Agency and Corporate Purchase of Insurance*

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Abstract

Consistent with the agency cost rational, this paper documents that managers having larger private benefits of control purchase more insurance to reduce their own exposure to the probability of left-tail outcomes and hence the volatility of the firm's cash flows. Private benefits of control are estimated by the market value of the right to vote (measured as the difference between the price of the stock and an equivalent synthetic stock that is constructed with options). Our results hold when we control for the probability of a control contest. We also find that firms with larger private benefits of control tend to use more debt.

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I. Introduction

In a frictionless economy, unsystematic risks faced by a corporation have no effect on its market value, yet, essentially all firms buy insurance. Motivated by this evidence, financial economists have suggested incentives for corporate purchase of insurance other than straightforward risk reduction. The main driving forces behind corporate purchase of insurance that have been identified by the literature are: the attempt to reduce the Myers (1977) underinvestment problem, the desire to minimize the expected bankruptcy cost thereby increasing debt capacity (Aunon-Nerin and Ehling, 2008), the need to lower the expected corporate tax payments, and finally, an agency cost based rational - risk averse managers purchase insurance for their own self-interest (see Amihud and Lev, 1981; Ehling, 2013; Graham and Smith, 1999; Graham and Rogers, 2002; Main, 1983; Mayers and Smith, 1982, 1987; Stulz, 1996, among others).[1] This paper presents new and distinctive evidence consistent with the agency cost rational. Managers buy insurance to lower their exposure to the probability of left-tail outcomes and hence the volatility of the firm's cash flows. We show that firms whose managers have larger private benefits of control, other things equal, tend to buy more insurance.

Private benefits of control are benefits that accrue to managers or large controlling shareholders of firms, often at the expense of minority shareholders.[2] The current literature has so far employed two methods to quantify the private benefits of control – the block premium that uses negotiated block transfers, and the voting premium that uses dual-class shares.[3] However, by construction, both methods are restricted to a small

[1] Many of the theoretical driving forces for corporate hedging were initially derived for purchases of derivatives but are often equally well applicable to insurance. However, insurance hedges one-sided risk and thus can be used to control underinvestment problems only. In contrast, financial derivatives hedge two-sided risk and therefore can be used to control both underinvestment and free cash flow problems (Morellec and Smith, 2007; Stulz, 1990). Another difference is that the purchase of insurance provides real services such as the expertise of insurers in evaluating risks and managing claims settlement procedures (Mayers and Smith, 1982), while derivatives do not provide any real services.

[2] See for example, Demsetz and Lehn (1985), Jensen (1993), and Shleifer and Vishny (1989) for definitions of private benefits of control. For a review of the literature see Benos and Weisbach (2004).

[3] Barclay and Holderness (1989) and Dyck and Zingales (2004) compute a measure for the private benefits of control using block trades. Levy (1982), Lease, McConnell, and Mikkelson (1983), Rydqvist (1996), Zingales (1994), Zingales (1995) and Nenova (2003) compute the voting premium using dual class shares. Hauser and Lauterbach (2004) examine compensation paid to owners of superior voting rights during a process of unifications of dual classes of shares and find a positive value for the vote.

sample of stocks.[4] In this study, we employ a measure of private benefits of control that is based on the voting premium approach as proposed by Kalay, Karakas and Pant (2013). This approach is similar in spirit to the dual-class shares approach, and quantifies the voting premium as the difference between the prices of the stock and the synthetic stock, where the synthetic stock is constructed with put and call options trading on the stock. The synthetic stock provides its owners identical claims on cash flows (except for dividends) that the underlying stock provides but no voting rights. Hence, the difference between the price of the stock and the synthetic stock (adjusted for dividends) quantifies the voting premium during the life of the synthetic stock (we label this measure as VOTE).

To estimate VOTE, we construct synthetic stocks using data on options from the IvyDB OptionMetrics database. This gives us end of day data on options. OptionMetrics gives us Bid and Ask quotes, option volume, and open interest for Calls and Puts traded on the stocks. The option pairs that we chose to construct the synthetic stock are close to the money and have on average 43 days to expiration. Since the options are all American style, we compute the Early Exercise Premiums for the Put and the Call using the Binomial option pricing model.[5] This information enables us to construct the synthetic stock using the put call parity. We calculate the VOTE variable for each day of the year (where data is available) for all firms in our sample. The daily values are averaged for the entire year (Jan 1 through Dec 31) to get the value of the VOTE for that firm year observation. The mean (median) value of VOTE in our sample is 0.14% (0.17%).

Our insurance data consists of property insurance contracts from SwissRe used in Aunon-Nerin and Ehling (2008). The data correspond to direct insurance transactions over the period January 1996 through September 2002. We analyze 114 firm-year observations of 48 U.S. firms. To be included in the analysis, an insurance contract for a particular firm-year must represent a complete description of a company's property insurance purchases. The limit of coverage embedded in the insurance contract is the highest payment a firm

[4] Blocks trade infrequently and only 6% of the firms listed on Compustat have dual class shares (Gompers, Ishii and Metrick, 2010).
[5] See Appendix A for a detailed description on how we compute the synthetic stock.

can receive. It is scaled by property, plant and equipment plus inventory and in our sample ranges from close to zero to 3.36 with a mean of 0.2 and median 0.06.

To test the effect of our measure of private benefits of control on the decision to purchase insurance, we solve a set of simultaneous equations using the linear generalized method of moments (GMM). Our empirical analysis controls for simultaneity between the choice of limit of coverage and capital structure. Consistent with the prediction of a risk-reduction agency-cost rational for corporate purchase of insurance, controlling for the traditional factors that have been shown to affect such purchase, we find that our measure of private benefits of control, VOTE, is a significant explanatory variable of the coverage limit of corporate insurance contracts. VOTE shows a positive relation with the coverage limit of corporate insurance contracts. When the private benefits of control are high (estimated by a high value of VOTE), managers tend to purchase more insurance to reduce their exposure to the probability of left-tail outcomes and hence the volatility of the firms' cash flows.[6] We also corroborate previous findings that firms with higher long-term debt ratio and smaller market value tend to buy more property insurance.

We find that firms with larger private benefits (VOTE) tend to use more debt. This empirical evidence is consistent with the Jensen (1986) free cash flow hypothesis as well as with the use of debt as an antitakeover defense mechanism.

II. Private Benefits of Control

In this study we employ a measure of private benefits of control, based on the voting premium approach, proposed by Kalay, Karakas and Pant (2013).[7] Ownership of a stock gives the shareholder a claim on all future dividend payments and the right to vote on all future voting events. The synthetic stock gives the owner a claim to all future cash flows (except for dividends during the life of the synthetic stock), but does not give the owner

[6] VOTE is an exogenous variable as we assume that the private benefits of control are a given characteristic of the firm.
[7] Kalay and Pant (2011) show theoretically that at the time of a control contest, the difference between the stock and the synthetic stock quantifies the private benefits of control.

the right to vote during the life of the synthetic stock. The difference between the price of the stock and the synthetic stock (adjusted for dividends) quantifies the market value of the right to vote during the life of the synthetic stock. Following Kalay, Karakas and Pant (2013) we compute the normalized voting premium and call this VOTE.[8]

Zingales (1995) states that "...the price of a vote is determined by the *expected* additional payment vote holders will receive for their votes *in case* of a control contest." Therefore the magnitude of VOTE depends on the probability that a voting event would occur and the economic significance of the voting event.

Both the probability (p) and the economic significance (v) are functions of the underlying private benefits of control of the firm. The economic significance would be an increasing function of the magnitude of the private benefits of control that can be extracted. The probability of the voting event would also depend on the private benefits of control. On one hand, firms where private benefits of control are high and managers are entrenched would typically also have higher takeover defense mechanisms. This would result in a lower value for p. On the other hand, firms with higher private benefits of control will attract more acquirers since these are the firms that are likely being run inefficiently and are hence attractive targets for takeover. This would imply that firms with high private benefits of control will have high values of p. Theoretically, it is not clear which of the two effects dominates. To control for the possibility that the probability of a voting event can vary across our sample, we repeat our experiment with the probability normalized value of VOTE. Since VOTE is a product of the probability of a control contest (p) and the private benefits of control, VOTE/p proxies for the private benefits of control while controlling for p. We compute the probability of a firm being subjected to a takeover attempt from the model in Cremers, Nair and John (2009).

III. Data Sample and Hypotheses

[8] Kalay, Karakas and Pant (2013) find that the VOTE increases around special meetings and the increase is higher for contentious meetings. They also document a sharp increase in the VOTE at the announcement of M&A events, and a decline in the VOTE at the completion of the M&A event. Finally, an increase in value of the VOTE around hedge fund activism is observed.

A. Measure for Private Benefits of Control

We follow Kalay, Karakas and Pant (2013) in calculating a proxy for the private benefits of control for firms in our sample. The measure is the difference between the price of the stock and the price of an equivalent synthetic stock. We label this measure as VOTE.

The synthetic stock is constructed with options. To construct synthetic stocks we use data on options from the IvyDB OptionMetrics database. This gives us end of day data on options. OptionMetrics gives us bid and ask quotes, option volume, and open interest for calls and puts traded on the stocks. We have data for options with 90 days or less to expiration. We form option pairs that are used to construct the synthetic stock. An option pair consists of a call option on the underlying stock matched with a put option with the same strike price X and time to maturity T. We discard option pairs where the quotes for either the call or the put option are locked or crossed. We keep only those option pairs for which the volume for the call is greater than 0 and the implied volatility (calculated using the Binomial option pricing model) for the call and put is defined. Next, we match the data with CRSP to get information on distributions and the corresponding ex-dates. Since the options are all American style we compute the early exercise premium for the put and the call using the binomial option pricing model.[9] This information enables us to construct the synthetic stock using the following equation:

$$\hat{S}(T) = C - EEP_{call} - P + EEP_{put} + PV(X) + PV(div) \qquad (1)$$

Here C and P are the mid-points of the closing bid and ask quotes for the call and put options respectively. The difference between the closing price of the stock and the synthetic stock normalized by the price of the stock is calculated as the normalized value of the right to vote in the next T days, and is labeled as VOTE

$$\text{VOTE} = (S - \hat{S}(T)) / S \qquad (2)$$

[9] See Appendix A for details.

We calculate VOTE for each day of the year (where data is available) for all firms in our sample. The daily values are averaged for the entire year (Jan 1 through Dec 31) to get the value of VOTE for that firm year observation.

Table 1 illustrates the descriptive statistics of the vote variable. Firms in our sample have a mean (median) value of 0.14% (0.17%) for the vote variable. Also note that the average time to maturity of the options used is around 43 days (Table 2). This implies that the voting premium of the average firm in our sample over the next 43 days is 0.14% of the market value of the firm. As is evident in Table 1, there exists substantial cross sectional variation in the vote variable for our sample of firms. Note that VOTE takes both positive and negative values.[10]

As discussed in Section II, to adjust for the probability of a control contest we construct a probability normalized value of VOTE. The probabilities are constructed using the model described in Cremers, Nair, and John (2009). The probability normalized measure is then:

$$\text{VOTE\_EXPROB} = \text{VOTE} / \text{PROB} \tag{3}$$

Table 1 also contains the descriptive statistics of VOTE_EXPROB.

Table 2 reports descriptive statistics on the options used to construct the synthetic stock. The options used are close to the money and have short time to maturity. This minimizes the bias in the estimation of VOTE as pointed out by Kalay, Karakas and Pant (2013). Short maturity options that are close to the money are desirable also because they are heavily traded and have high open interest. This helps to alleviate measurement errors associated with liquidity and asynchronous trading concerns.

B. Insurance Data

[10] VOTE is likely a noisy estimate of the private benefits of control, hence the negative values.

Our data consists of coverage limits of property insurance contracts obtained from SwissRe (and used in Aunon-Nerin and Ehling, 2008). The limit of coverage defines the highest possible payment the insured may receive from the insurer or the syndicates after the incidence of a casualty loss. Limit of coverage are typically smaller than the market value of the asset insured as major casualty loss does not destroy its entire value.[11] The data used contains direct insurance transactions between SwissRe and a sample of US listed firms over the period January 1996 through September 2002.

Typically, property insurance coverage limits are defined per insurance event and include annual aggregates. The insurer may choose to eliminate the annual aggregate at its discretion. In such cases the market value of the property insured is the upper bound of the coverage.

We match the data used in Aunon-Nerin and Ehling (2008) with our VOTE data and analyze the 114 firm-year observations from 48 U.S. firms with complete set of variables from Compustat. To be included in the study, an insurance contract for a particular firm-year must specify a complete description of the company's property insurance strategy.[12]

Table 3 contains descriptive statistics of our sample firms' insurance data. Companies obtain tailored property insurance contracts, hence, it is important to scale the insurance variables by property, plant and equipment plus inventory (PP&E+I).[13] The normalized coverage, LIMIT, quantifies the maximum insurance as a fraction of the assets insured. Note that the normalized coverage can exceed one. We normalize the coverage limits by book values that are possibly lower than the market value of the asset insured. Furthermore, the book value of assets and in particular tangible assets is reported in the balance sheets net of amortization. Finally, the normalized coverage can exceed one since the property coverage limit may include business interruption insurance.[14]

[11] For liabilities occurring during a casualty, corporations need a separate liability insurance contract.
[12] A detailed account of the selection method is provided in Appendix A of Aunon-Nerin and Ehling (2008).
[13] Operating leases and capital leases that are immaterial will not be included in PP&E but a firm must insure if it is a triple net lease. Our data does not allow controlling for this potential bias other than that industry dummy variables may pick up industry level property insurance stipulated by leases.
[14] Liabilities are not included in our property insurance contracts.

Table 3 also reports normalized property deductible and normalized premium. The mean (median) of the ratio of the insurance deductible to PP&E+I is 0.01 (0.00). We observe a wide variation across firms as evidenced by the difference between the minimum (0.00) and maximum (0.08) ratio. Further, the ratio of limit of coverage to PP&E+I has a mean (median) of 0.20 (0.06). The mean (median) ratio of the premium paid for property insurance to PP&E+I is 0.00 (0.01). The distributions of all normalized insurance variables are skewed, that is medians are always smaller than the means.

C. Financial Data and Hypotheses

Our accounting and financial data are from COMPUSTAT and the Compact Discloser disc of the Securities and Exchange Commission (SEC) filings.[15] We use standard variables as proxies for the various known corporate incentives to buy insurance. The predicted signs are found at Appendix B.[16]

Below we focus discussion and our empirical analysis on only one proxy for each corporate incentive to buy insurance. Our choices, for instance long-term debt ratio over interest coverage ratio, are motivated by the empirical evidence in Aunon-Nerin and Ehling (2008). Further, we exclude variables such as analysts' earnings forecasts or institutional ownership that proxy for informational asymmetries from our analysis. This incentive to hedge likely relates to cash flow risk only and is therefore less relevant as an incentive for corporate purchase of insurance. Indeed, Aunon-Nerin and Ehling (2008) find that analysts' earnings forecasts or institutional ownership show no relation with LIMIT.

[15] We thank John Graham for supplying corporate marginal tax rates.

[16] We deviate from the analysis in Aunon-Nerin and Ehling (2008) and discard the insurance deductible in this study. We have to do it since matching the coverage limits with the vote variable reduces the sample size to the point where we cannot estimate a simultaneous system of three equations. In addition, Aunon-Nerin and Ehling (2008) demonstrated that the choice of the deductible is affected by exogenous forces such as industry captives as well as unobservable behavior like self-insurance. To address these issues one would need a much larger sample than we have.

To test the effect of our measure of private benefits of control on the decision to purchase insurance, we solve a set of simultaneous equations using the linear generalized method of moments (GMM). The simultaneous equations analysis controls for simultaneity between the choice of limit of coverage and capital structure.[17]

C.1. Incentives for the Purchase of Corporate Insurance

Bondholders and corporate purchase of insurance: As Mayers and Smith (1982) propose firms with high expected bankruptcy costs are expected to purchase more insurance coverage than firms with low expected bankruptcy costs.[18] The net benefit associated with the purchase of property insurance is reflected in bond covenants that stipulate the necessity to buy such insurance.[19] We use the long-term debt ratio (LTD) to take into account the influence of expected default costs on the propensity of firms to buy property insurance. Fixed costs and potential scale economies in bankruptcy imply that expected bankruptcy costs fall with firm's size (Warner, 1977). We use LTD times the logarithm of firm size (LOGSIZE) to control for this possibility.

A related incentive to purchase corporate insurance (Mayers and Smith, 1987) or to engage in corporate hedging (Shapiro and Titman, 1986; Lessard, 1990; Stulz, 1990; Froot, Scharfstein and Stein, 1993) is the attempt to reduce the Myers (1977) underinvestment problem. Firms with a different split of assets in place and growth opportunities will chose different levels of property insurance. We employ the firm's book-to-market ratio (BM) as a proxy for the firm's relative importance of the growth opportunities. We also include an interactive term between the inverse of BM, that is market-to-book (MB), and LTD as a control variable.

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[17] Our method reduces simultaneous-equation biases yet it might not eliminate them entirely. For instance, lagged data do only imperfectly tackle the time-series dependency in our explanatory variables. Another potential problem, that our methods cannot tackle, is that the insurance strategies could depend on forecasted firm characteristics.

[18] In related work, Smith and Stulz (1985) and Shapiro and Titman (1986) argue that expected bankruptcy costs provide a rational for bondholders to demand hedging.

[19] Other agreements such as supplier, employment, and customer contracts also stipulate levels of insurance coverage (Smith, 1995).

The effects of liquidity on corporate purchase of insurance: The level of corporate liquidity can influence the choice of property insurance. Firms with more liquid assets relative to their current liabilities would find it easier to resolve short term problems associated with unexpected damage to their property and equipment. They can use their liquid asset to finance the purchase of replacements. In addition, other things constant, having liquid assets reduces the likelihood of financial distress. On the other hand, mangers of firms with more liquidity would find it easier to finance the purchase of property insurance. We measure the influence of liquidity through the quick ratio – the ratio of cash and short-term assets to current liabilities (QUICK).

We conjecture that the payout ratio (PAYOUT) could play a role in the decision to purchase insurance, though its predicted sign is unclear. On the one hand, Allen and Michaely (2003) summarize the evidence on dividend policy by stating that dividends are typically paid by large, profitable firms and firms with less information asymmetry; they also note that firms with high dividend yields tend to be less risky. This evidence indicates that dividend paying firms are less likely to be in financial distress thus their managers have a lower propensity to purchase insurance. On the other hand firms with severe agency problems may use dividend payments to mitigate it (Jensen, 1986). Managers of these firms with high agency costs are also more likely to purchase insurance. Thus, we could find firms with larger dividend yield buying more corporate insurance. Previous literature entertains the view that dividend payers would buy more insurance (see Nance, Smith and Smithson (1993), Geczy, Minton and Schrand (1997), and Graham and Rogers (2002)).

Taxes and corporate purchase of insurance: As Smith and Stulz (1985) argue, convex tax structure results in higher expected tax the more volatile is the taxable income. Hence firms can reduce their expected tax payments by reducing the volatility of their taxable income. The purchase of insurance or/and the engagement in hedging activity are possible financial mechanisms to reduce the cash flows' volatility. The empirical evidence on this conjecture is mixed. Main (1983) reports large estimates of the tax benefits for equityholders stemming from insurance purchases. Yet, Chen and Ponarul

(1989) show, to the contrary, that the tax related benefits associated with insurance purchases are rather small. Graham and Rogers (2002) conclude that firms do not hedge in response to the convexity of the tax code. We do not expect taxes to be important in our case given the mixed empirical results and since insurance seems less important than a derivative position as a means of altering the volatility of taxable income. Yet, we do include a proxy for the potential effects of taxes in some versions of our regressions. To measure tax incentives, we construct a variable that measures the potential tax savings (TAXSAVE) from a 5% reduction in the volatility of taxable income (following [Eq. 1] in Graham and Smith, 1999).[20]

Managers' invested wealth and corporate purchase of insurance: Managerial risk aversion might influence the demand for corporate insurance (Smith and Stulz, 1985; Stulz, 1984; Stulz, 1990). Yet, managers invested wealth in the firm they manage has ambiguous effects. On the one hand, stock ownership and stock options should align the interests of managers with outside owners (Campbell and Kracaw, 1987; Campbell and Kracaw, 1990; Han, 1996; Smith and Stulz, 1985; Stulz, 1984) resulting in closer to optimal purchase of property insurance. On the other hand, the higher is a manager's stock or option based ownership, the less likely it is that she can maintain a well-diversified portfolio. Since the managerial option holding data has many missing observations we must focus attention on managerial wealth invested in shares as a percentage of outstanding shares (INSIDERS).[21]

Private benefits of control and corporate purchase of insurance: Risk-averse managers are likely to choose a lower level of investment risk than is optimal for the firm's claimholders (Amihud and Lev, 1981). The more control they have over the firm's decision, the more likely they are to deviate from the level of risk that firm's claimholders would implement otherwise. One way managers can achieve a direct reduction, in left-tail

[20] The 5% assumption builds upon the findings in Guay (1999). See also Graham and Rogers (2002) and Dionne and Garand (2003) who also rely on Graham and Smith (1999).
[21] It should be pointed out that INSIDERS is an incomplete proxy for managers' invested wealth. Data limitations exclude managerial option holdings and we do not observe managerial firm-specific human capital. In addition we cannot distinguish managerial holdings between restricted (with limits on transferability) and unrestricted (held voluntarily) shares.

risk, and/or an indirect reduction, in volatility of the firm's cash flows, is by buying more property insurance. Importantly, if risk-averse managers with substantial firm-specific human capital would require a compensating differential in wages that exceeds the insurance premium to bear the extra risk, then insurance can be optimal. As detailed above we estimate managers' and/or large controlling shareholders' private benefits of control by the market value of the vote (VOTE). ***The main hypothesis of this paper is that larger private benefits of control will result in the purchase of more insurance*.**

Industry effects: Our method controls for industry effects by including industry dummy variables in the regression with LTD as a dependent variable. We group the data into five industries: automotive (Auto), food and pharmaceuticals (FoodPharm), mining and energy (MinEn), oil and chemicals (OilChem), and telecommunications (Tel). This is the industry classification of SwissRe. This classification is similar to one-digit SIC codes. For example, firms classified as OilChem in our sample have either 1 or 2 as a SIC code. A more detailed industry classification would be desirable but our small sample size prevents it.

Size effects: We also control for size. In general, one would expect that insurance plays a more prominent role for small firms than for large firms. For example, large firms tend to be better diversified and therefore might need less insurance. In addition, small firms are more likely to demand others services that insurer can provide and is absent from hedging activity. We measure size effects by LOGSIZE, which is the sum of the logarithm of equity, the book value of long-term debt and of the book value of preferred stock.

C.2. Financial Data

Table 4 summarizes the descriptive statistics (mean, standard deviation, minimum, median, and maximum) of the corporate variables that motivate the purchase of insurance for the 48 publicly traded firms in our sample. Again, the distribution of many variables is skewed, i.e., the median is smaller than the mean.

Financial stock data in Table 4 such as the book value of debt are from the fiscal year before the insurance contract is initiated. Flow data such as earnings are from the same fiscal year as the insurance contract. This matching procedure is used in Geczy, Minton and Schrand (1997) and Aunon-Nerin and Ehling (2008) and several other works in the literature. VOTE is also treated as flow data, i.e., we assume that managers and/or large controlling shareholders understand how their actions may affect VOTE.

IV. Results

To test the effect of our measure of private benefits of control on the decision to purchase insurance, we solve a set of simultaneous equations using the linear generalized method of moments (GMM). The p-values are heteroskedasticity and autocorrelation consistent.

Table 5 presents three simultaneous equation regressions. The models differ in that we exclude INSIDERS from Model 2 and Model 3 since its predicted sign is ambiguous, it is insignificant, and its inclusion decreases the sample size by sixteen observations (14%). Model 3 includes LTD × LOGSIZE to control for the notion that expected bankruptcy costs is conjectured to fall with size (Warner, 1977). Our three regression models closely follow the regressions in Aunon-Nerin and Ehling (2008).

Importantly, we find that our measure of private benefits of control, VOTE, shows an economically significant positive relation with the coverage limit of corporate insurance contracts in all three regression models. The p-values are 0.09, 0.09 and 0.11, respectively. This result is consistent with the view that firms that are subject to high agency costs i.e. have high private benefits of control, exhibit a propensity to purchase higher coverage limits.

The proxies for corporate hedging motives in the LTD regression of all three models show coefficient estimates with signs as well as the levels of significance that are comparable to the findings of Aunon-Nerin and Ehling (2008).[22] INSIDERS, in Model 1, shows the same sign as in Aunon-Nerin and Ehling (2008) but is insignificant. We suspect that this is due to the lower number of observations in our regressions and thus exclude INSIDERS from the Models 2 and 3. Excluding INSIDERS not only increases sample size but also leads to a significant coefficient estimate for LTD in Models 2 and 3. The coefficient of LIMIT in the regression with LTD as a dependent variable is positive and significant and the coefficient of LTD in the regression with LIMIT as a dependent variable is positive and significant. This evidence is consistent with the hypothesis that one reason for corporate purchase of property insurance is to increase its debt capacity.

We find that firms with larger private benefits (VOTE) tend to use more debt. This empirical evidence is consistent with the Jensen (1986) free cash flow hypothesis as well as with the use of debt as an antitakeover defense mechanism.

The empirical evidence presented demonstrate that PAYOUT is not associated with the corporate decision to buy insurance (it's coefficient estimate in all the regressions is insignificant).[23] It seems that once a measure of private benefits of control is added, the incremental effect of the dividend payout disappears. In the previous literature, PAYOUT could have been an instrumental variable to VOTE. Indeed, we find a positive correlation of 0.35 between PAYOUT and VOTE, which is insignificant but is likely to be significant in large samples.

We repeated our experiment, eliminating TAXSAVE as a control variable. As mentioned above, TAXSAVE is unlikely to be important given the mixed empirical evidence that exists in the literature and the marginal impact property insurance has on the volatility of the firm's cash flows. With a sample as small as ours including explanatory variables with at best marginal impact is very costly. Indeed, as reported in Table 6, when

[22] The same observation can be made about the two Limit regressions with the exception of INSIDERS, LTD and PAYOUT.
[23] This result is different from the findings of Aunon-Nerin and Ehling (2008) and could be due to the reduced sample size relative to their sample.

TAXSAVE is excluded the p-values of VOTE in a regression where LIMIT is the dependent variable are down to 0.02, 0.04 and 0.06 for models 1, 2 and 3, respectively.

To control for the differences in the probability of a control contest, we repeat our experiment with the probability normalized value of VOTE. Results are presented in Table 7. We find that our results continue to hold. The p-values of VOTE_EXPROB in a regression where LIMIT is the dependent variable are 0.01, 0.08 and 0.09 for models 1, 2 and 3, respectively.

Further, we find that our qualitative results are unaffected when we measure VOTE from January to March instead of January to December. Our qualitative results are also unaffected when we exclude PAYOUT. Finally, in addition to documenting the effects of private benefits of control on the propensity to buy insurance, we essentially replicate the main results in Aunon-Nerin and Ehling (2008) with a smaller set of data. Overall, it is difficult to perform additional robustness checks with a sample as small as ours.

V. Conclusions

This paper documents that managers having larger private benefits of control tend to purchase more insurance to reduce their exposure to the probability of left-tail outcomes and hence the volatility of the firm's cash flows. Private benefits of control are estimated by the market value of the right to vote (measured as the difference between the price of the stock and the price of the synthetic stock that is constructed with put and call options written on the stock).

Our empirical analysis controls for simultaneity between the choice of limit of coverage and capital structure. We find that our measure of the private benefits of control is a significant and positive explanatory variable of the coverage limit of corporate insurance contracts. This result is consistent with an agency cost based rational for the purchase of corporate insurance. Firms with high agency costs, i.e. firms that have high private benefits of control, exhibit a propensity to purchase higher coverage limits.

Since our measure of private benefits of control depends on both the probability of a control contest and the benefits that can be extracted, we repeat our experiment while controlling for the probability of the control contest and find that our results hold. We also corroborate previous findings that firms with higher long term debt ratio and smaller market value tend to buy more property insurance. Finally, we find that firms with larger private benefits of control tend to have more debt in their capital structure.

Appendix

A. Early Exercise Premium

The early exercise premium for put options and call options with dividends is calculated using the Binomial option pricing model. We use the Cox, Ross and Rubinstein (1979) method to generate the lattice. This implies that the up and down factors for the lattice are generated using the following equations:

$$u = e^{\sigma\sqrt{\Delta t}} \qquad (3)$$

$$d = e^{-\sigma\sqrt{\Delta t}} \qquad (4)$$

The inputs to the algorithm are the volatility, time to expiration, strike price, price of the underlying stock, risk free rate, array of dividends and ex-dates if applicable. We get the implied volatility, time to expiration, strike price and price of the underlying from the OptionMetrics database. OptionMetrics also provides risk free rate data for certain maturities. We interpolate the risk free rate data to get the risk free rate for the exact maturity of the option being considered. Data on dividends and ex-dates is obtained from CRSP.

We calculate the early exercise premium for the put options and the call options using 1000 steps. Over the course of each step the security price is assumed to move either "up" or "down". The size of this move is a function of the up and down factors that are in turn determined by the implied volatility and the size of the step. In order to determine the early exercise premium we start at the current security price S_0 and build a "tree" of all the possible security prices at the end of each sub-period, under the assumption that the security price can move only either up or down. Next, the option is priced at each node at expiration by setting the option expiration value equal to the exercise value: $C = max(S^i$ -

X; 0) and $P = max(X - S^i; 0)$, where X is the strike price, and S^i is the projected price at expiration at node *i*. The option price at the beginning of each sub-period is determined by the option prices at the end of the sub-period. At each node we determine whether early exercise is optimal or not. Working backwards we estimate the price of the American option. In a similar fashion we determine the price of the equivalent European option (the only difference being that early exercise is not an option until the very end of the tree). The difference between the price of the American option and the European option gives us the early exercise premium.

B. Data Description

The Insurance Data

Our data are property insurance contracts from SwissRe over the period January 1996 through September 2002. For a complete description of the data see Aunon-Nerin and Ehling (2008).

We match the insurance data from Aunon-Nerin and Ehling (2008) and select firm-year observations included on the COMPUSTAT database. We then eliminate all financial firms (SIC codes between 6000 and 6999). Finally, we match the resulting data set with our VOTE data.

Firm and Ownership Data

Book-to-market ratio (BM): Total assets minus total liabilities minus outstanding preferred stock (COMPUSTAT items 6, 181, and 130, respectively) divided by the market value of equity (COMPUSTAT item 199 times COMPUSTAT item 25). MB is the inverse of BM.

Dividend payout ratio (PAYOUT): Dividends per share (COMPUSTAT item 26) divided by earnings per share (COMPUSTAT item 13 divided by COMPUSTAT item 25).

Long-term debt ratio (LTD): Book value of long-term debt (COMPUSTAT items 9 and 34) divided by SIZE.

Managerial ownership (INSIDERS): Managerial ownership in percentage (SEC disclosure disc).

PPE investment expenditures/SIZE (PPE): Expenditures for property, plant, and equipment (COMPUSTAT item 30) divided by SIZE.

Quick-ratio (QUICK): Ratio of cash and short-term investments (COMPUSTAT item 1) to current liabilities (COMPUSTAT items 34, 70, 71 and 72).

SIZE: Market value of equity (COMPUSTAT item 199 times COMPUSTAT item 25) plus book value of long-term debt (COMPUSTAT items 9 and 34) plus book value of preferred stock (COMPUSTAT item 130). LOGSIZE is the logarithm of SIZE.

TAXSAVE: The tax save variable is constructed using Eq. (1) from Graham and Smith (1999, Eq.1).

Sign Predictions

The predictions for the limit of coverage as a function of the explanatory variables are as follows:

BM: negative influence on insurance coverage.

INSIDERS: no prediction.

LOGSIZE: negative influence on insurance coverage.

LTD: positive influence on insurance coverage.

LTD × LOGSIZE: negative influence on insurance coverage.

MB × LTD: negative influence on insurance coverage.

PAYOUT: no prediction.

PPE: positive influence on insurance coverage.

QUICK: no prediction.

TAXSAVE: marginally positive influence on insurance coverage.

VOTE or VOTE_EXPROB: positive influence on insurance coverage.

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Table 1: Descriptive Statistics of the Vote Variable

This Table reports the descriptive statistics of the vote variable for 48 publicly traded U.S. firms. PROB is constructed from Cremers, Nair, John (2009). VOTE_EXPROB is the ratio of VOTE and PROB. The sample consists of 114 firm-year observations ranging from January 1996 through September 2002.

Variable	N	Mean	Std. Dev.	Minimum	Median	Maximum
VOTE	114	0.14	0.21	-0.99	0.17	0.73
VOTE_EXPROB	114	1.78	2.60	-9.62	2.18	9.11
PROB	114	0.08	0.03	0.03	0.08	0.28

Table 2: Descriptive Statistics of the Options Used to Construct the Synthetic Stock

This Table reports the descriptive statistics of the Put and Call options that are used to construct the synthetic stocks. For each firm year observation synthetic stocks are constructed for every day of the year (where available). The average of the daily variables for each firm year is first computed. The means of each firm year observation are then used to compute the descriptive statistics. Moneyness is defined as ln(S/X), where S is the spot price of the stock and X is the strike price of the option. Call Volume is the volume of the Call option. Call Open Interest is the open interest of the Call option. Put Volume is the volume of the Put option as reported in OptionMetrics. Put Open Interest is the open interest of the Put option.

Variable	N	Mean	Std. Dev.	Minimum	Median	Maximum
Time to Maturity	114	43.46	5.24	16.00	43.05	69.89
Moneyness	114	-0.01	0.03	-0.15	-0.01	0.05
Call Volume	114	109.82	168.70	9.43	52.40	1091.98
Call Open Interest	114	1025.22	1519.68	0.00	513.45	8738.31
Put Volume	114	45.33	86.94	0.00	11.60	499.37
Put Open Interest	114	623.42	1001.43	0.82	198.99	5758.32

Table 3: Insurance Data

The table summarizes descriptive statistics of the insurance variable characteristics for 48 publicly traded U.S. firms. The sample consists of 114 firm-year observations ranging from January 1996 through September 2002. The deductible is the uninsured lower part of the loss distribution. The limit of coverage is the highest payment a firm can receive. Total premium is the estimated premium a company pays for an insurance policy, estimated by linear extrapolation from the premiums paid to SwissRe. The insurance variables are scaled by property, plant and equipment plus inventory. The insurance data are from SwissRe, while firm data are from COMPUSTAT.

Variable	N	Mean	Std. Dev.	Minimum	Median	Maximum
Deductibles/ PP&E+I	114	0.01	0.02	0.00	0.00	0.08
Limit of coverage/PP&E+I	114	0.20	0.42	0.00	0.06	3.36
Total premium/ PP&E+I	114	0.00	0.00	0.00	0.00	0.01

Table 4: Summary of Explanatory Variables

This table summarizes descriptive statistics of financial characteristics for 48 publicly traded US firms. The sample consists of 114 firm-year observations ranging from January 1996 through September 2002. The variables are proxies related to incentives for corporate insurance use. BM is the book-to-market ratio. INSIDERS is the managerial ownership in percentage points. LOGSIZE is the logarithm of firm size (SIZE). MB times LTD is the market-to-book ratio times the long-term debt ratio. PAYOUT is the dividend payout ratio. PP&E is property, plant, and equipment by total assets. QUICK is the quick ratio. SG&A is selling, general, and administrative expenses scaled by net sales revenue. TAXSAVE is constructed from Graham and Smith (1999, Eq.1). Flow financial data are measured as of fiscal year-ends after the starting date of the insurance contract, while stock data are measured as of fiscal year-ends before the starting date of the insurance contract. The data are from COMPUSTAT, the SEC disclosure disc, and our own calculations. Corporate marginal tax rates (MTR) are from John Graham. See the Appendix B for all variable definitions.

Variable	N	Mean	Std. Dev.	Minimum	Median	Maximum
BM	114	0.53	0.52	-0.03	0.36	2.83
INSIDERS	98	4.75	11.15	0.00	0.71	78.89
LOGSIZE	114	3.77	0.69	2.31	3.67	5.44
LTD	114	0.44	0.38	0.00	0.33	1.99
PAYOUT	114	0.10	0.09	0.00	0.09	0.32
PP&E	114	0.12	0.12	0.01	0.09	0.94
QUICK	114	0.24	0.38	0.00	0.12	2.44
SG&A	114	0.12	0.10	-0.05	0.09	0.44
TAXSAVE	114	4.01	3.25	-1.33	3.58	12.89

Table 5: Simultaneous Analysis of Debt Ratio, Insurance, and Private Benefits of Control I

This table reports linear GMM coefficient estimates from a simultaneous equations model for insurance (LIMIT) and debt (LTD) decision. The p-values are heteroskedasticity and autocorrelation consistent. The insurance data consist of 48 publicly traded U.S. firms with 114 firm-year observations ranging from January 1996 through September 2002. LIMIT is the ratio of the limit of coverage to property, plant and equipment plus inventory. Limit of coverage represents the highest possible payment a firm can receive. LTD is the (contemporaneous) long-term debt ratio. BM is the book-to-market ratio. INSIDERS is the managerial ownership in percentage points. LOGSIZE is the logarithm of firm size (SIZE). MB is the market-to-book ratio. PAYOUT is the dividend payout ratio. PP&E is property, plant, and equipment by total assets. QUICK is the quick ratio. SG&A is selling, general, and administrative expenses scaled by net sales revenue. TAXSAVE is constructed from Graham and Smith (1999, Eq.1). VOTE is the average of the daily difference between the stock and the synthetic stock for the entire year – Jan 1 through Dec 31. Flow financial data are measured as of fiscal year-ends after the starting date of the insurance contract while stock data are measured as of fiscal year-ends before the starting date of the insurance contract. Industries are the automotive industry (Auto), food and pharmaceuticals (FoodPharm), mining and energy (MinEn), oil and chemicals (OilChem), and telecommunications (Tel). The insurance data are from SwissRe, the VOTE data is from OptionMetrics, and the financial data are from COMPUSTAT, the SEC disclosure disc, and our own calculations. See the Appendix for all variable definitions.

	Model 1				Model 2				Model 3			
	LTD		LIMIT		LTD		LIMIT		LTD		LIMIT	
Variable	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Constant	0.0135	0.91	1.7975	0.00	0.0114	0.89	1.4995	0.00	-0.0342	0.64	1.1530	0.00
BM			-0.3460	0.00			-0.3060	0.00			-0.3798	0.00
INSIDERS			0.0003	0.86								
LOGSIZE			-0.3924	0.00			-0.3310	0.00			-0.2096	0.00
LTD			0.1070	0.27			0.1951	0.02			1.7368	0.00
LTD × LOGSIZE											-0.4955	0.00
MB × LTD			0.0033	0.06			0.0036	0.02			0.0038	0.01
PAYOUT			0.0066	0.98			0.0191	0.95			-0.1547	0.54
PP&E	1.8822	0.00			1.6220	0.00			1.7360	0.00		
QUICK			0.2378	0.01			0.2333	0.01			0.1366	0.03
SGA	-0.6812	0.02			-0.7248	0.00			-0.9145	0.00		

TAXSAVE	0.0147	0.06	-0.0196	0.05	0.0127	0.10	-0.0176	0.04	0.0160	0.03	-0.0102	0.12
VOTE	0.3115	0.01	0.2164	0.09	0.2360	0.05	0.1852	0.09	0.2250	0.05	0.1523	0.11
LIMIT	0.4560	0.00			0.5156	0.00			0.4475	0.00		
Dummy Variables:												
Auto	0.3415	0.01			0.1789	0.10			0.2219	0.04		
FoodPharm	0.1474	0.06			0.1818	0.02			0.2557	0.00		
MinEn												
OilChem	0.1506	0.14			0.1444	0.10			0.2216	0.01		
Tel	0.0286	0.71			0.0687	0.39			0.1359	0.06		
Sample Size		98				114				114		

Table 6: Simultaneous Analysis of Debt Ratio, Insurance, and Private Benefits of Control II

This table reports linear GMM coefficient estimates from a simultaneous equations model for insurance (LIMIT) and debt (LTD) decision. The p-values are heteroskedasticity and autocorrelation consistent. The insurance data consist of 48 publicly traded U.S. firms with 114 firm-year observations ranging from January 1996 through September 2002. LIMIT is the ratio of the limit of coverage to property, plant and equipment plus inventory. Limit of coverage represents the highest possible payment a firm can receive. LTD is the (contemporaneous) long-term debt ratio. BM is the book-to-market ratio. INSIDERS is the managerial ownership in percentage points. LOGSIZE is the logarithm of firm size (SIZE). MB is the market-to-book ratio. PAYOUT is the dividend payout ratio. PP&E is property, plant, and equipment by total assets. QUICK is the quick ratio. SG&A is selling, general, and administrative expenses scaled by net sales revenue. VOTE is the average of the daily difference between the stock and the synthetic stock for the entire year – Jan 1 through Dec 31. Flow financial data are measured as of fiscal year-ends after the starting date of the insurance contract while stock data are measured as of fiscal year-ends before the starting date of the insurance contract. Industries are the automotive industry (Auto), food and pharmaceuticals (FoodPharm), mining and energy (MinEn), oil and chemicals (OilChem), and telecommunications (Tel). The insurance data are from SwissRe, the VOTE data is from OptionMetrics, and the financial data are from COMPUSTAT, the SEC disclosure disc, and our own calculations. See the Appendix for all variable definitions.

	Model 1				Model 2				Model 3			
	LTD		LIMIT		LTD		LIMIT		LTD		LIMIT	
Variable	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Constant	0.0552	0.64	1.6685	0.00	0.0469	0.55	1.4208	0.00	0.0105	0.88	1.0132	0.00
BM			-0.3991	0.00			-0.3780	0.00			-0.4110	0.00
INSIDERS			-0.0003	0.88								
LOGSIZE			-0.3688	0.00			-0.3255	0.00			-0.1764	0.00
LTD			0.1064	0.27			0.2414	0.01			1.9941	0.00
LTD × LOGSIZE											-0.5781	0.00
MB × LTD			0.0036	0.07			0.0037	0.03			0.0036	0.02
PAYOUT			-0.1974	0.51			-0.0595	0.83			-0.2095	0.41
PP&E	2.1736	0.00			1.8785	0.00			1.9805	0.00		
QUICK			0.2250	0.01			0.2537	0.00			0.1255	0.04
SGA	-0.6786	0.02			-0.7630	0.00			-0.9734	0.00		
VOTE	0.2732	0.02	0.2979	0.02	0.2085	0.07	0.2191	0.04	0.1921	0.08	0.1737	0.06

LIMIT	0.4646	0.00	0.5235	0.00	0.4524	0.00
Dummy Variables:						
Auto	0.2522	0.06	0.1062	0.33	0.1139	0.30
FoodPharm	0.1382	0.09	0.1846	0.02	0.2649	0.00
MinEn						
OilChem	0.1691	0.11	0.1697	0.05	0.2678	0.00
Tel	-0.0144	0.85	0.0364	0.65	0.1087	0.13
Sample Size	98		114		114	

Table 7: Simultaneous Analysis of Debt Ratio, Insurance, and Private Benefits of Control III

This table reports linear GMM coefficient estimates from a simultaneous equations model for insurance (LIMIT) and debt (LTD) decision. The p-values are heteroskedasticity and autocorrelation consistent. The insurance data consist of 48 publicly traded U.S. firms with 114 firm-year observations ranging from January 1996 through September 2002. LIMIT is the ratio of the limit of coverage to property, plant and equipment plus inventory. Limit of coverage represents the highest possible payment a firm can receive. LTD is the (contemporaneous) long-term debt ratio. BM is the book-to-market ratio. INSIDERS is the managerial ownership in percentage points. LOGSIZE is the logarithm of firm size (SIZE). MB is the market-to-book ratio. PAYOUT is the dividend payout ratio. PP&E is property, plant, and equipment by total assets. QUICK is the quick ratio. SG&A is selling, general, and administrative expenses scaled by net sales revenue. VOTE_EXPROB is the ratio of VOTE and PROB. VOTE is the average of the daily difference between the stock and the synthetic stock for the entire year – Jan 1 through Dec 31. PROB is constructed from Cremers, Nair, John (2009). Flow financial data are measured as of fiscal year-ends after the starting date of the insurance contract while stock data are measured as of fiscal year-ends before the starting date of the insurance contract. Industries are the automotive industry (Auto), food and pharmaceuticals (FoodPharm), mining and energy (MinEn), oil and chemicals (OilChem), and telecommunications (Tel). The insurance data are from SwissRe, the VOTE data is from OptionMetrics, and the financial data are from COMPUSTAT, the SEC disclosure disc, and our own calculations. See the Appendix for all variable definitions.

	Model 1				Model 2				Model 3			
	LTD		LIMIT		LTD		LIMIT		LTD		LIMIT	
Variable	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Constant	0.0634	0.59	1.6426	0.00	0.0344	0.66	1.3686	0.00	0.0025	0.97	0.9921	0.00
BM			-0.3821	0.00			-0.3629	0.00			-0.4027	0.00
INSIDERS			0.0001	0.97								
LOGSIZE			-0.3647	0.00			-0.3134	0.00			-0.1722	0.00
LTD			0.0966	0.32			0.2412	0.01			1.9653	0.00
LTD × LOGSIZE											-0.5689	0.00
MB × LTD			0.0033	0.13			0.0035	0.07			0.0033	0.06
PAYOUT			-0.1775	0.55			-0.0269	0.92			-0.2045	0.41
PP&E	2.1325	0.00			1.8797	0.00			1.9696	0.00		
QUICK			0.2216	0.01			0.2461	0.00			0.1228	0.05
SGA	-0.7086	0.02			-0.7696	0.00			-0.9692	0.00		

VOTE_EXPROB	0.0231	0.01	0.0240	0.01	0.0177	0.04	0.0140	0.08	0.0170	0.04	0.0128	0.09
LIMIT			0.4739	0.00			0.5404	0.00			0.4595	0.00
Dummy Variables:												
Auto	0.1326	0.10			0.1936	0.01			0.2701	0.00		
FoodPharm	0.2408	0.08			0.1105	0.31			0.1168	0.29		
MinEn												
OilChem	0.1714	0.11			0.1858	0.03			0.2774	0.00		
Tel	-0.0134	0.86			0.0482	0.55			0.1137	0.11		
Sample Size		98				114				114		