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Author
Pezone, Vincenzo

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Essays in Corporate Finance

by

Vincenzo Pezone

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Professor David Sraer

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Abstract

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This dissertation consists of three chapters, each of them analyzing different important managerial choices: payout policies, financing decisions and acquisitions.

The first chapter argues that workers' unemployment risk may induce firms to adopt conservative payout policies. I show that firms increase their dividend payout following sharp increases in unemployment insurance generosity, a policy effective in reducing human costs due to layoffs. By focusing on policy changes plausibly unrelated to macroeconomic conditions, I show that firms increase payout by about 6% in presence of stronger protection for unemployed workers. Consistent with public insurance crowding out private insurance by firms, I find that this effect is driven by firms with worse growth prospects, high labor intensity, and in more volatile industries. Overall, this evidence suggests that labor market considerations play an important role in shaping firms' payout decisions.

The second chapter, co-authored with Ulrike Malmendier and Hui Zheng, focuses on financing choices made by potentially biased managers. Analyzing the traits and biases of individual managers, such as CEOs, in isolation can result in the misattribution of corporate outcomes, especially under assortative matching. We illustrate this insight for the role of CEO and CFO overconfidence in financing decisions. We show that the CFO's rather than the CEO's type dominates in determining the choice of external financing when we consider their beliefs jointly. At the same time, overconfident CEOs (and not CFOs) obtain significantly better financing conditions, as predicted by our theoretical model. Moreover, overconfident CEOs tend to hire overconfident CFOs whenever given the opportunity, generating a multiplier effect.

The third chapter analyzes the ex-post ouctomes of acquisitions presenting different degrees of synergies between acquirors and targets. Theoretical and empirical work suggests that mergers involving vertically integrated firms are more likely to produce gains in productivity. I show that the post-merger change in productivity is positively related to the degree of relatedness between acquirors and targets. On the other hand, firms acquiring unrelated targets display a drop in stock and cash flow volatility, suggesting that such acquisitions are motivated by managers willing to "enjoy the quiet life." Yet this information is not apparent to investors at announcement and only becomes available slowly. Notably, acquirors of unrelated targets significantly underperform acquirors of

related targets in the 18 months following a merger announcement. These results suggest that the announcement returns may be a poor proxy for the "diversification discount," and that investors may be unable to realize how different industries exhibit different degrees of connection.

To my parents and my brother

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Chapter 1

Unemployment Risk and Dividend Payout Policy

1.1 Introduction

Unemployment risk faced by workers is a crucial determinant of firms' financial policies, as shown both in theoretical (Titman (1984) and Berk, Stanton, and Zechner (2010)) and empirical (Agrawal and Matsa (2013)) research. A worker's human capital is fully invested in the firm she is employed with; on the other hand, shareholders can, in principle, diversify away all the idiosyncratic risk. Since unemployment risk originated by a firm's distress would be priced in higher wages, firms may find it optimal to reduce fluctuations in workers' wages and lower the risk of distress, as predicted by implicit contract models along the lines of Baily (1974) and Azariadis (1975). To accomplish this, managers will engage in more conservative financial policies, such as lower leverage (Agrawal and Matsa (2013)) or R&D expenditures (Ellul, Wang, and Zhang (2015)).

In this paper, I argue that dividend payout policies, as a result of the above logic, may also be shaped by labor market considerations. The intuition is straightforward. When determining the aggressiveness of their payout policies, managers face a trade-off. A higher dividend payout may have benefits such as mitigating agency problems, signaling good earnings prospects, or attracting particular types of investors, like tax-free institutions. Oppositely, aggressive payout policies may reduce a firm's operating flexibility, especially given that dividend policies may be hard to reverse even in periods of distress.

Workers are likely to be among the most affected stakeholders by payout policies. First, a lower cash buffer may render a firm more vulnerable to the entry of competitors in the same market (Fresard (2010)) or to the tightening of financial constraints (Opler et al. (1999), Bates, Kahle, and Stulz (2009)). Consistent with this idea, firms with volatile earnings are unlikely to pay dividends (Jagannathan, Stephens, and Weisbach (2000)) Second, because managers may be reluctant to cut dividends during downturns to avoid sending negative signals to investors (Allen and Gale (2002)), workers may be exposed to layoffs to free up resources. As a result, workers may negatively perceive cash transfers to shareholders as they may increase their human capital risk.[1]

Crucially, incentives to provide job security to workers are shaped by the generosity of the insurance provided by the public sector. Private insurance will be crowded out by public insurance, so long as the latter is effective in mitigating human costs of unemployment. If this is the case, firms may engage in more aggressive payout policies when the public unemployment insurance (UI) system is more generous. Indeed, an extensive literature documents that UI provided by the public sector does indeed have first order effects on unemployed workers' welfare, for example by reducing their consumption volatility (as shown in Gruber (1997)).

International evidence seems to support to this conjecture. Figure 1.2a shows a scatter plot of a country-level measure of the dividend payout ratio and the replacement rate, a measure of UI generosity adopted from Schindler and Aleksynska (2011), in a cross-section developed countries. Each dot is a country-year observation. The dividend payout ratio in each country is computed as the ratio of total dividend paid divided by total earnings in a given country-year.[2] A kernel regression of dividend payout on the replacement rate[3] shows a strong positive association between the two: in a country with a replacement rate of 0.7, such as the Netherlands, this aggregate payout ratio is 15 basis points higher relative to a country with a replacement rate of 0.2, such as the United Kingdom. Of course, a number of factors may be correlated with both payout policies and UI generosity, therefore this relationship cannot be interpreted in a causal sense.[4] Figure 1.2b shows that a similar picture emerges when looking at US states, which will be the focus of the analysis in this paper. However, the pattern in this example is somewhat more muted, given the lower heterogeneity in unemployment generosity across states.

In this paper, I analyze how dividend payout decisions are affected by large sharp increases in UI generosity across US states between 1991 and 2007. I identify 61 instances where a state legislator increased the maximum weekly benefit and document, in a difference-in-difference framework, that payout increases by about 4 percentage points following each event.

While this preliminary evidence is robust to a number of different empirical specifications, in most of the paper I focus on a restricted sample of events and firms. I proceed as follows. First, I identify the underlying cause and political context that was the basis of the policy shift. I obtain detailed information regarding 18 out of 61 reforms. I then identify 12 instances in which the precise timing of the reforms was neither likely to be related to changing economic conditions nor associated with the adoption of other significant policies. Such events are common, given that political factors unrelated to significant economic events often influence UI policies adopted by

[1]For example, consider the following quote of a union leader from the "Massachusetts Jobs with Justice": *Some CEOs get bonuses if their company pays stockholder dividends above certain levels. The easiest way to increase dividends is to pay out profits rather than reinvesting them in the company's employees. There is no incentive for corporate CEOs to expand hiring and create new jobs with decent wages; instead, CEOs have a strong incentive to cut positions and reduce wages and benefits.* (Tom Iacobucci, "On Labor Day", The Valley Advocate (09/01/2011))

[2]Data on dividends and earnings are from Compustat Global. In computing this dividend payout measure, I keep only countries with at least 50 listed companies and only firms with positive earnings.

[3]The local linear regression is estimated using a local-mean smoothing with a rule-of-thumb bandwith.

[4]Interestingly, regressing the replacement rate on some of the most obvious confounding factors, such as GDP per capita, measures of financial development such as market capitalization over GDP and unemployment rate and then regressing dividend payout on the residual from the first regression produces similar results.

states (Blaustein (1993)). Each firm headquartered in a treated state is matched with a control firm similar in terms of a number of covariates, where both firms operate in the same industry and census region. This matching procedure provides a stringent test, as it controls for a number potential unobserved confounding factors, such as demand shocks, which may vary at the regional or industry level. I find that treated firms increase their payout by roughly 6% relative to matched control firms, although this effect is relatively short-lived. Results are qualitatively similar when restricting the analysis to firms that, previous to the increase in UI generosity, were not paying dividends.

Several robustness checks help to rule out the possibility of omitted variables or alternative interpretations. First, the change in payout occurs only *after* a benefit increase is announced; no difference in trends can be detected before the policy change between treated and control firms. Second, treated and control firms are headquartered in states that share similar levels of growth in unemployment and income per capita. This suggests that macroeconomic shocks are unlikely to be a significant confounding factor. Third, I find similar results when I focus on different measures of payout, such as total payout (which includes repurchases), dividend per share, and dividend per asset.

The fact that I obtain similar results when I ignore the potential endogeneity related to the adoption of some of the policies and the possibility that treated and control firms are not well-matched is particularly reassuring for two reasons. First, it suggests that dramatically different results are unlikely when adopting different screening criteria for selecting the policy changes or using a different matching procedure. Second, the smaller magnitude of the effect of UI changes on payout obtained when using this less conservative approach underscores that some of these events, excluded from the main analysis, may be related to the anticipation of economic downturns. This would bias the coefficient downward, as firms may be less prone to increase dividends when anticipating periods of poor economic conditions.

The cross-sectional heterogeneity of these results supports this "implicit insurance" channel. I expect that firms employing extensively labor, as opposed to capital, in their production process will react more strongly to the provision of public insurance. Using two proxies for labor intensity (number of employees per dollar of assets or property, plant, and equipment), I find that the effect on payout is significant and large only in high labor intensity firms.

Moreover, firms operating in less risky industries should be less affected by UI policies, given that in such sectors there should be little reason for insulating workers from adverse demand shocks. Using proxies for earnings and employment volatility at the industry level, I document that the increase in payout is present only in firms in high volatility industries.

Workers in firms with poor growth prospects are also more likely to be exposed to layoff risk. Consistent with this hypothesis, I show that the increase in payout is concentrated among firms with low profitability, profitability growth, or Tobin's Q, which are three strong predictors of future employment growth.

Finally, I show that UI generosity affects firms' payout policies only for firms in industries with low wage or employment growth. Intuitively, workers' costs of unemployment will be higher if the probability of being quickly re-absorbed by the labor market are low. This should be true especially for workers employed in industries with declining employment. Similarly, workers in industries with low wage growth will be unlikely to find attractive jobs after a period of unemployment.

Evidence on additional outcomes provides additional support to this implicit contract hypothesis. Investment growth is not significantly related to changes in UI policies, suggesting that the results are not driven by a decrease in growth opportunities. However, I find some evidence of a decline in cash holding and an increase in leverage and net leverage, albeit only for firms with negative earnings[5], consistent with the findings of Agrawal and Matsa (2013). Moreover, in line with the theoretical predictions of Baily (1974), Azariadis (1975), and with corroborating international empirical evidence (Ellul, Pagano, and Schivardi (2014)), employment growth becomes more responsive to industry-level growth opportunities, as measured by the firms' industry median Tobin's Q.

Alternatively, plausible arguments which could in principle be consistent with such evidence find little support. Feldstein (1976) contends that UI policies act as an implicit subsidy to firms that experience large, seasonal shifts in demand. Possibly, this may induce managers to remunerate shareholders with higher dividends. Additionally, firms may find it optimal to reduce firm liquidity in order to counteract workers' bargaining power (Matsa (2010)). None of these alternative explanations find support in the data. The effect of UI policies on payout is largely independent of firms' sales seasonality or their state's degree of unionization.

This paper is related to recent work in Corporate Finance that argues that labor market considerations are important determinants of financial decisions (Serfling (Forthcoming) and Simintzi, Vig, and Volpin (2015)), particularly those that emphasize the effects of UI provisions on managers' choices (Agrawal and Matsa (2013), Ellul, Wang, and Zhang (2015), Ellul, Pagano, and Schivardi (2014), Dou, Khan, and Zou (2016)). Additionally, empirical work has documented that unions' power may influence payout decisions (He, Tian, and Yang (2016), DeAngelo and DeAngelo (1991), Chino (2016)). Even so, none of those papers have focused explicitly on the implicit contract channel I propose.

By documenting a relation between payout decisions and unemployment costs, I complement this empirical and theoretical work by analyzing another, important dimension through which the labor market impacts firms' actions. Moreover, while most of the literature on dividends payout focuses primarily on shareholders' and managers' objectives, I argue that other stakeholders' interests, such as those of workers, are important determinants of payout policies.

This paper is structured as follows. Section 1.2 surveys the related literature. Section 1.3 presents data and the empirical strategy. Section 1.4 presents the main empirical results and Section 1.5 analyzes the cross-sectional heterogeneity in the effect of UI on payout decisions. Finally, Section 1.6 concludes.

1.2 Literature Review

An extensive body of empirical work has documented that labor market considerations impact firms' financial decisions. Serfling (Forthcoming) and Simintzi, Vig, and Volpin (2015) document

[5]These firms are excluded in the majority of the analysis because their payout ratio is not well-defined.

that leverage is inversely related to labor rigidities due to higher firing costs both in the US and in a cross-section of countries. Matsa (2010) documents how firms use leverage strategically in order to improve their bargaining position vis-a-vis unionized workers, whereas Schmalz (2015) studies close unionization elections and finds that this relationship depends on a firm's degree of financial constraints.

Most studies at the intersection of labor and dividend payout policies focus on managers' conflict with unions. Associated work includes DeAngelo and DeAngelo (1991), who show that unionized firms sharply cut dividend payments in period of distress, and He, Tian, and Yang (2016), who illustrate how firms adopt conservative payout policies following unionization to preserve operating flexibility.

This paper is also related to empirical work on the effect of UI policies on unemployed workers. There is strong evidence that UI has the beneficial effect of allowing laid off workers to smooth their consumption (Gruber (1997), Bloemen and Stancanelli (2005), Browning and Crossley (2001)) or stabilize the business cycle (Di Maggio and Kermani (2015)).

Other papers have focused on the possible moral hazards created by more generous UI policies, which may induce workers to reduce effort in their job search (Solon (1985), Card and Levine (2000), Card, Chetty, and Weber (2007)). While there is overall support to the idea that UI may subsidize longer unemployment spells, there is disagreement about the actual magnitude of this effect. Chetty (2008) explicitly derives a formula for the optimal UI benefit which accounts for this trade-off. Supplemental work has focused on the potential improvement in matching resulting from the ability of the unemployed workers to search for longer periods of time, with ambiguous results (see for example Card, Chetty, and Weber (2007)). Overall, this evidence supports the idea that UI provisions represent meaningful shocks to the labor market environment.

Theoretical and, more recently, empirical work, have found that it may be optimal for firms to provide partial insurance to workers in order to reduce wage premia related to unemployment risk. Theoretical papers include Baily (1974) and Azariadis (1975), which show that firms may be willing to avoid fluctuations in wages and, under certain conditions, employment by absorbing shocks connected with uncertain demand.

Relatedly, Titman (1984) has demonstrated that the optimal capital structure is related to the costs of distress borne by workers and other stakeholders (such as customers and suppliers). Similar predictions are obtained in a dynamic moral hazard model by Berk, Stanton, and Zechner (2010). Empirical work has found support for these predictions, relying on the observation that the lower unemployment costs, the more generous the public UI system. Agrawal and Matsa (2013) show that leverage is positively correlated with unemployment benefits in the US. Similarly, Ellul, Wang, and Zhang (2015) show that a larger fraction of CEOs' compensation is based on stock or options when UI generosity is higher, suggesting that shareholders may induce managers to exploit riskier growth opportunities. Finally, Ellul, Pagano, and Schivardi (2014) find that in countries with lower UI generosity, firms are less likely to lay off workers following negative industry shocks.

Additional evidence on the effects of UI policies on firms' decisions includes Dou, Khan, and Zou (2016), who find that firms are less likely to manage earnings in the presence of more generous UI policies. This suggests that firms try to improve employee perceptions of employment security when human costs of unemployment are large. Overall, the empirical evidence presented here complements this work and suggests an additional important channel through which the labor market affects managers' choices.

My results relate, more broadly, also to papers analyzing factors influencing firms' payout. A number of reasons may influence payout policies, such as signaling motives, agency conflict considerations, and management incentives (recent surveys include Farre-Mensa, Michaely, and Schmalz (2014) and DeAngelo, DeAngelo, and Skinner (2008)). Recent empirical work has, however, emphasized how such benefits are traded-off against costs in terms of loss of financial flexibility, the ability to avoid costly financial distress, as well as underinvestment.

Firms favoring dividends payment over repurchases are more likely to hedge risk using financial instruments, such as derivatives (Bonaim, Hankins, and Harford (2014)). These also tend to have more volatile cash flows (Jagannathan, Stephens, and Weisbach (2000)). While these papers have typically emphasized either shareholders' or managers' payoffs, I find support for the hypothesis that others stakeholders' interests, such as those of workers, have a first-order influence on such financial decisions, which was a concept posited theoretically by Titman (1984) and Cornell and Shapiro (1987).

1.3 Data and Descriptive Statistics

1.3.1 Data

Since the adoption of the Social Security Act in 1935, the US has established a joint federal-state system to provide benefits to unemployed workers. Each state sets the generosity of its UI program, which is funded through taxes levied on employers. Such taxes are "experience rated," meaning that firms more prone to lay off workers suffer higher marginal rates.

Such UI policies in the US represent a relevant setting to test my hypothesis. First, as suggested by the evidence surveyed in the previous section, they are salient and economically meaningful to workers. Second, they exhibit substantial variation, both across states and over time.

I obtain data on UI benefits for each state and year from the Department of Labor website.[6] for each state and year. Similarly to Di Maggio and Kermani (2015) and Agrawal and Matsa (2013), I focus on the maximum benefit (maximum weeks $\times$ maximum weekly benefit amount) for each state. This measure is likely to be the most salient to workers and exhibit the highest variation across time and state.

Not all changes in UI benefits necessarily correspond to actual legislative acts for two reasons. First, in some states UI benefit changes are adjusted periodically and are linked to the macroeconomic environment. For example, the maximum weekly benefit changes in every year of my sample in Colorado. This is because UI benefits are revised annually and are typically mechanically indexed to the average wage in the manufacturing sector. Second, UI revisions can be pre-announced. For example, in 1990 the State of California raised the maximum weekly benefit from \$166 to \$190. However, it was also announced that subsequent increases would follow in 1991 (\$210) and 1992 (\$230).

[6] `http://workforcesecurity.doleta.gov/unemploy/statelaws.asp`

In the following, I examine the response of dividend payout following sharp changes in UI generosity. Therefore, I exclude these instances because, in the first case, they are mechanically correlated with the macroeconomic outcomes of the state where firms are headquartered. In the second case, they are fully anticipated by managers. I obtain relevant UI changes from several editions of the changes in UI legislation bulletins published by the Bureau of Labor Statistics for the period of 1991 to 2007. I code all the legislative changes remaining after adopting the previous two filters. In order to focus only on meaningful changes, I also set a minimum threshold of $100 (in 2010 dollars) in the maximum UI benefit change. This results in 61 changes across 26 states over the sample period. I complement this dataset with basic macroeconomic variables, measured at the state-level, from the US Bureau of Economic Analysis.

The data and is then merged with Compustat annual data, using each firm's historical headquarter. As aforementioned, the time frame covers the years 1991 to 2007. 1991 is the first year of my sample due to the fact that I use the *historical* headquarter of firms in my analysis. In the Compustat database, the headquarter is backfilled, and by not accounting for this, I may end up coding as treated firms that should belong to the control group, and vice versa (see Heider and Ljunqvist (2015)). However, I can access historical information on a firm's headquarter starting from 1991 onwards from the "Compustat Historical Database."

The last year of the dataset is 2007 to avoid the years of the Great Recession, which involved a series of temporary UI extensions (Di Maggio and Kermani (2015)). While most of a firm's workers are likely to operate in the state where the firm is headquartered, it is plausible that some of its workforce will be located in different states, especially in large firms. To attenuate measurement error, in most of the analysis I exclude firms operating in "dispersed" industries, as identified by Agrawal and Matsa (2013) (wholesale, trade, retail), that is, firms likely to have a geographically dispersed workforce.

I also exclude from the sample financial and utility related firms because accounting variables are not directly comparable between them and firms in other industries. Moreover, since all the control variables are expressed as ratios with total assets as denominator, the inclusion of very small firms in the sample tends to add noise to the estimates. Therefore, following the example of Baker, Stein, and Wurgler (2003), I exclude the smallest companies in the sample. I do so by computing the mean asset value over the full sample period and dropping the firms in the bottom decile of the distribution.

1.3.2 Descriptive Statistics

Descriptive statistics for the outcome variables and the main control variables in the full sample are in Table 1.1. As further explained below, it will be convenient to estimate a model in first differences in order to absorb unobserved heterogeneity across firms. To account for this, I report descriptive statistics on both levels and first differences of each variable. The main dependent variable is the change in dividend payout, measured as the common dividend over net income, with all multiplied by 100 for ease of interpretation. This ratio is meaningful only for positive values of earnings, ergo, in each year I keep only firms with positive earnings in year t and $t+1$, as well as non-missing control variables and dividend payments.

The full sample includes 22,595 firm-year observations and 3,738 unique firms. The 61 UI increases affect 1,273 firm-years (931 unique firms). These 61 "shocks" are associated with an average increase in the maximum benefit of \$1,008, or 3.37% in terms of the replacement rate, which are meaningful numbers compared to the sample means of \$14,503 and 40.2%, respectively. The average dividend payout is 15.58%, and its average growth is 0.32%. More details regarding construction and sources of the other variables are in the following sections and in Appendix 1.A.

1.3.3 Empirical Strategy

I estimate a model of corporate investment in first differences, similar to Heider and Ljunqvist (2015)). The advantage of this empirical framework is that it allows control for unobserved heterogeneity. Furthermore, it can easily accommodate multiple shocks occurring in the same state over time. The baseline empirical specification is:

$$\Delta DIV_{i,t+1} = \beta UI_{s,t} + \delta' \Delta X_{i,t} + \theta' \Delta Z_{s,t} + \vartheta_s + \delta_t + \varepsilon_{i,t+1} \tag{1.1}$$

where the i, s, j and t subscripts correspond to each firm, state, and year, respectively, and Δ is the first-difference operator.

The dependent variable is the change in the dividend payout, defined as common dividends divided by net income, with all multiplied by 100. UI is a dummy equal to 1 if one of the 61 events identified according to the procedure described in Section 1.3.1 occurs in state s and year t. In Section 1.4.2 and in most of the paper, however, I will restrict the analysis to 12 events plausibly unrelated to macroeconomic conditions and on a matched sample of firms. $\Delta Z_{s,t-1}$ is a vector of state-level control variables. Because unemployment benefits are likely to grow in response to an increase in the number of unemployed workers and will be correlated with workers' income, I include the two arguably most relevant controls following Agrawal and Matsa (2013): per capita GDP growth and unemployment rate growth.[7] Beyond that, I also include state-level dummies, which absorb time-invariant state-level characteristics and year dummies.

$\Delta X_{i,t-1}$ is a vector of firm-level controls, also expressed in first differences. It includes Q, ROA, size, and debt to asset ratios, along with industry dummies (defined using the 2-digit SIC classification). Q is defined as the total assets plus the market value of the firm (number of shares outstanding $\times$ fiscal year-end price) minus common value of equity, all divided by total assets. This captures a firm's investment opportunities. Cash flow is net income over lagged total assets. It can correlate with dividend payout either because of financial constraints or because it is associated with investment opportunities not adequately captured by Q. Debt to assets (long-term plus short-term liabilities, all divided by total assets) is included as an additional control variable and as proxy for a firm's financial soundness. Finally, I include size, defined as Log(total assets), because large, mature firms are on average more likely to issue dividends (Jagannathan, Stephens, and Weisbach

[7] In unreported tests, I include additional changes in a number of potential determinants for UI policies, such as the state balance deficit, the state-level percentage of unionized workers, and the political affiliation of the governor. Results are unaffected by the inclusion of these additional variables.

(2000)). Following the recommendations of Bertrand, Duflo, and Mullainathan (2004), standard errors are clustered at the state-level in all the regressions.

1.4 Unemployment Insurance and Dividend Payout Policies

1.4.1 Preliminary Evidence

Estimates of equation 1.1 are reported in Table 1.2, which shows five different specifications, ranging from the least to the most conservative. In specification (1), I include only the UI dummy and year and state dummies. The relevant coefficient is significant at the 5% level and equal to 3.60. Column (2) adds state controls (the change in the logarithm of per capita income and unemployment rate), with the UI coefficient being essentially unaffected. Column (3) includes industry dummies, and Column (4) firm-level controls.

The coefficients on the control variables have the expected sign: larger and more profitable firms are more likely to issue dividends, while riskier firms (in terms of change in debt to assets), or firms with stronger future prospects (higher ΔQ) are less likely to do so. Firm controls are endogenous, so they may bias the estimates, but it is reassuring that both the point estimate and the statistical coefficients of the UI coefficient are unaffected.[8] To interpret the economic magnitude of this effect, consider that the standard deviation of the dividend payout ratio in the full sample is 23.57, and the standard deviation of ΔDiv is 41.01. Therefore, a coefficient of 4.214 (last specification) corresponds to an increase in the dividend payout ratio equal to roughly 10% of a standard deviation of the dependent variable.

Panels 1.2a, 1.2b and 1.2b of Figure 1.2 plot the average maximum benefit, replacement rate, and dividend payout, respectively, for treated and untreated firms in the five years surrounding a UI increase. There is no evidence of differences in trends before year *t+1*although the levels of the three variables are much lower for the eventually treated firms. The gap in UI generosity narrows in year *t+1*, and dividend payout for treated firms jumps by about three and a half percentage points, so much that its mean level is higher than that of control firms. In year *t+1*, there is a slight reversion and the two lines intersect each other.

Table 1.3 presents additional variations over the baseline specification of equation 1.1 (coefficients on the control variables are omitted for brevity). Column (1) presents the baseline model. Column (2) includes dispersed industries (resale, wholesale and trade). Here the coefficient drops slightly in magnitude (2.59), as expected, but remains marginally significant. Column (3) includes only firms in states that are eventually treated, as in Bertrand and Mullainathan (2003), with little effect on the baseline point estimate.[9] Column (4) includes year-industry dummies, and Column (5) adds year-industry-census region dummies. The results are robust, with the point estimates of the UI coefficient being again unchanged relative to the baseline specification of Column (1).

[8] For brevity, in all the tests that follow I will include all the control variables, but all the results that follow are very similar if control variables are excluded from the regressions.

[9] With only 26 clusters, standard errors are likely to be biased. However, clustering by firm produces very similar standard errors.

In Column (6), I replace UI with the fraction of each firm's workers treated by the UI benefit increase. I obtain data on establishment location and employee number from Dun and Bradstreet NETS, and manually match firms in Compustat with the D&B data using their names.[10] Unfortunately, such data is likely to be quite noisy.[11] Moreover, I was not able to match all the firms and the sample size drop by approximately 20%. Still, results to this additional test are quite robust. In particular, they suggest that a firm that has 100% of its workers subject to a UI generosity increase will increase its dividend payout by 4.64%.

1.4.2 A "Narrative Approach"

Although the results found in Section 1.4.1 appear robust to different specifications and choices of control variables, unobserved heterogeneity in underlying economic conditions may cast doubt on a causal interpretation. If policymakers adjust UI policies in order to respond to varying macroeconomic conditions or to meet their expectations of future events, the establishment of an association between corporate decisions and UI policies may be driven simply by underlying changes in the macroeconomic environment that affect both firms' and policymakers' actions.

Fortunately, a number of factors unrelated to the economic environment have been suggested to affect the variation of UI policies across time (Blaustein (1993)). Subsequently, it is possible, in practice, to identify instances where economic considerations were likely to play little or no role in shaping the timing of UI benefits revisions.

In this Section I provide more robust evidence by adopting a "narrative approach" in the spirit of Romer and Romer (2010). I perform a search of news articles through several sources (Factiva, Lexis Nexis, and search engines), and I collect information regarding the political and economic environment at the root of these bills together with any concurrent significant reforms simultaneously implemented.

This kind of strategy, popular in the Labor Economics and Macroeconomics literature, is becoming common also in recent Corporate Finance work. For example, Giroud and Rauh (2015) analyze changes in tax policies across US states and Simintzi, Vig, and Volpin (2015) study major labor reforms in a sample of developed countries. I am deliberately conservative in my search, and leave legislations without sufficient information out of my sample. I was able to obtain adequately detailed information for 18 out of 61 cases. Not surprisingly, they involve relative large states, which have more extensive media coverage. Therefore, they cover about half of the treated firm-years (639 out of 1,273).

I screen the UI increases according to two additional filters. First, I exclude all the legislative changes whose timing are clearly related to changing economic conditions. Second, I exclude those which coincide with confounding reforms, particularly where tax cuts or raises are concerned. It turns out that this second filter is the most important one of the two, with macro conditions playing little role in driving the policy changes. These filters leave me with 12 out 18 shocks (and 505

[10]More precisely, I use a fuzzy matching algorithm to link company names of the two datasets (using the Stata command *reclink* developed by Michael Blasnik) and verify manually the accuracy of each match.

[11]The correlation between the total number of employees reported in Compustat and NETS is 46.91%, quite large, yet still far from one.

treated firm-years). The most common reasons for these UI increases are federal funds inflows, upcoming elections, or isolated economic events, such as layoffs at a single large plant.

Admittedly, this procedure requires some degree of discretion. For this reason, I briefly describe the political environment surrounding each of the 18 changes in Appendix 1.B A review of these legislative changes shows that the 12 UI increases I am left with suggest that they provide a reasonably adequate setting to test for a causal link between unemployment risk and financial policies.[12] None of them is linked to changes in corporate or UI tax rates, or to reforms one would expect to substantially affect corporate behavior. The underlying causes vary, but they can hardly be linked to dramatic developments in the corporate or macroeconomic environment and can be roughly classified in four categories. Three legislative changes were motivated by layoffs or strikes in plants belonging to a single company (Missouri 1997, Virginia 2000, New Hampshire 2002).[13] In three other cases, the main driver was likely the upcoming gubernatorial election (New York 1998, California 2001, Georgia 2002). The third category includes UI increases resulting from lengthy negotiations between business lobbies and unions, which produced substantial uncertainty regarding the final outcome (Florida 1992, Tennessee 2001, Michigan 2002, Arizona 2004). The final group includes policy changes motivated by events unrelated to the local state economy, such as the expiration of federal funds (Maryland 2002) and political pressure to "match" other states UI policies (Alabama 2006).

1.4.3 Matching Procedure

Having identified these reforms, I adopt a standard matching procedure where each firm in a treated state is matched with a similar firm in terms of several covariates and operating in the same industry and geographic region. To the extent that treated firms share the same growth opportunities and operate in relatively homogeneous labor markets relative to firms operating in the same industry and geographic region, this test should absorb much of the unobserved heterogeneity across firms. This will force control and treated firms to share similar firm-level covariates, further increasing the stringency of the test.

I use a logistic regression to estimate the probability of being a treated firm. Propensity scores are estimated using the levels of the control variables at *t-1*. Each treatment firm in year *t-1* is matched to a control firm, matching on year, industry, census region, and closest propensity score (with a maximum difference between propensity scores of 0.01). Ideally, one would like to get as close as possible to a randomized experiment, where firms similar in terms of observable characteristics, same industry shocks, and relatively homogeneous labor market conditions are subject to different UI policies.

[12] State and year of each event are: FL (1992), MO (1997), NY (1998), VA (2000), CA (2001) TN (2001), GA (2002), MD (2002), MI (2002), NH (2002), AZ (2004), and AL (2006).

[13] These companies are McDonnell Douglas, Tultex and Fraser Papers, respectively. Fraser Papers was headquartered in Canada, so it is not included in the sample. Excluding the remaining two firms does not change the results. One concern could be that the difficulties these companies were going through were related to broader industry level demand shocks. However, the matching procedure in practice controls for time-varying industry trends.

The matching is performed with replacement, resulting in a lower number of control firms relative to those that are treated. The final sample includes 782 firms: 469 treated and 313 control firms. As Table 1.4 shows, the two groups are well-matched in terms of covariates.[14] Interestingly, the levels of the unemployment rate and the Log(income) of the states of treated and control firms also do not differ significantly.

The second Panel of Table 1.4 tests whether treated firms and control firms differ in terms of the trends of covariates by comparing their rate of growth between *t* and *t-1*. The parallel trend assumption for any of the control variables cannot dismissed, as well as the state-level controls. Moreover, all the differences are economically small. In Appendix 1.C, I test whether proxies for analysts' expectations differ in their trends or levels between treated and control groups. Following Fresard and Valta (2003) I focus on sell/buy recommendations, earnings per share, and long term growth forecasts. Again, there is no statistically significant difference between the two sets of firms in any of the three measures.

The UI reforms announced in year *t* are associated with sharp and large changes in UI generosity, as expressed in Panels 1.3a and 1.3b of Figure 1.3. Visual evidence shows that treated firms are headquartered in states with lower replacement rates and maximum weekly benefits relative to control firms, but this gap narrows quite sharply afterwards.

In unreported results, using data from the Bureau of Economic Analysis, I find that total UI payment increases by 18% in treated states, relative to control states. This suggests that changes in maximum benefits are strong predictors of actual UI payments. Figure 1.2c shows the evolution of the dividend payout of treated and control companies in the five years surrounding the UI generosity increases by plotting the mean payout of each subgroup. There is little evidence of anticipation. If anything, control firms have a higher payout in year *t-2*.

Interestingly, the levels of payout across groups are also similar, suggesting that the matching procedure does quite well in controlling for unobserved heterogeneity across treated and control firms. Payout jumps by about six percentage points in year *t+1* in treated firms relative to control firms. Similarly to the evidence of Figure 1.2, this gap is reduced in year *t+2*, up to about 2%, which suggests that the effect of higher UI provision is large but relatively short-lived. However, the matching procedure requires dividend payout to be defined (and net earnings to be correspondingly positive) only in years *t* and *t+1*, so attrition concerns may invalidate strong inferences regarding the behavior of firms far from the event year.[15]

[14] In unreported tests, I also find that trends in other potential confounding elements, such as the fact that top corporate income taxes or UI taxes do not differ between treated and control firms. I obtain corporate taxes from Heider and Ljunqvist (2015). For the second variable, I follow Di Maggio and Kermani (2015) and compute a simple approximation of the firm tax schedule as the maximum minus the minimum tax rate in each state. Di Maggio and Kermani (2015) find that this measure is strongly correlated with an industry-weighted average of Card and Levine (1994)'s measure of mean marginal tax costs in 1979-1987, constructed using confidential data. Unfortunately, I am able to construct this proxy only for the latter part of the sample, starting from 2003 onwards, and not for all the states.

[15] In particular, while the full sample employed in the regression includes 782 observations, there are only 654 observations in year *t-2* and 651 in year *t+2*.

1.4.4 Evidence from the Matched Sample

Table 1.5 replicates the baseline tests of Table 1.2. In this restricted sample, the results are very similar and, if anything, slightly stronger. Column (1) includes only the UI dummy. Column (2) adds industry fixed-effects. Column (3) adds state controls, and Column (4) firm-level controls. The inclusion of a different set of control variables does not affect the point estimate of the coefficient of interest, which is not surprising given the evidence in Table 1.5. The estimates suggest that treated firms increase dividend payout by 5.8 to 6 percentage points.

This effect is larger than what is found in Section 1.4. One possible reason for this is that some of the UI increases included in the full sample and excluded here are adopted in anticipation of poor economic conditions. This may not have been adequately captured by the control variables. If this is the case, firms may lower dividend payout in order to preserve financial liquidity.

Because the 12 different events correspond to UI revisions different in amount, the tests thus far described do not allow an easy interpretation of the quantitative effects of UI on payout policies. To do so, I project changes in UI benefits on the UI dummy, and then regress changes in dividend payout on the predicted value from this first stage regression in a simple IV framework.

More formally, I first estimate:

$$\Delta Benefits_{s,t+1} = \beta UI_{s,t} + \delta' \Delta X_{i,t} + \theta' \Delta Z_{s,t} + \vartheta_s + \delta_t + \varepsilon_{i,t+1} \tag{1.2}$$

where $\Delta Benefits_{i,t+1}$ is the change in the replacement rate or in the maximum benefit occurring between year *t* and *t+1* in state *s*. Then I use the predicted value from this regression $\Delta \widehat{Benefits}_{i,t+1}$ to estimate the following model:

$$\Delta DIV_{i,t+1} = \beta \Delta \widehat{Benefits}_{i,t+1} + \delta' \Delta X_{i,t} + \theta' \Delta Z_{s,t} + \vartheta_s + \delta_t + \varepsilon_{i,t+1} \tag{1.3}$$

The first two columns of Table 1.6 reflect the simple OLS regression of growth in dividend payout on change in benefits (either the change in the maximum amount, in thousands of dollars, or the change in the replacement rate), plus the usual controls. Columns (3) and (4) report the estimates of equation 1.2, with the dependent variable being the growth in maximum benefits or the replacement rate, respectively.

In both cases the t-statistics are well over 5, suggesting that the instrument is quite strong. Columns (5) and (6) estimate the IV regression of equation 1.3. The estimates from the OLS and the IV models are quite similar, but tend to be larger in the latter case and suggest that a rise in UI benefits of $1,000 or in the replacement rate of 1% causes an increase in dividend payout of 4.75 basis points and 1.86%, respectively.

1.4.5 Additional Payout Measures and Other Outcomes

Table 1.7 includes results obtained using different measures of payout and additional firm-level outcomes. Another common measure of payout is total payout, defined as the sum of dividend payment and repurchases scaled by earnings (see for example He, Tian, and Yang (2016)). The results, reported in Column (1), are qualitatively similar when using this alternative definition of the dependent variable. These suggest that an increase in UI generosity causes an increase in total payout of 20% relative to a standard deviation of 145% in the full sample. Column (3) shows that repurchases (again, scaled by earnings) do not react to changes in UI in a similar fashion. This is consistent with repurchases being driven primarily by considerations other than risk, such as temporary mispricing.

One possible concern could be that these results are driven by changes in earnings (the denominator of the dividend payout ratio) rather than actual changes in earnings. Appendix 1.C has robustness checks that are inconsistent with this alternative explanation. I redefine the dependent variable as the difference between dividend between periods *t+1* and *t* scaled by earnings in period *t*.[16] Alternatively, one can scale dividend payments by asset or use the change in dividend per share as the dependent variable.

Table 1.C.2 in the Appendix shows that using either of these three measures as dependent variable delivers qualitatively similar results. In the same table, I also analyze to which extent UI increases affect the intensive versus the extensive margin, by splitting the sample according to whether the firms in the sample have paid any dividends at time *t*. If such results were driven by a fall in demand, and so in earnings, we would not expect firms which are not paying dividends in year *t* to start doing so in the following year. Table 1.C.2, however, shows that the coefficients on the UI dummy is significant in both subgroups, although with different magnitudes.

Given this evidence, it is natural to ask whether the rise in dividend is associated with a drop in cash holdings. In Column (3), I show that cash (defined as cash and short-term securities scaled by assets) does indeed drop by 0.007 (with the standard deviation equal to 0.082), although this change is not statistically significant. In Column (4) I use a more refined measure of cash holding: "Z-cash" (as in Fresard (2010)), wherein the industry mean is subtracted from the cash holding and the difference is standardized by the industry standard deviation. This accounts for differences in cash needs across industries (due to either technological factors or different degrees of market competition) in a more direct way. The coefficient is now statistically significant at the 5%, and equal to -0.069, relative to a standard deviation of 0.557.

I also investigate whether higher payout is driven by crowding out of investment due to low growth opportunities. In Columns (5) and (6), where the dependent variables are the change in investment (defined as capital expenditure scaled by lagged total asset) and growth in employment, respectively, there is no evidence that this is the case. Both coefficients are small and insignificant.

Ellul, Pagano, and Schivardi (2014) show that, in countries where the UI system is more generous, firm employment is more sensitive to industry shocks. I follow them in regressing employment growth on industry revenue growth[17] and interact this measure with the UI dummy. Alternatively, I use the median Q in the industry as a proxy for industry growth opportunities. Intuitively, we expect both interactions of the coefficients to be positive. As UI becomes more generous, firms

[16]This approach has the additional advantage of avoiding potential forward-looking bias due to the requirement that firms have positive earnings in the year that follows the treatment, resulting in the sample size increasing to 983 observations. An alternative way to address this concern consists in adding the contemporaneous change in earnings as regressor. Including $ROA_{t+1} - ROA_t$ as additional control variable does not affect the results.

[17]Following Sraer and Thesmar (2007), I compute the mean rate of growth for all industry in a given industry and year rather than computing the growth in total sales to account for attrition among listed firms.

should have fewer incentives to smooth fluctuations in employment, and so will be more likely to exploit potential profit opportunities.[18]

In Columns (7) and (8) of Table 7, both measures are de-meaned and divided by their standard deviation for ease of interpretation. As expected, both coefficients are positive and relatively large, although the coefficient for the interaction between industry sale growth and the UI dummy is not significant. The coefficients on the non-interacted industry proxies are omitted for brevity. The coefficient for the interaction term between median industry Q and the UI dummy is, on the other hand, large and significant. This suggests that firms in industries with a median Q one standard deviation above the mean increase employment by 4.8% if headquartered in states with a UI increase.

In Appendix 1.C, I also test whether UI generosity is associated with an increase in leverage.[19] Consistent with Agrawal and Matsa (2013), who find that the positive association between leverage and UI generosity is driven primarily by firms with low cash flow, I find no evidence of a change in leverage for treated firms in my sample, all of which are required to have positive earnings (Column 1 of Table 1.C.3). When I repeat the matching procedure outlined in Section 1.4.3 on firms with negative earnings and re-estimate equation 1.1 in this sample of firms, I find that firms in the treatment group increase book leverage by 2.2% (relative to a standard deviation of 25.25% in the dependent variable). This effect is only marginally statistically significant (t-statistic=1.73). I also estimate the same model using net leverage as a dependent variable, which subtracts cash holding from the numerator. This measure is of additional interest, given the evidence on cash holding and total payout presented in Table 1.7. I find that net leverage drops by 3.1% (t-statistic=2.42), which is about a tenth of a standard deviation of the dependent variable (equal to 29.9%) in the negative earnings subsample but, again, I find no effet among firms with positive earnings.

1.5 Cross-Sectional Heterogeneity

1.5.1 Volatility in Real Activities

This section contains a number of cross-sectional tests that provide empirical support to the hypothesis that conservative payout policies are related to the desire of managers to provide some insurance to workers in presence of unemployment risk. To be conservative, I focus on the matched sample, selected according to the procedure outlined in Section 1.4.3.. Results are largely similar when extending the analysis to the full sample considered in Section 1.4.

First, I hypothesize that the effect of UI generosity will be weaker in industries where firms expect to enjoy relatively stable earnings streams. Committing to a high dividend policy is unlikely to reduce operating flexibility in such firms because severe negative shocks are unlikely to occur (Jagannathan, Stephens, and Weisbach (2000)). Following Brealey, Hodges, and Capron (1976) and other authors, including more recent work by Matsa (2010), I construct a simple measure

[18] Each proxy is also included in the regressions as standalone variable (not shown).

[19] The construction of book leverage follows Baker and Wurgler (2002); see details in Table 1.A.1 in Appendix 1.A.

of earnings variability by taking the standard deviation of the change in ROA for each firm in Compustat computed over the full sample period and requiring at least five observations per firm. I then average this measure across firms belonging to the same industry. The theoretical justification for using this measure is related to work by Baily (1974), who argues that firms may have incentives to stabilize workers' employment, primarily when facing frequent spells of high or low demand, also reflected in earnings.

I also construct more direct measures, aimed at proxying for employment volatility, its input being the change in Log(employment), to capture the actual unemployment risk faced by workers. The two measures exhibit a strong positive association (the correlation coefficient is 64.6%) but are related to different aspects of industry-level risk.

I then replicate the main analysis of Section 1.4.4 in four distinct subgroups by sorting firms according to whether the industry or the employment volatility proxy are above or below the sample median and compare the coefficients of interest. Table 1.9 shows evidence consistent with the expected pattern. In particular, the coefficient on the UI dummy more than doubles when moving from low to high volatility industries and is significant only in the latter two subgroups.

The last two rows of the table report χ^2-statistics computed under the null hypothesis that the two coefficients are equal, along with their p-values. Even though such tests do not reject the null hypothesis of equality at conventional significance levels, the differences are economically meaningful.

1.5.2 Growth Prospects

Firms lacking encouraging growth prospects are likely to respond strongly to changes in unemployment costs. They may have high incentives to issue dividend from the start: companies that are performing well are unlikely to reinvest the proceeds of previous investments if their growth opportunities are scarce. Moreover, free cash flow concerns may be relevant, as managers may be tempted to use their internal funds to finance "pet projects" or diversify their personal risk through investments unrelated to their core business activity (Gormley and Matsa (2016)). More importantly, these firms are where workers face higher unemployment risk because of the poor performance of the businesses they are employed in.

In the analysis that follows, I employ three proxies for growth opportunities. The first is simply a firm's Tobin's Q, which is likely to be most appropriate because it incorporates investors' expectations about future investment opportunities. I also employ two backward looking measures based on earnings: the current ROA and the current change in ROA (that is, $ROA_t - ROA_{t-1}$). Importantly, all three measures are strong predictors of future employment growth.[20]

For each year I sort firms according to whether each proxy for growth opportunities is above or below the sample median. Results of this exercise are in Table 1.8. The coefficient on the UI dummy is about three times larger when moving from the low versus high Q firms (3.15 versus

[20] I test this hypothesis by regressing the change in Log(employment) between *t+1* and *t* on each of the three measures separately, and on firm and year dummies. A decline of a standard deviation in Q, ROA and ΔROA is associated with a fall in employment growth equal to 4.16%, 2.83% and 0.87%. These coefficients are highly statistically significant.

10.08), and is five times larger when moving from the low versus high ROA firms (2.096 versus 10.74). The UI coefficient is, instead, slightly negative in the high ROA growth group, relative to 15.54 in the low ROA growth group. These differences are statistically significant at conventional levels, except when firms are sorted according to Q (p-value of the χ^2-statistic=0.061).

1.5.3 Evidence on the Labor Channel

A more direct test of the labor insurance channel consists in examining the response of firms that differ in terms of workers' importance to their production function. I expect firms that use labor more heavily to be more affected by changes in UI generosity. I follow Serfling (Forthcoming) and use the number of employees, scaled by assets or property, plants, and equipment (PP&E) as proxies for labor intensity. Table 1.10 shows that, once sorting by either measure, the coefficient on the UI dummy is significant only in the high labor intensity firms, and almost triples in magnitude relative to the low labor intensity firms.

The effect of insurance policies on corporate decisions is likely to be shaped by the underlying structure of the labor market and, in particular, by the probability of being quickly re-employed. Indeed, as Anderson and Meyer (1997) document, many unemployed workers do not take any UI benefits because they are likely to find a new job in a relatively short period of time.

Intuitively, this should be true especially in industries where labor demand is falling. I proxy for trends in labor demand by measuring the percentage rate of change in employment in each industry. Moreover, because the welfare gain from being re-employed after a layoff depends also on how attractive a job is in terms of wage offers, I also analyze the effect of UI generosity on payout in industries with different average wage growth. I construct measures of employment and wage growth at the industry level (at the 4-digit NAICS level), using data from the Bureau of Labor Statistics.

Table 1.11 analyzes the response of payout policies in different industries, sorting as usual in two groups according to either characteristic (employment growth or wage growth). The coefficient on the UI dummy is significant only in low employment and wage growth industries (coefficients are 10.06 and 12.82, respectively), whereas UI generosity is unrelated to payout policies in better performing industries. The differences in the coefficients across subgroups are not only economically large but also statistically significant, as shown in the last two rows of Table 1.11.

1.5.4 Alternative Interpretations

Although results so far are consistent with an implicit contract interpretation, different conjectures are possible. Feldstein (1976) suggests that UI acts as an implicit subsidy to firms with large seasonal shifts in demand. Such firms can temporarily lay off workers during low demand spells and re-hire them in periods of high demand. A rise in UI payments improves workers' well-being during periods of temporary unemployment, enabling employers to pay lower wages when workers are re-hired.

In Table 1.12, Columns (1) and (2), I sort firms according to their degree of sales seasonality. I measure seasonality as the standard deviation of the Log(revenues) changes in the previous four quarters. If anything, low seasonality firms seem to respond with greater intensity to higher UI, although this effect is not very precisely estimated.

A second possibility is that higher UI increases workers' bargaining power by raising their reservation wages. Managers may be willing to reduce a firm's liquidity in order to gain a stronger bargaining position and avoid wage concessions, as in DeAngelo and DeAngelo (1991). Although it is not obvious how to rule out this possibility, it is plausible that unionized workers, thanks to their superior organization, may be more likely to exploit this advantage in the bargaining process. As Agrawal and Matsa (2013) note, employed workers would not be eligible for UI payments if they refused to work when denied a wage raise, but UI provisions may still affect wage negotiations for unionized workers. In Columns (3) and (4) of Table 1.12 I sort firms according to the degree of unionization of the state they are headquartered in. Again, the two point estimates look very similar.

1.6 Conclusion

In this paper, I have argued that firms engage in conservative payout policies partly to protect workers from the unemployment risk that derives from concerns about a firm's operating flexibility. Consistent with this hypothesis, firms increase payout following increases in UI generosity, which provide meaningful shocks to human costs from unemployment. This evidence on payout policies complements previous work on leverage, earnings management, and sensitivity of employment to industry shocks. Cross-sectional tests support this conjecture by focusing on heterogeneity in firms across several dimensions, such as labor intensity, volatility in real activities, growth prospects, and labor opportunities for unemployed workers. Furthermore, alternative, plausible hypotheses do not find much support in the data.

I suggest two possible extensions to this work. It may be worthwhile to test whether these results hold worldwide. Visual evidence provided in Figure 1.2a suggests that this may be the case. More generally, it would be interesting to ask how much of the cross-country heterogeneity in financial policies (cash holding, leverage, payout, etc.) is explained by unemployment regulations, which would complement recent work that uses cross-country data (Simintzi, Vig, and Volpin (2015) and Ellul, Pagano, and Schivardi (2014) among others).

Second, this paper has hypothesized that labor market considerations affect the *cost* of issuing dividends. In principle, they could also shape the *benefits* deriving from such choices. For example, managers may screen for risk-loving workers by adopting riskier financial policies. This and other hypotheses would require more refined matched employee-employer data to be tested.

1.7 Figures and Tables

Figure 1.1
Dividend Payout and UI Generosity: Non-Parametric Evidence

Figure 1.2a plots local linear regressions estimated using a local-mean smoothing with a rule-of-thumb bandwith of the country level dividend payout ratio on replacement rate (unemployment insurance payments divided by national income). The dividend payout ratio is computed as the sum of all dividend paid by listed firms in a country divided by the sum of earnings. Only firms with positive earnings are included in computing in the ratio, and only country-years with at least 50 firms listed in a given year. Figure 1.2b is constructed in the same way, but the unit of observation is a US state-year.

(a) USA | **(b)** Worldwide

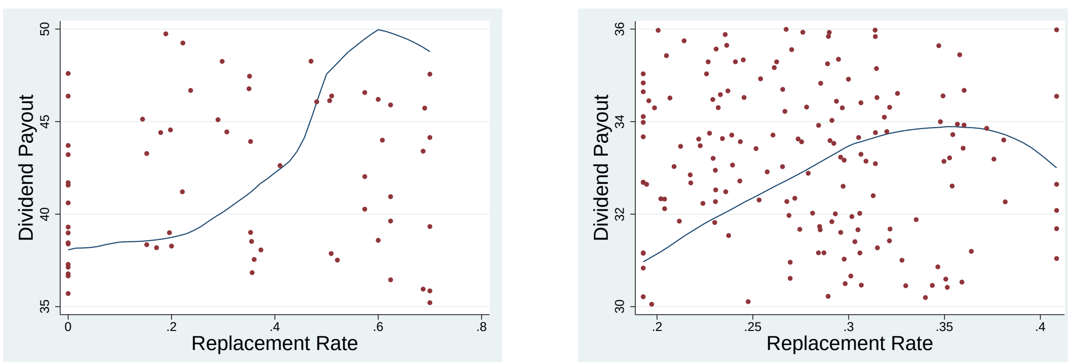
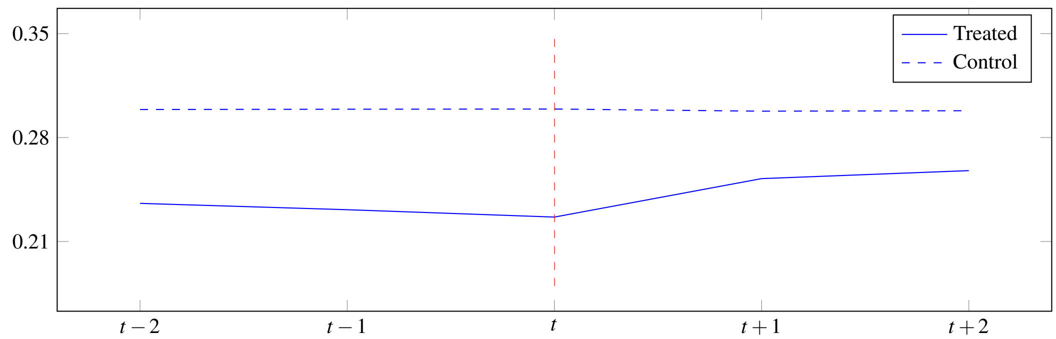


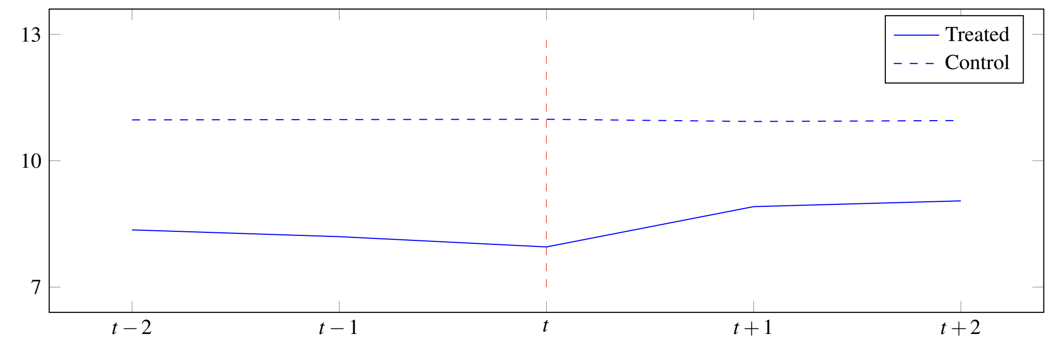
Figure 1.2
UI Generosity and Payout around Policy Changes: Full Sample

Panel 1.2a, 1.2b and 1.2c of Figure 1.2 plot the yearly means of maximum benefits, replacement rate and dividend payout, respectively, for treated (solid line) and control (dotted line) firms in the five years surrounding a UI increase (see Section 1.3.1 for details.)

(a)
Replacement Rate



(b)
Maximum Benefits ($1000s)



(c)
Dividend Payout

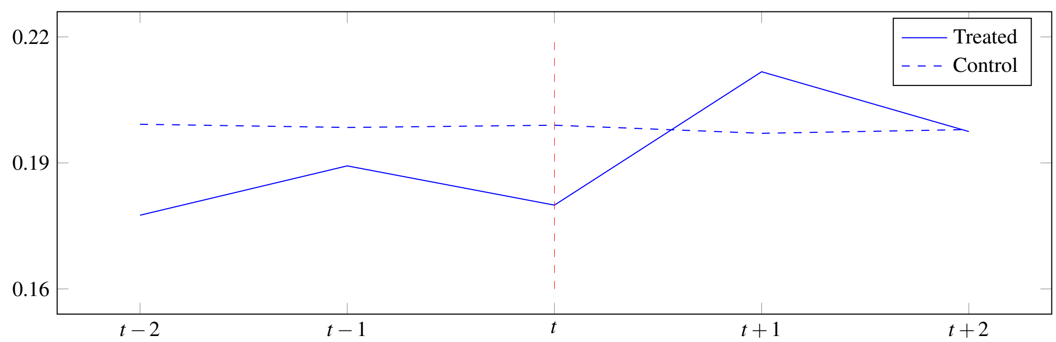
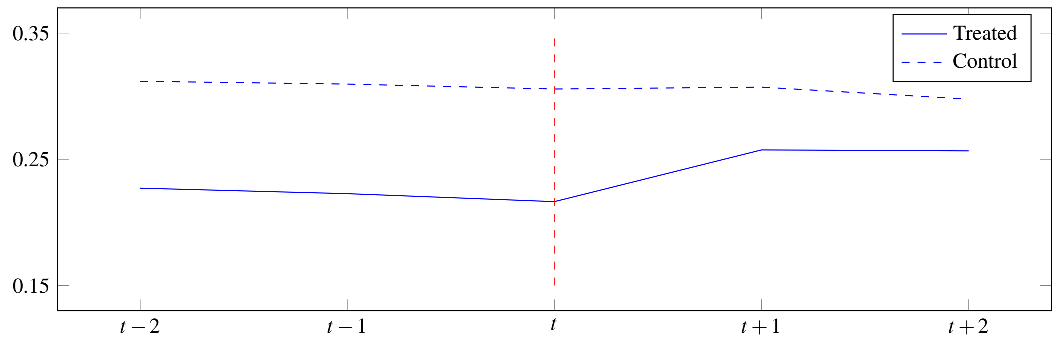


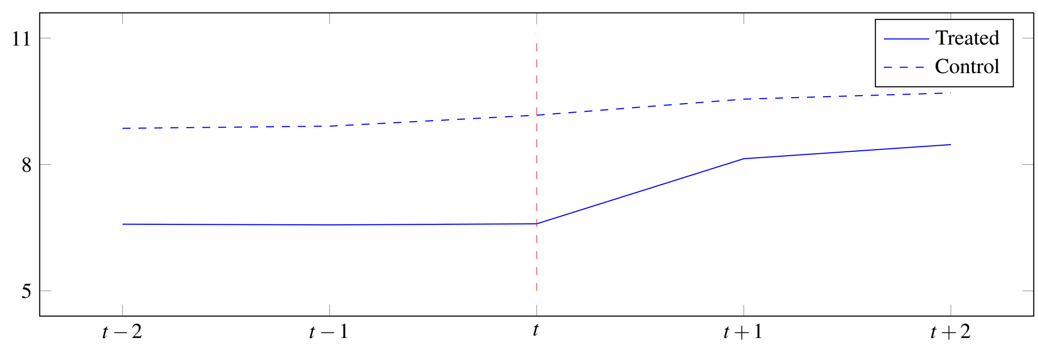
Figure 1.3
UI Generosity and Payout around Policy Changes:
Matched Sample

Panel 1.3a, 1.3b and 1.3c of Figure 1.3 plot the yearly means of maximum benefits, replacement rate and dividend payout, respectively, for treated (solid line) and control (dotted line) firms in the five years surrounding a UI increase (see Section 1.3.1 for details). The sample includes only firms selected according to the procedure outlined in Section 1.4.3.

(a)
Replacement Rate



(b)
Maximum Benefits ($1000s)



(c)
Dividend Payout

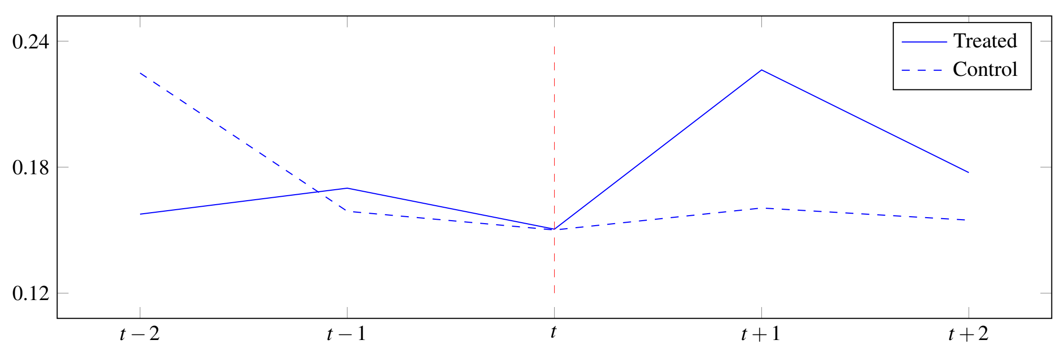


Table 1.1
Summary Statistics

Table 1.1 presents the variables used in the firm-level regressions. Dividend Payout is defined as Common Dividend over Net Income. Total Payout is defined as Commond Dividend plus Repurchases, all divided by Net Income. Investment is defined as Capital Expenditures divided by lagged Total Assets. Debt to Assets is defined as Long-Term Debt plus Debt in Current Liabilities, all divided by Total Assets. Q is defined as Total Assets plus Market Value of the Firm (Number of Shares Outstanding $\times$ Fiscal Year-End Price) minus Common Value of Equity, all divided by Total Assets. ROA is Earnings Before Interest, Taxes, Depreciation and Amortization divided by lagged Total Assets. UI is a dummy equal to 1 if the firm's headquarter is in a state that experienced a UI benefit increase of at least $100 (see 1.3.1 for details). Log(Income) is the Logarithm of the Per Capita Income at the state level. Unemployment is the state level unemployment. Max Benefits is defined as maximum number of weeks of unemployment coverage times maximum benefit. Δ is the first-difference operator.

	Obs.	Mean	Median	St. Dev.	1^{st} P.	99^{th} P.
Dividend Payout	22,595	15.582	0	23.548	0	79.944
Q	22,595	2.115	1.639	1.762	0.715	8.463
Debt to Assets	22,595	0.198	0.172	0.184	0	0.722
ROA	22,595	0.097	0.076	0.105	0.002	0.430
Log(Assets)	22,595	5.830	5.702	1.867	2.361	10.504
Investment	22,595	7.384	4.947	8.002	0.201	48.620
Log(Employees)	22,286	0.614	0.543	1.804	-3.612	4.850
Total Payout	21,287	0.549	0.211	0.995	0	6.745
UI	22,595	0.056	0.000	0.231	0	1
Max Benefits	22,595	14,503	14,303	1,755	11,595	17,531
Max Benefits / Income	22,595	0.402	0.397	0.050	0.296	0.523
ΔDividend Payout	22,595	0.322	0	41.008	-191.787	201.881
ΔQ	22,595	0.025	0.025	0.790	-2.837	2.726
ΔDebt to Assets	22,595	-0.008	-0.004	0.079	-0.250	0.280
ΔCash Flow	22,595	0.022	0.007	0.089	-0.182	0.412
Δ Log(Assets)	22,595	0.149	0.098	0.219	-0.256	1.085
ΔInvestment	22,595	0.031	0.012	5.212	-21.307	19.940
ΔLog(Employees)	22,197	8.373	5.009	20.059	-44.274	90.441
ΔTotal Payout	20,832	6.986	0	132.812	-574.353	710.092

Table 1.2
UI and Payout: Baseline Results

Table 1.2 reports regressions of changes in dividend payout on a UI dummy and lagged changes in Q, Log(assets), debt to assets, ROA, Log(income) and unemployment rate. Please refer to the Appendix for a definition of the variables. Each regression includes state and year dummies and, when indicated, industry dummies (defined according to the two digits SIC classification). Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
UI	3.597**	3.582**	3.619**	3.544**	4.214**
	(1.477)	(1.490)	(1.494)	(1.522)	(1.883)
ΔLog(Income)		-0.155	-0.152	-0.147	-0.126
		(0.104)	(0.104)	(0.103)	(0.133)
ΔUnemployment		0.714	0.704	0.688	0.626
		(0.628)	(0.626)	(0.627)	(0.725)
ΔLog(Assets)				4.731***	6.982***
				(0.958)	(1.553)
ΔDebt to Assets				-18.39***	-21.88***
				(4.063)	(4.707)
ΔQ				-1.272***	-1.438***
				(0.360)	(0.367)
ΔCash Flow				13.36***	22.70***
				(2.856)	(4.164)
Observations	22,595	22,595	22,595	22,595	21,970
R-squared	0.006	0.006	0.007	0.010	0.069
Year FE	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES
State Controls	NO	YES	YES	YES	YES
Industry FE	NO	NO	YES	YES	YES
Firm Controls	NO	NO	NO	YES	YES
Firm FE	NO	NO	NO	NO	YES

Table 1.3
UI and Payout: Robustness Checks

Table 1.3 reports regressions of changes in dividend payout on a UI dummy and lagged changes in Q, Log(assets), debt to assets, ROA, Log(income) and unemployment rate. Please refer to the Appendix for a definition of the variables. Each regression includes state, year and industry dummies (defined according to the two digits SIC classification). Please refer to the Appendix for a definition of the variables. Column (2) includes in the sample dispersed industries (wholesale, trade and retail). Column (3) includes only firms headquartered in states which are eventually subject to a UI increase during the sample (26 states). Column (4) includes industry-year region fixed effects. Column (5) includes industry-year-census region fixed effects. Column (6) replaces the UI dummy with the fraction of firm's workers in states covered by a UI increase. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1) Baseline	(2) With Disp. Industries	(3) Only Treated	(4) Year-Ind. FE	(5) Reg.-Ind. -Year FE	(6) Fraction Treated
UI	3.544**	2.590*	3.165**	3.650***	3.511***	4.643**
	(1.522)	(1.514)	(1.444)	(1.361)	(1.216)	(1.781)
Observations	22,595	27,336	13,143	22,553	22,200	18,092
R-squared	0.010	0.009	0.010	0.053	0.130	0.012
Year FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
State Controls	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES	YES	YES

Table 1.4
Treated VS Control Firms: Summary Statistics

Table 1.4 reports means of treated and control firms control variables, matched according to the procedure outlined in Section 1.4.3. Variables definitions are in Appendix 1.A. Δ is the difference operator.

	Treated (Std. Error) Obs.=469	Control (Std. Error) Obs.=313	Treated - Control (Std. Error) Obs.=782
Levels			
Log(Asset)	5.657	5.580	0.076
	(0.152)	(0.094)	(0.159)
Debt to Assets	0.203	0.211	-0.008
	(0.016)	(0.012)	(0.016)
ROA	0.075	0.072	0.002
	(0.011)	(0.005)	(0.011)
Q	2.217	2.085	0.131
	(0.130)	(0.081)	(0.149)
Log(Income)	10.32	10.29	0.032
	(0.051)	(0.033)	(0.055)
Unemployment Rate	5.334	4.819	0.514
	(0.418)	(0.209)	(0.488)
Trends			
ΔLog(Asset)	0.124	0.135	-0.010
	(0.007)	(0.010)	(0.012)
ΔDebt to Assets	-0.012	-0.005	-0.006
	(0.005)	(0.007)	(0.008)
ΔROA	0.015	0.019	-0.003
	(0.010)	(0.005)	(0.011)
ΔQ	-0.108	-0.023	-0.084
	(0.043)	(0.050)	(0.069)
ΔLog(Income)	5.259	4.578	0.680
	(1.101)	(0.257)	(1.141)
ΔUnemployment Rate	-0.146	-0.121	-0.025
	(0.203)	(0.087)	(0.236)

Table 1.5
UI and Payout: Evidence from Matched Sample

Table 1.5 reports regressions of changes in dividend payout on a UI dummy and lagged changes in Q, Log(assets), debt to assets, ROA, Log(income) and unemployment rate. Each regression includes year and industry dummies (defined according to the two digits SIC classification). The sample comprises matched and treated firms that experience a UI increase between 1991 and 2007. In the year before a UI increase treated firms are matched by Tobin's Q, the logarithm of total assets, ROA, debt to total assets and industry. Please refer to the Appendix for a definition of the variables. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
UI	5.796**	6.025***	5.905***	6.004***
	(2.200)	(2.104)	(1.981)	(2.064)
Δ log(Income)			-0.206	-0.270
			(0.542)	(0.557)
ΔUnemployment			2.761	3.023
			(3.189)	(3.201)
ΔLog(Asset)				1.190
				(6.152)
ΔDebt to Assets				14.919
				(17.961)
ΔQ				0.502
				(0.957)
ΔCash Flow				-14.634
				(10.377)
Observations	782	782	782	782
R-squared	0.005	0.071	0.071	0.074
Year FE	NO	YES	YES	YES
Industry FE	NO	YES	YES	YES
State Controls	NO	NO	YES	YES
Firm Controls	NO	NO	NO	YES

Table 1.6
Economic Magnitudes

Table 1.6 reports, in the first two columns, regressions of changes in dividend payout on changes in the maximum benefit (Column (1)) and in the replacement rate (Column (2)). Columns (3) and (4) report regressions of changes in maximum benefit (Column (13) and in the replacement rate (Column (4)) on a UI dummy. Columns (5) and (6) report IV regressions of changes in dividend payout on changes in the maximum benefit (Column (5)) and in the replacement rate (Column (6)), where the instrument is the UI dummy. All regressions include, as control variables, lagged changes in Q, Log(assets), debt to assets, ROA, Log(income) and unemployment rate. Each regression includes year and industry dummies (defined according to the two digits SIC classification). The sample comprises matched and treated firms that experience a UI increase between 1991 and 2007. In the year before a UI increase treated firms are matched by Tobin's Q, the logarithm of total assets, ROA, debt to total assets and industry. Please refer to the Appendix for a definition of the variables. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	First Stage	First Stage	IV	IV
			Δ Ben.	Δ Ben. / Inc.		
Δ Max Benefit	2.905**				4.745***	
	(1.310)				(1.665)	
Δ Max Benefit / Income		1.174**				1.855***
		(0.531)				(0.643)
UI			1.265***	3.237***		
			(0.194)	(0.463)		
Observations	782	782	782	782	782	782
R-squared	0.073	0.073	0.702	0.699	0.071	0.071
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
State Controls	YES	YES	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES	YES	YES

Table 1.7
Evidence on Additional Outcomes

Table 1.7 reports regressions of changes in several dependent variables on a UI dummy and lagged changes in Q, ROA, debt to assets, Log(asset), logarithm of state income per capita and unemployment rate. The model is estimated in first differences. Dividend Payout is defined as Common Dividend over Net Income. All regressions include, as control variables, lagged changes in Q, Log(Assets), Debt to Assets, ROA, Log(Income) and Unemployment Rate. Each regression includes year and industry dummies (defined according to the two digits SIC classification). The dependent variables are: total payout (dividend plus repurchases, all divided by net income) in Column (1), repurchases (repurchases divided by net income) in Column (2), cash (defined as cash over total assets) in Column (3), z-cash (defined as cash over total asset minus the industry mean and divided by the industry standard deviation) in Column (4), investment (capital expenditures divided by lagged total assets) in Column (5), Log(employees) in Column (6). The sample comprises matched and treated firms that experience a UI increase between 1991 and 2007. In the year before a UI increase treated firms are matched by Tobin's Q, the logarithm of total assets, ROA, debt to total assets and industry. Please refer to the Appendix for a definition of the variables. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tot. Pay.	Rep.	Cash	Z-Cash	Inv.	Empl.	Empl.	Empl.
UI	20.808**	0.074	-0.007	-0.069**	0.003	-0.012	-0.012	-0.011
	(9.183)	(0.055)	(0.006)	(0.033)	(0.002)	(0.011)	(0.011)	(0.011)
UI × Industry Growth							0.018	
							(0.017)	
UI × Industry Q								0.048***
								(0.012)
Observations	718	718	781	772	782	773	773	773
R-squared	0.105	0.118	0.022	0.063	0.196	0.180	0.182	0.193
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State Controls	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES	YES	YES	YES	YES

Table 1.8
Heterogeneity in Growth Prospects

Table 1.8 reports regressions of changes in dividend payout on a UI dummy and lagged changes in Q, ROA, Debt to Assets, Log(Asset), the logarithm of state income per capita and unemployment rate. Each regression includes year and industry dummies (defined according to the two digits SIC classification). Firms are sorted according to whether their Q (Columns (1) and (2)), ROA (Columns (3) and (4)) and lagged change in ROA (Columns (5) and (6)) is above or below the yearly median. The sample comprises matched and treated firms that experience a UI increase between 1991 and 2007. In the year before a UI increase treated firms are matched by Tobin's Q, the logarithm of total assets, ROA, debt to total assets and industry. Please refer to the Appendix for a definition of the variables. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1) High Q	(2) Low Q	(3) High Prof.	(4) Low Prof.	(5) High Prof. Growth	(6) Low Prof. Growth
UI	3.149**	10.080**	2.096	10.740***	-0.807	12.539***
	(1.358)	(3.763)	(2.109)	(3.638)	(2.208)	(3.554)
Observations	389	393	389	393	389	393
R-squared	0.091	0.117	0.104	0.156	0.220	0.114
State Controls	YES	YES	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
χ^2-Stat (p-value)	3.50* (0.0614)		5.18** (0.023)		14.64*** (0.000)	

Table 1.9
Heterogeneity in Industry Volatility

Table 1.9 reports regression of changes in dividend payout on a UI dummy and lagged changes in Q, ROA, Debt to Assets, Log(Asset), the logarithm of state income per capita and unemployment rate. Each regression includes year and industry dummies (defined according to the two digits SIC classification). Firms are sorted according to whether their employment volatility (Columns (1) and (2)), revenues volatility (Columns (3) and (4)) and earnings volatility (Columns (5) and (6)) is above or below the yearly median. Each measure is computed by calculating the standard deviation of the rate of change of each measure for each firm over the sample period and then averaging firm-level standard deviations at the industry level. The sample comprises matched and treated firms that experience a UI increase between 1991 and 2007. In the year before a UI increase treated firms are matched by Tobin's Q, the logarithm of total assets, ROA, debt to total assets and industry. Please refer to the Appendix for a definition of the variables. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1) High Empl. Volatility	(2) Low Empl. Volatility	(3) High Earn. Volatility	(4) Low Earn. Volatility
UI	8.708***	3.866	9.360***	3.956
	(2.912)	(3.133)	(1.873)	(2.957)
Observations	366	416	321	461
R-squared	0.087	0.103	0.063	0.097
State Controls	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
χ^2-Stat (p-value)	1.22 (0.269)		3.32* (0.068)	

Table 1.10
Heterogeneity in Labor Intensity

Table 1.10 reports regression of dividend payout on a UI dummy and lagged changes in Q, ROA, debt to assets, Log(asset), the logarithm of state income per capita and unemployment rate. Each regression includes year and industry dummies (defined according to the two digits SIC classification). Firms are sorted according to whether their labor intensity is above or below the yearly median. Labor intensity is measured in Columns (1) and (2) as number of employees divided by Property, Plant and Equipment; in Columns (3) and (4) it is defined as number of employees divided by Total Asset. The sample comprises matched and treated firms that experience a UI increase between 1991 and 2007. In the year before a UI increase treated firms are matched by Tobin's Q, the logarithm of total assets, ROA, debt to total assets and industry. Please refer to the Appendix for a definition of the variables. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1) High Empl./Assets	(2) Low Empl./Assets	(3) High Empl./PP&E	(4) Low Empl./PP&E
UI	9.788***	3.362	10.464***	3.845
	(2.987)	(4.206)	(2.129)	(3.626)
Observations	392	390	393	389
R-squared	0.088	0.160	0.212	0.101
State Controls	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
χ^2-Stat (p-value)	1.64 (0.200)		2.73* (0.098)	

Table 1.11
Heterogeneity in Labor Market Conditions

Table 1.11 reports regression of changes in dividend payout on a UI dummy and lagged changes in Q, ROA, debt to assets, Log(asset), the logarithm of state income per capita and unemployment rate. Each regression includes year and industry dummies (defined according to the two digits SIC classification). Firms are sorted according to whether they belong to industries whose employment growth (Columns (1) and (2)) or wage growth (Columns (3) and (4)) is above or below the yearly median. The sample comprises matched and treated firms that experience a UI increase between 1991 and 2007. In the year before a UI increase treated firms are matched by Tobin's Q, the logarithm of total assets, ROA, debt to total assets and industry. Please refer to the Appendix for a definition of the variables. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1) Low Empl. Growth	(2) High Empl. Growth	(3) Low Wage Growth	(4) High Wage Growth
UI	12.062***	-1.249	10.819***	0.658
	(2.328)	(3.606)	(2.575)	(2.691)
Observations	393	374	392	375
R-squared	0.102	0.148	0.165	0.094
State Controls	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
χ^2-Stat (p-value)	12.44*** (0.000)		8.58*** (0.003)	

Table 1.12
Alternative Interpretations:
Unionization and Demand Seasonality

Table 1.12 reports regressions of changes in dividend payout on a UI dummy and lagged changes in Q, ROA, debt to assets, Log(asset), the logarithm of state income per capita and unemployment rate. Each regression includes year and industry dummies (defined according to the two digits SIC classification). Firms are sorted according to whether they belong to states whose average unionization level (Columns (1) and (2)) is above or below the yearly median, or whether their sales seasonality (measures as the standard deviation of the Log change in quarterly revenues in the previous year (Columns (3) and (4)) is above or below the yearly median. The sample comprises matched and treated firms that experience a UI increase between 1991 and 2007. In the year before a UI increase treated firms are matched by Tobin's Q, the logarithm of total assets, ROA, debt to total assets and industry. Please refer to the Appendix for a definition of the variables. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1) High Unionization	(2) Low Unionization	(3) High Seasonality	(4) Low Seasonality
UI	5.358*	6.905***	5.263	5.980**
	(2.901)	(2.374)	(3.866)	(2.415)
Observations	350	432	389	393
R-squared	0.100	0.075	0.165	0.082
State Controls	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
χ^2-Stat (p-value)	0.23 (0.633)		0.03 (0.860)	

Appendix

This Appendix has additional results and details omitted from the main text for the sake of brevity. Appendix 1.A gives definitions and sources of the main variables used in the empirical analysis. Appendix 1.B provides a brief synopsis of 12 UI benefit increases considered in the text (and of the 6 excluded). Appendix 1.C includes additional robustness checks and evidence on the relationship between UI generosity and leverage.

1.A Data Definitions

Table 1.A.1
Variables Definitions and Sources
This table has definitions and data sources of the main variables used in the paper. Compustat items are in italic.

Variable	**Definition**	**Source**
Dividend Payout	Common Dividend (*dvc*) divided by Net Income (*ni*)	Compustat
Total Payout	Common Dividend (*dvc*) plus Repurchases (*prstkc*), all divided by Net Income (*ni*)	Compustat
Debt to Assets	Long-Term Debt (*dltt*) plus Debt in Current Liabilities (*dlc*), all divided by Total Assets	Compustat
Investment	Capital Expenditures (*capx*) divided by lagged Total Assets (*at*)	Compustat
ROA	Earnings Before Interest, Taxes, Depreciation and Amortization (*ebitda*) divided by lagged Total Assets (*at*)	Compustat
Cash	Cash and Short-Term Investments (*che*) divided by Total Assets (*at*)	Compustat
Repurchase	Repurchases (*prstkc*) divided by Net Income (*ni*)	Compustat
Z-Cash	Cash minus the average cash within the industry divided by its standard deviation	Compustat
Cash Flow	Net Income (*ni*) divided by lagged Total Assets (*at*)	Compustat

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Table 1.A.1 – *Continued from previous page*

Variable	**Definition**	**Source**
Leverage	Book Debt divided by Total Assets (*at*). Book Debt is defined as Total Assets minus Book Equity. Book Equity is Total Assets Total Liabilities (*lt*) minus Preferred Stock (*pstk*) + Deferred Taxes (*txdb*) plus Convertible Debt (*dcvt*). If Preferred Stock Variable is missing, Redemption Value of Preferred Stock (*pstkrv*) is used instead.	Compustat
Leverage	Book Debt (defined as in the variable "Leverage") minus cash (*che*) divided by Total Assets (*at*).	Compustat
Employment Volatility	Average of the firm standard deviation of change in Log(Employment) (*emp*) computed across all firms in each industry (defined at the 2-digits SIC level) between 1991 and 2007. Only firms with at least 5 non-missing observations are kept.	Compustat
Earnings Volatility	Average of the firm standard deviation of change in ROA computed across all firms in each industry (defined at the 2-digits SIC level) between 1991 and 2007. Only firms with at least 5 non-missing observations are kept.	Compustat
Q	Total Assets plus Market Value of Equity (*csho* $\times$ *prcc_f*) minus Common Value of Equity (*ceq*), all divided by Total Assets	Compustat
Labor Intensity	Number of employees (*emp*) divided by either Total Assets (*at*) or Property, Plant and Equipment (*ppent*)	Compustat
Seasonality	Standard Deviation of change in the logarithm of quarterly revenues (*saleq*) over the year	Compustat Quarterly
EPS	Last analysts' consensus (average) forecast of earning per share preceding the end of the firm fiscal year divided by share price at the end of the fiscal year	I/B/E/S and CRSP
Recommendation	Last analysts' consensus (average) recommendation preceding the end of the firm fiscal year on a 1 (strong sell) to 5 (strong buy) scale	I/B/E/S

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Table 1.A.1 – *Continued from previous page*

Variable	**Definition**	**Source**
LT Growth	Last analysts' consensus (average) forecast of long term earnings growth preceding the end of the firm fiscal year	I/B/E/S
Income	State Income per Capita	US Bureau of Economic Analysis
UI	A dummy equal to 1 if the firm's headquarter is in a state that experiences an increase in the maximum unemployment benefit of at least $100 (in 2010 dollars)	Elaborations from "Changes in Unemployment Insurance Legislation" in several editions of the "Monthly Labor Reviews" (Bureau of Labor Statistics)
Unionization	State Union Coverage Density	Hirsch and Macpherson UnionStats Database
Unemployment Rate	State Unemployment Rate	US Bureau of Labor Statistics
Industry Wage Growth	Yearly Percentage Average Wage Growth at the industry level (defined at the 4-digits NAICS level)	US Bureau of Labor Statistics
Industry Employment Growth	Yearly Percentage Employment Growth at the industry level (defined at the 4-digits NAICS level)	US Bureau of Labor Statistics

1.B Case Studies

In this Appendix I reconstruct briefly the political environment surrounding the twelve UI changes for which I was able to obtain sufficient information through newswire and articles searches in Factiva, Lexis Nexis and Google. I also add some details regarding concurrent policies adopted. I first describe the 12 events which I judged unconnected to macroeconomic or unrelated to the adoption of significant additional policies, and then the 6 excluded events. More details about the screening criteria are in Section 1.4.3.

Selected Events

(1) Florida 1992
Maximum Unemployment benefits was raised from $225 to $250 a week. For the previous 11 years, lawmakers had increased the benefit cap every few years in $25 increments. The measure passed the Senate with a close vote (18-16) because some senators had originally proposed a percentage increase anchored to the average statewide weekly wage. The proposal was rejected as it would have implied an automatic increase each year. The increase was estimated to cost $37 million out of the $104 million of Unemployment Benefits Trust Fund. *(Source: St. Petersburg Times, 06/06/1992)*

(2) Missouri 1997
Missouri increased maximum payment from $175 to $205, to increase $15 a year up to $250 in 2001. The most recent increase was in 1992, by $5. The bill was a compromise between business lobbies and unions motivated by the strikes occurred the same year at the McDonnell Douglas plant, where many business groups were outraged when the state granted benefits to strikers. Under the new bill, workers' representatives accepted that no benefits would be paid to strikers, but obtained the raise in the maximum weekly cap. *(Source: St. Louis Post-Dispatch, 05/21/1997)*

(3) New York 1998
On August 14th, Governor Pataki, at that time running for re-election, signed into law raising maximum unemployment benefits from $300 to $365 per week, with an additional increase in 2000 up to one-half the state's average weekly wage. It was the first increase in six years. The law was the outcome of negotiations with the AFL-CIO and the Business Council of New York state, a lobbying group representing corporate interests. The new law also put in place a wage reporting system, in which computerized information from the state tax department will be used to verify wages, a system less prone to fraud. New York had been the only state in the nation not using a wage reporting system at that time. *(Source: Buffalo News, 08/14/1998)*

(4) Virginia 2000
Governor Gilmor signed the so-called "Tultex bill," a reference to the textile company that laid off 2,000 workers. The bill initially was meant to boost unemployment benefits and provide health insurance for unemployed textile workers. Both Gilmor and the Republicans congressmen felt it would be unfair to raise jobless benefits for Virginians in some parts of the state and not others. After a lengthy political battle, a bill backed by Gilmore that raised the maximum weekly unemployment benefits by $36, to $268, passed the legislature. *(Sources: KRTBN Knight Ridder Tribune Business News, 04/20/2000; Associated Press Writer, 03/11/2000)*

(5) California 2001
On October 1st, Governor Davis signed a legislation boosting unemployment benefits by $100 a week starting from January 1, 2002, the first raise in nine years. Davis vetoed a similar legislation the previous year but, lagging in public opinion polls, was seeking to shore up support from organized labor, which had made an increase in unemployment benefits one of its top priorities. The bill established additional increases amounting in $40 per week each year until 2005, when the maximum unemployment insurance check reached $450 per week. No increase in UI taxes

were expected in the near future because, as a result of the booming economy in the late 1990s, California's unemployment insurance trust fund amounted to more than $6 billion. *(Source: Los Angeles Times, 10/01/2001)*

(6) Tennessee 2001

The legislation signed by Governor Sundquist increased the maximum weekly unemployment benefit by $20 to $275. This was part of a compromise with lobbyists for labor and business. Union leaders obtained the increase and accepted that certain companies would continue getting state-funded training for their workers under the state Job Skills program for another five years. *(Source: Associated Press Newswires, 07/06/2001)*

(7) Georgia 2002

Governor Barnes approved and increase in unemployment benefits to be phased in over two calendar years to $300 per week from the current $284. In 2003, benefits went up by $6 a week, followed by a $10 increase during 2004. Because of a healthy state's fund, no increases in unemployment taxes were foreseen. The main additional provision was a sales-tax holiday for clothing, school supplies, and computer equipment, in an attempt to curry favor with Georgia businesses during Barnes' (failed) re-election campaign. *(Source: Associated Press Newswires, 02/06/2002)*

(8) Maryland 2002

Maximum unemployment benefits were increased by $30 (from $280 to $310) as a result of protests by unemployed workers and their families in conjunction with union, community, and religious leaders. All parties petitioned for more generous unemployment insurance following the $143 million the state Unemployment Insurance system received as a result of the economic stimulus bill passed by the US Congress. Had the Assembly not taken action before their April 8th session, the infusion of the new federal funds would have triggered an automatic reduction in the unemployment taxes paid by state employers. *(Source: U.S. Newswire, 03/28/2002)*

(9) Michigan 2002

Maximum unemployment benefits were increased by $62 (from $300 to $362) by Governor Engler, the first time since 1995. The law passed after weeks of debate and failed deals, with one GOP House member even losing his committee chairmanships in the political dispute and more than 1,500 workers protesting the delay in the benefit increase on the Capitol lawn. The most controversial point was the "waiting week" requested by Republican legislator and business lobbies, which was opposed by unions. The legislation in the end did not include such provision but reduced the maximum cap to $362, relative to the initially planned $415. No other provisions regarding taxes were included in the bill. *(Sources: Associated Press, 04/19/2002, 04/26/2002; U-Wire, 08/05/2002)*

(10) New Hampshire 2002

New Hampshire increased the maximum benefits cap from $331 to $372. Governor Jeanne Shaheen, who would soon be involved in the state Senate elections, urged lawmakers to act on the bill. Among the reasons cited were the layoffs of mill workers in the Berlin area that had occurred the previous year. No tax increases were expected to occur. *(Source: Associated Press, 02/13/2002)*

(11) Arizona 2004

Governor Napolitano signed a legislation increasing maximum unemployment benefits from $205 to $240 in April 2004, after she vetoed a similar bill during the previous year. The bill was declared dead by a Republican congresswoman, as unions and business groups lobbies could not find an agreement. A business lobby obtained the inclusion of stricter eligibility restrictions on payment of unemployment benefits while former employees receive severance pay, whereas unions condensed an initially planned two-step increase in an immediate boost of maximum claim. *(Sources: Associated Press, 04/02/2004, 03/17/2004, 04/07/2004, 05/17/2004)*

(12) Alabama 2006

Governor Riley signed into a low a bill raising the maximum cap from $220 to $230 (and to $235 the following year). No other provision were included in the bill. According to the president of the Alabama AFL-CIO "the legislation was needed because Mississippi had decided to raise its lowest-in-the nation unemployment compensation rate, and Alabama would have become the lowest paying state." *(Source: Associated Press, 04/17/2006)*

Excluded Events

(1) Florida 1997

Governor Chiles approved an increase in the maximum weekly benefit of $25 (from $250 to $275). The idea was suggested first by unofficial gubernatorial candidate Jeb Bush, who, given the large surplus in the state unemployment fund, suggested a one year $158 million tax cut. The bill also had tax cuts for new businesses. In order to appeal to labor advocates, however, the bill also included an increase in the weekly benefit cap. Some labor advocates and a few Democrat House members argued that the bill was disproportionately favoring businesses over workers. *(Sources: Associated Press, 04/18/1997; St. Petersburg Times, 03/07/1997)*

(2) Louisiana 1997

Louisiana increased maximum unemployment benefits from $193 to $215 following a compromise between labor and business unions regarding how to employ the state trust fund, which had reached over $1 billion. After an initial request made by unions of an increase up to $230, closer to the southern average, the measure passed, together with a reduction in employers' unemployment taxes and a worker training fund for businesses. *(Sources: Associated Press, 04/18/1997, 09/19/1997)*

(3) Arizona 1998

Governor Hull signed a legislation increasing weekly benefits from $185 to $195 in 1999 and $205 in 2000. The decision was part of a large-scale plan for business tax cuts, including one in the vehicle license tax, an increase in exemptions for personal income taxes, and cuts in personal income tax as well. As a political compromise, Democrats managed to add a provision to increase state payments to unemployed workers. *(Sources: Associated Press, 03/17/1998, 03/25/1998, 04/16/1998, 04/24/1998)*

(4) Kentucky 1998

Maximum unemployment benefits were increased $32 (from $256 to $288) by Governor Patton. The legislation was made possible by the healthy state of the UI fund (which had risen to $555 million, well above the $350 million required by the Kentucky law), which had a $24 million surplus and was accompanied by reduction in the UI tax rates. *(Sources: Associated Press, 02/04/1998, 03/23/1998; Capital Markets Report, 03/24/1998)*

(5) Georgia 1999
Maximum unemployment benefits were increased by $40 in Georgia, jointly with the approval of a large-scale four-year tax cut put forward by Governor Roy Barnes. This was part of his first year legislative agenda, and was made possible by the fact that state's unemployment reserve held in Washington was at about $2 billion. Similar tax cuts were approved by other Southern states (Florida, Virginia, South Carolina and North Carolina). *(Sources: The Atlanta Constitution, 04/28/1999; Associated Press, 04/27/1999)*
(6) Alabama 2002
In April, Alabama increased the maximum weekly cap by $20 (from $190 to $210) due to pressure from labor unions (Alabama was still at the last place in the country) and thanks also to $111 million from a federal economic stimulus package to help the unemployed. Business lobbies would have accepted an even larger increase, but requested a one-week waiting period before laid-off workers could qualify, which was rejected by unions. Although initially no tax change was foreseen, a later change to slightly increasing UI taxes was approved. *(Source: Associated Press, 04/17/2002)*

1.C Additional Results and Robustness Checks

This Appendix has additional robustness checks. Table 1.C.1 shows that analysts forecasts for the treated and control firms selected according to the procedure outlined in Section 1.4.3 do not differ prior to the UI changes. Following Fresard and Valta (2003), I consider three measures: average sell/buy recommendation (which varies between 1 and 5, with higher values corresponding to more optimistic forecasts), average of earnings per share forecast standardized by the stock price at the end of the fiscal year, and average Long Term Growth, which is the mean 5-years growth earnings forecast. None of the differences in mean are statistically significant.

In Table 1.C.2, I employ three alternative measures of change in dividend payout as dependent variables. In Column (1) the dependent variable is the change in common dividend between year $t+1$ and year t, all scaled by net earnings. In Column (2) the dependent variable is the change in dividend over total assets. Column (3) is the change in dividend per share. Results are qualitatively similar to those of Table 5. In Columns (4) and (5) I split the sample according to whether the firms in the sample have paid any dividends at time t.

Un Table 1.C.3 I use, as dependent variables, the change in book leverage and net leverage. In Columns (3) and (4) equation 1.1 is estimated on a sample of treated and control firms with negative earnings in year t. The matching procedure is identical to that described in Section 1.4.3.

Table 1.C.1
Treated VS Control Firms: Analysts' Forecasts

Table 1.C.1 reports means of treated and control firms control variables, matched according to the procedure outlined in Section 1.4.3. Variables definitions are in Appendix 1.A. Δ is the difference operator.

	Treated (Std. Error)	Control (Std. Error)	Treated - Control (Std. Error)
Levels			
Recommendation	1.989	2.038	-0.048
	(0.045)	(0.045)	(0.072)
Growth	18.66	18.15	0.507
	(1.383)	(0.619)	(1.465)
Earnings	0.043	0.041	0.002
	(0.005)	(0.004)	(0.007)
Trends			
ΔRecommendation	-0.007	-0.000	-0.007
	(0.005)	(0.003)	(0.006)
ΔGrowth	0.001	0.045	-0.044
	(0.025)	(0.032)	(0.037)
ΔEarnings	-0.950	-0.624	-0.325
	(0.276)	(0.296)	(0.400)

Table 1.C.2
Alternative Payout Measures and
Intensive VS Extensive Margin

Table 1.C.2 reports regressions of different measures changes in dividend payout on a UI dummy and several control variables and lagged changes in Q, Log(assets), debt to assets, ROA, Log(income) and unemployment rate. In Columns (1), (4) and (5), the dependent variable is the change in common dividend between year *t+1* and year *t* scaled by earnings in year *t*. In Column (2) it is the change in common dividend scaled by total assets. In Column (3) it is the change in dividend per share. Column (4) includes only firms with zero dividend payout at time *t*; Column (5) includes only firms with positive dividend payout at time *t*. Each regression includes year and industry dummies (defined according to the two digits SIC classification). The sample comprises matched and treated firms that experience a UI increase between 1991 and 2007. In the year before a UI increase treated firms are matched by Tobin's Q, the logarithm of total assets, ROA, debt to total assets and industry. Please refer to the Appendix for a definition of the variables. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
	$\frac{Div_{t+1} - Div_t}{Earnings}$	$\Delta \frac{Div}{Assets}$	$\Delta \frac{Div}{Shares}$	Zero Div.	Pos. Div.
UI	0.814***	0.228**	6.116*	1.753***	12.372**
	(0.298)	(0.106)	(3.146)	(0.563)	(5.787)
Observations	983	782	782	477	305
R-squared	0.079	0.053	0.291	0.033	0.156
Year FE	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES
State Controls	YES	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES	YES

Table 1.C.3
UI and Leverage

Table 1.C.3 reports regressions of changes in leverage (Columns (1) and (3)) and net leverage (Columns (2) and (4) on a UI dummy and lagged changes in Q, ROA, debt to assets, Log(asset), the logarithm of state income per capita and unemployment rate. Each regression includes year and industry dummies (defined according to the two digits SIC classification). The sample comprises matched and treated firms that experience a UI increase between 1991 and 2007. In the year before a UI increase treated firms are matched by Tobin's Q, the logarithm of total assets, ROA, debt to total assets and industry. Please refer to the Appendix for a definition of the variables. The sample of Columns (1) and (2) includes only firms with positive earnings in year *t* and *t+1*. In Columns (3) and (4) the same matching procedure is adopted, but requiring each firm to have negative earnings in year *t*. Standard errors, clustered at the state level, are reported in parentheses. *, ** and *** denote statistical significance at the 10% 5%, and 1% levels, respectively.

VARIABLES	(1) Positive Earn. Leverage	(2) Positive Earn. Net Leverage	(3) Negative Earn. Leverage	(4) Negative Earn. Net Leverage
UI	-0.005	0.005	0.022*	0.031**
	(0.006)	(0.008)	(0.013)	(0.013)
Observations	736	735	582	582
R-squared	0.214	0.111	0.079	0.064
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
State Controls	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES

Chapter 2

Managerial Duties and Managerial Biases

2.1 Introduction

Managerial biases, and especially managerial overconfidence, appear to have significant explanatory power for corporate decisions. The idea that personal "traits" matter for organizational outcomes dates back at least to Hambrick and Mason (1984). Recent empirical work has provided convincing evidence of the significant role of individual traits in investment, merger, and financing decisions (see, e.g., the overview in Baker and Wurgler (2013)). The spectrum of managerial traits considered in the corporate-finance literature ranges from risk aversion, education, childhood experiences, and gender to behavioral biases such as overconfidence, loss aversion, and escalation of commitment.[1] Kaplan, Klebanov, and Sorensen (2012) argue that these traits and biases have a first-order impact on corporate performance. The behavioral corporate-finance literature, and in particular theoretical and empirical research on managerial biases, is currently the fastest-growing strand of behavioral finance research.[2]

Much of this research focuses on one type of manager, typically the chief executive officer (CEO). The emphasis on CEOs reflects both their central role as the top decision maker in their firm and, more mundanely, data availability. Few papers touch on the roles of other top managers, such as the chief financial officer (CFO),[3] and even less attention has been paid to interaction effects between managers: Do other managers in a given firm tend to adhere to similar beliefs, and what is the joint effect? If other top-level managers are not subject to the same biases as the CEO, why are they not able to correct the biased decision-making of the CEO? If they are instead subject

[1]See Graham, Harvey, and Puri (2013), Bertrand and Schoar (2003), Malmendier and Tate (2005),Malmendier and Tate (2008) , Malmendier, Tate, and Yan (2011), Chevalier and Ellison (1997), Huang and Kisgen (2013), Faccio, Marchica, and Mura (2016), Yim (2013), Camerer and Malmendier (2012), Bazerman and Neale (1992), and Ross and Staw (1993), among others.

[2]Malmendier (Forthcoming) shows the publication growth rates of different fields within behavioral finance, including the explosion (31-70%) in research on managerial biases and ties over the last years, compared to 9-12% in other behavioral finance research.

[3]Notable examples of CFO studies include Ben-David, Graham, and Harvey (2007),Ben-David and Graham (2013) , Jiang, Petroni, and Wang (2010), and Chava and Purnanandam (2010). Studies that analyze several of the C-suite managers include Aggarwal and Samwick (1999), Datta, Iskandar-Datta, and Raman (2001), and Selody (2010).

to the same biases, might prior research misattribute outcomes to the CEO as it does not account for the traits of other managers? Indeed, misattribution is likely if there is assortative matching of managers of a similar type.

In other words, accounting for managers other than the CEO is crucial if we want to assess the magnitude of biases and their empirical relevance for corporate outcomes. It is also relevant when devising corporate-governance responses to biased managerial behavior, as it affects how boards should compose the C-suite. For example, it is an oft-discussed question whether one type of managerial personality on the board should counterbalance the other, or whether it is better if managers have compatible beliefs and styles.

In this paper, we take a first step towards addressing these questions. We focus on corporate financing choices as outcome variables, and analyze the respective influence of CEO and CFO overconfidence. Our focus on corporate financing choices as the outcome variable reflects our aim to analyze a set of corporate decisions over which two different types of managers plausibly exert a large influence the CEO since she is the ultimate decision-maker, and the CFO since the firm's financial activities and operations are his core responsibilities (see, e.g., Berk and DeMarzo (2007)).[4] Our focus on overconfidence as the managerial trait reflects the fact that this particular bias is the most extensively researched and most robustly documented non-traditional influence on corporate decision-making, or "the mother of all biases," as Bazerman (2006) put it.[5] In the context of our analysis, we define managerial overconfidence as managers' overoptimistic belief about future cash flows accruing to their firm. To proxy for such overestimation, we employ the widely used measure of personal overinvestment in the firm in the form of delayed option exercise (see, e.g., the overview in Malmendier and Tate (2015)). The basic idea of our empirical proxy is that managers who overestimate the future returns to their firm tend to bet on future stock-price increases and overinvest, personally, in their companies. One way to do so while avoiding concerns about negative signaling, is to not exercise in-the-money executive stock options. Using this proxy, we find that optimistic beliefs of both the CEO and the CFO tilt external financing towards debt. However, the CFO's beliefs strictly outweigh those of the CEO in predicting debt issuance and leverage decisions. At the same time, we also find that CEO overconfidence matters indirectly as it affects the cost of financing: Firms with overconfident CEOs tend to obtain significantly better financing conditions, i.e., lower interest rates on their corporate loans. Moreover, the latter result is driven by firms with a medium range of variability in earnings, that is, by firms for whom the CEO's overly positive beliefs make a difference for project continuation in the bad states of the world. In other words, this finding indicates that the influence of overconfidence on the cost of financing reflects the better motivation and effort of overconfident CEOs, even when facing bad states of the world. Finally, we also show that overconfident CEOs tend to select like-minded CFOs when given the opportunity, confirming the presence of assortative matching.

[4]Our approach can be applied to other C-suite managers, e.g., the COO and operating decisions. The intersection of ExecuComp and Thompson data is currently too small to perform such an analysis in our data. (See Section 2.3.1 for details about the construction of the data set.)

[5]Malmendier (Forthcoming) calculates that 53% of all papers on managerial biases published in top finance and economics journals analyze overconfidence biases. See also Meikle, Tenney, and Moore (2016) for a survey of the large research on the organizational consequences of overconfidence in firms.

Our theoretical framework differs from previous work on CEO overconfidence (Malmendier and Tate (2005), Malmendier and Tate (2008)) in two important dimensions. First, we allow both CEOs and CFOs to exhibit overconfidence. Here, it is important to be precise about the definition. In the CEO's case, overconfidence reflects a biased belief in her own abilities to generate returns. In the CFO's case, overconfident beliefs stem from overestimating the CEO's ability to create value in the firm, i.e., reflect an overoptimistic belief in another person (the CEO) or in the firm. Despite these differences, we stick to a common label, overconfidence, both for simplicity and because both biases directly link to the same empirical measure, late exercise of executive stock options, precisely under this definition. A second difference relative to some of the prior work is that we consider how the CEO's optimistic beliefs affect her effort. Our model illustrates the circumstances under which overconfidence induces a CEO to exert more effort than a rational CEO, and how the CFO, in turn, accounts for such behavior in his financing choice.

The model generates three main testable predictions. First, holding constant the CEO's type, an overconfident CFO exhibits a preference for debt when accessing external finance. Intuitively, overconfident CFOs perceive the value of their firm (or, the stream of future cash flows generated by the CEO's investment choices) to be underestimated in the broader market. Since equity prices are more sensitive to differences in opinions about future cash flows, overconfident CFOs find equity too costly ("even more overpriced") relative to debt. This argument is similar to the prediction for CEOs in Malmendier, Tate, and Yan (2011), with the important difference that, arguably more realistically, the CFO exerts a major influence on the means of financing. While we will also analyze, empirically, the role of the CEO in determining the type of financing, we focus the theoretical analysis on the case in which capital structure decisions are delegated to the CFO. Second, we show a significant *indirect* influence of CEO overconfidence on financing, even when we shut down any direct influence: The CEO's bias can lower the cost of financing, especially for firms in intermediate ranges of profit variability. The reason is that overconfident CEOs overestimate returns to effort. These optimistic beliefs induce higher effort, similarly to the mechanisms in Pikulina, Renneboog, and Tobler (2014) or Gervais, Heaton, and Odean (2011), as the reactions of an overconfident and a non-overconfident CEO to negative profitability shocks differ. Following a negative shock, a rational CEO is less willing to work hard than an overconfident CEO, who might be optimistic enough to work towards the good outcome regardless. In this case, overconfidence helps solve the incentive problem. Anticipating such behavior, debtholders will require a higher premium on debt from a rational than from an overconfident CEO.

The model also generates the refined prediction that the association between CEO overconfidence and cost of debt should vary non-monotonically with profit variability: A severe shock diminishes the incentives to work for any type of CEO, and a mild shock might not matter much for the effort choice of either type of CEO. After an intermediate shock, however, a rational CEO might anticipate the project to be out of the money and not exert effort, while an overconfident CEO overestimates the returns to effort and might work hard. This "non-monotonicity" is specific to our model of biased beliefs and helps rule out alternative explanations under which CEO overconfidence is a proxy for some omitted firm characteristic.

Finally, the model also illustrates another indirect channel through which CEO overconfidence affects financing, namely hiring. We show that an overconfident CEO who is in the position to select a new CFO is more likely to choose an overconfident one. The intuition is straightforward: To the extent that the CEO delegates capital-structure decisions to the CFO, she prefers to hire a CFO who shares her views regarding the firm's profitability. As CEOs have a significant say in the selection of board members (Shivdasani and Yermack (1999); Cai, Garner, and Walkling (2009); Fischer et al. (2009)), who are in turn in charge of the CFO choice, this prediction implies a potential multiplier effect of overconfident managers.

All predictions find strong support in the data. We employ the "Longholder_Thomson" measure from Malmendier, Tate, and Yan (2011), which uses delayed option exercise as a proxy for managerial overconfidence, relative to a benchmark model of optimal exercise of executive stock options. We replicate their CEO measure, and generate a parallel CFO measure. As a robustness check, we also construct a continuous version of our Longholder proxy following recent work by Otto (2014).

First, we analyze the roles of the CEO and the CFO in the choice between debt and equity, conditional on accessing external sources of financing. Using various measures of net debt issuance from Compustat and SDC, as well as traditional financing-deficit models, we find that overconfident executives are reluctant to issue equity. We also find a positive association between overconfidence and leverage choices. CFO overconfidence is statistically and quantitatively more important than CEO overconfidence and, if analyzed jointly, CEO overconfidence is insignificant in our data. Thus, the manager whose beliefs matter for capital budgeting decisions directly appears to be the CFO, not the CEO, who was singled out in prior research.[6] At the same time, CEO overconfidence exhibits a strong indirect influence by affecting investors' assessment of risk and the resulting cost of financing.

To test the second model prediction, on the cost of financing, we merge the DealScan data on syndicated loans with our data set. We show that, conditional on the known determinants of the cost of debt, overconfident CEOs pay significantly lower interest rates. The effect is non-monotonic in the manner predicted by our model: We estimate a significant effect only for companies with intermediate profit variability. This holds regardless of whether we use earnings volatility, analysts' coverage, or analysts' forecasts variability as proxies for profit variability, and robustly so over a broad range of cutoff points for the intermediate' range. The latter result also addresses concerns about other, unobserved determinants of the cost of debt. Such alternative determinants would need to exhibit the same non-monotonic influence on financing, and to be correlated only with the CEO Longholder variable, not the CFO Longholder variable.

Finally, we also show that companies with overconfident CEOs are more likely to appoint like-minded CFOs. The statistical and economic magnitudes of the effect are large. Thus, CEOs exert indirect influence on corporate financing also via their influence on CFO selection.

Overall, our findings confirm the thrust of the existing literature by providing evidence on the significant role of managerial biases on corporate outcomes. By focusing on the CFO and showing that his beliefs significantly affect outcomes in his domain, we help to complete the literature on managerial overconfidence, which has been more focused on the CEO, or at least did not consider

[6]Note that our estimates are not directly comparable to the earlier literature in that, in our more recent data, we do not detect strong CEO effects in capital structure decisions to begin with, even when neglecting the CFO.

the interplay of CEO and CFO. The domain-specific relevance of managerial overconfidence (i.e., CFO overconfidence for financing tasks, CEO overconfidence for other managerial tasks) also corroborates the empirical importance and interpretation of the widely used Longholder measure of overconfidence. At the same time, our results caution against the focus on one single manager that characterizes much of the existing literature. In considering only one manager, empirical analyses might misattribute outcomes to CEO biases and fail to recognize multiplier effects. Our results suggest that previously identified effects of CEO overconfidence on the choice of external financing may reflect biases of the CFO though with the explicit caveat that our newer data does not suggest strong CEO effects in capital structure decisions to begin with, even when neglecting the CFO. Our estimates are thus not comparable and cannot be interpreted as contradicting prior findings. At the same time, the impact of CEO biases may increase rapidly whenever the CEO has the opportunity to select other top managers. Our research suggests that the managerial-traits analysis might need to move towards more complete firm data sets, including several or all top managers who influence firm outcomes.

Literature Review. In addition to the literature on managerial traits cited above, our analysis builds on previous work on the role of CFOs and their biases in determining corporate outcomes, including, among others, Ben-David, Graham, and Harvey (2007), Ben-David and Graham (2013), Jiang, Petroni, and Wang (2010), and Chava and Purnanandam (2010). Using a methodology similar to Bertrand and Schoar (2003), Ge, Matsumoto, and Zhang (2011) find that CFO "style" is related to a number of accounting choices. Huang and Kisgen (2013) establish a link between the gender of CEOs and CFOs and the returns to acquisitions (where male executives are likely to be more overconfident). Outside the behavioral realm, Jiang, Petroni, and Wang (2010) and Kim, Li, and Zhang (2011) show that CFOs' equity incentives have much stronger explanatory power for earnings management and stock crashes than those of CEOs. In this paper, we confirm that the traits of CFOs have more explanatory power than those of CEOs for financing decisions, and we are the first to bring this comparison to the realm of overconfidence, and to jointly consider different managers and the indirect channels through which the beliefs of CEOs still matter.

Our paper also extends the literature that links overconfidence to capital-structure decisions. Graham and Harvey (2001) present survey evidence suggesting that CFOs' reluctance to issue equity may reflect overconfidence. From a theoretical perspective, Hackbarth (2009) predicts higher debt ratios for managers who overestimate earnings growth. Landier and Thesmar (2009) and Graham, Harvey, and Puri (2013) confirm empirically that overconfidence is associated with higher leverage and, in particular, a preference for short-term debt. Consistent with this prior work, our model connects overconfidence with higher debt ratios, but we also find that overconfidence at the CFO level, rather than at the CEO level, matters most in this context.

With our second set of results, on CEO overconfidence predicting better terms of financing, our paper also contributes to the literature emphasizing the "bright side" of overconfidence. Ever since the influential paper by Roll (1986) on the link between managerial "hubris" and poor returns to acquirers, it has been a puzzle why boards continue to appoint overconfident managers, who exhibit poor decision making in a host of contexts (see the overview in Malmendier and Tate (2015)). More recent papers point out that overconfident managers may increase firm value (Goel and Thakor (2008)), engage in more innovative activities (Hirshleifer, Low, and Teoh (2012)), and require lower levels of incentive compensation for a given amount of effort (Otto (2014)). Others argue that (mild) overconfidence can prevent underinvestment (Campbell et al. (2011)), reduce conflicts between bondholders and shareholders such as the debt overhang problem (Hackbarth (2009)), or can be advantageous in oligopolistic market settings with strategic interaction between firms (Englmaier (2010), Englmaier (2011)). Consistent with this latter view, our theoretical model illustrates that overconfident CEOs may exert more effort, consistent with the work of Gervais and Goldstein (2007) and Hilary et al. (2016). We provide a new angle on the "bright side" of overconfidence by showing that overconfident CEOs obtain lower interest rates on corporate loans. Moreover, we also sort out the firms that may benefit most from hiring an overconfident manager by identifying companies with intermediate ranges of profit variability as most affected.

Finally, our model relates to recent studies of dissent between managers in organizations (Landier and Thesmar (2009); Landier et al. (2013)), which suggest that CEOs are more likely to hire like-minded executives.[7] Our empirical results support this hypothesis in the context of an easily measurable, widely studied, and relevant personal bias, managerial overconfidence. As such, our findings also relate to the finding in Goel and Thakor (2008) that overconfident managers are more likely to be appointed as CEOs. Here, we ask who is likely to be chosen as CFO conditional on the overconfidence of the CEO. We expect the commonality of personal traits to play an important role. For example, Graham, Harvey, and Puri (2015) report that 48.2% of the CEOs they survey claim that "gut feel" is an important element in their decision to delegate corporate investment tasks to lower level executives.

In the remainder of the paper we first introduce our theoretical framework and generate the three main predictions about the impact of CEO and CFO overconfidence on firm outcomes (Section 2.2). We then introduce our data and measures of CEO and CFO overconfidence (Section 2.3). We relate these measures to the choice of financing in Section 2.4, and to the terms of financing in Section 2.5. In Section 2.6, we study the CFO hiring decisions, revealing the endogeneity of the relationship between CEO and CFO overconfidence. Section 2.7 concludes.

2.2 Theoretical Framework

2.2.1 Setting of the Model

We consider a simple model of investment and financing to capture the effect of distorted beliefs of CEOs and CFOs on corporate decision-making. The role of the CEO ("she") is to make an investment decision, whereas the CFO ("he") chooses the financing of the investment. The project costs I and generates an uncertain return $\tilde{R}$, which equals either $I+\sigma$ or $I-\sigma$, each with probability 1/2, where $\sigma \in (0,I]$ measures the "return variability." If the CEO exerts effort, she increases the expected return to $\tilde{R}+\Delta$.[8] Effort is costly, which is modeled as giving up a private benefit , similarly

[7] Also related is empirical work analyzing when and where managers are more likely to delegate their decisions, such as Graham, Harvey, and Puri (2015), Acemoglu et al. (2007), and Bloom, Sadun, and Van Reenen (2012).

[8] Note that, if the CEO does not exert effort, the expected net return is zero. This assumption merely serves to reduce the number of cases to consider, e.g., to exclude cases of severe financial constraints (very low $\tilde{R}$) or cases

to the approach in Dewatripont and Tirole (1994) Holmstrom and Tirole (1997), and Holmström and Tirole (1998)[9]. For simplicity, we assume no discounting, and there are no other assets.

The firm has no internal funds, and the CFO's job is to raise external financing, either by issuing debt with a face value of D, or by issuing shares for a fraction γ of the firm.[10] External investors are risk neutral and must break even in equilibrium. As in previous models of overconfidence (Malmendier and Tate (2005), Malmendier and Tate (2008)), we abstract from the problem of optimal compensation. We simply assume that the CEO and the CFO own a fraction α and β of the firm, respectively, where $\alpha, \beta > 0$ and $\alpha + \beta \leq 1$ This assumption is common in the literature on managerial myopia (cf. Stein (1989); Edmans (2009)), and ensures that managers "care" about firm value.

Managers might be rational, or they might exhibit overconfidence. We define managerial overconfidence as managers' overoptimistic beliefs about the future cash flows accruing to the firm when the CEO exerts effort. Specifically, an overconfident CEO overestimates the return to her effort by an amount ω. That is, she believes that by exerting effort, she increases cash flows by an amount $\Delta + \omega$. Similarly, an overconfident CFO also overestimates the returns to the CEO's efforts by ω. That is, an overconfident CFO believes that whenever the CEO exerts effort, the return of the project increases by $\Delta + \omega$. Both managers are aware of each other's beliefs. When one manager is biased and the other is not, they "agree to disagree." At the cost of some ambiguity in the notation, we refer to both belief distortions as "overconfidence." The common label is appropriate in our context, despite the subtle differences between CEO and CFO overconfidence, as the proper empirical proxy for both biases is the same, late option exercise. However, for a CFO, late option exercise indicates an overestimation of the future returns to the company at which he is employed with, not necessarily an overestimation of his ability.

We focus the analysis on the parameter range $\Delta > B/\alpha \geq \omega$, which is the range where moral hazard affects both rational and overconfident CEOs. The first inequality guarantees that the CEO's effort is not only socially valuable ($\Delta > B$), but also valuable to the (rational) CEO given the compensation arrangement ($\alpha\Delta > B$). The second inequality implies that the additional return to effort an overconfident CEO mistakenly expects to obtain ($\alpha\omega$) is bounded above by the private benefit from shirking B.[11]

The CEO maximizes her expected utility, given by a fraction α of the expected (net) return plus (if applicable) the private benefit. The CFO maximizes his expected payoff, given by a fraction β

where moral hazard becomes irrelevant to financing (very high $\tilde{R}$).

[9]See also Tirole (2010), Pagano and Volpin (2005), and Matsa (2010), among others. In these papers, is interpreted as the benefit from working on other projects (which reduces the expected revenue of the main project), or as the personal benefits of a "softer" management style toward workers (such as less stress and confrontation), or simply as the opportunity costs from managing the project diligently.

[10]For tractability, we do not consider the possibility of issuing debt and equity simultaneously.

[11]These restrictions merely serve to streamline the theoretical discussion. The result that overconfidence helps obtain better financing terms is robust to removing the restriction. Broadly speaking, if the first part of the double-inequality does not hold, i.e., $\Delta \leq B/\alpha$, the rational CEO never exerts effort (except in the knife-edge case $\Delta = B/\alpha$). If the second part does not hold, i.e., $B/\alpha < \omega$, the optimal debt contract becomes more complicated, but without generating new insights. The assumption does, however, affect the CFO's funding choice. We analyze all of these variations and show the robustness of our results in detail in Online Appendix 2.A.5.

of the expected return. Both managers form expectations using their personal beliefs.[12]

Investors anticipate correctly the true expected payoffs of the investment project. This modelling choice embeds two assumptions. First, as in previous literature (see Malmendier and Tate (2005), Malmendier and Tate (2008)), investors do not share managers' overly optimistic views. Second, in equilibrium investors rationally predict the effort a CEO will put into the project. For example, they might recognize managerial overconfidence and anticipate how it will affect managerial behavior.[13]

The timing is as follows. At $t = 0$, the CEO announces the planned investment project, and the CFO chooses between debt and equity financing. If funding is obtained, then the profitability of the investment is revealed at $t = 1$, i.e., everybody learns whether the return equals $I + \sigma$ or $I - \sigma$. At $t = 2$, after having observed the realization of $\tilde{R}$, the CEO decides whether to exert effort. At $t = 3$, the cash flow is realized and investors are repaid. Figure 1 shows the full timeline. The dotted line on the left captures the extended model from Section 2.2.5, where we analyze the endogenous pairing of CEO and CFO overconfidence during a pre-period $t = -1$.

2.2.2 CEO Overconfidence and Moral Hazard

Solving backward, we first analyze the effort decision of the CEO at $t = 2$, given the capital structure choice of the CFO at $t = 0$. We will then turn to the CFO's problem.

We denote the return the CEO expects to obtain from exerting effort as $\Delta + \hat{\omega}_{CEO}$ with $\Delta + \hat{\omega}_{CEO} = \omega$ if she is overconfident, and $\Delta + \hat{\omega}_{CEO} = 0$ if she is rational. As standard in this type of models, we assume that the manager exerts effort rather than shirking whenever she is indifferent.

At $t = 2$, the CEO knows the state of the world and the CFO's financing choice. We have four incentive compatibility (IC) constraints to consider regarding the CEO's effort choice, one for each state of the world and each financing choice. For debt financing, i.e., conditional on issuing debt with a face value D, and in the good state of the world, the CEO exerts effort if

$$\alpha \cdot \max\{0, I + \sigma + \Delta + \hat{\omega}_{CEO} - \Delta\} \geq \alpha \cdot \max\{0, I + \sigma - D\} + B \tag{2.1}$$

Similarly, the IC for exerting effort under debt financing in the bad state of the world is

$$\alpha \cdot \max\{0, I - \sigma + \Delta + \hat{\omega}_{CEO} - \Delta\} \geq \alpha \cdot \max\{0, I - \sigma - D\} + B \tag{2.2}$$

[12] We can also model the CFO as maximizing firm value, or existing shareholders' surplus. The CFO's decision remains the same since the optimization is equivalent up to a multiplication factor when he is a partial owner of the firm (share β). Yet another possibility is that the CFO gives some weight to the CEO's well-being, which includes B. In unreported results, we have modeled the CFO as "fully committed" to the CEO, i.e., as maximizing the CEO's expected utility including B, and the model delivers the exact same insights.

[13] This assumption is supported by the evidence in Otto (2014), who shows that shareholders recognize managerial optimism and adjust incentive contracts accordingly. It is also consistent with the evidence in Malmendier and Tate (2008) and Hirshleifer, Low, and Teoh (2012), who show that the option-exercise based measure of overconfidence is correlated with press portraits, suggesting that outsiders are able to identify overconfident managers. For the empirical results, however, it is not necessary that investors recognize the cause of managers' effort choices, only that they predict them correctly. For example, they may expect managers to exert effort in bad states of the world because they are subject to a stricter governance, or because they perceive them to enjoy "leisure" less.

In the case of equity financing, the CEO obtains a fraction $\alpha(1-\gamma)$ of the project payoff, plus the private benefit (if she does not exert effort). In this case, the ICs for the good state of the world, $\alpha(1-\gamma)(I+\sigma+\Delta+\hat{\omega}_{CEO}) \geq \alpha(1-\gamma)(I+\sigma)+B$, and for the bad state of the world, $\alpha(1-\gamma)(I-\sigma+\Delta+\hat{\omega}_{CEO}) \geq \alpha(1-\gamma)(I-\sigma)+B$, can both be simplified to

$$\alpha(1-\gamma)(\Delta+\hat{\omega}_{CEO}) \geq B \tag{2.3}$$

2.2.3 CEO Overconfidence and the Cost of Debt

The CFO chooses between debt and equity at $t=0$. We first condition on the choice of debt and derive the optimal debt contract. In the next subsection, we also consider the optimal equity contract (derived in Appendix 2.A.2), conditional on equity financing, and then solve for the CFO's choice between debt and equity.

We denote the return to the project in state $S \in \{Good, Bad\}$ and after effort $e \in \{0,1\}$ as $\pi(S,e)$; for example, $\pi(Good,1) = I+\sigma+\Delta$. Similarly, we denote the return *expected* by the CEO and the CFO given their beliefs, as $\hat{\pi}_{CEO}(S,e)$ and $\hat{\pi}_{CFO}(S,e)$, respectively.

Conditional on debt financing, the CFO solves the following maximization program:

$$\max_{D} \beta E[\max\{0, \hat{\pi}_{CFO}(S,e_S)-D\}] \tag{2.4a}$$

$$u_{CEO}(S,D,e_S) \geq u_{CEO}(S,D,e'_s)\ \forall\, S \text{ and } e_S \neq e'_S \tag{2.4b}$$

$$E[\min\{D,\pi(S,e_S)\}] \geq I \tag{2.4c}$$

where $u_{CEO}(S,D,e_S)$ denotes the CEO's utility in state S under a debt contract with face value D if she exerts effort e_S. Note that, as the CFO's compensation is linear in the value of the firm, the CFO maximizes shareholders' value, albeit *as perceived by him*. The participation constraint in equation 2.4c uses the fact that the payoff to debtholders in each state of the world and for effort level e_S is $\min\{D,\pi(S,e_S)\}$. If returns are larger than D, debtholders are paid the face value of debt and incumbent shareholders enjoy the residual revenue of the project. If returns are lower than D, the CEO defaults, debtholders obtain all of the return, and shareholders are left with 0.

We denote the face value of debt that solves this maximization problem, given CEO belief $\hat{\omega}_{CEO}$, as $D^*_{\hat{\omega}}$. (We will see below that the optimal contract does not depend on CFO's beliefs.)

We can now establish our first result.[14] (The thresholds mentioned in the proposition are made precise in the proof in Appendix 2.A.1.)

Proposition 1 (Cost of Debt)

The cost of debt financing under the equilibrium debt contract is lower for firms with an overconfident CEO, and is independent of the CFO's beliefs. Specifically, the face value offered to firms with overconfident CEOs is strictly lower for intermediate ranges of return variability, with $D^*_{\omega} = I$ for an overconfident CEO and $D^*_0 = I+\sigma$ for a rational CEO. And it is identical for sufficiently low

[14]We obtain the same results if we reduce the role of the CFO to choosing debt or equity while the CEO rejects or accepts the contract proposed by investors, i.e., if the contract maximizes the CEO's rather than the CFO's utility.

or high return variability, with $D_0^* = D_\omega^* = I$ for the case of low variability and $D_0^* = D_\omega^* = I + \sigma$ for the case of high variability.

Proof: See Appendix 2.A.1.

Intuitively, for small levels of ex-ante variability in returns, both types of CEOs exert high effort regardless of the realized state of the world. Even in the bad state of the world payoffs are high enough so that it is worthwhile for both types of CEOs to exert effort. For very high levels of variability, instead, both types of CEOs shirk in the bad state of the world, and anticipating such behavior debtholders seek compensation in the good state of the world by imposing a higher face value of debt. For moderate levels of variability, however, the low payoffs in the bad state deter a rational CEO from working hard, but not an overconfident CEO, who overestimates the value she can generate.[15]

Hence, Proposition 1 delivers the prediction that the positive influence of overoptimistic beliefs on financing conditions should be observed in firms with a medium range of return volatility, holding constant their profitability. What exactly constitutes a medium range of volatility' depends of course on the parametrization of our model, including the unknown traits (B, ω) of the CEO. In our empirical analysis, we will first split the sample into terciles of volatility as a natural starting point, and then explore a wide range of alternative sample splits to test for the existence and robustness of the predicted non-monotonicity.

In Appendix 2.A.2, we solve for the optimal equity contract in a similar fashion, and derive how the cost of equity financing (conditional on obtaining equity financing) responds to overconfidence. Here, the optimal contract either assigns ownership of a fraction $\gamma_{\hat{\omega}}^* = I/(I+\Delta)$ to outside investors and the CEO exerts effort in both states of the world, or it assigns full ownership, $\gamma_{\hat{\omega}}^* = 1$, and the CEO does not exert effort in either state of the world. Which solution applies depends on the extent of the moral hazard problem. If the moral hazard problem is not too severe, the CEO will be more likely to exert effort and pay a low cost of equity. Consistent with the analysis of the optimal debt contract, we also predict that overconfident CEOs will enjoy a lower cost of equity financing within certain parameter ranges. However, the theoretical prediction varies with parameters that are hard to pin down empirically (B, Δ, and I) and is less robust to, for example, strategic reasons for equity issuance (such as signaling or market timing). We will thus focus the empirical analysis of the cost of financing under overconfidence on the case of debt issuance.

2.2.4 CFO Overconfidence and the Choice between Debt and Equity

In order to derive the CFO's choice between the optimal debt contract (derived in the previous subsection) and the optimal equity contract (derived in Appendix 2.A.2), we compare his perceived expected utility in four cases: both managers are rational; both managers are overconfident; the CFO is overconfident and the CEO is rational; and the CFO is rational and the CEO is overconfident. Since both a rational and an overconfident CFO correctly take the CEO's beliefs and their

[15] In a more general model where managers also choose the investment level, this insight still holds to the extent that the resulting overinvestment problem (Malmendier and Tate (2005)) is not "too severe" relative to the moral hazard problem.

impact on the cost of debt and equity into account, even a rational CFO's choice will be affected by the CEO being overconfident. Proposition 2 summarizes the results:

Proposition 2 (Choice between Debt and Equity)

An overconfident CFO uses (weakly) more debt and less equity than a rational CFO, both with an overconfident and under a rational CEO.

Proof: *See Online-Appendix 2.A.3.*

As made more precise in the proof, there are parameter ranges for which both types of CFOs strictly prefer debt over equity; and there are parameter ranges where an overconfident CFO strictly prefers debt over equity while a rational CFO does not. In the latter case, the overconfident CFO uses more debt financing, as long as a rational CFO does not always pick debt when indifferent between the two financing choices. The intuition is similar to the one in Malmendier, Tate, and Yan (2011), albeit applied to the CFO's: Biased CFOs overestimate the return to the investment project if the CEO works hard. For this reason, they perceive external financing to be too costly. Under equity financing, this difference in opinion matters for all the states of the world; under debt financing it matters only for the default states, which explains the relative preference for debt.

2.2.5 CEO Overconfidence and CFO Hiring

The CEO's beliefs might also affect the selection of a new CFO. The recruiting of the CFO is a prerogative of the board of directors. However, a large empirical literature documents the strong influence of the CEO on the appointment of board members (Shivdasani and Yermack (1999); Cai, Garner, and Walkling (2009); Fischer et al. (2009)), and CEOs also control the selection of all other C-suite managers, whether or not they sit on the board. In our simplified setting, we assign the CEO sole discretion in replacing a CFO. For this part of the analysis, we add a period $t = -1$ in which the CEO chooses the CFO.

Proposition 3: CEO's Hiring Decision *An overconfident CEO (weakly) prefers to hire an overconfident CFO.*

Proof: *See Appendix 2.A.4*

Proposition 3 is not immediate since the CEO and the CFO maximize different objective functions even when they share the same degree of bias. The reason, then, for the assortative matching result of Proposition 3 is that there is no disagreement regarding the CEO's moral hazard problem. Therefore, all that matters for the financing choice of the CFO is the commonality or discrepancy of beliefs. Since a rational CFO deviates from the preferred choices of the overconfident CEO (over some parameter ranges), overconfident CEOs prefer the financial decision-making of overconfident CFOs on average, and hence hire an overconfident CFO when given the opportunity.

We summarize our findings in the format of three testable predictions:

Prediction 1. Overconfident CFOs are more likely to issue debt rather than equity when accessing external financing, conditioning on the CEO's type.

Prediction 2. CEO overconfidence is associated with a lower average cost of debt. This effect is driven by firms with an intermediate range of profit volatility.

Prediction 3. A firm run by an overconfident CEO is more likely to hire an overconfident CFO.

2.3 Data

2.3.1 Overconfidence Measure

Measuring managerial overconfidence is a challenge to empirical researchers. The existing methodologies fall into four categories: the option-based approach, the earnings-forecast-based approach, the survey-based approach, and the press-based approach. Option-based measures, first proposed by Malmendier and Tate (2005), are by far the most widely-used, likely since the identification relies on individual choices and "revealed beliefs:" These proxies allow us to infer managerial beliefs about their own companies from managers' personal investments in their companies. Managers who overestimate the future cash flows to their firms tend to overinvest in their companies with their personal funds in order to personally benefit from (perceived) future stock-price increases. As a result, they fail to diversify their stock-based compensation, and delay the exercise of executive stock options.[16] Galasso and Simcoe (2011), Malmendier, Tate, and Yan (2011), Otto (2014), and Hirshleifer, Low, and Teoh (2012) also adopt this measurement strategy. Relatedly, Sen and Tumarkin (2015) derive their overconfidence measure from the share retention rate of stocks obtained from an option exercise. The earnings-forecast-based approach, proposed by Otto (2014), infers overconfidence from overstated earnings forecasts. The survey-based approach, developed by Ben-David, Graham, and Harvey (2007), Ben-David and Graham (2013), constructs CFO overconfidence proxies based on miscalibrated stock-market forecasts by CFOs who participated in the Duke/CFO Business Outlook survey.[17] The media-based approach, employed by Malmendier and Tate (2008) and Hirshleifer, Low, and Teoh (2012), constructs CEO overconfidence measures based on the characterization of CEOs reported in the press.

We follow the "revealed beliefs" route and replicate the "Longholder_Thomson" proxy of Malmendier, Tate, and Yan (2011), which exploits the timing of option exercise to measure managerial overconfidence. We also replicate our results using a continuous variant proposed by Otto (2014).

The "Longholder_Thomson" measure is based on a benchmark model of option exercise for managers (Hall and Murphy (2002)), where the optimal exercise schedule depends on individual wealth, degree of risk aversion, and diversification. Given that stock options granted to managers are not tradable and short-selling of company stock is prohibited, managers holding stock and options are highly exposed to the idiosyncratic risk of their companies. Under the rational benchmark, risk-averse managers address their under-diversification by exercising options early. However, overconfident managers, who overestimate the expected future cash flows of their firms, postpone exercising in-the-money options in order to tap expected future gains. Based on this theoretical model, Malmendier and Tate (2005) define a binary variable called "Longholder," which equals one if the manager at some point of his tenure held an option until the last year before expiration, even though the option was at least 40% in-the-money. Empirically, Malmendier and Tate

[16]Overconfident managers also tend to delay the sale of stock grants, despite personal under-diversification, or even buy stock of their firms. Empirical research has relied more on option-based measures, rather than utilizing direct stock purchases and sales, as they raise fewer concerns about signaling to the market; cf. Malmendier and Tate (2008).

[17]This behavioral bias reflects an underestimation of variance but is sometimes also called overconfidence. However, it does imply delayed option exercise. See Malmendier, Tate, and Yan (2011) (fn. 1) for a brief discussion.

(2005) use CEO option-package-level data from a sample of 477 large publicly traded U.S. firms from 1980 to 1994 to identify CEO option exercise.

In order to replicate the original Longholder measure for longer and more recent time periods, and for a broader set of managers and firms, we reconstruct the Longholder_Thomson measure of Malmendier, Tate, and Yan (2011). Their proxy has the same definition as the original Longholder measure, but uses the Thomson insider filing data set to identify the option exercise by managers in public U.S. firms. We extend the measure to CFOs. The control group consists of managers who are also in the Thomson database but do not meet the criteria of overconfidence.

We also use the same data to construct a continuous version of the Longholder measure following Otto (2014), which weights each overconfident transaction' by the number of shares exercised. (Details of the construction and replications of all estimation results with the continuous measure are in Appendix 2.C.) We note that the discrete and the continuous measures are strongly correlated, with correlation coefficients of 41.9% and 46.5% for CEOs and CFOs, respectively. As we will see, the estimation results are also generally similar under both measures for our main specifications, and differ only when we work with relatively small and selected samples. The differences may reflect the fact that the dummy approach gives us more variation than a continuous measure,[18] or that the linearity implicit in the continuous measure is an imperfect representation of the variation in the degree of overconfidence. Here, we choose to emphasize the more widely used indicator version in the main text because of a different and somewhat subtle point that suggests favoring the dummy approach for our sample: A necessary condition for a manager to be classified as Longholder is that she experiences at least one instance in which options are deeply in the money. In order to "score high" in terms of overconfidence under the continuous measure, the manager needs to experience many of these instances. This condition is significantly more demanding, especially in the more limited data on CFOs, and likely to be met only for particularly successful companies. The indicator approach avoids such issues of selection or misattribution. At the same time, we acknowledge the appeal of a continuous measure with its finer distinction, which is why we replicate all estimations under the continuous measure in Appendix 2.C.

The Thomson insider filing data set includes forms 3, 4, and 5 reported by insiders to the SEC. The data consists of two data sets called ”Table 1" (Stock Transactions) and "Table 2" (Derivative Transactions). We extract the option exercise data from the "Table 2" data, which collects information from Form 4. (Changes in ownership must be reported to the SEC within two business days on Form 4.) These transactions data are available since 1996. However, as our measure of overconfidence is a managerial permanent characteristic, we can also include the years 1992-1995 into our sample, as long as the companies in this time period had managers for which we can obtain transactions data in Form 4. We keep only records with Thomson cleanse indicators R, H, and C (very high degree of confidence in data accuracy and reasonableness) or Thomson cleanse indicators L and I (reasonably high degree of confidence). Following prior literature (e.g., Lakonishok and Lee (2001)), we drop records that are amendments to previous records and records with

[18]For example, the standard deviations of the Longholder CEO and Longholder CFO dummies are 0.46 and 0.49, respectively, in our largest sample, but only 0.017 and 0.07 for the continuous measure. Notice that in the Appendix the Longholder proxies are normalized by their sample standard deviation for ease of interpretation.

obvious errors, such as an indicated maturity date that is earlier than the exercise date and options with missing exercise date. To reduce the effect of extreme outliers, we keep only those records for which the exercise price of the option is within the range of $0.1 to $1000.

We calculate the percentage-in-the-money for each option using stock price data from CRSP. We obtain tenure as well as stock and option holdings of the CEOs and CFOs in the Thomson database from ExecuComp. The last step limits our sample to the intersection of the ExecuComp and Thomson databases, i.e., a subset of S&P 1500 U.S. firms, including small, medium and large cap firms, from 1992 to 2015. We use CUSIPs to merge the firm-level information in Thomson and Compustat/ExecuComp, and employ a conservative fuzzy algorithm to link the names of the executives in the two data sets. We verify manually the accuracy of each match, and discard all transactions in which the names do not coincide. In a few cases a firm has more than one CEO or CFO listed in ExecuComp. In these instances, we manually check the 10-K forms on the SEC website[19] and identified the executive who held the relevant position at the end of the fiscal year.

An empirical issue with the CFO data is the significantly lower number of transactions available to construct the overconfidence proxy. CFOs typically receive smaller option grants than CEOs, and are also covered less in ExecuComp. This introduces measurement error when we categorize a CFO as non-overconfident. To address this problem, we keep only managers for which we observe at least 10 transactions; this restriction ensures that we capture a systematic behavior.

2.3.2 Alternative Interpretations

Before turning to the remaining data construction, we address possible alternative interpretations of the Longholder_Thomson measure and their implications for the results of this paper.

Procrastination. The Longholder_Thomson overconfidence measure captures a persistent tendency of managers to delay option exercise. One might be concerned that such behavior is due to "inertia" or "procrastination." We find, however, that 74% of overconfident CEOs and 69% of overconfident CFOs conduct portfolio transactions one year prior to the year when options expire, which is inconsistent with the interpretation of persistent delay in managing the personal portfolio. Relatedly, it is also hard to reconcile with "inertia" as the explanatory personality feature, that such managers actively borrow more debt when the financing deficit is high, as we will show below.

Insider Information. Managers may choose to hold exercisable options because they have positive inside information about future stock prices. One issue with this alternative explanation is that inside information should, by definition, be transitory rather than persistent, but Longholders persistently hold exercisable options for five years or longer. Moreover, insider traders should earn positive abnormal returns from holding options until expiration. While we cannot test the expected profitability from an ex-ante perspective, we calculate the actual returns of Longholder CEOs and CFOs from holding options that were at least 40% in-the-money ("Longheld" transactions) until their expiration. We then calculate hypothetical returns from exercising these options 1, 2, 3, or 4 years earlier and investing the proceeds in the S&P 500 Index until the options were actually ex-

[19] See http://www.sec.gov/edgar.shtml. The Edgar database contains 10-K forms starting in 1994. For some earlier cases we cannot recover the information and exclude those observations.

ercised. We find that, depending on the horizon chosen, approximately 45-48% of the "Longheld" transactions do not earn positive abnormal returns. We then re-estimate our results with the subset of Longholders who lose money by holding their options. The resulting estimates either confirm or even strengthen the results, whenever the sample is large enough to separately estimate "winner" and "loser" Longholder variables. The same has been found in previous research employing Longholder-type measures; see, e.g., Malmendier and Tate (2008).

Signaling. One might argue that managers who persistently hold exercisable options intend to signal to the capital market that their firms have better prospects than other similar firms. However, a similar argument applies as in the discussion of insider trading: A firm may be temporarily overvalued, but our measure captures a permanent managerial behavior. Moreover, in our regressions, we include the number of vested options held by the manager (standardized by total number of shares outstanding of the firm) to account for the possibility of signaling via option holdings.

Risk Tolerance. The Longholder_Thomson overconfidence measure captures a habitual tendency of managers to hold company risk. One might be concerned that risk-tolerant or risk-seeking managers prefer to hold exercisable options longer, and therefore appear to be overconfident under the Longholder_Thomson measure. However, risk tolerance does not predict aversion to equity financing, or preference for debt financing, which is a robust finding of our analysis. Moreover, if Longholder managers were simply more risk-loving and undertook riskier projects, we would expect the cost of debt to be higher for their firms; in our analysis we find the opposite.

Agency Problems. Another alternative interpretation is that, being more incentivized, option-holding managers are more willing to act in the interest of (existing) shareholders. However, in all of our regressions, we control for both the shares and the vested options owned by managers. Moreover, the observed differences in the behavior of Longholders are not easily interpreted as shareholder-value maximizing. By increasing leverage, Longholders might reduce the cash flow available to shareholders, which may be costly to shareholders if this behavior increases default probability and there are non-negligible bankruptcy costs. Firm's performance. An additional concern is a potential mechanical correlation with past performance. Given the construction of our proxy, an executive cannot be considered overconfident unless his firm's stock has appreciated by at least 40%. Therefore, in our empirical analysis, overconfident managers may simply be those running particularly successful firms. To address this confound, we compute, for each firm, the buy-and-hold return over the previous 1, 2, 3, 4, and 10 years and test whether they are systematically correlated with the overconfidence measures. We find that the correlations of the two Longholder dummies with lagged buy-and-hold returns are small and often negative. For example, when we look at the ten-year horizon, which is the most relevant horizon for our analysis, the two correlation coefficients are not only very small in absolute value but also of opposite signs, positive for the CEO Longholder (0.024) and negative for the CFO Longholder (-0.009) proxies. This is at odds with the idea that our measures are capturing a common underlying pattern of past performance in the data.

As a second way to address concerns about links with past performance, we re-run our analysis on the subsample of firms that have appreciated by more than 40% in the previous ten years. However, such a subsample selection is quite restrictive not because of the 40% requirement, but because it excludes all firms that, in any given year, have less than 10 years of past data. (The

10-year restriction reduces the sample by about 26%, but only 18% of the remaining firm-years had returns lower than 40% over the previous ten years.) Despite the significant loss of sample size and power, we replicate our estimations on this subsample. We find that our main results are qualitatively and quantitatively unaffected, except in those instances where we work with a very small sample and where the data offer limited variation due to our empirical strategy (see Tables 2.3 and 2.4 below). We include one table with CFO effects (debt issues) and one with CEO effects (net interest) in the Appendix, Tables 2.C.8 and 2.C.9.

Mismeasurement. The proxy for managerial overconfidence that we employ here draws a simple dichotomous distinction between overconfident and rational managers. It may thus be vulnerable to mismeasurement. First, it is sensitive to data errors in the Thomson Reuters database (e.g., in the grant or expiration dates of the options). Second, it does not distinguish between managers for whom the late exercise of in-the-money options is an occasional behavior and those who persistently do so. The continuous version of the Longholder measure developed by Otto (2014) is unlikely to be affected by occasional errors in the Thomson database, and allows us to distinguish, more finely, different degrees of overconfidence. As we anticipated in Section 2.3.1, we obtain largely similar results when following this approach, reported in Appendix 2.C.[20]

Hence, while the results of this, and any other, empirical analysis using option-based overconfidence measure must be subjected to additional scrutiny, as they are not the result of randomized controlled variation, the leading alternative interpretations appear to be addressed in the details of the construction of the measure and with the empirical results.

2.3.3 Other variables

Our empirical analysis requires a broad array of firm-level financial variables as well as other firm and industry characteristics. We retrieve these variables from Compustat, excluding financial firms and regulated utilities (SIC codes 6000 - 6999 and 4900 - 4999) for the usual concern about lack of comparability of accounting data. Below, we describe briefly our main variables of interest. Additional details are in Appendix 2.B.

The key variables for our analysis of financial policies are Net Debt Issues and Net Financing Deficit. Using the definitions from Malmendier, Tate, and Yan (2011), we construct Net Debt Issues as long-term debt issues minus long-term debt reductions; and Net Financing Deficit is cash dividends plus investment plus the change in working capital minus cash flow after interest and taxes. Net Debt Issues and Net Financing Deficit are normalized by assets at the beginning of the year.

[20]To summarize briefly, results using the alternative measures are qualitatively similar for the analyses of Debt Issuance using Compustat and CFO Hiring (Tables 2.C.2 and 2.C.7 in Appendix 2.C); similar but slightly weaker statistically for the Interest Rates regressions (Table 2.C.6); statistically stronger for the Leverage regressions (Table 2.C.5); and inconsistent only for the regressions which adopt the "Financing Deficit" approach (Table 2.C.4) and the analyses of Debt Issuance using SDC (Table 2.C.3, where, however, we use a very small sample). Also, quantitatively the variation explained under the dummy measure and the variation explained under the continuous measure are of the same order of magnitude. For example, we find that an increase of one standard deviation in CFO overconfidence using the continuous measure increases the odds ratio of issuing debt by 15.8% (Table 2.C.2), which is in line with our results of Table 2.2.

We also construct standard firm-level control variables including Q, profitability, tangibility, size, book leverage, and annual changes in these variables. Q is given by assets plus market value of equity (price times common shares outstanding) minus common equity and balance sheet deferred taxes and investment tax credit, all divided by assets. Profitability is operating income before depreciation, normalized by assets at the beginning of the year. Tangibility is property, plants and equipment normalized by assets at the beginning of the year. Size is the natural logarithm of sales. Book leverage is the sum of debt in current liabilities and long-term debt, divided by the sum of debt in current liabilities, long-term debt, and common equity. We combine firm-level variables with manager-level variables to form the whole sample, a panel of 675 S&P 1500 firms from 1992 to 2015.

Table 2.1 reports summary statistics for firm-level variables in Panel A, and for CEO- and CFO-specific variables in Panel B. Each panel contains separate tables for the different (sub)samples used in each analysis. Not surprisingly, the typical company in our data set is large relative to the Compustat universe. The average revenues in our overall sample (the data used in the Financial Deficit analysis of Table 2.2) amount to $5.7bn, relative to a mean of $2.5bn for the full Compustat data set over the same time period. Our companies also tend to have slightly lower book leverage (28.6% versus 31.5%) and significantly higher profitability (18.5% versus 7.0%). Relative to the ExecuComp database, however, of which our data is a subset, the differences are much less pronounced. The respective figures are $4.7 billion, 36.2%, and 13.3%. Hence, our sample appears to be fairly representative of those studied in past empirical work on executive compensation.

Panel B of Table 2.1 reveals that, on average, CEOs tend to own significantly more stock of their companies than CFOs (18.18% versus 1.22% in the sample used in Tables 2.4 and 2.5). The difference is somewhat less pronounced for vested options (10.19% versus 2.39%). We have also analyzed managerial controls separately for the full sample and for overconfident managers and find that they tend to have fairly similar equity incentives.

For completeness, Appendix-Table 2.C.1 reports the descriptive statistics for our largest sample, used in Tables 2.4 and of the paper, split by the four possible combinations of executives' biases (both executives rational, both overconfident, rational CEO and overconfident CFO, overconfident CEO and rational CFO).

Compared to the samples used in Malmendier and Tate (2005, 2008), Malmendier, Tate, and Yan (2011), Galasso and Simcoe (2011), the Thomson and ExecuComp-based data sets in Malmendier, Tate, and Yan (2011) and Hirshleifer, Low, and Teoh (2012), and also compared to the survey sample of Ben-David and Graham (2013), our sample differs in three ways: First, it extends to a more recent time period. Second, it considers small and medium firms in addition to large firms. And third, it includes overconfidence measures for both the CEO and the CFO. The last difference is key in that we aim to fill a gap in the existing literature by estimating the effects of CEO and CFO overconfidence separately and jointly.

These differences in sample composition also help us to understand the different frequencies of overconfidence classification. In our sample, the Longholder_Thomson classifies 66.5-69.8% of CEOs and 52.8-57.5% of CFOs as overconfident. These frequencies are two to three times as high as in the first wave of overconfidence research, which used option exercise date from the 1980s until mid-1990s, but in line with the more recent wave of research, which also uses the more recent option-exercise data (see for example Malmendier and Tate (2015)). An interesting observation is that the restriction to managers with at least 10 transactions increases the relative frequency of firm-years with overconfident managers, especially among CFOs. If we do not impose this requirement, the frequencies drop to 60% for CEOs and 43% for CFOs. Thus, the restriction increases the percentage of overconfident CFOs considerably more than that of overconfident CEOs. Because CFOs' options packages are in practice much smaller than those of CEOs (see Table 2.1, Panel B), this observation cautions that managers are less likely to be classified as overconfident when they have fewer opportunities to trade options. Hence, a restriction to a subset of managers with similar transaction frequencies might generally be in order, even when looking at CFOs or other managers that are less well covered than CEOs.

We complement our main data with the SDC database on bond and equity issuance and confirm our result that overconfident CFOs present a higher propensity to issue debt relative to equity also in this smaller sample. Because in this case we restrict our attention to firms issuing debt, equity, or hybrid securities, our sample drops to 694 observations (287 firms). Following Malmendier, Tate, and Yan (2011), we define equity issues as issues of common stock or nonconvertible preferred stock; debt issues are issues of nonconvertible debt; and hybrid issues are issues of convertible debt or convertible preferred stock.

Finally, we merge our ExecuComp-Compustat data with the Dealscan database on syndicated loans to test our predictions regarding the relation between executive overconfidence and the cost of debt. Dealscan provides detailed information regarding the pricing, type, maturity, and size of loans. The coverage is typically limited to large and medium size firms, which are the main focus of our analysis. We merge this data set with the quarterly Compustat file, using the mapping provided by Chava and Roberts (2008).[21] Our outcome of interest is the amount the borrower pays in basis points over the London Interbank Offered Rate, a variable called allindrawn in Dealscan. In our main specification, we are able to use 1,651 observations (408 different firms). We will discuss in detail the main control variables used in these tests in Section 2.5.

2.4 Overconfidence and Financing Choices

2.4.1 Empirical Strategy

Prediction 1 of our model is that overconfident CFOs exhibit a preference for debt over equity, conditional on accessing the market for external financing. Here, we will test both for the impact of the CFO, as predicted by the theoretical model, and for the impact of the CEO, whose overconfidence has been found to exert significant influence in prior literature.

We use three different empirical approaches. Under our first approach, we focus on those firms that access external funding (debt or equity) in a given year, and ask whether overconfident managers are more likely to issue debt. We estimate the corresponding logit models on two different data sets, Compustat (in Section 2.4.2.2) and SDC (in Section 2.4.3.3). These analyses restrict the

[21]The data is made available on finance.wharton.upenn.edu/ mrroberts/styled-9/styled-12/index.html. The crosswalk is available only up to 2012.

sample to firms that, in a given year, issue either debt or equity. Hence, we cannot include firm fixed effects to control for time-invariant firm characteristics for lack of sufficient variation. Under the second and third approach, we make use of our full sample and control for firm fixed effects. The second approach (Section 2.4.4) employs the standard financing deficit framework' of Shyam-Sunder and Myers (1999), also used in Malmendier, Tate, and Yan (2011). The third approach (Section 2.4.5) extends the test of the potential influence of managerial bias to the resulting leverage structure. We ask whether the influence of managerial characteristics on the flow of financing is strong enough, and persistent enough, to have a significant effect on firms' capital structures, above and beyond the influence of permanent firm characteristics. If so, firms run by overconfident executives with a strong preference for debt should be systematically more leveraged, even after controlling for firm fixed effects and our large array of control variables.

2.4.2 Debt Issues using Compustat

We first test whether overconfident managers are more likely to issue debt than equity in the Compustat data set. As implied by the model, we need to condition the regression analysis on accessing external capital. The conditional analysis also controls for potential differences in the baseline frequencies of debt and equity issues by overconfident managers and their rational peers. Therefore, the regression sample only includes observations with either positive net debt issues or positive net equity issues. In total, we have 2,875 firm-years with external financing (632 firms). We test whether, conditional on using external financing, overconfident managers prefer debt over equity using the following logit model:

$$\begin{aligned} &Pr(NDI_{i,t}|LTCEO_{i,t}, LTCFO_{I,t}, X_{i,t}, \delta_t) \\ &= G(\beta_1 + \beta_2 LTCEO_{i,t} + \beta_3 LTCFO_{i,t} + X'_{i,t}B + \delta_t + \varepsilon_{i,t}) \end{aligned} \tag{2.5}$$

where G is the cumulative logistic distribution function, and the subindex *i,t* indicates years in which company i accessed external financing. The dependent variable $NDI_{i,t}$ is an indicator of firm i issuing positive net debt in year t. $LTCEO_{i,t}$ and $LTCFO_{i,t}$ represent the Longholder_Thomson measures for managerial overconfidence of the CEO and the CFO, respectively. $X_{i,t}$ is the vector of standard firm-level and manager-level control variables for firm i in year t. Firm-level control variables are the traditional determinants of capital structurebook leverage, Log(Sales), profitability, Q, and tangibility, and also include two-digit SIC industry fixed effects (following Ben-David and Graham (2013)). Manager-level control variables are option-excluded stock ownership and vested options, and control for the incentive effect of stock-based executive compensation. In addition, we include a vector of year fixed-effects . Standard errors are adjusted for firm-level clustering. We note that the fixed effects are not a reason for concerns about incidental parameter problems in our logit estimations.[22] Coefficient estimates are transformed to indicate, for a unit increase in each independent variable, the expected change in the log odds of issuing debt.

[22]The incidental parameters problem arises in panel estimations if, with increasing sample size, the number of fixed-effect parameters also grows, implying that it is impossible to estimate coefficients consistently. This does not apply to industry fixed-effects (Bester and Hansen (2016)). Nevertheless, we have used a number of alternative estimation strategies as robustness checks. Our results do not change if we estimate a linear probability model or

Table 2.2 reports the results. We start by only including the CEO overconfidence proxy (columns 1 and 2), replicating the analyses of prior literature. We then use the CFO measures instead of the CEO measures (columns 3 and 4), which capture the predictions of our model. Finally, we include both overconfidence measures jointly (columns 5 to 7). The joint analyses test whose managerial trait predicts a more pronounced pecking-order preference, and whether the separately estimated impacts of CEO and CFO overconfidence are robust when estimated jointly.

In the baseline logit estimations with only the CEO overconfidence proxy included we estimate a small positive and insignificant log odds ratio, whether we only control for industry specific effects (column 1) or include the whole range of firm-level and manager-level controls detailed above, as well as year dummies, which remove cyclical effects of debt issues (column 2). The estimated coefficients of the firm-level control variables are generally similar to those found in the existing capital-structure literature. Firm size is positively related to the likelihood of debt issues, possibly reflecting easier access to bank loans or bond markets for larger firms with sufficient collateral. Profitability and tangibility also have the expected, positive sign, but are not statistically significant predictors of debt issuance. Q is negatively correlated with debt issues, although not significantly. Most importantly, the inclusion of control variables does not alter the lack of explanatory power of the CEO overconfidence proxy, and if anything, appears to reduce the size of the coefficient. In other words, in this first data set, CEO overconfidence appears to be less predictive of financing choices than found in previous analyses for earlier sample periods and (partly) different firms.

In columns 3 and 4, we turn to the prediction of our model and replace the CEO overconfidence measure with the CFO overconfidence measure. For the baseline regression with only industry controls, the estimated coefficient of the CFO overconfidence measure is large and significant at the 1% level (coefficient = 0.372, t-statistic = 3.307). It indicates that the odds ratio of debt issues for overconfident CFOs is 45% higher than that of rational CFOs. This finding remains unaffected when we control for CFO-level variables, firm-level variables, industry dummies and year dummies in column 4. The estimated coefficient of CFO overconfidence increases slightly to 0.408. The stability of the coefficient estimate also helps address concerns about potential confounds related to an executive's risk tolerance (see Section 2.3.2). If risk tolerance, rather than overconfident beliefs, induced the manager to issue more debt and raise default risk, the explanatory power of Longholder should decline once we include both book leverage (as a measure for firm-level risk) and vested options (as proxy of willingness to hold risk in a manager's portfolio). However, the coefficient on Longholder CFO turns out to be unaffected by the inclusion of these variables, which do not enter significantly in any of our specifications.

In columns 5 to 7, we include both CEO and CFO overconfidence measures, first in the baseline regression, then adding only managerial controls, and finally including the full set of controls. These specifications test whether the finding of a significant CFO effect is robust to the inclusion of the corresponding CEO control. We find that, while the coefficient on CEO overconfidence

a conditional logit model. Moreover, we get similar point estimates for our baseline model with a coarser industry classification (Fama-French 12 industries). These remarks also apply to Section 2.4.3, where we adopt the same empirical strategy.

remains insignificant, CFO overconfidence retains its economic and statistical magnitude. In the estimation that includes the full set of control variables (column 7), the coefficient on Longholder CFO is 0.443 (and highly significant with a t-statistic of 3.703). It implies that an overconfident CFO is 56% more likely than a rational CFO to issue debt, conditional on accessing external markets.

2.4.3 Debt Issues using SDC Data

As a robustness check, we re-estimate the same model from equation 2.5 using the SDC data on equity and bond issuance by US corporations. The advantage of the SDC data is that it identifies the timing of issuances more precisely, relative to the (noisier) accounting data from Compustat. Its disadvantage is that it misses those increases or decreases in firms' use of external financing that are not (new) issues recorded in SDC.

We include issues of nonconvertible debt in the category of debt issues, and issues of convertible debt or convertible preferred stock as hybrid issues. We match all issuances of debt, equity, and hybrid securities with the ExecuComp-Compustat merged sample described above. As expected, the sample size and heterogeneity of firms in the SDC-based sample is significantly reduced, with a starting sample size of 694 observations, and 647 observations in the subsample where all control variables are available. Moreover, as the industry dummies perfectly predict some of the debt issuances, the actual sample usable for identification varies between 694 observations (when no other controls are included) and 585 observations (when the full set of controls is included).[23]

We estimate again a logit model with a dummy equal to one if a firm issued debt in a given year, and 0 otherwise (i.e., if the firm issued equity or hybrid securities). The control variables are the same as in the previous analysis (in Table 2.2). Given the small sample, we choose to display the estimations using all available observations for the respective specifications. In all estimations, the control variables generally have the predicted sign.[24]

In column 1, we include only the Longholder CEO proxy and industry dummies, mirroring column 1 of Table 2.2. In this specification, CEO overconfidence is positive but insignificant. Once the control variables are included (column 2), the coefficient remains insignificant and its magnitude drops sharply. The association between CFO overconfidence and the propensity to issue debt, instead, is strong and statistically robust (columns 3 and 4), with a log odds coefficient of about 0.8. The inclusion of Longholder CEO and firm and managerial controls (columns 5-7) does not significantly change the magnitude of the coefficient. We note that the association between CEO overconfidence and propensity to issue debt from column 1 is completely absorbed

[23]The small sample size may also explain why the continuous measure of Otto (2014) fails to produce robust results here. As shown in Appendix-Table 2.C.2, the estimates are sensitive to firm-level controls, and often inconsistent with the estimates in the main table. The coefficients of the control variables are also unstable. Hence, in this smaller sample, the continuous proxy may largely capture firm-level variation, rather than mere managerial effects. As anticipated, this discrepancy in results only occurs when we use particularly small and selected samples.

[24]Profitability and size predict a significantly higher probability of issuing debt, possibly reflecting the roles of stable cash flows and collaterals. The coefficient of Q is negative. Leverage is also negatively related to debt issuance, though not significantly. Only the negative and significant coefficient on tangibility is perhaps surprising.

by CFO overconfidence. This is consistent with the CEO's influence on capital structure being exerted primarily through his hiring choices, as modeled in our extended theoretical framework.

Overall, Table 2.3 confirms the findings from the estimations in the previous subsection: Conditional on using external funds, overconfident CFOs strongly favor debt. The magnitude of the estimated effect is even larger in the SDC data, with the odds of overconfident CFOs issuing debt being about two and a half times as high as the odds of their rational peers issuing debt.

2.4.4 Financing Deficit and Managerial Overconfidence

We now turn to our second approach of testing Prediction 1, the standard financing deficit framework' of Shyam-Sunder and Myers (1999). This framework allows to analyze whether, for a given need of external funding, managers display a preference towards debt financing over equity. Here, we examine the impact of managerial overconfidence on the association between the net financing deficit and the type of external financing chosen by the managers, as in Malmendier, Tate, and Yan (2011), though they only conducted this analysis for the CEO. The estimation framework allows for overconfident managers and their rational peers to have different baseline needs for external financing. Another advantage of this approach is that it utilizes all firm-years, resulting in a larger sample.

We estimate OLS regressions using the following equation:

$$\begin{aligned} D_{i,t} = \beta_1 + \beta_2 FD_{i,t} + \beta_3 LTCEO_{i,t} + \beta_4 LTCFO_{i,t} + \beta_5 FD_{i,t} LTCEO_{i,t} \\ \beta_6 FD_{i,t} LTCFO_{i,t} + X'_{i,t} B + FD_{i,t} X'_{i,t} B_2 + \theta_i + \delta_t + \varepsilon_{i,t} \end{aligned} \tag{2.6}$$

where $D_{i,t}$ is Net Debt Issues and is the Net Financing Deficit, which measures the amount of external financing needed in a given year. $LTCEO_{i,t}$ and $LTCFO_{i,t}$ are our measures for managerial overconfidence (Longholder CEO and Longholder CFO), and $X_{i,t}$ is a set of manager-level and firm-level control variables including executive stock and option holdings, changes in Q, profitability, tangibility, and size. In the most conservative specifications, we also interact our vector of controls with the financing deficit variable. For brevity, we choose not to report the coefficients on the control variables, but note that they generally show the expected signs.[25] We control for firm and year fixed-effects in all regressions. The coefficients of interest are β_5 and β_6, which measure the effects of CEO and CFO overconfidence, respectively, on debt financing, conditional on the amount of financing deficit. If, for given financing needs, overconfident CFOs issued disproportionately more debt than unbiased managers, as predicted by our model, we would estimate to be positive.

We start again from the relationship between CEO overconfidence and financing, which has been the focus of prior research, before turning to CFO biases, which our model predictions pertain to. The baseline regression in column 1 of Table 2.4 includes only the CEO overconfidence measure, its interaction with the net financing deficit, and firm fixed effects. Column 2 adds the full set of control variables, including CEO stock and option holdings, firm-level variables, and

[25]For example, Q is negatively related to debt issuance, whereas tangibility and size exhibit a positive association. (All variables are in first differences.)

year fixed-effects. In column 3, we further add the interactions between the financing deficit and the control variables. Across all three specifications, we find little evidence for a role of CEO overconfidence in financing decisions, consistent with our results from the prior debt issuance regressions. The coefficients of CEO overconfidence interacted with net financing deficit are positive but insignificant, except in column 3, where the coefficient is equal to 0.168, and is significant at the 5% level.

In columns 4 to 6, we employ the specifications from columns 1 to 3 but replace the CEO overconfidence measure with the CFO overconfidence measure. We find that CFO overconfidence increases the sensitivity of net debt issues to the net financing deficit significantly. The coefficient estimates of the interaction of CFO overconfidence and net financing deficit lie between 0.187 and 0.236. These results corroborate our finding that CFO biases influence a firm's tilt towards debt financing.

Finally, we include CEO and CFO overconfidence measures jointly (columns 7 to 9). The results remain very similar to those from the separate estimations. The estimated effect of CFO overconfidence on the sensitivity of net debt issues to the net financing deficit ranges from 0.174 to 0.238, and is significant at the 1% or 5% level. The effects of CEO overconfidence remain small and insignificant. The estimated effect of CFO overconfidence is also quantitatively important. To get a sense of the magnitude, consider that in column 8 the stand-alone coefficient on the financing deficit is 0.081. This sensitivity more than triples for overconfident CFOs, to 0.279 (0.081 + 0.198). We also note that that the statistical significance of our coefficient of interest tends to grow in the most demanding specifications, in which the control variables are interacted with the financing deficit (columns 6 and 9), suggesting that Longholder CFO is not simply picking up variation associated with well-known predictors of debt issuance.

Taking the results from the three estimations of overconfidence on debt issuance together, CFO overconfidence emerges as a statistically and economically significant determinant while CEO overconfidence appears to exert at most marginal (though still positive) influence. These findings are consistent with Prediction 1 of our model.

2.4.5 Leverage and Managerial Overconfidence

Given the magnitude of our estimates so far, it is conceivable that the effect of managerial overconfidence might even translate into a measurable impact on firms' capital structure. As overconfident CFOs tend to prefer debt over equity issuances, their companies should display, on average, higher leverage. Note that, for this implication to hold, the overconfidence-induced bias towards debt needs to be persistent and strong enough to dominate other determinants of leverage, e.g., the well-documented persistence of past leverage ratios.

To investigate this question, we estimate the following empirical specification, following the empirical strategy in Bertrand and Schoar (2003) and Malmendier, Tate, and Yan (2011):

$$Leverage_{i,t} = \beta_1 + \beta_2 LTCEO_{i,t} + \beta_3 LTCFO_{i,t} + X'_{i,t}B + \theta_i + \delta_t + \varepsilon_{i,t} \tag{2.7}$$

$LTCFO_{i,t}$ and $LTCEO_{i,t}$ are our usual Longholder proxies for managerial overconfidence, $X_{i,t}$ is a vector of control variables, θ_i are firm fixed effects, and δ_t are year dummies. After controlling for firm fixed-effects, the identifying variation comes from firms that switch from an unbiased to an overconfident manager, and vice versa. Our dependent variable is market leverage, expressed as the ratio of long-term debt plus debt in current liabilities over the market value of assets, i.e., over market capitalization (price times common shares outstanding) plus the value of debt from the numerator. This estimation allows us again to use the full sample.[26]

Table 2.5 reports the results. In column 1, we include only Longholder CEO, plus firm and year dummies. The sign of the coefficient estimate for CEO overconfidence is consistent with Malmendier, Tate, and Yan (2011): CEO overconfidence is associated with higher leverage. However, this effect is very small and insignificant in our sample, with a coefficient of 1.167 (t-statistic of 0.85). Even if the coefficient were significant, it would imply that switching from a non-overconfident to an overconfident CEO induces an increase in leverage by slightly more than 1 percentage point, relative to a sample mean of 23.90 (and a standard deviation of 52.42). The coefficient estimate is further reduced, and remains insignificant, when control variables are included (column 2). All the firm level control variables, on the other hand, have the expected sign. Larger firms with higher tangibility are more levered, whereas profitability and Q are negatively related to leverage. We do not find any association with managerial controls (shares and vested options owned).

Turning to the CFO effect, in columns 3 and 4, we estimate a strong and sizeable positive association with market leverage. It makes little difference whether or not we include control variables. In column 4, the coefficient is 4.012 (with a t-statistic of 3.628), roughly a quarter of a standard deviation. When we consider both managerial biases jointly, in columns 5 and 6, the effect of CEO overconfidence vanishes further, while the coefficient estimate on Longholder CFO becomes slightly larger and more precisely estimated, e.g., 3.865 with a t-statistic of 2.678 in the specification with the full slate of controls (column 6). Among the managerial controls, CFO stock ownership is negatively related to leverage, perhaps because risk aversion induces CFOs to adopt more conservative financial policies when their wealth is heavily invested in their company. To further probe the robustness of this result, we also add controls for financing deficit (in column 7) and lagged one-year returns (in column 8). Both variables have significant explanatory power for market leverage. The coefficient on Net Financing Deficit is positive, giving support to traditional pecking-order models of corporate financing (Shyam-Sunder and Myers (1999)). The coefficient on past returns is negative, likely capturing both market timing reasons (see, e.g., Welch (2004)) and a mechanical effect: past high returns lower market leverage simply because they increase the denominator. In all cases, our coefficient of interest is unaffected.

We also explore the inclusion of additional lags of stock returns. In unreported tests, we find that the explanatory power of lagged stock returns declines as the time lag increases. The coefficient on Longholder CFO, instead, remains very stable. In all cases, having a CFO Longholder in a firm predicts a significantly higher market leverage ratio.[27] The latter finding helps address-

[26] We lose 20 observations relative to the empirical specification in Table 2.4 because either long-term debt or short-term debt is missing.

[27] The effect of overconfidence on market leverage is also significant in all specifications when using Otto (2014)'s

ing concerns about insider information as an alternative interpretation, i.e., the interpretation that Longholders are managers with positive inside information, who may be reluctant to issue equity and choose high leverage. As discussed in Section 2.3.2, this concern is unlikely to hold up since positive insider information should be transitory rather than persistent, and since we control for the amount of vested options held at the same point in time. The inclusion of lagged returns (and Q) further addresses this concern, as these controls are strong predictors of future returns. Nevertheless, the magnitude or significance of the Longholder coefficient is unaffected.

In summary, our analysis of leverage confirms the empirical relevance of our findings regarding Prediction 1: The influence of CFO overconfidence appears to be strong and persistent enough to translate into measurable influence even on the overall leverage ratio.

2.5 Overconfidence and the Cost of Debt

2.5.1 Empirical Strategy

We now turn to our second, novel prediction that CEO overconfidence is associated with a lower cost of debt, as investors anticipate the extra effort upward biased beliefs will induce. To test this prediction, we merge our overconfidence measures with the DealScan database. Matching the finer time periods in DealScan, we re-construct our main firm-level control variables using the Compustat quarterly database, following Valta (2012), among others. We measure the cost of debt financing as the spread between the interest rate paid by the firm and the Libor (in basis points). This variable is slightly right-skewed, and we employ the natural logarithm in our specifications. (Results are unaffected if we use the actual spread.)

We relate this outcome variable to managerial overconfidence as follows:

$$Log(Net\,Interest_{i,t}) = \beta_1 + \beta_2 LTCEO_{i,t} + \beta_3 LTCFO_{i,t} + X'_{i,t}B + \delta_t + \varepsilon_{i,t} \qquad (2.8)$$

where $LTCEO_{i,t}$ and $LTCFO_{i,t}$ are our usual proxies for overconfidence (Longholder CEO and Longholder CFO) and is a vector of control variables at the manager, firm, and loan level, and also includes industry fixed-effects. At the firm level, we include Log(Assets)[28] as larger firms might be perceived as less risky by lenders; book leverage, given that highly indebted firms presumably face a higher cost of debt; cash holding scaled by total assets as an additional proxy for a firm's liquitidy; and z-score, which captures the firm's default risk. Following Valta (2012), we also include earnings volatility, defined as the ratio of the standard deviation of the past eight earnings changes to the average book assets over the past eight quarters. At the loan level, we include Log(Maturity) (in months) and Log(Loan Amount) (in millions of dollars). We do not have a prior on the signs

measure (see Appendix-Table 2.C.4). We find that a standard deviation increase in CFO overconfidence is associated with a 2.47% increase in leverage. Results are slightly weaker for book leverage, perhaps because it is a noisier measure of the desired capital structure; but our main coefficient is still positive in all specifications and significant at the 5% or 10% level.

[28]We use Log(Assets) rather than Log(Sales) as a proxy for size here for consistency with Valta (2012). Using our usual proxy, Log(Sales), produces the same results.

of the coefficients on these controls. Loans with shorter horizon and for a higher amount may, intuitively, be riskier, and so may be associated with higher spreads; however, in equilibrium, these may be precisely the loans made only to solid, safe firms. Finally, in some specifications we also add loan-type fixed effects. At the managerial level, we include as usual both the total number of shares and the number of vested shares owned by each executive, standardized by the number of shares outstanding, to capture the moral hazard problem generated by the separation of ownership and control. Finally, δ_t captures year-quarter fixed-effects.

2.5.2 Baseline Results

Table 2.6 shows the main results of estimating equation 2.9. In this analysis, our prediction pertains to the role of the CEO rather than the CFO since the actual implementation of an investment project (and its continuation under adverse circumstances) rely predominantly on the effort and decision-making of the CEO. Column 1 shows the baseline version of the estimation, which includes only Longholder CEO, industry fixed effects, and year-quarter fixed effects as independent variables. We find that CEO overconfidence is associated with a lower cost of debt. The coefficient on Longholder CEO is -0.191 and highly significant (p ¡ 0.01). The estimated effect is economically sizeable, amounting to about one fifth of a standard deviation of the outcome variable. Since our dependent variable is log-transformed, we can interpret the coefficient as indicating a percentage change in interest rates, i.e., a reduction of 19.1%, or 24.44 basis points relative to a sample mean of 127.97 basis points.

In column 2 we include the control variables mentioned above. Our coefficient of interest is slightly reduced (-0.160), but the statistical significance increases, with a t-statistic over 3. Among the other regressors, four firm-level control variables are significant: Leverage and maturity enter with a positive sign, and size and loan amount are associated with lower interest rates. Earnings volatility is associated with higher interest rates, albeit insignificantly. The same holds in all other estimations shown in Table 2.6. (Only the coefficient on Log(Maturity) becomes insignificant when we include loan type dummies) The managerial control variables for the CEO are insignificant or very small. (An exception is the coefficient on the number of vested options owned by the CEO, normalized by the number of outstanding shares, 0.006 with a t-statistic of 2.197). In the other columns, we will see that the number of vested options owned by the CFO is, however, positive and significant. While we do not have a particular explanation for this result, we notice that it is at odds with a possible alternative interpretation of our overconfidence interpretation, namely, the "signaling" argument. If managers were to hold vested options in order to signal the quality of their projects, we would expect a negative coefficient in a separating equilibrium.

In columns 3 and 4 we turn to CFO overconfidence. We find some association between Longholder CFO and lower interest rates in the baseline estimation, and it becomes significant in the specification with control variables. However, when we include our measures of CEO and CFO overconfidence jointly (in columns 5 and 6), the association with CFO overconfidence becomes insignificant while the coefficient on Longholder CEO is still large in magnitude and significant (-0.147, with a t-statistic of -2.751). Hence, it appears that the effect of optimistic beliefs on banks' willingness to finance a loan more cheaply does not extend to the CFO. The interpretation offered by the model is that the CFO is involved in financing choices but not in decisions and effort choices pertaining to the implementation and continuation of the project.

This result persists even when we add loan-type fixed effects (in column 7). The latter specification is very conservative and has to be interpreted with some caution: A CEO's beliefs may affect the cost of financing also via the type of loan that financial intermediaries are willing to grant, as some types of loans may come with higher and others with lower interest rates. Hence, the inclusion of loan effects may absorb some of the relation between overconfidence and the cost of debt. Moreover, the analysis within loan type is very demanding statistically, as our sample includes 18 different loan types.[29] Nevertheless, we estimate a similar effect. The coefficient on Longholder CEO is somewhat reduced (-0.099, corresponding to a 10% reduction in interest rate spreads) and still significant, with a p-value less than 0.05.

Overall, having an overconfident CEO run the firm appears to induce more favorable financing conditions. Longholder CFOs affect the type of financing but not the cost of financing.

2.5.3 Effect of Overconfidence in Different Subsamples

Our theoretical model has a distinctive prediction regarding the type of firms that are able to obtain more favorable debt financing under an overconfident CEO: firms with intermediate ranges of return variability. That is, CEO overconfidence should matter most for differences in loan pricing when the uncertainty about future cash flows (parameter in the model) is large enough to reduce the incentives to work hard' on the implementation and continuation of the investment project in bad states of the world for rational CEOs, but not for overoptimistic CEOs. In such firms, overconfidence drives a wedge into managerial choices and the resulting loan pricing as only overconfident CEOs continue to believe that they can generate a positive outcome when the intermediate signal is negative. If instead uncertainty is either very small or very large, there are no such differences in CEO behavior rational and overconfident CEOs will either both continue their investment efforts, or will both abandon their efforts upon negative intermediate news. Anticipating these choice, we do not predict differences in loan pricing between firms with and without overconfident CEOs if their variability in returns is either small or large.

To test the predicted non-monotonicity (in variability) of the effect of CEO overconfidence, we construct several empirical proxies for firms' return variability. A first natural proxy is earnings volatility, estimated from actual earnings realizations. As defined above, we use the ratio of the standard deviation of the past eight earnings changes to average book assets over the past eight quarters. This is a popular proxy for profit variability (at least) since Brealey, Hodges, and Capron (1976); recent uses include Valta (2012) and Matsa (2010). It is particularly suitable in our context, as it allows for earnings variability to vary over time and through a firm's life cycle. That is, since the measure uses the standard deviation of actual realizations of earnings in the eight quarters preceding the loan issue, it allows for a firm to experience different levels of volatility throughout its life cycle and as the managerial composition changes. At the same time, we find that the

[29]The most common loan types are: revolving loans provided over more than one year (950 observations), 364 days facilities (263 observations) and generic term loans (124 observations).

correlation of the volatility measure with its own lagged value is about 78% (at annual frequencies) in our data. Hence, in practice, lagged values of volatility are strong predictors of future firm-level risk, making our measure of return variability a good proxy for a firm's risk from the lenders' perspective.

It is also worth clarifying why we measure the volatility of earnings, not the volatility of project returns for our empirical analysis. In our model, the firm's investment consists of one project, and the two types of volatility coincide. In practice, however, firm cash flows do not consist of the returns to one project, and hence project volatility is unlikely to affect the cost of financing (even ignoring the empirical difficulties of finding a project-specific proxy). For example, if a single project is very risky but the firm is fully solvent, lenders will not be concerned about managerial efforts and loan repayment, as they are able to recover the full amount of the loan. It is the occurrence of firm-level shocks, as captured by the firm's earnings, that induces or exacerbates the agent's moral hazard problem and lenders' uncertainty about repayment. Hence, the volatility of overall earnings captures precisely the mechanism the model illustrates: Lenders price the risk that, following a negative shock, a CEO will have little incentive to carry through with a project.

In addition to employing earnings volatility, we use two measures as robustness checks, both of which capture uncertainty as perceived by outside observers: (1) analyst coverage, measured as the number of analysts who made at least one annual earnings forecast and are included in IBES (similarly to Hong, Lim, and Stein (2000)); and (2) the coefficient of variation of analysts' annual earnings forecasts, defined as the standard deviation of forecasts normalized by the absolute value of the mean forecast. As for the first, Whited and Wu (2006) show that low analyst coverage is associated with financial constraints, which in turn might indicate uncertainty regarding their ability to repay their debt. As for the second, a large literature in accounting (see for example Cheng and Warfield (2005)) argues that the coefficient of variation is associated with larger earnings surprises. One appealing feature of the coefficient of variation of earnings estimates, as a proxy for earnings variability, is that it is not related to past earnings but to expectations of future earnings, held by sophisticated market participants. For this last measure, we restrict our sample to firms that are covered by at least ten analysts (896 observations). Both of these additional measures capture the uncertainty a firm faces only indirectly as they rely on outsiders' (analysts') views, but provide useful robustness checks.

For each of our three proxies for, we proceed as follows. First, we sort firms every year into a region of low, medium, or high variability. We then estimate equation 2.9 on each of the three resulting subsamples, separately for each of the three proxies. Since our theoretical model does not pin down the thresholds between low, medium, and high variability, we use tercile splits as a natural starting point. Terciles allow us to test for the predicted non-monotonicity while leaving sufficient statistical power in each subsample and producing estimates of comparable reliability across subgroups. However, we also check a wide range of different percentile cutoffs to test the robustness of our results, using percentile cutoffs of 35-30-35, 30-40-30, and 25-50-25.

The results of this exercise are reported in Table 2.7. For brevity, we employ directly the empirical model with the full set of controls, mirroring column 7 of Table 2.6, and report only the coefficients of Longholder CEO and Longholder CFO. Thus, in all estimations, we continue to control for loan riskiness in multiple ways, as discussed above.

Starting from the earnings volatility proxy, in Panel 2.7a we see that the coefficient on Longholder CEO is large and significant in the intermediate tercile, with a coefficient equal to -0.306 and a t-statistic equal to 3.288. In terciles 1 and 3, instead, the coefficients on CEO overconfidence are small (-0.087 and -.121) and insignificant. In terms of economic magnitude, the estimate in the medium terciles implies that a Longholder CEO is charged a spread that is about 30% lower than an unbiased manager. Despite the small sample size, the differences between the low and medium sample and between the high and the medium sample are also statistically significant at the 5% and 10% confidence level, respectively, with χ^2-statistics 5.034 and 2.988 computed under the null hypothesis of equality of the Longholder CEO coefficients.

When using alternative sample splits, shown below the tercile splits in Panel 2.7a, we obtain qualitatively similar results, with the Longholder CEO coefficient being highly statistically significant only in the medium variability subsample. We also replicate the result that the economic magnitude is always largest in the medium region (except in the 25-50-25 split, where high-variability coefficient is slightly larger, albeit only marginally significant).

We obtain similar results when we use the two alternative proxies for σ, analyst coverage and the coefficient of variation (CV) of earnings estimates. In the case of analyst coverage, shown in Panel 2.7b, the estimated effect of having an overconfident CEO on the cost of debt financing for the company is large and significant only in the medium range for the tercile split and all other quantile splits. In the low analyst-coverage and the high analyst-coverage subsamples, instead, shown in columns 1 and 3 of Panel 2.7b, the Longholder CEO coefficients are always small and insignificant coefficient. The same holds for the estimated effect of CFO overconfidence. We note though that the differences in the estimated coefficients on CEO Longholder between subsamples are generally not significant at conventional levels.

The CV-based estimates, instead, shown in Panel 2.7c, are particularly precise under the tercile split. Here, the differences between the coefficient estimates across the bottom and medium subsamples and across the top and medium subsamples are different at the 5% and 1% significance levels (with corresponding chisquared statistics of 4.142 and 9.747), respectively. Also under the alternative quantile splits, shown in the lower part of Panel 2.7c, the coefficient estimates in the medium range are always significant and typically largest (most negative), though we note that the bottom range also features some negatively significant estimates, even for the CFO. The latter inconsistency reflects that the distribution of the coefficient of variation is very right-skewed in our sample, with a median of 1.25% and a mean of 2.88%, so that the low and medium CV subsamples are relatively similar in terms of the sorting variable.

Overall, these results, as well as estimation results from a host of alternative definitions of "medium" uncertainty and corresponding alternative sample splits,[30] reveal that the CEO's over-

[30] In addition to the quantile splits shown in Table 2.7, we conducted further variations increasing and decreasing the top/bottom ranges in 5%-steps. Our results are very stable. In addition, we replicate the results using the continuous overconfidence proxy of Otto (2014). We find the same pattern of non-monotonicity for our main proxy, earnings volatility, as shown in Appendix-Table 2.C.6, Panel B: CEO overconfidence is significant at the 5% level and large only in the intermediate tercile, with a coefficient of -5.287 and a t-statistic of -2.423. We do not observe similar patterns for CFO overconfidence and when using the other, more indirect, proxies for earnings volatility (omitted for brevity). We note that, as shown in Panel A of Appendix-Table 2.C.6, the baseline CEO Longholder coefficients for

confident beliefs predict a willingness of banks to finance at lower costs only over a medium range of uncertainty exactly as predicted by the model. The reliability of our results in the medium range of uncertainty, and the lack thereof in the remaining subsamples, provide a strong corroboration of our theoretical interpretation.

The subsample results are central to the test of our model-based hypotheses in that they address concerns about unobserved covariates and alternative explanations more sharply. The key finding above is that the influence of CEO overconfidence on loan pricing is concentrated in the subsample of firms with intermediate uncertainty. Hence, if an unobserved variable were to explain our findings, this omitted variable ought to vary non-monotonically with earnings volatility in order to rationalize the set of results reported in Table 2.6. In addition, such an unobserved alternative interpretation of our Longholder coefficients also would have to explain the variation in whether the CFO or the CEO proxy is significant in predicting an outcome variable (e.g., type of financing versus cost of financing). This variation is predicted by the model for our overconfidence interpretation but hard to explain under the alternative explanation that an unobserved variable is correlated with the Longholder proxy. Both restrictions taken together, non-monotonicity and variation in which Longholder proxy matters, seem unlikely to be met by a hypothetical unobserved variable.

2.6 CFO Hiring Decisions

As the final step in our empirical analysis, we provide evidence on the prediction that overconfident CEOs are more likely to hire similarly optimistic CFOs. Though a CEO may not select other top executives single-handedly, she is able to influence the board toward the selection of a CFO who will not systematically contradict her views (Landier et al. (2013)), and can strongly affect the overall composition of the board (Shivdasani and Yermack (1999)).

As a first piece of suggestive evidence we note that our measures of CEO and CFO overconfidence are strongly correlated. The correlation coefficient is 25.3%, significant at the 1% level. However, CFOs may have been appointed before the CEO, and hence the correlation may simply reflect firm effects or other factors outside the CEO's managerial choice. Thus, our main analysis focuses on CFOs appointed after a given CEO, and we test whether a CFO is more or less likely to be overconfident depending on the CEO's bias.

We identify all cases in which a given firm in our data set changes CFO, using the execid identifier provided by ExecuComp. We assume that, for any new CFO appointed in year , the relevant decision maker is the CEO of the company at time . The analysis requires the following variables to be available: (i) the time t Longholder CFO proxy; (ii) the time $t-1$ Longholder CEO proxy; (iii) all relevant control variables at time $t-1$. These filters leave us with 202 observations. We estimate the following logit model:

$$Pr(LTCFO_{i,t} = 1 | LTCEO_{i,t-1}, X_{i,t-1}, \delta_t) = G(\beta_1 + \beta_2 LTCEO_{i,t-1} + X'_{i,t-1}B + \delta_t + \varepsilon_{i,t} \quad (2.9)$$

the overall sample are less strong under the continuous measure, and significant only in the specification of column 2.

where $LTCFO_{i,t}$ and $LTCEO_{i,t-1}$ are our overconfident proxies for the CFO and the CEO, respectively, $X_{i,t-1}$ is a vector of control variables, and δ_t is a vector of year dummies.

Results are reported in Table 2.8. In column 1, we include only our CEO overconfidence proxy and year fixed effects as regressors. In column 2, we add industry fixed effects, which take into account the fact that overconfident executives may tend to sort into specific industries. For instance, Hirshleifer, Low, and Teoh (2012) find that overconfident CEOs are more common in innovative industries.[31] Column 3 adds our usual set of managerial controls, and column 4 also includes firm-level variables. Among all of the control variables, only the CEO's vested options significantly reduce the probability of selecting an overconfident CFO; however, the inclusion of this variable does not diminish, but rather increases the coefficient on Longholder CEO.

All four empirical models consistently show that overconfident CEOs are more likely to appoint overconfident CFOs. Despite the small number of observations, the coefficient on Longholder CEO is always significant at the 1% level. In our most demanding model (column 4), the estimates imply that an overconfident CEO is over seven times more likely to hire an overconfident CFO relative to a rational CEO.

Our results indicate that, above and beyond the direct influence of CEOs' biased beliefs on corporate outcomes, they exert an indirect influence via assortative matching. The finding also relates to recent work by Landier et al. (2013), who find that firms with boards that have a larger fraction of executives appointed after the CEO tend to underperform their rivals. We point out, however, that in our model we do not allow for varying project quality, so we cannot make precise predictions regarding the link between firm value and agreement (or disagreement) among top managers. It would be interesting for future research to use a more sophisticated theoretical framework to examine how the relation between firm performance and board structure could be linked to CEO's characteristics.

2.7 Conclusion

A key question in the analysis of managerial biases and the assessment of their empirical relevance is whether and how biased managers interact with other executives who may have different beliefs. Prior research has mostly focused on one type of manager, typically the CEO. As a result, it remained an open question whether the estimated impact of, say, CEO overconfidence on financing choices actually reflected the influence of another manager for instance, the influence of overconfident CFOs, who may assortatively match with overconfident CEOs. In this paper, we have advanced this line of research and have considered the beliefs of two key managers, the CEO and the CFO, jointly. We find that CFOs' behavioral traits have significant predictive power in explaining capital structure decisions while CEOs' behavioral traits play a significant role in predicting the cost of debt. Specifically, while firms with overconfident CFOs are more likely to issue debt when accessing external capital, CFOs are not relevant for loan interest rates. Instead, the cost of debt

[31] We include dummies for the Fama and French (1997) 12 industries classification rather than two-digit SIC Code industry dummies (as in the other tables) because of the small number of observations. That said, the use of the latter, more stringent industry classification has no effect on our results.

financing varies significantly by the type of CEO who runs the firm. Overconfident CEOs are able to obtain cheaper debt financing than their rational peers. Finally, overconfident CEOs are more likely to appoint overconfident managers as CFOs. We provide a unifying theoretical framework that can parsimoniously accommodate these results.

Our findings corroborate previous findings on the significant role of managerial biases in corporate decisions, and point to the importance of extending the analysis beyond the person of the CEO. As such, our results help to address concerns about possible confounds of the Longholder overconfidence proxy in prior research. We find that CEO overconfidence influences those corporate outcomes that are determined by CEOs, while CFO overconfidence does not. Similarly, CFO overconfidence affects outcomes that fall in the realm of the CFO and, here, CEO overconfidence does not matter. Given these results, it is unlikely that the "Longholder" construct captures other unobserved factors that are correlated with late option exercise.

Furthering this research, it will be interesting to explore the traits of other (C-suite) managers such as CTOs or COOs and their influence on corporate decisions. Can we test whether their beliefs, biases, and personal characteristics are associated with other firm outcomes related to their duties, and not associated with outcomes that do not fall into their decision-making realm? Such an analysis will require a more comprehensive data set than the one employed here, and will be feasible as more and more detailed data on board members' characteristics are becoming available.

Our findings also suggest that the economic implications of managerial characteristics are richer than demonstrated in previous research, pointing to their influence on effort choices and on hiring decisions. Future research on interaction and peer effects among managers that accounts for biased belief formation thus appears to be another promising avenue.

Finally, while our last set of estimations points to a significant role of CEO biases in the hiring of other managers, our findings do not rule out a significant influence of boards on the choice of managers. As such, it might be interesting to explore how managerial traits and biases of candidates affect how boards make hiring decisions.

2.8 Figures and Tables

Figure 2.1
Timeline of the Model

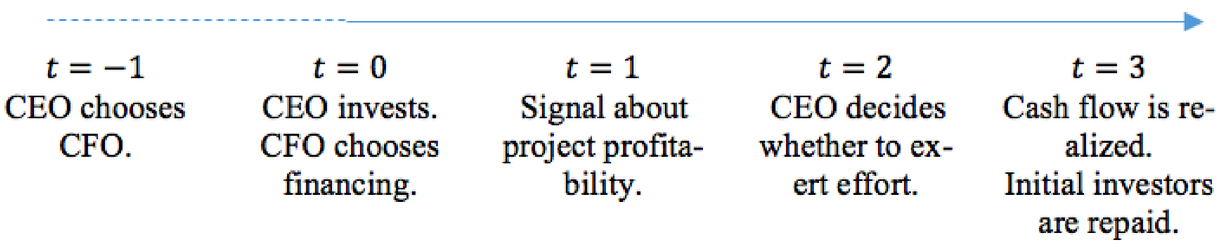

Table 2.1
Summary Statistics

Panel A. Firm Variables

	Table 2.2 (Debt Issues, Compustat)			
Variable	Obs.	Mean	Median	St. Dev.
Net Debt Issue Indicator	2,875	0.503	1	0.5
Q	2,875	2.392	1.807	2.134
Profitability	2,875	0.178	0.172	0.151
Tangibility	2,875	0.325	0.217	0.305
Log(Sales)	2,875	7.153	7.09	1.62
Book Leverage	2,875	0.31	0.281	0.45
	Table 2.3 (Debt Issues, SDC)			
Variable	Obs.	Mean	Median	St. Dev.
Net Debt Issue Indicator	694	0.69	1	0.463
Q	679	2.301	1.716	2.35
Profitability	657	0.177	0.171	0.138
Tangibility	656	0.384	0.274	0.339
Log(Sales)	679	8.27	8.523	1.815
Book Leverage	608	0.401	0.382	0.326
	Tables 2.4 and 2.5 (Financing Deficit, Leverage)			
Variable	Obs.	Mean	Median	St. Dev.
Assets ($m)	4,452	5,682.17	1,627.00	14,213.81
Sales ($m)	4,452	5,678.41	1,515.03	17,497.40
Capitalization ($m)	4,452	8,102.13	2,229.38	20,551.44
Net Financing Deficit ($m)	4,452	-245.76	-16.22	2,171.99
Net Fin. Def. / Assets	4,452	-0.03	-0.018	0.367
Net Debt Issues / Assets	4,452	0.027	0	0.155
Book Leverage	4,452	0.286	0.256	0.43
Q	4,452	2.409	1.858	1.969
Change in Q	4,452	-0.037	0.028	1.646
Profitability	4,452	0.185	0.173	0.141
Change in Profitability	4,452	-0.002	0.002	0.098

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Table 2.1 – *Continued from previous page*

Tangibility	4,452	0.298	0.2	0.287
Change in Tangibility	4,452	-0.007	-0.003	0.146
Log(Sales)	4,452	7.266	7.215	1.579
Change in Log(Sales)	4,452	0.108	0.098	0.223
Market Leverage	4,432	23.9	11.82	52.42
	Tables 2.6 and 2.7 (Cost of Debt Financing)			
Variable	Obs.	Mean	Median	St. Dev.
Interest Spread (bp)	1,651	127.97	100	102.497
Loan Maturity (Months)	1,651	46.409	60	21.778
Loan Amount ($m)	1,651	590.82	300	1,080.37
Log(Assets)	1,651	7.951	7.841	1.377
Book Leverage	1,651	0.234	0.23	0.15
Z-Score	1,651	3.585	2.452	4.475
Earnings Volatility	1,651	0.018	0.008	0.072
Cash Holding	1,651	0.122	0.062	0.191
Analysts' Coverage	1,651	12.009	10	7.6
Coeff. Var. of Earn. Est.	896	0.029	0.013	0.064

Panel B. Manager Variables

	Table 2.2 (Debt Issues, Compustat)			
Variable	Obs.	Mean	Median	St. Dev.
CEO Longholder	2,875	0.682	1	0.466
CEO Stock Ownership (%)	2,875	18.831	3.413	46.721
CEO Vested Options (%)	2,875	9.994	6.511	12.573
CFO Longholder	2,875	0.528	1	0.499
CFO Stock Ownership (%)	2,875	1.188	0.41	3.341
CFO Vested Options (%)	2,875	2.424	1.289	3.506
	Table 2.3 (Debt Issues, SDC)			
Variable	Obs.	Mean	Median	St. Dev.
CEO Longholder	694	0.682	1	0.466
CEO Stock Ownership (%)	646	11.358	1.877	38.944
CEO Vested Options (%)	646	6.318	3.82	7.921
CFO Longholder	694	0.555	1	0.497
CFO Stock Ownership (%)	626	1.087	0.314	8.836
CFO Vested Options (%)	626	1.417	0.724	2.077
	Tables 2.4 and 2.5 (Financing Deficit, Leverage)			
Variable	Obs.	Mean	Median	St. Dev.
CEO Longholder	4,452	0.683	1	0.465
CEO Stock Ownership (%)	4,452	18.18	3.062	48.709
CEO Vested Options (%)	4,452	10.194	6.689	13.788
CFO Longholder	4,452	0.53	1	0.499
CFO Stock Ownership (%)	4,452	1.223	0.405	4.358
CFO Vested Options (%)	4,452	2.39	1.282	3.352
	Tables 2.6 and 2.7 (Cost of Debt Financing)			
Variable	Obs.	Mean	Median	St. Dev.
CEO Longholder	1,651	0.665	1	0.472
CEO Stock Ownership (%)	1,651	13.179	2.83	38.76
CEO Vested Options (%)	1,651	8.73	5.857	9.731

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Table 2.1 – *Continued from previous page*

CFO Longholder	1,651	0.543	1	0.498
CFO Stock Ownership (%)	1,651	1.16	0.398	3.604
CFO Vested Options (%)	1,651	2.127	1.131	3.021

Table 2.2
Debt Issues (Compustat)

Table 2.2 shows the estimated log odds ratios from logistic regressions. The binary dependent variable is equal to 1 if Net Debt Issues during the year are positive. Net Debt Issues is long-term debt minus long-term debt reduction. Longholder CEO/Longholder CFO is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. We require managers to have at least ten transactions recorded in Thomson Reuters to be included in the sample. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Q is the book value of assets plus the market value of equity minus the book value of equity minus deferred tax, divided by the book value of assets. Profitability is operating income before depreciation divided by lagged assets. Tangibility is property, plants and equipment divided by lagged assets. Book Leverage is the sum of current liabilities and long-term debt divided by the sum of current liabilities, long-term debt and book equity. Stock Ownership, Vested Options, Q, Profitability, Tangibility, Log(Sales), and Book Leverage are measured at the beginning of the year. 2-digit SIC level industry fixed-effects are included in all regressions. Standard errors are adjusted for clustering at the firm level. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	0.122	0.005			0.021	0.044	-0.113
	(1.036)	(0.040)			(0.173)	(0.357)	(-0.957)
Longholder CFO			0.372***	0.408***	0.366***	0.431***	0.443***
			(3.307)	(3.509)	(3.174)	(3.174)	(3.703)
CEO Shares		-0.001				-0.002	-0.001
		(-0.615)				(-1.496)	(-0.662)
CEO Vested Options		0.001				-0.007	0.004
		(0.145)				(-1.186)	(0.860)
Q		-0.058		-0.057			-0.057
		(-1.418)		(-1.358)			(-1.359)
Profitability		0.655		0.631			0.640
		(1.101)		(1.076)			(1.085)
Tangibility		0.319		0.320			0.342
		(1.082)		(1.078)			(1.138)
Log(Sales)		0.477***		0.465***			0.470***
		(9.607)		(9.408)			(9.264)
Book Leverage		0.079		0.083			0.074
		(0.630)		(0.660)			(0.613)
CFO Shares				-0.007		-0.013	-0.005
				(-0.569)		(-0.946)	(-0.454)
CFO Vested Options				-0.019		-0.076***	-0.023
				(-1.124)		(-3.458)	(-1.279)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Observations	2,875	2,875	2,875	2,875	2,875	2,875	2,875
Pseudo R-squared	0.045	0.152	0.050	0.157	0.050	0.102	0.158

Table 2.3
Debt Issues (SDC)

Table 2.3 presents the estimated log odds ratios from logit regressions with a binary variable equal to one if the firm issued debt during the fiscal year, conditioning on having issued debt, equity, or hybrid securities. Data on public issues are from SDC and include 330 firms. Equity issues are issues of common stock or non-convertible preferred stock. Debt issues are issues of non-convertible debt. Hybrid issues are issues of convertible debt or convertible preferred stock. CEO Longholder/CFO Longholder is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. Manager-level control variables include Stock Ownership and Vested Options. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Firm-level control variables include changes in Q, Profitability, Tangibility and Log(Sales). Q is the book value of assets plus the market value of equity minus the book value of equity minus deferred tax, divided by the book value of assets. Profitability is operating income before depreciation divided by assets at the beginning of the year. Tangibility is property, plants and equipment divided by assets at the beginning of the year. Manager-level and firm-level control variables are all measured at the beginning of the year. 2-digit SIC level industry fixed effects are included in all the regressions. Standard errors are adjusted for clustering at the firm level. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	0.716**	0.206			0.528*	0.275	-0.075
	(2.537)	(0.519)			(1.856)	(0.810)	(-0.180)
Longholder CFO			0.819***	0.791**	0.688**	0.952***	0.819**
			(3.019)	(2.197)	(2.476)	(2.881)	(2.203)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Observations	694	611	694	587	694	598	585
Pseudo R-squared	0.092	0.549	0.098	0.558	0.105	0.255	0.558

Table 2.4
Financing Deficit

Table 2.4 presents the estimates of OLS regressions with Net Debt Issues normalized by assets at the beginning of the year as the dependent variable. Net Debt Issues is long-term debt minus long-term debt reduction. CEO Longholder/CFO Longholder is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. FD is the Net Financing Deficit, which is defined as cash dividends plus investment plus change in working capital minus cash flow after interest and taxes, normalized by assets at the beginning of the year, which is identical to that in Malmendier, Tate and Yan (2011). Manager-level control variables include Stock Ownership and Vested Options. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Firm-level control variables include changes in Q, Profitability, Tangibility and Log(Sales). Q is the book value of assets plus the market value of equity minus the book value of equity minus deferred tax, divided by the book value of assets. Profitability is operating income before depreciation divided by assets at the beginning of the year. Tangibility is property, plants and equipment divided by assets at the beginning of the year. Manager-level and firm-level control variables are all measured at the beginning of the year. Columns (3), (6), and (9) also include the interaction of Net Financing Deficit with the manager and firm control variables. All standard errors are adjusted for clustering at the firm level. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FD x Longh. CEO	0.029	0.059	0.168**				-0.015	0.020	0.110*
	(0.245)	(0.603)	(2.100)				(-0.156)	(0.244)	(1.831)
FD x Longh. CFO				0.236**	0.202*	0.187*****	0.238**	0.198**	0.174***
				(2.080)	(1.527)	(3.054)	(2.158)	(1.999)	(3.056)
FD	0.188**	0.143**	0.133	0.098***	0.091***	0.036	0.106*	0.081	0.076
	(2.167)	(2.356)	(1.062)	(2.824)	(2.804)	(0.307)	(1.706)	(1.581)	(0.794)
Longholder CEO	-0.007	-0.005	0.002				-0.007	-0.003	0.003
	(-0.657)	(-0.444)	(-0.163)				(-0.673)	(-0.316)	(0.236)
Longholder CFO				0.001	-0.002	-0.003	0.002	-0.006	-0.009
				(0.034)	(-0.147)	(-0.199)	(0.101)	(-0.401)	(-0.663)
Manager Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Firm Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
FD x Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES	NO	YES	YES
Observations	4,452	4,452	4,452	4,452	4,452	4,452	4,452	4,452	4,452
R-squared	0.195	0.287	0.419	0.258	0.328	0.455	0.258	0.330	0.465

Table 2.5
Leverage

Table 2.5 presents the estimates of OLS regressions with market leverage (multiplied by 100) as dependent variable. Market leverage is long-term debt plus debt in current liabilities item, all divided by price times common shares outstanding plus the numerator. CEO Longholder/CFO Longholder is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Firm-level control variables include Q, Profitability, Tangibility, Log(Sales) and Net Financing Deficit. Q is the book value of assets plus the market value of equity minus the book value of equity minus deferred tax, divided by the book value of assets. Profitability is operating income before depreciation divided by lagged assets. Tangibility is property, plants and equipment divided by lagged assets. Manager-level and firm-level control variables are all measured at the beginning of the year. Net Financing Deficit (FD) which is cash dividends plus investment plus change in working capital minus cash flow after interest and taxes, normalized by lagged assets. Returnst-1 are lagged one year returns. All the regressions include year and firm fixed-effects. All standard errors are adjusted for clustering at the firm level. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Longholder CEO	1.167	0.623			0.751	0.172	0.128	0.074
	(0.853)	(0.468)			(0.541)	(0.127)	(0.096)	(0.056)
Longholder CFO			4.012***	3.628**	3.930***	3.865***	3.819***	3.887***
			(2.697)	(2.530)	(2.657)	(2.678)	(2.657)	(2.709)
CEO Shares		0.003				0.009	0.009	0.009
		(0.495)				(1.545)	(1.468)	(1.509)
CEO Vested		0.034				0.031	0.030	0.033
Options		(1.462)				(1.332)	(1.289)	(1.392)
CFO Shares				-0.033**		-0.056***	-0.054**	-0.050**
				(-2.428)		(-2.603)	(-2.525)	(-2.335)
CFO Vested				0.133		0.090	0.088	0.086
Options				(1.477)		(0.914)	(0.888)	(0.879)
Q		-0.669***		-0.652***		-0.646***	-0.747***	-0.622***
		(-4.216)		(-4.205)		(-4.183)	(-4.391)	(-3.831)
Profitability		-14.894***		-14.967***		-14.903***	-14.385***	-13.805***
		(-5.472)		(-5.579)		(-5.552)	(-5.355)	(-5.029)
Tangibility		6.781***		6.844***		6.839***	6.688***	6.660***
		(4.725)		(4.794)		(4.802)	(4.585)	(4.492)
Log(Sales)		2.970***		3.042***		3.098***	3.318***	3.130***
		(3.949)		(3.932)		(3.999)	(4.182)	(3.942)
FD							2.807***	2.874***
							(4.139)	(4.237)
$Return_{t-1}$								-0.917***
								(-4.474)
Manager Controls	NO	YES	NO	YES	NO	YES	YES	YES
Firm Controls	NO	YES	NO	YES	NO	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4,429	4,429	4,429	4,429	4,429	4,429	4,429	4,429
R-squared	0.089	0.142	0.094	0.147	0.094	0.148	0.160	0.168

Table 2.6
Cost of Debt Financing

Table 2.6 presents regressions of Log(Interest Spread) on our overconfidence measures and several control variables, including year-quarter and industry fixed-effects. Log(Interest Spread) is the difference between the interest rate of the loan in basis points and the London Interbank Offered Rate. CEO Longholder/CFO Longholder is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Book Leverage is (long-term debt + debt in current liabilities) / (long-term + debt in current liabilities + common equity). Z-Score is 1.2 × (current assets - current liabilities) + 1.4 × retained earnings + 3.3 × pretax income + 0.6 × market capitalization / total liabilities xtotal assets + 0.9 × sales, all scaled by total assets. Cash holding is cash and short-term investments divided by total assets. Earnings Volatility is the standard deviation of the past eight earnings changes to the average book asset size over the past eight quarters. Control variables are all measured at the beginning of the year. All standard errors are adjusted for clustering at the firm level. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	-0.191***	-0.160***			-0.187**	-0.147***	-0.099*
	(-2.652)	(-3.212)			(-2.498)	(-2.751)	(-2.062)
Longholder CFO			-0.071	-0.113**	-0.012	-0.067	-0.071
			(-0.937)	(-2.201)	(-0.153)	(-1.219)	(-1.466)
Log(Assets)		-0.191***		-0.188***		-0.182***	-0.183***
		(-6.877)		(-6.852)		(-6.643)	(-7.210)
Leverage		0.930***		0.954***		0.916***	0.700***
		(4.521)		(4.579)		(4.471)	(3.850)
Z-Score		-0.013*		-0.015**		-0.015**	-0.016**
		(-1.847)		(-2.220)		(-2.092)	(-2.545)
Log(Amount)		-0.111***		-0.112***		-0.111***	-0.102***
		(-4.336)		(-4.504)		(-4.444)	(-4.088)
Log(Maturity)		0.187***		0.191***		0.185***	0.071
		(5.817)		(5.785)		(5.785)	(1.359)
Earnings Volatility		0.334		0.333		0.336	0.360
		(1.325)		(1.252)		(1.326)	(1.482)
Cash Holding		0.250		0.231		0.264	0.229
		(1.229)		(1.078)		(1.221)	(1.238)
CEO Shares		0.000				0.000	0.000
		(0.675)				(0.373)	(0.437)
CEO Vested Options		0.006**				0.003	0.003
		(2.197)				(1.114)	(1.083)
CFO Shares				0.000		0.001	0.002
				(0.106)		(0.370)	(0.760)
CFO Vested Options				0.029***		0.026***	0.019***
				(3.867)		(3.625)	(3.022)
Manag. Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Loan Type FE	NO	NO	NO	NO	NO	NO	YES
Observations	1,651	1,651	1,651	1,651	1,651	1,651	1,651
R-squared	0.419	0.619	0.412	0.620	0.420	0.625	0.676

Table 2.7
Net Interest Rates Across Subsamples (Different Cutoffs)

Panel 2.7a, 2.7b, and 2.7c test the relation between CEO overconfidence and the cost of debt across different subsamples, using different cutoffs for low, medium, and high variability in each sorting variable (Earnings Volatility in Panel 2.7a, Analysts Coverage in Panel 2.7b, and Coefficient of Variation of Earnings Forecasts in Panel 2.7c). All panels show regressions of Log(Interest Rate Spread) on our measures of overconfidence and the same control variables and fixed effects as in Column 7 of Table 2.6. We estimate the empirical model specified in equation 2.9 in the main text in each subsample. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

(a)
Sorting by by Earnings Volatility

	(1)	(2)	(3)
	Bottom Tercile	Medium Tercile	Top Tercile
Longholder CEO	-0.087	-0.306***	-0.121
	(-1.417)	(-3.288)	(-1.480)
Longholder CFO	-0.081	0.031	-0.021
	(-1.224)	(-0.384)	(-0.276)
Observations	549	549	553
R-squared	0.805	0.746	0.593
	Bottom 35%	Medium 30%	Top 35%
Longholder CEO	-0.099	-0.326***	-0.115
	(-1.651)	(-3.427)	(-1.351)
Longholder CFO	-0.073	0.004	-0.012
	(-1.164)	(0.050)	(-0.153)
Observations	580	496	575
R-squared	0.802	0.763	0.75
	Bottom 30%	Medium 40%	Top 30%
Longholder CEO	-0.077	-0.236***	-0.122
	(-1.188)	(-3.196)	(-1.374)
Longholder CFO	-0.094	0.004	0.011
	(-1.379)	(0.049)	(0.137)
Observations	495	658	498
R-squared	0.815	0.711	0.767
	Bottom 25%	Medium 50%	Top 25%
Longholder CEO	-0.074	-0.176***	-0.188*
	(-0.933)	(-2.711)	(-1.814)
Longholder CFO	-0.055	-0.002	0.005
	(-0.646)	(-0.026)	-0.058
Observations	417	823	411
R-squared	0.837	0.692	0.786

(b)
Sorting by Analysts' Coverage

	(1)	(2)	(3)
	Bottom Tercile	Medium Tercile	Top Tercile
Longholder CEO	-0.110	-0.168**	-0.012
	(-1.569)	(-2.087)	(-0.123)
Longholder CFO	-0.046	-0.060	-0.070
	(-0.658)	(-0.769)	(-0.888)
Observations	548	554	548
R-squared	0.697	0.733	0.770
	Bottom 35%	Medium 30%	Top 35%
Longholder CEO	-0.084	-0.176*	-0.009
	(-1.302)	(-1.929)	(-0.093)
Longholder CFO	-0.043	-0.049	-0.079
	(-0.634)	(-0.562)	(-1.028)
Observations	583	495	573
R-squared	0.694	0.726	0.767
	Bottom 30%	Medium 40%	Top 30%
Longholder CEO	-0.088	-0.175**	-0.009
	(-1.217)	(-2.369)	(-0.091)
Longholder CFO	-0.033	-0.055	-0.063
	(-0.477)	(-0.702)	(-0.763)
Observations	500	653	498
R-squared	0.727	0.725	0.772
	Bottom 25%	Medium 50%	Top 25%
Longholder CEO	-0.094	-0.163***	0.026
	(-1.205)	(-2.714)	(0.220)
Longholder CFO	-0.080	-0.074	-0.036
	(-1.049)	(-1.079)	(-0.376)
R-squared	429	818	404
Observations	0.773	0.698	0.779

(c)
Sorting by Coefficient of Variation of Earnings Estimates

	(1)	(2)	(3)
	Bottom Tercile	Medium Tercile	Top Tercile
Longholder CEO	-0.149	-0.391***	0.097
	(-1.596)	(-3.074)	-0.616
Longholder CFO	-0.250**	-0.065	-0.156
	(-2.454)	(-0.630)	(-0.937)
Observations	293	296	307
R-squared	0.883	0.854	0.776
	Bottom 35%	Medium 30%	Top 35%
Longholder CEO	-0.185*	-0.250**	0.046
	(-1.935)	(-2.198)	-0.341
Longholder CFO	-0.256**	-0.009	-0.146
	(-2.571)	(-0.090)	(-1.005)
Observations	313	270	313
R-squared	0.867	0.855	0.768
	Bottom 30%	Medium 40%	Top 30%
Longholder CEO	-0.185*	-0.250**	0.046
	(-1.935)	(-2.198)	-0.341
Longholder CFO	-0.256**	-0.009	-0.146
	(-2.571)	(-0.090)	(-1.005)
Observations	269	357	270
R-squared	0.893	0.827	0.819
	Bottom 25%	Medium 50%	Top 25%
Longholder CEO	-0.259**	-0.256**	-0.009
	(-2.425)	(-2.533)	(-0.061)
Longholder CFO	-0.286***	-0.03	-0.21
	(-3.076)	(-0.346)	(-1.282)
Observations	231	440	225
R-squared	0.909	0.806	0.841

Table 2.8
CFO Hiring

Table 2.8 presents regressions of Log(Interest Spread) on our overconfidence measures and several control variables, including year-quarter and industry fixed-effects. Log(Interest Spread) is the difference between the interest rate of the loan in basis points and the London Interbank Offered Rate. CEO Longholder/CFO Longholder is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Book Leverage is (long-term debt + debt in current liabilities) / (long-term + debt in current liabilities + common equity). Z-Score is 1.2×(current assets - current liabilities) + 1.4×retained earnings + 3.3×pretax income + 0.6 × market capitalization / total liabilities ×total assets + 0.9×sales, all scaled by total assets. Cash holding is cash and short-term investments divided by total assets. Earnings Volatility is the standard deviation of the past eight earnings changes to the average book asset size over the past eight quarters. Control variables are all measured at the beginning of the year. All standard errors are adjusted for clustering at the firm level. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)
Longholder CEO	1.124***	1.436***	1.993***	1.991***
	(2.791)	(3.247)	(4.284)	(4.195)
CEO Vested Options			-0.073***	-0.075***
			(-2.993)	(-2.626)
CEO Shares			-0.002	-0.002
			(-0.591)	(-0.490)
Q				-0.081
				(-0.519)
Profitability				1.838
				(0.958)
Tangibility				1.581*
				(1.863)
Log(Sale)				-0.019
				(-0.129)
Book Leverage				0.097
				(0.274)
Manager Controls	NO	NO	YES	YES
Firm Controls	NO	NO	NO	YES
Industry FE	NO	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	202	202	202	202
Pseudo R-squared	0.085	0.196	0.194	0.212

Appendix

This Online Appendix consists of three parts. Appendix 2.A provides the proofs referenced in Section 2.2 of the paper. Appendix 2.B lists detailed definitions of the variables in our empirical analysis. Appendix 2.C provides summary statistics for specific subsamples of the data as well as numerous robustness checks.

2.A Proofs

Below, we prove Propositions 1, 2, and 3 of the paper (in subsections 2.A.1, 2.A.3, and 2.A.4, respectively). In subsection 2.A.2, we define the optimal equity contract, which is a necessary step to prove Propositions 2 and 3. In subsection 2.A.5, we discuss the robustness of our theoretical results to different parametric assumptions.

2.A.1 Optimal Debt Contract

The thresholds implied in Proposition 1 are $\sigma \leq \Delta - B/\alpha$ as the threshold for low return variability, $\Delta - B/\alpha + \omega \geq \sigma > \Delta - B/\alpha$ as the range for intermediate return variability, and $\sigma > \Delta - B/\alpha + \omega$ as the threshold for high return variability.

Proof of Proposition 1. First, we show that $D^*_{\hat{\omega}} = I$ for the case of low variability ($\sigma \leq \Delta - B/\alpha$) and, when the CEO is overconfident, also for the case of intermediate variability ($\Delta - B/\alpha + \omega \geq \sigma > \Delta - B/\alpha$). We can summarize these two cases as $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$

We start by showing that the CEO's IC constraints are satisfied in both states of the world. In the good state, the CEO exerts effort iff

$$\begin{aligned}
\alpha \cdot \max\{0, I + \sigma + \Delta + \hat{\omega}_{CEO} - I\} &\geq \alpha \cdot \max\{0, I + \sigma - I\} + B \\
\iff \max\{0, \sigma + \Delta + \hat{\omega}_{CEO}\} &\geq \max\{0, \sigma\} + B/\alpha \\
\iff \sigma + \Delta + \hat{\omega}_{CEO} &\geq \sigma + B/\alpha \\
\iff \sigma + \Delta + \hat{\omega}_{CEO} &\geq \sigma + B/\alpha
\end{aligned} \tag{2.10}$$

which holds given our initial assumption $\Delta \geq B/\alpha$. In the bad state, the CEO exerts effort iff

$$\begin{aligned} \alpha \cdot \max\{0, I - \sigma + \Delta + \hat{\omega}_{CEO} - I\} &\geq \alpha \cdot \max\{0, I - \sigma - I\} + B \\ \iff \max\{0, -\sigma + \Delta + \hat{\omega}_{CEO}\} &\geq \max\{0, -\sigma\} + B/\alpha \\ \iff -\sigma + \Delta + \hat{\omega}_{CEO} &\geq B/\alpha \\ \iff \Delta - B/\alpha + \hat{\omega}_{CEO} &\geq \sigma \end{aligned} \tag{2.11}$$

which is exactly the parameter range we are considering. Thus, the CEO will exert high effort in both states of the world.

Turning to the participation constraint 2.4c, we can now plug in $e_S = 1$, and obtain

$$\frac{1}{2}(\min\{I, I + \sigma + \Delta\} + \min\{I, I - \sigma + \Delta\}) = I \tag{2.12}$$

That is, the participation constraint holds with equality for the case considered here (as $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO} \wedge B/\alpha \geq \omega \implies \sigma < \Delta$). Hence, with $\Delta^*_{\hat{\omega}} = I$, all of the net the surplus goes to existing shareholders, which in turn implies that the perceived firm value (under the CFO's beliefs) is maximized under this contract. The expected utility of a rational CFO is $\beta\Delta$, whereas the overconfident CFO expects to get $\beta(\Delta + \omega)$.

To prove uniqueness, consider any other contract with face value $\tilde{D} \gtreqless I$. We can rule out $\tilde{D} < I$ as it does not satisfy the participation constraint. For $\tilde{D} < I$, there are two cases to consider: either the CEO exerts effort in both states of the world, or she does not. If she does, debtholders extract positive rents, and hence this type of contract cannot be optimal. If she does not, the resulting welfare loss implies that the rents that the CFO can extract (under debtholders' break-even constraint) will not be maximized. Hence, $D^*_{\hat{\omega}} = I$ is optimal when $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$.

Second, we show that $D^*_{\hat{\omega}} = I + \sigma$ for the case of high variability ($\sigma > \Delta - B/\alpha + \omega$),[32] and when the CEO is a rational CEO, also for the case of intermediate variability ($\Delta - B/\alpha + \omega \geq \sigma > \Delta - B/\alpha$). We can summarize these two cases as $\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$.

We start again from the IC constraints and show that, under $D^*_{\hat{\omega}} = I + \sigma$, the CEO exerts effort in the good state and shirks in the bad state. In the good state, the CEO exerts effort iff

$$\begin{aligned} \alpha \cdot \max\{0, I + \sigma + \Delta + \hat{\omega}_{CEO} - I - \sigma\} &\geq \alpha \cdot \max\{0, I + \sigma - I - \sigma\} + B \\ \iff \max\{0, \Delta + \hat{\omega}_{CEO}\} &\geq \max\{0, 0\} + B/\alpha \\ \iff \Delta + \hat{\omega}_{CEO} &\geq B/\alpha \end{aligned} \tag{2.13}$$

[32] We also note that this parameter range can be empty, and that the corresponding results further corroborate our finding that overconfidence helps overcome the moral hazard problem: Since σ is bounded above by I (returns cannot be negative in the bad state of the world),σ might not be larger than $\Delta - B/\alpha + \omega$, namely if either Δ or ω are large. If $\Delta - B/\alpha \geq I$, even the rational CEO will always exert effort under the optimal debt contract. If $\Delta - B/\alpha + \omega \geq I$, only the overconfident CEO will always exert effort. In other words, a sufficiently high value of ω mechanically solves any incentive problem for the overconfident CEO but not the rational CEO. Here, we focus on the more interesting case $\Delta - B/\alpha + \omega < I$ (and hence $\Delta - B/\alpha < I$).

which is implied by our initial assumption $\Delta > B/\alpha$. In the bad state, the CEO exerts shirks iff

$$\begin{aligned} &\alpha \cdot \max\{0, I-\sigma\Delta+\hat{\omega}_{CEO}-I-\sigma\} < \alpha \cdot \max\{0, I-\sigma-I-\sigma\}+B \\ \Longleftrightarrow\ &\max\{0, I-\sigma+\Delta+\hat{\omega}_{CEO}-I-\sigma\} < \alpha \cdot \max\{0, I-\sigma-I-\sigma\}+B \\ \Longleftrightarrow\ &\max\{0, -2\sigma+\Delta+\hat{\omega}_{CEO}\} < B/\alpha \end{aligned} \tag{2.14}$$

This is satisfied if $-2\sigma+\Delta+\hat{\omega}_{CEO} \leq 0$ since $0 < B/\alpha$. It is also satisfied if $-2\sigma+\Delta+\hat{\omega}_{CEO} > 0$ since, over the parameter range $\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$, it must also hold that $2\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$. Therefore, under $D^*_{\hat{\omega}} = I+\sigma$, the CEO exerts effort in the good state of the world and shirks in the bad state of the world. Turning to the participation constraint (4c), we can now use $e_{Good} = 1$ and $e_{Bad} = 0$, and show that the participation constraint holds with equality:

$$\frac{1}{2}(\min\{I+\sigma, I+\sigma+\Delta\} + \min\{I+\sigma, I-\sigma\}) = I \tag{2.15}$$

Again, debtholders receive I in expectation, and all of the net the surplus goes to existing shareholders. In this case, a rational CFO's expected utility is $\beta\Delta/2$, and an overconfident CFO expects to get $\beta(\Delta+\omega)/2$.

To see that this is an optimal contract, and that it is the unique optimal contract, consider an alternative contract $\tilde{D} \neq D^*_{\hat{\omega}}$. We can again rule out $\tilde{D} < I$ since debtholders cannot break even. For $\tilde{D} \leq I$, we first ask in which state of the world the CEO would exert effort under such a contract. In the bad state of the world, the CEO exerts effort under contract $\tilde{D}$ iff

$$\alpha \cdot \max\left\{0, I-\sigma+\Delta+\hat{\omega}_{CEO}-\tilde{D}\right\} \geq \alpha \cdot \max\left\{0, I-\sigma-\tilde{D}\right\}+B \tag{2.16}$$

With $\tilde{D} \geq I$, the IC becomes:

$$\alpha \cdot \max\left\{0, I-\sigma+\Delta+\hat{\omega}_{CEO}-\tilde{D}\right\} \geq B \tag{2.17}$$

which holds only if $I-\tilde{D} \geq \sigma - (\Delta+\hat{\omega}_{CEO}-B/\alpha)$. However, as we are analyzing the parameter space of $\sigma-(\Delta+\hat{\omega}_{CEO}-B/\alpha) > 0$, this implies $I-\tilde{D} > 0$, contradicting that $\tilde{D} \geq I$. Hence, the CEO will exert low effort in the bad state of the world. Because debtholders cannot obtain more than $I-\sigma$ in the bad state of the world, the optimal contract requires $\tilde{D} \leq D^*_{\hat{\omega}} = I+\sigma$ in order for debtholders to break even. Because $\tilde{D} \neq D^*_{\hat{\omega}}$, we must have $\tilde{D} > D^*_{\hat{\omega}}$.

We are left with two cases: Either the CEO exerts effort only in the good state of the world, or in neither state. In the former case, debtholders extract a strictly positive rent because of the higher face value $\tilde{D} > D^*_{\hat{\omega}}$, contradicting optimality. In the latter case, the contract with face value $D^*_{\hat{\omega}}$ generates higher total surplus for the CFO because of the CEO's higher effort choice (in the good state of the world), in combination with the lower face value. This contradicts optimality. ■

2.A.2 Optimal Equity Contract and Cost of Equity

As an intermediate step for the analysis of the CFO's choice between debt and equity, we first derive the optimal equity contract, conditional on equity financing, in Lemma 1, and discuss the resulting cost of equity. As in the case of debt, we will see that the optimal equity contract is independent of the CFO's type. We adopt the same notation as for the debt contract. Let $\hat{\pi}_{CFO}(S,e)$ be the return to the project under the CFO's beliefs. We denote the fraction of the firm owned by new shareholders by γ. The CFO solves the following program to determine the (second-best) optimal equity contract:

$$\max_{\gamma} \beta(1-\gamma)E[\hat{\pi}_{CFO}(S,e_S)] \tag{2.18a}$$

$$u_{CEO}(S,\gamma,e_S) \geq u_{CEO}(S,\gamma,e'_S)\,\forall\,\text{and}\,e_S \neq e'_S \tag{2.18b}$$

$$\gamma E[\pi(S,e_S)] \geq I \tag{2.18c}$$

Lemma 1 (Optimal Equity Contract). The optimal equity contract depends on the CEO's but not on the CFO's bias. In particular, we have

$$\gamma^*_{\hat{\omega}} = \tfrac{I}{I+\Delta}\,\text{and}\,e_S = 1\,\forall S\,\text{if}\,\tfrac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq \tfrac{B}{\alpha}\,\text{and}$$
$$\gamma^*_{\hat{\omega}} = 1\,\text{and}\,e_S = 0\,\forall S\,\text{if}\,\tfrac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta < \tfrac{B}{\alpha}$$

Proof of Lemma 1. We start from the IC constraint under equity financing, shown in inequality 2.3 in the paper. We know from 2.3 that the CEO's choice of effort is independent of the state of the world. She will exert high effort in both states iff

$$\alpha(1-\gamma)(\Delta+\hat{\omega}_{CEO}) \geq B \iff \gamma \leq 1 - \frac{B/\alpha}{\Delta+\hat{\omega}_{CEO}} \tag{2.19}$$

In this case, i.e., if (A.10) is satisfied, the participation constraint of new shareholders becomes

$$\gamma(I+\Delta) \geq I \tag{2.20}$$

Conversely, she will exert low effort in both states of the world if and only if $\gamma > 1 - \frac{B/\alpha}{\Delta+\hat{\omega}_{CEO}}$. In the latter case the participation constraint becomes $\gamma \geq 1$, and the only feasible equity financing contract assigns full ownership to new shareholders. The CFO obtains zero payoff. In the former case, instead, the participation constraint will be satisfied with equality, $\gamma^*_{\hat{\omega}} = \frac{I}{I+\Delta}$, and the resulting (perceived) payoff of the CFO is $\beta(1-\gamma^*_{\hat{\omega}})E[\hat{\pi}_{CFO}(S,1)] = \beta\frac{\Delta}{I+\Delta}(I+\Delta+\hat{\omega}_{CFO}) = \beta(\Delta+\frac{\Delta}{I+\Delta}\hat{\omega}_{CFO}) > 0$.

Hence, inducing high effort is optimal if $\gamma^*_{\hat{\omega}} = \frac{I}{I+\Delta}$ satisfies the IC constraint, i.e., if $\frac{I}{I+\Delta} \leq 1 - \frac{B/\alpha}{\Delta+\hat{\omega}}$ or, solving for B/α, if $\frac{B}{\alpha} \leq \frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta$. If, instead, $\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta < \frac{B}{\alpha}$, the CEO cannot be induced to exert effort under any equity contract that allows new shareholders to break even. Therefore, the project is going to deliver I in expectation and the only contract satisfying equity holders' participation constraint requires $\gamma^*_{\hat{\omega}} = 1$. ■

2.A.3 Choice between Debt and Equity

We show that an overconfident CFO is weakly more likely to issue debt relative to a rational CFO, whether the CEO is overconfident or rational. Specifically, we will show that there are parameter ranges for which an overconfident CFO strictly prefers debt while a rational CFO does not; he is instead indifferent between the two financing choices.[33] Whenever the overconfident CFO strictly prefers equity, instead, so does the rational CFO. The proof of Proposition 2 involves computing the CFO's perceived utility under both debt and equity financing. By comparing the two, we can predict his choice of financing. Because both the CEO and the CFO can be either rational or overconfident, there are four cases to consider. We combine the cases when the CEO is rational and the cases when the CEO is overconfident using again the notation $\hat{\omega}_{CEO} = \omega$ if the CEO is overconfident, and $\hat{\omega}_{CEO} = 0$ if the CEO is rational. As before, "perceived firm value" is short-hand for "expected payoff to incumbent shareholders conditioning on CFO's beliefs."

Proof of Proposition 2. Recall from Appendix 2.A.2 that, the optimal equity contract depends on whether $\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta} \gtreqless B/\alpha$. This holds whether the CEO is rational or overconfident.

If $\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta < B/\alpha$, the optimal equity contract assigns all surplus to new shareholders, i.e., $\gamma^* = 1$, and the CEO shirks in both states of the world. We have also shown that the optimal debt contract induces the CEO to exert effort in at least in one state of the world, achieving a strictly higher firm value, and that not all surplus is assigned to the lenders. Since investors must break even (under any type of financing), the gain in firm value translates into rents to incumbent shareholders, and thus to the CFO. Therefore, both types of CFOs prefer debt financing.

If instead $\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$, the optimal equity contract does not assign all surplus to new shareholders, and the CEO exerts effort in both states of the world. As a result, a rational and an overconfident CFO have different perceptions of the value created by the CEO:

i. Rational CFO. Under the optimal equity contract, incumbent shareholders obtain $(1-I/(I+\Delta))(I+\Delta) = \Delta$. Under the optimal debt contract, we have to consider two cases: If $\sigma \leq \Delta B/\alpha + \hat{\omega}_{CEO}$, the CEO exerts effort in both states of the world, and the expected firm value is $(I+\sigma+\Delta+I-\sigma+\Delta)/2-I = \Delta$. If $\sigma > \Delta B/\alpha + \hat{\omega}_{CEO}$, the CEO exerts effort only in the good state of the world, and the expected firm value is $(I+\sigma+\Delta+\Delta-I-\sigma)/2 = \Delta/2$. Comparison of these firm values gives us the CFO's choice, shown in the table below:

Perceived Firm Value with...	**Debt**	**Equity**	***Preferred Choice***
$\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$	Δ	Δ	Indifferent
$\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma > \Delta - B/\sigma + \hat{\omega}_{CEO}$	$\frac{\Delta}{2}$	Δ	Equity

ii. Overconfident CFO. The overconfident CFO believes incorrectly that the CEO's effort is worth $\Delta+\omega$ instead of Δ. Thus, as the CEO exerts effort in both states of the world under equity financing, the CFO perceives firm value to incumbent shareholders under equity financing to be

[33] If the rational CFO randomizes his financing choice when indifferent, with positive probability for both debt and equity, the average choices of a rational and overconfident CFO will differ over this parameter ranges.

$(1-\frac{I}{I+\Delta})(I+\Delta+\omega)=\Delta+\frac{\Delta}{I+\Delta}\omega$. The same misperception applies under debt financing when $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$: As the CEO exerts effort in both states of the world, and the face value of debt is I, the CFO perceives firm value to equal $(I+\sigma+\Delta+\omega+I-\sigma+\Delta+\omega)/2-I=\Delta+\omega$. If instead $\sigma > \Delta B/\alpha + \hat{\omega}_{CEO}$, the CEO shirks in the bad state of the world, and the CFO's perceived firm value is therefore $(I+\sigma+\Delta+\omega-I-\sigma)/2=(\Delta+\omega)/2$.

The table below summarizes these computations and the CFO's choices.

Perceived Firm Value with...	**Debt**	**Equity**	***Preferred Choice***
$\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma \geq \Delta - B/\alpha + \hat{\omega}_{CEO}$	$\Delta+\omega$	$\Delta+\frac{\Delta}{I+\Delta}\omega$	Debt
$\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$	$\frac{\Delta+\omega}{2}$	$\Delta+\frac{\Delta}{I+\Delta}\omega$	Equity

In summary, for either rational or overconfident CEO, we find that both types of CFO choose debt financing for some parameter ranges ($\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta < B/\alpha$), and both types choose equity financing for other ranges ($\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$). However, we also find that in some instances only the overconfident CFO strictly prefers debt ($\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$). In other words:
- if the rational CFO strictly prefers debt, so does the overconfident CFO;
- if the rational CFO is indifferent between debt and equity, the overconfident CFO strictly prefers debt;
- if the rational CFO strictly prefers equity, so does the overconfident CFO.

Taken together, these results imply that, conditioning on the CEO's type, an overconfident CFO weakly prefers debt relative to a rational CFO. ■

2.A.4 Hiring Decision

Proof of Proposition 3. The CEO is indifferent between the two types of CFOs if she expects either type to make the same financing choice. Therefore, we only need to analyze cases, in which the two types of CFOs may behave differently, given the CEO's bias. We start by considering the rational CEO's choice ($\hat{\omega}_{CEO}=0$). From Section 2.A.3 above, we know that if $\frac{\Delta^2}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma \leq \Delta B/\alpha$, the overconfident CFO strictly prefers debt (see 2.A.3.ii) but the rational CFO does not (see 2.A.3.i) - he is indifferent. The rational CEO, instead, is always indifferent between a debt and an equity contract, as she expects to obtain $\alpha\Delta$ under either contract. Therefore, she will not exhibit any preference regarding the CFO to be appointed. Moving to an overconfident CEO's choice ($\hat{\omega}_{CEO}=\omega$), from Section 2.A.3 above, we know that if $\frac{\Delta+\omega}{I+\Delta}\Delta \geq B$ and $\sigma \geq \Delta B+\omega$, the rational CFO is indifferent between debt and equity, whereas the overconfident CFO strictly prefers debt. With debt financing, the overconfident CEO expects to obtain $\alpha(\Delta+\omega)$; with equity her perceived

future payoff is only $\alpha(\Delta + \frac{\Delta}{I+\Delta}\omega)$. Therefore, under the CEO's beliefs, debt strictly dominates equity, and she prefers an overconfident CFO, who chooses debt financing for sure, to a rational CFO, who instead may choose equity. In sum, a rational CEO is indifferent between appointing an overconfident or a rational CFO; an overconfident CEO weakly prefers an overconfident CFO.[34]
■

2.A.5 Robustness of the Theoretical Results

We now provide a detailed discussion of the robustness of our results to removing either of our two main assumptions regarding the extent of the moral hazard problem for the rational CEO ($\Delta > B/\alpha$)and for the overconfident CEO ($B/\alpha \geq \omega$).

a. Assume $B/\alpha \geq \Delta$. If $B/\alpha > \Delta$, a rational CEO never exerts effort. The optimal debt contract will thus be $D_0^* = I + \sigma$. Similarly, the optimal debt contract will be $\gamma_0^* = 1$, and the CEO will not exert effort either. In both cases, the value of the project to incumbent shareholders is zero. Only in the knife-edge case $B/\alpha = \Delta$, it is still possible to induce the rational CEO to exert high effort in the good state of the world, but only under a debt contract, by keeping her indifferent between shirking and working hard (again $D_0^* = I + \sigma$).

The overconfident CEO, instead, can still be induced to exert effort if $B/\alpha > \Delta$, namely, as long as $\omega \geq B/\alpha - \Delta$. Under the optimal contract, she will work hard either in both states of the world or only in the good one, at least under a debt contract. Hence, by altering the assumption $\Delta > B/\alpha$, we affect the rational CEO's effort decision, but not the main insight that overconfidence can ameliorate conditional financing terms.

b. Assume $\omega > B/\alpha$. The assumption $\omega \leq B/\alpha$ is more relevant to our analysis. It means that the discrepancy in beliefs between the overconfident CEO and debtholders is not too large and ensures that whenever the CEO exerts effort, she does not default. We analyze how removing this assumption affects the optimal debt contract and CFO's choice between debt and equity.

b.i) Optimal debt contract. If we assume that $\omega > B/\alpha$, there is an additional case to consider under debt financing: The overconfident CEO may exert effort in the bad state of the world. In particular, consider the constraint 2.21:

$$\alpha \cdot \max\{0, I - \sigma + \Delta + \hat{\omega}_{CEO} - D\} \geq \alpha \cdot \max\{0, I - \sigma - D\} + B \tag{2.21}$$

There are two subcases. First, suppose that $\sigma \leq \Delta - 1/2(B/\alpha - \omega)$. In this case, the optimal contract for the overconfident CEO requires $D_\omega^* = I + \sigma - \Delta$. Plugging D_ω^* into the constraint 2.21 we get

$$\alpha \cdot \max\{0, I - \sigma + \Delta + \omega(I + \sigma - \Delta)\} \geq \alpha \cdot \max\{, I - \sigma - (I + \sigma - \Delta)\} + B \tag{2.22}$$

or

$$\alpha \cdot (2\Delta - 2\sigma + \omega) \geq B, \tag{2.23}$$

[34] As in Appendix-Section 2.A.3, we use the expression "*weakly* prefers" because we have not specified how to break indifference between debt and equity. If we assume that a CFO randomizes between the two financing choices whenever indifferent, an overconfident CEO will *strictly* prefer an overconfident CFO to a rational one.

which is satisfied under $\sigma \leq \Delta - 1/2(B/\alpha - \omega)$. Hence, the overconfident CEO mistakenly expects not to default after exerting effort, but debtholders correctly anticipate that they will receive only $I - \sigma + \Delta$ in the bad state of the world. At the same time, ICD,Good is satisfied, delivering $I + \sigma - \Delta$ to debtholders in the good state of the world. Therefore, debtholders will break even in expectation. The proofs of optimality and uniqueness are similar to those in subsection 2.A.1 of this appendix and are omitted for brevity.

Now consider the subcase $\sigma > \Delta - 1/2(B/\alpha - \omega)$. Here, it is not possible to induce the overconfident CEO to exert effort and simultaneously ensure debtholders to break even. Intuitively, any debt contract that induces effort in the bad state of the world would require a face value of debt that is too low to satisfy debtholders' participation constraint.

Without making any assumption on the relative size of and , we conclude that the optimal debt contract for an overconfident CEO is given by:

- $D^*_\omega = I + \sigma$ if $\sigma > \Delta - B/\alpha + \omega$ or $\Delta - 1/2(B/\alpha - \omega) < \sigma \wedge \sigma > \Delta$;
- $D^*_\omega = I + \sigma - \Delta$ if $\Delta - 1/2(B/\alpha - \omega) \geq \sigma > \Delta$;
- $D^*_\omega = I$ if $\Delta - B/\alpha + \omega \geq \sigma$ and $\Delta \geq \sigma$.

Thus, although the optimal debt contract becomes slightly more complicated in this more general case, the basic insight of Proposition 1 remains unaffected, with overconfidence reducing the cost of debt when profit variability is large but not extreme.

b.ii) Financing choice. Moving to the analysis of the CFO's choice between debt and equity, we find that if $\omega > B/\alpha$, the different structure of the optimal debt contract can affect the overconfident CFO's preference between debt and equity whenever:

(i) the CEO is overconfident, with bias ω;
(ii) $\frac{\Delta+\omega}{I+\Delta}\Delta \geq B/\alpha$ (i.e., equity financing is available with $\gamma^*_\omega = I/(I+\Delta)$);
(iii) $\Delta - 1/2(B/\alpha - \omega) \geq \sigma > \Delta$.

In this case, the rational CFO will be indifferent between debt and equity. The reason is that he correctly anticipates that the CEO defaults in the bad state of the world but, because of the lower cost of debt, firm value will still be maximized. In particular, the *unbiased* expected value of the firm is $(I + \sigma + \Delta + 0 - (I + \sigma - \Delta))/2 = \Delta$. This is equivalent to the firm value obtained under an equity contract, making him indifferent between the two funding choices. For an overconfident CFO (who shares the bias ω of the CEO) the *perceived* expected firm value under optimal debt contract $D^*_\omega = I + \sigma - \Delta$ equals $(I + \sigma + \Delta + I - \sigma + \Delta + \omega)/2 - (I + \sigma - \Delta) = 2\Delta + \omega - \sigma$. Therefore, he (weakly) prefers debt if

$$2\Delta + \omega - \sigma \leq \Delta + \frac{\Delta}{I+\Delta}\omega, \tag{2.24}$$

Without further assumptions we cannot establish whether 2.24 holds or not. Notice, however, that this inequality reduces to

$$\omega \frac{I}{I+\Delta} \leq \sigma - \Delta \tag{2.25}$$

The left-hand side of this expression is increasing in ω. This means that we can always find a sufficiently large value for ω such that 2.25 holds. In particular, we can exploit the fact that $\sigma \leq I$.

Replacing $\sigma = I$ in 2.25 and rearranging terms, we get

$$\omega \geq I - \frac{\Delta^2}{I} \tag{2.26}$$

In other words, the overconfident CFO displays a preference for debt for sufficiently high overconfidence, with expression 2.26 providing a lower bound for ω Note that this kind of indeterminacy result for certain parameter ranges is common when debt is very risky (see for example the model in Malmendier, Tate, and Yan (2011)). Here, however, the main contribution is to distinguish the role of CEO and CFO's traits, with the latter dominating in financing choices.

2.B Variables Definitions

Below, we provide detailed definitions of the variables used in the empirical analyses. For the variables extracted from Compustat, ExecuComp and Dealscan we also indicate the data item.

Table 2.B.1
Variables Definitions and Sources

Variable	**Definition**
Manager Variables	*constructed from Thomson Insider Filing Dataset, CRSP and ExecuComp*
LTCEO/LTCFO	binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year
Stock Ownership	option-excluded shares (*shrown_excl_opts*) held by the CEO/CFO as a percentage of common shares outstanding (*csho*)
Vested Options	number of exercisable options (*opt_unex_exer_num*) held by the CEO/CFO as a percentage of common shares outstanding (*csho*)
Firm Variables	*constructed from Compustat (Annual or Quarterly), SDC, Dealscan*
Net Debt Issues ($m)	long term debt issuance (*dltis*) - long term debt reduction (*dltr*)
Net Debt Issues Indicator (Compustat)	binary variable where 1 signifies that Net Debt Issues during the year is positive
Net Debt Issues Indicator (SDC)	binary variable where 1 signifies that the company issued bonds during the year
Book Leverage	(long-term debt (*dltt*) + debt in current liabilities (*dlc*)) / (long-term debt (*dltt*) + debt in current liabilities (*dlc*) + common equity (*ceq*))
Net Financing Deficit($m)	cash dividends (*dv*) + investment + change in working capital cash flow after interest and taxes, where
...investment	*capx* + *ivch* + *aqc* + *fuseo* - *sppe* - *siv* for firms with cash flow format code 1 to 3; *capx* + *ivch* + *acq* - *sppe* - *siv* - *ivstch* *ivaco* for firms with cash flow format code 7; 0 for other firms
...change in working capital	*wcapc* + *chech* + *dlcch* for firms with cash flow format code 1;

Continued on next page

Table 2.B.1 – *Continued from previous page*

Variable	Definition
	wcapc + *chech dlcch* for firms with cash flow format code 2 and 3; *recch invch apalch txach aoloch* + *chech fiao dlcch* for firms with cash flow format code 7; 0 for other firms
...cash flow after interest and taxes	*ibc* + *xidoc* + *dpc* + *txdc* + *esubc* + *sppiv* + *fopo* + *fsrco* for firms with cash flow format code 1 to 3; items *ibc* + *xidoc* + *dpc* + *txdc* + *esubc* + *sppiv* + *fopo* + *exre* for firms with cash flow format code 7; 0 for other firms
Book Leverage	(long-term debt (*dltt*) + debt in current liabilities (*dlc*)) / (long-term debt (*dltt*) + debt in current liabilities (*dlc*) + common equity (*ceq*))
Market Leverage	(long-term debt (*dltt*) + debt in current liabilities (*dlc*)) / (price (*prcc*) × common shares outstanding (*csho*) + debt in current liabilities (*dlc*) + long-term debt (*dltt*))
Q	(assets (*at*) + price (*prcc*) × common shares outstanding (*csho*) common equity (*ceq*) - balance sheet deferred taxes and investment tax credit (*txditc*)) / assets (*at*)
Profitability	operating profit (*oibdp*) / lagged assets (*at*)
Changes in Profitability	profitability - lagged profitability
Tangibility	property, plants and equipment (*ppent*) / lagged assets (*at*)
Changes in Tangibility	tangibility - lagged tangibility
log(Sales)	log(sales (*sale*))
Changes in log(Sales)	log(sales) - lagged log(sales)
log(Interest Spread)	difference between the interest rate the borrower pays in basis points and the London Interbank Offered Rate (variable *allindrawn* in Dealscan)
Z-Score	1.2 × (current assets (*actq*) - current liabilities (*dlcq*)) / total assets (*atq*) + 1.4 × (retained earnings (*req*) / total assets (*atq*)) + 3.3 × (pretax income (*piq*) / total assets (*atq*)) + 0.6 × (market capitalization (*cshoq* × *prccq*) / total liabilities (*ltq*)) + 0.9 × (sales (*saleq*) / total assets (*atq*))
Earnings Volatility	(standard deviation of the past eight earnings changes) / (average book asset size over the past eight quarters). Earnings are defined as sales (*saleq*) cost of goods sold (*cogsq*) selling, general and administrative expenses (*xsgaq*)

Continued on next page

Table 2.B.1 – *Continued from previous page*

Variable	**Definition**
log(Amount)	log (natural logarithm) of the amount of the loan (in million dollars) (*amt*)
Analysts' Coverage	number of analysts making at least one annual earnings forecast in a given year
Coefficient of Variation of Earnings Estimates	standard deviation of annual earnings forecasts normalized by the absolute value of the mean forecast (We require at least ten forecasts made.)

2.C Robustness Checks

In Appendix-Table 2.C.1 we show descriptive statistics (for our largest sample, employed in Table 2.4 and 2.5 in the main text) split by the four possible combinations of executives' biases: both executives rational, both overconfident, rational CEO and overconfident CFO, overconfident CFO and rational CEO. Moreover, we provide a series of robustness checks for all of our empirical results in the paper. Most tables (2.C.2-2.C.5 and 2.C.7) show the estimation results if we use Otto (2014)'s continuous empirical measure of CEO overconfidence. Under this approach overconfidence is measured as the average of transaction-specific classifications. For each option exercise of an executive, the transaction-specific dummy takes the value one if the options were exercised within one year of their expiration date and at least 40% in the money at the end of the preceding year. Otherwise, the dummy takes the value zero.

The final measure for each executive averages the value of the optimism dummies across transactions, weighting each exercise observation by the number of options that were exercised. Therefore, the measure is continuous and takes values between 0 and 1, rather than a dummy. We repeat all of our empirical analyses using this measure and show the results below, omitting the coefficients on the control variables for brevity. The specifications and the control variables are exactly the same, except in Appendix-Table 2.C.7 (CFO Hiring) where, given the nature of our dependent variable, we estimate a Tobit rather than a logit model. In Table 2.C.6 we test the relation between CEO overconfidence and the cost of debt (in Panel 2.C.6a) and how this result varies with earnings volatility (in Panel 2.C.6b). In all the regressions where we use the Otto's approach, the Longholder proxies are normalized by their respective sample standard deviations for ease of interpretation.

As mentioned in the main text, we have also re-run all our tests by restricting the analysis to firms that have appreciated by more than 40% in the previous ten years. This robustness check has the limitation that it mechanically excludes from the sample all firms that, in any given year, have been listed for less than 10 years. We show, for brevity, the replications of Tables 2.2 and 2.6 in the main text (Tables 2.C.8 and 2.C.9 of this Appendix).

Table 2.C.1
Summary Statistics split by Executives' Bias

(a)
Both Executives Rational

Variable	Obs.	Mean	Median	St. Dev.
Assets ($m)	1,876	5,912.871	1,699.334	13,943.250
Sales ($m)	1,876	7,017.986	1,574.769	23,865.190
Capitalization ($m)	1,876	8,641.219	2,257.638	24,432.000
Net Fin. Deficit ($m)	1,876	-248.692	-13.442	1,717.889
Net Fin. Deficit / Assets	1,876	-0.011	-0.015	0.303
Net Debt Issues / Assets	1,876	0.030	0.000	0.164
Book Leverage	1,870	0.301	0.277	0.382
Q	1,876	0.438	0.000	0.496
Change in Q	1,876	0.356	0.000	0.479
Profitability	1,876	2.251	1.776	1.731
Change in Profitability	1,876	-0.019	0.022	1.403
Tangibility	1,876	0.185	0.177	0.124
Change in Tangibility	1,876	-0.003	0.002	0.079
Log(Sales)	1,876	0.322	0.201	0.304
Change in Log(Sales)	1,876	-0.007	-0.003	0.116
Market Leverage	1,876	7.350	7.249	1.590
CEO Stock Ownership (%)	1,876	0.097	0.093	0.222
CEO Vested Options (%)	1,870	0.155	0.122	0.153
CFO Stock Ownership (%)	1,876	20.626	3.716	48.044
CFO Vested Options (%)	1,876	10.136	7.066	10.224

Table 2.C.1
Summary Statistics split by Executives' Bias (cont.)

(b)
Rational CEO, Overconfident CFO

Variable	Obs.	Mean	Median	St. Dev.
Assets ($m)	485	5,555.820	1,460.343	11,423.020
Sales ($m)	485	4,525.942	1,190.236	8,402.887
Capitalization ($m)	485	7,422.425	1,939.312	14,330.950
Net Financing Deficit ($m)	485	62.438	-23.443	2,914.404
Net Fin. Deficit / Assets	485	-0.040	-0.023	0.422
Net Debt Issues / Assets	485	0.028	0.000	0.193
Book Leverage	484	0.252	0.251	0.212
Q	485	0.427	0.000	0.495
Change in Q	485	0.338	0.000	0.474
Profitability	485	2.451	1.963	2.043
Change in Profitability	485	-0.111	0.015	1.716
Tangibility	485	0.191	0.180	0.133
Change in Tangibility	485	-0.005	0.002	0.114
Log(Sales)	485	0.276	0.201	0.302
Change in Log(Sales)	485	-0.004	-0.003	0.288
Market Leverage	485	7.206	7.012	1.532
CEO Stock Ownership (%)	485	0.092	0.075	0.229
CEO Vested Options (%)	484	0.130	0.104	0.131
CFO Stock Ownership (%)	485	11.674	1.840	50.052
CFO Vested Options (%)	485	6.924	3.999	8.652

Table 2.C.1
Summary Statistics split by Executives' Bias (cont.)

(c)
Overconfident CEOs, Rational CFOs

Variable	Obs.	Mean	Median	St. Dev.
Assets ($m)	1,164	6,473.587	1,927.986	17,659.620
Sales ($m)	1,164	5,208.397	1,743.329	11,486.040
Capitalization ($m)	1,164	9,540.316	2,858.486	21,270.590
Net Financing Deficit ($m)	1,164	-469.385	-12.600	2,861.776
Net Fin. Deficit / Assets	1,164	-0.049	-0.014	0.379
Net Debt Issues / Assets	1,164	0.022	0.000	0.123
Book Leverage	1,152	0.257	0.212	0.309
Q	1,164	0.497	0.000	0.500
Change in Q	1,164	0.299	0.000	0.458
Profitability	1,164	2.615	1.989	2.250
Change in Profitability	1,164	-0.020	0.030	2.029
Tangibility	1,164	0.191	0.176	0.158
Change in Tangibility	1,164	-0.001	0.000	0.115
Log(Sales)	1,164	0.286	0.202	0.261
Change in Log(Sales)	1,164	-0.009	-0.004	0.099
Market Leverage	1,164	7.351	7.348	1.532
CEO Stock Ownership (%)	1,164	0.120	0.105	0.213
CEO Vested Options (%)	1,152	0.128	0.079	0.144
CFO Stock Ownership (%)	1,164	17.945	3.149	47.226
CFO Vested Options (%)	1,164	11.166	7.570	13.288

Table 2.C.1
Summary Statistics split by Executives' Bias (cont.)

(d)
Both Executives Overconfident

Variable	Obs.	Mean	Median	St. Dev.
Assets ($m)	927	4,287.630	1,244.837	10,710.660
Sales ($m)	927	4,160.591	1,316.779	10,433.410
Capitalization ($m)	927	5,560.889	1,727.764	11,662.620
Net Financing Deficit ($m)	927	-120.282	-20.624	1,358.831
Net Fin. Deficit / Assets	927	-0.041	-0.023	0.432
Net Debt Issues / Assets	927	0.024	0.000	0.152
Book Leverage	926	0.312	0.274	0.667
Q	927	0.471	0.000	0.499
Change in Q	927	0.292	0.000	0.455
Profitability	927	2.446	1.807	1.982
Change in Profitability	927	-0.057	0.052	1.521
Tangibility	927	0.176	0.161	0.155
Change in Tangibility	927	-0.001	0.005	0.101
Log(Sales)	927	0.276	0.192	0.270
Change in Log(Sales)	927	-0.007	-0.002	0.139
Market Leverage	927	7.019	7.060	1.615
CEO Stock Ownership (%)	927	0.125	0.110	0.231
CEO Vested Options (%)	926	0.159	0.108	0.176
CFO Stock Ownership (%)	927	16.927	2.557	50.831
CFO Vested Options (%)	927	10.803	5.996	20.833

Table 2.C.2
Debt Issues (Compustat)

Logit regressions with the Net Debt Issues Indicator as the dependent variable, regressed on Otto (2014)'s overconfidence measure (normalized by its sample standard deviation) for CEOs and CFOs and the same control variables as in Table 2.2. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	0.092*	0.105			0.070	0.057	0.059
	(1.645)	(1.591)			(1.222)	(0.942)	(0.853)
Longholder CFO			0.094	0.157***	0.070	0.100*	0.147**
			(1.610)	(2.720)	(1.154)	(1.655)	(2.379)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Observations	2,874	2,874	2,874	2,874	2,874	2,874	2,874
Pseudo R-Squared	0.044	0.153	0.047	0.157	0.047	0.099	0.157

Table 2.C.3
Debt Issues (SDC)

Logit regressions with a binary variable equal to one if the firm issued debt during the fiscal year, conditioning on having issued debt, equity, or hybrid securities. Regressors include Otto (2014)'s overconfidence measure (normalized by its sample standard deviation) for CEOs and CFOs and the same control variables as in Table 2.3. Data on public issues are from SDC. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	0.212	0.166			0.210	0.148	0.149
	(1.441)	(0.800)			(1.408)	(0.851)	(0.623)
Longholder CFO			0.078	-0.032	0.006	0.145	-0.082
			(0.633)	(-0.205)	(0.045)	(0.806)	(-0.477)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Observations	694	611	694	587	694	598	585
Pseudo R-Squared	0.080	0.543	0.079	0.544	0.800	0.218	0.549

Table 2.C.4
Financing Deficit

Replication of the estimation of Table 2.4 with Otto (2014)'s overconfidence measure (normalized by its sample standard deviation) for CEOs and CFOs and the same control variables as in Table 2.4. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FD x Longh. CEO	-0.003	0.003	0.046				-0.024	-0.006	-0.016
	(-0.053)	(0.074)	(1.036)				(-0.369)	(-0.108)	(-0.515)
FD x Longh. CFO				0.045	0.017	0.027	0.064	0.022	0.034
				(0.497)	(0.221)	(0.762)	(0.614)	(0.239)	(0.862)
FD	0.207***	0.175***	0.155	0.192***	0.178**	0.075	0.207***	0.183***	0.142
	(3.219)	(3.489)	(1.023)	(3.123)	(3.025)	(0.467)	(3.420)	(3.445)	(1.018)
Longholder CEO	-0.009	-0.006	-0.000				-0.008	-0.006	0.001
	(-1.350)	(-0.746)	(-0.065)				(-1.496)	(-0.749)	(0.312)
Longholder CFO				-0.003	-0.005	-0.003	-0.001	-0.004	-0.005
				(-0.862)	(-0.944)	(-0.762)	(-0.179)	(-0.620)	(-0.976)
Manager Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Firm Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
FD x Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES	NO	YES	YES
Observations	4,450	4,450	4,450	4,450	4,450	4,450	4,450	4,450	4,450
R-squared	0.194	0.283	0.407	0.209	0.291	0.469	0.213	0.292	0.472

Table 2.C.5
Leverage

OLS regressions with market leverage as dependent variable, regressed on Otto (2014)'s overconfidence measure (normalized by its sample standard deviation) for CEOs and CFOs and the same control variables as in Table 2.5. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Longholder CEO	1.234*	0.559			0.727	0.083	0.087	0.081
	(1.789)	(0.850)			(1.049)	(0.125)	(0.126)	(0.115)
Longholder CFO			2.801***	2.464***	2.608***	2.481***	2.452***	2.468***
			(5.991)	(4.822)	(4.693)	(4.367)	(4.280)	(4.266)
Manager Contr.	NO	YES	NO	YES	NO	YES	YES	YES
Firm Controls	NO	YES	NO	YES	NO	YES	YES	YES
$Return_{t-1}$	NO	NO	NO	NO	NO	NO	NO	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4.427	4.427	4.427	4.427	4.427	4.427	4.427	4.427
R-squared	0.090	0.143	0.095	0.146	0.096	0.147	0.158	0.166

Table 2.C.6
Cost of Debt Financing

Panel 2.C.6a shows regressions of Log(Interest Spread) on Otto (2014)'s overconfidence measures (normalized by its sample standard deviation) for CEOs and CFOs and the same control variables and fixed effects as in Table 2.6. Log(Interest Spread) is the difference (in basis points) between the interest rate the borrower pays and the LIBOR. In Panel 2.C.6b we test the relation between CEO overconfidence and the cost of debt across different subsamples, using different cutoffs for low, medium, and high Earnings Volatility. The controls variables are as in column (7) of Panel A. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively

(a)
Baseline Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	-0.028	-0.049**			-0.037	-0.036	-0.028
	(-0.817)	(-2.111)			(-1.027)	(-1.446)	(-1.215)
Longholder CFO			0.012	-0.034	0.024	-0.022	-0.023
			(0.387)	(-1.635)	(0.751)	(-0.953)	(-1.066)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Loan Type FE	NO	NO	NO	NO	NO	NO	YES
Observations	1,650	1,650	1,650	1,650	1,650	1,650	1,650
R-squared	0.405	0.614	0.405	0.616	0.406	0.618	0.672

Table 2.C.6
Cost of Debt Financing (cont.)

(b)
Earnings Volatility Subsamples

	Bottom Tercile	Medium Tercile	Top Tercile
Longholder CEO	-0.000	-0.080**	-0.018
	(-0.004)	(-2.423)	(-0.449)
Longholder CFO	-0.004	-0.023	0.025
	(-0.132)	(-0.802)	(0.805)
Observations	548	549	553
R-squared	0.802	0.737	0.757
	Bottom 35%	Medium 30%	Top 35%
Longholder CEO	-0.017	-0.083**	-0.026
	(-0.455)	(-2.465)	(-0.644)
Longholder CFO	-0.006	-0.037	0.012
	(-0.178)	(-1.115)	(0.384)
Observations	579	496	575
R-squared	0.799	0.751	0.748
	Bottom 30%	Medium 40%	Top 30%
Longholder CEO	0.014	-0.065**	-0.019
	(0.317)	(-2.270)	(-0.465)
Longholder CFO	-0.003	0.006	0.031
	(-0.088)	(0.205)	(1.024)
Observations	0.813	0.705	0.765
R-squared	0.813	0.705	0.765
	Bottom 25%	Medium 50%	Top 25%
Longholder CEO	0.018	-0.050*	0.004
	(0.351)	(-1.841)	(0.102)
Longholder CFO	0.016	-0.012	0.030
	(0.383)	(-0.458)	(0.931)
Observations	417	822	411
R-squared	0.836	0.688	0.781

Table 2.C.7
CFO Hiring

Logit regressions with a binary variable equal to one if the firm issued debt during the fiscal year, conditioning on having issued debt, equity, or hybrid securities. Regressors include Otto (2014)'s overconfidence measure (normalized by its sample standard deviation) for CEOs and CFOs and the same control variables as in Table 2.3. Data on public issues are from SDC. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)
Longholder CEO	0.269	0.278*	0.323*	0.338**
	(1.577)	(1.686)	(1.906)	(2.017)
Manager Controls	NO	NO	YES	YES
Firm Controls	NO	NO	NO	YES
Industry FE	NO	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	203	203	203	203
Pseudo R-Squared	0.007	0.106	0.119	0.140

Table 2.C.8
Debt Issues (Compustat), Restricted Sample

Logit regressions with the Net Debt Issues Indicator as the dependent variable, regressed on our measure of overconfidence for CEOs and CFOs and the same control variables as in Table 2.2. The sample includes only firms in the Restricted Sample, i.e., firms that have appreciated by more than 40% in the previous ten years (therefore excluding from the sample all the firms that, in any given year, have been listed for less than 10 years). ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	0.010	-0.063			-0.102	-0.103	-0.183
	(0.0623)	(-0.398)			(-0.612)	(-0.617)	(-1.132)
Longholder CFO			0.419***	0.457***	0.439***	0.483***	0.501***
			(2.982)	(3.075)	(3.054)	(3.098)	(3.289)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Observations	1,744	1,744	1,744	1,744	1,744	1,744	1,744
Pseudo R-Squared	0.041	0.170	0.048	0.176	0.048	0.115	0.176

Table 2.C.9
Cost of Debt Financing, Restricted Sample

Regressions of Log(Interest Spread) on our overconfidence measures for CEOs and CFOs and several control variables (defined in Table 2.6), including year and industry fixed-effects. Log(Interest Spread) is the difference between the interest rate the borrower pays in basis points and the London Interbank Offered Rate. The sample includes only firms in the Restricted Sample, i.e., firms that have appreciated by more than 40% in the previous ten years (therefore excluding from the sample all the firms that, in any given year, have been listed for less than 10 years). ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	-0.237***	-0.186***			-0.266***	-0.189***	-0.135**
	(-2.611)	(-3.092)			(-2.926)	(-3.010)	(-2.384)
Longholder CFO			0.016	-0.050	0.089	0.012	-0.000
			(0.168)	(-0.851)	(1.010)	(0.192)	(-0.004)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Loan Type FE	NO	NO	NO	NO	NO	NO	YES
Observations	1,162	1,162	1,162	1,162	1,162	1,162	1,162
R-squared	0.479	0.668	0.468	0.664	0.481	0.674	0.711

Chapter 3

Diversifying Mergers and Vertical Integration

3.1 Introduction

Diversifying mergers, or to be more specific, mergers among firms operating in different product markets, are traditionally perceived by academics and practitioners as value-destroying (Amihud and Lev (1981)). As such, they are associated with negative market reactions at announcement. There are two main reasons proposed for such empirical regularity. First, a manager may not have sufficient expertise to operate in different industries. Second, she may use corporate resources to reduce her personal risk at the expense of shareholders.

A simple dichotomous classification between diversifying and non-diversifying acquisitions will likely be too stark. In practice, significant synergies may exist between firms operating in different industries. Therefore, while some mergers may be induced by the desire to reduce the manager's personal risk, others may actually be value-enhancing.

The purpose of this paper is to "zoom in" a sample of diversifying mergers by using a simple, theoretically motivated proxy for the expected synergies between the acquiror and the target. This will illustrate whether such a measure can help disentangle which acquisitions are actually value destroying and which ones benefit shareholders.

Although in practice a number of measures could be used, I will be focusing on a proxy for vertical integration between the acquiror and the target in this paper. Vertical integration in an acquisition occurs if the target's industry is a supplier of the acquiror's industry. The reason for this choice is twofold.

First, there are plausible and well-known arguments for why a firm purchasing a potential acquiror may increase its productivity, like those in the classic work by Williamson (1975) and Williamson (1985) which are related to the internalization of potential costs due to incomplete contract enforcement. Indeed, recent work by Alfaro et al. (2016) finds that higher vertical integration is associated with higher productivity, as measured by revenue over number of employees. Second, constructing a reliable proxy for integration opportunities is relatively easy using publicly available data from the Bureau of Economic Analysis, in the same vein as the seminal work by seminal work by Fan and Goyal (2006).

Therefore, using a large sample of diversifying mergers between manufacturing firms, I hypothesize and show that deals where a vertical integration linkage exists between the acquiror's and target's industry should exhibit superior performance for the acquiror following the merger. Importantly, such synergies are not priced at announcement. There do not appear to be significant differences in abnormal returns surrounding the mergers announcement for mergers involving firms with different degrees of relatedness. However, analyzing subsequent performance, we do find that vertical integration is a strong predictor of a number of outcomes.

First, I hypothesize that mergers involving unrelated industries (at least from a supplier-customer point of view) may originate from governance problems. A manager may want to reduce the riskiness of the company she is running, given that her human capital is fully invested in it, as suggested by Amihud and Lev (1981), Morck, Shleifer, and Vishny (1990) and Gormley and Matsa (2016), among others. I do indeed find that lower vertical integration in diversifying mergers is associated with a decline in a number of proxies for volatility for up to one or two years after each deal relative to the pre-merger values with regard to stock or accounting measures.

This decline in volatility is consistent with a "quiet life" hypothesis that managers will try to diversify their personal risk at the expense of their firm's profitability. Crucial corroboration for this hypothesis involves testing whether acquirors' operating performance also deteriorates following mergers with non-customer targets. I examine whether return-on-assets (ROA) and return-on-equity (ROE) are significantly related to the proxy of vertical integration. I find a decline, on average, in both measures, which becomes large and statistically significant two years after a deal for mergers involving unrelated targets.

Given that vertical integration is a strong predictor of future operating performance but is not associated with stock market reactions at announcement, I expect the change in profitability to be slowly reflected in firm value as newer information becomes available to investors. I test this hypothesis first by regressing future one-year abnormal stock returns on the vertical integration proxy, employing different strategies to estimate an appropriate benchmark return and different horizons. Second, I adopt a standard calendar time portfolio approach. Both strategies deliver the same answer: a low degree of vertical integration in diversifying mergers is associated with significantly lower long-run stock returns. The magnitudes of these effects are also relevant from an economic point of view.

The hypothesis that conglomerate mergers may serve to reduce the manager's personal risk dates back at least to Amihud and Lev (1981). Due to the fact that a large fraction of a manager's human capital is invested in the firm she is running, she may be willing to reduce her personal risk by acquiring targets whose profitability is uncorrelated with the core activity of her company, even at the cost of lower profits. Because shareholders are able to diversify their holdings, these acquisitions will be value-destroying from their perspective.

A number of papers have since found evidence consistent with a "diversification" discount, particularly in Schoar (2002).[1] More recently, work by Gormley and Matsa (2016) has found that,

[1] 1Challenges against these results can be found in Villalonga (2004).

when insulated from takeover risk, managers engage in value-destroying diversifying acquisitions in order to reduce their personal risk, linking such mergers to governance problems.

However, recent empirical work has also shown that diversification is not necessarily value-destroying if motivated by actual synergies between the target's and the acquiror's industry. For example, Ozbas and Scharfstein (2010) document a significant diversification discount in conglomerate firms. This result is driven by firms with a large number of segments belonging to industries unrelated to the core activity of the company. Moreover, Alfaro et al. (2016) find that companies increase their degree of vertical integration when insulated from foreign producers to exploit profit opportunities and document a higher degree of vertical integration associated with higher productivity, as measured by sales over number of employees.

Acemoglu, Johnson, and Mitton (2009) find that firms may increase their degree of vertical integration in order to overcome contracting costs when financial constraints are not relevant enough to prevent a value-enhancing merger between a supplier and a customer. I document, consistent with these papers, that deals involving a high degree of vertical integration are indeed associated with larger post-merger gains.

Empirical work has tried to examine whether the degree of relatedness between an acquiror and a target are indeed priced in announcement returns, but results are mixed. Fan and Goyal (2006) find that vertical mergers are associated with higher returns at announcement relative to purely diversifying acquisitions. On the other hand, Simi Kedia and Pons (2011), by examining a different and larger sample, find no significant differences.

Using a related approach, Ahern (2012) focuses on the bargaining power of acquirors and targets, examining how gains from the merger are split. None of these papers examine actual post-merger outcomes and stock returns, which is the focus of this paper.

The present work is also related to recent work that examines whether investors correctly perceive linkages among industries and firms. In particular, Menzly and Ozbas (2010) ffind that returns in certain industries predict returns in other industries that are either major suppliers or major customers, whereas Cohen and Frazzini (2008) show that returns of major customers predict suppliers' returns. This evidence suggests that investors may systematically understate economic linkages across firms or industries, and motivates the present analysis.

This paper is structured as follows. Section 3.2 outlines the conceptual framework and describes the empirical strategy. Section 3.3 shows how acquirors' announcement returns, volatility and profitability are related to vertical integration. Section 3.4 provides evidence regarding long-run returns. Section 3.5 concludes.

3.2 Data and Empirical Strategy

3.2.1 The Vertical Integration Proxy

Following Fan and Goyal (2006), I measure the vertical relatedness between an acquiror and a target as:

$$VI_{A,T} = \frac{Inputs_{A,T}}{\sum_{j} Inputs_{A,j}} \tag{3.1}$$

where A is the acquiror industry, T is the target industry and j is any industry that supplies commodities to the acquiror's industry.

To fix ideas, consider the following two deals, both present in my sample. Both the acquirors, RC2 Corp and Kid Brands Inc, produced "dolls, toys, games and sporting and athletic goods" (SIC code 394). In 2004, RC2 acquired a company selling "Miscellaneous Plastics Products" (SIC code 308). In 2008, Kid Brands also made an acquisition by merging with a company producing household furniture (SIC Code 251).

Clearly, these three industries operate in very different markets. Even so, the acquisition made by RC2 can hardly be considered as totally unrelated to its core activity, considering that plastic goods are likely to be a major component in the production of toys. This intuition is confirmed by my *VI* proxy: RC2's industry obtains about 7% of its input value from the plastic goods industry. Contrasting this first case, *VI* equals zero in the second, suggesting that the second acquisition is less likely to enhance the acquiror's productivity in its core activity.

The hypothesis of this paper postulates that mergers with high VI should be more likely to be conducted for strategic reasons and may generate larger synergies and shareholders' gains. Mergers with low VI are more likely to be conducted purely for diversification or empire building reasons. Therefore, acquisitions such us those made by RC2 Corp should be, on average, more likely to enhance value over mergers similar to Kid Brands.[2]

These measures are computed using the 1992 "use" tables from the BEA accounts.[3] The sample starts in 1993, immediately after the year to which the BEA accounts refer to. I do not update *VI* in the years that follow because the BEA classification switches from a SIC to a NAICS.

To keep the distinction between diversifying and non-diversifying acquisitions consistent over time, I prefer the SIC coding. The use of an outdated proxy for vertical integration should, if anything, make results more conservative[4] Some significant complications arise when mapping the 478 different BEA industry codes to the SIC codes.

First, BEA industry definitions are often extremely coarse. For example, the retail sector (SIC codes 5000- 5999) is divided into only two groups. This is problematic since, depending on the industry of the acquiror and the target, the requirements for an acquisition to be classified as diversifying will have different degrees of stringency. Second, the matching is not one-to-one. Some BEA industry codes match more than one SIC code and vice versa. Alfaro et al. (2016) deal with this problem by assigning randomly the variable *VI* to different industries, a solution that will clearly introduce significant noise in my smaller sample.

[2]Incidentally, while RC2 Corp was acquired by a Japanese multinational in 2011 in a $640 million deal, Kid Brands filed bankruptcy in 2014.

[3]Available at `https://www.bea.gov/industry/io_benchmark.htm`

[4]Additionally, the SIC coding changes over time. The 1992 BEA accounts tables use the 1987 "Standard Industrial Classification" edition, after which the classification remained consistent.

Fortunately, the BEA industry codes are relatively easy to match within three digits of the SIC codes for manufacturing industries (SIC codes 2000-3999), with minor adjustments described in Appendix 3.B. Moreover, the classification is quite refined: 354 out of 478 of the BEA industry codes refer to the manufacturing sector, perhaps reflecting the fact that until the early 1990s, the service industry played a more limited role in the US economy. For these two reasons, I limit the analysis that follows to mergers where both the acquiror and the target operate in the manufacturing sector.

3.2.2 Data and Descriptive Statistics

I obtain from the SDC Thomson Reuters Database all the deals occurring between between 1992 and 2012. I keep completed deals coded as "Merger" and "Acquisition," requiring that the acquiror owned less than 50% of the target's shares before the merger and more than 50% after.

Following Savor and Lu (2009), I require the deal value to be at least 5% of the acquiror's market capitalization (measured three months before the deal announcement) and exclude acquisitions made by firms belonging to the bottom decile of market capitalization, using the breakpoints from the CRSP "Cap. Deciles" file. Firms which engage in more than one diversifying acquisition within the same year are excluded, as this does not allow for attributing future firm outcomes to each deal.

I identify the acquiror's and target's industry using the "Acquiror Ultimate Parent SIC" and the "Target Primary SIC Code" variables in SDC. I require both codes to be between 2000 and 3999. The bulk of the analysis will focues on mergers where the acquiror and the target belong to two different BEA industries, for a total of 768 mergers, although in most tests the sample will be smaller due to data availability requirements.

SDC data is matched with CRSP using the historical CUSIP code available in both datasets, and then to the CRSP-Compustat database, which has the relevant accounting variables. Additional sources are Eventus, for abnormal returns, and the CRSP dataset for monthly returns.

Descriptive statistics for the main variables used in the paper are shown in Table 3.1. This includes those which previous work has generally found to be associated with either the announcement market response or future outcomes. Details regarding the construction of each variable are in Table 3.A.1. *VI* is the vertical integration proxy described in Section subsection:proxy.

As shown in Table 3.1, the data is strongly right-skewed, with a median of 0.001 and a mean of 0.017. In order to account for the possibility of a small number of extreme observations driving the results, in untabulated tests I have also replicated the regressions using the logarithm of $1+VI$. The results are qualitatively unchanged.

Deal value / market value is given by the total deal amount (in millions of dollars) divided by the firm's market value. Percentage of stock is the percentage of the transaction value paid in stock. Stock transactions are generally associated with lower announcement return (see, for example, the summary of evidence in Andrade, Mitchell, and Stafford (2001)).

A common explanation for this pattern is that firms engage in stock transactions when they are overvalued, with the announcement of a stock-financed acquisition partially revealing the mispricing (Shleifer and Vishny (2003)). For this reason, I include a measure of firm valuation, the book-to-market, defined as the book value of equity (BE) divided by the market value of equity.

BE is constructed in line with the Fama and French (1993) definition, where BE is the Compustat book value of stockholders' equity plus balance-sheet deferred taxes and investment tax credit minus the book value of preferred stock. Following their procedure, I use the redemption, liquidation, or par value (in that order) to estimate the value of preferred stock.

The market value of equity is given by the number of shares multiplied by the share price at the end of the fiscal year. Mergers concluded by large acquirors are generally associated with lower announcement returns (Netter, Stegemoller, and Wintoki (2011)). In order to control for this size effect, I include in all the regressions the natural logarithm of total assets as well. Leverage is long-term debt plus debt in current liabilities, all divided by total assets and controls for the financial soundness of the acquiror.

I also control for the correlation between the acquiror's and the target's industry return (Corr(A,T)), following Morck, Shleifer, and Vishny (1990), who suggest that this measure of "relatedness" may capture whether managers are trying to diversify their personal risk. It is important to avoid the risk of *VI* being simply a proxy for this relatedness measure. Using CRSP monthly returns of individual US firms, I compute the monthly value weighted returns for each industry and calculate the correlation coefficient between the industries of the acquiror and the target over the 60 months preceding the acquisitions.

Table 3.1 also includes measures of performance and firms' volatility. As measures of performance, I use ROA and ROE. The former is measured as net income plus interest and related expense, all divided by total assets. The latter is computed in the same way, but using shareholders' equity as the denominator.

In order to test the "quiet life" hypothesis, following Gormley and Matsa (2016), I construct four different measures of volatility. The first, Vol. Ret., is computed as the square root of the sum of squared daily returns over the year, multiplied by 252 and divided by the number of trading days. To avoid mismeasurement errors, I require at least 100 non-missing daily observations to construct this proxy. The second, Op. Vol. ("operating volatility"), takes into account the possible changes in capital structure following the merger. It is obtained by multiplying Vol. Ret. by the ratio of the market value over the market value plus net liabilities.

The latter two variables for the "quiet life" hypothesis measure a firm's volatility in cash flow or earnings, by resorting to the Compustat Quarterly dataset. CF Vol. is the standard deviation of quarterly cash flow. Earnings Vol. is the standard deviation of the change in quarterly earnings scaled by the average total assets over the fiscal year. Because in Section 3.3 tests how these variables' changes are related to the degree of vertical integration, Table 3.1 reports the *change* iin each variable from the year preceding the merger to one or two years following the deal. Therefore, Therefore, for example, $\Delta ROA_{t-1,t+2}$ stands for $ROA_{t+2} - ROA_{t-1}$.

To get a sense of how representative my sample is relative to the full universe of manufacturing firms in Compustat throughout the same period, firms in the sample studied here have, on average, slightly higher leverage (23.80% 20.41%), higher ROA (3.32% versus -4.30%), and are smaller (total assets are \$2.37 billion versus \$2.90 billion). The latter comparison may seem surprising, given that acquirors tend, on average, to be relatively large firms, but it turns out this is largely influenced by outliers in the full Compustat universe. The median acquiror in my sample is much larger than the median manufacturing firm in Compustat (\$431.79 million versus \$150.60 million).

3.3 Vertical Integration and Subsequent Outcomes

3.3.1 Vertical Integration and Announcement Returns

A standard way to assess the benefits of a merger from the acquiror's perspective is to run an event study around the day surrounding the announcement of the merger. I estimate the following regression:

$$CAR_{i,t+\tau,t-\tau} = \beta VI_{k,k'} + \gamma' X_{i,t-1} + \delta_t + \gamma_k + \varepsilon_t \text{ where } \tau = 1,3 \tag{3.2}$$

where $CAR_{i,t+\tau,t-\tau}$ is computed as:

$$CAR_{i,t+\tau,t-\tau} = \sum_{j=t-\tau}^{t+\tau} Ret_{i,j} - \sum_{j=t-\tau}^{t+\tau} \beta_{i,t} Mkt_j \tag{3.3}$$

Here i, t and k index firms, day and industry, respectively. $Ret_{i,j}$ is the daily raw return of firm i on day j, β is the coefficient computed from a regression of daily returns on the daily market return Mkt_j (computed as the CRSP value weighted index) over the the period $t-250$ to $t-45$.[5] Therefore, the dependent variable is the cumulative abnormal return computed using the market model, obtained from Eventus.

In the full specification, the abnormal return is regressed on $VI_{k,k'}$, a vector $X_{i,t-1}$ of control variables, time dummies (δ_t) and industry dummies (γ_k). In what follows, k represents the acquiror's industry and *k'* the target's industry, so that $VI_{k,k'}$ represents the degree of vertical integration between the acquiror's industry k and the target's industry *k'*. Control variables are those listed in Section 3.2.2. Standard errors are clustered at the acquiror's industry level.

Estimating equation 3.2 produces the results shown in Table 3.2. In column 1, only year and industry fixed effects are included with the proxy *VI*. The coefficient on the vertical integration proxy is negative but insignificant. Once control variables are included (column 2), the coefficient becomes marginally significant and is equal to -0.12. The magnitude of the coefficient suggests that an increase of a standard deviation in emphVI is associated with a *lower* announcement return of about 56 basis points.

I also estimate the same model over a longer horizon (-3, +3 days) to account for a possible delayed market reaction. In columns 3 and 4, the relevant coefficient becomes positive, although it is much smaller and statistically insignificant in both specifications, independently of whether control variables are included or not.

The control variables that are significant across specifications are size and book-to-market. The latter variable enters negatively in regression 3.2, perhaps because investors may be more pes-

[5]When fewer days are available, I require at least 50 days for computing β.

simistic about mergers made by acquirors with poor growth prospects. Size also enters negatively, consistent with previous evidence (Netter, Stegemoller, and Wintoki (2011)).

Overall, there does not appear to be any reliable association between announcement returns and the degree of vertical integration between acquirors and targets. The coefficient of interest switches sign across specification and, in the only specification where it is marginally significant (column 2 of Table 3.2), it is *negative*. As we will see, these inconclusive results are in stark contrast with the evidence that follows.

3.3.2 Vertical Integration and Changes in Firm Volatility

The hypothesis presented in Section 3.1 asserts that diversifying mergers entailing a low degree of vertical integration are more likely to be pursued for diversifying managers' personal risk. In order to test this hypothesis, I estimate coefficients from the following regression:

$$\Delta Vol_{t+\tau,t-1} = \beta VI_{k,k'} + \gamma' X_{i,t-1} + \delta_t + \gamma_k + \varepsilon_t \text{ where } \tau = 1,2 \tag{3.4}$$

where *Vol* is a measure of firm volatility. Using a similar approach to Gormley and Matsa (2016), I first explore whether stock volatility falls one and two years after the mergers, relative to the pre-deal value, using the change in daily stock returns volatility as a dependent variable. Changes in stock volatility may be driven by changes in capital structure (i.e., lower leverage). Due to this, I also proxy for the volatility of a firm's returns on operating assets by multiplying the firm's stock volatility by the ratio of its market value ratio of equity to operating assets (see Gormley and Matsa (2016)).

Results are reported in Table 3.3. The coefficient on *VI* is positive and statistically significant when looking at changes in volatility occurring one year after the merger (as in columns 1 and 3, where changes in return volatility and operating volatility are examined, respectively). In terms of magnitude, these estimates suggest that a standard deviation increase in *VI* is associated with a 15% increase in volatility and a 10% rise in operating volatility.

The coefficients are positive also when we look at the $t-1$ to $t+2$ horizon, but lose statistical significance (columns 2 and 4). Coefficients on the control variables are generally inconsistent in sign and statistical significance, with the exception of the book-to-market, which appears with a positive sign.

From a manager's perspective, the change in volatility of earnings and cash flow is likely to be more relevant, as it may more directly proxy for a firm's distress risk. I construct, using the Compustat Quarterly dataset, proxies of cash flow and earnings volatility using the procedure outlined in Section 3.2.2. I estimate equation 3.5 using changes in these two variables as dependent variables. The results are reported in Table 3.4, where the *VI* coefficients are always significant at the 5% or 1% level, except when looking at $\Delta Earn.Vol_{t+1,t-1}$ as dependent variable.

These results are relevant from a quantitative point of view. A standard deviation increase in the degree of vertical integration is followed, on average, by a rise in cash flow volatility of 8.5% standard deviations, and an increase of 12.5% standard deviations in earnings volatility two years after. As in Table 3.3, only book-to-market enters significantly in all the specifications, again with a positive sign.

The tests of Tables 3.3 and 3.4 broadly support the hypothesis that the change in volatility, and potentially in distress risk, is highly dependent on the degree of integration between acquiror and target. The next section tests whether there is a detectable change in firm's performance.

3.3.3 Vertical Integration and Changes in Firm's Performance

In this section I test whether the degree of vertical integration between acquiror and target is associated with a change in firms' performance. If managers acquire unrelated targets to diversify their personal risk, satisfy their "hubris" (Roll (1986)), or engage in "pet projects" beyond their field of expertise, we expect acquirors with low VI to exhibit inferior performance. On the other hand, significant synergies due to vertical integration should be associated with improved performance, as in Alfaro et al. (2016).

In order to test this hypothesis in the data, I adopt the same approach as Section 3.3.2 by estimating the following model:

$$\Delta Y_{t+\tau,t-1} = \beta VI_{k,k'} + \gamma' X_{i,t-1} + \delta_t + \gamma_k + \varepsilon_t \text{ where } \tau = 1,2 \text{ and } Y = ROA \text{ or } Y = ROE \quad (3.5)$$

Here Y is a measure of a firm's performance. The most natural measure is ROA. As a robustness test, I scale the numerator by common equity to compute ROE. Results are presented in Table 3.5. As in the previous section, I use the change in each performance measure between time *t-1* and *t+1* and between *t-1* and *t+2* as dependent variables.

As shown in column 1, where the dependent variable is $\Delta ROA_{t+1,t-1}$, the coefficient on *VI* is positive but small and statistically insignificant. However, once we move to column 2 (with $\Delta ROA_{t+2,t-1}$ as the dependent variable), the coefficient becomes large and statistically significant at the 5% level and is equal to 0.17. The point estimate suggests that an increase of a standard deviation in *VI* is associated with an increase in $\Delta ROA_{t+2,t-1}$ of about 5.5% of a sample standard deviation of the dependent variable.

A similar picture emerges when looking at ΔROE as dependent variable (columns 3 and 4). Here the *VI* coefficients are similar for both horizons; however. β is precisely estimated only when looking at $\Delta ROE_{t-2,t-1}$, and is significant at the 5% level. Here an increase of a standard deviation in *VI* is followed by a rise in the dependent variable of about 8.3 percentage points of a standard deviation, an even larger effect.

The fact that statistically significant effects on performance arise only two years after the merger is broadly consistent with the results of Section 3.3.2. Although changes in return volatility are immediately apparent following the merger (Table 3.3), variation in accounting variables occur with some delay (Table 3.4), precisely as in the results on firms' performance of Table 3.5.

3.4 Stock Returns

This section examines in detail the post-merger performance of acquirors. As we have seen in Section 3.3.1, vertical integration between targets and acquirors is not associated with different stock market responses at the announcement, but predicts substantially different performances in many respects. Therefore, I hypothesize that such differences will show up in the market valuation as information is revealed to market participants.

Evaluating stock returns over long horizons presents non-trivial problems. As Fama (1998) has emphasized, the compounding of stock returns over long periods exacerbates "bad model" issues. Minor errors in the modelling of the expected returns will tend to be magnified, thus he advocates the use of a calendar time portfolio approach focused on monthly returns.

On the other hand, Barber and Lyon (1997) suggest that although such strategy may be more robust, it may lead to biased inferences. They recommend evaluating abnormal returns as the difference between the raw stock returns and the return of portfolios of "twin" firms matched on standard predictors of stock returns. As both approaches have advantages and disadvantages, I pursue both in the following.

3.4.1 Abnormal Returns

To estimate the relation between degree of vertical integration and subsequent abnormal returns, I make use of the approach suggested by Savor and Lu (2009). For each deal, I first identify all the firms that have market capitalization between 50% and 150% of each acquiror's market value (measured at the end of the month preceding the deal) and belong to the same industry.

Among these firms, I then select the ten firms with the closest book-to-market ratio and compute the average buy-and-hold return over the following 12 months. If fewer than ten firms satisfy the size and industry requirements, only those are selected as benchmarks. The abnormal buy-and-hold (BHAR) return of firm i is defined as:

$$BHAR_{i,t\to t+12} = \prod_{j=1}^{12}(1+Ret_{i,t+\tau}) - \prod_{j=1}^{12}(1+Ret_{B,t+\tau}) \tag{3.6}$$

where $Ret_{i,t}$ is the monthly return of the acquiror and $Ret_{B,t}$ is the average return of the matched firms.

I then estimate the following regression:

$$BHAR_{i,t\to t+12} = \beta VI_{k,k'} + \gamma' X_{i,t-1} + \delta_t + \gamma_k + \varepsilon_t \tag{3.7}$$

where the vector $X_{i,t-1}$ includes the usual controls, plus the logarithm of the market value. Unfortunately, some firms do not have a matched firm in the same industry satisfying the size restriction. Therefore, adopting this approach reduces the sample size to 690 firms. However, below I show how changing the matching procedure in order to include all the acquirors does not affect the results.

Table 3.6 shows estimates of the coefficients in equation 3.7. Column 1 includes as regressors *VI*, firm and deal controls, and year and industry dummies. The coefficient β is equal to 1.331 and significant at the 5% level, suggesting that an increase in *VI* of a standard deviation predicts an increase in abnormal returns of about 6.26%.

In columns 2 through 4 I relax the requirement restricting matched firms to the same industry of the acquiror. Different benchmarking procedures not only allow for the testing of the robustness of the results, but also for the estimation of equation 3.7 over the full sample. In column 2, I only require the benchmark firms to operate in the manufacturing sector. The coefficient rises slightly, to 1.55 and is significant at the 1% level, suggesting that an increase of a standard deviation in *VI* is associated with a rise in the abnormal return of 7.28%. In column 3 I do not impose any industry requirement (therefore, firms are matched only on size and book-to-market). Finally, in column 4 I do not impose any adjustments, with the dependent variable simply being the difference between the acquiror's raw return and the buy-and-hold risk-free rate.

Coefficients are 1.28 and 1.20, respectively, which are very similar to the estimates of column 1. The larger sample size of the models estimated in columns 2 through 4 also raises the statistical power, with the coefficients being all significant at the 1% level. It is safe to say that the matching procedure has very little impact on both the point estimate of β and its statistical significance, with βs varying between 1.20 and 1.55.

Because the 12-months horizon is somewhat arbitrary, Figure 3.1 plots the coefficient β obtained by estimating equation 3.7 at different horizons. Here the dependent variable is $BHAR_{i,t\rightarrow t+\tau}$ with $\tau = 1,...,18$, together with 95% confidence intervals. For brevity, only estimates that use the most conservative benchmark are reported (with matched firms belonging to the same industry of the acquiror, as in column 1 of Table 3.6).

The coefficient β rises almost monotonically with the horizon, becoming significant after ten months, and reaches its peak and stabilizes at $\tau = 12$. The plot confirms that an increase of a standard deviation in *VI* is associated with roughly a 6%-7% higher return over the 12- to 18-month horizon.

3.4.2 Calendar Time Portfolio

As explained at the beginning of this section, computing abnormal returns over long horizons can potentially generate problems due to the misspecification of the benchmark. In the second approach, I estimate the return of a zero-cost trading strategy, by proceeding as follows.

Every year *t*, I sort all the mergers according to their value of *VI* and classify acquirors as "Low" or "High" *VI* according to whether the proxy for vertical integration falls below or above the yearly median. Then I average the net returns of each subgroup in each month from January up to December of year *t+1*.

Following standard practice, stocks with share price below $5 at the beginning of the month are excluded to avoid placing too much weight on illiquid stocks. The difference of these averages is then regressed on the standard Fama and French (1993) three factors (the market, size, and value factors). The three factors model is also augmented by a momentum factor, following Carhart (1997) and the Pastor and Stambaugh (2003) liquidity factor.

I also employ the procedure proposed by Daniel et al. (1997), henceforth referred to as DGTW (see also Wermers (2003)).[6]. Accordingly, the return of each portfolio is computed by subtract-

[6]The DGTW benchmarks are available via `http://www.smith.umd.edu/faculty/rwermers/ftpsite/Dgtw/coverpage.htm`.

ing from the raw return the average return of a portfolio matched by size, book-to-market, and momentum.

Results are recorded in Table 3.7. Column "High" shows the average monthly return of the high *VI* stocks as the net of the risk-free rate. Column "Low" has the average net return of the low *VI* stocks. Column "High-Low" reports the average difference between "High VI" and "Low VI" average returns. Finally, the fourth column reports the mean net return of the non-diversifying mergers (810 deals) excluded from the analysis so far for comparison. Standard errors are reported in parentheses as usual.

The first row of Table 3.7 ("Raw") shows that the average net return of the high *VI* stocks is a significant 1.07%. The average net return of the low *VI* stocks is, instead, an insignificant 0.50%. The profit from the zero-cost strategy that buys high *VI* stocks and sells low *VI* stocks is 0.57%, significant at the 5% level.

When regressing the monthly return of each strategy on the Fama and French (1993) three factors (the market, size, and value factors), I find that the high *VI* stocks earn, on average, an insignificant 0.15%, whereas the mean net return of the low *VI* stocks is a significant -0.40%. The difference is 0.55%, again significant at the 5% level.

Augmenting the three factors model with the momentum factor and the liquidity factor (4 and 5 factors model, respectively), has little effect on the results. The profitability of the portfolio is now more equally distributed between the two legs of the strategy, with high *VI* stocks earning now between 0.30% and 0.27% and the low *VI* stocks losing between -0.39% and -0.33%. Here only the latter mean returns are significantly different, albeit at the 10% level.

The average profitability of the trading strategy is now 0.59% and 0.60% for the 4 factors and 5 factors models, respectively. Both are significant at the 5% level. Results are similar, but the statistical power of the average return of the High-Low portfolio falls when the DGTW benchmark is used, although it is still significant at the 10% level and equal to 0.55%.[7]

As a point of comparison, I also show the average monthly return of the non-diversifying acquirors. If non-diversifying mergers are easier to analyze by investors, then all the expected synergies of the deal should be incorporated in the price change at announcement. Ergo, we do not expect any abnormal return over time once properly adjusting for risk.

The fourth column of Table 3.7 confirms this hypothesis. The average return from a long strategy that buys stocks of non-diversifying acquirors lies consistently between the returns of the high and low *VI* acquirors and, once adjusted for risk, is very close to zero.

Table 3.8 shows the loadings of the 5 factor model. Only the value factor is statistically significant at the 5% level. It is strongly negative, suggesting that low *VI* acquisitions may be driven at least in part by high valuations. As Table 3.7 shows, adjusting for risk has a negligible effect on the profitability of the trading strategy, which varies little independently of the factors model used.

In summation, the evidence supports the hypothesis of low *VI* acquirors systematically underperforming high *VI* acquirors. The monthly return of the long-short strategy is positive and varies

[7]Notice that benchmark returns are available only through 2012, so I lose 12 observations. This may partially explain the loss in statistical significance.

between 55 and 60 basis points, depending on the adjustment used, and is significant at the 5% level in every test, except when using the DGTW procedure.

3.5 Conclusion

Diversifying mergers may imply very different subsequent performance for the acquirors, depending on the synergies between the merging firms. A simple, theoretically motivated and commonly used proxy for vertical integration goes a long way in predicting a number of relevant outcomes, such as volatility, profitability and stock returns.

However, the degree of vertical integration is not associated with announcement returns. Overall, this evidence points toward a need for more refined measures of relatedness among firms to correctly assess the profitability of an acquisition. It also confirms previous theoretical and empirical work suggesting a positive link between the degree of vertical integration and firms' performance.

Additionally, the evidence on the reduction in firms' volatility following mergers between unrelated firms is consistent with the postulation that managers try to reduce their personal risk. As such, corporate boards should be more aware of managers' incentives when authorizing possibly value destroying deals.

This work could be extended in different directions. First, more refined measures of relatedness could be used, relying not on industry but on firms' connection (such as the customer-supplier links in Cohen and Frazzini (2008)). SSecond, this paper did not attempt to establish a causal relationship between the degree of vertical integration and performance, but more research on this issue would be welcome (for example, by comparing failed versus completed mergers, as in Savor and Lu (2009) and Seru (2014)). Finally, with regard to the merger decision, it would be interesting to explore in depth the factors affecting the optimal degree of integration a firm chooses to pursue. This would extend the work by Acemoglu, Johnson, and Mitton (2009) and Alfaro et al. (2016), among others, by investigating whether governance problems and managerial incentives play a role in such decisions.

3.6 Figures and Tables

Figure 3.1
Buy-and-Hold Returns over Different Horizons

Figure 3.1 plots coefficients from the regression $BHAR_{i,t,t+\tau} = \beta VI_{k,k'} + \gamma' X_{i,t-1} + \delta_t + \gamma_k + \varepsilon_t$, where $\tau = 1, \ldots, 12$. The dependent variable is computed as the difference between the buy-and-hold 1,2,...,18 months return of the acquiror and the average buy-and hold return of up to 10 firms matched by industry, size and book-to-market. *VI* is the proxy for vertical integration between the acquiror's and the target's industry. The vector of control variables $X_{i,t}$ includes Deal Value / Mkt Value, Percentage of Stock, Leverage, B/M, Corr(A,T). Deal Value / Mkt Value is the transaction value (in $ million) divided by the acquiror's market capitalization measured three months before the deal. Percentage of Stock is the percentage of the transaction value paid in stock. Leverage is long-term debt plus debt in current liabilities, all divided by total assets. B/M is book value of assets divided by market value of assets. Log(Assets) is the logarithm of total assets. Corr(A,T) is the correlation between the monthly returns of acquiror's and target's industry returns over the 60 months preceding the deal. Year and industry dummies (δ_t and γ_k, respectively) are also included. Unless otherwise noted, control variables are all measured at the beginning of the year.

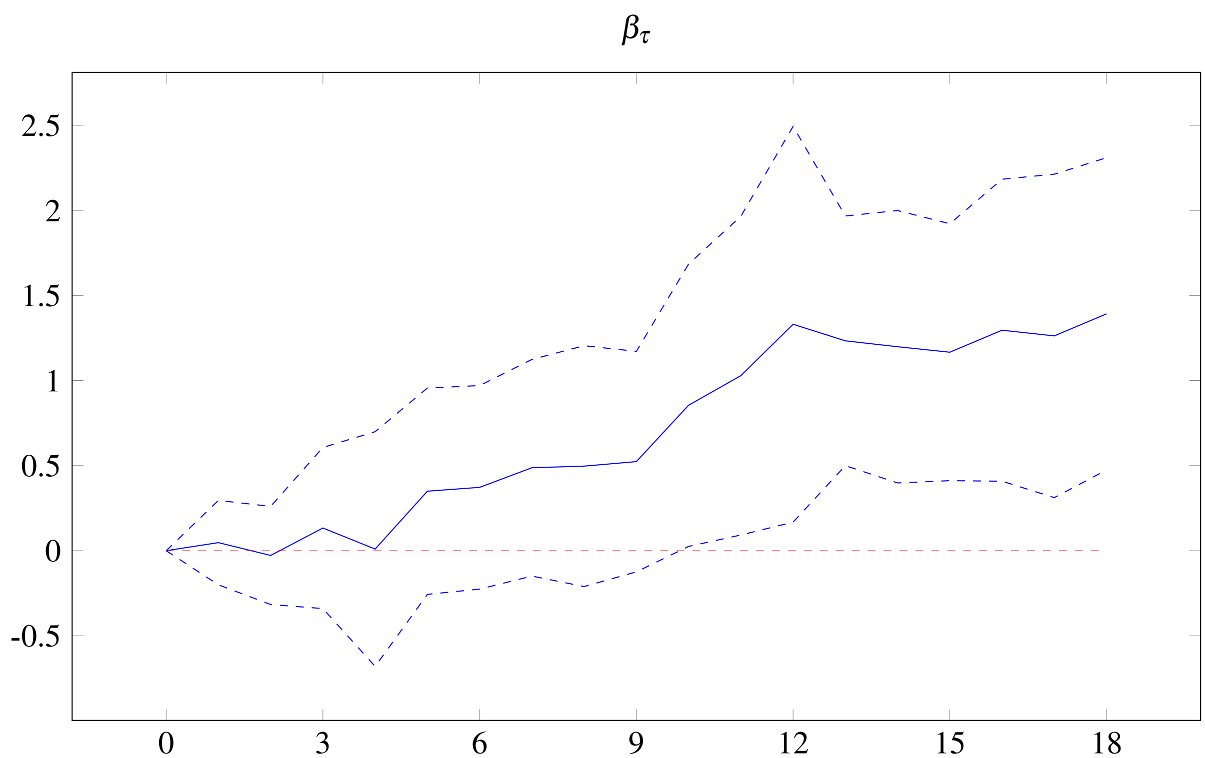

Table 3.1
Summary Statistics

Table 3.1 has descriptive statistics for the main variables considered in this paper. *VI* is a proxy for the degree of vertical integration between the acquiror's and the target's industry. Deal Value / Mkt Value is the transaction value (in millions of dollars) divided by the acquiror's market capitalization measured three months before the deal. Percentage of Stock is the percentage of the transaction value paid in stock. Leverage is long-term debt plus debt in current liabilities, all divided by total assets. B/M is book value of assets divided by market value of assets. Log(Asset) is the logarithm of total assets. Corr(A,T) is the correlation between the monthly returns of the acquiror's and target's industry returns over the 60 months preceding the deal. Δ is the difference operator, so that $\Delta Y_{y,z}$ represents the difference in the variable Y between year y and year z. Ret. Vol. is defined as the square root of the sum of squared daily returns over the year. Op. Vol. is the Ret. Vol. multiplied by market value of equity, all divided by the total liabilities + market value of equity - cash. CF Vol. is the standard deviation of quarterly cash flow, computed as operating income before depreciation minus accruals. Earn. Vol. is the standard deviation of change in quarterly earnings divided by average total assets over the fiscal year. ROA is defined as net income divided by total assets; ROE as net income scaled by shareholders' equity.

	(1)	(2)	(3)	(4)
	CAR(-1 +1)	CAR(-1 +1)	CAR(-3 +3)	CAR(-3 +3)
VI	-0.118	-0.120*	0.042	0.046
	(0.072)	(0.072)	(0.149)	(0.142)
Deal Value / Mkt Value		0.026*		0.042***
		(0.013)		(0.014)
Percentage of Stock		-0.000		-0.000
		(0.000)		(0.000)
Leverage		-0.022		-0.014
		(0.031)		(0.041)
B/M		-0.016**		-0.029***
		(0.008)		(0.008)
Log(Assets)		-0.006**		-0.006*
		(0.002)		(0.004)
Corr(A,T)		0.020		0.022
		(0.020)		(0.029)
Observations	768	768	768	768
R-squared	0.141	0.160	0.167	0.196
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Deal Controls	NO	YES	NO	YES
Firm Controls	NO	YES	NO	YES

Table 3.2
Announcement Cumulative Abnormal Returns

Table 3.2 presents regressions of abnormal returns around the deal announcement date on the vertical integration proxy VI and several control variables, including year and industry fixed-effects. The dependent variable is $CAR_{i,t+\tau,t-\tau}$, where $\tau = 1,3$ and CAR is the abnormal cumulative return around the merger announcement date computed using the market model. *VI* is a proxy for the degree of vertical integration between the acquiror's and the target's industry. Deal Value / Mkt Value is the transaction value (in millions of dollars) divided by the acquiror's market capitalization measured three months before the deal. Percentage of Stock is the percentage of the transaction value paid in stock. Leverage is long-term debt plus debt in current liabilities, all divided by total assets. B/M is book value of assets divided by market value of assets. Log(Asset) is the logarithm of total assets. Corr(A,T) is the correlation between the monthly returns of the acquiror's and target's industry returns over the 60 months preceding the deal. Unless otherwise noted, control variables are all measured at the beginning of the year. ***, **, and * indicate statistical difference from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1) CAR(-1 +1)	(2) CAR(-1 +1)	(3) CAR(-3 +3)	(4) CAR(-3 +3)
VI	-0.118	-0.120*	0.042	0.046
	(0.072)	(0.072)	(0.149)	(0.142)
Deal Value / Mkt Value		0.026*		0.042***
		(0.013)		(0.014)
Percentage of Stock		-0.000		-0.000
		(0.000)		(0.000)
Leverage		-0.022		-0.014
		(0.031)		(0.041)
B/M		-0.016**		-0.029***
		(0.008)		(0.008)
Log(Assets)		-0.006**		-0.006*
		(0.002)		(0.004)
Corr(A,T)		0.020		0.022
		(0.020)		(0.029)
Observations	768	768	768	768
R-squared	0.141	0.160	0.167	0.196
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Deal Controls	NO	YES	NO	YES
Firm Controls	NO	YES	NO	YES

Table 3.3
Return Volatility

Table 3.3 presents regressions of measures of change in volatility on the vertical integration proxy VI and several control variables, including year and industry fixed-effects. The dependent variables are: changes in return volatility between year *VI* and several control variables, including year and industry fixed-effects. The dependent variables are: changes in return volatility between year *t-1* and *t+1* (column 1) and between year *t-1* and *t+2* (column 2); changes in operating volatility between year *t-1* and *t+1* (column 3) and between year *t-1* and year *t+2*. Return volatility is defined as the square root of the sum of squared daily returns over the year; operating asset volatility as return volatility multiplied by market value of equity, all divided by the total liabilities + market value of equity - cash. *VI* is a proxy for the degree of vertical integration between the acquiror's and the target's industry. Deal Value / Mkt Value is the transaction value (in millions of dollars) divided by the acquiror's market capitalization measured three months before the deal. Percentage of Stock is the percentage of the transaction value paid in stock. Leverage is long-term debt plus debt in current liabilities, all divided by total assets. B/M is book value of assets divided by market value of assets. Log(Asset) is the logarithm of total assets. Corr(A,T) is the correlation between the monthly returns of acquiror's and target's industry returns over the 60 months preceding the deal. Unless otherwise noted, control variables are all measured at the beginning of the year. ***, **, and * indicate statistical difference from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)
	$\Delta Ret.Vol_{t+1\,t-1}$	$\Delta Ret.Vol_{t+2\,t-1}$	$\Delta Op.Vol_{t+1\,t-1}$	$\Delta Op.Vol_{t+2\,t-1}$
VI	0.478**	0.594*	1.040***	0.536
	(0.208)	(0.325)	(0.304)	(0.434)
Deal Value / Mkt Value	0.008	-0.001	-0.178***	-0.242***
	(0.038)	(0.042)	(0.050)	(0.052)
Percentage of Stock	0.000	-0.000	0.002***	0.002***
	(0.000)	(0.000)	(0.001)	(0.001)
Leverage	-0.125*	-0.045	0.221**	0.288**
	(0.066)	(0.094)	(0.103)	(0.123)
B/M	0.058**	0.067**	0.104***	0.137***
	(0.027)	(0.031)	(0.033)	(0.042)
Log(Assets)	0.009	0.016*	0.017	0.024**
	(0.007)	(0.009)	(0.011)	(0.011)
Corr(A,T)	-0.038	-0.031	-0.085	0.088
	(0.076)	(0.101)	(0.107)	(0.121)
Observations	745	704	735	695
R-squared	0.591	0.634	0.342	0.400
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Deal Controls	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES

Table 3.4
Cash Flow and Earnings Volatility

Table 3.4 presents regressions of measures of change in profitabiloty on the vertical integration proxy *VI* and several control variables, including year and industry fixed-effects. The dependent variables are: changes in cash flow volatility between year *t-1* and *t+1* (column 1) and between year *t-1* and *t+2* (column 2); changes in earnings volatility between year *t-1* and *t+1* (column 3) and between year *t-1* and year *t+2*. Cash flow volatility is defined as standard deviation of quarterly cash flow, computed as operating income before depreciation minus accruals; earnings volatility as standard deviation of change in quarterly earnings divided by average total assets over the fiscal year. *VI* is a proxy for the degree of vertical integration between the acquiror's and the target's industry. Deal Value / Mkt Value is the transaction value (in millions of dollars) divided by the acquiror's market capitalization measured three months before the deal. Percentage of Stock is the percentage of the transaction value paid in stock. Leverage is long-term debt plus debt in current liabilities, all divided by total assets. B/M is book value of assets divided by market value of assets. Log(Asset) is the logarithm of total assets. Corr(A,T) is the correlation between the monthly returns of the acquiror's and target's industry returns over the 60 months preceding the deal. Unless otherwise noted, control variables are all measured at the beginning of the year. ***, **, and * indicate statistical difference from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1) $\Delta CF\,Vol_{t+1\,t-1}$	(2) $\Delta CF\,Vol_{t+2\,t-1}$	(3) $\Delta Earn.Vol_{t+1\,t-1}$	(4) $\Delta Earn.Vol_{t+2\,t-1}$
VI	0.056**	0.068**	-0.007	0.069***
	(0.025)	(0.027)	(0.020)	(0.024)
Deal Value / Mkt Value	-0.001	-0.011	-0.007*	-0.006**
	(0.009)	(0.007)	(0.004)	(0.003)
Percentage of Stock	-0.000	-0.000	0.000	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.003	-0.003	0.007	0.004
	(0.019)	(0.017)	(0.011)	(0.006)
B/M	-0.005	0.002	0.005***	0.006**
	(0.005)	(0.005)	(0.002)	(0.002)
Log(Assets)	0.002	0.002*	0.000	0.000
	(0.002)	(0.001)	(0.001)	(0.001)
Corr(A,T)	0.004	0.004	-0.000	0.003
	(0.011)	(0.011)	(0.005)	(0.007)
Observations	608	573	715	681
R-squared	0.220	0.279	0.164	0.157
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Deal Controls	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES

Table 3.5
Firm's Performance

Table 3.5 presents regressions of measures of change in profitability on the vertical integration proxy *VI* and several control variables, including year and industry fixed-effects. The dependent variables are: changes in ROA between year *t-1* and *t+1* (column 1) and between year *t-1* and *t+2* (column 2); changes in ROE between year *t-1* and *t+1* (column 3) and between year *t-1* and year *t+2* (column 4). ROA is defined as net income divided by total assets; ROE as net income scaled by shareholders' equity. *VI* is a proxy for the degree of vertical integration between the acquiror's and the target's industry. Deal Value / Mkt Value is the transaction value (in millions of dollars) divided by the acquiror's market capitalization measured three months before the deal. Percentage of Stock is the percentage of the transaction value paid in stock. Leverage is long-term debt plus debt in current liabilities, all divided by total assets. B/M is book value of assets divided by market value of assets. Log(Asset) is the logarithm of total assets. Corr(A,T) is the correlation between the monthly returns of the acquiror's and target's industry returns over the 60 months preceding the deal. Unless otherwise noted, control variables are all measured at the beginning of the year. ***, **, and * indicate statistical difference from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1) $\Delta ROA_{t+1\,t-1}$	(2) $\Delta ROA_{t+2\,t-1}$	(3) $\Delta ROE_{t+1\,t-1}$	(4) $\Delta ROE_{t+2\,t-1}$
VI	0.039	0.167**	0.852	0.863**
	(0.122)	(0.072)	(0.575)	(0.406)
Deal Value / Mkt Value	0.019	0.023	0.040	0.052
	(0.014)	(0.016)	(0.079)	(0.082)
Percentage of Stock	-0.001***	-0.000	-0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)
Leverage	0.068	0.100***	0.166	-0.086
	(0.051)	(0.037)	(0.211)	(0.227)
B/M	-0.002	0.007	-0.020	0.038
	(0.015)	(0.013)	(0.051)	(0.043)
Log(Assets)	0.001	-0.006	0.007	-0.013
	(0.004)	(0.004)	(0.014)	(0.014)
Corr(A,T)	0.016	0.045	0.085	0.301**
	(0.025)	(0.033)	(0.090)	(0.124)
Observations	723	682	723	682
R-squared	0.209	0.240	0.217	0.199
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Deal Controls	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES

Table 3.6
Buy-and-Hold Returns

This table presents regressions of benchmark adjusted returns on the vertical integration proxy VI and several control variables, including year and industry fixed-effects. In columns 1 and 2, the dependent variable is computed as the difference between the buy-and-hold 12-month return of the acquiror and the average buy-and hold return of up to 10 firms matched by industry, size, and book-to-market. In column 3 benchmark firms are matched by size and capitalization and are required to operate in the manufacturing sector. In column 4 benchmark firms are matched only by size and market capitalization. In column 5 the dependent variable is computed as the difference between the buy-and-hold return of the acquiror and the buy-and-hold risk free rate of the same 12-months period. *VI* is a proxy for the degree of vertical integration between the acquiror's and the target's industry. Deal Value / Mkt Value is the transaction value (in millions of dollars) divided by the acquiror's market capitalization measured three months before the deal. Percentage of Stock is the percentage of the transaction value paid in stock. Leverage is long-term debt plus debt in current liabilities, all divided by total assets. B/M is book value of assets divided by market value of assets. Log(Asset) is the logarithm of total assets. Corr(A,T) is the correlation between the monthly returns of acquiror's and target's industry returns over the 60 months preceding the deal. Unless otherwise noted, control variables are all measured at the beginning of the year. ***, **, and * indicate statistical difference from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)
VI	1.331**	1.549***	1.278***	1.199***
	(0.579)	(0.404)	(0.314)	(0.402)
Leverage	0.007	-0.154	-0.096	-0.174
	(0.209)	(0.235)	(0.205)	(0.169)
Log(Asset)	-0.022	0.045	0.034	0.072
	(0.044)	(0.056)	(0.054)	(0.055)
Corr(A,T)	-0.103	-0.203	-0.169	-0.103
	(0.119)	(0.130)	(0.110)	(0.083)
B/M	-0.008	-0.116	-0.091	0.116*
	(0.098)	(0.104)	(0.083)	(0.066)
Log(Mkt Value)	0.044	-0.042	-0.041	-0.076
	(0.054)	(0.062)	(0.061)	(0.066)
Deal Value / Mkt Value	0.004	-0.018	-0.037	-0.021
	(0.087)	(0.081)	(0.072)	(0.066)
Percentage of Stock	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	690	768	768	768
R-squared	0.169	0.166	0.165	0.251
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Deal Controls	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES
Benchmark	Industry	Manufacturing	All Firms	None

Table 3.7
Portfolio Analysis

Table 3.7 presents alphas from the following trading strategy. Every year, deals are sorted according to whether the acquirer and the target had a value of the proxy for vertical integration VI higher or lower than the yearly median. The strategy buys high *VI* acquirors' stocks and sells low *VI* acquirors' stocks and holds them for one year. The average monthly return of the high *VI* stocks is in Column *High*; the average monthly returns of the low *VI* is in Column *Low*. The average difference is reported in Column *High-Low*. Column *Non-Div* reports the average monthly return of the non diversifying acquisitions. Net Returns are either (1) raw; (2) adjusted using the 3, 4 and 5 factors model, respectively; (3) adjusted using the procedure suggested by Daniel et al. (1997). Standard errors are reported in parenthesis. ***, **, and * indicate statistically different from zero at the 1%, 5% and 10% level of significance, respectively.

Model	High	Low	High-Low	Non-Div
Raw	1.070**	0.500	0.569**	0.939**
	(0.449)	(0.370)	(0.270)	(0.439)
3 Factors Model	0.150	-0.400**	0.550**	0.009
	(0.230)	(0.170)	(0.239)	(0.159)
4 Factors Model	0.300	-0.289*	0.589**	0.159
	(0.209)	(0.170)	(0.25)	(0.159)
5 Factors Model	0.270	-0.330*	0.600**	0.180
	(0.219)	(0.189)	(0.270)	(0.150)
5 Factors (DGTW)	0.239	-0.310	0.550*	-0.019
	(0.200)	(0.219)	(0.300)	(0.170)

Table 3.8
Factor Loadings

This Table shows coefficients from the regressing the average monthly return of a portfolio consisting of stocks of firms which have engaged in an acquisition in the previous year on the three Fama and French (1993) factors, the Carhart (1997) and the Pastor and Stambaugh (2003) factor. In column 1 the dependent variable is the average monthly net return of high *VI* stocks; in column 2 the dependent variable is the average monthly net return of low *VI* stocks; in column 3 the dependent variable is the average monthly difference between the return of High versus Low *VI* stocks. In column 4, the dependent variable is theaverage monthly net return of stocks of companies which engaged in a non-diversifying acquisition. ***, **, and * indicate statistically different from zero at the 1%, 5% and 10% level of significance, respectively.

	(1) High	(2) Low	(3) High-Low	(4) Non-Div
MKT	1.143***	0.996***	0.146*	1.065***
	(0.0669)	(0.0480)	(0.0764)	(0.0467)
HML	-0.0804	0.322***	-0.402***	0.0925
	(0.101)	(0.0770)	(0.117)	(0.0616)
SMB	0.801***	0.645***	0.156	0.846***
	(0.0889)	(0.107)	(0.148)	(0.0593)
MOM	-0.189***	-0.137***	-0.0523	-0.00189***
	(0.0544)	(0.0431)	(0.0745)	(0.000497)
LIQ	0.0561	0.0756	-0.0196	-0.0309
	(0.0585)	(0.0584)	(0.0717)	(0.0467)
Constant	0.271	-0.332*	0.603**	0.181
	(0.220)	(0.187)	(0.269)	(0.152)
Observations	252	252	252	252

Appendix

Section 3.A contains definitions for the main variables used in this paper. Section 3.B describes how industry definitions are redefined to construct the vertical integration proxy.

3.A Variables Definitions

Table 3.A.1
Variables Definitions and Sources
This Table has definitions and data sources of the main variables used in the paper. Compustat items are in italic.

Variable	**Definition**	**Source**
Leverage	Long-Term Debt (*dltt*) plus Debt in Current Liabilities (*dlc*), all divided by Total Assets (*at*)	Compustat
Q	Total Assets (*at*) plus Market Value of Equity ($csho \times prcc\_f$) minus Common Value of Equity (*ceq*), all divided by Total Assets	Compustat
ROA	Net Income (*ni*) plus Interest and Related Expense (*xint*), if available, all divided by lagged Total Asset (*at*)	Compustat
ROE	Net Income (*ni*) plus Interest and Related Expense (*xint*), if available, all divided by lagged Common Equity (*ceq*)	Compustat
Book-to-Market	Book equity divided by the market value of equity. Book equity is the book value of stockholders' equity (*seq*), plus balance-sheet deferred taxes (*tsbd*) and investment tax credit (*itcb*, if available), minus the book value of preferred stock. Redemption (*pstkrv*), liquidation (*pstkl*), or par value (*pstk*), in that order, are used to estimate the book value of preferred stock, depending on availability. If stockholders' equity is not available, is is replaced by common equity (*ceq*) plus the par value of preferred stock (*pstk*), or total assets (*at*) minus total liabilities (*lt*), in that order. Market value of equity is price ($prcc\_f$) × shares outstanding (*shrout*).	Compustat
Log(Asset)	Natural Logarithm of Total Assets (*at*)	Compustat
Deal Value / Mkt Value	Value of Transaction in Million divided by Market Capitalization ($prc \times shrout$) measured three monhts before the deal date	CRSP and SDC
Percentage of Stock	Percentage of the transaction value paid in stock, set to zero if missing	SDC

Continued on next page

Table 3.A.1 – *Continued from previous page*

Variable	**Definition**	**Source**
Leverage	Long-Term Debt (*dltt*) plus Debt in Current Liabilities (*dlc*), all divided by Total Assets (*at*)	Compustat
Return Volatility	Square root of the sum of squared daily returns (*ret*) over the year, multiplying the raw sum is multiplied by 252 and divided by the number of trading days. At least 100 non-missing return observations are required	CRSP
Operating Asset Volatility	Return volatility $\times[E/(V-C)]$,where $E/(V-C)$ is computed as $(csho \times prcc\_f)/[lt+(csho \times prcc\_f)-ch]$	Compustat and CRSP
Cash Flow Volatility	Standard deviation of quarterly cash flow, computed as Operating Income Before Depreciation ($oiadpq_t$) minus accruals $((actq_t - act_{t-1}) - (cheq_t - cheq_{t-1}) - (lctq_t - lctq_{t-1}) + (dlcq_t - dlcq_{t-1}) - dpq_t)$. All four observations in every fiscal year are required for the variable to be coded as non-missing.	Compustat Quarterly
Earnings Volatilty	Standard Deviation of change in quarterly earnings $(saleq - cogsq - xsgaq)$ divided by average Total Assets (*atq*) over the fiscal year. All four observations in every fiscal year are required for the variable to be coded as non-missing.	Compustat Quarterly
CAR$(-\tau,+\tau)$	Cumulative abnormal return surrounding the merger announcement date, over either a 3-days ($\tau = 1$) or 7-days ($\tau = 3$) window. The benchmark return is computed using the market model. Beta is computed using daily returns from day -250 to day -46, requiring at least 50 days of non-missing observations	Eventus
Corr(A,T)	Correlation between the monthly returns of value weighted portfolios comprising all the firms in the acquiror's industry and all the firms in the target's industry, measured over the 60 months preceding the deal. If, in a given month, no firm is present in either industry, the returns is set to zero	CRSP

3.B Industry Definitions

Matching BEA codes with three digits SIC codes is fairly straightforward, given that the link is typically either "one to one" (one BEA code corresponds to a single SIC code), "one to many" (one BEA code matches with multiple SIC codes), or "many to one" (multiple BEA codes match a single SIC code). There are only a few problem instances where the match is "many to many." For example, the BEA code 270100 corresponds to SIC codes 281 and 286. However, the SIC code 286 also matches with the BEA code 270401. The solution is to redefine a single industry which matches BEA codes 270100 and 270401 and SIC codes 281 and 286. Table A2 shows how each industry (identified with by numerical identifier) is linked to the corresponding BEA and SIC codes, whenever this redefinition was necessary (i.e., whenever the match was "many to many").

Table 3.B.1
Industry Coding

Table 3.B.1 presents, for each industry, the corresponding BEA codes and SIC codes.

Industry	BEA Codes	SIC Codes
1	160100, 160300, 160400	221, 222, 223, 226, 228
2	270100, 270401	281, 286
3	350100, 350200	321, 322, 323
4	600100, 600200, 600400, 610300, 130100	372, 374, 376

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