

# How Stock Price Informativeness Can Affect Labor Investment Efficiency

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## Abstract

In this paper, we examine whether managers use information included in stock prices when making labor investment decisions. Specifically, we examine whether stock price informativeness affects labor investment efficiency. We find that a higher probability of informed trading (*PIN*) is associated with lower deviations of labor investment from the level justified by economic fundamentals i.e., higher labor investment efficiency. This finding is robust to using alternative proxies for stock price informativeness and labor investment efficiency, when we control for earnings quality and mispricing, and when we address endogeneity issues. Furthermore, we examine how the impact of stock price informativeness on labor investment efficiency depends on labor union and financial constraints. Particularly, we find stock price informativeness helps mitigating the adverse effects of labor union and financial constraints on labor investment, respectively. Collectively, our results highlight the importance of information included in stock prices for the investment in human capital.

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# How Stock Price Informativeness Can Affect Labor Investment Efficiency

## 1. Introduction

A growing strand of literature suggests that the information aggregated and transmitted into stock prices via the trading activities of different speculators and investors in the stock markets (Grossman and Stiglitz, 1980; Kyle, 1985), may be used by managers when making investment decisions. Empirical literature provides large support for this point of view. For example, Durnev, Morck and Yeung (2004) show that more informative stock prices help improving investment efficiency. Similarly, Chen, Goldstein, and Jiang (2007) report evidence suggesting that stock price informativeness is associated with higher investment-stock price sensitivity, hence more efficient investment. More recently, Foucault and Frésard (2012), using a large sample of U.S. cross-listings, confirm the findings of Chen et al. (2007). In this paper, we extend the aforementioned strand of literature by examining whether managers use information incorporated in stock prices when investing in human capital. Specifically, we examine whether more informative stock prices are associated with lower deviations of labor investment from the level justified by economic fundamentals i.e., higher labor investment efficiency.

Stock price informativeness may affect labor investment efficiency in two ways. First, stock prices include information that managers do not possess such as information about future investment and growth opportunities, future demand of the firm's products and services, and financing opportunities, which may affect labor investment decisions (Pinnuck and Lillis, 2007; Benmelech, Bergman, and Seru, 2011). Second, more informative stock prices are associated with better external and/or internal monitoring of managers (Ferreira, Ferreira, and Raposo, 2011; Holmström and Tirole, 1993), hence help mitigating the empire building problem (i.e., the fact to hire more employees than required to run profitable projects (i.e., over-hiring) or to keep the employees that are used in non-profitable projects (i.e., under-firing)). Consequently, more informative stock prices may result in a level of labor investment that is close to the one justified by economic fundamentals i.e., a more efficient labor investment.

Our research question is important for several reasons. First, we choose to examine the impact of stock price informativeness on labor investment because human capital is one of the important factors of production that determine the firm's output. Second, focusing on labor as a

factor of production used by all firms rather than on other types of investment such as research and development (R&D), allows us to test the impact of stock price informativeness on investment across a broad cross-section of firms. Third, labor investment is affected by empire building motivations. Given that, examining the impact of stock price informativeness on labor investment efficiency allows us to further test the hypothesis stating that more informative stock prices alleviate the empire building problems, which leads to over-investment. Finally, focusing on labor investment as one of the first factor of productions to be cut (Pinnuck and Lillis (2007), allows us also to examine how stock price informativeness may limit divestments that are not justified by economic fundamentals (i.e., under-investment).

To empirically test our hypothesis, we follow Pinnuck and Lillis (2007) and estimate the level of labor investment (i.e., the percentage change in the number of employees) justified by economic fundamentals (e.g., profitability, liquidity, leverage, sales growth and losses). Our main proxy for labor investment efficiency is the absolute value of the difference between the observed level of labor investment and the one justified by economic fundamentals. The lower is this difference the higher is labor investment efficiency. To measure the extent of informed trading, hence the degree by which firm-specific information is incorporated into stock prices (i.e., stock price informativeness), we follow Chen et al. (2007) and Ferreira et al. (2011) and use the Probability of Information trading (*PIN*) derived from Easley, Kiefer, and O'Hara's (1996) market microstructure model. A higher value for *PIN* indicates higher probability of informed trading, hence higher stock price informativeness. In robustness tests, we use alternative proxies for stock price informativeness. First, we use Amihud's (2002) illiquidity proxy. Second, we use firm-specific return variation proxies based on the following models: (i) Fama and French's three-factor model, (ii) Brockman and Yan's (2009) model, and (iii) Jin and Myers's (2006) model.

Using a sample of U.S. firms over the period 1994-2010, we show that a higher probability of informed trading (*PIN*) (i.e., higher stock price informativeness) is associated with lower deviations of labor investment from the level justified by economic fundamentals i.e., higher labor investment efficiency. *PIN* is economically highly significant. In fact, moving *PIN* from its first to its third quartile is associated with a 17.4% decrease in labor investment inefficiency. This finding is consistent with the view that managers use the information

incorporated in stock prices (e.g., information about future investment and growth opportunities, future relationship with stakeholders, and future financing policies) when investing in human capital. This result is also consistent with the view that stock prices act as a disciplinary mechanism of managers. Specifically, more informative stock prices result in a better monitoring of managers (Ferreira et al., 2011), which alleviates the empire building problem, leading to a more efficient investment in labor. This finding remains robust when we address the endogeneity of *PIN*. Indeed, this result remains qualitatively unchanged when we use firm fixed-effects model and the two-stage instrumental variable approach.

We also show that labor union affects the relationship between stock price informativeness and labor investment efficiency. Firms operating in highly unionized industries may be unable to invest efficiently in labor i.e., to have a level of labor investment that is close to the one justified by economic fundamentals. For example, it is more difficult for firms operating in highly unionized industries to fire employees when suggested by economic fundamentals. We report evidence suggesting that stock price informativeness helps mitigating distortions in labor investment created by labor union. Additionally, we examine whether the relationship between stock price informativeness is affected by financial constraints. Financial constraints determine labor investment (Benmelech et al., 2011), suggesting that some of labor costs are fixed costs (e.g., hiring and training costs), hence requires financing. We find that our results are robust to the introduction of a proxy for financial constraints (i.e., external financing dependence proxy in line with Foucault and Frésard, 2012). We also report evidence suggesting that stock price informativeness helps mitigating labor investment inefficiencies for firms that are more financially constrained.

In line with prior research on investment efficiency (e.g., Biddle et al., 2009), we split our sample based on whether the difference between the observed labor investment and the one justified by economic fundamentals is positive (i.e., over-investment) or negative (i.e., under-investment). We report evidence suggesting that stock price informativeness helps mitigating all kind of inefficiencies in labor investment. Specifically, we find that stock price informativeness alleviates over-investment and under-investment problems in labor, respectively. We also find that stock price informativeness helps mitigating over-investment

and under-investment problems in periods of expected expansion (i.e., over-hiring and under-firing) and expected recession (i.e., under-hiring and over-firing).

We also perform several tests to ensure that our findings are not driven by non-labor investments (i.e., capital expenditures, R&D expenses, advertising expenses, and acquisition expenses). We examine the relationship between on the association between stock price informativeness and labor investment efficiency when: (i) labor investment and non-labor investment are positively correlated, (ii) labor investment and non-labor investment are negatively correlated, and (iii) the firm has a missing value for non-labor investment. We find that the negative relationship between stock price informativeness and labor investment efficiency is not concentrated in the sub-samples of firms with a positive relationship between non-labor investment and labor investment, suggesting that our findings are not driven by non-labor investments.

We also perform several other robustness tests to ensure the robustness of our findings. We find that our results are robust to the use of alternative proxies of labor investment efficiency as well as alternative definitions of the *PIN* variable. We also find that our results remain qualitatively unchanged after controlling for variables that have been shown to affect labor investment efficiency, particularly earnings management (Jung et al., 2013) and earnings informativeness (Pinnuck and Lillis, 2007). Furthermore, our findings remain robust when control mispricing proxies (i.e., analyst forecast bias, analyst forecast dispersion, and cumulative abnormal returns) that have been shown to affect investment efficiency (e.g., Chen et al., 2007; Bakke and Whited, 2010).

Our paper contributes to the literature in two ways. First, we extend the literature on managerial learning (e.g., Durnev et al., 2004; Chen et al., 2007; Bakke and Whited, 2010; Foucault and Frésard, 2012; Ferreira et al., 2011; Zuo, 2013) by focusing on the investment in human capital. Second, we add to the literature on labor investment (e.g., Pinnuck and Lillis, 2007; Benmelech et al., 2011; Hall, 2013; Faccio and Hsu, 2013) by examining whether informed trading helps improving labor investment efficiency.

The rest of the paper is organized as follows. Section 2 reviews the literature and develops our testable hypothesis. Section 3 presents our stock price informativeness and labor

investment efficiency proxies, describes the sample, and provides descriptive statistics for the regression variables. Section 4 presents our empirical results. Section 5 summarizes our findings and offers a conclusion.

## **2. Hypothesis development**

The managerial learning hypothesis suggests that managers can learn new private information from their stock prices that helps improving their decisions efficiency (Hayek, 1945), hence increases the value of the firm. This private information is aggregated and transmitted into stock prices via the trading activities of different speculators and investors in the stock markets (Grossman and Stiglitz, 1980; Kyle, 1985). This information can be about future investment opportunities (Dow and Gorton, 1997), demand for the firm's product and services, and financing policies (Subrahmanyam and Titman, 1999). It can also take the form of information about relationships with different shareholders and competition with other firms.

Several empirical papers support the managerial learning hypothesis. For example, Durnev et al. (2004) report evidence suggesting that managers are more likely to undertake efficient investment decisions when the firm's stock price conveys more private information from investors. In the same vein, Chen et al. (2007) show that more informative stock prices are associated with higher investment-stock price sensitivity, again supporting the argument that more informative stock prices lead to more efficient investment decisions. This finding is confirmed by Bakke and Whited (2010) who use a different research methodology and Foucault and Frésard (2012) who use a large sample of U.S. cross-listings. Stock price informativeness has been also shown to affect other corporate decisions. In fact, Frésard (2012) shows that higher stock price informativeness improves the efficiency of corporate savings decisions. Similarly, Luo (2005) reports evidence suggesting that managers use information from the stock markets when finalizing mergers and acquisitions deals. More recently, Zuo (2013) reports evidence suggesting that the information included in stock prices affect forward-looking disclosures. Given the above mentioned arguments, stock price informativeness may affect the investment in labor since it includes information that managers do not possess about the future demand of the firm's products and services, growth opportunities, and financing policies which determines the level of investment in labor (Pinnuck and Lillis, 2007; Benmelech et al., 2011).

The managerial learning hypothesis also suggests that better informed stock prices are associated with better corporate governance (Ferreira et al., 2011; Holmström and Tirole, 1993). Specifically, informative stock prices discipline managers and enhance external monitoring mechanisms. For example, the announcement of non-efficient investments increases the hostile takeover likelihood. Consistent with this point of view, Edmans, Goldstein, and Jiang (2012), using mutual fund redemptions as an instrument for price changes, show that market prices have a strong impact on takeover activity. Informative stock prices may discipline managers since they may be replaced if the takeover succeeds (Holmström and Tirole, 1993). Furthermore, more informative stock prices may be associated with more efficient internal monitoring by the board of directors. Indeed, the board of director's members may learn new information from the stock market; hence better monitor managers. Consistent with this point of view, Ferreira et al. (2011) show that more informative stock prices are associated with less board independence, suggesting that stock price informativeness may replace a disciplinary mechanism such as board monitoring.

Given that Stock price informativeness is associated with better monitoring of managers, it may mitigate the empire building problem. Indeed, empire building ambitions may induce managers to hire more employees than required by profitable projects or to keep employees used in non-profitable projects. Stock price informativeness which is associated with better monitoring of managers may alleviate this problem, resulting in a level of investment in labor that is close to the one justified by economic fundamentals i.e., a more efficient investment in labor.

### 3. Empirical design

#### 3.1 Stock price informativeness proxies

In line with Chen et al. (2007) and Ferreira et al. (2011), we use the Probability of Information trading (*PIN*) derived from Easley et al.'s (1996) market microstructure model.

$$PIN = \frac{\alpha\mu}{\alpha\mu + \varepsilon_B + \varepsilon_S} \quad (1)$$

where  $\alpha$  is the probability of informed trading,  $\mu$  is the daily rate of informed trading occurrence,  $\varepsilon_B$  is the daily arrival rate of uninformed buy orders, and  $\varepsilon_S$  is the daily arrival rate of uninformed sell orders. Brown, Hillegeist, and Lo (2004) use intra-day transaction data to estimate  $\alpha$ ,  $\mu$ ,  $\varepsilon_B$ , and  $\varepsilon_S$  and consequently  $PIN$ . In this paper, we use Brown et al.'s (2004) continuously updated  $PIN$  data.<sup>1</sup> A higher value for  $PIN$  indicates higher probability of informed trading, hence higher stock price informativeness.

### 3.2 Labor investment efficiency proxy

To examine the impact of stock price informativeness on the efficiency of investment in Labor, we follow Pinnuck and Lillis's (2007) two steps approach. First, we estimate the expected change in the number of employees based on economic fundamentals using the following model:

$$\begin{aligned}
LABOR\_INVEST_{i,t} = & \theta_0 + \theta_1 RET_{i,t} + \theta_2 MV\_RANK_{i,t} + \theta_3 ROA_{i,t} + \theta_4 QUICK\_RATIO_{i,t-1} + \theta_5 LEVERAGE_{i,t-1} \\
& + \sum_{j=0}^1 \phi_j SG_{i,t-j} + \sum_{j=0}^1 \phi_j \Delta ROA_{i,t-j} + \sum_{j=0}^1 \alpha_j \Delta QUICK\_RATIO_{i,t-j} + \sum_{j=1}^5 \beta_j LOSS\_DUMMY_{i,t,j} \\
& + \sum_{j=1}^{48} \alpha_j \gamma_j + \varepsilon_{i,t}
\end{aligned} \tag{2}$$

$LABOR\_INVEST_{i,t}$  represents the difference between the number of employees for firm  $i$  at year  $t$  and  $t-1$  scaled by the number of employees for firm  $i$  at year  $t-1$ ;  $RET_{i,t}$  is the annual return for firm  $i$  at year  $t$ ;  $MV\_RANK_{i,t}$  is the percentile rank of the logarithm of market value for firm  $i$  at year  $t$ ;  $ROA_{i,t}$  is the ratio of net income over total assets for firm  $i$  at year  $t$ ;  $QUICK\_RATIO_{i,t}$  is calculated as the ratio of the sum of cash and short-term investments for firm  $i$  at year  $t$  and receivables for firm  $i$  at year  $t$  over current liabilities for firm  $i$  at year  $t$ ;  $LEVERAGE_{i,t}$  is calculated as the ratio of long-term debt for firm  $i$  at year  $t$  over total assets for firm  $i$  at year  $t$ ;  $SG_{i,t}$  represents the difference between sales revenue for firm  $i$  at year  $t$  and year  $t-1$  scaled by sales revenue for firm  $i$  at year  $t-1$ ;  $LOSS\_DUMMY_{i,t}$  are five dummy

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<sup>1</sup> The database is available at <http://www.rhsmith.umd.edu/faculty/sbrown/pinsdata.html>. See Brown et al. (2004) for a description of the approach used to estimate  $PIN$  values.



variables indicating each 0.005 interval of  $ROA_{i,t-1}$  from 0 to -0.025;  $\gamma_t$  are industry dummies controlling for industry fixed-effects;  $\varepsilon_{i,t}$  is the error term.

We estimate equation (2) for each firm-year observation. The absolute value of the difference between the observed value for  $LABOR\_INVEST_{i,t}$  and the predicted value for  $LABOR\_INVEST_{i,t}$  using equation (2) (i.e., abnormal change in labor investment),  $|ABN(LABOR\_INVEST_{i,t})|$ , is our proxy for the inefficiency of investment in labor. A higher deviation of labor investment from its predicted value based on economic fundamentals indicates lower labor investment efficiency.<sup>2</sup>

To test the relationship between stock price informativeness and labor investment efficiency, we estimate the following regression model:

$$|ABN(LABOR\_INVEST_{i,t})| = \delta_0 + \delta_1 SPI_{i,t-1} + \delta_2 CONTROLS_{i,t} + \gamma_t + \varepsilon_{it} \quad (3)$$

Following the recent literature on investment efficiency (e.g., Biddle, Hilary, and Verdi, 2009; Jung, Lee, and Weber, 2013), we include in  $CONTROLS$  the following variables: the natural logarithm of the firm's market value at the beginning of the year ( $SIZE_{i,t-1}$ ) to control firm size,  $LEVERAGE_{i,t-1}$  to control for financial risk, the market-to-book ratio ( $MB_{i,t-1}$ ) at the beginning of the year to control for growth opportunities, the ratio of net property, plant, and equipment at year  $t-1$  over total assets at year  $t-1$  ( $NET\_PPE_{i,t-1}$ ) to control for the extent of investment in fixed assets,  $QUICK\_RATIO_{i,t-1}$  to control for liquidity, a dummy variable ( $LOSS_{i,t-1}$ ) equal to one (1) if  $ROA_{i,t-1}$  is negative, and zero (0) otherwise to control for economic losses, a dummy variable equal to one (1) if the firm  $i$  pays dividends at year  $t-1$ , and zero (0) otherwise ( $DIV\_PAYER_{i,t-1}$ ) to control for dividend payout, the volatility of cash flow from

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<sup>2</sup> In line with Pinnuck and Lillis (2007), we find a positive and significant coefficient for  $SG_{i,t}$ ,  $SG_{i,t-1}$ ,  $ROA_{i,t}$ ,  $\Delta ROA_{i,t-1}$ ,  $RET_{i,t}$ ,  $MV\_RANK_{i,t}$ ,  $QUICK\_RATIO_{i,t-1}$  and  $\Delta QUICK\_RATIO_{i,t-1}$ , respectively. We also find a negative and significant coefficient for  $\Delta ROA_{i,t}$ ,  $\Delta QUICK\_RATIO_{i,t}$ ,  $LEV_{i,t-1}$ , and all  $LOSS\_DUMMY$  variables, respectively.

operations ( $CF\_VOL_{i,t}$ ) and sales revenue ( $SALES\_VOL_{i,t}$ ) over the period from  $t-1$  to  $t-5$ , respectively, to control for operating and sales volatility, the volatility of  $LABOR\_INVEST_{i,t}$  over the period from  $t-1$  to  $t-5$  ( $LABOR\_INVEST\_VOL_{i,t}$ ) in order to control for the volatility of labor investment, and the absolute value of the residuals,  $|ABN(OTHER\_INVEST_{i,t})|$ , from the regression of non-labor investment ( $OTHER\_INVEST_{i,t}$ ) on  $SG_{i,t}$  to control for non-labor investment efficiency.  $OTHER\_INVEST_{i,t}$  is the sum of capital expenditures, acquisition expenditures, and R&D expenses less the proceeds from the sale of property, plant, and equipment). We also include in *CONTROLS* the fraction of the firm's shares held by institutional investors at year  $t-1$  ( $IO_{i,t-1}$ ) to control for institutional ownership, industry unionization rate ( $UNION_{t-1}$ ) to control for labor protection, and the ratio of the number of employees over total assets at year  $t-1$  ( $LABOR\_INTENSITY_{t-1}$ ) to control for labor intensity. The other variables are as previously defined.

### 3.3 Sample and descriptive statistics

3.2.1 *Sample.* We collect financial data from *COMPUSTAT*. We also collect firm and market stock returns as well as three factors of Fama-French returns, used to estimate our alternative proxies for stock price informativeness, from *CRSP*. We obtain analyst coverage data from *I/B/E/S* summary files. Additionally, we collect institutional ownership data from Thomson Financial institutional holdings (13f) database and labor union data from Hirsch and Macpherson (2003)'s updated database of Union Membership and Coverage.<sup>3</sup> Data on the probability of informed trading (PIN) comes from Brown et al.'s (2004) continuously updated database of PIN estimates. We start with estimating the expected level of investment in labor based on economic fundamentals using Model (2) for all firms listed in *COMPUSTAT* during the period between 1992 and 2010.<sup>4</sup> Then we calculate our proxy of Labor inefficiency as absolute value of the difference between the observed and the expected values of Labor

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<sup>3</sup> The database is available at <http://www.unionstats.com>. See Hirsch and Macpherson (2003) for a description of the approach used to construct this database.

<sup>4</sup> *PIN* data is available for the period between 1993 and 2010. We use *COMPUSTAT* data on the period between 1992 and 2010 to estimate equation (2) because it contains lagged variables.

investment. We obtain a sample of 63,558 firm-year observations for the period from 1993 and 2010. Then, we merge estimated Labor investment efficiency data with Brown et al.'s (2004) continuously updated database of  $PIN$  estimates available for the period from 1993 to 2010. Additionally, we merge the resulting data with data on the control variables outlined in section 3.2. Finally, we winsorize all firm-level variables at the 1<sup>st</sup> and the 99<sup>th</sup> percentiles to mitigate the effect of outlier observations. We end-up with a sample of 21,551 firm-year observations for the period from 1994 and 2010.<sup>5</sup>

3.2.2 *Descriptive statistics and univariate results.* Table 1 reports descriptive statistics on the variables used to estimate equation (3). The average (median) of  $|ABN(LABOR\_INVEST_{i,t})|$  is equal to 0.152 (0.099). The average (median) of  $PIN_{i,t-1}$  is equal to 0.189 (0.170). These numbers are comparable to those reported in Brown et al. (2004). The descriptive statistics of the control variables are also comparable to related investment studies (e.g., Biddle et al., 2009, and Jung et al., 2013).

**[Insert Table 1 about here]**

Table 2 reports Pearson correlation coefficients between  $|ABN(LABOR\_INVEST_{i,t})|$ ,  $PIN_{i,t-1}$ , and the control variables. The correlation coefficients that are significant at the 1% level are shown in bold. Consistent with our hypothesis, we find that  $PIN_{i,t-1}$  is significantly and negatively correlated at the 1% level with  $|ABN(LABOR\_INVEST_{i,t})|$ , suggesting that more informative stock prices lead to more efficient investment in labor. As for the control variables, we report several significant correlations which are consistent with prior related investment literature. In fact,  $|ABN(LABOR\_INVEST_{i,t})|$  is negatively and significantly correlated at the 1% level with  $SIZE_{i,t-1}$ ,  $DIV\_PAYER_{i,t-1}$  and  $IO_{i,t-1}$ , indicating that large firms, firms paying dividends, and firms with higher institutional ownership have more efficient investment in labor.  $|ABN(LABOR\_INVEST_{i,t})|$  is also positively correlated at the 1% level with  $CF\_VOL_{i,t}$ ,  $SALES\_VOL_{i,t}$ , and  $LABOR\_INVEST\_VOL_{i,t}$ , implying that firms with more volatile cash

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<sup>5</sup> We lost the observations for 1993 because equation (3) includes lagged  $PIN$ .

flows, sales, and investment in labor have less labor investment efficiency, respectively. Finally,  $|ABN(LABOR\_INVEST_{i,t})|$  is positively correlated at the 1% level with  $|ABN(OTHER\_INVEST_{i,t})|$ , indicating that firms with higher abnormal levels of non-labor investments have lower labor investment efficiency. We generally report low correlation coefficients between  $PIN$  and our control variables, thus mitigating multicollinearity concerns that could affect our regression results.

**[Insert Table 2 about here]**

## 4. Empirical results

### 4.1 Main evidence

Table 3 reports the OLS results obtained by regressing our proxy for labor investment efficiency on  $PIN$ . In all models, we control for firm-level and year fixed-effects. The results reported in Model 1, our basic regression, provide evidence that supports our hypothesis, suggesting that more informative stock prices are associated with a level of investment in labor that is close to the one justified by economic fundamentals i.e., higher labor investment efficiency. To be precise, we find that the coefficient of  $PIN_{i,t-1}$  is negative and statistically significant at the 1% level, suggesting that managers use the information incorporated in stock prices (e.g., information about future investment and growth opportunities, future relationship with stakeholders, and financing policies) which leads to more efficient investment in labor. An alternative explanation of our finding is that informative stock prices act as a disciplinary mechanism of managers, hence better monitoring, which alleviates the empire building problem, resulting in a more efficient investment in labor.  $PIN_{i,t-1}$  is economically highly significant. It shows conclusively that moving stock price informativeness from its first to its third quartile is associated with a 17.4% decrease in labor investment inefficiency.<sup>6</sup>

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<sup>6</sup> The sample average value  $|ABN(LABOR\_INVEST_{i,t})|$  is 0.152. The coefficient for  $PIN_{i,t-1}$  is equal to -0.209. Moving  $PIN_{i,t-1}$  from the first quartile (0.117) to the third quartile (0.244) is associated with a 17.4% decrease in labor investment inefficiency  $(-0.209 \times 0.127 / 0.152) = -0.174$ .

The rest of the Models of Table 3 reports the results of estimating regression (3) with different approaches to ensure the robustness of our finding. One potential concern is that  $PIN$  and labor investment efficiency may be jointly determined by unobservable factors. We use the lagged value of  $PIN$  as an explanatory variable instead of its current value, which helps addressing this issue. We further address this concern using the firm-fixed effects approach (Model 2) and the two-stage least squares approach (Models 3 and 4).

The results of Model 2 show that coefficient for  $PIN_{i,t-1}$  is still negative and significant at the 1% level, corroborating our earlier finding.  $PIN_{i,t-1}$  is also still highly economically significant. In fact, moving  $PIN_{i,t-1}$  from its first quartile to its third quartile is associated with a 16.9% decrease in labor investment efficiency. Model 3 reports the results of the first-stage in which we predict  $PIN$  on the basis of instruments along with the other independent variables used in our basic regression (Model 1 of Table 3). We use the natural logarithm of one plus the number of analysts following the firm ( $ACOV$ ) as well as turnover ratio ( $TURNOVER$ ), calculated as the ratio of the number of shares traded over the number of shares outstanding, as instruments for  $PIN$ . Piotroski and Roulstone (2004) and Chan and Hameed (2006) show that higher analyst coverage is associated with more synchronous stock prices with the market, i.e., less informative stock prices. Ferreira et al. (2011) also report evidence suggesting that share turnover is associated with lower stock price informativeness. These findings are consistent with the conjecture that firms with higher analyst coverage and greater trading activity have more uninformed order flow, i.e., lower stock price informativeness, respectively. Given that, we expect a negative coefficients for both  $ACOV$  and  $TURNOVER$ . The results, reported in Model 3 of Table 3, show that  $ACOV$  and  $TURNOVER$  loads negative and significant at the 1% level, consistent with our predictions.<sup>7</sup> In the second stage, we use the first-stage fitted values as instruments for  $PIN$ . The results, reported in Model 4 of Table 2, show that the coefficient for  $PIN$  remains negative and significant at the 1% level, again supporting our earlier finding.

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<sup>7</sup> To validate our choice of instruments for  $PIN$ , we follow Larcker and Rusticus (2010, page 190) and perform an over-identifying restriction test, that is, we regress the residuals of the second stage on the exogenous variables (i.e.,  $ACOV$ ,  $TURNOVER$ , and the control variables). We find that the explanatory variables are jointly not significant, suggesting that  $ACOV$  and  $TURNOVER$  is exogenous.

Additionally, we use Fama and MacBeth (1973) approach as well as median (least absolute value regression), respectively, in Models 5 and 6 to ensure that our findings are not affected by potential outlier problems and cross-sectional error correlation. The coefficient for  $PIN_{i,t-1}$  remains negative and significant at the 1% level, corroborating our earlier finding.

We report several significant relations between the control variables and our proxy for labor investment efficiency. The coefficients for  $SIZE_{i,t-1}$ ,  $DIV\_PAYER_{i,t-1}$  and  $IO_{i,t-1}$  are negative and significant at the 1% level, across all specifications, suggesting that large firms, dividend payers firms, and firms with higher institutional ownership invest more efficiently in labor. Additionally, we find a positive and generally significant coefficients for  $LEV_{i,t-1}$ ,  $QUICK\_RATIO_{i,t-1}$ ,  $LOSS_{i,t-1}$ ,  $LABOR\_INVEST\_VOL_{i,t}$ , implying that firms with higher leverage, higher liquidity, losses and higher labor investment volatility have less labor investment efficiency., respectively. Finally, we find that  $|ABN(OTHER\_INVEST_{i,t})|$  is positive and significant at the 1% level, across all specifications, consistent with the conjecture that firms with higher absolute value of non-labor investment have higher labor investment efficiency.

**[Insert Table 3 about here]**

#### 4.2 Alternative proxies for stock price informativeness

We use several other stock price informativeness proxies as robustness. First, we use Amihud's (2002) illiquidity proxy. The illiquidity ratio is defined as the annual average of the ratio of the daily absolute stock return over the daily transaction volume (multiplied by  $10^6$ ).

$$ILLIQ_{i,t} = \frac{1}{D_{i,t}} \sum_{\tau=1}^{D_{i,t}} \frac{|r_{i,\tau}|}{VOLD_{i,\tau}} \quad (4)$$

where  $r_{i,\tau}$  is the stock return of firm  $i$  at day  $\tau$ ,  $VOLD_{i,\tau}$  is the dollar volume of firm  $i$  at day  $\tau$ , and  $D_{i,t}$  is the number of transactions of firm  $i$ 's stock at year  $t$ . This measure gives the absolute percentage change of stock price per dollar trading volume, hence proxies the impact of trades on price. A higher value of  $ILLIQ_{i,t}$  indicates more informed trading (Kyle, 1985), hence more informative stock prices (Ferriera et al., 2011, and Frésard, 2012).

Third, we use three different firm-specific return variation proxies of stock price informativeness. *Firstly*, we estimate our measure of firm-specific variation using Fama and French three-factor model. Specifically, we regress the difference between weekly stock return and the risk free rate (i.e., excess return) of each firm in our sample on the three factors from the model of Fama and French:

$$RET_{it} - R_{ft} = \alpha_i + \beta_{1i}RM_t + \beta_{2i}SMB_t + \beta_{3i}HML_t + \varepsilon_{it} \quad (5)$$

where  $RET_{it}$  is stock return for firm  $i$  at week  $t$ ,  $R_{ft}$  is the risk free rate at week  $t$ ,  $RM_t$  is equal to the value-weighted excess market at week  $t$ ,  $SMB_t$  is the small-minus-big size factor return at week  $t$ ,  $HML_t$  is the high-minus-low book-to-market factor return at week  $t$ , and  $\varepsilon_{it}$  is an error term. The logistic transformation of the ratio of idiosyncratic volatility to total volatility ( $1 - R^2$ ) estimated using equation (5),  $\log\left(\frac{1 - R^2}{R^2}\right)$  is our first proxy for stock firm-specific return variation ( $SPI1$ ). A higher value for  $SPI1$  indicates higher firm-specific stock return variation i.e., more informative stock prices.

*Secondly*, we estimate our measure of firm-specific variation using Brockman and Yan's (2009) model. We regress the weekly stock return of each firm in our sample on the current and previous week's value-weighted market return as well as the current and previous week's value-weighted industry return:

$$RET_{it} = \alpha_i + \beta_{1i}MARKET\_RET_{it} + \beta_{2i}MARKET\_RET_{i,t-1} + \beta_{3i}INDUST\_RET_{it} + \beta_{4i}INDUST\_RET_{i,t-1} + \varepsilon_{it} \quad (6)$$

where  $MARKET\_RET_{it}$  is value-weighted market return at week  $t$ .  $INDUST\_RET_{it}$  is equal to the value-weighted return for the industry to which firm  $i$  belongs at week  $t$ . Industry is based on Fama and French's (1997) classification. The rest of the variables are as previously defined. The logistic transformation of the ratio of idiosyncratic volatility to total volatility estimated using equation (6) is our second proxy for stock firm-specific return variation ( $SPI2$ ).

*Thirdly*, we estimate our measure of firm-specific variation using Jin and Myers's (2006) model. We regress the weekly stock return of each firm in our sample on the current week,

previous week, two weeks back, one week ahead and two weeks ahead value-weighted market return:

$$RET_{it} = \alpha_i + \beta_{1i} MARKET\_RET_{it} + \beta_{2i} MARKET\_RET_{i,t-1} + \beta_{3i} MARKET\_RET_{i,t-2} + \beta_{4i} MARKET\_RET_{i,t+1} + \beta_{5i} MARKET\_RET_{i,t+2} + \varepsilon_{it} \quad (7)$$

the variables are as previously defined. The logistic transformation of the ratio of idiosyncratic volatility to total volatility estimated using equation (7) is our third proxy for stock firm-specific return variation (*SPI3*).

The results for the Amihud's (2002) illiquidity measure are reported in Model 1 of Table 4. We find that the coefficient for  $ILLIQ_{i,t-1}$  is negative and significant at the 1% level, corroborating our previous finding and suggesting that firms are more likely to invest efficiently in labor when price contains more private information.  $ILLIQ_{i,t-1}$  is also economically highly significant. Indeed, moving  $ILLIQ_{i,t-1}$  from its first to its third quartile is associated with a 9.12% decrease in labor investment inefficiency. The results for our first proxy for firm-specific stock return variation are reported in Model 2 of Table 4. We find that the coefficient of  $SPI1_{i,t-1}$  is negative and significant at the 1% level, suggesting that firms whose stock returns are less synchronized with the market invest more efficiently in labor.  $SPI1_{i,t-1}$  is also economically highly significant. In fact, moving  $SPI1_{i,t-1}$  from its first to its third quartile decreases labor investment inefficiency by 10.03%. The results for our second proxy and third proxy for firm-specific stock return variation are reported in Models 3 and 4 of Table 4, respectively. We find that the coefficients of  $SPI2_{i,t-1}$  and  $SPI3_{i,t-1}$  are negative and significant at the 1% level, respectively. These results again suggest that a high degree firm-specific stock return variation is associated with more efficient labor investment.

**[Insert Table 4 about here]**

### **4.3 The role of labor union and financial constraints**

In this section, we examine the impact of labor union and financial constraints on the relationship between stock price informativeness and labor investment efficiency, respectively. In Models 1 and 2, we separately include these variables as well as interaction terms between



stock price informativeness and these variables. In Model 1, we examine how labor union measured by the industry-level of unionization (*UNION*) affects the association between *PIN* and labor investment efficiency. Wages are sticky and layoffs are more costly in highly unionized industries (e.g., Chen et al., 2011). These firms may be less able to invest efficiently in labor. For example, they may be less able to fire employees when it is justified by economic fundamentals (i.e., period of expected recession). Given that, we expect that stock price informativeness helps mitigating distortions in labor investment created by labor union. The results reported in Model 1 of Table 5 show that the coefficient for  $PIN_{i,t-1} * UNION_{i,t-1}$  is negative and statistically significant at the 5% level, suggesting that stock price informativeness is associated with a lower  $|ABN(LABOR\_INVEST_{i,t})|$  i.e., higher labor investment efficiency in highly unionized industries, consistent with our predictions.

In Model 2, we examine the impact of financial constraints on the association between stock price informativeness and labor investment efficiency. Benmelech et al., (2011) show that financial constraints determine labor investment. This finding is consistent with the argument that labor costs are not pure variable costs, hence require financing. Indeed, several labor costs are fixed costs such as hiring and training costs (e.g., Oi, 1962; Hamermesh, 1993). To rule out the possibility that our findings are driven by financial constraints, we control for external financing dependence (*EF*) using the industry-median value of the difference between capital expenditures and cash flow from operations scaled by capital expenditures, in line with Foucault and Frésard (2012). A higher value of *EF* for a specific industry indicates that a firm belonging to this industry is more likely to be highly financially constrained. As for the impact of financial constraints on the relationship between stock price informativeness and labor investment efficiency, we expect that stock price informativeness better helps alleviating labor investment inefficiencies for firms that are more financially constrained. The results reported in Model 1 show that the coefficient for  $EF_{i,t-1}$  is positive and significant at the 1% level, suggesting that firms that are more financially constrained are less likely to invest efficiently in labor, consistent with Benmelech et al. (2011). This finding is robust to the use of alternative proxies for financial constraints (i.e., Kaplan and Zingales's index (*KZ*) and a credit rating dummy from *COMPUSTAT* (i.e., a variable equal to one if a firm has an S&P long-term domestic issuer credit rating and zero otherwise)). We still report a negative and significant coefficient at the 1% level

for  $PIN_{i,t-1}$ , suggesting that our findings are not driven by financial constraints. We also find that the coefficient for  $PIN_{i,t-1} * EF_{i,t-1}$  is negative and significant at the 1% level, consistent with our predictions and suggesting that stock price informativeness helps mitigating the adverse effects of financial constraints on labor investment.

**[Insert Table 5 about here]**

#### **4.4 Over-investment versus under-investment**

We extend our previous analysis by separately examining the impact of stock price informativeness on labor investment efficiency for the sub-sample of firms for which the observed labor investment is higher than expected (over-investment) and the sub-sample of firms for which the observed labor investment is lower than expected (under-investment). The results for the over-investment sub-sample are reported Panel A of Table 6. The results of the total over-investment sub-sample firms are reported in Model 1. We find that the coefficient for  $PIN_{i,t-1}$  is negative and significant at the 1% level, suggesting that more informative stock prices help mitigating over-investment problems in labor, also consistent with the conjecture that informative stock prices help mitigating the empire building problem. We split our over-investment sub-sample based on whether the expected level of labor investment (i.e., estimated using equation (2)) is positive (over-hiring) or negative (under-firing). The results of the over-hiring sub-sample are reported in Model 2 of Table 6. We find that the coefficient for  $PIN_{i,t-1}$  is negative and significant at the 1% level, suggesting that stock price informativeness help mitigating over-investment problems in period of expected expansion. The results of the under-firing sub-sample are reported in Model 3 of Table 6. We find that the coefficient for  $PIN_{i,t-1}$  is negative and highly significant, suggesting that stock price informativeness also mitigates over-investment problems in period of expected recession.

The results for the under-investment sub-sample are reported in Panel B of Table 6. The results of the total under-investment sub-sample firms are reported in Model 4. We find a negative and significant coefficient for  $PIN_{i,t-1}$  at the 1% level, suggesting that more informative stock prices also mitigate under-investment problems in labor. Additionally, we split our under-investment sub-sample based on whether the expected level of labor investment is

positive (under-hiring) or negative (over-firing). The results of the under-hiring (over-firing) sub-sample are reported in Model 5 (6) of Table 6. As we can observe,  $PIN_{i,t-1}$  is negative and significant in Models 5 and 6, suggesting that informative stock prices help mitigating under-investment in periods of expected expansion and expected recession, respectively. Collectively, these results suggest that informative stock prices help alleviating all kind of inefficiencies in labor investment, hence are associated with a level of labor investment that is close to the one justified by economic fundamentals.

**[Insert Table 6 about here]**

#### **4.5 The role of non-labor investments**

Labor investment is to some extent a complement to other investments (Benmelech et al., 2011). Given that, our findings may be driven by non-labor investments. In a first step, we address this issue by controlling in all regressions for the non-labor investment efficiency using the absolute value of abnormal non-labor investment. In this section, we further address this issue by examining the impact of non-labor investments (i.e., capital expenditures (*CAPX*), R&D expenses (*XRD*), advertising expenses (*XAD*), and acquisitions (*AQC*)) on the association between stock price informativeness and labor investment efficiency. We divide our sample in three sub-samples: (i) the sub-sample of firms for which an increase (a decrease) in labor investment is accompanied with an increase (a decrease) in non-labor investment (i.e., a positive relationship between labor and non-labor investment), (ii) the sub-sample of firms for which an increase (a decrease) in labor investment is accompanied with a decrease (an increase) in non-labor investment or decrease labor investment, and (iii) the sub-sample of firms with a missing value for non-labor investment (i.e., firms without *CAPX* or *XRD* or *XAD* or *AQC*). Panel A of Table 7 reports the results for the sub-samples based on the relationship between *CAPX* and labor investment. We find that the negative relationship between stock price informativeness and labor investment efficiency is not concentrated in the sub-sample of firms with a positive relationship between *CAPX* and labor investment (i.e., Model 1). In fact, we also find negative and significant coefficients for  $PIN_{i,t-1}$  in Models from 2 and 3. Panel B of Table 7 reports the results for the sub-samples based on the relationship between *XRD* and labor investment. We find that the coefficient for  $PIN_{i,t-1}$  is negative and significant at the 1% not only in Model 4 (i.e.,

the sub-sample of firms with a positive relationship between  $XRD$  and labor investment), but also in Models 5 and 6. Panel C of Table 7 reports the results for the sub-samples based on the relationship between  $XAD$  and labor investment. We find that coefficient for  $PIN_{i,t-1}$  is again not only negative and significant in the sub-sample of firms with a positive relationship between  $ACQ$  and labor investment (i.e., Model 7). In fact,  $PIN_{i,t-1}$  is also negative and significant at the 1% level in Models 8 and 9. Finally, Panel D of Table 7 reports the results based on the relationship between  $AQC$  and labor investment. As we can observe,  $PIN_{i,t-1}$  is negative and at the 1% level in Models 10, 11, and 12, confirming that the negative relationship between stock price informativeness and labor investment is not concentrated in the sub-sample firms for which labor investment is positively correlated with  $XRD$ . Collectively, these results suggest that our findings are not driven by non-labor investments.

**[Insert Table 7 about here]**

#### **4.6 Other robustness tests**

In this section, we describe additional tests conducted to ensure the robustness of our findings. The results of these tests, reported in Table 8, generally confirm the core findings presented in Table 3: more informative stock prices are associated with more efficient labor investment.

*Alternative proxies for labor investment efficiency.* We use alternative labor investment efficiency proxies to ensure the robustness of our findings. First, we use the difference between the observed value of labor investment and the industry-median value of labor investment, in line with Cella (2010). The results reported in Model 1 of Table 8 show that the coefficient for  $PIN_{i,t-1}$  remains negative and significant at the 1% level, corroborating our earlier findings. Second, we use the absolute value of the difference between the observed value for labor investment and the residuals from the regression of the observed value of labor investment on sales growth ( $SG$ ), in line with Biddle et al. (2009), as an alternative proxy for labor investment efficiency. The results reported in Model 2 of Table 8 show that the coefficient for  $PIN_{i,t-1}$  is still negative and significant at the 1% level, again supporting our earlier findings. Third, we augment regression (2) with several additional variables such as the logarithm of GDP per

capita (*LGDP*), industry unionization rate (*UNION*), capital expenditures (*CAPEX*), research and development expenses (*XRD*), acquisition expenses (*AQC*), and lagged value of observed labor investment, in line with Pinnuck and Lillis (2007). We re-calculated the absolute value of abnormal labor investment as the difference between the observed labor investment and the residuals from the augmented version of regression (2). The results reported in Model 3 of Table 8 show that the coefficient for  $PIN_{i,t-1}$  remains again negative and significant at the 1% level. Finally, we estimate equation (2) separately for each industry of our sample. Then, we calculate our proxy for labor investment efficiency as the difference between the observed value of labor investment and the residuals from the industry-level version of regression (2). The results reported in Model 4 again corroborate our earlier findings. Collectively, these results suggest that our findings are not affected by the choice of the labor investment efficiency proxy.

*Alternative definitions of PIN.* We also use alternative definitions of the Probability of Information trading (*PIN*) to ensure that our findings are not affected by measurement errors in *PIN*, in line with Ferreira et al. (2011). First, we re-estimate our basic model for firm-year observations with  $PIN_{i,t-1}$  above the 80<sup>th</sup> percentile (Q5) and below the 20<sup>th</sup> percentile (Q1) and replace  $PIN_{i,t-1}$  by  $PIN_{i,t-1}(Q5-Q1)$ .  $PIN_{i,t-1}(Q5-Q1)$  is a dummy variable equal to one if  $PIN_{i,t-1}$  is higher than the 80<sup>th</sup> percentile (Q5), and zero for firm-year observations with  $PIN_{i,t-1}$  below the 20<sup>th</sup> percentile (Q1). The results reported in Model 5 of Table 8 show that the coefficient for  $PIN_{i,t-1}(Q5-Q1)$  is negative and significant at the 1% level, further supporting our earlier findings. Second, we re-estimate our basic model after replacing  $PIN_{i,t-1}$  by  $PIN_{i,t-1}(dummy)$ , a dummy variable equal to one for firm-year observations with  $PIN_{i,t-1}$  higher than the sample median, and zero otherwise. The results reported in Model 6 of table 8 show that the coefficient for  $PIN_{i,t-1}(dummy)$  is negative and significant at the 1% level, in line with our previous findings. Collectively, these results suggest that our findings are not affected by measurement errors in *PIN*.

*Additional control variables.* We introduce additional control variables to ensure the robustness of our findings. First, we control for earnings quality ( $AQ_{i,t-1}$ ). Earnings management may also affect labor investment efficiency (Jung et al., 2013)), consistent with the conjecture that higher earnings quality mitigates the agency problems between managers and suppliers of financing, hence reduces labor adjustment costs, which leads to more efficient investment in

labor. In line with Gul, Srinidhi, and Ng (2011), we use the absolute value of Dechow and Dichev's (2002) measure of abnormal accruals, as modified by Ball and Shivakumar (2005) ( $AQ$ ), as a proxy for earnings management. The results reported in Model 7 of Table 8 show that the coefficient for  $PIN_{i,t-1}$  is negative and significant at the 1% level, corroborating our earlier findings. Second, we control for earnings informativeness ( $ERC_{i,t-1}$ ) since it also may affect labor investment efficiency (e.g., Pinnuck and Lillis (2007)). We estimate the earnings response coefficient ( $ERC$ ) by regressing cumulative abnormal returns on unexpected earnings calculated as the difference between current net income before extraordinary items and lagged net income before extraordinary items over the lagged market value. The results reported in Model 8 of Table 9 show that the coefficient for  $PIN_{i,t-1}$  is still negative and significant at the 1% level, supporting our earlier findings.

Third, we use several mispricing proxies to ensure that our findings are due to market stock price mispricing (i.e., deviations of stock price from its fundamental value) rather than to informed trading. Managers may respond to market mispricing of their stock when making investment decisions (Bakke and Whited, 2010). Specifically, managers tend to invest more when their stocks are overpriced (Baker and Wurgler, 2002; Baker, Stein, and Wurgler, 2003). Given that, we expect that mispricing leads to less investment efficiency. *Firstly*, we control for analyst forecast bias using the ratio of difference between one-year-ahead consensus earnings per share and realized earnings per share over the previous year's stock price ( $BIAS$ ). Consensus and realized earnings per share are extracted from I/B/E/S while stock price is extracted from CRSP. A higher value for  $BIAS$  indicates that the stock is over-evaluated while a negative value indicates that the stock is under-evaluated. A missing value for  $BIAS$  indicates also that analysts also disagree about the earnings per share forecasts. *Secondly*, we use standard deviation of analysts' earnings-per-share from I/B/E/S ( $VAR\_ANALYST\_COV$ ), in line with Bakke and Whited (2010). Analysts' disagreement about forecasted earnings per share may lead to overvaluation of stock prices (e.g., Panageas, 2005; Gilchrist, Himmelberg, and Huberman, 2005), which lead managers to increase investment. The results reported in Model 9 show that the coefficient for  $VAR\_ANALYST\_COV_{i,t-1}$  is positive and significant at the 1% level, suggesting that analysts forecast dispersion is associated with lower labor investment efficiency, consistent with the mispricing argument. More importantly for our purposes, we find that the coefficient for  $PIN_{i,t-1}$  is negative and significant at the 1% level, confirming our earlier findings.

Thirdly, we control for cumulative abnormal returns (*CAR*) dummies, to ensure that our findings are not driven by extreme stock performance, in line with Ferreira et al. (2011). We control for: (i) a dummy variable equal to one if a firm has a *CAR* below the 20th percentile (Q1), and zero otherwise and (ii) a dummy variable equal to one if a firm has a *CAR* above the 80th percentile (Q5), and zero otherwise. We calculate *CAR* over a period of 12 months starting at the beginning of the fiscal year and ending at the end of the fiscal year. The results reported in Model 11 show that the coefficients for *CAR* (below Q1 dummy) and *CAR* (above Q5 dummy) are positive and significant at the 1% level, suggesting that extreme stock performance is associated with less efficient investment in labor. Again, we still report a negative and significant coefficient at the 1% level for  $PIN_{i,t-1}$ . Collectively, these results suggest that although mispricing in stock prices does affect labor investment efficiency, price informativeness is still an important factor that determines labor investment efficiency.

*Excluding financial and utility industries.* Finally, we test the robustness of our findings to an alternative sample. Specifically, we re-run our basic model after excluding firms belonging to Financial or Utility industries. The results reported in Model 12 of Table 8 show that the coefficient for  $PIN_{i,t-1}$  is still negative and significant at the 1% level, corroborating our earlier findings.

**[Insert Table 8 about here]**

## **5. Conclusion**

In contributing to the managerial learning literature, we choose to focus on the efficiency of investment in human capital that is one of the important factors of production that determines the firm's output. Specifically, using a sample of U.S. firms over the period 1994-2010, we show that a higher probability of informed trading (*PIN*) (i.e., higher stock price informativeness) is associated with lower deviations of labor investment from the level justified by economic fundamentals i.e., higher labor investment efficiency. This result is consistent with the view that managers use the information incorporated in stock prices (e.g., information about future investment and growth opportunities, future relationship with stakeholders, and financing policies) when investing in human capital. This result is also consistent with the view that more informative stock prices result in a better monitoring of managers (Ferreira et al.,

2011), which alleviates the empire building problem, leading to a more efficient investment in labor. This finding is robust to using alternative proxies for stock price informativeness and labor investment efficiency, when we control for earnings quality and mispricing, and when we address the endogeneity of *PIN*.

We also report evidence suggesting that stock price informativeness helps mitigating over-investment (over-hiring and under-firing) and under-investment (under-hiring and over-firing) problems in labor. Additionally, we find that our findings are not affected by other investments such as capital expenditures, R&D expenses, advertising expenses, and acquisition expenses. Finally, we report evidence suggesting that stock price informativeness helps mitigating distortions in labor investment created by labor union as well as labor investment inefficiencies for firms that are more financially constrained. While the present paper highlights the importance of information incorporated into stock prices for the investment in human capital, future research can add further to the understanding of the role of stock price informativeness in determining corporate decisions by investigating whether it guides other corporate decisions, such as corporate innovation and advertising.



## Appendix

Variable	Description	Source
<i> ABN(LABOR_INVEST) </i>	The absolute value of the difference between the observed value for labor investment (i.e., the difference between the current and the previous number of employees) and the predicted value of labor investment based on economic fundamentals using Model (2).	Authors' calculation
<i>PIN</i>	Probability of Information trading (PIN) derived from Easley, Kiefer, and O Hara (1996)'s market microstructure model.	Brown et al.'s (2004) continuously updated database
<i>SIZE</i>	The natural logarithm of the firm's market value.	Authors' calculation
<i>LEV</i>	The ratio of long-term debt over total assets.	Authors' calculation
<i>MB</i>	The market-to-book ratio.	Authors' calculation
<i>NET_PPE</i>	The ratio of the current year value of net property, plant, and equipment over the previous year value of total assets.	Authors' calculation
<i>QUICK_RATIO</i>	The ratio of the sum of cash and short-term investments and receivables over current liabilities.	Authors' calculation
<i>LOSS</i>	A dummy variable equal to one (1) if the ratio of net income over total assets (ROA) is positive, and zero (0) otherwise.	Authors' calculation
<i>DIV_PAYER</i>	A dummy variable equal to one (1) if the firm pays dividends, and zero (0) otherwise.	Authors' estimation
<i>CFO_VOL</i>	The volatility of Cash flow from operations calculated over a period of five years.	Authors' calculation
<i>SALES_VOL</i>	The volatility of sales and revenue calculated over a period of five years.	Authors' calculation
<i>LABOR_INVEST_VOL</i>	The volatility of labor investment calculated over a period of five years.	Authors' calculation
<i> ABN(OTHER_INVEST) </i>	The absolute value of the residuals from the regression of non-labor investment (i.e., the sum of capital expenditures, acquisition, and R&D expenses less proceeds from the sale of property, plant, and equipment) on sales growth.	Authors' calculation
<i>UNION</i>	The industry unionization rate.	Authors' calculation
<i>LABOR_INTENSITY</i>	The ratio of the number of employees over total assets.	Authors' calculation
<i>IO</i>	The fraction of the firm's shares held by institutional investors.	Authors' calculation
<i>ACOV</i>	The natural logarithm of one plus the number of analysts following a firm.	I/B/E/S

<i>TURNOVER</i>	The ratio of the number of shares traded over the number of shares outstanding	Authors' calculation
<i>ILLIQ</i>	Amihud's (2002) illiquidity ratio is defined as the annual average of the ratio of the daily absolute stock return over the daily transaction volume.	Authors' calculation
<i>SPI1</i>	Annual firm-specific return variation proxy ( $\log(R2/(1-R2))$ ) estimated from regressing the firm's weekly excess return on the weekly value-weighted excess market return, the weekly small-minus-big size factor return, and the weekly high-minus-low book-to-market factor return.	Authors' calculation
<i>SPI2</i>	Annual firm-specific return variation proxy ( $\log(R2/(1-R2))$ ) estimated from regressing the firm's weekly returns on current and lagged market returns as well as current and lagged industry returns.	Authors' calculation
<i>SPI3</i>	Annual firm-specific return variation proxy ( $\log(R2/(1-R2))$ ) estimated from regressing the firm's weekly stock returns on the current week, previous week, two weeks back, one week ahead and two weeks ahead value-weighted market returns.	Authors' calculation
<i>PIN (Q5-Q1)</i>	A dummy variable equal to one if <i>PIN</i> is higher than the 80 <sup>th</sup> percentile (Q5), and zero for firm-year observations with <i>PIN</i> below the 20 <sup>th</sup> percentile (Q1)	Authors' calculation
<i>PIN (dummy)</i>	A dummy variable equal to one for firm-year observations with <i>PIN</i> higher than the sample median and zero otherwise.	Authors' calculation
<i>EF</i>	The external financing dependence calculated as the industry-median value of the difference between capital expenditures and cash flow from operations scaled by capital expenditures, in line with Foucault and Frésard (2012).	Authors' calculation
<i>AQ</i>	The absolute value of Dechow and Dichev's (2002) measure of abnormal accruals, as modified by Ball and Shivakumar (2005).	Authors' calculation
<i>ERC</i>	The earnings response coefficient ( <i>ERC</i> ) calculated by regressing cumulative abnormal returns on unexpected earnings calculated as the difference between current net income before extraordinary items and lagged net income before extraordinary items over the lagged market value.	Authors' calculation
<i>BIAS</i>	Analyst forecast bias calculated as the ratio of difference between one-year-ahead consensus earnings per share and realized earnings per share over the previous year's stock price.	I/B/E/S & CRSP
<i>VAR_ANALYST_COV</i>	The standard deviation of one year-ahead analysts forecasts over mean one year-ahead analyst forecasts of earnings per share from I/B/E/S.	Authors' calculation
<i>CAR (below Q1 dummy)</i>	A dummy variable equal to one if a firm has 12 months cumulative abnormal returns ( <i>CAR</i> ) below the 20 <sup>th</sup> percentile (Q1), and zero otherwise.	Authors' calculation
<i>CAR (above Q3 dummy)</i>	A dummy variable equal to one if a firm has 12 months <i>CAR</i> above the 80 <sup>th</sup> percentile (Q5), and zero otherwise.	Authors' calculation

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**TABLE 1**  
*Descriptive Statistics*

Variable	N	Mean	Median	Standard deviation	Q1	Q3
ABN(LABOR_INVEST <sub><i>i,t</i></sub> )	21,551	0.152	0.099	0.156	0.045	0.202
PIN <sub><i>i,t-1</i></sub>	21,551	0.189	0.170	0.099	0.117	0.244
SIZE <sub><i>i,t-1</i></sub>	21,551	6.082	5.993	2.101	4.580	7.506
LEV <sub><i>i,t-1</i></sub>	21,551	0.200	0.183	0.174	0.033	0.319
MB <sub><i>i,t-1</i></sub>	21,551	2.673	2.043	2.143	1.325	3.282
NET_PPE <sub><i>i,t-1</i></sub>	21,551	0.284	0.233	0.208	0.121	0.400
QUICK_RATIO <sub><i>i,t-1</i></sub>	21,551	1.842	1.217	2.394	0.781	2.023
LOSS <sub><i>i,t-1</i></sub>	21,551	0.213	0.000	0.410	0.000	0.000
DIV_PAYER <sub><i>i,t-1</i></sub>	21,551	0.471	0.000	0.499	0.000	1.000
CF_VOL <sub><i>i,t-1</i></sub>	21,551	0.075	0.051	0.491	0.030	0.086
SALES_VOL <sub><i>i,t-1</i></sub>	21,551	0.243	0.187	0.216	0.109	0.308
LABOR_INVEST_VOL <sub><i>i,t-1</i></sub>	21,551	0.192	0.126	0.229	0.069	0.226
ABN(OTHER_INVEST <sub><i>i,t</i></sub> )	21,551	0.105	0.093	0.109	0.052	0.130
UNION <sub><i>i,t-1</i></sub>	21,551	10.785	7.800	10.223	2.900	14.900
LABOR_INTENSITY <sub><i>i,t-1</i></sub>	21,551	0.009	0.005	0.017	0.003	0.010
IO <sub><i>i,t-1</i></sub>	21,551	0.510	0.535	0.275	0.281	0.740

This table presents descriptive statistics for the variables used in our multivariate regression analysis to examine the impact of stock price informativeness on labor investment efficiency for a sample of 21,551 firm-year observations for the 1994-2010 period. Descriptions and sources of these variables are provided in the Appendix.

**Table 2**  
Pearson Correlation Coefficients

Variable	$ ABN(LABOR\_INVEST_{i,t}) $	$PIN_{i,t-1}$	$SIZE_{i,t-1}$	$LEV_{i,t-1}$	$MB_{i,t-1}$	$NET\_PPE_{i,t-1}$	$QUICK\_RATIO_{i,t-1}$	$LOSS_{i,t-1}$	$DIV\_PAYER_{i,t-1}$	$CF\_VOL_{i,t-1}$	$SALES\_VOL_{i,t-1}$	$LABOR\_INVEST\_VOL_{i,t-1}$	$ ABN(OTHER\_INVEST_{i,t}) $	$UNION_{i,t-1}$	$LABOR\_INTENSITY_{i,t-1}$
$PIN_{i,t-1}$	<b>-0.028</b>														
$SIZE_{i,t-1}$	<b>-0.129</b>	<b>-0.595</b>													
$LEV_{i,t-1}$	-0.001	0.006	<b>0.057</b>												
$MB_{i,t-1}$	<b>0.044</b>	<b>-0.255</b>	<b>0.327</b>	<b>-0.088</b>											
$NET\_PPE_{i,t-1}$	-0.046	0.003	<b>0.121</b>	<b>0.343</b>	<b>-0.116</b>										
$QUICK\_RATIO_{i,t-1}$	<b>0.082</b>	-0.013	<b>-0.100</b>	<b>-0.308</b>	<b>0.078</b>	<b>-0.250</b>									
$LOSS_{i,t-1}$	<b>0.144</b>	<b>0.086</b>	<b>-0.274</b>	<b>0.053</b>	<b>-0.053</b>	<b>-0.093</b>	<b>0.104</b>								
$DIV\_PAYER_{i,t-1}$	<b>-0.163</b>	<b>-0.121</b>	<b>0.407</b>	<b>0.094</b>	-0.001	<b>0.250</b>	<b>-0.180</b>	<b>-0.276</b>							
$CF\_VOL_{i,t-1}$	<b>0.021</b>	0.014	<b>-0.050</b>	<b>-0.038</b>	<b>0.074</b>	<b>-0.046</b>	<b>0.034</b>	<b>0.047</b>	<b>-0.057</b>						
$SALES\_VOL_{i,t-1}$	<b>0.122</b>	<b>-0.071</b>	<b>-0.069</b>	<b>-0.060</b>	<b>0.195</b>	<b>-0.117</b>	<b>0.242</b>	<b>0.169</b>	<b>-0.276</b>	<b>0.073</b>					
$LABOR\_INVEST\_VOL_{i,t-1}$	<b>0.131</b>	<b>0.034</b>	<b>-0.143</b>	<b>0.038</b>	0.012	<b>-0.114</b>	<b>0.047</b>	<b>0.128</b>	<b>-0.241</b>	<b>0.041</b>	<b>0.387</b>				
$ ABN(OTHER\_INVEST_{i,t}) $	<b>0.166</b>	<b>0.021</b>	<b>-0.084</b>	<b>0.018</b>	<b>0.068</b>	<b>-0.043</b>	<b>0.043</b>	<b>0.071</b>	<b>-0.072</b>	0.013	<b>0.118</b>	<b>0.051</b>			
$UNION_{i,t-1}$	<b>-0.057</b>	<b>0.022</b>	<b>0.085</b>	<b>0.220</b>	<b>-0.136</b>	<b>0.368</b>	<b>-0.130</b>	<b>-0.087</b>	<b>0.241</b>	<b>-0.034</b>	<b>-0.127</b>	<b>-0.073</b>	<b>-0.042</b>		
$LABOR\_INTENSITY_{i,t-1}$	0.004	<b>0.109</b>	<b>-0.128</b>	<b>-0.067</b>	-0.005	0.005	<b>-0.070</b>	<b>-0.052</b>	<b>-0.040</b>	-0.001	<b>-0.047</b>	0.007	0.008	<b>-0.108</b>	
$IO_{i,t-1}$	<b>-0.096</b>	<b>-0.509</b>	<b>0.613</b>	0.005	<b>0.070</b>	<b>-0.041</b>	<b>-0.040</b>	<b>-0.140</b>	<b>0.170</b>	<b>-0.045</b>	<b>-0.084</b>	<b>-0.104</b>	<b>-0.048</b>	<b>-0.036</b>	<b>-0.077</b>

This table presents Pearson pairwise correlation coefficients between the regression variables. The full sample includes 21,551 firm-year observations for the 1994-2010 period. Bold face indicates statistical significance at the 1% level. Descriptions and data sources for these variables are provided in the Appendix.



**TABLE 3**  
*Stock price informativeness and labor investment efficiency*

Variable	Basic	Firm fixed	2SLS		Fama-	Median
	Model	effects	First stage	Second stage	MacBeth	Regression
	(1)	(2)	(3)	(4)	(5)	(6)
$PIN_{i,t-1}$	-0.209 (-14.856)***	-0.202 (-14.602)***		-0.284 (-3.135)***	-0.176 (-6.716)***	-0.144 (-12.863)***
$SIZE_{i,t-1}$	-0.008 (-5.615)***	-0.027 (-10.099)***	-0.017 (-14.712)***	-0.009 (-3.292)***	-0.008 (-7.312)***	-0.005 (-7.844)***
$LEV_{i,t-1}$	0.014 (1.249)	0.007 (0.553)	0.007 (1.390)*	0.012 (0.944)	0.014 (2.804)***	0.013 (2.402)***
$MB_{i,t-1}$	0.003 (3.390)***	0.005 (5.164)***	-0.001 (-3.192)***	0.003 (2.987)***	0.003 (4.781)***	0.002 (4.968)***
$NET\_PPE_{i,t-1}$	0.014 (1.237)	0.022 (1.133)	0.007 (1.571)	0.016 (1.245)	0.014 (1.892)*	-0.023 (-4.887)***
$QUICK\_RATIO_{i,t-1}$	0.003 (3.265)***	0.001 (1.290)*	-0.001 (-2.672)***	0.002 (2.443)***	0.003 (4.689)***	0.002 (5.505)***
$LOSS_{i,t-1}$	0.029 (8.245)***	0.008 (2.535)***	-0.011 (-7.274)***	0.029 (6.996)***	0.029 (6.235)***	0.025 (11.086)***
$DIV\_PAYER_{i,t-1}$	-0.022 (-5.642)***	0.003 (0.563)	0.004 (2.235)**	-0.023 (-5.066)***	-0.021 (-5.950)***	-0.016 (-7.859)***
$CF\_VOL_{i,t-1}$	0.000 (0.527)	-0.005 (-8.792)***	0.000 (0.561)	0.000 (0.513)	0.045 (2.727)***	-0.001 (-2.042)**
$SALES\_VOL_{i,t-1}$	0.005 (0.564)	0.010 (1.005)	-0.019 (-5.426)***	-0.001 (-0.141)	-0.005 (-0.791)	-0.003 (-0.618)
$LABOR\_INVEST\_VOL_{i,t-1}$	0.052 (6.664)***	-0.027 (-3.307)***	0.004 (1.299)*	0.058 (6.421)***	0.051 (9.448)***	0.036 (8.728)***
$ ABN(OTHER\_INVEST_{i,t}) $	0.197 (11.664)***	0.221 (11.765)***	-0.009 (-2.108)**	0.204 (11.462)***	0.199 (12.096)***	0.181 (22.826)***
$UNION_{i,t-1}$	0.000 (0.893)	-0.001 (-3.066)***	0.000 (0.035)	0.000 (0.037)	0.000 (0.193)	-0.001 (-7.540)***
$LABOR\_INTENSITY_{i,t-1}$	0.038 (0.477)	-0.971 (-3.287)***	0.142 (2.495)**	0.054 (0.682)	0.122 (1.734)	0.062 (1.181)
$IO_{i,t-1}$	-0.034 (-3.682)***	-0.002 (-0.195)	-0.062 (-17.445)***	-0.045 (-3.974)***	-0.024 (-3.039)***	-0.040 (-9.449)***
$ACOV_{i,t-1}$			-0.019 (-8.761)***			
$TURNOVER_{i,t-1}$			-0.009 (-10.192)***			
Intercept	0.212 (22.334)***	0.321 (16.967)***	0.368 (82.467)***	0.235 (6.745)***	0.197 (11.695)***	0.166 (28.989)***

INDUSTRY EFFECTS	YES	YES	YES	YES	YES	YES
YEAR EFFECTS	YES	YES	YES	YES	YES	YES
R <sup>2</sup>	0.085	0.057	0.472	0.074	0.102	
N	21,551	21,551	17,962	17,962	21,551	21,551

This table presents regression results of the impact of stock price informativeness on labor investment efficiency. The full sample includes 21,551 firm-year observations for the 1994-2010 period. Bold face indicates statistical significance at the 1% level. Descriptions and data sources for the regression variables are provided in the Appendix. z-statistics based on robust standard errors adjusted for clustering by firm are shown below each estimate - in parentheses. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively, one-tailed when directional predictions are made, and two-tailed otherwise.

**TABLE 4**  
*Alternative proxies for stock price informativeness*

Variable	Illiquidity	Firm-Specific return variation		
	proxy	proxies		
	(1)	(2)	(3)	(4)
<i>ILLIQ<sub>i,t-1</sub></i>	-0.002 (-7.615) <sup>***</sup>			
<i>SPI1<sub>i,t-1</sub></i>		-0.007 (-7.361) <sup>***</sup>		
<i>SPI2<sub>i,t-1</sub></i>			-0.009 (-8.463) <sup>***</sup>	
<i>SPI3<sub>i,t-1</sub></i>				-0.008 (-6.604) <sup>***</sup>
<i>SIZE<sub>i,t-1</sub></i>	-0.006 (-4.736) <sup>***</sup>	-0.005 (-4.068) <sup>***</sup>	-0.006 (-4.564) <sup>***</sup>	-0.008 (-5.259) <sup>***</sup>
<i>LEV<sub>i,t-1</sub></i>	0.036 (3.167) <sup>***</sup>	0.035 (3.776) <sup>***</sup>	0.031 (2.555) <sup>***</sup>	0.040 (2.865) <sup>***</sup>
<i>MB<sub>i,t-1</sub></i>	-0.001 (-1.060)	-0.001 (-0.723)	-0.001 (-0.892)	0.000 (0.189)
<i>NET_PPE<sub>i,t-1</sub></i>	0.000 (0.004)	0.007 (0.775)	0.010 (0.914)	0.022 (1.590)
<i>QUICK_RATIO<sub>i,t-1</sub></i>	0.004 (4.276) <sup>***</sup>	0.005 (6.477) <sup>***</sup>	0.005 (7.095) <sup>***</sup>	0.005 (6.765) <sup>***</sup>
<i>LOSS<sub>i,t-1</sub></i>	0.027 (8.618) <sup>***</sup>	0.031 (9.564) <sup>***</sup>	0.025 (7.080) <sup>***</sup>	0.027 (6.551) <sup>***</sup>
<i>DIV_PAYER<sub>i,t-1</sub></i>	-0.020 (-5.727) <sup>***</sup>	-0.021 (-6.055) <sup>***</sup>	-0.023 (-5.612) <sup>***</sup>	-0.024 (-5.268) <sup>***</sup>
<i>CF_VOL<sub>i,t-1</sub></i>	0.067 (2.454) <sup>**</sup>	0.036 (1.563) <sup>*</sup>	0.000 (0.363)	-0.001 (-0.784)
<i>SALES_VOL<sub>i,t-1</sub></i>	0.005 (0.673)	0.010 (1.091)	0.015 (1.621) <sup>*</sup>	0.014 (1.257)
<i>LABOR_INVEST_VOL<sub>i,t-1</sub></i>	0.042 (5.731) <sup>***</sup>	0.042 (5.559) <sup>***</sup>	0.046 (5.497) <sup>***</sup>	0.058 (5.910) <sup>***</sup>
<i> ABN(OTHER_INVEST<sub>i,t</sub>) </i>	0.210 (11.854) <sup>***</sup>	0.157 (8.532) <sup>***</sup>	0.256 (11.753) <sup>***</sup>	0.317 (12.645) <sup>***</sup>
<i>UNION<sub>i,t-1</sub></i>	0.000 (0.411)	0.000 (0.440)	0.000 (1.027)	0.000 (1.266)
<i>LABOR_INTENSITY<sub>i,t-1</sub></i>	0.089 (0.547)	0.055 (1.470)	0.347 (1.431)	0.200 (1.481)
<i>IO<sub>i,t-1</sub></i>	-0.034 (-4.451) <sup>***</sup>	-0.032 (-4.137) <sup>***</sup>	-0.034 (-3.859) <sup>***</sup>	-0.034 (-3.554) <sup>***</sup>

Intercept	0.167 (21.174)***	0.171 (22.740)***	0.179 (19.930)***	0.178 (20.113)***
INDUSTRY EFFECTS	YES	YES	YES	YES
YEAR EFFECTS	YES	YES	YES	YES
R <sup>2</sup>	0.084	0.085	0.089	0.102
N	23,157	22,348	22,619	22,542

This table presents results using alternative stock price informativeness proxies. The sample period is 1994-2010 period. Bold face indicates statistical significance at the 1% level. Descriptions and data sources for the regression variables are provided in the Appendix. z-statistics based on robust standard errors adjusted for clustering by firm are shown below each estimate - in parentheses. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively, one-tailed when directional predictions are made, and two-tailed otherwise.

**TABLE 5**

*Stock price informativeness and labor investment efficiency: The role of labor union and financial constraints*

Variable	(1)	(2)
$PIN_{i,t-1}$	-0.177 (-9.103)***	-0.231 (-15.731)***
$PIN_{i,t-1} * UNION_{i,t-1}$	-0.003 (-2.176)**	
$PIN_{i,t-1} * EF_{i,t-1}$		-0.003 (-2.853)***
$SIZE_{i,t-1}$	-0.177 (-9.103)***	-0.009 (-6.045)***
$LEV_{i,t-1}$	0.014 (1.245)	0.018 (1.568)*
$MB_{i,t-1}$	0.003 (3.446)***	0.003 (3.000)***
$NET\_PPE_{i,t-1}$	0.014 (1.210)	0.022 (1.810)*
$QUICK\_RATIO_{i,t-1}$	0.003 (3.281)***	0.002 (2.986)***
$LOSS_{i,t-1}$	0.029 (8.227)***	0.028 (7.925)***
$DIV\_PAYER_{i,t-1}$	-0.022 (-5.691)***	-0.019 (-4.936)***
$CF\_VOL_{i,t-1}$	-0.001 (-0.571)	0.000 (0.377)
$SALES\_VOL_{i,t-1}$	0.005 (0.589)	0.003 (0.365)
$LABOR\_INVEST\_VOL_{i,t-1}$	0.052 (6.632)***	0.052 (6.583)***
$ ABN(OTHER\_INVEST_{i,t}) $	0.197 (11.657)***	0.203 (11.972)***
$UNION_{i,t-1}$	0.000 (1.065)	0.000 (0.329)
$LABOR\_INTENSITY_{i,t-1}$	0.036 (0.456)	0.011 (0.136)
$IO_{i,t-1}$	-0.033 (-3.600)***	-0.030 (-3.318)***
$EF_{i,t-1}$		0.002 (6.320)***
Intercept	0.206 (19.931)***	0.218 (22.920)***

INDUSTRY EFFECTS	YES	YES
YEAR EFFECTS	YES	YES
R <sup>2</sup>	0.085	0.089
N	21,551	21,228

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This table presents results for the impact of labor union and financial constraints on the relationship between stock price informativeness and labor investment efficiency. The full sample includes 21,551 firm-year observations for the 1994-2010 period. Bold face indicates statistical significance at the 1% level. Descriptions and data sources for the regression variables are provided in the Appendix. z-statistics based on robust standard errors adjusted for clustering by firm are shown below each estimate - in parentheses. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively, one-tailed when directional predictions are made, and two-tailed otherwise.

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**TABLE 6**

*Stock price informativeness and labor investment efficiency: Over-investment versus under-investment*

Variable	Panel A: Over-investment			Panel B: Under-investment		
	Total	Over-hiring	Under-firing	Total	Under-hiring	Over-firing
	(1)	(2)	(3)	(4)	(5)	(6)
$PIN_{i,t-1}$	-0.137 (-6.417)***	-0.145 (-6.235)***	-0.102 (-2.164)**	-0.224 (-13.062)***	-0.229 (-13.180)***	-0.175 (-3.639)***
$SIZE_{i,t-1}$	-0.005 (-2.814)***	-0.005 (-2.736)***	-0.001 (-0.371)	-0.008 (-4.287)***	-0.007 (-4.036)***	-0.006 (-1.378)*
$LEV_{i,t-1}$	0.002 (0.165)	0.016 (1.186)	-0.069 (-2.880)***	0.019 (1.273)	0.025 (1.592)*	-0.004 (-0.192)
$MB_{i,t-1}$	0.006 (5.341)***	0.006 (5.246)***	0.005 (1.767)**	0.001 (0.928)	0.001 (0.592)	0.000 (0.191)
$NET\_PPE_{i,t-1}$	-0.049 (-4.545)***	-0.049 (-4.089)***	-0.020 (-1.028)	0.034 (2.332)**	0.037 (2.431)**	-0.080 (-3.831)***
$QUICK\_RATIO_{i,t-1}$	0.003 (2.332)**	0.003 (2.303)**	0.010 (2.755)***	0.003 (2.668)***	0.003 (2.559)**	-0.008 (1.939)**
$LOSS_{i,t-1}$	-0.014 (2.844)***	-0.022 (3.355)***	0.008 (-0.974)	0.047 (10.553)***	0.054 (11.513)***	0.029 (2.996)***
$DIV\_PAYER_{i,t-1}$	-0.018 (-4.056)***	-0.016 (-3.314)***	-0.022 (-2.722)***	-0.021 (-4.214)***	-0.020 (-3.774)***	-0.009 (-1.032)
$CF\_VOL_{i,t-1}$	-0.001 (-2.855)***	-0.001 (-2.478)**	0.016 (0.187)	0.050 (1.517)*	0.051 (1.545)*	-0.067 (-0.743)
$SALES\_VOL_{i,t-1}$	0.042 (3.431)***	0.038 (2.886)***	0.110 (3.713)***	-0.008 (-0.653)	-0.011 (-0.944)	0.037 (1.224)
$LABOR\_INVEST\_VOL_{i,t-1}$	0.043 (3.693)***	0.042 (3.346)***	0.049 (2.190)**	0.055 (5.683)***	0.056 (5.634)***	-0.021 (-1.103)
$ ABN(OTHER\_INVEST_{i,t}) $	0.282 (13.456)***	0.289 (13.361)***	0.112 (1.425)*	0.050 (2.259)**	0.054 (2.376)**	0.098 (1.552)*
$UNION_{i,t-1}$	0.000 (1.897)*	0.000 (1.745)*	0.000 (0.756)	0.000 (0.858)	0.000 (0.119)	0.000 (0.733)
$LABOR\_INTENSITY_{i,t-1}$	0.973 (3.764)***	0.899 (3.528)***	3.343 (5.153)***	-0.102 (-1.363)	-0.106 (-1.415)	-1.987 (-1.901)**
$IO_{i,t-1}$	-0.003 (-0.308)	-0.007 (-0.615)	0.019 (1.063)	-0.044 (-3.554)***	-0.041 (-3.223)***	-0.040 (-1.998)**
Intercept	0.122 (8.192)***	0.126 (8.075)***	0.060 (1.705)*	0.237 (19.767)***	0.233 (19.302)***	0.213 (4.610)***
INDUSTRY EFFECTS	YES	YES	YES	YES	YES	YES
YEAR EFFECTS	YES	YES	YES	YES	YES	YES
R <sup>2</sup>	0.157	0.158	0.144	0.082	0.084	0.107
N	7,171	6,005	1,166	14,380	13,775	605

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This table presents the results for the over-investment and under-investment sub-samples. The results for the over-investment sub-sample are reported in **Panel A**. Model 1 reports the results for the total over-investment sub-sample (i.e., all sample firms for which the observed labor investment is higher than expected). Model 2 reports the results for the over-investment sub-sample of firms for which the expected level of labor investment is positive (over-hiring). Model 3 reports the results for the over-investment sub-sample of firms for which the expected level of labor investment negative (under-firing). The results for the under-investment sub-sample are reported in **Panel B**. Model 4 reports the results for the total under-investment sub-sample (i.e., all sample firms for which the observed labor investment is lower than expected). Model 5 reports the results for the under-investment sub-sample of firms for which the expected level of labor investment is positive (under-hiring). Model 6 reports the results for the over-investment sub-sample of firms for which the expected level of labor investment negative (over-firing). The full sample includes 21,551 firm-year observations for the 1994-2010 period. Bold face indicates statistical significance at the 1% level. Descriptions and data sources for the regression variables are provided in the Appendix. z-statistics based on robust standard errors adjusted for clustering by firm are shown below each estimate – in parentheses. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively, one-tailed when directional predictions are made, and two-tailed otherwise.

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**TABLE 7**

*Stock price informativeness and labor investment efficiency: The role of other investments*

Variable	Panel A: CAPX			Panel B: XRD		
	Positive	Negative	Zero	Positive	Negative	Zero
	(1)	(2)	(3)	(4)	(5)	(6)
$PIN_{i,t-1}$	-0.222 (-11.978)***	-0.192 (-10.497)***	-0.158 (-1.732)**	-0.208 (-9.090)***	-0.138 (-6.873)***	-0.253 (-11.164)***
Intercept and controls	YES	YES	YES	YES	YES	YES
INDUSTRY EFFECTS	YES	YES	YES	YES	YES	YES
YEAR EFFECTS	YES	YES	YES	YES	YES	YES
R <sup>2</sup>	0.102	0.066	0.180	0.125	0.100	0.082
N	11,864	9,518	169	5,982	5,120	10,449

  

Variable	Panel C: XAD			Panel D: AQC		
	Positive	Negative	Zero	Positive	Negative	Zero
	(7)	(8)	(9)	(10)	(11)	(12)
$PIN_{i,t-1}$	-0.144 (-4.476)***	-0.160 (-5.899)***	-0.231 (-12.990)***	-0.245 (-13.805)***	-0.156 (-5.775)***	-0.106 (-3.230)***
Intercept and controls	YES	YES	YES	YES	YES	YES
INDUSTRY EFFECTS	YES	YES	YES	YES	YES	YES
YEAR EFFECTS	YES	YES	YES	YES	YES	YES
R <sup>2</sup>	0.106	0.100	0.085	0.127	0.064	0.083
N	3,218	2,804	15,529	6,861	3,623	11,067

This table presents the results for the impact of non-labor investment on the relationship between stock price informativeness and labor investment efficiency. The results for the sub-samples based on capital expenditure (CAPX) are reported in **Panel A**. The results for the sub-samples based on R&D expenses (XRD) are reported in **Panel B**. The results for the sub-samples based on advertising expenses (XAD) are reported in **Panel C**. The results for the sub-samples based on acquisitions (AQC) are reported in **Panel D**. Models 1, 4, 7, and 10 report the results for the sub-sample of firms for which an increase (a decrease) in labor investment is accompanied with an increase (a decrease) in non-labor investment (i.e., a positive relationship between labor and non-labor investments). Models 2, 5, 8, and 11 report the results for the sub-sample of firms for which an increase (a decrease) in labor investment is accompanied with a decrease (an increase) in non-labor investment (i.e., a negative relationship between labor and non-labor investments). Models 3, 6, 9, and 12 report the results for the sub-sample of firms with a missing value for non-labor investment (i.e., firms without CAPX, XRD, XAD, and AQC, respectively). We only report (for the sake of space) the results for our test variable i.e.,  $PIN_{i,t-1}$ . The full sample includes 21,551 firm-year observations for the 1994-2010 period. Bold face indicates statistical significance at the 1% level. Descriptions and data sources for the regression variables are provided in the Appendix. z-statistics based on robust standard errors adjusted for clustering by firm are shown below each estimate – in parentheses. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively, one-tailed when directional predictions are made, and two-tailed otherwise.

**TABLE 8**  
*Stock price informativeness and labor investment efficiency: Additional robustness tests*

Variable	Alternative proxies for labor investment efficiency				PIN	PIN
	(1)	(2)	(3)	(4)	Q5-Q1	dummy
$PIN_{i,t-1}$	-0.092 (-9.104)***	-0.128 (-12.639)***	-0.110 (-11.009)***	-0.049 (-6.563)***		
$PIN_{i,t-1}$ (Q5-Q1)					-0.019 (-3.469)***	
$PIN_{i,t-1}$ (dummy)						-0.011 (-3.420)***
Intercept and controls	YES	YES	YES	YES	YES	YES
INDUSTRY EFFECTS	YES	YES	YES	YES	YES	YES
YEAR EFFECTS	YES	YES	YES	YES	YES	YES
R <sup>2</sup>	0.077	0.118	0.111	0.058	0.071	0.075
N	21,551	21,551	21,522	21,551	8,610	21,551
Variable	Additional control variables				Excluding financial &	
	$AQ_{i,t-1}$	$ERC_{i,t-1}$	$BIAS_{i,t-1}$	$VAR\_ANALYST\_COV_{i,t-1}$	CAR	utility
	(7)	(8)	(9)	(10)	(11)	(12)
$PIN_{i,t-1}$	-0.202 (-13.902)***	-0.209 (-14.866)***	-0.131 (-6.918)***	-0.073 (-3.007)***	-0.203 (-14.486)***	-0.220 (-16.601)***
$AQ_{i,t-1}$	0.003 (1.204)					
$ERC_{i,t-1}$		0.000 (0.725)				
$BIAS_{i,t-1}$			0.003 (1.435)*			
$VAR\_ANALYST\_COV_{i,t-1}$				0.004 (1.328)*		
$CAR_{i,t-1}$ (below Q1 dummy)					0.012 (4.588)***	
$CAR_{i,t-1}$ (above Q3 dummy)					0.018 (6.071)***	
Intercept and controls	YES	YES	YES	YES	YES	YES
INDUSTRY EFFECTS	YES	YES	YES	YES	YES	YES
YEAR EFFECTS	YES	YES	YES	YES	YES	YES
R <sup>2</sup>	0.082	0.085	0.076	0.073	0.088	0.112
N	20,012	21,551	17,771	14,722	21,551	19,244

This table presents results of additional robustness tests. We only report (for the sake of space) the results for our test variable i.e.,  $PIN_{i,t-1}$  and the added control variables. The full sample includes 21,551 firm-year observations for the 1994-2010 period. Bold face indicates statistical significance at the 1% level. Descriptions and data sources for the regression variables are provided in the Appendix. z-statistics based on robust standard errors adjusted for clustering by firm are shown below each estimate – in parentheses. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively, one-tailed when directional predictions are made, and two-tailed

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otherwise.

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