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Abstract

In response to technological change, U.S. corporations have been investing more in intangible capital. This transformation is empirically associated with lower leverage and greater cash holdings, and commonly explained as a precautionary response to reduced debt capacity. We model how firms' payout and cash holding policies are affected by this shift. Our insight is that the creation of intangibles is largely achieved by human capital investment and requires lower upfront outlays. Firms can self-finance the retention of human capital by granting deferred equity compensation. Interestingly, retaining cash and repurchasing shares enhances the value of unvested equity, thereby facilitating retention and reducing equity dilution. Our empirical evidence confirms that firms with higher intangible investment have lower upfront investment needs. They make similar payouts as tangible investment firms, suggesting they are not on average more financially constrained. They also tend to grant more deferred equity and prioritize repurchases over dividends in particular when their stock volatility is high, in line with our model's predictions.

Keywords. Technological change, corporate leverage, cash holdings, human capital, intangible capital, equity grants, deferred equity, share vesting.

JEL classifications. G32, G35, J24, J33

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1. Introduction

Progress in information technology since 1980 has transformed corporate investment in developed countries. Intangible assets associated with skilled human capital have grown rapidly relative to tangible assets (Corrado and Hulten, 2010). Such a major shift in the composition of capital can be expected to alter corporate finance practices. Indeed, the evidence relates rising intangible investment to falling corporate leverage and higher cash holdings (Bates et al., 2009; Falato et al., 2013). Figure 1 confirms that these patterns are highly concentrated among high-intangibles (henceforth HINT) firms.

A natural explanation for this evolution is a reduced corporate debt capacity. Raising external financing depends on the ability to pledge collateral, but intangible capital is hard for outsiders to appropriate (Hart and Moore, 1994).[1] Thus as investment patterns change over time, firms may face a greater risk of becoming financially constrained. This view is reinforced by evidence that increased corporate cash holdings are highly correlated with R&D investment and cashflow volatility (Bates et al., 2009; Pinkowitz et al., 2016; Graham and Leary, 2016).

In this paper we model and test how the composition of investment affects corporate funding and payout policy. While it is well established that lower asset tangibility implies a larger need for internal financing and hedging (e.g. Almeida and Campello, 2007), a simple insight offers some additional perspective. Since intangible investment relies largely on human capital investment over time, it requires less upfront capital spending than the creation of tangible assets. Figure 2 confirms that HINT firms indeed appear to invest less of their annual cashflows.

These higher free cashflows suggest that for a given level of profitability, HINT firms have lower investment outlays on average and are thus less likely to become constrained (Figure 3). We offer further evidence that HINT firms do not appear to be *more* financially constrained on average, as they pay out similar amounts of cash as firms with more tangible assets. Yet even if the chance of being constrained may be lower, the opportunity cost of future constraints can be very high for firms with significant growth potential (Opler et al., 1999; Froot et al., 1993). In this case a strong precautionary motive for low net leverage is justified for HINT firms.

[1] Patents are a rare example of intangible capital on which property rights may be established.

A second aspect of the process of creating intangible capital is a novel conflict on the capture of its value that mirrors the agency problem associated with external financing of conventional investment. Since the value of human capital cannot be appropriated by others, critical employees have a credible threat to leave with the essential knowledge and start an own firm, capturing the value of the intangible capital they create. However, remaining in the firm has some advantages, as starting a new firm incurs additional costs and exposes the agent to more risk.

This insight suggests a second reason for high cash holdings at HINT firms. Retaining cash decreases future share price volatility, increasing the utility value of the innovator's deferred compensation. For the same reason, HINT firms should favor repurchases over dividends. The intuition is that dividends are a payout to vested equity only, while repurchases support the value of both vested and unvested shares. While vested shareholders may be tempted to pay out large dividends, this would hurt the firm's reputation with skilled employees and increase future retention costs. Thus a policy of accumulating cash and repurchasing shares is beneficial as it reduces the deferred equity compensation needed for retention, limiting dilution for existing shareholders.

We formalize this insight using a simple model of corporate investment. Firms are characterized by the composition of their investment, and choose their cash and payout policy accordingly. Any firm may need to make some additional investment before the project's cashflows are realized. Firms that operate more tangible assets require larger upfront investment but their assets can be pledged to external creditors. On the other hand, innovative firms require smaller upfront outlays but rely on creative employees to develop their intangible assets, and human capital cannot be pledged to raise external financing. Overall, innovative firms may or may not face greater financial constraints, depending on the balance between the two effects.

We show that innovative firms will retain skilled employees using deferred compensation that vests after the project's cashflows are realized. While we consider both deferred equity and fixed compensation, in practice firms overwhelmingly choose to grant unvested equity rather than deferred cash, either by individual contracts or through broader employee stock ownership plans (ESOPs).[2] While unvested equity conveys retention incentives, it also exposes skilled

[2]The choice of equity over fixed compensation may be due to fiscal advantages (Babenko and Tserlukevich, 2009;

employees to risk. Since cash holdings decrease share price volatility, they increase the utility value of the innovator's unvested equity and reduce the total amount of deferred compensation needed for retention.

Our model thus shows that as firms come to rely on more innovative technologies, they use less external financing and instead internally fund employees' human capital investment. Firms additionally accumulate cash in order to insure their risk-averse employees. These effects can help to explain why HINT firms have higher free cashflows and hold more cash even if they are not necessarily more financially unconstrained. It is consistent with HINT firms making similar payouts as traditional firms, while using deferred equity compensation to retain employees.

A final implication from our framework is that the cost of retention is reduced when firms can build a reputation by a payout policy favoring repurchases rather than dividends. Dividend payments reduce the value of unvested equity, while fair price repurchases maintain the market value of unvested equity.

We find supportive empirical evidence for our model predictions in a large sample of Compustat firms. We start by showing that HINT firms invest significant less, but also pay out similar amounts of cash to external shareholders via stock buybacks and dividends.[3] These empirical findings indicate that a view of HINT firms being more financially constrained does not fully explain why these firms hold more cash.

Next, we test our model's prediction that HINT firms pledge a larger amount of total equity to highly skilled employees. We measure pledged equity using the fraction of total shares that firms hold in their corporate treasuries, as well as net shares added each year to the treasury. Firms typically use treasury stock to fund future equity grants to employees, or to fulfill their option exercises, without diluting existing shareholders in the process. We find that a one-standard-deviation increase in intangibles usage is associated with 14% more stock held in the corporate treasury. We further show that HINT firms pay out 90% more stock options each

Hanlon and Shevlin, 2002) or the need to index compensation to the ex-post value of the outside option (Oyer and Schaefer, 2005) It may also be due to the greater credibility of a property grant over a nominal contractual promise.

[3]We measure intangible assets by capitalizing investment into knowledge and organizational structure, following Peters and Taylor (2016). HINT firms are those with intangibles to total assets in the highest tercile of the sample distribution.

year, as a fraction of total market value of equity, to non-executive employees.

Equity grants facilitate human capital retention, but also expose employees to idiosyncratic share price risk. To test our model's prediction that riskier HINT firms provide employees with more insurance, we regress cash holdings on intangibles usage interacted with stock volatility. We find that more volatile HINT firms hold more cash than less volatile HINT firms, after controlling for investment opportunities and financial constraints. Moreover, this result is concentrated among HINT firms that pledge large amounts of equity to employees.

Finally, we find that HINT firms prefer to repay cash using share repurchases, as our model predicts. A one-standard-deviation increase in intangibles usage is associated with an 8 percentage-point higher ratio of repurchases to total payouts.

Our results are robust to excluding firms in the computers industry or firms that recently completed an IPO. While these firms are often regarded as leaders in technological innovation, our robustness tests show that intangibles usage is associated with lower upfront investment and greater equity compensation among other economic sectors and older firms. We further obtain all of our results among a subset of S&P 500 firms, which are likely financially unconstrained.

1.1. Related literature

A wide literature examines the determinants of the evolution of corporate cash holdings and leverage. One prominent theory is that firms accumulate cash to buffer against future financing constraints (Kim et al. (1998), Almeida et al. (2004), Harford et al. (2014)). This contrasts with a long-standing view that retention of free cashflow is symptomatic of agency problems between management and shareholders, which can be mitigated by higher net leverage (Jensen (1986), Pinkowitz et al. (2006),Dittmar and Mahrt-Smith (2007), Harford et al. (2008)). This conflict is less acute when profitability reflects quasi rents that require investment to be maintained. Another possible determinant is the U.S. policy of taxing profits globally, which may encourage firms to retain cash abroad (Foley et al., 2007). Other work argues that cash holdings are related to transaction costs of raising new funding (Miller and Orr (1966), Mulligan (1997)) or the opportunity cost of holding cash (Azar et al. (2016)). Begenau and Palazzo (2015) argue that rising average cash holdings are driven by new entrants that invest more in R&D.

Intangible capital is developed by human capital investment by key employees, but its value is hard for firms to appropriate as "assets may simply walk out of the door". It is well recognized that outsiders cannot easily appropriate the value created by human capital (Hart and Moore, 1994), as the firm needs the full cooperation of an innovating employee. To ensure commitment over time, firms need to reward and retain creative workers by some form of deferred compensation, typically in the form of share or option grants.

Several recent papers highlight how technological progress has boosted the role of human capital and induced changes in funding and employee compensation choices.[4] Lustig et al. (2011) recognize the impact of technology on the productivity of organizational capital, and are able to explain the rising role and dispersion of managers' pay for performance in large firms.[5] Thakor and Lo (2015) show that cash holdings are essential in a competitive environment where success in R&D is critical. Döttling and Perotti (2016) show how technological progress can account for major financial trends in developed economies since the 1980s, starting with declining interest rates and falling corporate net leverage. A distinct result in the paper is the link of cash retention and a preference for repurchases over dividends to the optimal compensation and retention of critical employees.[6]

Our paper also relates to a nascent literature showing that firms choose their leverage ratios in part to insure risk-averse employees against costly bankruptcy (Berk et al. (2009), Agarwal and Matsa (2013), Kim et al. (2016)). We contribute to this literature by showing that even in the absence of bankruptcy or distress costs, innovative firms may hold more cash and use less leverage in order to insure employees with large equity stakes.

Sun and Zhang (2015) offers a related theory of how firms that invest in intangible capital grant unvested equity compensation to retain innovative employees. Their model takes the conventional view that these firms still need as much external finance as traditional firms, and

[4]This process is believed to account for a drastic rise in the skill premium since 1980 (see, e.g., Katz and Murphy (1992) and Autor et al. (1998)).

[5]Interestingly, their estimates suggest managers may be able to claim as much as half of total value of organizational capacity they create. As in our approach, employee risk aversion enables firms to retain more of the value created.

[6]A general treatment on the governance and incentive role of cash retention in rewarding employees in the future is offered by Acharya et al. (2011), who show how the dividend payout is chosen by self-interested CEOs to maintain a balance between external control by shareholders and internal support by younger managers.

studies under what conditions compensating human capital crowds out debt financing. In contrast, our approach yields unique predictions that associate intangibles with cash holdings and payout policy, and that seem to be borne out by the data.

The rest of the paper is organized as follows. Section 2 develops a model of intangible investment, generating predictions for capital structure, payouts and cash holdings. Section 3 describes our sampling procedure and key empirical measures. Section 4 presents empirical tests of our model's predictions for corporate financing and employee compensation. Proofs are in Appendix A, and variable definitions are in Appendix B.

2. Model

2.1. Model setup

Consider a risk-neutral firm with a mandate to maximize inside shareholder value, and a risk-averse, highly skilled employee. There are three time periods. At $t = 0$, the firm chooses how much of its initial endowment to invest into a project, and how much cash C_0 to retain. The project has fixed scale I, and generates a stochastic gross return $\tilde{R}$ at $t = 2$, with CDF $F(\tilde{R})$ and support $[0, \bar{R}]$. In the interim period the firm experiences a liquidity shock with probability λ, in which case some of its assets depreciate and an additional investment of ρI is needed. The project generates $\tilde{R}$ if the firm reinvests, else it is worthless.

The firm is unconstrained at $t = 0$, so it can freely choose how much cash to retain after funding investment. Holding cash from $t = 0$ to $t = 1$ generates a zero risk-free return. At $t = 1$, the firm can use its retained cash to reinvest if needed, to make payouts to existing shareholders, and to retain some remainder C_1 until the last period. Holding cash for more than one period generates a moral hazard deadweight loss of χ per unit, associated with managerial discretion, in the spirit of Jensen (1986).

Each firm is characterized by a technology parameter $\eta \in (0, 1)$, which determines how much production depends on intangible capital. Specifically, the firm must invest $H = \eta I$ into intangible assets, and $K = (1 - \eta)I$ into tangible assets.[7] There are two key differences between

[7]The fixed tangible-intangible investment ratio can be motivated by a Leontief production function, where the

tangible and intangible assets. First, intangible capital is not pledgeable and needs to be fully self-financed. On the other hand, a fraction $(1-\theta)$ of tangible capital can be collateralized, so the firm must self-finance only θ. Second, the creation of intangible capital is supported by the highly skilled employee's human capital contribution, so that the firm only needs to make a cash outlay of αH, with $\alpha < 1$. Without loss of generality we assume that the employee's cost of exerting effort is 0.

Notably, there is a moral hazard problem associated with intangible assets. After observing the firm's re-investment and cash retention decisions at $t = 1$, the employee can depart and use her intangible capital to start up an own firm. The source of this conflict is the inalienability of the employee's human capital (Hart and Moore, 1994). In the new firm the employee earns a payoff $(1-\alpha)H\tilde{R}$, proportional to the share of total capital that she contributes. For simplicity we assume that the firm generates no return if the employee departs.

Due to this moral hazard problem, it is optimal for the firm to offer deferred compensation to the employee. Motivated by firms' empirically observed policies, we assume that this compensation takes the form of an unvested equity share ω, which vests after the project's cashflow is realized at $t = 2$. Such a grant conveys retention incentives, because employees typically forfeit unvested equity when departing voluntarily.[8] Figure 4 summarizes all the actions in the model.

We assume that the employee has CRRA preferences over time-2 consumption x,

$$U(x) = \frac{x^{1-\gamma}}{1-\gamma}, \tag{1}$$

where $\gamma > 0$ reflects her relative risk aversion. Further, to ensure that the project has positive NPV we assume

Assumption 1.

$$\mathbb{E}\tilde{R} \geq (1 + \lambda\rho)$$

In this setup, there are two motives for the firm to hold cash. First, a precautionary savings

total return at $t = 2$ is given by $\tilde{R}\mathcal{I}$, with $\mathcal{I} = \min\left\{I, \frac{H}{\eta}, \frac{K}{1-\eta}\right\}$. If the project has positive NPV, a firm with this production function will always choose $H = \eta I$ and $K = (1-\eta)I$.

[8] In appendix A.2 we show that the main results of the model hold when the firm offers deferred cash compensation.

policy ensures that the firm has enough liquidity to withstand the shock at $t = 1$. Second, cash retained by the firm buffers against uncertainty in $\tilde{R}$, thereby reducing the volatility of the employee's equity stake ω. This increases the certainty equivalent value of the deferred equity claim at $t = 0$ and reduces the overall compensation cost. We next solve the firm's decision problem.

2.2. Precautionary cash holdings

If the firm is hit by a shock at $t = 1$, it needs to fund investment of $\rho(\alpha H + K)$. The amount $\rho(1-\theta)K$ can be financed externally by pledging tangible assets as collateral, so the firm requires liquidity of $\rho(\alpha H + K) - \rho(1-\theta)K$ to withstand the shock. These precautionary cash holdings can be expressed as

$$C^p = \rho I[\theta + (\alpha - \theta)\eta] \tag{2}$$

Note that the amount of cash required at the interim date depends on the technology. A traditional firm (small η) incurs a larger expenditure but can fund a larger fraction externally, while an innovative firm needs to self-finance all intangible investment. Whether C^p increases or decreases in η therefore depends on whether the self investment need for intangible capital exceeds the non-collateralizable fraction of physical capital ($\alpha > \theta$). In this case cash holdings will increase in η, as suggested in the empirical literature (Bates et al., 2009; Falato et al., 2013). In contrast, if $\alpha < \theta$ innovative firms actually have a weaker precautionary motive to hold cash. As such, it is not a priori clear whether intangible firms face a greater future funding risk.

2.3. Cash holdings and employee compensation

If the employee starts an own firm, she receives a fraction $(1-\alpha)H = (1-\alpha)\eta$ of the project's returns. Therefore her incentive compatibility constraint to remain at the firm is

$$\int U(\omega[RI + (1-\chi)C_1])dF(R) \geq \int U((1-\alpha)\eta RI)dF(R) \tag{IC}$$

Note that (IC) always holds when the firm sets $\omega = (1-\alpha)\eta$ and $C_1 = 0$. In this case the employee's equity stake (and risk exposure) is the same as her outside option, so she will stay

even if the firm holds no cash. However, retaining cash allows the firm to partially insure the employee, providing higher utility than she could receive from self-employment. As a result, choosing $C_1 > 0$ allows the firm to reduce the optimal equity grant to $\omega^* < (1-\alpha)\eta$. This observation immediately yields the following result:

Lemma 1. *Under assumption 1, it is always optimal for the firm to invest, and retain cash* $C_0 \geq C^p$ *at* $t = 0$ *to withstand the shock at* $t = 1$.

Proof. The firm will invest if

$$(1-\omega)\mathbb{E}RI \geq (1+\lambda\rho)(\alpha H + K) + C_1 \tag{3}$$

Evaluating (3) at $\omega = (1-\alpha)\eta$ and $C_1 = 0$ yields a necessary condition for firm participation. Since $\rho \leq 1$ this also implies that it is optimal to reinvest after a liquidity shock. Rearranging and using the equilibrium levels of investment gives the condition in assumption 1. □

When assumption 1 is satisfied, it follows from lemma 1 that the firm's retained cash at $t = 0$ equals

$$C_0 = \underbrace{\rho I[\theta + (\alpha - \theta)\eta]}_{C^p} + C_1^*,$$

where C_1^* denotes the period-1 level of cash holdings that optimally trades off the moral hazard cost of cash holdings χ against a reduction in ω.

At time $t = 1$, the firm may be hit by a re-investment need, in which case it uses its precautionary cash holdings C^p. If the firm does not need to re-invest it is optimal to pay out the excess cash C^p to its shareholders in the form of a dividend. Note that since the employee holds unvested equity she does not receive any dividends, so that in both states the firm can reach its target cash level C_1^* at $t = 1$, without needing to share any of the excess cash with the employee.

We now consider the firm's optimization problem over C_1 and ω, which can be written as

$$\begin{aligned} \max_{C_1,\omega} \quad & V(\omega, C_1) = (1-\omega)[\mathbb{E}\tilde{R} + (1-\chi)C_1] - (\alpha H + K + \lambda C^p + C_1) \\ s.t. \quad & (IC) \\ & C_1, \omega \geq 0 \end{aligned}$$

Higher values of ω lead to greater dilution of external shareholders, so the firm's objective function is decreasing in ω. This means that the firm sets ω to the lowest value that satisfies (IC), i.e., (IC) always binds. Using (IC) and the employee's utility function (1) allows to derive ω as a function of C_1:

$$\omega(C_1) = \eta(1-\alpha)S(C_1), \tag{4}$$

where

$$S(C_1) = \left[\frac{\int (RI)^{1-\gamma} dF(R)}{\int [RI + (1-\chi)C_1]^{1-\gamma} dF(R)}\right]^{\frac{1}{1-\gamma}}.$$

Eq. (4) shows that ω is proportional to $\eta(1-\alpha)$, scaled down by a factor $S(C_1) \leq 1$. Since $S'(C_1) < 0$ the required equity payment is decreasing in the amount of cash that the firm retains until $t = 2$. Furthermore, the sensitivity of ω to cash holdings depends on the employees' risk-aversion γ and the underlying risk in the distribution of $\tilde{R}$.

Substituting (4) into the firm's objective function the first order condition w.r.t. C_1 implicitly defines optimal cash holdings C_1^*:

$$(1-\chi)(1-\omega(C_1^*)) - \omega'(C_1^*)(\mathbb{E}R + (1-\chi)C_1^*) = 1. \tag{5}$$

The left hand side is the marginal benefit from an additional unit of cash retained. This equals the direct gain of $(1-\chi)$, weighted by the share $(1-\omega(C_1^*))$ that accrues to the firm, plus the benefit from the marginal reduction in the share grant ω. The right hand side is the marginal cost, which is simply 1.

The following proposition clarifies how equilibrium cash holdings C_1^* interact with technology η.

Proposition 1. *The firm's optimal time-1 cash holdings are increasing in η:*

$$\frac{dC_1^*}{d\eta} \geq 0$$

The formal proof is in Appendix A.1. To interpret the result, note that the value of the employee's outside option increases in η. Therefore, a firm with a higher η holds more cash and offers a greater share grant to ensure retention.

Figure 5 uses a numerical example to plot the optimal cash holdings C_1^* and share grant ω^*. It shows that both increase with η, as the firm's reliance on human capital increases. Additionally, for higher levels of employee risk-aversion γ the firm holds more cash and offers a smaller equity grant, reflecting that retained cash insures the risk-averse employee.

To summarize, the firm's cash holdings at $t = 0$ are composed of a precautionary and a retention component,

$$C_0 = C^p + C_1^*.$$

The precautionary motive may induce higher or lower cash holdings for intangible firms, depending on the relative size of external investment need for tangible and intangible capital, θ and α.[9] The retention motive is always increasing in the technological reliance on intangibles η. The setup thus gives a simple rationale why high-intangible firms hold more cash, even in the absence of stricter external financial needs ($\alpha < \theta$).

2.4. Payout policy

We present a simple extension to study the effect of intangible investment on corporate payout policy. Dividend policy creates a second internal conflict in the firm. Since dividends are only paid out to vested shareholders, they reduce the value of the employee's unvested equity.

It is intuitive why in our setup an innovative firm will generally avoid making large dividend payments at $t = 1$. The employee will depart if the value of ω^* falls below the expected utility from an own firm, undermining the profitability of the project. Thus dividend payments reduce shareholder value whenever the project's present value exceeds the agency cost of retaining cash

[9]Note that the standard assumption in the literature is that $\alpha > \theta$.

until $t = 2$.

A more interesting possibility arise when the firm can pay a dividend at $t = 2$, just before the employee's shares vest. As by this date the employee has contributed their human capital, she can no longer depart to start her own firm. A late dividend payment thus transfers value from the employee to external shareholders, without affecting the project's return. Thus the creation of intangible via the commitment of human capital over time has to resolve a double-sided moral hazard problem.

Anticipating this possibility, creative employees would leave the firm at $t = 1$ and firms could only acquire intangible capital from startups. Co-investment at $t = 0$ will occur only if the firm commits to refrain from paying out dividends before deferred equity grants vest. This can be achieved in a repeated game setting where firms can build a reputation by following a payout policy that does not dilute unvested equity. Interestingly, a payout policy that favors repurchases over dividends can achieve this purpose. By acquiring shares at a fair price they maintain the value of unvested shares (although their volatility increases). Thus the utility of an employee who is risk-neutral is unaffected by a repurchase ahead of vesting.

To see this, let the firm's total shares be 1, with a fraction ω unvested. Denote the risk-neutral firm value in the absence and after a repurchase as V_{NR} and V_R, respectively. In order to repurchase a fraction x of shares, the firm spends xV_{NR} of its cash, reducing firm value to $V_R = (1-x)V_{NR}$. After a fair price repurchase, the unvested equity share rises to $\omega' = \omega/(1-x)$, so for a risk-neutral agent its value is constant at $\omega' V_R = \omega V_{NR}$. A risk-averse employee suffers some utility loss as she holds a larger claim on a riskier pool of assets. Nevertheless, the negative effect is much smaller than from a dividend payout.

In summary, when firms repurchase shares the size of the unvested stake exactly offsets the cash paid out by the firm, unlike dividend payments that reduce the value of unvested equity. While firms may adopt other solutions to solve the commitment problem, repurchases clearly support the value of unvested equity and allow firms to improve the effectiveness and cost of employee retention.[10]

[10] In our setup there is no reason for an innovative firm to pay dividends, while in reality there are valid reasons (eg related to fiscal rules or control issues) for dividends instead of repurchases.

2.5. Empirical Predictions

Our model predicts that relative to firms using few intangible assets, HINT firms:

1. have higher cash holdings and lower net leverage, and both are increasing in the volatility of returns
2. are not necessarily more frequently financially constrained
3. pledge a larger fraction of the equity stake to employees
4. prefer to pay cash using repurchases instead of dividends

3. Sample and Empirical Measures

Our sampling procedure starts with all 33,320 firms that are in Compustat between 1970 and 2010. We exclude 8,677 financial and utilities firms (SIC codes 6000 through 6999 and 4900 through 4999, respectively). We further exclude 3,815 firms with assets that are missing or below $5 million and sales that are missing or negative; 3,695 firms incorporated outside the United States; and 4,800 firms that have less than 5 years of data. Our final sample contains 12,242 firms and 172,264 individual firm-years. Our sampling criteria are identical to Bates et al. (2009) and Falato et al. (2013).

3.1. Measuring Intangible Capital

Corporate balance sheets do not list most of the intangible assets that firms use for production. U.S. accounting rules require firms to expense in their income statements the annual amount spent to create intangible capital. Investments that develop knowledge, establish a brand, or enhance organizational culture (such as R&D, advertising, and employee training) are deducted from a firm's revenues prior to calculating operating earnings. An exception is externally acquired intangible assets, which are capitalized on the balance sheet as part of Goodwill or as Other Intangible Assets.[11]

[11] A small amount of internally produced intangibles can also be included in Other Intangible Assets. Firms can capitalize legal and consulting fees incurred when developing a patent, and also spending on software that has reached commercial viability (or the coding stage, if used internally).

We estimate firms' stock of intangible assets by following the method developed by Peters and Taylor (2016). This procedure separately capitalizes past years' spending on R&D and SG&A, using the perpetual inventory method for each. When capitalizing R&D, missing values are set to 0 after 1977. Depreciation rates are from the Bureau of Economic Analysis, and range from 10% to 40% (see Li (2012)). The procedure also capitalized a portion of SG&A, to reflect that some of these business expenses increase the value of organizational capital. It first subtracts R&D spending from SG&A, because Compustat almost always combines the two expenditures. We count 20% of remaining SG&A spending as intangible investment, although we obtain very similar results for other weights.[12] A depreciation rate of 20% is used for organizational capital. Finally, we add the balance sheet value of Other Intangible Assets to the firm's stock of intangible capital.[13]

The variable *Intangibles Ratio* equals the stock of intangible assets divided by total assets. Throughout the paper, we measure total assets as the sum of tangible and intangible assets, where the former is measured as the balance sheet value of Property, Plant, and Equipment (PP&E).

3.2. Dependent Variables

We measure *Tangible Investment* as the annual change in PP&E net of depreciation. This measure incorporates all of a firm's investment into its stock of physical assets, including those that are created via capital expenditures, externally acquired, or booked as part of R&D spending. To measure intangible investment, we sum firms' annual R&D spending, 20% of their SG&A spending, and the annual change in Other Intangible Assets net of amortization. *Total Investment* is the sum of these two investment measures.

We scale our investment variables by the amount of annual cashflows that is available to the firm to fund investment. We define these cashflows as earnings prior to depreciation and tangible or intangible investment, minus taxes and interest payments. As such, *Tangible Investment*

[12] Peters and Taylor (2016) count 30% of SG&A as intangible investment. Our baseline analysis uses a lower weight because the data show an economy-wide decrease in SG&A expenditure since 2001, and it is not clear whether this is due to lower organizational investment or efforts to cut costs and boost efficiency following recent recessions.

[13] We do not count Goodwill as an intangible asset, because it also includes the market premium for tangible assets.

and *Total Investment* represent how much is invested out of each dollar of cash generated by the firm. This definition ensures that our comparison of investment across HINT and LINT firms is not drive solely by differences in these firms' performance. We set investment variables to missing for firms with negative cashflows.

We measure shareholder payouts as annual common dividend payments *Dividends*, annual stock repurchases (*Repurchases*), and the sum of the two (*Total Payouts*). We divide each payout amount by total assets. We do not scale by cashflows, because this could create a mechanical correlation between firm profitability and our primary measure of financial constraints. Notably, our measure of repurchases represents cash transfers to outside shareholders, and not share buybacks that are immediately used to fulfill employee option exercises. We follow Fama and French (2001) by measuring repurchases as the annual change in the value of common shares held in the corporate treasury.[14] For years in which this data is unavailable, and for firms that retire repurchased shares, we measure repurchases as the difference between purchases and sales of common stock from the cash flow statement. We also measure the ratio of stock repurchases to total payouts using *Repurchases/Payouts*.

We use three measures of employee equity compensation. First, *Treasury Shares* is the fraction of total issued shares that are held in the corporate treasury. These shares are typically used to fulfill future employee share grants or option exercises, although a small number of firms also re-issue treasury shares in the future in a seasoned equity offering.[15] This variable therefore is one way to measure the amount of equity that a firm has pledged to its employees. Second, *Shares Retained* is the year-on-year change in the value of treasury shares, divided by total assets. This variable represents the amount of shares that firms set aside each year, net of share payouts, to fulfill employees' future option grants. Treasury shares are recorded at cost in financial statements, so this variable is not influenced by changing market valuations of the firm. Third, because some firms do not store stock in their treasury, we also use *Option*

[14] When a firm purchases a share on the open market and transfers it to employees within the same year, the amount of stock held in its treasury will not change. On the contrary, when the firm retains the share for at least a year, the book value of treasury shares (recorded as the price paid by the firm to buy the stock from shareholders) increases.

[15] Firms typically prefer to compensate employees with shares from the treasury than to issue new shares, in order to avoid diluting existing equity claims.

Compensation to measure the fraction of firm value that is transferred to employees each year. This variable is the Black-Scholes value of stock options granted to all employees excluding the 5 highest-paid executives, divided by market capitalization.[16]

3.3. Control Variables

A large body or prior research shows that corporate investment depends on firms' investment opportunities and their financial slack. All of our regressions therefore use *Tobin's Q* to control for investment opportunities. We measure Q as the value of firms' liabilities and equity divided by total assets, including intangible capital. Peters and Taylor (2016) show that this is a better proxy for investment opportunities than traditional definitions of Q. We account for financial constraints by controlling for cashflows divided by total assets (*Cashflow*) and firm size, measured as the natural logarithm of total assets (*Log Assets*).

In some regressions we further control for *Book Leverage*, which is total debt divided by total assets minus cash and marketable securities; the annual *Stock Return*; and *Cashflow Volatility*, which as in Bates et al. (2009) is the standard deviation of *Cashflow* over the previous 10 years, averaged across the firm's 2-digit SIC code industry. We further use either industry fixed effects (based on Fama-French 48 industry) or firm fixed effects, and all regressions include year fixed effects.

3.4. Data Descriptives

Figure 1 plots the *Intangibles Ratio* of the median firm for each year in our sample. The figure shows that intangibles usage has almost doubled across the entire sample, from 0.4 in 1970 to 0.71 in 2010. The stock of intangible assets was largely flat during the 1970s and began to grow steadily in 1980. It then rose most sharply from 1995 to 2001, at the same time that Internet usage became widespread. Since the mid-2000s, intangible assets account for more than 2/3 of the median firm's capital stock.

[16] We measure the value of annual employee option grants prior to 2005 following Bergman and Jenter (2007). Starting in 2005, we use Compustat data on the value of total options granted to all employees, minus the value of options granted to top executives.

Table 1 presents the evolution of intangible usage separately for each industry in our sample. It shows that the composition of capital stock has changed dramatically across a wide range of industries. *Intangibles Ratio* is highest among firms that produce pharmaceuticals (0.96) and computers (0.90). However, numerous industries that are not commonly considered "high-tech" also experienced large increases in *Intangibles Ratio*, such as construction, candy and soda, apparel, fabricated products, and recreation. On the other end of the spectrum, the transportation and resource extraction industries create the least intangible capital (the chemicals industry also had a relatively high *Intangibles Ratio*, in 1970, but subsequently experienced little change). Across the entire sample *Intangibles Ratio* has almost doubled, from 0.398 in 1970 to 0.711 in 2010.

TABLE 1 ABOUT HERE

Table 2 presents summary statistics for all of the variables used in our analysis, separately for HINT and LINT firms. It also presents the difference in means across the two groups.

TABLE 2 ABOUT HERE

The table shows that HINT firms have substantially higher cash holdings, and lower net leverage and investment rates than LINT firms. The difference in cash holdings represents 39% of the variable's standard deviation of 0.57 across all sample firms, while the difference in net leverage is equal to 56% of its overall standard deviation of 0.89. HINT firms also grant employees significantly more option compensation and pay out a higher fraction of cash via share repurchases. In the following section we use a regression analysis to test whether these and other relationships are consistent with our model's predictions after controlling for firm characteristics.

The statistics further shows that HINT firms are significantly smaller than LINT firms, but with higher Q values. HINT firms also have significantly higher cashflows, but their stock returns are statistically indistinguishable from LINT firms.

4. Empirical Analysis of Intangibles Usage

4.1. Investment

The foundation of our theory is that firms require less upfront investment to create intangible capital, as they instead rely partly on the commitment of human capital by highly skilled employees. We begin our empirical analysis by examining whether the data support this key modeling prior. Figures 2 and 3, which are discussed above, provide preliminary evidence that HINT firms have lower tangible and total investment rates than LINT firms throughout the sample period. We now proceed to statistically test this relationship while controlling for standard determinants of corporate investment.

Table 3 presents estimates from regressions of *Tangible Investment* on *Intangibles Ratio* in columns (1) through (3), and from regressions of *Total Investment* on *Intangibles Ratio* in columns (4) through (6). Each column shows a negative, highly statistical significant association between usage of intangible assets and corporate investment, which is measured as a fraction of annual cashflows. Column (2) for example indicates that a one-standard-deviation increase in *Intangibles Ratio* corresponds to a 0.43 ($= -0.21 \times 0.3 =$) lower tangible investment rate, which is equal to 34% of the variable's standard deviation of 1.28.[17]. The coefficients on the control variables show that investment opportunities (measured by *Tobin's Q*) are positively associated with investment, while larger and more volatile firms invest less.

TABLE 3 ABOUT HERE

The regressions in columns (3) and (6) include firm fixed effects, and show that firms invest less in the years in which their *Intangibles Ratio* is higher. These models provide some evidence that firms' investment spending has decreased over time, as the composition of their capital stock has shifted toward more intangible assets.

In summary, the results in Table 3 show that firms that use more intangible assets also engage

[17] Throughout the empirical analysis, we calculate economic magnitudes using variables' standard deviations across the entire sample. These may differ from the standard deviations for HINT and LINT firms presented in Table 2.

in less investment spending.

4.2. Evidence on Financial Constraints

Our model shows that lower investment by HINT firms could also be due to a greater need to preserve financial liquidity to fund future investment needs. HINT firms may need to pursue a precautionary cash retention policy because their intangible assets are not pledgeable, thus limiting the ability to raise external financing. We test this alternative explanation by first examining HINT firms' choices for paying out cash to shareholders. If these firms are preserving cash because they are financially constrained or expect to be in the near future, then they also should refrain from making substantial amounts of shareholder payouts.

Figure 6 tests this hypothesis by plotting share repurchases, dividends payments, and total payouts for the average HINT and LINT firm.[18] The figure uses a regression analysis to calculate mean payout values after controlling for *Log Assets*, in order to compare payouts at similarly sized HINT and LINT firms. The figure shows that HINT firms spend more cash on share repurchases in all sample years, and typically also make smaller dividend payments. Importantly, Panel C of the figure shows that total payouts are almost identical at HINT and LINT firms, which is inconsistent with HINT firms anticipating greater financially constraints.

Table 4 confirms these results after controlling for additional determinants of shareholder payouts. Columns (1) and (2) show that the relationship between intangibles usage and total payouts is statistically indistinguishable from 0. In other words, there is no evidence that firms which use more intangible assets also pay out less cash, as one would expect if these firms use cash holdings to buffer against financial constraints. Indeed, Column (3) indicates that HINT firms engage in *greater* payouts in years when their capital stock includes more intangible assets. The results also show that intangibles usage is associated with larger share repurchases and smaller dividend payments.

TABLE 4 ABOUT HERE

[18] This figure plots values for the average instead of median firm because fewer than half of our sample firms engage in shareholder payouts. Our baseline analysis includes firms that do not pay out cash, but Table 8 shows that we obtain the same results when restricting the sample to only firms that make payouts.

Next, we examine whether HINT firms historically have experienced cash shortfalls more frequently than LINT firms. Figure 7 plots the fraction of HINT and LINT firms that have insufficient investment coverage. We classify firms as having insufficient investment coverage when their cash holdings at the start of the year plus their annual cashflow are less than the average total investment from the past three years. In such cases, firms must either raise external financing or reduce their investment from previous years' levels. The figure shows that in all sample years, HINT firms are less likely to have experienced cash shortfalls. This suggests that historically, firms that use large amounts of intangible assets have had less need to raise external financing to fund investment.

On the other hand, HINT firms may face higher costs upon becoming financially distress. Precautionary savings certainly explain some of the times-series growth in cash holdings at HINT firms, yet HINT firms' payout policies suggest they are well able to manage their ability to pursue investment opportunities. We now consider whether the composition of their assets suggests additional causes for cash holdings.

4.3. Employee Equity Compensation

Our theory posits that a significant portion of intangible investment at HINT firms comes from highly skilled employees, and that their investment in human capital is support by unvested equity grants. Table 5 tests this prediction by examining the relationship between intangibles usage and three measures of equity compensation. In columns (1) through (3) the dependent variable is the fraction of total shares issued that firms hold in their corporate treasuries, and columns (4) through (6) examine the year-on-year change in treasury stock. As explained above, firms use treasury shares mostly to fund stock grants to employees, or to fulfill exercises of their stock option exercises. Some firms do not store stock in their treasuries, so these regressions are estimated only on the subsample of firms with positive *Treasury Shares* values.

Table 5 About Here

The results show that *Intangibles Ratio* is positively associated with the amount of shares

held in the treasury, and also with the annual change in treasury stock. The coefficient in Column (2), for example, indicates that a one-standard-deviation increase in *Intangibles Ratio* corresponds to 0.5% (=0.015×0.3) more shares held in the treasury. This is a 14% increase in the median value of *Treasury Shares* of 3.5% among firms that use their treasuries. Additionally, the regression models with firm fixed effects in columns (3) and (6) show that firms hold more treasury stock in years in which their intangibles usage is higher.

Next, columns (7) through (9) test whether firms that use large amounts of intangible assets grant more annual option compensation. The results show a positive relationship between *Intangibles Ratio* and *Option Compensation*. Column (8) indicates that a one-standard-deviation increase in *Intangibles Ratio* is associated with 0.27% (= 0.009×0.3) more of the firm's total market value being pledged to employees each year. This is equal to 90% of the median value of *Option Compensation* of 0.3%. Column (9) shows that this relationship is statistically insignificant when estimated using firm fixed effects. One explanation is that data on *Option Compensation* becomes available only in 1992, so the regressions omit much of the within-firm variation in *Intangibles Ratio*.

These results support our prediction that HINT firms use more inside equity to finance investment than traditional firms. Unvested equity promotes retention of highly skilled employees, but exposes them to idiosyncratic firm risk. Our model predicts that HINT firms insure employees against this risk by retaining cash, and that the amount of insurance is positively related to firms' share price volatility. Note that this is a related but distinct measure of risk than cashflow volatility.

We test this prediction in Table 6 by regressing firms' cash holdings on the *Intangibles Ratio* interacted with their idiosyncratic stock price volatility over the previous 48 months. A positive coefficient on this interaction term would indicate that HINT firms that expose employees to more risk also provide them with more insurance. An alternative interpretation is that stock volatility could be closely related to underlying cashflow risk. To account for this precautionary savings channel, we control for *Cashflow Volatility* interacted with the Hadlock and Pierce (2010) index of financial constraints (*Financially Constrained*).[19]. We further measure firms'

[19]This index is based on firm size and age, based on empirical findings that smaller and younger firms have more

investment opportunities using *Tobin's Q*.

TABLE 6 ABOUT HERE

The results in Column (1) show that firms with more volatile stocks hold less cash overall, but riskier HINT firms hold more cash. Cash holdings are also positively associated with the degree to which firms are financial constrained and with their cashflow volatility. Thus, there is evidence in support of both a retention and precautionary motive.

Next, columns (2) and (3) partition the sample based on the amount of equity that firms pledge to employees. Column (2) contains firms that hold stock in their corporate treasuries or that grant options to employees, while Column (3) contains firms that do neither. The coefficient on *Intangibles Ratio*×*Stock Volatility* is positive and significant only in Column (2). This indicates that HINT firms' cash holdings are related to share price volatility only when their employees are exposed to substantial idiosyncratic risk.

4.4. Composition of Payouts

Finally we examine how intangible investment affects firms' payout policy to shareholders. Our model predicts that HINT firms favor paying out cash via share repurchases that support the value of highly skilled employees' unvested equity grants, rather than dividends that reduce it. Table 4 has already shown that HINT firms engage in larger repurchases and smaller dividend payments than LINT firms. We test this prediction formally in Table 7, by examining the relationship between *Intangibles Ratio* and the fraction of total payouts made via stock repurchases.

TABLE 7 ABOUT HERE

The results show clear evidence that firms with more intangibles also pay out cash to shareholders primarily by repurchasing shares. Column (2) shows that a one-standard-deviation increase in *Intangibles Ratio* is associated with a 0.08 ($= 0.271 \times 0.3$) higher value of *Repurchases/Payouts*, which is equal to 19% of the variable's standard deviation of 0.42.

difficulty raising external financing.

4.5. Robustness Checks

We examine the general validity of our results by testing whether they are robust to the exclusion of different subsamples of firms. Table 8 re-estimates our main regressions on investment, total payouts, and employee equity compensation. The table presents coefficient estimates for *Intangibles Ratio*, but the regressions include all other control variables and industry and year fixed effects.

TABLE 8 ABOUT HERE

Column (1) excludes computer firms and Column (2) excludes firms that completed an IPO within the past 5 years tests, as such firms may be technological innovators. The table shows that our main results apply also to non-computer industries and mature firms. Column (3) shows that intangible assets are negatively associated with investment and positively associated with equity grants also among the largest firms in the economy, which are unlikely to be at high risk of becoming financially constrained. Column (4) further confirms these results among the subsample of firms that make positive payouts to external shareholders.

5. Conclusions

The paper has studied empirically the effect of evolving technology on funding and payout policy through the lens of a simple model of corporate investment.

To understand the implications of the increasing role of human capital for cash holdings and capital structure, we develop a simple investment model that distinguishes across firms in terms of their adoption of intangible investment. In our setup there are two key differences. Traditional firms rely on large-scale upfront investments, while intangible capital needs to be developed and innovated by creative employees contributing their human capital.

We show that innovating firms indeed tend to have more free cashflow, and are on average less likely to be financially constrained. Yet they appear to follow a precautionary policy of lower net leverage via higher cash holdings, presumably as such firms' opportunity cost of miss-

ing resources for investment opportunities is high. In contrast, intangible capital requires less spending on asset acquisition, as it is developed over time by human capital investment by key employees. This co-funding of investment by skilled labor is optimally rewarded by deferred equity compensation.

The significant share of firm value promised to unvested equity suggests a complementary explanation for rising cash holdings. The empirical evidence broadly supports the notion of a retention motive to limit dividend and retain cash, namely to provide adequate reward and efficient hedging to risk averse human capital committed to the intangible investment process of the firm.

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Appendix A Proofs and Extensions of Model

A.1 Proof of proposition 1

This appendix proves the result of proposition 1, that optimal period-1 cash holdings increase in the firm's technological reliance on intangibles, i.e. that $\frac{dC_1^*}{d\eta} \geq 0$. To prove the proposition, we first derive the following intermediate result:

Lemma 2. *Consider two pairs (ω', C_1') and (ω'', C_1'') that are the firm's optimal choice given two different parameter values $\eta' \neq \eta''$. If $\omega'' > \omega'$ then it must also be that $C_1'' \geq C_1'$.*

Proof. Suppose the contrary. We will show that this is inconsistent with the firm's optimization. To see this, use (4) to write the firm's first order condition (5) as

$$[\mathbb{E}R + (1-\chi)C_1]\frac{S'(C_1)}{S(C_1)} = \frac{(1-\omega)(1-\chi)-1}{\omega}$$

Since (ω', C_1') and (ω'', C_1'') are both optimal choices, the first order condition must be satisfied for each pair.

Clearly, the RHS increases in ω. Similarly, the LHS can be written as

$$-(1-\chi)\frac{\int(R+(1-\chi)C_1)dF(R)\int(R+(1-\chi)C_1)^{-\gamma}dF(R)}{\int(R+(1-\chi)C_1)^{1-\gamma}dF(R)},$$

which increases in C_1 for $\gamma \geq 0$. However, this implies that if $\omega'' > \omega'$ and $C_1'' < C_1'$, (5) cannot be satisfied for both (ω', C_1') and (ω'', C_1''), thus contradicting that both can be optimal choices by the firm. □

Next, observe that a higher η increases the bargaining power of the employee. If $\eta'' > \eta'$, the incentive compatibility constraint (IC) requires that $\omega'' > \omega'$, or $C_1'' > C_1'$, or both. The only way an increase in η can possibly increase cash holdings is therefore if $\omega'' > \omega'$ and $C_1'' < C_1'$. However, this is ruled out by the result in lemma 2, completing the proof of proposition 1. □

A.2 Deferred cash compensation

This appendix shows that when the employee is compensated with a deferred cash payment instead of unvested equity, the firm still optimally retains cash to reduce retention costs. Suppose that at $t = 0$, the firm grants the employee a cash payment w that vests after returns are realized at $t = 2$. The crucial insight is that if the firm does not retain enough cash, it may default on the promised compensation.[20] In particular, the firm's effective payment to the employee is

$$\min\{RI + (1-\chi)C_1, w\}.$$

The cash grant is therefore riskless if and only if $C_1 \geq \frac{w}{(1-\chi)}$. Essentially, deferred cash compensation has a debt-like payout structure, and cash holdings shrink the default region.

Now, denote by

$$\hat{R}(C_1) = \frac{w - (1-\chi)C_1}{I}$$

the threshold such that for realizations of $R < \hat{R}(C_1)$ the firm defaults on the employee's compensation. The incentive compatibility constraint to prevent the employee from leaving can be re-expressed as

$$\Pr[R \geq \hat{R}(C_1)]U(w) + \int_0^{\hat{R}(C_1)} U([RI + (1-\chi)C_1])dF(R) \geq \int U((1-\alpha)\eta RI)dF(R). \quad \text{(IC')}$$

The first term on the left hand side is the employee's utility from the deferred cash-payment, and the second term is the expected utility upon default. As in the model with unvested equity, this must exceed the expected utility from starting an own firm.

The firm's problem is now to choose a level of period-1 cash holdings C_1 and deferred cash

[20] Recall that the support of $\tilde{R}$ is $[0, \bar{R}]$

payment w to maximize

$$\begin{aligned} \max_{C_1,w} \quad & V(w,C_1) = \Pr[R \geq \hat{R}(C_1)][\mathbb{E}\tilde{R} + (1-\chi)C_1 - w] - (\alpha H + K + \lambda C^p + C_1) \\ s.t. \quad & (IC) \\ & C_1, w \geq 0 \end{aligned}$$

Clearly, the firm's objective function is decreasing in w, so that it chooses the minimum level consistent with (IC'), implicitly defining $w(C_1)$. Condition (IC') shows that the employee's utility from staying inside the firm (the left-hand-side of the condition) is increasing in both w and C_1. This implies that $w'(C_1) \leq 0$, i.e. holding cash reduces the size of the deferred cash grant necessary to retain the employee.

There are now two cases to consider. First, the firm may choose to fully insure the worker by setting $w = \underline{w}$ and $C_1 = \frac{\underline{w}}{(1-\chi)}$, where

$$\underline{w} = \eta(1-\alpha)\left[\int (R)^{1-\gamma} dF(R)\right]^{\frac{1}{1-\gamma}}.$$

Note that the firm will never hold more cash than $\frac{w}{(1-\chi)}$, since the employee is already fully insured and additional cash holdings have a moral hazard cost χ. Second, the firm may choose an interior solution $C_1^* \in \left[0, \frac{\underline{w}}{(1-\chi)}\right)$ and $w^* > \underline{w}$ that maximizes $V(w, C_1)$.

Importantly, under deferred cash compensation the same motive to hold cash prevails. Since the firm is risk-neutral, it may choose to hold some cash to insure the risk-averse employee against defaulting on the promised payment, decreasing the overall cost of employee retention.

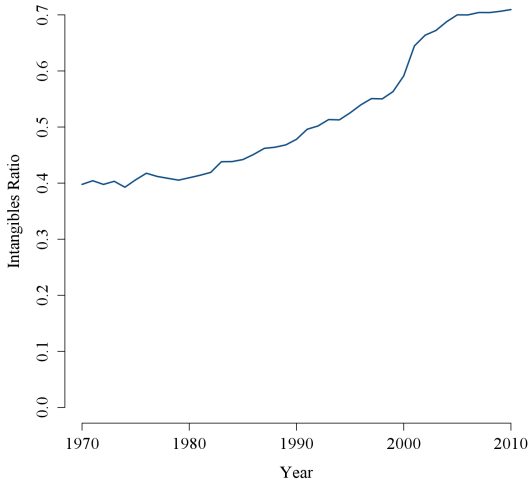
Appendix B Variable Definitions

Variable	Definition
Intangibles Ratio	The value of the firm's stock of intangible assets, divided by total assets. Throughout this appendix, total assets is defined as the sum of intangible assets and PP&E (data item PPENT). The stock of intangible assets is measured based on Peters and Taylor (2016). Two differences are that we count 20% of SG&A as investment into organizational capital, and we count Other Intangible Assets (INTANO) but not Goodwill as part of the intangible capital stock.
Cash	The sum of cash and marketable securities (data item CHE), divided by total assets. This variable is winsorized at the 1-99 level.
Net Leverage	Total debt (the sum of data items DLTT and DLC) minus cash and marketable securities (CHE), divided by total assets. This variable is winsorized at the 1-99 level.
Tangible Investment	The annual change in PP&E (data item PPENT) net of depreciation (DPACT), divided by *Cashflow*. This variable is winsorized at the 1-99 level.
Total Investment	The sum of *Tangible Investment* and the firm's annual investment into intangible assets, divided by *Cashflow*. Intangible investment is measured as the sum of R&D spending, 0.2×SG&A expenditures, and acquisition of externally produced intangibles. This variable is winsorized at the 1-99 level.
Total Payouts	The sum of *Repurchases* and *Dividends*.
Repurchases	Stock repurchases divided by total assets. Repurchases equals the year-on-year change in the number of shares in the corporate treasury (TSTKC). For firms with zero or missing values of treasury shares in the past two years, repurchases equals open-market purchases of common stock (PRSTKC) minus sales of common stock (SSTK). This variable is winsorized at the 1-99 level.
Dividends	Common dividends (data item DVC) divided by total assets. This variable is winsorized at the 1-99 level.
Treasury Shares	The amount of shares in the corporate treasury (data item TSTKN) divided by total shares issued (CSHI). This variable is winsorized at the 1-99 level.
Shares Retained	The year-on-year change in the value of shares in the corporate treasury (data item TSTKC) divided by total assets. This variable is winsorized at the 1-99 level.
Option Compensation	The Black-Scholes value of stock options granted to all employees excluding the 5 highest-paid executives, divided by market capitalization. Before 2005, we follow the method developed by Bergman and Jenter (2007). First, we calculate the number of implied options by dividing the number of securities granted to each top executive (ExecuComp data item NUMSECUR) by that grant's percentage of total options awarded (PCTTOTOP). Second, we average the number of implied options across all executives, excluding firm-years in which the standard deviation of the number of implied options across executives is higher than 0.1. Third, we calculate the total value of implied options by multiplying the number of implied options by the Black Scholes value of executive option grants (BLKSHVAL divided by NUMSECUR) averaged across all executives. Fourth, we subtract the value of executives' options from the total value of implied options. Starting in 2005, we calculate the total value of options as the number of options granted to all employees (Compustat data item OPTGR) multiplied by the Black Scholes value of total option grants (OPTFVGR). We subtract the value of executives' option grants (ExecuComp data item OPTION_AWARDS_FV) summed across all executives. Market capitalization is the firm's end-of-year stock price (Compustat data item PRCC_F) multiplied by common shares outstanding (CSHO). This variable is winsorized at the 1-99 level.
Repurchases/Payouts	*Repurchases* divided by *Total Payouts*.
Log Assets	The natural logarithm of total assets. This variable is winsorized at the 1-99 level.
Tobin's Q	Total debt (the sum of data items DLTT and DLC) plus the market value of equity (PRCC_F×CSHO) minus current assets (ACT), all divided by total assets. This variable is winsorized at the 1-99 level.
Cashflow	Operating earnings (data item OIDBP) plus intangible investment minus tax payments (TXT) and interest payments (XINT), all divided by total assets. This variable is winsorized at the 1-99 level.
Stock Return	The end-of-year stock price (data item PRCC_F) plus common dividends paid during the year (DVPSX), divided by the stock price from the end of the previous year, minus 1. All stock prices and dividends are scaled by that year's stock adjustment factor (ADJEX). This variable is winsorized at the 5-95 level.
Cashflow Volatility	The standard deviation of *Cashflow* over the previous 10 years, averaged across the firm's 2-digit SIC code industry. Prior to averaging, cashflow volatility is set to missing for firms with fewer than 3 years of data. This variable is winsorized at the 1-99 level.
Stock Volatility	The standard deviation of the firm's stock returns from the 48 months prior to the start of the year. This variable is winsorized at the 5-95 level.
Financially Constrained	An index of financial constraints, based on Hadlock and Pierce (2010).

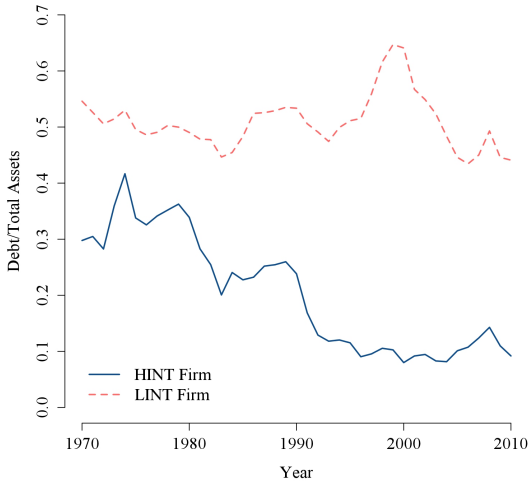
Figure 1: Intangibles Usage and Corporate Financing

HINT firms have an *Intangibles Ratio* in the highest tercile of the sample distribution, and LINT have an *Intangibles Ratio* in the lowest tercile. *Intangibles Ratio* is the firm's stock of intangible assets divided by total assets, measured as the sum of intangible assets and PP&E. All panels plot values for the median firm. Cash holdings include marketable securities.

Panel A. Intangibles Usage



Panel B. Book Leverage



Panel C. Cash Holdings

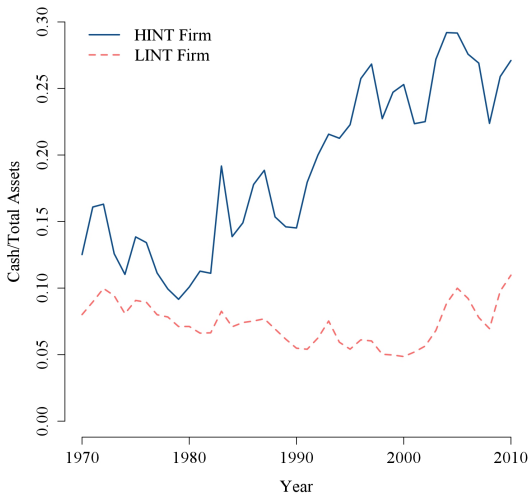


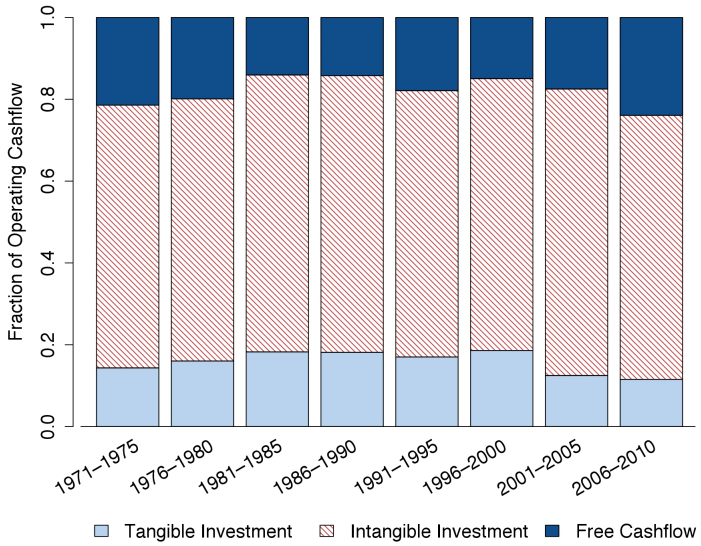
Figure 2: Intangibles Usage and Corporate Investment Rates

The figure plots investment at the median HINT firm minus investment at the median LINT firm. Tangible investment is the annual change in PP&E (net of depreciation), and total investment is tangible plus annual investment into intangible assets. Intangible investment is measured as the sum of R&D spending, 0.2×SG&A expenditures, and acquisition of externally produced intangibles. Both tangible and total investment are scaled by operating cashflows, measured as earnings prior to depreciation and investment, minus taxes and interest payments. HINT firms have an *Intangibles Ratio* in the highest tercile of the sample distribution, and LINT have an *Intangibles Ratio* in the lowest tercile. *Intangibles Ratio* is the firm's stock of intangible assets divided by total assets, measured as the sum of intangible assets and PP&E..

Figure 3: Cashflow Usage at HINT vs. LINT Firms

Operating cashflows are earnings prior to depreciation and investment, minus taxes and interest payments. Tangible investment is the annual change in PP&E (net of depreciation). Intangible investment is measured as the sum of R&D spending, 0.2×SG&A expenditures, and acquisition of externally produced intangibles. Free Cashflow is the remainder of operating cashflows. HINT firms have an *Intangibles Ratio* in the highest tercile of the sample distribution, and LINT have an *Intangibles Ratio* in the lowest tercile. *Intangibles Ratio* is the firm's stock of intangible assets divided by total assets, measured as the sum of intangible assets and PP&E. Both panels plot values for the median HINT or LINT firm.

Panel A. HINT Firms



Panel B. LINT Firms

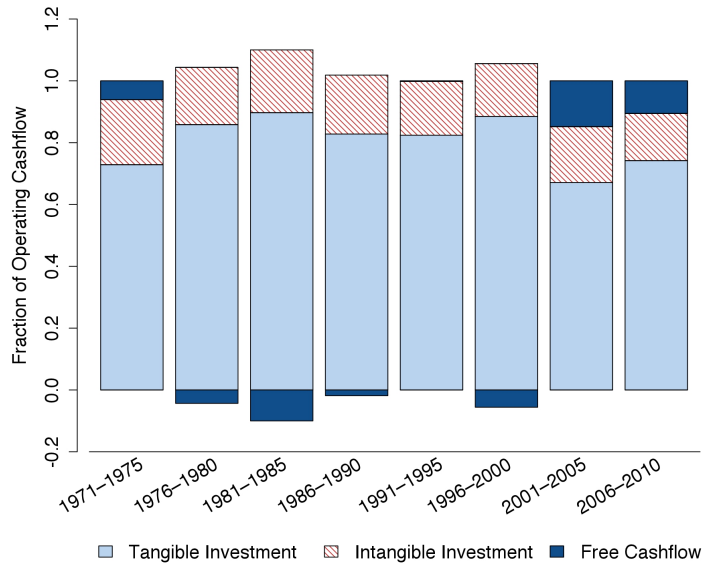


Figure 4: Timeline of actions

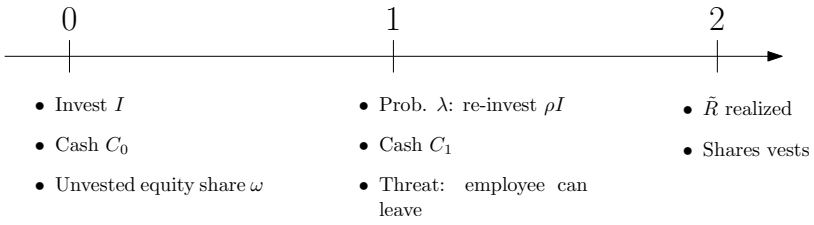
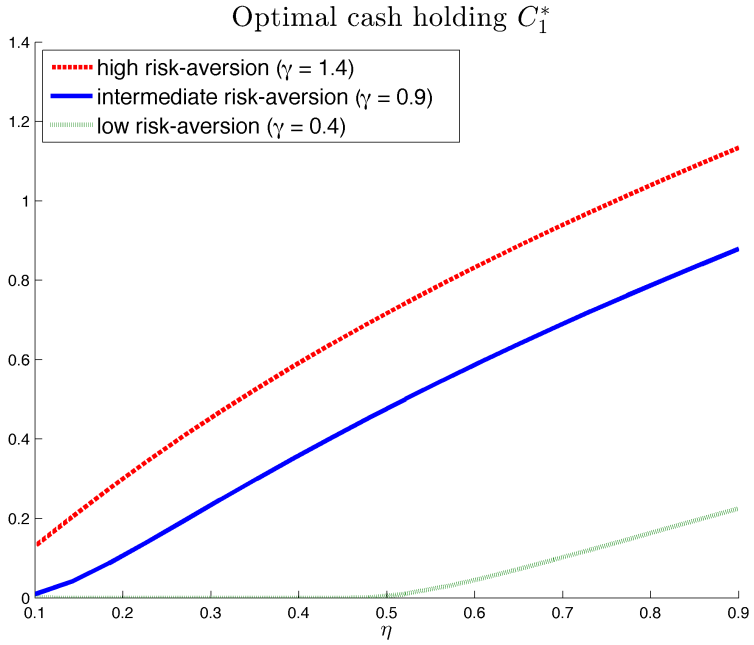


Figure 5: Optimal cash retention (top panel) and equity grant ω^* (lower panel) in terms of firm technology

This figure plots optimal time-1 cash holdings C_1^* and equity grant ω^* as a function of η, for employee risk-aversion $\gamma = (1.4, 0.9, 0.4)$. Here $\chi = 0.1$, $I = 1$, $\alpha = 0.3$, and $\tilde{R} \sim U(0, 5)$.



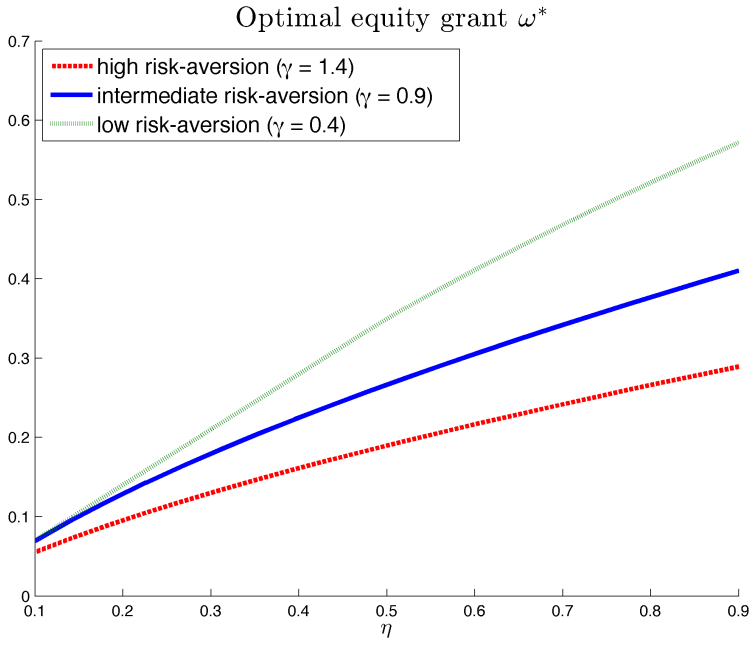
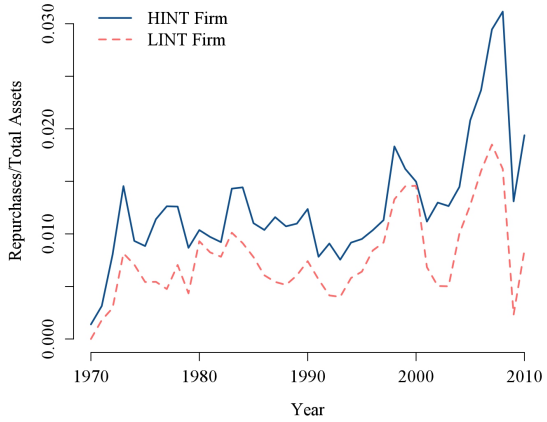


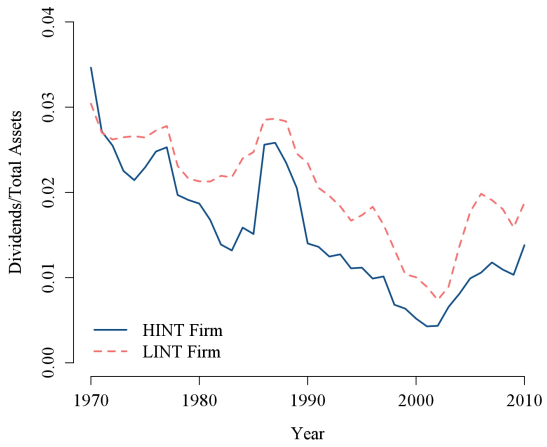
Figure 6: Financial Constraints at HINT Firms: Evidence from Shareholder Payouts

Panel A excludes those repurchases in which shares are immediately used to fulfill employee option exercises. In Panel C, total payouts is the sum of share repurchases and common dividends. HINT firms have an *Intangibles Ratio* in the highest tercile of the sample distribution, and LINT have an *Intangibles Ratio* in the lowest tercile. *Intangibles Ratio* is the firm's stock of intangible assets divided by total assets, measured as the sum of intangible assets and PP&E. All panels plot values for the average HINT or LINT firm after adjusting for differences in firm size.

Panel A. Share Repurchases



Panel B. Common Dividends



Panel C. Total Payouts

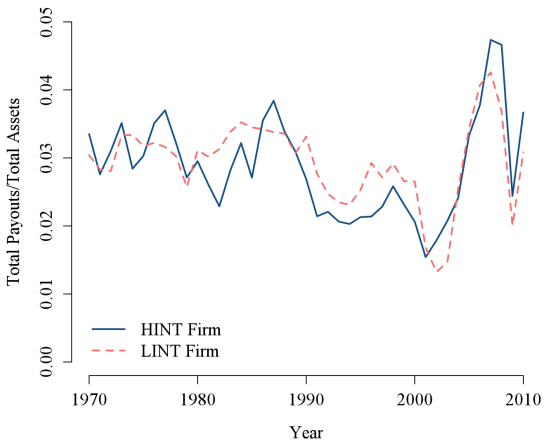


Figure 7: Financial Constraints at HINT Firms: Evidence from Investment Coverage

Plots show the fraction of HINT and LINT firms whose annual operating cashflow and cash holdings at the start of the year are less than average total investment from the past three years. Operating cashflows are earnings prior to depreciation and investment, minus taxes and interest payments. Cash holdings include marketable securities. Total investment is the sum of tangible investment (measured as the annual change in PP&E net of depreciation) and intangible investment (measured as the sum of R&D spending, 0.2×SG&A expenditures, and acquisition of externally produced intangibles). HINT firms have an *Intangibles Ratio* in the highest tercile of the sample distribution, and LINT have an *Intangibles Ratio* in the lowest tercile. *Intangibles Ratio* is the firm's stock of intangible assets divided by total assets, measured as the sum of intangible assets and PP&E.

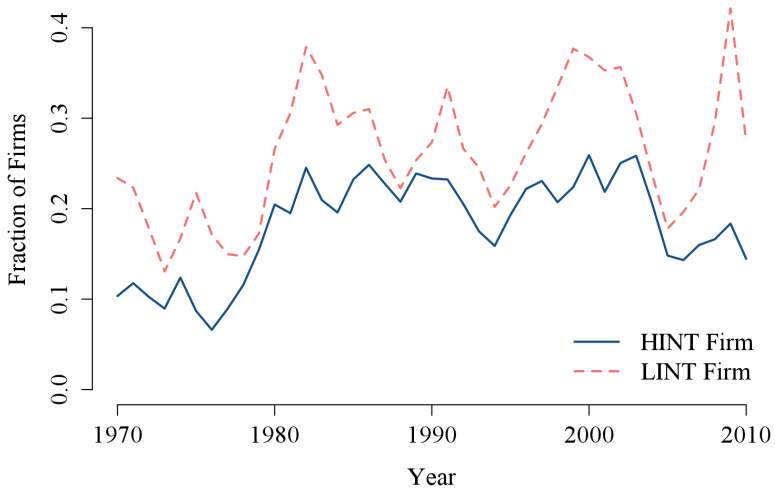


Table 1: Growth of Intangibles Usage across Industries

The table presents the median *Intangibles Ratio* for each industry. *Intangibles Ratio* is the firm's stock of intangible assets divided by total assets, measured as the sum of intangible assets and PP&E. Industries are based on the Fama-French 48-industry classification. The sample contains 12,242 U.S. non-financial and utilities firms and covers the years 1970 through 2010. Firms with less than 5 years of data, non-positive sales, or total assets below $5 million are excluded.

	Industry	*Intangibles Ratio* in 1970	*Intangibles Ratio* in 2010	Change from 1970 to 2010
	Construction	0.151	0.808	0.657
	Healthcare	0.091	0.637	0.546
	Business Services	0.382	0.882	0.500
	Communication	0.153	0.556	0.403
	Candy & Soda	0.359	0.731	0.372
	Computers	0.549	0.897	0.349
	Pharmaceutical Products	0.628	0.962	0.333
	Personal Services	0.206	0.539	0.333
	Medical Equipment	0.542	0.859	0.317
Top 10	Apparel	0.491	0.808	0.317
	Fabricated Products	0.330	0.645	0.315
	Recreation	0.584	0.886	0.302
	Measuring & Control Equipment	0.548	0.836	0.288
	Textiles	0.223	0.500	0.277
	Electronic Equipment	0.548	0.824	0.276
	Tobacco Products	0.568	0.820	0.252
	Wholesale	0.538	0.780	0.242
	Business Supplies	0.241	0.453	0.212
	Consumer Goods	0.565	0.759	0.194
	Electrical Equipment	0.547	0.735	0.188
	Automobiles & Trucks	0.378	0.565	0.187
	Construction Materials	0.315	0.499	0.183
	Machinery	0.498	0.676	0.178
	Aircraft	0.456	0.619	0.164
	Food Products	0.398	0.533	0.135
	Printing & Publishing	0.615	0.748	0.133
	Rubber & Plastic Products	0.406	0.532	0.126
	Beer & Liquor	0.490	0.609	0.119
	Restaurants, Hotels, & Motels	0.084	0.203	0.119
	Defense	0.416	0.533	0.116
	Retail	0.571	0.654	0.083
	Steel Works	0.187	0.257	0.071
Bottom 10	Shipping Containers	0.212	0.261	0.049
	Entertainment	0.200	0.239	0.039
	Chemicals	0.422	0.451	0.029
	Transportation	0.071	0.087	0.015
	Shipbuilding & Railroad Equipment	0.220	0.203	-0.017
	Coal	0.058	0.035	-0.023
	Non-Metallic & Industrial Metal Mining	0.095	0.067	-0.029
	Petroleum & Natural Gas	0.086	0.045	-0.041
	Agriculture	0.320	0.271	-0.050
	Precious Metals	0.356	0.037	-0.319
	Entire Sample	0.398	0.711	0.314

Table 2: Summary Statistics for High- and Low-Intangibles Firms

HINT firms have an *Intangibles Ratio* in the highest tercile of the sample distribution, and LINT have an *Intangibles Ratio* in the lowest tercile. *Intangibles Ratio* is the firm's stock of intangible assets, divided by total assets which are measured as the sum of intangible assets and PP&E. *Cash* is the sum of cash and marketable securities, divided by total assets. *Net Leverage* is total debt minus cash and marketable securities, divided by total assets. *Tangible Investment* is the annual change in PP&E (net of depreciation), divided by *Cashflow*. *Total Investment* is *Tangible Investment* plus annual investment into intangible assets, divided by *Cashflow*. Intangible investment is measured as the sum of R&D spending, 0.2×SG&A expenditures, and acquisition of externally produced intangibles. *Total Payouts* is the sum of *Repurchases* and *Dividends*. *Repurchases* is the annual value of stock repurchases, divided by total assets. It excludes repurchases in which shares are immediately used to fulfill employee option exercises. *Dividends* is the annual value of common dividend payouts, divided by total assets. *Treasury Shares* is the amount of shares in the corporate treasury divided by total shares issued. *Shares Retained* is the year-on-year change in the value of shares in the corporate treasury divided by total assets. *Option Compensation* is the Black-Scholes value of stock options granted to all employees excluding the 5 highest-paid executives, divided by market capitalization. *Repurchases/Payouts* is stock repurchases divided by the sum of stock repurchases and common dividends. It excludes repurchases in which shares are immediately used to fulfill employee option exercises. *Tobin's Q* is total debt plus the market value of equity minus current assets, all divided by total assets. *Cashflow* is earnings prior to depreciation and investment minus taxes and interest payments, all divided by total assets. *Book Leverage* is total debt, divided by total assets minus cash and marketable securities. *Stock Return* is the annual stock return. *Cashflow Volatility* is the standard deviation of *Cashflow* over the previous 10 years, averaged across the firm's 2-digit SIC code industry. The sample contains 12,242 U.S. non-financial and utilities firms and covers the years 1970 through 2010. Firms with less than 5 years of data, non-positive sales, or total assets below $5 million are excluded. Standard errors are clustered by firm and year. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	HINT Firm				LINT Firm				
	Mean	Median	St. Dev	No. Obs	Mean	Median	St. Dev	No. Obs	Diff.
Intangibles Ratio	0.815	0.813	0.103	55,175	0.131	0.115	0.103	51,953	0.684***
Cash	0.449	0.210	0.650	55,169	0.230	0.072	0.513	51,934	0.219***
Net Leverage	-0.034	-0.033	0.958	54,960	0.464	0.412	0.808	51,794	-0.498***
Tangible Investment	0.238	0.151	0.790	41,236	1.255	0.785	1.746	43,915	-1.017***
Total Investment	1.331	0.821	2.135	41,236	1.612	0.995	2.348	43,915	-0.282***
Total Payouts	0.029	0.000	0.080	55,067	0.033	0.005	0.073	51,807	-0.004**
Repurchases	0.014	0.000	0.048	55,175	0.009	0.000	0.036	51,953	0.005***
Dividends	0.012	0.000	0.037	55,067	0.022	0.000	0.044	51,807	-0.010***
Treasury Shares	0.035	0.000	0.078	54,542	0.033	0.000	0.072	49,861	0.002
Shares Retained	0.010	0.000	0.045	46,408	0.007	0.000	0.036	34,124	0.003***
Option Compensation	0.012	0.006	0.018	9,201	0.005	0.002	0.010	6,761	0.007***
Repurchases/Payouts	0.496	0.481	0.463	19,587	0.244	0.000	0.392	29,277	0.252***
Tobin's Q	2.075	0.836	3.786	51,806	1.737	1.012	2.771	42,858	0.338***
Assets	345	39	1,357	55,175	825	93	2,215	51,953	-480***
Cashflow	0.264	0.281	0.300	49,059	0.182	0.173	0.214	49,212	0.083***
Book Leverage	0.451	0.175	1.166	54,960	0.734	0.546	1.180	51,794	-0.282***
Stock Return	0.104	0.000	0.580	49,261	0.122	0.053	0.503	42,299	-0.018
Cashflow Volatility	0.173	0.147	0.110	55,165	0.145	0.101	0.154	51,934	0.028***

Table 3: Intangibles Usage and Investment

Tangible Investment is the annual change in PP&E (net of depreciation), divided by *Cashflow*. *Total Investment* is *Tangible Investment* plus annual investment into intangible assets, divided by *Cashflow*. Intangible investment is measured as the sum of R&D spending, 0.2×SG&A expenditures, and acquisition of externally produced intangibles. *Intangibles Ratio* is the firm's stock of intangible assets, divided by total assets which are measured as the sum of intangible assets and PP&E. *Tobin's Q* is total debt plus the market value of equity minus current assets, all divided by total assets. *Log Assets* is the natural logarithm of total assets. *Cashflow* earnings prior to depreciation and investment minus taxes and interest payments, all divided by total assets. *Book Leverage* is total debt, divided by total assets minus cash and marketable securities. *Stock Return* is the annual stock return. *Cashflow Volatility* is the standard deviation of *Cashflow* over the previous 10 years, averaged across the firm's 2-digit SIC code industry. The sample contains 12,242 U.S. non-financial and utilities firms and covers the years 1970 through 2010. Firms with less than 5 years of data, non-positive sales, or total assets below $5 million are excluded. All control variables are lagged one year, except *Intangibles Ratio*. Industry fixed effects are based on the Fama-French 48 industry classification. In parentheses we report t-statistics based on standard errors that are clustered at the firm level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Tangible Investment*			*Total Investment*		
Intangibles Ratio	-1.482***	-1.439***	-2.728***	-0.238***	-0.210***	-1.941***
	(-57.55)	(-55.87)	(-39.99)	(-5.88)	(-5.15)	(-20.47)
Log Assets	-0.068***	-0.064***	-0.245***	-0.131***	-0.125***	-0.262***
	(-23.28)	(-21.93)	(-19.88)	(-29.11)	(-27.67)	(-15.12)
Tobin's Q	0.031***	0.025***	0.001	0.062***	0.061***	0.016***
	(14.07)	(10.96)	(0.24)	(17.23)	(16.00)	(3.36)
Cashflow	-0.797***	-0.795***	-0.285***	-2.583***	-2.544***	-1.293***
	(-25.55)	(-24.79)	(-7.32)	(-42.91)	(-41.02)	(-17.75)
Book Leverage		0.005	-0.008		0.021**	0.010
		(1.09)	(-1.40)		(2.55)	(0.99)
Stock Return		0.110***	0.076***		-0.009	-0.023
		(12.51)	(8.27)		(-0.64)	(-1.54)
Cashflow Volatility		-0.112*	-0.309***		-0.074	-0.302***
		(-1.69)	(-4.03)		(-0.80)	(-2.81)
Industry Fixed Effects	Yes	Yes	No	Yes	Yes	No
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	No	No	Yes	No	No	Yes
Observations	109,395	104,974	104,974	109,395	104,974	104,974
Adjusted R^2	0.176	0.174	0.075	0.097	0.094	0.029

Table 4: Intangibles Usage and Shareholder Payouts

Total Payouts is the sum of *Repurchases* and *Dividends*. *Repurchases* is the annual value of stock repurchases, divided by total assets which are measured as the sum of intangible assets and PP&E. It excludes repurchases in which shares are immediately used to fulfill employee option exercises. *Dividends* is the annual value of common dividend payouts, divided by total assets. *Intangibles Ratio* is the firm's stock of intangible assets, divided by total assets. *Tobin's Q* is total debt plus the market value of equity minus current assets, all divided by total assets. *Log Assets* is the natural logarithm of total assets. *Cashflow* earnings prior to depreciation and investment minus taxes and interest payments, all divided by total assets. *Book Leverage* is total debt, divided by total assets minus cash and marketable securities. *Stock Return* is the annual stock return. *Cashflow Volatility* is the standard deviation of *Cashflow* over the previous 10 years, averaged across the firm's 2-digit SIC code industry. The sample contains 12,242 U.S. non-financial and utilities firms and covers the years 1970 through 2010. Firms with less than 5 years of data, non-positive sales, or total assets below $5 million are excluded. All control variables are lagged one year, except *Intangibles Ratio*. Industry fixed effects are based on the Fama-French 48 industry classification. In parentheses we report t-statistics based on standard errors that are clustered at the firm level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Total Payouts*			*Repurchases*			*Dividends*		
Intangibles Ratio	-0.002	-0.003	0.022***	0.005***	0.005***	0.013***	-0.007***	-0.009***	0.003
	(-0.65)	(-1.13)	(5.62)	(4.28)	(3.87)	(6.08)	(-3.76)	(-4.25)	(1.49)
Log Assets	0.004***	0.004***	0.003***	0.002***	0.002***	0.003***	0.002***	0.002***	-0.000
	(12.74)	(11.88)	(3.44)	(13.39)	(12.84)	(6.39)	(10.82)	(9.87)	(-0.31)
Tobin's Q	0.003***	0.004***	0.002***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(10.52)	(11.69)	(7.82)	(9.20)	(10.54)	(4.85)	(6.78)	(7.37)	(6.61)
Cashflow	0.066***	0.071***	0.044***	0.026***	0.028***	0.018***	0.032***	0.034***	0.021***
	(25.86)	(25.73)	(18.38)	(23.03)	(22.91)	(14.14)	(21.12)	(20.56)	(16.81)
Book Leverage		-0.004***	-0.002***		-0.001***	-0.001***		-0.003***	-0.001***
		(-9.15)	(-5.52)		(-3.43)	(-4.00)		(-12.10)	(-6.33)
Stock Return		-0.007***	-0.003***		-0.003***	-0.002***		-0.002***	-0.001***
		(-9.90)	(-6.62)		(-8.73)	(-5.36)		(-6.31)	(-4.04)
Cashflow Volatility		0.008*	-0.000		-0.001	-0.001		0.008***	0.001
		(1.74)	(-0.10)		(-0.55)	(-0.34)		(2.69)	(0.23)
Industry Fixed Effects	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	123,607	118,340	118,340	123,775	118,504	118,504	123,607	118,340	118,340
Adjusted R^2	0.117	0.130	0.041	0.063	0.069	0.036	0.154	0.167	0.045

Table 5: Intangibles Usage and Employee Equity Compensation

Treasury Shares is the amount of shares in the corporate treasury, divided by total shares issued. *Shares Retained* is the year-on-year change in the value of shares in the corporate treasury, divided by total assets which are measured as the sum of intangible assets and PP&E. These variables are measured only for firms that retain shares in their treasury. *Option Compensation* is the Black-Scholes value of stock options granted to all employees excluding the 5 highest-paid executives, divided by market capitalization. *Intangibles Ratio* is the firm's stock of intangible assets, divided by total assets. *Tobin's Q* is total debt plus the market value of equity minus current assets, all divided by total assets. *Log Assets* is the natural logarithm of total assets. *Cashflow* earnings prior to depreciation and investment minus taxes and interest payments, all divided by total assets. *Book Leverage* is total debt divided by total assets minus cash and marketable securities. *Stock Return* is the annual stock return. *Cashflow Volatility* is the standard deviation of *Cashflow* over the previous 10 years, averaged across the firm's 2-digit SIC code industry. The sample contains 12,242 U.S. non-financial and utilities firms and covers the years 1970 through 2010. Firms with less than 5 years of data, non-positive sales, or total assets below $5 million are excluded. All control variables are lagged one year, except *Intangibles Ratio*. Industry fixed effects are based on the Fama-French 48 industry classification. In parentheses we report t-statistics based on standard errors that are clustered at the firm level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Treasury Shares*			*Shares Retained*			*Option Compensation*		
Intangibles Ratio	0.014**	0.015***	0.027***	0.007***	0.006**	0.012**	0.009***	0.009***	0.002
	(2.56)	(2.70)	(3.14)	(2.86)	(2.48)	(2.29)	(10.70)	(10.69)	(1.27)
Log Assets	0.001**	0.001**	-0.007***	0.001***	0.001***	0.000	-0.001***	-0.001***	0.001**
	(2.04)	(2.10)	(-3.63)	(4.34)	(4.25)	(0.37)	(-9.00)	(-9.08)	(2.29)
Tobin's Q	-0.003***	-0.003***	-0.003***	0.004***	0.005***	0.003***	0.000***	0.000***	0.001***
	(-9.34)	(-9.01)	(-8.04)	(13.52)	(13.06)	(8.94)	(6.40)	(6.71)	(6.85)
Cashflow	0.023***	0.023***	-0.008**	0.042***	0.043***	0.032***	-0.010***	-0.010***	-0.002*
	(5.64)	(5.45)	(-2.09)	(16.72)	(16.06)	(10.04)	(-9.45)	(-9.38)	(-1.91)
Book Leverage		-0.000	-0.000		-0.002***	-0.002***		-0.000	-0.000
		(-0.25)	(-0.14)		(-4.29)	(-3.78)		(-0.29)	(-0.56)
Stock Return		0.004***	0.002***		-0.005***	-0.003***		-0.001***	-0.001***
		(4.40)	(2.68)		(-6.67)	(-4.76)		(-5.22)	(-4.56)
Cashflow Volatility		-0.024**	-0.002		0.000	0.002		0.004***	0.003*
		(-2.32)	(-0.22)		(0.01)	(0.35)		(2.98)	(1.76)
Industry Fixed Effects	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	61,791	60,265	60,265	43,226	42,125	42,125	20,831	20,347	20,347
Adjusted R^2	0.079	0.082	0.165	0.115	0.120	0.049	0.199	0.199	0.086

Table 6: Intangibles Usage, Stock Volatility, and Cash Holdings

Cash is the sum of cash and marketable securities, divided by total assets. High Pledged Equity firms are those with positive values for either *Treasury Shares* or *Option Compensation*, and Low Pledged Equity firms are those with 0 values for both variables. *Treasury Shares* is the amount of shares in the corporate treasury, divided by total shares issued. *Option Compensation* is the Black-Scholes value of stock options granted to all employees excluding the 5 highest-paid executives, divided by market capitalization. *Intangibles Ratio* is the firm's stock of intangible assets, divided by total assets. *Stock Volatility* is the standard deviation of the firm's stock returns from the 48 months prior to the start of the year. *Financially Constrained* is an index of financial constraints based on Hadlock and Pierce (2010). *Cashflow Volatility* is the standard deviation of *Cashflow* over the previous 10 years, averaged across the firm's 2-digit SIC code industry. *Cashflow* earnings prior to depreciation and investment minus taxes and interest payments, all divided by total assets. *Tobin's Q* is total debt plus the market value of equity minus current assets, all divided by total assets. The sample contains 12,242 U.S. non-financial and utilities firms and covers the years 1970 through 2010. Firms with less than 5 years of data, non-positive sales, or total assets below $5 million are excluded. All control variables are lagged one year, except *Intangibles Ratio*. Industry fixed effects are based on the Fama-French 48 industry classification. In parentheses we report t-statistics based on standard errors that are clustered at the firm level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Cash*		
	All Firms	High Pledged Equity	Low Pledged Equity
Intangibles Ratio	0.136***	0.046	0.265***
	(3.16)	(0.80)	(5.49)
Stock Volatility	-0.841***	-0.881***	-0.559***
	(-6.69)	(-4.86)	(-4.29)
Intangibles Ratio×*Stock Volatility*	0.384**	0.853***	-0.119
	(2.18)	(3.44)	(-0.60)
Financially Constrained	0.090***	0.086***	0.088***
	(12.01)	(9.01)	(9.05)
Cashflow Volatility	0.264**	0.411***	0.070
	(2.57)	(2.95)	(0.52)
Financially Constrained×*Cashflow Volatility*	0.093***	0.137***	0.038
	(2.71)	(3.14)	(0.81)
Tobin's Q	0.055***	0.056***	0.055***
	(21.79)	(15.54)	(23.46)
Industry Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	109,649	64,952	53,005
Adjusted R^2	0.209	0.220	0.222

Table 7: Intangibles Usage and Composition of Shareholder Payouts

Repurchases/Payouts is stock repurchases divided by the sum of stock repurchases and common dividends. It excludes repurchases in which shares are immediately used to fulfill employee option exercises. *Intangibles Ratio* is the firm's stock of intangible assets, divided by total assets which is measured as the sum of intangible assets and PP&E. *Tobin's Q* is total debt plus the market value of equity minus current assets, all divided by total assets. *Log Assets* is the natural logarithm of total assets. *Cashflow* earnings prior to depreciation and investment minus taxes and interest payments, all divided by total assets. *Book Leverage* is total debt divided by total assets minus cash and marketable securities. *Stock Return* is the annual stock return. *Cashflow Volatility* is the standard deviation of *Cashflow* over the previous 10 years, averaged across the firm's 2-digit SIC code industry. The sample contains 12,242 U.S. non-financial and utilities firms and covers the years 1970 through 2010. Firms with less than 5 years of data, non-positive sales, or total assets below $5 million are excluded. All control variables are lagged one year, except *Intangibles Ratio*. Industry fixed effects are based on the Fama-French 48 industry classification. In parentheses we report t-statistics based on standard errors that are clustered at the firm level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Repurchases/Payouts*		
Intangibles Ratio	0.396***	0.271***	0.193***
	(26.87)	(14.79)	(6.85)
Log Assets	-0.014***	-0.041***	-0.020***
	(-7.50)	(-20.06)	(-3.31)
Tobin's Q	0.028***	0.006***	-0.002
	(16.80)	(3.88)	(-1.50)
Cashflow	-0.330***	-0.235***	-0.058***
	(-17.46)	(-13.84)	(-3.35)
Book Leverage		0.021***	0.001
		(7.37)	(0.48)
Stock Return		-0.041***	-0.015***
		(-10.06)	(-4.24)
Cashflow Volatility		0.073**	0.017
		(2.11)	(0.49)
Industry Fixed Effects	Yes	Yes	No
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	No	No	Yes
Observations	65,147	63,792	63,792
Adjusted R^2	0.074	0.255	0.080

Table 8: Robustness Checks

For each cell, the listed dependent variable is regressed on *Intangibles Ratio* and control variables using a particular subset of sample firms. The tables presents the resulting coefficient estimates and *t*-statistics for *Intangibles Ratio*. Column (1) excludes firms in "Business Equipment", according to the Fama-French 12-industry classification. Column (2) excludes firms that conducted an IPO in the past 5 years. Column (4) contains firms with positive values of *Total Payouts* in the year. *Tangible Investment* is the annual change in PP&E (net of depreciation), divided by *Cashflow*. *Total Investment* is *Tangible Investment* plus annual investment into intangible assets, divided by *Cashflow*. Intangible investment is measured as the sum of R&D spending, 0.2×SG&A expenditures, and acquisition of externally produced intangibles. *Intangibles Ratio* is the firm's stock of intangible assets, divided by total assets which is measured as the sum of intangible assets and PP&E. *Total Payouts* is the sum of *Repurchases* and *Dividends*. *Treasury Shares* is the amount of shares in the corporate treasury, divided by total shares issued. *Shares Retained* is the year-on-year change in the value of shares in the corporate treasury, divided by total assets. These variables are measured only for firms that retain shares in their treasury. *Option Compensation* is the Black-Scholes value of stock options granted to all employees excluding the 5 highest-paid executives, divided by market capitalization. Variables that are included in the regression but not reported are *Log Assets*, *Book Leverage*, *Stock Return*, *Cashflow Volatility*, and year and industry fixed effects. The sample contains 12,242 U.S. non-financial and utilities firms and covers the years 1970 through 2010. Firms with less than 5 years of data, non-positive sales, or total assets below $5 million are excluded. All control variables are lagged one year, except *Intangibles Ratio*. Industry fixed effects are based on the Fama-French 48 industry classification. *t*-statistics are based on standard errors that are clustered at the firm level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	Panel A. Investment and payout policies			
Dependent Variable	No computer firms	No recent IPOs	S&P 500 firms	Positive payouts
Tangible Investment	-1.492***	-1.370***	-1.228***	-1.288***
	(-51.57)	(-52.41)	(-24.11)	(-44.69)
Total Investment	-0.317***	-0.171***	-0.454***	-0.387***
	(-6.89)	(-4.15)	(-7.42)	(-9.47)
Total Payouts	0.001	-0.004	0.001	0.010**
	(0.33)	(-1.33)	(0.05)	(2.10)
	Panel B. Employee equity compensation			
Treasury Shares	0.023***	0.012***	0.050***	0.037***
	(6.17)	(3.24)	(4.28)	(7.09)
Shares Retained	0.005***	0.004***	0.010	0.015***
	(3.81)	(2.59)	(1.40)	(5.34)
Option Compensation	0.005***	0.009***	0.006***	0.005***
	(5.95)	(10.16)	(5.02)	(7.03)