we do not find such an effect (as measured by the comparables' daily standard deviations).[25] There is however a second way to diversify the portfolio. Instead of selecting more projects with lower absolute volatility, GPs might simply invest into more but smaller deals. Why might GP's be reluctant to undertake the former type of diversification and prefer the latter type ? GP's generally are not passive investors like a mutual fund manager but are expected to actively influence the firms they are invested into. If there is a link between GP ability and a certain type of industry or firm type then GP's might be reluctant to invest into projects where they would have a reduced ability to influence the firm. Hence, due to the role of GPs there are reasons not to diversify optimally by increasing the number of investment and reducing the size of the individual investment, However, we would expect that "skin in the game" tilts the objectives of the GP in the direction of more and smaller investments.

If our conjecture is correct, we would expect to see that higher personal risk leads to more diversification in the form of more but smaller investments. In table 8 we investigate this relationship. We regress the relative co-investment percentage on each firm's total assets divided by fund size. We call this variable "Ticket Size". We find that there is a negative correlation between co-investment amount and ticket size, consistent with our conjecture. More "skin in the game" seems to be an incentive for the GP to reduce the size of the individual investment allowing him – given the size of the fund (for which we control) to invest in more

[25]To conserve space we omit the relevant tables.

portfolio firms.

Insert Table 8 about here

There is an additional tradeoff here: if GP's are constraint in how large a fund they can raise then an increase in leverage could lead to an increase in the number of deals to be financed. In a sense this is a trade-off between firm risk and portfolio risk, in the sense that an increase in leverage may lead to an increase in firm risk but could lead to a decrease in portfolio risk.

This finding suggests that GPs prefer to correct for lower personal diversification caused by a higher relative-co-investment percentage by investing into more deals rather than by lowering total risk. This result may also suggest that a pure portfolio-theoretic approach to portfolio risk may neglect the fact that GPs tend to be specialized in their skills and hence there may be limits to their desire to diversify away certain types of risk.

4.5 Returns

We also look at the returns delivered by the firms in our sample. Unfortunately we only have return (or valuation) data available for 26 firms. We have quarterly valuations and divestments or additional investments. Valuations are a mixture of market based and model based valuations as some of them are based on partial sales while others are just NAVs reported by the GP. We also keep track of intermediate cash-flows as there are frequent add-on investments and recapitalizations. We transform this two data sources into a single cash flow for each firm by treating the last valuation in our data set as the firm's ultimate value and discount this final value and each intermediate cash-flow back to the initial investment date. We compute a risk adjusted discount rate for each firm by using the leverage ratio in the first year of the buyout deal and we use the equity beta that corresponds to this rate.[26] We then sum up all the cash flows to get the deal's NPV. We do get a negative relationship between the GP's relative co-investment and the risk adjusted returns, however the relationship is not even remotely significant. In fact, none of the GP investment related variables turn out to be significant. Controlling for other GP characteristics reduces the sample to 17 observations but does not change the findings.

[26]We use the Nibor in the deal year and a five percent equity market premium.

What should we expect to find? We beleive we should not expect to find a relationship between the GP's co-investment level and the NPV of the investment. If risk is properly accounted for and the GPs' get the right set of incentives, then in equilibrium all should deliver the same risk-adjusted rate of return. This is exactly what we find here. Our conjecture is based on the assumption that we can properly capture the project's risk through the risk adjustment.

The other alternative is of course that, given the small sample size, we simply do not have the power to detect statistical significance.

4.6 Wealth effects

In this subsection we explore whether additional aspects of the GP's wealth affect the GP's decisions to take on risk. We begin this analysis by exploring whether it is the GP's absolute level of wealth that is driving our results. Tables **??**, 10, **??** and **??** show that the coefficient for *Partner Average Wealth* is insignificant in almost every specification and hence, it is not the absolute level of wealth that influences risk taking. Next we consider if changes in the GP's wealth affect his desire to take on risk. We compute the change in wealth from the year prior to the year of the deal and include it in the regression. We interpret this as evidence how changes to the GP's wealth portfolio influence his risk choice. Given that on average a large fraction of the GP's wealth is invested in his funds this variable should also be a reasonable proxy for previous fund returns (especially distributions). *Partner Year on Year Wealth Change* in table **??**, 10, **??**, and **??** is not significant apart from model two and three in table **??**. We interpret this as evidence that there is no influence of wealth changes in the GP's portfolio on risk taking. Moreover the estimated coefficient is positive, not negative. This result is interesting as it also indicates that past losses do not seem to lead to an increase in current risk taking. This result essentially rules out a risk shifting channel that would run from wealth losses to increased portfolio risk.

Insert Table ables **??**, 10, **??** and **??** about here

Finally we include our standard relative GP percentage measures to see if they survive the inclusion of these additional controls and we find that (apart from asset beta where the coefficient is slightly below the 10 percent significance level) they do not seem to be affected by these additional variables.

A final note is due on the number of observations. As we include wealth changes we lose one observation where we do not have information about the GP's wealth in the year prior to the deal.

5 Conclusion

In this paper, we examine how the requirement for a co-investment by a private equity fund manager affect his incentives to make risky investments for the fund. We first develop a model, which predicts that a higher co-investment reduces the appetite for project risk while at the same time increasing the appetite for leverage. We then take the model predictions to the data, using a unique sample of Norwegian private equity transactions. The Norwegian institutional setting allows us to control for the fund managers' wealth, which may have important implications for risk aversion.

The predictions of our model are borne out in the data. Cross-sectional regressions show that a higher co-investment fraction is associated with less risky portfolio companies (lower assets beta) and a higher degree of debt financing. Importantly, the co-investment fraction is a significant determinant of investment risk only when adjusted for the fund manger's wealth. This emphasizes the importance of wealth data in research examining the effect of variable compensation on the incentives to take risk.

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Table 1: **Summary Statistics**

The table shows summary statistics for the sample of 20 buyout funds that have partners bases in Norway. The GP characteristics are measured in the year of fund's inception - with the exception of number of portfolio firms. The firm characteristics are from the fiscal year following the buyout. All variables are defined in Appendix Table 2. *Relative coinvestment* is the total required coinvestment for the fund as a fraction of the professionals' or partners' total wealth averaged over the three prior to the buyout transaction. We assume that one doller is equal to six kroner.

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
Panel A: Fund Characteristics						
Total Number of employees	20	16.6	10	17.95	4	83
Total Number of Partners	20	8.45	7	4.25	3	21
Total Average Wealth All Employees (in $m)	20	1.92	1.31	2.05	0.02	6.82
Total Average Wealth Partners (in $m)	20	3.22	1.53	4.27	0.03	17.33
Number of Portfolio Firms in Sample	20	3.1	3	1.619	1	7
Panel B: Dependent Variables						
Rel. coinv. all	20	1.177	0.426	1.740	0	5
Rel. coinv. partners	20	1.138	0.425	1.730	0	5
Absolute GP Investment (in $m)	20	17.83	5.45	26.17	0.00	88.33
Absolute GP Percentage	20	0.031	0.015	0.043	0	0.15
Panel C: Fund Characteristics						
GP Age	20	9.65	8.5	6.53	1	20
Fund Size (in $m)	20	942	325	1700	53	5883
log(Fund Size)	20	21.491	21.389	1.314	19.57	24.29
Fund Sequence Number	20	3.65	3	2.35	1	8
Fund Inception Year	20	2004	2004	4.30	1989	2008
Carry	11	0.18	0.2	0.05	0.02	0.2
Management Fee	14	0.02	0.2	0.00	0.013	0.023
Hurdle Rate	12	0.08	0.08	0.00	0.07	0.08
Fund Duration	14	9.64	10	0.93	7	10

Table 2: **Summary statistics of firm characteristics and required coinvestment**

The table shows summary statistics for the sample of 62 Norwegian portfolio companies, acquired by Nordic buyout funds between 2000 and 2010. The GP characteristics are measured in the year of the buyout. The firm characteristics are from the fiscal year following the buyout. All variables are defined in Appendix Table 2. *Relative coinvestment* is the total required coinvestment for the fund as a fraction of the professionals' or partners' total wealth averaged over the three prior to the buyout transaction.

	N	Mean	Median	Std.dev.	Min	Max
Panel A: Dependent Variables						
Asset Beta	62	0.473	0.459	0.298	-0.29	1.237
Leverage Ratio	62	0.618	0.641	0.276	0.02	1.325
Equity Beta	62	0.691	0.586	0.538	-0.47	2.747
Ticket Size	62	0.410	0.586	0.487	0.01	2.431
Panel B: Fund characteristics						
Rel. coinv. all	62	0.893	0.427	1.32	0	5
Rel. coinv. partners	62	0.932	0.476	1.33	0	5
Absolute GP Investment Amount (in $m)	62	13.02	5.90	20.67	0	88.33
Absolute GP Investment Fraction	62	0.037	0.015	0.049	0	0.15
GP Age	62	9.903	8	5.955	1	21
Panel C: Firm characteristics						
Fund Size (in $m)	62	652	315	1232	53	5883
log(Fund Size)	62	21.3	21.4	1.152	19.6	24.3
Fund Sequence Number	62	3.6	3	2.129	1	8
Total Assets (in $m)	62	119.7	67	223	2.10	1717
log(TA)	62	12.86	12.91	1.157	9.44	16.15
Fixed Asset Ratio	62	0.08	0.004	0.149	0	0.554
RoA	62	0.03	0.072	0.243	-1.66	0.315
Firm Volatility	62	0.03	0.031	0.016	0.011	0.078
Industry Control	62	0.42	0	0.497	0	1
Panel D: Macro characteristics						
Credit Spread	62	5.65	4.742	3.042	2.702	10.27
Nibor	62	4.23	3.58	1.507	2.21	7.19
Year	62	2007	2007	2.285	2000	2010

Table 3: **Univariate comparison of the required coinvestment**

The table shows the average coinvestment for firms in a double sort on asset beta (vertical) and leverage (horizontal). The sample is 62 Norwegian portfolio companies acquired by Nordic buyout funds between 2000 and 2010. Panel A shows the *Relative coinvestment*, defined as the total required coinvestment for the fund as a fraction of the professionals' (columns (1) to (3)) or partners' (columns (4) to (6)) total wealth averaged over the three years prior to the buyout transaction. All variables are defined in Appendix Table 2. At the bottom of each panel is a one-sided t-test that the difference in mean between firms with high asset beta/low leverage and firms with low asset beta/high leverage is postive. The p-value for the t-test is in parenthesis. The number of observations for each subsample is shown in square brackets.

	All professionals			Partners only		
	High leverage (1)	Low leverage (2)	Total (3)	High leverage (4)	Low leverage (5)	Total (6)
Panel A: Relative coinvestment						
High beta	0.991	0.444	0.701	1.069	0.480	0.756
	[15]	[17]	[32]	[15]	[17]	[32]
Low beta	1.407	0.745	1.098	1.431	0.765	1.120
	[16]	[14]	[30]	[16]	[14]	[30]
Total	1.206	0.580	0.893	1.256	0.609	0.932
	[31]	[31]	[62]	[31]	[31]	[62]
Difference in mean			-0.963			-0.951
p-value			(0.045)			(0.048)

Table 4: **Coinvestment and total risk**

The table shows correlations for the independent variables in our sample. The sample is 62 Norwegian portfolio companies acquired by Nordic buyout funds between 2000 and 2010. *Rel. coinvestment* is the total required coinvestment for the fund as a fraction of the professionals' or partners' total wealth averaged over the three prior to the buyout transaction. All variables are defined in Appendix Table 2. Standard errors are clustered by private equity firm and shown in parenthesis. ***, ** and * denote that the coefficient is significantly different from zero at the 1%, 5% and 10% level, respectively.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Rel. Coinv. Partners	(1)	1													
Rel. Coinv. All	(2)	0.9976	1												
Abs. GP Investment Amount	(3)	0.3007	0.3183	1											
Abs. GP Investment in %	(4)	0.0404	0.031	-0.0063	1										
GP Age	(5)	0.2878	0.2912	0.2428	0.0171	1									
log(Fund Size)	(6)	0.2067	0.2231	0.6681	-0.5522	0.1706	1								
Actual Sequence	(7)	0.3563	0.3616	0.2632	0.0677	0.7833	0.2064	1							
log(TA)	(8)	0.3032	0.3113	0.3099	-0.2027	0.0249	0.4378	0.0758	1						
Fixed Asset Ratio	(9)	0.0644	0.0572	-0.047	0.0501	0.139	-0.0009	0.1	0.1975	1					
RoA	(10)	-0.0057	0.0001	0.0316	-0.3478	0.0919	0.2289	0.0875	0.3802	0.1051	1				
Firm Volatility	(11)	-0.1873	-0.1908	-0.1602	-0.0149	0.1377	-0.0483	0.0271	-0.3432	0.1646	-0.1804	1			
Industry Control	(12)	0.2017	0.2129	0.1569	-0.078	0.1191	0.0633	0.0719	-0.0162	-0.1165	0.0002	0.0414	1		
Credit Spread	(13)	-0.1873	-0.192	0.0438	-0.1353	0.1113	0.1213	0.0985	-0.1899	0.0294	0.025	0.6766	0.0449	1	
Nibor	(14)	-0.2147	-0.2231	-0.0724	0.1774	-0.1424	-0.1957	-0.1574	-0.1337	-0.2714	-0.1503	0.3633	-0.0271	0.5464	

Table 5: **Coinvestment and project choice**

The table shows the coefficient estimates from cross-sectional ordinary least squares regressions of asset beta. The sample is 62 Norwegian portfolio companies acquired by Nordic buyout funds between 2000 and 2010. *Rel. coinvestment* is the total required coinvestment for the fund as a fraction of the professionals' or partners' total wealth averaged over the three prior to the buyout transaction. All variables are defined in Appendix Table 2. Standard errors are clustered by private equity firm and shown in parenthesis. ***, ** and * denote that the coefficient is significantly different from zero at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Asset Beta							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rel. coinv. partners	-0.0490*		-0.0463**					
	(0.0235)		(0.0212)					
Rel. coinv. all		-0.0539**		-0.0497**				
		(0.0225)		(0.0205)				
Absolute GP Investment Amount					-2.80e-10		-0	
					(3.32e-10)		(4.61e-10)	
Absolute GP Investment in %						0.108		-0.0881
						(0.867)		(1.076)
Fund characteristics:								
GP Age	-0.0111	-0.0111	-0.0241**	-0.0238**	-0.0106	-0.0115	-0.0252***	-0.0252**
	(0.00995)	(0.00993)	(0.00911)	(0.00904)	(0.0102)	(0.00992)	(0.00877)	(0.00899)
log(Fund Size)	-0.0120	-0.0127	-0.0131	-0.0141	0.00607	-0.0143	-0.0225	-0.0259
	(0.0317)	(0.0319)	(0.0351)	(0.0352)	(0.0350)	(0.0429)	(0.0633)	(0.0388)
Fund Sequence Number	0.0533*	0.0540*	0.0794**	0.0794**	0.0452	0.0430	0.0720**	0.0724*
	(0.0271)	(0.0268)	(0.0337)	(0.0332)	(0.0291)	(0.0312)	(0.0335)	(0.0355)
Firm characteristics:								
log(TA)	-0.0398	-0.0382	-0.00887	-0.00759	-0.0566	-0.0552	-0.0199	-0.0194
	(0.0435)	(0.0432)	(0.0351)	(0.0351)	(0.0433)	(0.0449)	(0.0362)	(0.0340)
Fixed Asset Ratio	0.182	0.185	0.295	0.294	0.182	0.173	0.271	0.271
	(0.348)	(0.348)	(0.398)	(0.398)	(0.342)	(0.346)	(0.393)	(0.397)
RoA	-0.0810	-0.0855	-0.238	-0.240	-0.0628	-0.0350	-0.205	-0.208
	(0.0901)	(0.0881)	(0.195)	(0.195)	(0.106)	(0.0996)	(0.200)	(0.182)
Macro Controls:								
Credit Spread	0.00635	0.00618			0.00954	0.0106		
	(0.0126)	(0.0127)			(0.0118)	(0.0126)		
Nibor	-0.0242	-0.0246			-0.0168	-0.0254		
	(0.0325)	(0.0323)			(0.0388)	(0.0336)		
Constant	1.224**	1.221**	0.633	0.634	1.015	1.454*	0.993	1.065
	(0.492)	(0.498)	(0.534)	(0.531)	(0.658)	(0.702)	(1.024)	(0.673)
Industry Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	No	No	Yes	Yes	No	No	Yes	Yes
Observations	62	62	62	62	62	62	62	62
R-squared	0.183	0.190	0.347	0.351	0.155	0.150	0.319	0.320

Table 6: **Coinvestment and gearing**

The table shows the coefficient estimates from cross-sectional ordinary least squares regressions of leverage. The sample is 62 Norwegian portfolio companies acquired by Nordic buyout funds between 2000 and 2010. *Leverage* is defineds as Liabilities/Total Assets. *Rel. coinvestment* is the total required coinvestment for the fund as a fraction of the professionals' or partners' total wealth averaged over the three prior to the buyout transaction. All variables are defined in Appendix Table 2. Standard errors are clustered by private equity firm and shown in parenthesis. ***, ** and * denote that the coefficient is significantly different from zero at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Leverage Ratio							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rel. coinv. partners	0.0700*		0.0876**					
	(0.0357)		(0.0348)					
Rel. coinv. all		0.0669*		0.0875**				
		(0.0363)		(0.0348)				
Absolute GP Investment Amount					-8.62e-10		-7.72e-10	
					(5.74e-10)		(6.03e-10)	
Absolute GP Investment in %						-1.895		-1.339
						(1.225)		(1.164)
Fund characteristics:								
GP Age	0.00561	0.00563	-0.00267	-0.00292	0.00907	0.00592	0.00361	0.000193
	(0.00794)	(0.00797)	(0.00616)	(0.00620)	(0.00660)	(0.00641)	(0.00832)	(0.00812)
log(Fund Size)	0.0648	0.0666	0.0424	0.0456	0.141*	0.0295	0.140*	0.0400
	(0.0610)	(0.0609)	(0.0608)	(0.0600)	(0.0697)	(0.0601)	(0.0744)	(0.0738)
Fund Sequence Number	-0.0483**	-0.0474**	-0.0416**	-0.0405**	-0.0297*	-0.0235	-0.0232	-0.0195
	(0.0201)	(0.0195)	(0.0180)	(0.0178)	(0.0162)	(0.0217)	(0.0212)	(0.0247)
Firm characteristics:								
log(TA)	-0.00440	-0.00354	-0.0191	-0.0199	0.0121	0.0221	-0.00992	0.00469
	(0.0341)	(0.0334)	(0.0451)	(0.0445)	(0.0291)	(0.0346)	(0.0439)	(0.0484)
Fixed Asset Ratio	0.257	0.255	0.324*	0.329*	0.286	0.308	0.417**	0.398**
	(0.209)	(0.211)	(0.183)	(0.181)	(0.230)	(0.238)	(0.167)	(0.179)
RoA	-0.182	-0.183	-0.259	-0.260	-0.305	-0.345	-0.358	-0.386
	(0.214)	(0.214)	(0.239)	(0.238)	(0.210)	(0.229)	(0.225)	(0.255)
Macro Controls:								
Credit Spread	0.00132	0.000759			-0.00743	-0.00681		
	(0.0110)	(0.0111)			(0.0118)	(0.0126)		
Nibor	0.0135	0.0140			0.0394	0.0231		
	(0.0254)	(0.0254)			(0.0240)	(0.0256)		
Constant	-0.686	-0.734	0.146	0.0933	-2.580*	-0.239	-1.971	-0.00482
	(1.415)	(1.409)	(1.093)	(1.076)	(1.446)	(1.212)	(1.224)	(1.172)
Industry Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	No	No	Yes	Yes	No	No	Yes	Yes
Observations	62	62	62	62	62	62	62	62
R-squared	0.243	0.236	0.463	0.463	0.224	0.227	0.387	0.376

Table 7: **Coinvestment and total risk**

The table shows the coefficient estimates from cross-sectional ordinary least squares regressions of equity beta. The sample is 62 Norwegian portfolio companies acquired by Nordic buyout funds between 2000 and 2010. *Rel. coinvestment* is the total required coinvestment for the fund as a fraction of the professionals' or partners' total wealth averaged over the three prior to the buyout transaction. All variables are defined in Appendix Table 2. Standard errors are clustered by private equity firm and shown in parenthesis. ***, ** and * denote that the coefficient is significantly different from zero at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Equity Beta							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rel. coinv. partners	-0.151***		-0.169***					
	(0.0281)		(0.0410)					
Rel. coinv. all		-0.157***		-0.174***				
		(0.0266)		(0.0394)				
Absolute GP Investment Amount					4.81e-10		9.54e-10	
					(7.77e-10)		(9.01e-10)	
Abolsute GP Investment in %						1.178		0.817
						(1.905)		(2.328)
Fund characteristics:								
GP Age	-0.0194	-0.0193	-0.0320*	-0.0314*	-0.0223	-0.0205	-0.0414**	-0.0368**
	(0.0201)	(0.0201)	(0.0169)	(0.0168)	(0.0184)	(0.0196)	(0.0158)	(0.0174)
log(Fund Size)	-0.0396	-0.0425	-0.00771	-0.0127	-0.0930	-0.0279	-0.143	-0.0343
	(0.0568)	(0.0556)	(0.0739)	(0.0717)	(0.0582)	(0.0857)	(0.0995)	(0.107)
Fund Sequence Number	0.136**	0.137**	0.167***	0.165***	0.104*	0.0995	0.134**	0.134*
	(0.0545)	(0.0539)	(0.0540)	(0.0526)	(0.0599)	(0.0659)	(0.0618)	(0.0664)
Firm characteristics:								
log(TA)	0.00746	0.00966	0.0628	0.0657	-0.0363	-0.0422	0.0374	0.0215
	(0.0522)	(0.0514)	(0.0799)	(0.0790)	(0.0605)	(0.0572)	(0.0791)	(0.0780)
Fixed Asset Ratio	0.0559	0.0623	0.233	0.224	0.0250	0.0103	0.0843	0.124
	(0.586)	(0.586)	(0.665)	(0.665)	(0.571)	(0.590)	(0.660)	(0.666)
RoA	-0.218	-0.225	-0.413	-0.415	-0.0580	-0.0291	-0.247	-0.251
	(0.133)	(0.131)	(0.254)	(0.254)	(0.148)	(0.151)	(0.264)	(0.236)
Macro Controls:								
Credit Spread	0.0226	0.0228			0.0369	0.0367		
	(0.0243)	(0.0242)			(0.0249)	(0.0257)		
Nibor	-0.0249	-0.0261			-0.0410	-0.0325		
	(0.0600)	(0.0600)			(0.0726)	(0.0609)		
Constant	1.131	1.166	-0.482	-0.422	2.821**	1.461	2.650	0.590
	(0.925)	(0.902)	(1.286)	(1.239)	(1.079)	(1.682)	(1.542)	(1.898)
Industry Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	No	No	Yes	Yes	No	No	Yes	Yes
Observations	62	62	62	62	62	62	62	62
R-squared	0.295	0.304	0.452	0.459	0.203	0.204	0.356	0.343

Table 8: **Coinvestment and Relative Investment Size**

The table shows the coefficient estimates from cross-sectional ordinary least squares regressions of ticket size. Ticketsize is defined as balance sheet size of the firm divided by fund size. The sample is 62 Norwegian portfolio companies acquired by Nordic buyout funds between 2000 and 2010. *Rel. coinvestment* is the total required coinvestment for the fund as a fraction of the professionals' or partners' total wealth averaged over the three prior to the buyout transaction. All variables are defined in Appendix Table 2. Standard errors are clustered by private equity firm and shown in parenthesis. ***, ** and * denote that the coefficient is significantly different from zero at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Ticket Size							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rel. coinv. partners	-0.0701**		-0.0681**					
	(0.0278)		(0.0284)					
Rel. coinv. all		-0.0677**		-0.0666**				
		(0.0270)		(0.0275)				
Absolute GP Investment Amount					2.50e-10		4.27e-10	
					(6.50e-10)		(6.38e-10)	
Abolsute GP Investment in %						2.072**		1.361
						(0.957)		(0.856)
GP Age	-0.00971	-0.00973	-0.00368	-0.00354	-0.0111	-0.0100	-0.00768	-0.00604
	(0.00870)	(0.00874)	(0.0101)	(0.0101)	(0.00768)	(0.00598)	(0.00796)	(0.00846)
log(Fund Size)	-0.288***	-0.290***	-0.262***	-0.265***	-0.315***	-0.249***	-0.321***	-0.254***
	(0.0620)	(0.0628)	(0.0461)	(0.0472)	(0.0848)	(0.0592)	(0.0695)	(0.0668)
Fund Sequence Number	0.0352	0.0344	0.0199	0.0188	0.0200	0.00938	0.00650	0.000808
	(0.0277)	(0.0275)	(0.0259)	(0.0255)	(0.0179)	(0.0154)	(0.0208)	(0.0239)
log(TA)	0.371***	0.370***	0.376***	0.377***	0.351***	0.344***	0.367***	0.357***
	(0.0941)	(0.0946)	(0.0984)	(0.0989)	(0.0951)	(0.0946)	(0.0985)	(0.100)
Fixed Asset Ratio	-0.0354	-0.0333	-0.140	-0.145	-0.0504	-0.0903	-0.203	-0.205
	(0.239)	(0.240)	(0.229)	(0.230)	(0.241)	(0.217)	(0.218)	(0.214)
RoA	-0.322*	-0.321*	-0.295	-0.293	-0.245	-0.148	-0.226	-0.182
	(0.174)	(0.175)	(0.225)	(0.225)	(0.194)	(0.190)	(0.226)	(0.232)
Credit Spread	0.00479	0.00529			0.0115	0.0131		
	(0.0129)	(0.0129)			(0.0138)	(0.0118)		
Nibor	0.0294	0.0288			0.0212	0.0189		
	(0.0224)	(0.0228)			(0.0213)	(0.0227)		
Constant	1.651	1.696	2.162*	2.215**	2.482	1.126	3.500**	2.138*
	(1.064)	(1.076)	(1.041)	(1.040)	(1.663)	(1.107)	(1.575)	(1.133)
Industry Control								
Year Dummies								
Observations	62	62	62	62	62	62	62	62
R-squared	0.716	0.714	0.790	0.789	0.692	0.714	0.772	0.777

Table 9: **Wealth and project choice**

The table shows the coefficient estimates from cross-sectional ordinary least squares regressions for partner's (all professional's) total wealth, their change in wealth from last year and their skin on the game on asset beta, the deal's leverage ratio, equity beta, and ticket size. The sample is 59 Norwegian portfolio companies acquired by Nordic buyout funds between 2000 and 2010. *Partner (All employee's) Average Total Wealth* is the average wealth per partner per fund for the year prior to the deal. *Partner (All employee's) YoY Wealth Change (in %)* is the change in wealth between t-2 and t-1. *Rel. coinvestment* is the total required coinvestment for the fund as a fraction of the professionals' or partners' total wealth averaged over the three prior to the buyout transaction. All variables are defined in Appendix Table 2. Standard errors are clustered by private equity firm and shown in parenthesis. ***, ** and * denote that the coefficient is significantly different from zero at the 1%, 5% and 10% level, respectively.

		(1)	(2)	(3)	(4)	(9)	(10)	(11)	(12)
VARIABLES	Asset Beta	Leverage Beta	Equity Beta	Ticketsize	Asset Beta	Leverage Beta	Equity Beta	Ticketsize	
Partner Average Total Wealth	0	-2.56e-09	8.05e-10	0.00400***	6.30e-10	-3.14e-09	3.36e-09	0.00490**	
	(2.35e-09)	(1.98e-09)	(3.51e-09)	(0.00133)	(2.46e-09)	(2.49e-09)	(3.75e-09)	(0.00171)	
Partner YoY Wealth Change (in %)	0.0150**	-0.000276	0.0113	-9,528	0.0123	0.000649	0.00780	-10,974	
	(0.00695)	(0.00482)	(0.0161)	(9,714)	(0.00766)	(0.00591)	(0.0162)	(9,374)	
Rel. coinv. partners	-0.0357	0.0807**	-0.162***	-41,262	-0.0373	0.0981***	-0.177***	-37,690	
	(0.0223)	(0.0349)	(0.0509)	(30,877)	(0.0288)	(0.0232)	(0.0562)	(32,306)	
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Industry Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Year Dummies	No	No	No	No	Yes	Yes	Yes	Yes	
Observations	59	59	59	59	59	59	59	59	
R-squared	0.179	0.340	0.267	0.735	0.324	0.566	0.435	0.814	
All Emp. Average Total Wealth	-2.64e-09	-4.56e-09	3.17e-10	0.00546**	-1.65e-09	-5.96e-09**	4.72e-09	0.00720***	
	(2.45e-09)	(2.79e-09)	(5.08e-09)	(0.00199)	(2.25e-09)	(2.56e-09)	(5.49e-09)	(0.00192)	
All Emp. YoY Wealth Change (in %)	0.0221	0.00577	0.00471	-24,702	0.0160	0.00643	-0.00169	-23,944	
	(0.0181)	(0.0112)	(0.0386)	(16,929)	(0.0192)	(0.0134)	(0.0377)	(17,691)	
Rel. coinv. all	-0.0441	0.0792**	-0.168***	-51,411**	-0.0437	0.103***	-0.187***	-50,257*	
	(0.0262)	(0.0312)	(0.0442)	(24,391)	(0.0295)	(0.0200)	(0.0503)	(24,551)	
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Industry Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Year Dummies	No	No	No	No	Yes	Yes	Yes	Yes	
Observations	59	59	59	59	59	59	59	59	
R-squared	0.179	0.349	0.271	0.737	0.318	0.597	0.443	0.820	

Table 10: Variable Definitions

Notes: In this table we.... Standard errors are clustered by PE Fund.

	Variables used in the paper
Variable	Definition
Leverage 1	= (sumeiend - ek)/sumeiend
Leverage 2	= (capital employed - ek)/capital employed
Leverage 3	$rgjeld_{max}$ /($rgjeld_{max}$ + ek)
Asset Beta 1	= Equally weighted average of the five closest firms, using Leverage 1, where the individual $\beta_a = \beta_e * \frac{marketcap}{(marketcap+sumeiend*1000-ek)}$
Asset Beta 2	= Equally weighted average of the five closest firms, using Leverage 2, where the individual $\beta_a = q\beta_e * \frac{marketcap}{(marketcap+(capitalemployed)*1000)}$
Asset Beta 3	Equally weighted average of the five closest firms, using Leverage 3. where the individual $\beta_a = q\beta_e * \frac{marketcap}{(marketcap+rgjeld_max*1000)}$
Ticket Size	= sumeiend*1000/Fund Size in NOK
Rel. coinvestment all	= GP Co-investment current fund in fund per person/Average wealth over the last three years
Rel. coinvestment all Partners Only	= GP Co-investment current fund in fund per partner/Average wealth per partner over the last three years
Absolute GP Investment Amount	= Absolute GP's co-investment amount
Absolute GP Percentage	= Absolute GP's co-investment in percentage points
Partner Average Wealth	= Absolute Amount of Partner Wealth
Partner YoY Wealth Change	= Year Change in Absolute Amount of Partner Wealth
All Employee Average Total Wealth	= Absolute Amount of otal Employee Wealth
All Employee YoY Wealth Change	= Year Change in Absolute Amount of Total Employee Wealth
PE Firm Founding Year	= Year the GP was founded
Fund Sequence Number	= Sequence number for the funds in the sample
Credit Spread	= Credit Spread for European Bond issues from Bloomberg
NIBOR	= Norwegian Interbank Interest Rate at the year end from the Norwegian Central Bank
log(Fund Size)	= log (Fund Size in NOK)=
Fixed Asset Ratio	= (eiend+ maskanl)/sumgjek
log(TA)	= log(sumeiend)
Sales	= salgsinn/sumgjek
RoA	= ebitda/sumgjek

Table 11: **Coinvestment and total risk**

The table shows the variable definitions for our sample based on the definitions used by **?**.

Variable	Definition
Market Cap	From NHH's Børsprosjekt
Capital Employed	sumeiend -cash -invest -varer -kundef -pforpl
rgjeld avg	$(rgjeld_{max} + rgjeld_{min})/2$
ebitda	'Earnings before interest, tax, depreciation, and amortisation'
rentekost	'Interest expenses'
sumeiend	'Total assets'
ek	'Shareholder's equity'
gjeld	'Total Liabilities'
cash	'Bank deposits, cash etc.'
invest	'Investments'
varer	'Stocks'
kundef	'Trade debtors'
pforpl	'Pension commitment'
$rgjeld_{min}$	'Total interest-bearing liabilities, minimum'
$rgjeld_{max}$	'Total interest-bearing liabilities, maximum'
rlgjeld	'Interest-bearing long-term liabilities'
sumgjek	'Total equity and liabilities'
	All years. Total all liabilities and equity. Total gjeld + ek
salgsinn	'Sales revenues'
eiend	'Real property'
maskanl	'Machinery and plant'
drlosore	'Operating equipment, fixtures and fittings'
skiprigfl	'Ships, rigs, planes etc.'

Table 12: **Sample Comparison**

The table compares the 60 firms included in the sample relative to the 51 firms for which we do not have information about the GP's co-investment. The first part of the sample has at maximum 51 firms from between 1996 and 2010 whereas the other contains 60 Norwegian portfolio companies acquired by Nordic buyout funds between 2000 and 2010. We report the difference in means between the two samples and run a t-test on the difference. All variables are defined in Appendix Table 2. ***, ** and * denote that the coefficient is significantly different from zero at the 1%, 5% and 10% level, respectively.

Variable	N	Mean	Std. Dev.	N	Mean	Std. Dev.	Diff	
Fund characteristics:								
GP Age	28	7.607	6.136	62	9.90	5.96	-2.30	
log(Fund Size)	28	20.979	1.267	62	21.29	1.15	-0.32	
Fund Sequnce Number	32	2.688	1.839	62	3.63	2.13	-0.94	**
Firm characteristics:								
log(TA)	51	11.94	2.009	62	12.86	1.16	-0.93	***
Fixed Asset Ratio	51	0.142	0.250	62	0.08	0.15	0.06	
RoA	51	-0.155	1.040	62	0.03	0.24	-0.19	
Industry Control	51	0.490	0.505	62	0.42	0.50	0.07	
Macro characteristics:								
Credit Spread	40	4.757	2.326	62	5.65	3.04	-0.89	*
Nibor	51	4.183	1.606	62	4.23	1.51	-0.05	
Year	51	2004	4.043	62	2007	2.28	-3.49	***