Cash Savings and Stock Price Informativeness

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Abstract

This paper shows that managers use the information they learn from the stock market when they decide on corporate cash savings. In particular, corporate savings are much more sensitive to stock price when the price contains more information that is new to managers. Moreover, the significant effect of stock price informativeness on the savings-to-price sensitivity is not due to market mispricings, and remains even after controlling for various sources of public and managerial private information. Overall, the results highlight a new channel through which stock prices affect corporate decisions, which suggests that the stock market is not a sideshow.

JEL Classification: G15, G34, G31

Keywords: Corporate Savings, Cash Holdings, Price Informativeness, Private Information, Managerial Learning

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1. Introduction

Do managers learn from the stock market? This question has recently attracted much attention among finance researchers. Indeed, understanding whether and how information flows from the stock market to companies turns out to be of paramount importance to properly appraise the impact of financial markets on the real economy. The mechanism underlying such learning from managers roots in the long-standing idea that prices aggregate diverse pieces of information via the trading activity of a myriad of different investors. As a result, market prices may embed some specific information that managers do not have yet. This new information, in turn, can guide them towards a more efficient allocation of corporate resources and hence may contribute to increase firm value.

Recent research provides ample empirical support for this idea. In particular, several studies document that managers learn information from their stock price and use this information when they decide on corporate investment. Prominent examples are Durnev, Morck and Yeung (2004), Luo (2005), Chen, Goldstein and Jiang (2007), or Bakke and Whited (2010). This line of research offers important insights on the multifaceted linkages between stock prices and managerial decisions. Yet, the literature has so far focused exclusively on the effects of managerial learning on corporate investment. However, to the extent that prices really transmit new information to managers, this information should also affect other decisions that managers have to make.

This paper argues, and provides strong evidence, that decisions on corporate cash savings depend on managers learning from the stock market. As a matter of fact, both theory and economic intuition predict that managers can glean a variety of useful information from the stock price.[1] Market prices may for example contain specific information about future investment and financing opportunities (e.g. in the models of Dow and Gorton (1997) or Subrahmanyam and Titman (1999)). Also, prices could vehicle information about strategic issues such as future competitive changes or the evolution of firms' relationships with their different stakeholders. Arguably, all these potential sources of information are directly tied to firms' decisions to save cash. Indeed, according to the growing literature on corporate cash holdings, firms systematically hoard cash to secure the financing of future

[1] Note that the models remain vague on defining the kind of information that managers can learn from the stock market.

investment (e.g. Almeida, Campello, and Almeida (2004) or Acharya, Almeida, and Campello (2007)). Hence, we expect firms' savings behavior to be affected by the information that prices transmit about the value of their growth prospects. From a different perspective, existing research reveals that firms also use cash as a strategic weapon in the product market (e.g. Frésard (2010)) or in their negotiations with workers or suppliers (e.g. Klasa, Maxwell, and Ortiz-Molina (2009)). Hence, to the extent that prices inform managers about future strategic issues, cash savings should be determined by the informational content of prices.

To empirically assess the hypothesis that managers learn from their stock price when they make corporate savings decisions, I follow Chen, Goldstein, and Jiang (2007) and examine the relation between the informativess of stock prices and the sensitivity of savings to price. The logic of this approach is as follows. When deciding on the level of cash savings that maximizes the expected value of the firm, managers will use all the information available to them. This set includes the information aggregated in the stock price, as well as managers' private information that has not been incorporated into the price yet. Because managers are more likely to learn from stock price when the price conveys more private information from investors, cash savings should be more sensitive to price when the price contains a larger fraction of private investors' information.

A key ingredient to the analysis is to determine *when* stock prices contain more information that is new to managers. To do so, I rely primarily on firm-specific return variation (or price non-synchronicity). First proposed by Roll (1988), this measure is computed on the basis of the correlation between the stock's return and the market and industry returns. When a significant portion of a stock return variation is not explained by market and industry movements, i.e. when firm-specific return variation is high, the stock price is more likely to convey firm-specific information. Considerable research establishes that firm-specific return variation and price informativeness are closely related. In particular, firm-specific return variation is associated with more information about future earnings embedded in stock prices (e.g. Durnev, Morck, Yeung, and Zarovin (2003)) and with more efficient capital allocation (e.g. Durnev, Morck, and Yeung (2004) or Wurgler (2000)).[2]

[2] Section 3.1 discusses in detail the foundations and controversies of this measure of price informativness.

In a first set of results, I find that the sensitivity of firms' savings to their stock price is positively and strongly correlated with price informativeness. Precisely, using a large sample of U.S. firms over the period 1970-2006, I estimate that cash savings become significantly more sensitive to stock price when firm-specific return variation is high. This first result is consistent with the hypothesis that prices with large content of private information provide managers with new information, which, in turn, affects their savings behavior. Breaking down firms into quintiles based on the sample distribution of firm-specific return variation, additional estimations reveal that cash savings are about two times more sensitive to price in the fifth quintile of firm-specific return variation (highly informative prices) than in the first quintile (poorly informative prices). Noticeably, this result is economically non-negligible. While a one standard deviation increase in price is associated with a 1.27% increase in cash savings for firms that have non-informative stock prices, it boosts savings by 2.55% when firms benefit from highly informative prices. Additional specifications confirm that this pattern is robust to the potential effect of outliers in the measurement of firm-specific return variation, to alternative proxies for private information in prices, as well as to several estimation methods.

A second set of tests provides further support for the managerial learning hypothesis. Importantly, a positive relation between price informativeness and the sensitivity of savings to price can only be taken as evidence of managerial learning if the information learned from stock prices is new to managers. Note, however, that rigorously testing this claim is difficult because the information that managers use to decide on cash savings is not directly observable. To overcome this difficulty, I take an indirect approach. I hypothesize that when managers possess more private information their propensity to learn from the stock market is limited. Hence, when they know more, their cash savings should be *less* sensitive to price. On this ground, I use three variables to proxy for the amount of information that managers already possess and check how the savings-to-price sensitivity depends on these measures. First, I estimate that cash savings are much *less* sensitive to price when firms benefit from a large coverage by financial analysts. To the extent that analysts essentially transfer information from managers to investors, the informational content of analysts' release is very unlikely to be new to managers. As such, corporate savings do not appear to be sensitive to this public information. From a related perspective, I use insiders' trading activity and earnings' surprise to capture the amount of

managerial private information. Indeed, because managers are likely to trade their own stock when they possess private information, and because they know their own firm's accounting numbers before they are released to the public, these variables can be viewed as reasonable measures of private information. Again, the savings-to-price sensitivity appears to weaken when managers have more private information.

Overall, while the above findings are largely consistent with the idea that managers use the information they learn from the stock market to decide on corporate cash savings, the relationship between stock price and corporate cash savings could be contaminated by market mispricings. As argued by Baker and Wurgler (2002) and Baker, Stein, and Wurgler (2003) firms with mispriced securities may take advantage of irrationally low discount rates to raise capital at a cheaper price. In this context, the positive relationship between firms' cash savings and their stock price could simply reflect the fact that managers issue equity when their market price is high and channel the proceeds into cash savings. Several tests lessen this concern. Especially, while I find that firms indeed channel a significant fraction of their issuance proceeds into cash savings, the effect of price informativeness on the saving-to-price sensitivity remains equally strong when I control for firms issuance activity. Moreover, I offer additional evidence that the results are not affected by the inclusion of different commonly used proxies for market mispricing.

This paper contributes to two different strands of research. First, by documenting that managers exploit the information they learn from the stock market when they decide on corporate cash savings, this paper adds to the growing literature on managerial learning. Whereas existing studies emphasize the existence of an informative feedback going from the stock market to corporate *investment* decisions, this paper points to a new channel through which security prices influence corporate actions. In that respect, my findings suggest that prices contain a variety of valuable information that can help managers in their decisions making besides corporate investment. Overall, the present analysis provides novel support for the idea that information flows from the stock market to the real sector. As such, it confirms that financial markets are not a side-show, but they contribute to economic efficiency by facilitating the adequate allocation of corporate resources to their best use.

Second, this paper contributes to the literature on cash holdings. Undeniably, recent developments have considerably broadened our understanding of the determinants of cash holdings

and the impact of cash policy on corporate performance.[3] Yet, the literature has so far paid very little attention to the economic mechanisms whereby firms build up their cash reserves, i.e. how they save or dissave. By focusing on the informational role played by stock prices on cash savings, this paper helps to bridge part of this gap. In short, this paper highlights that the availability and precision of information appears to be a key determinant in explaining observed cash savings behaviors. Because the information incorporated in prices is forward-looking by nature, my results confirm the precautionary role of cash savings in counteracting costly or limited access to external financing (e.g. Almeida, Campello, and Weisbach (2004), Acharya, Almeida, and Campello (2007)).

Finally, it is important to note that the interpretation of the main findings crucially depends on the availability of variables that accurately measure the amount of private information in prices. Clearly, it is possible that some estimates are driven by unobservables that directly affect the firm-specific return variation and simultaneously render cash savings more sensitive to stock price. Nevertheless I believe that the use of alternative proxies for price informativeness, together with extensive robustness tests substantially mitigate this concern.

The next section reviews the related literature, discusses the theoretical background, and outlines the main hypothesis. Section 3 presents the empirical methodology and describes the data. Section 4 reports the results. The conclusions are presented in section 5 together with some implications for future research.

2. Related literature and hypothesis development

A recent stream of research argues that managers can learn valuable information about the prospects of their own firm from observing their stock price. This idea relies primarily on Hayek's (1945) intuition that stock prices efficiently aggregate information from various participants and hence help improving the allocation of resources. The aggregation of information is permitted by the trading activity of diverse speculators that transmit their private information into market prices via their trades (e.g. Grossman and Stiglitz (1980) or Kyle (1985)). Because these speculators may not have the possibility or willingness to share their information with managers directly, stock prices may incorporate specific

[3] See Bates, Kahle, and Stulz (2009) for a comprehensive survey of the literature on corporate cash holdings.

information that managers do not possess. As a result, if (some) investors have information about a company's prospects that those running the company ignore, the information embedded in stock prices may help reduce this information asymmetry and improve firms' decisions.

In theory, this information can take different forms. It can be about future investment opportunities, but also about the future demand for the firm's products, strategic competition with other firms, relationships with various stakeholders, or future financing possibilities. On this ground, a number of recent theoretical works highlight that managers can use the information they infer for their stock prices to improve the efficiency of their decisions, and thus enhance the value of their firm. Two prominent examples of this line of research are Dow and Gorton (1997) and Subrahmanyam and Titman (1999). Dow and Gorton (1997) develop of model where stock market traders have important information that managers do not have about the value of prospective investment opportunities. In equilibrium, they show that the stock market guides corporate investment by transferring valuable information to managers. In a related spirit, Subrahmanyam and Titman (1999) explore the linkages between the informational content of stock prices and firms' choice between private and public financing. Their analysis indicates that public financing has the advantage to provide managers with information coming from the stock market. Therefore, public financing is preferred when information is particularly important for the allocation of corporate resources. Other related models include, among others, Dye and Sridhar (2002), Goldstein and Guembel (2008), Foucault and Gehrig (2008) or Chang and Yu (2004). Collectively, these models have far-reaching implications as they entail that financial markets affect the real economy and are not just a sideshow (e.g. Morck, Shleifer, and Vishny (1990) or Stein (2003))

On the empirical front, several studies document that corporate decisions are materially affected by the informational content of security prices. In particular, Durnev, Morck and Yeung (2004) show that firms invest more efficiently when their stock price incorporates a larger amount of private information. Chen, Goldstein, and Jiang (2007) report that corporate investment is more sensitive to stock price when prices are more informative. They interpret this result as evidence that managers extract valuable information from observing their stock price, and use this information when deciding on corporate investment. Using a different methodology, Bakke and Whited (2010) reach a similar conclusion. Foucault and Frésard (2010) confirm the positive impact of stock price on investment by focusing on a sample of

foreign firms that cross-list on U.S. exchanges and benefit from more informative stock prices. From a different perspective, Luo (2005) estimate that the abnormal returns occurring around merger announcements are strong predictors of deal completion. He concludes that the managers of merging companies learn from observing the market reaction and adjust their actions accordingly.

By and large, the above pieces of evidence corroborate the existence of an informational channel going from stock prices to managerial decisions. Yet, existing research has almost exclusively concentrated on linking the information contained in stock price to one specific dimension: decisions on capital investment. This unilateral focus appears surprising. Indeed, to the extent that stock prices vehicle new and valuable information to managers, informative prices are likely to affect other decisions managers have to make. Building on this intuition, this paper argues that decisions on cash savings are particularly likely to be affected by the information managers can obtain from the stock market. Specifically, I conjecture that savings decisions are likely to be sensitive to the kind of information that the stock market have been shown to transmit to managers. At least two reasons motivate this idea. First, the common assumption in all models of managerial learning is that stock prices provide managers with new information about the value of their firm's future investment opportunities (e.g. Dow and Gorton (1997) or Subrahmanyam and Titman (1999)). From this perspective, because cash savings are inextricably related to investment prospects, they will respond to price if prices convey valuable signals about future prospects. As a matter of fact, the growing literature on cash holdings emphasizes firms hoard cash as a way to secure the financing of future investment.[4] Important examples are Almeida, Campello, and Weisbach (2004) and Acharya, Almeida, and Campello (2007) who formalize the long-standing idea that cash savings serve a precautionary motive. They show that when future projects are valuable and future external financing is uncertain, cash savings become a key element of firms' financial policy. In this spirit, Dasgupta, Noe, and Wang (2008) demonstrate that corporate savings are systematically used to finance future capital investment. In particular, they report that firms systematically funnel a fraction of their cash flows into cash savings. Subsequently, they draw down part of the accumulated cash reserves to increase capital spending. Similarly Denis and Sibilkov (2009) document that firms actively use their saved cash to fund future investment. Overall, the recent research on corporate cash policy underlines that cash savings

[4] See Bates, Kahle and Stulz (2009) for a comprehensive survey on corporate cash holdings.

can be viewed as a specific type of investment in financial (liquid) assets. This investment gives firms an option to invest in physical assets in the future. Interpreted in light of models such as Dow and Gorton (1997) or Subrahmanyam and Titman (1999), the literature on cash holdings indirectly suggests a link between the informativeness of stock prices and investment in liquid assets, i.e. cash savings. To the extent that stock prices convey useful information about future investment opportunities, cash savings are likely to be sensitive to this specific information.

Alternatively, the decision of managers to save cash could also be affected by the information they learn from stock prices due to the *strategic* value of cash savings. Indeed, cash savings have been shown to comprise various strategic dimensions. For instance, Frésard (2010) and Boutin, Cestone, Fumagalli, Pica, and Serrano-Velarde (2009) show that cash savings provide an important advantage over product market rivals because deep pockets act as a credible threat of aggressive behaviors in the product market. Also Klasa, Maxwell, and Ortiz-Molina (2009) stress that firms tactically use cash reserves to gain bargaining power vis-à-vis workers and unions. In a closely related spirit, Itzkowitz (2010) reports that corporate cash policy represents a useful tool to manage firms' relationship with their suppliers. In all these examples, the benefits of cash savings are not directly tied to the financing of future investment but stem from their strategic importance. Hence, to the extent that stock prices confer to managers new information about future strategic issues (e.g. the evolution of competition in the product market or changes in the relationships with employees and suppliers) cash savings can be sensitive to the informational content of prices.[5] Next sections provide strong support for this claim.

3. Data and methodology

This section presents the two building blocks of my empirical analysis. I first present and discuss the measures of stock price informativeness and then describe the econometric methodology used to gauge whether managers learn from stock price when deciding on corporate savings. I also present descriptive statistics.

[5] As recognized by Subrahmanyam and Titman (1999) and Chen, Goldstein, and Jiang (2007) the information that managers learn from prices is likely to be about strategic issues. It is less likely to be about the technology used by the firm because the manager is expected to have an informational advantage about technological factors.

3.1. Measures of stock price informativeness

One central element of the empirical analysis is the measurement of price informativeness. As a proxy for the amount of private information embedded in stock prices, I rely primarily on firm-specific stock return variation (or price non-synchronicity). The rationale for using firm-specific return variation is based on a large body of literature, both empirical and theoretical. French and Roll (1986) and Roll (1988) were the first to show that a significant portion of stock return variation is not explained by market movements. On this ground, Roll (1988) argues that firm-specific return variation has to be correlated with private information. Indeed, stock prices move with the arrival of new information, which gets impounded into prices in two ways. The first one occurs through a revaluation of prices following the release of public information, e.g. news on macroeconomic conditions or earnings announcements. The second is through the trading activity of investors who possess private information. As Roll (1988) found no relationship between firm-specific return variation and various news releases, he acknowledges that either private information or else occasional frenzy unrelated to information (noise) could explain firm-specific return variation.

Several recent studies provide strong empirical support for Roll's (1988) former view that firm-specific return variations reflect the incorporation of private information into prices via the active trading of informed investors. Chief among them, Durnev, Morck, Yeung, and Zarovin (2003) document that firm-specific return variation is highly correlated with stock prices' ability to predict future earnings. Stocks exhibiting more specific return variation convey more information about future earnings in their current prices. These stocks have prices that are more informative. Other studies provide consistent evidence. Morck, Yeung, and Yu (2000) and Jin and Myers (2006) show that firm-specific return variation is high in countries with developed and transparent financial markets, where informed traders have larger incentive to search for and exploit private information. In a related spirit, Fernandes and Ferreira (2008) document that firms that are cross-listed on U.S. exchanges display higher specific return variation than non-cross-listed firms, because a U.S. cross-listing typically expands the set of informed investors. Wurgler (2000) and Durnev, Morck, and Yeung (2004) show that industries with high firm-specific return variation allocate capital more efficiently.

On the theoretical front, Veldkamp (2006) demonstrates that when the cost of producing information is high, investors rely more on common signals. Her model therefore predicts a positive association between the amount of information that investors produce about a firm and its return variation. From a related perspective, Peng and Xiong (2006) show that when the attention of investors is limited, informative stock price endogenously exhibits higher specific return variation.

To empirically implement Roll's (1988) idea, I follow Durnev, Morck, and Yeung (2004) and define firm-specific return variation for each year as $\psi_{i,t} = \ln[(1-R^2_{i,t})/ R^2_{i,t}]$, where $R^2_{i,t}$ are estimated each year from the following regressions:

$$r_{i,j,t} = \alpha_i + \beta_{i,m} r_{m,t} + \beta_{i,j} r_{j,t} + \varepsilon_{i,t} \ , \qquad (1)$$

where $r_{i,j,t}$ is firm *i* weekly returns , $r_{m,t}$ is the market and $r_{j,t}$ the industry returns. The market index and industry indices are value-weighted and exclude the firm in question. This exclusion prevents spurious correlation between firm and industry returns in industries that contain few firms**.** Similarly to Durnev, Morck, and Yeung (2004), I define industry at the three-digit SIC-code level. Note that I use weekly returns because CRSP daily returns data reports a zero return when a stock is not traded in a given day.[6] In line with Roll's (1988) intuition, the logic of this measure is as follows. In the absence of firm-specific information, stock returns only vary because they correlate with industry and markets returns. In contrast, the presence of firm-specific information renders returns less correlated with market and industry returns. Therefore, stock price is more informative when a stock becomes less correlated with the market and industry returns, i.e. when $\psi_{i,t}$ is high.

While the literature has provided various justifications for using firm-specific return variation as a proxy for price informartiveness, this interpretation is not without controversy. In particular, Skaife, Gassen, and LaFond (2006) and Dasgupta, Gan, and Gao (2009) suggest that the relation between price informativeness and firm-specific return variation is ambiguous. Kelly (2007), Hou, Peng, and Xiong

[6] The sample contains 4.5% of daily observations that are not traded (reporting zero return and zero volume). The presence of zero (non-traded) returns could artificially decrease the explanatory power in the return regressions and therefore inflate mechanically the proxy for private information in price. Although small stocks may not trade for a day or more, they generally trade at least once every few weeks. Weekly returns are thus less likely to suffer from "thin trading" problems.

(2006), or Xing and Anderson (2010) also cast doubt on the ability of this measure to clearly identify the extent of private information. To strengthen my analysis, I use two alternative trading-based variables that have been used as proxies for price informativeness. First, I replace firm-specific return variation by the illiquidity ratio (*Illiq*) of Amihud (2002). This measure is computed as the annual average of the daily ratio between a stock's absolute return and its dollar volume (multiplied by 10^6).

$$Illiq_{i,t} = \frac{1}{D_{i,t}} \sum_{\tau=1}^{D_{i,t}} \frac{\left| r_{i,\tau} \right|}{VOLD_{i,\tau}}, \tag{2}$$

where $D_{i,t}$ is the number of valid observation days for firm i in year t, $r_{i,\tau}$ is firm i's daily return and $VOLD_{i,\tau}$ is the dollar volume of firm i on day τ. So, *illiq* captures the absolute percentage price change per dollar of daily trading volume and is a proxy for the price impact of trades. As in Kyle (1985), the magnitude of the price impact should be a positive function of the perceived amount of informed trading on a stock, and thus a proxy for the amount of private information embodied into the prices (e.g. Ferreira, Ferreira and Raposo (2008)).

In addition, I use the private information trading measure suggested by Llorente, Michaely, Saar, and Wang (2002), which is based on stock return autocorrelation conditional on trading volume. To construct this measure, I estimate the following regression for each firm and each year:

$$r_{i,t} = \alpha_i + \phi_i r_{i,t-1} + \beta_i r_{m,t} + \gamma_i (r_{i,t-1} \times V_{i,t-1}) + \varepsilon_{i,t}, \tag{2}$$

where $r_{i,t}$ ($r_{i,t-1}$) is again firm i's weekly returns, $r_{m,t}$ is the market return and $V_{i,t}$ represents the logarithm of firm i's weekly turnover, detrended by substracting its 26-week moving average. According to Llorente, Michaely, Saar, and Wang (2002), the amount of information-based trading is given by the regression coefficient γ_i on the interaction variable. With this procedure, I have one observation of γ (*Gamma*) for each firm-year. Higher values of this variable indicate more information-based trading (as opposed to noise or liquidity trading). The idea that, in periods of high volume, stocks with a high degree of

information-based trading, i.e. stock with informative prices, tend to display positive return autocorrelation. Fernandes and Ferreira (2008, 2009) use this measure as a proxy for price informativeness.

3.2. Measuring the sensitivity of cash savings to price

To gauge whether and how managers use some private information embedded in their stock price to decide on cash savings, I examine the relation between the amount of private information in stock prices and the sensitivity of cash savings to price. To do so, I follow and adapt the approach of Chen, Goldstein, and Jiang (2007) who investigate whether price informativeness affects the sensitivity of corporate investment to stock price. Based on their argument, stock prices aggregate all public and private information about firms' fundamental value. Hence, when deciding upon the optimal level of cash savings, a value maximizing manager will consider all relevant and available information. This set includes both private information that managers possess, and that is not yet integrated into the stock price, as well as the overall public information reflected in the stock price.[7] If managers learn from observing their stock price and factor this information into savings choices, we expect cash savings to be more sensitive to stock price when the price conveys more private information that is new and valuable to managers.

To test this hypothesis, I draw from Almeida, Campello, and Weisbach (2004) and specify the following model of cash savings:

$$Savings_{i,t} = \alpha_i + \eta_t + \beta_1 Q_{i,t-1} + \beta_2 (Q_{i,t-1} \times \psi_{i,t-1}) + \boldsymbol{\varphi} \mathbf{X}_{i,t} + \varepsilon_{i,t}, \quad (4)$$

where the subscripts i and t represent respectively the firm and the year. The dependent variable $Savings_{i,t}$ is the annual change in the holdings of cash and other liquid assets divided by lagged assets. All the variables are described in the Appendix. $Q_{i,t-1}$ is the normalized stock price, and is computed as the market value divided by the book value of assets. The variable of interest $\psi_{i,t-1}$ represents the firm-specific return variation and is used as a proxy for the amount of private investors' information.

[7] As noted in Chen, Goldstein, and Jiang (2007), information that managers already had will move the price but not affect the savings decisions (as it already affected past savings) and thus will decrease the sensitivity of savings to price.

To reliably estimate the combined effect of price and private information on cash savings, the matrix **X** includes control variables designed to capture a number of factors that affect cash savings decisions that may also directly correlate with stock price and its informativeness. First, I include $\psi_{i,t-1}$ separately in order to control for the effect of private information on cash savings. I also include the natural logarithm of assets (*Size*) to neutralize the impact of size on the genuine need to save cash, as well as the potential effect of economies of scale in cash management. To accommodate the documented precautionary allocation of cash inflows into cash savings, I include cash flow (*CF*) as a control variable; see Almeida, Campello, and Weisbach (2004) and Riddick and Whited (2009). Also, because the decision to change the cash position likely depends on the available stock of cash, I include the beginning of period cash holdings (*Cash*). I account for time-invariant firm heterogeneity and time effects by including firm fixed effects as well as time dummies (α_i and η_t). Finally, I allow the error term in (1) to be serially correlated for the same firm. Hence, in all estimations, the standard errors are adjusted for heteroskedasticity and within firm-period clustering as defined in Petersen (2009). In estimating equation (1), the primary interest is on the coefficient β_2. Indeed, this coefficient measures the extent to which the association between saving and price is affected by the amount of private information contained in the price. If savings decisions are guided by private information embedded in price, we expect this coefficient to be significantly positive.

3.3. Sample and summary statistics

I obtain cash holdings and accounting data from the annual Compustat industrial files. This data constitutes an unbalanced panel that covers the period 1970-2006. I exclude firm-year observations for which total assets and cash holdings are missing, and for which sales are negative. I omit all firms in the financial (SIC code 6000-6999) and utility industries (SIC code 4900-4999). Stock price and return information are from CRSP. After merging the CRSP with the Compustat data and after deleting the top and bottom 1% of the regression variables, the sample comprises 88'501 firm-years observations with 11'937 firms. In robustness tests, I use additional data on analysts' coverage and insiders' transactions. Data on analysts' earnings forecasts is from I/B/E/S summary files and data on insiders' trading is from

Trade and Quote (TAQ) database.[8] The appendix defines the variables used in this study and describes their source.

Table I presents descriptive statistics. Noticeably, the average cash savings (*Savings*) is 0.012 indicating that the average saving rate is slightly more than 1% of total asset over the sample period. In dollar terms, this represents slightly more than $10 million per year. To put this number in perspective, note that the average cash flow represents 5.4% of firms' assets. Hence, broadly speaking, firms save an amount that is equal to one fifth of their annual operating revenues. Noteworthy, the mean of ψ is 1.92, corresponding to an average firm return-specific variation of 79% (1-R^2 in yearly firm-level return regressions). This number is in line with that displayed in Roll (1988) and subsequent studies.

[Insert Table I about here]

The average firm in the sample has a size (total assets) of $835 million and cash-to-asset ratio of 11%. Its investment rate (capital expenditure over assets) is 6.8 % and its acquisition rate is (acquisitions over assets) is 1.4%. The mean net working capital represents 12.8% of firm's assets while the mean short-term debt accounts for 6%. Overall, these numbers are comparable to those found in closely related studies, such as Almeida, Campello, and Weisbach (2004), Riddick and Whited (2009) and Chen, Goldstein, and Jiang (2007).

4. Results

4.1. The effect of price informativeness on the savings-to-price sensitivity

Before formally testing the hypothesis delineated in section 2, I start by documenting that cash savings are sensitive to stock price. Column 1 of Table II presents the results of a simple OLS regression of cash savings (*Savings*) on stock price (*Q*). Notably, we observe a positive and significant association between *Savings* and *Q*, with a coefficient for *Q* estimated at 0.013, significant at less than the 1% level. The magnitude of this estimate is in line with Almeida, Campello, and Weisbach (2004) and Riddick and Whited (2009) and confirms that savings are positively correlated with prices.[9] Firms appear to save more

[8] I thank Wei Jiang for sharing her insider trading data with me.
[9] Almeida, Campello, and Weisbach (2004) do not report an estimate of the sensitivity of savings to price for their whole sample. Splitting their sample by the severity of financing constraints, they report estimates ranging between 0.0001 and 0.0029. Similarly, Riddick and Whited (2009) presents estimates between 0.006 and 0.045.

when they experience positive shocks to their stock price. The economic magnitude of this effect appears small but non-negligible. A one standard deviation increase in Q (1.066) boosts corporate savings by 1.38% (1.066×0.013). This represents an increase of 108% of the sample average corporate savings (1.20%). This finding confirms the idea that, on average, firms' decision to allocate resources to their cash savings is related to the level of their stock price.

[Insert Table II about here]

Column 2 of Table III displays the central finding of this paper. The coefficient for $\psi \times Q$ is positive and statistically significant (0.002 with a *t-statistic* of 4.48). Cash savings are more sensitive to stock price when the price contains a larger amount of private information. In other words, managers save more following a positive signal given by the market price, when this signal contains a larger amount of private investors' information.

Controlling for other firm characteristics does not alter this central result. Column 3 presents estimates for a specification that includes the control variables described in equation (4). Importantly, the positive coefficient for $\psi \times Q$ remains highly significant (0.002 with a *t-statistic* of 4.14). Note that the other estimates have the expected signs. In particular and consistent with Almeida, Campello, and Weisbach (2004), cash flow contributes significantly to explain cash savings. In essence, this result confirms that the average firm has a positive propensity to save cash out of cash inflows. Also, *Size* displays a positive sign, indicating that larger firms tend to save more (or use less) cash.[10] As expected, a firm's stock of cash is negatively related to cash accumulation. A similar result is shown in Campello and Graham (2009). Finally, we observe that the coefficient on $\psi_{i,t-1}$ is not significant. This suggests that price informativeness has no direct effect on corporate savings.

To appraise the economic magnitude of the effect of price informativeness on the sensitivity of corporate savings to price, I estimate the savings-price sensitivity across different quintiles of the price informativeness distribution (ψ). Figure 1 displays the results where the first quintile comprises firms whose price is the least informative (low ψ) while the fifth quintile includes firms with very informative stock price (high ψ). Confirming previous estimates, we observe a monotonic increase in the savings-price

[10] Maybe small firms actively use the cash to grow while large mature firms accumulate cash (due to lack of valuable investment opportunities).

sensitivity across the five quintiles. Savings are about two times more sensitive to price in the fifth quintile (coefficient on Q of 0.024 with a t-statistic of 12.24) than in the first quintile (coefficient on Q of 0.012 with a t-statistic of 12.24). This difference is also economically large. While a one standard deviation increase in Q (1.066) is associated with a 1.27% (1.066×0.012) increase in savings for firms having low informative stock prices, it increases savings by 2.55% (1.066×0.024) when firms benefit from a very informative stock price.[11] This stands for a 221% increase of the sample average savings (1.20%).

[Insert Figure 1 about here]

To complement this first set of findings, I further isolate the effect of stock prices on savings by including a number of sources and competing uses of funds. Because cash savings are likely to be determined jointly with other financial choices, the estimates may be biased by the presence of important omitted variables. To address this concern, I follow Almeida, Campello, and Weisbach (2004) and control for discretionary spending by including capital expenditure (*Capex*) and acquisitions (*Acquisitions*) because firms can draw down their cash reserves in order to pay for valuable growth opportunities. I add change in net working capital (ΔNWC) since working capital can be a substitute for cash (Opler, Pinkowitz, Stulz, and Williamson (1999)) or it may compete for the available pool of resources. I include changes in short-term debt ($\Delta ShortDebt$) due to the substitutability between cash and debt, and because a firm can use short-term debt financing to build up cash reserves. When I add these variables, I explicitly recognize the endogeneity of financing and spending decisions and use an Instrumental Variable (IV) estimation. As recognized by Almeida, Campello, and Weisbach (2004), finding appropriate instruments is not an obvious task. My approach strictly follows their and includes two lags of the level of fixed capital (property, plant and equipment over assets), lagged acquisitions, lagged net working capital, lagged short-term debt as well as industry dummies (two-digit SIC codes).

Column 4 of Table II reports the results from the instrumental variables (IV) estimation of this augmented specification. Although slightly smaller, the coefficient for $\psi \times Q$ continues to be significantly positive. The decrease in estimated sensitivity is expected given that this specification controls for additional sources and uses of funds. Again, most of the coefficients for the other regressors attract the

[11] Note that the average (median) value of Q in each quintile ranges from 1.56 (0.98) in the first quintile to 1.49 (1.11) in the fifth quintile.

expected signs.[12] Moreover, we note that the test of overidentifying restrictions (*J*-statistic) cannot reject the joint null hypothesis that the instruments (lagged variables) are uncorrelated with the error term and are correctly excluded from the second-stage regression. Taken together, this first set of results supports the view that managers use part of the private information embedded in their stock price when they decide upon cash savings.

4.2. Sensitivity analysis

To give additional support for the findings, I extend the analysis in several dimensions. First, I use alternative definitions of firm-specific return variation. Second, I use two alternative variables to measure the amount of private information in price. Third, I address the possibility that the inference is misstated by changing the model specification and the estimation procedure. I start by performing robustness checks with respect to the computation of firm-specific return variation. In Table III I use three complementary methods to compute firm-specific return variation using daily returns data instead of weekly data. Despite the advocated potential problem of "thin trading", column 1 reports the results of using daily returns to compute ψ. In column 2, I account for infrequent trading of daily frequency returns by cumulating the returns in days where no trading took place. This strategy mitigates the potential bias created by the zeros in returns series. In column 3, I add (one day) lagged market and industry returns to the regression estimating R^2 to control for some market and industry information that might find their way into prices with some delay. Although the magnitude of the estimates changes slightly across the three first columns of Table III, the effect of price informativeness on the sensitivity of savings to price is still positive and significant. Then, in column 4, I estimate firm-specific return variation by regressing weekly stock returns on the three factors from Fama and French. Indeed, we might argue that those factors are part of the systematic variation in individual returns. The results remain unchanged.

[Insert Table III about here]

In Table IV, I replace firm-specific return variation by the two alternative variables capturing price informativeness described earlier (*Illiq* and *Gamma*) defined earlier. It is worth saying that these two

[12] Note that this estimation is made via instrumental variables. The J-statistics indicate that the instruments employed overidentify the model's parameters.

measures are positively correlated with firm-specific return variation. Precisely, the correlation between ψ and *Illiq* is 0.36, and amounts to 0.24 between ψ and *Gamma*. As such, we may expect that these two variables capture other dimensions of price informativeness. Consistent with the results so far, the first column reveals that the coefficient on the interaction between *Q* and *Illiq* is positive but only significant at a 12% level (coefficient of 0.017 with a *t*-statistic of 1.56). Corporate savings are marginally more sensitive to stock price when the price is more likely to contain private information. In a similar way, the second column indicates that the savings-price sensitivity is larger when the price contains more information-based trading. As a matter of fact, the estimated interaction between *Q* and *Gamma* turns out to be positive and significant (coefficient of 0.001 with a t-statistic of 3.34). Reassuringly, these additional results alleviate the concerns that above results only stem from the (controversial) use of firm-specific return variation to identify the informativeness of stock prices.

[Insert Table IV about here]

To further verify the solidity of the inference, I reassess the base specification (4) following alternative estimation procedures. An important concern is that the results are driven by extreme observations in the information proxy. To reduce the potential impact of outliers, I first re-estimate specification (4) without firm-years observations for which ψ is above the 90th percentile and below the 10th percentile. Column 3 of Table IV shows that this winsorizing does not alter the main findings. In column 4, I perform a similar test but trimming firm-years observations with ψ above (below) the 75th (25th) percentile and continue to observe a positive effect of price informativeness on the savings-to-price sensitivity. Another possible issue is the presence of time and cross-sectional dependence in the sample. Despite the use of time and firm fixed effects and firm-clustered standard errors, it might be that the results stem from the misspecification of dependencies. To validate the inference, I use the Fama and MacBeth (1973) methodology. Specifically, I estimate specification (4) separately for each year and report the average of yearly estimated coefficients. Column 5 displays the Fama-MacBeth results. The estimates are qualitatively similar to those reported in Table IV. The coefficient for $\psi \times Q$ is 0.001 with a *t*-statistic of 2.84. The coefficients of the other firm characteristics are also consistent with the previous OLS regression estimates.

4.4. The Managerial Learning Hypothesis

So far, the results are consistent with the intuition that managers integrate some private information in prices into their savings' decisions. However, the documented association between private information in price and the savings-to-price sensitivity would only be reflective of managerial learning to the extent that the private information in price is new to managers. Testing this hypothesis is challenging because we do not directly observe the information used by managers for their savings decisions. To overcome this problem of identification, I gauge whether other competing sources of information affect the savings-to-price sensitivity. To do so, I follow Chen, Goldstein, and Jiang (2007) and consider one measure of public information and two measures of managerial private information. Specifically, I test whether the previous results are robust to the insertion of additional information channels in the baseline specification (4) and assess their effect on the estimated saving-to-price sensitivity.

To measure the quantity of public information, I rely on the number of analysts covering a firm. I define *Coverage* as the number of analysts that have issued earnings forecasts for the firm during the previous year. To the extent that analysts transfer information from managers to investors, the content of the information analysts release is unlikely to be new to managers.[13] Hence, one would expect less managerial learning, and consequently a lower savings-to-price sensitivity, when many analysts generate information about a firm's prospects.

[Insert Table V about here]

Column 1 of Table V confirms this intuition. We remark that analyst coverage has a negative and significant effect on the savings-to-price sensitivity. Similarly to Chen, Goldstein, and Jiang (2007), this result is consistent with managers already knowing the information released by analysts.[14] Importantly, the inclusion of *Coverage* has no bearing on the estimated effect of price informativeness on the savings-to-

[13] See for instance Agrawal, Chadha, and Chen (2006) for evidence that a considerable fraction of information produced by analysts is obtained from managers.

[14] As pointed out by Chen, Goldstein, and Jiang (2007), another possible effect that might explain the negative effect of analyst coverage on the savings-to-price sensitivity is offered in Easley, O'Hara, and Paperman (1998). These authors argue that the presence of analysts may attract more noise trading to the stock. This reduces the content of private information in the stock price and thus further decreases the sensitivity of savings to price. In this spirit, we find a positive negative correlation between analyst coverage and stock price informativeness (ψ) is -0.26.

price sensitivity. As a matter of fact, we continue to observe a positive and significant relation between the saving-to-price sensitivity and price informativeness.

In turn, I use insiders' trading activities to capture the amount of private information that managers possess. I define *Insiders* as the total number of inside stock transactions for a given year divided by that year's total transactions. The intuition behind this measure lies in the fact that managers are likely to trade if they possess more private information. I use equivalently buys and sells to compute this measure. Because the computation of *Insiders* requires data from Trades and Quotes (TAQ) database, the sample is limited to the period 1993-2001. Alternatively, I consider earnings' surprise (*ERC*) as a second proxy for managerial private information. This variable is defined as the average of the absolute market-adjusted stock returns over the four quarterly earnings announcements periods (day-1 to day 1). I conjecture that a positive absolute earnings' surprise reveals that some information in earnings was not fully anticipated by the market and hence not impounded entirely into prices. Because managers know allegedly the accounting numbers before they are released to investors, *ERC* can be viewed as a reasonable measure of managerial private information.

Columns 2 and 3 of Table V present the results when I include these two measures as well as their interaction with Q in specification (4). The first thing to notice is that when *Insiders* and *ERC* are included, the coefficient on $\psi \times Q$ remains virtually unchanged. This again corroborates the idea that some information in the stock price is really new to managers. Noteworthy, both coefficients on the interaction between Q and *Insiders* and *ERC* display the expected negative sign. These coefficients, however, are not statistically significant at conventional levels.

All in all, the results in this section lend additional support for the interpretation. Indeed, the results are not affected by the inclusion of measures of alternative sources of information. As such, they confirm that corporate savings are more sensitive to stock price when prices vehicle more private information new to managers.

4.4. Are the results driven by market mispricings?

While the results hitherto are largely consistent with managerial learning, this section explores an alternative explanation. Even in the absence of managerial learning, savings can be more sensitive to price

simply because the price of the stock deviates from it fundamental value. Indeed, as argued by Baker and Wurgler (2002) and Baker, Stein, and Wurgler (2003) overvalued firms may take advantage of irrationally low discount rates to issue securities at a cheaper price.[15] On this ground, there is a possibility that the documented sensitivity of savings to prices reflects the fact that managers act on mispricing by issuing overvalued stocks and then channel the proceeds into their cash balances. Several recent papers provide evidence in favor of a "market mispricing" explanation for cash accumulation. In particular, Campello and Graham (2009) document that during the technology bubble (1995-1999) financially constrained non-technology firms issued equity in response to unjustified high stock prices, and subsequently saved a significant part of those funds. Similarly, Hertzel and Li (2010) show that mispriced firms tend to increase their cash holdings after issuing equities. Kim and Weisbach (2007) report similar results in an international context.[16]

I address the possibility that the above patterns of the savings-to-price sensitivity are due to market mispricing in different ways. First, I look at how issuance activity affects the estimated saving-to-price sensitivity. Indeed, if stock prices influence corporate savings only through hoarding the proceeds of the issuance of overvalued securities, the positive saving-to-price sensitivity should vanish when I control for issuance activity. To test this claim, I define *Issuance* as the yearly change in equity and introduce this additional variable into specification (4).[17] Column 1 of Table VI displays the results. As expected, we observe that the coefficient on *Issuance* is significantly positive. Firms that issue equity set aside part of the proceeds into their cash balances. Also, we note that the effect of prices on savings is slightly reduced when I control for issuance activity. These results corroborate Kim and Weisbach (2007) and Campello and Graham (2009) and indicate that part of the effect of price on cash savings materializes through "market timing". However, the estimated coefficient for $\psi \times Q$ remains largely significant. Reassuringly, the positive effect of private information in price on the savings-to-price sensitivity is not an artifact of managers timing the market.

[15] Bakke and Whited (2010) provide a comprehensive survey of this literature.
[16] In contrast, D'Angelo, D'Angelo, and Stulz (2010) and McLean (2010) show that a large part of equity issuance cannot be explained by the timing of overvalued stock prices.
[17] More precisely, Issuance is computed as yearly change in equity plus the change in deferred taxes minus change in retained earnings divided by the beginning-of-year equity stock.

Alternatively, I use future abnormal returns ($EXRET_{t+3}$) to proxy directly for market mispricing. This approach follows Baker and Wurgler (2002) and Baker, Stein, and Wurgler (2003) who use returns subsequent to the measurement of *Q* as a measure of mispricing. They argue that as mispricing is a transient phenomenon, firms with overvalued stocks ought to experience negative returns as the mispricing gets corrected. Hence, observing negative returns following the measurement of *Q* is suggestive that the stock was mispriced. I compute $EXRET_{t+3}$ as the value-weighted market adjusted three-year cumulative return, starting from the end of the saving year.[18] Consistent with a market mispricing argument, column 2 reveals that the estimate for $EXRET_{t+3}$ is negative and significant, indicating that firms save more intensively when their stock is *a priori* overvalued. Yet, the effect of price informativeness is not altered by the inclusion of future excess returns.

[Insert Table VI about here]

Finally, I control for firms' age. As documented in Bates, Kahle, and Stulz (2009), firms that have recently gone public tend to accumulate more cash. This intensified saving behavior may originate in the hoarding of the IPO proceeds and/or because IPO firms often issue equity within a few years following their IPO. Alternatively, it could also be argued that young firms are genuinely more exposed to pricing errors because their valuation is more complex. For those reasons, in columns 4, 5 and 6, I report estimates of specification (4) when I eliminate firms that had their IPO within one, two and three years respectively. Although the effect of information in price on the saving-to-price sensitivity decreases a little, it remains positive and largely significant.

5. Conclusions

The main message of this paper is that managers use the information they learn from the stock market to decide on cash savings. In particular, I document that cash savings are more sensitive to stock price when the price contains more information that is new to managers. This result holds with different proxies for the amount of information embedded in prices, and different estimation methodologies. Also, extensive robustness checks indicate that the significant effect of price

[18] As in Chen, Goldstein, and Jiang (2007), for observations in the last two years of the sample period, two-year or one-year future returns are used.

informativeness on the savings-to-price sensitivity is not due to market mispricing and remains even when one controls for various sources of public and managerial private information.

By highlighting that the informational content of stock prices significantly guides managers when they decide on cash savings, my findings offer novel evidence on the multifaceted interactions between the stock market and corporate actions. While establishing a salient new fact, this study leaves important issues unresolved and raise several new questions for future research, two of which I outline here. First, while my findings complement previous research by pointing out a new channel between the information managers learn from the stock market and their decisions, it would be interesting to explore whether learning also guides other corporate policies such as capital structure decisions or dividend policy.

In addition, it would be interesting to examine what are the *real* implications of managerial learning. Indeed, while it has been established that more informative stock prices is associated with more efficient decisions and with more intense learning from managers, we still do not know how exactly the information learned from the stock markets transmits into better corporate decisions. To answer this central question, it is necessary to further understand what kind of information managers really learn from observing their stock price. These are challenging questions that I leave to future research.

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Appendix. Definition of the main variables used in the analysis

Variable	Description
Cash	Cash and short-term investment (Compustat item 1) scaled by Total Assets
Total Assets	Total assets (item 6) (in million USD)
Savings	Cash and short-term investment (item 1) minus one-year lagged Cash and short-term investment divided by one-year lagged Total Assets
Q	Market value of equity (item 24 multiplied by item 25) plus book value of assets minus book value of equity minus deferred taxes (item 6 – item 60 – item 74), scaled by Total Assets
ψ_t	Firm specific return variation computed as $\psi_{i,t}=\ln((1-R^2_{i,t})/R^2_{i,t})$, where $R^2_{i,t}$ represents the R^2 from the regression of firm *i* weekly returns on value-weighted market and value weighted industry indices in year *t*.
Size	Logarithm of Total Assets (item 6)
CF	Sum of net income before extraordinary items (item 18) and depreciation and amortization (item 14) scaled by Total Assets
Capex	Capital expenditures computed as capital expenditures (item 30) minus sales of property, plant, and equipment (item 107) divided by Total Assets
Acquisitions	Amount spent in acquisitions (cash) (item 129) scaled by Total Assets
NWC	Net working capital computed as current non-cash assets (item 4 minus item 1) minus current liability (item 5) divided by Total Assets
ΔNWC	Change in net working capital computed as NWC_t - NWC_{t-1}
ShortDebt	Short-term debt computed as short-term debt (item 34) divided by Total Assets
ΔShortDebt	Change in short-term debt computed as $ShortDebt_t$ - $ShortDebt_{t-1}$
Capital stock	Gross property, plant, and equipment (item 7)
Illiq	Average daily ratio of a stock's absolute return by the dollar volume (Amihud (2002))
Gamma	Coefficient estimate on the interaction between lagged return and lagged volume from a regression of current return on lagged return, market return and the interaction between lagged return and lagged volume (Llorente, Michaely, Saar, and Wang (2002).
Coverage	Number of analysts that have issued earnings forecasts for the firm during the previous 12 months (from IBES)
Insiders	Total number of insiders' stock transactions (buys and sells) for a given year divided by that years' total transactions (from TAQ)
ERC	Average of the absolute market-adjusted stock returns over the four quarterly earnings announcements periods (day-1 to day 1)
Issuance	Yearly change in equity (item 60) plus the change in deferred taxes (item 74) minus change in retained earnings (item 36) divided by the beginning-of-year equity stock (item 60)
$EXRET_{t+3}$	Value-weighted market adjusted returns cumulated over three years

Figure 1. Savings-to-Price Sensitivity by quintiles of price informativeness

This figure report results from five regressions of the effect of price on savings estimated across subgroups based on the quintiles of the distribution of firm-specific return variation (ψ). The bars correspond to the estimated savings-to-price sensitivity for each quintile. 95% confidence interval are reported. The sample period is from 1973 to 2006. All estimations include firm and time fixed effects. The estimations correct the error structure for heteroskedasticity and within-firm error clustering.

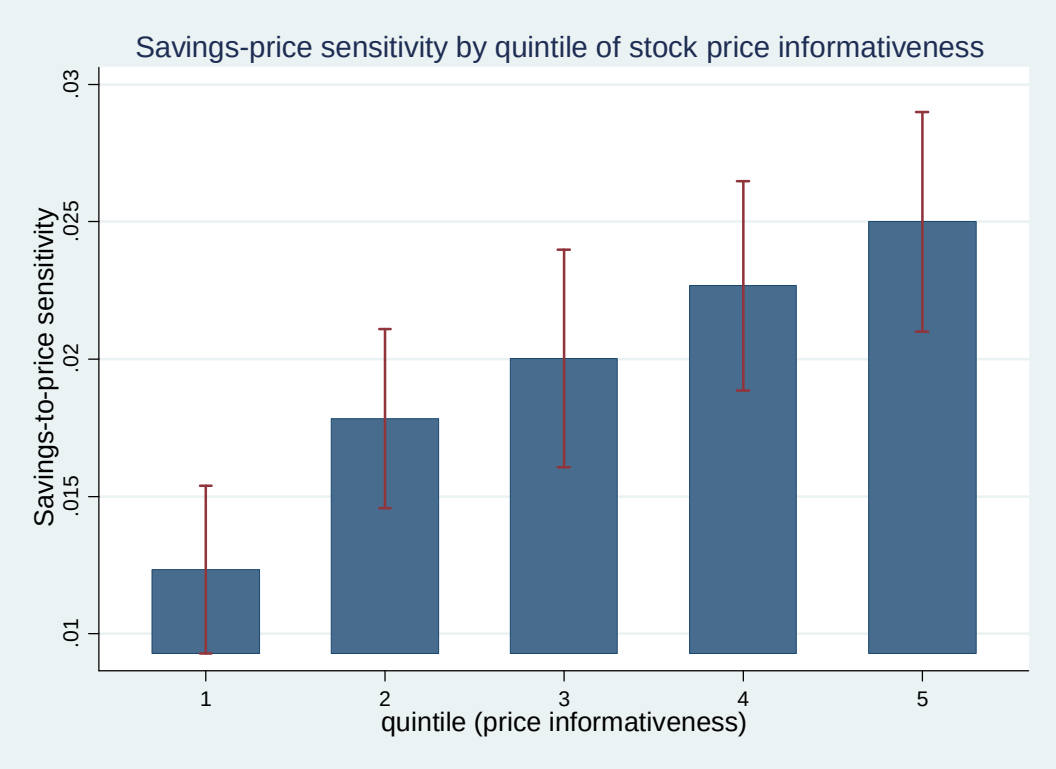

Table I. Descriptive Statistics

This table reports the mean, median, standard deviation, number of observations as well as the 10th, 25th, 75th and 90th percentiles for the main variables used in the analysis. The variables are defined in the Appendix. The sample covers the period 1970 to 2006 and exclude firms from the financial (SIC 6000-6999) and the utility (4900-4999) industries.

Variables	Mean	Median	St.Dev	#Obs	10th	25th	75th	90th
Q	1.515	1.176	1.066	87,145	0.779	0.924	1.684	2.580
Savings	0.012	0.001	0.113	88,501	-0.075	-0.020	0.030	0.097
ψ	1.922	1.902	1.825	87,612	0.082	0.886	2.982	4.092
Illiq	0.041	0.001	0.120	88,333	0.000	0.000	0.011	0.119
Gamma	0.029	0.026	0.216	58,798	-0.085	-0.029	0.091	0.159
Assets	835.483	99.470	2445.221	88,501	10.374	27.912	438.683	1927.249
Cash	0.114	0.059	0.142	87,947	0.009	0.023	0.148	0.297
CF	0.054	0.083	0.142	88,501	-0.070	0.038	0.122	0.161
Capex	0.068	0.050	0.065	88,501	0.011	0.025	0.090	0.150
Acquisitions	0.015	0.000	0.041	88,501	0.000	0.000	0.002	0.045
ΔNWC	0.063	0.048	1.607	88,501	-0.866	-0.244	0.335	0.975
$\Delta ShortDebt$	0.781	-0.045	3.867	88,501	-0.841	-0.433	0.447	2.007

Table II. Price Informativeness and the Saving-to-Price Sensitivity: Baseline Results

This table presents coefficient estimates of corporate savings on stock price and the amount of private information contained in price (specification (4)). The dependent variable is *Savings*, the annual change in cash holdings divided by lagged assets. Q is the normalized price, computed as the market value divided by the book value of assets. ψ is a proxy for the amount of private information in price and refers to firm-specific return variation . The set of control variables include cash flow (*CF*), firms' size (*Size*) and lagged cash (*Cash*). In addition, in column (4), we also include *Capex*, *Acquisitions*, ΔNWC and $\Delta Shortdebt$ as additional control variables. All the variables are defined in the Appendix. The sample period is 1973 through 2006. IV estimations display diagnostic statistics for instrument overidentification restrictions (*p*-values of *J*-statistics reported) and exogeneity conditions (*p*-values for Durbin-Hausman-Wu (D-H-W) reported). The estimations correct the error structure for heteroskedasticity and within-firm error clustering. *t*-statistics in brackets. ** and * denote statistical significance at the 1% and 5% level, respectively.

	Savings (annual change in cash holdings)			
	(1)	(2)	(3)	(4)
Variables	OLS	OLS	OLS	IV
Q_{t-1}	0.013**	0.010**	0.016**	0.017**
	[13.72]	[9.65]	[14.32]	[6.39]
$Q_{t-1} \times \psi_{t-1}$		0.002**	0.002**	0.001*
		[4.49]	[4.14]	[2.17]
ψ_{t-1}		0.000	0.000	-0.002
		[0.05]	[0.44]	[1.00]
CF_t			0.176**	0.206**
			[27.51]	[11.29]
$Size_t$			0.002	-0.020**
			[1.60]	[3.16]
$Cash_{t-1}$			-0.442**	-0.526**
			[51.58]	[17.34]
$Capex_t$				-0.809**
				[2.77]
$Acquisitions_t$				-0.697**
				[3.97]
ΔNWC_t				0.009
				[0.54]
$\Delta ShortDebt_t$				-0.003*
				[2.57]
Firm & Year FE	Yes	Yes	Yes	Yes
#Obs.	88,376	88,376	88,376	73,213
R^2	0.23	0.24	0.34	0.22
J-statistic (p-value)				0.18
D-H-W (p-value)				0.04

Table III. Price Informativeness and the Saving-to-Price Sensitivity: Sensitivity Analysis

This table presents coefficient estimates of corporate savings on stock price and the amount of private information contained in price (specification (4)). The dependent variable is *Savings*, the annual change in cash holdings divided by lagged assets. Q is the normalized price, computed as the market value divided by the book value of assets. ψ is a proxy for the amount of private information in price and refers to firm-specific return variation. The set of control variables include cash flow (*CF*), firms' size (*Size*) and lagged cash (*Cash*). Columns (1) to (3) use daily returns to compute ψ. In column (2) ψ is computed using daily returns that are cumulated in no-trading days. In column (3), ψ is computed by including lagged market and industry returns in the returns regressions. In column (4) ψ is computed by including the Fama and French factors in the returns regressions. The sample period is 1973 through 2006. The estimations correct the error structure for heteroskedasticity and within-firm error clustering. *t*-statistics in brackets. ** and * denote statistical significance at the 1% and 5% level, respectively.

	Savings (annual change in cash holdings)			
	(1)	(2)	(3)	(4)
Variables	Daily	Cumulated	Delay	Fama-French
Q_{t-1}	0.015**	0.014**	0.012**	0.012**
	[12.29]	[13.08]	[7.52]	[6.79]
$Q_{t-1} \times \psi_{t-1}$	0.002**	0.002**	0.003**	0.003**
	[5.82]	[5.81]	[5.65]	[5.50]
ψ_{t-1}	0.000	0.000	-0.003	0.000
	[0.54]	[0.94]	[1.43]	[0.09]
CF_t	0.175**	0.175**	0.176**	0.175**
	[27.36]	[27.46]	[27.34]	[27.62]
$Size_t$	0.003**	0.002	0.001	0.003**
	[2.60]	[1.82]	[1.05]	[2.60]
$Cash_{t-1}$	-0.443**	-0.443**	-0.443**	-0.440**
	[51.41]	[51.40]	[51.42]	[51.37]
Firm & Year FE	Yes	Yes	Yes	Yes
#Obs.	88,010	87,878	87,299	88,371
R^2	0.34	0.34	0.34	0.34

Table IV. Price Informativeness and the Saving-to-Price Sensitivity: Other specifications

This table presents coefficient estimates of corporate savings on stock price and the amount of private information contained in price (specification (4)). The dependent variable is *Savings*, the annual change in cash holdings divided by lagged assets. *Q* is the normalized price, computed as the market value divided by the book value of assets. ψ is a proxy for the amount of private information in price and refers to firm-specific return-variation. The set of control variables include cash flow (*CF*), firms' size (*Size*) and lagged cash (*Cash*). In column (1), *Illiq* refers to the Amihud (2002) liquidity ratio. In column (2), *Gamma* refers to the trading-based informativeness measure of Llorente, Michaely, Saar, and Wang (2002). In column (3) and (4), firm-years observations for which ψ is above (below) 90^{th} (10^{th}) percentile, respectively above (below) 75^{th} (25^{th}) percentile are not included. In column (5) specification (4) is estimated using the Fama and MacBeth (1973) approach. All the variables are defined in the Appendix. The sample period is 1973 through 2006. The estimations correct the error structure for heteroskedasticity and within-firm error clustering. *t*-statistics in brackets. ** and * denote statistical significance at the 1% and 5% level, respectively.

	Savings (annual change in cash holdings)				
	(1)	(2)	(3)	(4)	(5)
Variables	*Illiq*	*Gamma*	10^{th}-90^{th}	25^{th}-75^{th}	FM
Q_{t-1}	0.017**	0.015**	0.016**	0.014**	0.017**
	[16.49]	[12.59]	[12.15]	[8.54]	[14.04]
$Q_{t-1}\times\psi_{t-1}$			0.002**	0.003**	0.001**
			[4.50]	[4.61]	[2.84]
ψ_{t-1}			-0.001	-0.002	0.001*
			[0.84]	[1.92]	[2.34]
$Q_{t-1}\times Illiq_{t-1}$	0.017				
	[1.56]				
$Illiq_{t-1}$	0.01				
	[0.79]				
$Q_{t-1}\times Gamma_{t-1}$		0.001**			
		[3.34]			
$Gamma_{t-1}$		0.002*			
		[2.08]			
CF_t	0.183**	0.192**	0.187**	0.201**	0.137**
	[20.36]	[15.56]	[24.85]	[20.67]	[16.65]
$Size_t$	0.005**	0.006**	0.001	0.001	0.001*
	[3.54]	[3.28]	[1.09]	[0.55]	[1.99]
$Cash_{t-1}$	-0.271**	-0.173**	-0.441**	-0.442**	-0.122**
	[25.85]	[13.57]	[45.69]	[35.09]	[14.65]
Firm & Year FE	Yes	Yes	Yes	Yes	No
#Obs.	82,542	56,326	70,292	44,335	88,376
R^2	0.34	0.34	0.37	0.44	0.08

Table V. Price Informativeness and the Saving-to-Price Sensitivity: Managerial Learning

This table presents coefficient estimates of corporate savings on stock price and the amount of private information contained in price (specification (4)). The dependent variable is *Savings*, the annual change in cash holdings divided by lagged assets. *Q* is the normalized price, computed as the market value divided by the book value of assets. ψ is a proxy for the amount of private information in price and refers to firm-specific return variation. The set of control variables include cash flow (*CF*), firms' size (*Size*) and lagged cash (*Cash*). *Coverage* is the number of analysts that have issued earnings forecast during a year. *Insiders* represents the number of transaction by insiders scaled by the total number of transactions during a year. *ERC* is the average of the absolute market-adjusted stock returns over the four quarterly earnings announcements periods (day-1 to day 1). All the variables are defined in the Appendix. The sample period is 1973 through 2006. The estimations correct the error structure for heteroskedasticity and within-firm error clustering. *t*-statistics in brackets. ** and * denote statistical significance at the 1% and 5% level, respectively.

	Savings (annual change in cash holdings)		
Variables	(1)	(2)	(3)
Q_{t-1}	0.018**	0.016**	0.016**
	[13.85]	[5.48]	[7.32]
$Q_{t-1} \times \psi_{t-1}$	0.001**	0.002**	0.002**
	[3.21]	[2.88]	[3.20]
ψ_{t-1}	0.000	0.000	0.000
	[0.07]	[0.14]	[0.11]
CF_t	0.175**	0.210**	0.194**
	[27.41]	[8.90]	[20.86]
$Size_t$	0.006**	0.022**	0.005*
	[5.21]	[3.90]	[2.42]
$Cash_{t-1}$	-0.443**	-0.677**	-0.464**
	[51.82]	[25.80]	[38.48]
$Q_{t-1} \times Coverage_{t-1}$	-0.000**		
	[4.09]		
$Coverage_{t-1}$	-0.001**		
	[5.99]		
$Q_{t-1} \times Insiders_{t-1}$		-0.001	
		[1.40]	
$Insiders_{t-1}$		0.000	
		[1.34]	
$Q_{t-1} \times ERC_{t-1}$			-0.015
			[1.35]
ERC_{t-1}			0.172**
			[2.72]
Firm & Year FE	Yes	Yes	Yes
#Obs.	88,376	13,879	41,514
R^2	0.35	0.51	0.38

Table VI. Price Informativeness and the Saving-to-Price Sensitivity: Market Mispricings?

This table presents coefficient estimates of corporate savings on stock price and the amount of private information contained in price (specification (4)). The dependent variable is *Savings*, the annual change in cash holdings divided by lagged assets. *Q* is the normalized price, computed as the market value divided by the book value of assets. ψ is a proxy for the amount of private information in price and refers to firm-specific return variation. The set of control variables include cash flow (*CF*), firms' size (*Size*) and lagged cash (*Cash*). *Issuance* is the yearly change in equity plus the change in deferred taxes minus change in retained earnings divided by the beginning-of-year equity stock. $ABRET_{t+3}$ is the value-weighted market adjusted returns cumulated over three years. Columns (4) to (6) exclude firms-years that had their IPO less than one, two and respectively three years ago. All the variables are defined in the Appendix. The sample period is 1973 through 2006. The estimations correct the error structure for heteroskedasticity and within-firm error clustering. *t*-statistics in brackets. ** and * denote statistical significance at the 1% and 5% level, respectively.

	Savings (annual change in cash holdings)					
	(1)	(2)	(3)	(4)	(5)	(6)
Variables				IPO<1yr	IPO<2yrs	IPO<3yrs
Q_{t-1}	0.011**	0.014**	0.009**	0.016**	0.016**	0.016**
	[10.84]	[10.76]	[8.00]	[14.35]	[12.95]	[12.03]
$Q_{t-1} \times \psi_{t-1}$	0.001**	0.002**	0.001*	0.002**	0.002**	0.001**
	[2.65]	[3.82]	[2.37]	[4.16]	[3.98]	[2.91]
ψ_{t-1}	0.000	0.000	0.000	0.000	0.000	0.000
	[0.12]	[0.61]	[0.10]	[0.51]	[0.75]	[0.14]
CF_t	0.199**	0.201**	0.226**	0.176**	0.171**	0.169**
	[32.97]	[23.25]	[27.10]	[27.60]	[26.28]	[24.32]
$Size_t$	0.001	0.001	0.001	0.002	0.002*	0.003**
	[1.28]	[0.49]	[0.68]	[1.40]	[2.09]	[2.58]
$Cash_{t-1}$	-0.408**	-0.445**	-0.404**	-0.442**	-0.432**	-0.433**
	[50.57]	[43.21]	[41.88]	[51.41]	[47.58]	[46.38]
$Issuance_t$	0.078**		0.089**			
	[29.55]		[26.10]			
$EXRET_{t+3}$		-0.006**	-0.003**			
		[7.53]	[3.85]			
Firm & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
#Obs.	86,275	66,965	65,571	88,096	82,777	76,101
R^2	0.41	0.34	0.4	0.34	0.33	0.32