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**Do Directors Respond to Stock Mispricing?  
Evidence from CEO Turnovers**

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## **Abstract**

This paper examines whether and how stock mispricing can affect the probability of CEO turnover. In a sample of 1,573 US public firms, I find that, after controlling for fundamental performance, a one standard deviation negative uninformative stock price shock increases the likelihood of CEO turnover by 10%. The mispricing-turnover sensitivity is stronger at firms with an independent board, and a difference-in-difference analysis further supports that finding. Ancillary results suggest that independent directors' career concerns may play a role in the response of independent boards to mispricing.

## **I. Introduction**

The stock price guides several important decisions that the board of directors and shareholders make about a firm. Keeping or dismissing the chief executive officer (CEO) is one such decision, as the firm's stock price reflects the CEO's ability and affects the wealth of the shareholders that directors represent. At the same time, non-fundamental liquidity-driven shocks routinely make stock prices deviate from fundamental values. Fire sales, in particular, can depress a stock price for several quarters (Coval and Stafford (2007)). Non-fundamental liquidity shocks can have significant implications for asset pricing (e.g., Lou (2012)) and corporate investment (e.g., Lou and Wang (2018) ; Dessaint, Foucault, Fresard, and Matray (2019)). But despite the recurrence of these non-fundamental stock price shocks, the relevance of stock prices for CEO turnover decisions and the importance of firms' management for firm performance (Bloom, Eifert, Mahajan, McKenzie, and Roberts (2013); Bennedsen, Perez-Gonzalez, and Wolfenzon (2020)), we currently have a limited understanding of the possible effects of non-fundamental stock price shocks on CEO turnovers.

According to standard economic theory, managers should be sanctioned only for those changes in firm performance that are under their control (e.g., Holmström (1979)). To the extent

that CEOs cannot prevent stock price deviations from fundamental value, directors should thus not sanction CEOs for a temporary undervaluation of the firm, and non-fundamental stock price shocks should have a negligible effect on CEO replacements. Extending this standard view, however, two theoretical arguments suggest that CEO replacements could be sensitive to non-fundamental stock price movements. Specifically, the likelihood of CEO turnover may be related to non-fundamental stock price movements if directors wrongly interpret a non-fundamental shock as a signal about the CEO's performance, or attempt to accommodate a misinformed director labor market to enhance their reputation and improve their own career prospects. These channels are particularly relevant for independent directors as previous studies document that independent directors typically experience difficulties accessing private information (e.g., Duchin, Matsusaka, and Ozbas (2010)) and attach significant importance to their reputations (Guo and Masulis (2015)).

This paper studies whether and how non-fundamental movements in stock prices may affect CEO turnover decisions with a particular attention to the role independent directors may play in this relationship. To empirically examine these questions, I exploit the price pressure that results from the forced sale of stocks by mutual funds as a source of temporary undervaluation (cf. Coval and Stafford (2007); Lou (2012)) and relate it to CEO turnover events and directors' characteristics in a sample of large U.S. public firms. As proposed by Wardlaw (2020), I calculate stock price pressure in number of shares rather than in market values throughout the analysis. This avoids the mechanical effect of contemporaneous stock returns on the pressure measure.

Price pressure-induced mispricing offers an interesting setting to assess the sensitivity of CEO turnover to shocks against which a CEO has little control. Mispricing shocks are well suited to study possible misattribution by the board of directors or the director labor market, as the stock

price is a salient signal for directors and shareholders, and a CEO has limited scope to influence the exposure of a large public firm to these shocks. Mispricing shocks also tend to be firm-specific and are unlikely to systematically influence CEOs' outside options (for example, Eisfeldt and Kuhnen (2013) show how, in a competitive assignment framework, CEO turnovers could be sensitive to industry shocks as a result of changes in outside options). Finally, mispricing shocks allow to directly examine the possible effect of stock market trading on CEO turnover, providing possible evidence for a link between public listing and firm productivity.

The analysis yields three sets of findings. First, the central results show that non-fundamental downward movements in stock prices significantly increase the probability of CEO turnover at affected firms. In particular, after controlling for fundamental performance, a one standard deviation non-fundamental stock price shock results in a 0.94 to 1.06 percentage point increase in the likelihood of involuntary CEO turnover, that is a 10% to 11% relative increase over the unconditional likelihood of involuntary CEO turnover. This finding is consistent across various robustness tests and alternative econometric specifications. It does not change when I include firm fixed effects, estimate a logit rather than a linear probability model, or restrict the sample of firms to those that experience at least one severe stock mispricing shock during the sample period. These results suggest that on average mispricing affects boards' assessment of CEOs.

Second, in light of theories that may explain the sensitivity of CEO turnover to stock mispricing, I examine how the results vary with board independence. I establish that firms with an independent board (that is, boards where the majority of directors are independent) drive the sensitivity of CEO turnover to mispricing. Two further analyses alleviate the concern that this board independence result is driven by an omitted variable correlated with board independence. In a first test, I assess whether firm characteristics that might be correlated with board

independence are confounding the board independence result. Reassuringly, controlling for the interactions between stock mispricing and board size, shareholder rights, firm size, leverage, research and development (R&D) expenditures, and fraction of institutional ownership has little effect on the regression coefficient measuring the effect of board independence. As a second test, I exploit the change in listing rules around the passage of the Sarbanes-Oxley Act (SOX) as a plausibly exogenous regulatory shock to board independence. Implemented from 2001, the new rules required any firm with an insider-dominated board to increase its fraction of independent directors to at least 50%. Compared to firms whose boards were already independent, the rule changes increased the sensitivity of CEO turnover to stock mispricing at affected firms.

The third set of results sheds some light on two channels that could be at play in the mispricing-turnover sensitivity at firms with an independent board. A first possible channel recognizes that independent directors may, on average, receive little private information about the firms they monitor (Adams and Ferreira (2007); Harris and Raviv (2008); Duchin et al. (2010)) and rely on stock prices when assessing the CEO's performance. The average board tends to not fully filter out common industry shocks from firm performance when deciding on a CEO's fate (Jenter and Kanaan (2015)) and reward CEOs for changes in macroeconomic conditions that are, in fact, beyond their control (Bertrand and Mullainathan (2001)). If a misinformed independent board infers CEO performance from stock prices but fails to filter out mispricing, then it may misattribute an undervalued stock to CEO underperformance and consequently sanction the CEO. Examining how the sensitivity of CEO turnover to stock mispricing relates to the difficulty of acquiring information about the firm, however, I do not find much support for this channel in the data.

An alternative possible channel builds on the observation that, even as directors monitor the CEO, they are themselves disciplined by the firm's shareholders and by the wider labor

market for directors (Fama (1980); Fos, Li, and Tsoutsoura (2018)). Independent directors have strong incentives to develop their reputations, in the corporate directorship market, as skilled monitors (Guo and Masulis (2015)). So, if they expect stock mispricing to affect that market's evaluation of their performance — since, overall, the market seems unaware of stock mispricing — then they might respond to uninformative price movements irrespective of their own mispricing awareness (Fisman, Khurana, Rhodes-Kropf, and Yim (2014)). Aligned with the idea that career concerns may play a role in independent directors' reactions to stock mispricing, I find that independent boards whose independent directors plausibly care relatively more about the director labor market (i.e., boards on which independent directors are young, close to re-election, and have few board seats) are more sensitive to stock mispricing than less career-conscious independent boards.<sup>1</sup>

While these last results are consistent with the notion that independent directors' career concerns play a role in the sensitivity of CEO turnover to stock mispricing, a caveat to their interpretation is that they rely on non-exogenous variation in board characteristics and that these characteristics could be correlated with an omitted variable. Controlling for the interaction between stock mispricing and several observable board and firm characteristics, as I do here, helps mitigate this concern. Yet, in the absence of a source of exogenous variation in board characteristics, these results on the channel should be primarily interpreted as descriptive.

Collectively, the paper's findings contribute to several strands of the literature on corporate governance, organizational economics, and the real effects of the stock market. They

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<sup>1</sup> Consistent with a role played by directors' career concerns, additional results (available in the online appendix) suggest that three years after a CEO turnover independent directors involved in the turnover hold on average more external seats than otherwise similar independent directors sitting on the board of similar firms (in terms of size, profitability and mispricing). The sensitivity of CEO turnover to stock mispricing is also driven by cases where the CEO's successor is a firm insider; that is, where one can expect firms to already have a credible candidate for the CEO position at the time of the turnover decision, thereby reducing directors' replacement search cost for a new CEO.

first relate to the literature on CEO turnover and its sensitivity to firm performance (for a summary, see Brickley (2003)) and to outside factors. Whereas Jenter and Kanaan (2015) document that boards tend to discipline CEOs following industry shocks, this paper shows that boards may also impose discipline in response to firm-specific shocks that are largely beyond the CEO's control, and that the composition of the board of directors may affect the sensitivity of turnover to these firm-specific shocks.

The paper also contributes to the literature on independent directors. Although independent directors are presumed to be beneficial and effective monitors of CEO behavior (Weisbach (1988); Guo and Masulis (2015)), several studies offer a more nuanced view by highlighting the costs of independent boards. For example, independent directors may have greater difficulty accessing strategic information about the firm (Duchin et al. (2010)) and be less effective at advising executives (Adams and Ferreira (2007)).<sup>2</sup> The results here suggest that career concerns may contribute to independent directors acting on non-fundamental stock price movements. The association between independent boards' career concerns and the sensitivity of CEO turnover to stock mispricing is also consistent with the predictions of theoretical models in which un-entrenched agents (e.g., directors) respond to noise to cater to their uninformed monitors (Brandenburger and Polak (1996) ; Fisman et al. (2014)). Exploiting the heterogeneous response to mispricing shocks, as I do in this paper, yields novel results consistent with a mechanism underlying those models.

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<sup>2</sup> Two related papers study the interactions between stock price informativeness and board monitoring. Ferreira, Ferreira, and Raposo (2011) examine the relationship between such informativeness and board structure. They find that, on average, firms with more informative stock prices have less independent boards. Along the same lines, Gorton, Huang, and Kang (2017) show that when the board's monitoring intensity and informed traders' knowledge are both endogenized, there is a negative relationship between stock price informativeness and board monitoring. I extend these results by documenting the effect of well-defined, yet uninformative stock mispricing shocks on CEO turnover and by assessing how and why the effect varies with the board's independence.



Finally, the extent to which stock prices affect firms' investment decisions has long been subject to debate (Barro (1990); Morck, Shleifer, and Vishny (1990); Blanchard, Rhee, and Summers (1993)). Several measures of stock mispricing are related to firm investment either through equity issues (Baker and Wurgler (2002)) or through catering to market sentiment (Polk and Sapienza (2009)). More recent research shows that plausibly exogenous mispricing shocks induced by mutual fund forced sales affect capital issues (Kahn, Kogan, and Serafeim (2012)), as well as takeover decisions (Edmans, Goldstein, and Jiang (2012)) and investment levels (Hau and Lai (2013); Dessaint et al. (2019); Lou and Wang (2018)). I show that these non-fundamental shocks also affect leadership choices, a determinant of firm value and productivity.

The rest of the paper is organized as follows. Section 2 describes the data. Section 3 discusses the empirical methodology and Section 4 presents the results. Section 5 concludes.

## **II. Data**

The data on CEO turnover come from Jenter and Lewellen (2014), Peters and Wagner (2014), and Jenter and Kanaan (2015) who track these events until 2009. Algorithms that describe turnovers as "forced" or "voluntary" based on press releases are notoriously imprecise (Kaplan and Minton (2012); Jenter and Lewellen (2014)), and the majority of CEO turnovers are difficult to classify (Eisfeldt and Kuhnen (2013)). Replacements of a CEO that are triggered by non-fundamental movements in stock prices may also be less likely to be reported in press releases as clear-cut dismissals. For these reasons, I consider all CEO turnovers except for those of CEOs beyond the retirement age of 65 (Jenter and Lewellen (2014)). I require that CEOs be in the sample for at least two years.

The data on stock returns and firm characteristics are from the Center for Research in Security Prices (CRSP) and Compustat. The data on board characteristics and directors'

independence are available from 1997 from ISS/RiskMetrics. These data cover large firms that belong to the S&P 1500 index. I use the linking table provided by Coles, Daniel, and Naveen (2014) to merge Compustat and ISS/RiskMetrics. I exclude firms in the finance and utility industries (SIC codes 6000 to 6700 and 4000 to 4900). The final sample includes 1,573 unique firms.

To isolate non-fundamental movements in stock prices, I exploit the price pressure induced by the forced sales of mutual funds (Kahn et al. (2012), Lou and Wang (2018), Edmans et al. (2012), Dessaint et al. (2019)). Stock sales by diversified mutual funds in response to investor outflows generate large demand shocks on stocks in those funds' portfolios. As a result, these stocks experience substantial price declines (Coval and Stafford (2007)). Since only diversified mutual funds are considered in the construction of the measure, the investor outflows are unlikely to reflect investors' private information about a given firm. Nevertheless, fund managers have some discretion regarding which stocks to sell following outflows. A concern in this setting is that managers act on private information and choose to sell stocks that would have performed badly even in the absence of fund outflows. I address that concern by measuring only hypothetical sales that depend on the fund's holdings before a large investor outflow occurs. So, by construction, this measure avoids any correlation between the mutual fund's actual sales and the manager's private information. The measure includes only those funds that experience severe outflows; that is, flows that fall in the bottom 10% of the distribution (this amounts to considering outflows of at least 8% of total assets). In line with previous studies, I exclude all mutual funds specializing in a single sector to avoid the possibility that outflows are driven by negative views of one particular sector. As proposed by Wardlaw (2020), I compute the measure in "number of shares" rather than market values to avoid a mechanical relation between the measure and stock returns. I also implement robustness tests that address the concern of sample

selection bias in the firms affected by mispricing shocks (Berger (2017)).

Construction of the forced sales mispricing measure (MISPRICING) proceeds as follows. I first calculate quarterly mutual fund flows from the CRSP mutual fund database. Then, for each stock in each quarter, I use Thomson Reuter-CDA Spectrum data to compute the previous quarter total holdings (i.e., number of shares) of funds that experience at least 8% of outflows; that is, flows in the 10<sup>th</sup> percentile in the quarter. These holdings are next summed and divided by the number of shares outstanding (in the quarter preceding the severe outflows) for the focal stock. Finally, I sum the quarterly measures over the four quarters of the firm's fiscal year.

[[ INSERT Figure 1 about Here ]]

In Figure 1, I plot the sample firms' yearly cumulative average abnormal returns around forced sales events for the first annual mispricing measure falling below the 10<sup>th</sup> percentile. I regress firms' 12-month stock returns on the leads and lags of the event dummy and include time fixed effects to control for aggregate shocks. The figure shows the cumulative coefficients in event-time. It exhibits no significant abnormal decline before the event and an abrupt drop in stock returns immediately after the event. The returns reach about -10% in the year of the event and about +10% the following year. The price recovery, too, is consistent with these forced sales generating uninformative shocks.

[[ INSERT Figure 2 about Here ]]

Figure 2 presents the sample average of the mispricing measure and frequency of CEO turnover by year and industry. On average, 9.7% of CEOs are replaced before age 65. Stock mispricing occurs throughout the sample period and is not distinctly clustered, although there is significant increase in the measure in both 1999 and 2009. I include year fixed effects in the regressions to ensure that the inferences are not affected by aggregate shocks. Stock mispricing and CEO turnovers affect stocks across a wide variety of industries. Table 1 displays the

summary statistics for this sample of large public firms.

[[ INSERT Table 1 about Here ]]

### III. Methodology

To assess how sensitive CEO turnover is to non-fundamental shocks to the stock price, I implement a two-step procedure similar to that used by Dessaint et al. (2019).

The first step decomposes firms' 12-month stock return into a non-fundamental component (MISPRICING), which is based on stock price shocks due to mutual fund outflows, and a fundamental residual component ( $v$ ). That regression is:

$$(1) \quad \text{RETURN}_{it} = d_t + n_s + \psi(\text{MISPRICING})_{it} + v_{it},$$

where  $i$  indexes firms,  $t$  indexes years, and  $d_t$  and  $n_s$  represent year and industry (2-digit Standard Industrial Classification, SIC2) fixed effects, respectively. In a second step, I build on this decomposition to estimate the sensitivity of CEO turnover to such non-fundamental movements in stock price. For this purpose, I use the following linear probability model:

$$(2) \quad P(\text{CEO\_TURNOVER}_{it+1}) = d_t + n_s + \beta(\text{MISPRICING})_{it} + \gamma v_{it} + \rho \text{ROA}_{it} + \Phi X_{it} + \varepsilon_{it},$$

where  $v_{it}$  is the fundamental residual of equation (1) and  $\varepsilon$  is an error term. ROA is the firm's accounting performance (return on assets, calculated as the ratio of earnings before interests and taxes over total assets) and  $X$  is a vector of control variables that includes firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable for whether or not the CEO is also chairman of the board (COB). Standard errors are clustered at the firm level. The coefficient of interest is  $\beta$ , which measures the sensitivity of CEO turnover to non-fundamental movements in stock prices. Since MISPRICING is a negative number (greater mispricing implies a MISPRICING that is more negative), it follows that a negative  $\beta$  coefficient

indicates that non-fundamental declines in stock prices increase the likelihood of CEO turnover. To ease the interpretation of the coefficients, I scale MISPRICING,  $v$ , and ROA by their sample standard deviation.

These baseline regressions are comparable to the standard CEO turnover regressions estimated in the literature. In some tests, I further tighten the specifications — equations both (1) and (2) — by including industry-year fixed effects (which control for any industry-specific, time-varying factor) or firm fixed effects (which control for time-invariant firm characteristics). To address the concern that outflow-driven mispricing may affect only certain types of firms, I follow Berger (2017) and re-run my regressions on the sample of firms affected at least once by a severe mispricing event (i.e., MISPRICING falling below various thresholds). I also implement robustness tests where I further control for analysts' projection of the firm's growth prospects. The results are little affected by these variations.<sup>3</sup>

[[ INSERT Table 2 about Here ]]

The stock return regression results in Table 2 confirm that the mutual fund hypothetical sales measure is a strong predictor of declines in firms' raw and abnormal stock returns. An increase of one standard deviation in the annual stock mispricing measure is associated with a 4% to 5% reduction in stock returns, where the exact percentage by which that value falls depends on which fixed effects are included in the specification.

## **IV. Results**

### **A. Baseline Results**

I start by estimating the sensitivity of CEO turnover to stock mispricing using the two-step

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<sup>3</sup> The results are also robust to estimating a logit model rather than a linear probability model.

approach described by equations (1) and (2). Recall that in equation (1), the variation in firm stock returns is decomposed into a non-fundamental component associated with the forced sales of mutual funds (MISPRICING) and a fundamental residual component  $v$  (denoted FUNDAMENTAL in the tables). In equation (2), an indicator for CEO turnover is then regressed on these two components. If CEO turnover is sensitive to non-fundamental movements in stock prices, then the coefficient for MISPRICING will be negative and statistically significant.

[[ INSERT Table 3 about Here ]]

Table 3 presents the main results. When regressing CEO turnover on the fundamental and non-fundamental components of firm stock returns, both terms are strongly associated with CEO turnover. I first use the specification introduced in equation (2), without the industry fixed effects. The coefficient for MISPRICING in column 1 is negative and statistically significant (coeff. =  $-0.0101$ ,  $t$ -stat. = 2.68). I next add the industry fixed effects and then the industry-year fixed effects to account for time-varying industry shocks; these additional terms do not really affect the coefficients in column 2 (coeff. =  $-0.0094$ ,  $t$ -stat. = 2.49) or column 3 (coeff. =  $-0.0106$ ,  $t$ -stat. = 2.67), respectively. I then tighten the baseline specification by incorporating firm fixed effects. The coefficient in column 4, which is now estimated within firms, remains robust in magnitude and statistical significance (coeff. =  $-0.0105$ ,  $t$ -stat. = 2.46).

The effect of stock mispricing on CEO turnover is economically meaningful. In the industry fixed effects specification (column 2), an increase of one standard deviation in the non-fundamental shock increases the probability of CEO turnover by 0.94 percentage points; this amounts to a 9.7% increase over the unconditional probability of CEO turnover. In comparison, a one standard deviation decline in stock returns due to fundamental reasons increases CEO turnover by 1.95 percentage points (a 20.1% increase in the probability of CEO turnover), and a one standard deviation decline in the return on assets increases CEO turnover by 1.48 percentage

points (a 15.3% increase in the probability of CEO turnover). On average, non-fundamental movements in stock prices affect boards' assessment of CEOs.

[[ INSERT Table 4 about Here ]]

Table 4 presents robustness test results on the sensitivity of CEO turnover to stock mispricing. The results in columns 1 through 6 address the concern that CEO turnover sensitivity to stock mispricing may be driven by selection bias. Following Berger (2017), I re-estimate the regression on the sample of firms that are affected at least once by a severe mispricing event. A mispricing event is defined as severe if the price pressure measure falls within the 33<sup>rd</sup> percentile (columns 1 and 2), the 20<sup>th</sup> percentile (columns 3 and 4), or the 10<sup>th</sup> percentile (columns 5 and 6). I find that, despite the reduction in sample size, there is little effect on the magnitude of the coefficient for MISPRICING; that coefficient also remains statistically significant at conventional levels. In column 7, the results show that using a logit model instead of a linear probability model does not materially affect the finding either. To further mitigate the concern that the mispricing shocks may be correlated with fundamental performance, I show in Online Appendix Table A.1 that the results are also robust to controlling for analysts' long-term growth forecast, which proxies for fund managers' information about the firm's prospects.

## **B. Board Independence**

After establishing the main result, I now examine the role of the board of directors and study board characteristics that are associated with a sensitivity of CEO turnover to non-fundamental movements in stock prices.

Directors' independence may play a key role in the sensitivity of CEO turnover to stock mispricing. First, it might be difficult for independent boards to access inside information about the firm (Adams and Ferreira (2007); Harris and Raviv (2008); Duchin et al. (2010)). Lacking

sufficient strategic information, independent boards may rely more (than other boards) on public signals, such as the stock price, when assessing CEO performance. To the extent that independent directors might not filter out noise from the stock price, they may react to non-fundamental movements. Second, independent directors are disciplined by their own labor market (Fama (1980)). In a director labor market that rewards monitoring, independent directors may count on the labor market offering them additional board seats (as in, for example, Fos et al. (2018)). Hence, they may be more inclined to act on non-fundamental declines in the stock price so that they appear to be effective monitors. For this dynamic to play out, it may be sufficient for these directors to believe that the market will rely on public signals to assess their monitoring effectiveness but will not filter out mispricing in making that assessment (Fisman et al. (2014)).

In Table 5, I evaluate the possible role of board independence in the association between CEO turnover and stock mispricing. I measure board independence using a dummy variable that is set to 1 if independent directors represent at least 50% of the board, and is 0 otherwise.

[[ INSERT Table 5 about Here ]]

Column 1 reports the estimation results based on interacting non-fundamental performance with board independence. The interaction coefficient for non-fundamental performance is negative and statistically significant, which indicates that firms with independent boards are more sensitive to stock mispricing when it comes to CEO replacement. Adding industry, industry-year, or firm fixed effects (in columns 2, 3, and 4, respectively) barely changes the coefficients. In column 5, I augment the baseline model by adding the interaction of MISPRICING and dummies capturing three-year periods to control for possible time-series changes in the relationship between mutual fund forced sales and CEO turnover, which may be correlated with trends in board independence. The inclusion of these interactions does not materially change the magnitude of the regression results. In column 6, I end the sample in 2006



because there is little variation in board independence across firms after that year. The results remain robust.

A potential concern with the results in Table 5 is that board independence might be correlated with other firm characteristics that drive the association between board independence and the sensitivity of CEO turnover to stock mispricing. I address this concern in two ways. First, I study the determinants of board independence and assess whether predictors of that independence are also associated with the turnover-mispricing sensitivity. I use the first year in which each CEO takes office and regress both dichotomous and continuous measures of board independence on several firm characteristics: board size, shareholder rights as proxied by the G-index of Gompers, Ishii, and Metrick (2003), firm size, leverage, R&D expenditures over assets, and institutional ownership. The results in Table 6 show that board independence is significantly related to firm size, G-index, R&D expenditures over assets, and institutional ownership. Next, I re-estimate the baseline regressions but now interact MISPRICING with the firm characteristics introduced above. Focusing on each variable in turn, in Table 7 I find little association between the CEO turnover-mispricing sensitivity and these characteristics. More importantly, the sensitivity of CEO turnover to non-fundamental movements changes as a function of board independence (row 1), and remains robust to the inclusion of additional interaction terms between stock mispricing and board size, G-index, firm size, leverage, R&D expenditures over assets, or institutional ownership (columns 1 through 6). Likewise, including all the interactions between these characteristics and stock mispricing does not alter the effect of board independence (column 7). The results are also robust to further including firm fixed effects in the regression (column 8).

[[ INSERT Tables 6 and 7 about Here ]]

Second, I exploit the change in listing rules around the implementation of SOX as a further test of how independent directors may affect the CEO turnover-mispricing sensitivity.

One of the key listing rule provisions was to impose a majority of independent directors on the boards of listed firms. Although some firms (the “control” firms) were already in compliance with that requirement when the regulation was enacted, other firms (the “treatment” firms) were forced to increase the number of their independent directors. I follow Duchin et al. (2010), Guo and Masulis (2015), and Balsmeier, Fleming, and Manso (2017), and adopt a difference-in-differences framework for comparing the sensitivity of CEO turnover to stock mispricing for the treatment and control firms both before and after the listing rule changes. I estimate the following model:

$$(3) \quad P(\text{CEO\_TURNOVER}_{it+1}) = d_t + n_s + \beta_0(\text{MISPRICING}_{it} \times \text{TREAT}_i \times \text{AFTER}_{it}) + \beta_1(v_{it} \times \text{TREAT}_i \times \text{AFTER}_{it}) + \beta_2(\text{ROA}_{it} \times \text{TREAT}_i \times \text{AFTER}_{it}) + \beta_3(\text{MISPRICING}_{it} \times \text{TREAT}_i) + \beta_4(v_{it} \times \text{TREAT}_i) + \beta_5(\text{ROA}_{it} \times \text{TREAT}_i) + \beta_6(\text{MISPRICING}_{it} \times \text{AFTER}_{it}) + \beta_7(v_{it} \times \text{AFTER}_{it}) + \beta_8(\text{ROA}_{it} \times \text{AFTER}_{it}) + \beta_9 \text{MISPRICING}_{it} + \beta_{10} v_{it} + \beta_{11} \text{ROA}_{it} + \beta_{12}(\text{TREAT}_i \times \text{AFTER}_{it}) + \Phi X_{it} + \varepsilon_{it},$$

where the indicator variable TREAT is set to 1 if fewer than half of a firm’s directors were independent in 1999 (the year in which regulatory innovations with regard to directors’ independence started), and AFTER is set to 1 for years after 2001 for control firms and for years after the year of compliance for treatment firms.<sup>4</sup> This model is estimated on 5 years before and 5 years after the shock. The coefficient of interest is  $\beta_0$ , which measures the change in the post-compliance sensitivity of CEO turnover to non-fundamental shocks (MISPRICING) at treatment and control firms.

[[ INSERT Table 8 about Here ]]

Table 8 reports the results of this difference-in-difference analysis. Column 1 shows that

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<sup>4</sup> Firms were given until 2005 to comply with the change in listing rules that mandates a majority of independent directors on the board.

the shock is relevant: treatment firms significantly increased their fraction of independent directors in response to the regulation. Column 3 displays the basic regression results when industry fixed effects are included. Columns 4 and 5 (respectively) display the results when industry-year fixed effects and firm fixed effects are added to the regressions. Column 6 presents the results for the re-estimation of the firm fixed effect regression after matching the treatment and control firms, which addresses the imbalance of treatment and control firms regarding several observable characteristics (for example, treatment firms tend to be smaller).<sup>5</sup> In columns 2 to 6, the coefficient of interest,  $\beta_0$ , is consistently negative and statistically significant. In comparison with control firms, CEO turnover in treatment firms exhibits increased sensitivity to stock mispricing after implementing the change in listing rules. These results reinforce the notion that firms with an independent board are particularly responsive to non-fundamental movements in stock prices.

### **C. Investigating the Channel**

In this section, I explore two theoretical channels that might explain the sensitivity of CEO turnover to stock mispricing, particularly among firms with an independent board: misinformation and career concerns.

A widespread concern with independent boards is that executives may be reluctant to provide independent directors with timely information about the firm. Independent directors with inferior information may feel impelled to rely on public signals (e.g., stock prices) to monitor executives. If they fail to differentiate between fundamental and non-fundamental shocks to the stock prices, ill-informed independent directors may also (mistakenly) attribute the stock

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<sup>5</sup> The matching is performed as follows. I estimate the probability (i.e., the propensity score) that a firm is treated as a function of its size (log of assets), fraction of institutional ownership, leverage, board size, and return on assets, measured in 1999. I then perform a “radius” match (with a standard 0.005 caliper) based on that propensity score.

mispricing that is triggered by mutual funds' forced sales to CEO performance.

Under this hypothesis, the sensitivity of CEO turnover to stock mispricing would be greatest in firms with an independent board and in which it is difficult to acquire firm-specific information. To examine this possibility, I compare the sensitivity of CEO turnover to stock mispricing in firms with independent boards across firms with different costs of acquiring information (more and less "opaque" firms). If access to information plays a role in the sensitivity of CEO turnover to stock mispricing, I expect to find a greater sensitivity in the group of firms with high opacity, where information about the firm is more costly to obtain and where independent directors may rely more on the stock price to assess CEO ability. Indeed, Duchin et al. (2010) show that the effect of imposing board independence on firm value is related to the opacity of the firm. I therefore follow Duchin et al. (2010) and rely on analyst-based measures, such as minus the number of analysts covering the firm, the standard deviation of analysts' forecasts, and the analysts' average forecast errors as proxies of firm opacity and independent directors' access to firm information. I calculate the principal components of these variables and define an opaque firm as one for which the first principal component is above the median.<sup>6</sup>

The first three columns of Table 9 report the results of these tests for firms with an independent board. The point estimates on the interaction between MISPRICING and OPACITY are close to zero and statistically insignificant, be it with industry fixed effects in column 1 (coeff. = 0.0019,  $t$ -stat. = 0.32), with industry-year fixed effects in column 2 (coeff. = 0.0027,  $t$ -stat. = 0.43), or with firm fixed effects in column 3 (coeff. = 0.0018,  $t$ -stat. = 0.26). On average, information acquisition costs do not appear to play a major role in the sensitivity of CEO

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<sup>6</sup> The first principal component loads heavily and positively on the standard deviation of analyst forecasts and analysts' average forecast errors.

turnover to stock mispricing.<sup>7</sup>

[[ INSERT Table 9 about Here ]]

Next, I turn to the role of independent directors' career concerns. Fos et al. (2018) document that CEO turnover sensitivity to firm performance tends to increase as directors approach re-election and the director labor market tends to reward directors who replace CEOs with additional board seats. Independent directors are concerned about the labor market for director seats (Guo and Masulis (2015)), and this generalization holds even more for directors who are younger, are closer to the end of their current term, or hold few director seats. If independent directors expect stock mispricing to affect the labor market's evaluation of their performance — since, overall, the market seems unaware of stock mispricing — then they might respond to uninformative price movements irrespective of their own mispricing awareness (Fisman et al. (2014)). I use the average of each characteristic (age, number of years until re-election, and number of seats) across the firm's independent directors to construct an indicator of independent directors' career concerns.

I construct a career concerns index following the same methodology as for the opacity index above. I calculate the first principal component of the individual proxies (age, number of years until re-election, number of seats) to aggregate them into a single indicator. The first principal component loads positively on the three variables, particularly on age and number of

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<sup>7</sup> In Table A.2 of the online appendix, I also examine directors' trades of the firm's stock during undervaluation episodes to examine, from a different angle, whether directors may misattribute mispricing to information about the CEO. Ali, Wei, and Zhou, 2011 (2011), Kahn et al. (2012) and Dessaint et al. (2019) document that corporate officers have some awareness of the undervaluation triggered by mutual funds' forced sales, as evidenced by those officers trading the firm's stock against the undervaluation on their own account. Across several measures, I find that, like corporate officers, independent directors of sample firms trade against the undervaluation. While this trading pattern could reflect their awareness of the mispricing, a systematic contrarian strategy towards the firm's stock or learning from the main officers' trading, independent directors' purchase of the undervalued stock is indicative of their belief in the undervaluation and is hard to reconcile with the hypothesis that they respond to mispricing simply because they wrongly interpret the stock price fall for negative information about the firm.

years until re-election. I then take the opposite number of (i.e., minus) this first principal component (because age, number of years until re-election, and number of seats are negatively related to career concerns), and I define a board with career concerns as one for which the career concerns index is above the median.

In columns 4 to 6 of Table 9, I report the results for the effect of directors' career concerns on the sensitivity of CEO turnover to stock mispricing. The coefficient on the interaction between MISPRICING and CAREER\_CONCERNS is negative, statistically significant, and robust to the inclusion of industry fixed effects in column 4 (coeff. =  $-0.0107$ ,  $t$ -stat. = 1.88), industry-year fixed effects in column 5 (coeff. =  $-0.0124$ ,  $t$ -stat. = 2.09) and firm fixed effects in column 6 (coeff. =  $-0.0136$ ,  $t$ -stat. = 2.03).

In columns 7 to 9 of Table 9, I include both the interactions between MISPRICING and OPACITY and MISPRICING and CAREER\_CONCERNS in a single regression to assess the two channels jointly. These regressions effectively consider each channel while controlling for the other. Consistent with the results above, OPACITY is not significantly related to the sensitivity of CEO turnover to stock mispricing, but CAREER\_CONCERNS is. In column 10, I further saturate the firm fixed effects regression of column 9 by including the interactions between mispricing and the control variables to account for the possible correlation between CAREER\_CONCERNS (or OPACITY) and the control variables in assessing their sensitivity to mispricing. These additional interaction terms leave the findings unaffected. Overall, the results of Table 9 are consistent with the notion that independent boards with greater career concerns respond more to non-fundamental stock price shocks than other independent boards.

A career concerns channel might also suggest that independent directors can expect to benefit from participating in a CEO turnover in terms of labor market outcome, while minimizing their private cost of replacing the CEO. Consistent with this, the results in Online Appendix

Table A.3 indicate that, three years after a CEO change, independent directors involved in the CEO turnover hold on average about 15% more seats than matched control directors that experience similar mispricing. Online Appendix Table A.4 shows that the sensitivity of CEO turnover to mispricing primarily comes from firms that, ex post, replace their CEO with a firm insider; that is presumably cases with lower search costs where directors already had a suitable in-house successor at the time of the CEO turnover.

Together, the results of this section point to a possible role of independent directors' career concerns in the sensitivity of CEO turnover to stock mispricing. Although, absent exogenous variation in directors' characteristics, these results cannot be interpreted as definitive tests of these channels, the patterns are empirically consistent with the predictions of theoretical models like Brandenburger and Polak (1996) or Fisman et al. (2014) where unentrenched directors are more likely to act on faulty performance signals to accommodate their misinformed monitors and improve expected personal outcomes.<sup>8</sup>

## **V. Conclusion**

This paper investigates whether and how stock mispricing may affect the probability of CEO turnover. Using a sample of U.S. firms, I find that non-fundamental downward movements in stock prices significantly increase the probability of CEO turnover. This association between turnover and mispricing is stronger for firms with a majority of independent directors.

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<sup>8</sup> Allowing for the possibility that mispricing is in fact somewhat under the CEO's control, an additional possible explanation for the sensitivity of CEO turnover to stock mispricing might be that CEOs are sanctioned for not succeeding to correct the mispricing (for example, by undertaking share repurchases or purchasing the stock on their own account). I examined this possibility by controlling for these actions and assessing the coefficient on the interaction between MISPRICING and these variables. Table A.5 of the Online Appendix displays the results. Controlling for such actions does not materially affect the MISPRICING coefficient in Table 3, and the interactions between MISPRICING and these variables are statistically insignificant. In sum, I do not find evidence that these CEO actions affect the turnover-mispricing sensitivity.

Additional results are consistent with the notion that independent directors' career concerns may play a role in the stock mispricing-CEO turnover sensitivity. In contrast, there is little evidence that on average independent boards misinterpret non-fundamental shocks for informative signals when the cost of acquiring firm information is high.

These results constitute novel empirical evidence consistent with theoretical models under which independent directors act on faulty signals and accommodate the misinformed investors who monitor them. In this sense, the results may point to a possible agency conflict between independent directors and the shareholders whom they represent. Further research could examine whether this particular channel may be responsible for other real effects and whether it influences the broader labor market for CEOs.



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**Table 1**  
**Descriptive Statistics**

This table presents summary statistics of the main variables used in the analysis. For each variable, the statistics are computed across pooled observations for the entire sample period (1997–2009).

	Mean	Median	S.D.
RETURN_12M	0.121	0.066	0.488
MISPRICING	-0.007	-0.005	0.007
CEO_TURNOVER	0.097	0.000	0.296
CEO_AGE ( <i>Years</i> )	51.163	51.000	7.378
DUAL_CEO_COB	0.611	1.000	0.487
ASSETS ( <i>Millions of Dollars</i> )	5,067.347	1,350.637	14,105.011
ROA	0.099	0.101	0.099
R&D_ASSETS	0.034	0.006	0.056
LEVERAGE	0.210	0.201	0.169
INSTIT_OWN	0.730	0.749	0.198
BOARD_SIZE	9.007	9.000	2.360
INDEPENDENT	0.685	0.714	0.171
OPACITY	0.448	0.000	0.497
CAREER_CONCERNS	0.504	1.000	0.500

**Table 2**  
**Stock Returns and Price Pressure**

This table presents results from the regressions of 12-month stock returns on MISPRICING. Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. FE = fixed effects. MISPRICING, and ROA are divided by their standard deviation to facilitate the interpretation of the coefficients. Standard errors (in parentheses) are clustered at the firm level. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

	RETURN_12M				
	1	2	3	4	5
MISPRICING	0.0456*** (0.0043)	0.0511*** (0.0061)	0.0502*** (0.0061)	0.0452*** (0.0059)	0.0497*** (0.0067)
ROA		0.0863*** (0.0054)	0.0903*** (0.0057)	0.0800*** (0.0057)	0.1397*** (0.0092)
Year FE	No	Yes	Yes	No	Yes
Industry FE	No	No	Yes	No	No
Industry FE×Year FE	No	No	No	Yes	No
Firm FE	No	No	No	No	Yes
Controls	No	Yes	Yes	Yes	Yes
Observations	11244	11244	11244	11225	11166

**Table 3**  
**Stock Mispricing and CEO Turnover**

This table presents results from the estimation of equation (2). Non-fundamental movements in stock returns are measured by MISPRICING (mutual fund hypothetical sales). ROA is the firm's return on assets. Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. Fundamental movements in stock returns are measured as residuals ( $v$ ) from the estimation of equation (1). FE = fixed effects. MISPRICING, FUNDAMENTAL, and ROA are divided by their standard deviation to facilitate the interpretation of the coefficients. Standard errors (in parentheses) are clustered at the firm level. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

	CEO_TURNOVER			
	1	2	3	4
MISPRICING	-0.0101*** (0.0038)	-0.0094** (0.0038)	-0.0106*** (0.0040)	-0.0105** (0.0043)
FUNDAMENTAL	-0.0209*** (0.0032)	-0.0195*** (0.0030)	-0.0202*** (0.0030)	-0.0136*** (0.0030)
ROA	-0.0152*** (0.0031)	-0.0148*** (0.0032)	-0.0153*** (0.0034)	-0.0260*** (0.0056)
Year FE	Yes	Yes	No	Yes
Industry FE	No	Yes	No	No
Industry FE×Year FE	No	No	Yes	No
Firm FE	No	No	No	Yes
Controls	Yes	Yes	Yes	Yes
Observations	11244	11244	11225	11166

**Table 4**  
**Mispricing and CEO Turnover: Robustness**

This table presents results of several robustness tests on the sensitivity of CEO turnover to stock mispricing. Non-fundamental movements in stock returns are measured by MISPRICING (mutual fund hypothetical sales). ROA is the firm's return on assets. Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. Fundamental movements in stock returns are measured as residuals ( $v$ ) from the estimation of equation (1). Columns 1 through 6 display to the results of the baseline regression estimated on the sample of firms affected by at least one severe mispricing event, defined as an event for which MISPRICING falls below the 33<sup>rd</sup> percentile (columns 1 and 2), the 20<sup>th</sup> percentile (columns 3 and 4), or the 10<sup>th</sup> percentile (columns 5 and 6). Column 7 displays the results of the baseline regression estimated with a logit model rather than a linear probability model. FE = fixed effects. MISPRICING, FUNDAMENTAL, and ROA are divided by their standard deviation to facilitate the interpretation of the coefficients. Standard errors (in parentheses) are clustered at the firm level. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

	CEO_TURNOVER						
	p33		Selection bias p20		p10		Logit
	1	2	3	4	5	6	7
MISPRICING	-0.0103*** (0.0039)	-0.0118*** (0.0044)	-0.0101** (0.0041)	-0.0112** (0.0045)	-0.0116** (0.0047)	-0.0121** (0.0050)	-0.1145*** (0.0433)
FUNDAMENTAL	-0.0197*** (0.0032)	-0.0149*** (0.0031)	-0.0197*** (0.0036)	-0.0134*** (0.0034)	-0.0155*** (0.0046)	-0.0105** (0.0044)	-0.2871*** (0.0528)
ROA	-0.0127*** (0.0035)	-0.0249*** (0.0058)	-0.0145*** (0.0039)	-0.0288*** (0.0064)	-0.0174*** (0.0050)	-0.0309*** (0.0072)	-0.1756*** (0.0384)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	No	Yes	No	Yes	No	Yes
Firm FE	No	Yes	No	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9819	9783	8034	8014	5370	5361	11174

**Table 5**  
**Board Independence and Stock Mispricing**

This table presents the results from regressions that assess the role of independent directors. Non-fundamental movements in stock returns are measured by MISPRICING (mutual fund hypothetical sales), and Fundamental movements in stock returns are measured as residuals ( $v$ ) from the estimation of equation (1). ROA is the firm's return on assets. Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. The dummy variable INDEPENDENT (INDEP.) is set to 1 when independent directors account for more than half of the board. In the regression for the results in column 5, I control for the interaction between MISPRICING and three-year period dummies (1998 to 2000, 2001 to 2003, 2004 to 2006, and 2007 to 2009). In column 6, the sample ends in 2006. FE = fixed effects. MISPRICING, FUNDAMENTAL, and ROA are divided by their standard deviation to facilitate the interpretation of the coefficients. Standard errors (in parentheses) are clustered at the firm level. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

	CEO_TURNOVER					
	1	2	3	4	5	6
MISPRICING	0.0103 (0.0084)	0.0119 (0.0085)	0.0105 (0.0091)	0.0109 (0.0096)	0.0411 (0.0251)	0.0096 (0.0088)
MISPRICING×INDEP.	-0.0230*** (0.0087)	-0.0240*** (0.0089)	-0.0236** (0.0095)	-0.0241** (0.0102)	-0.0225** (0.0095)	-0.0273*** (0.0097)
FUNDAMENTAL	-0.0209*** (0.0032)	-0.0196*** (0.0030)	-0.0202*** (0.0030)	-0.0136*** (0.0030)	-0.0196*** (0.0030)	-0.0196*** (0.0034)
ROA	-0.0149*** (0.0031)	-0.0145*** (0.0032)	-0.0150*** (0.0034)	-0.0259*** (0.0056)	-0.0146*** (0.0032)	-0.0136*** (0.0037)
INDEPENDENT	-0.0032 (0.0114)	-0.0049 (0.0116)	-0.0022 (0.0121)	-0.0120 (0.0156)	-0.0041 (0.0119)	-0.0068 (0.0120)
Year FE	Yes	Yes	No	Yes	Yes	Yes
Industry FE	No	Yes	No	No	No	Yes
Industry FE×Year FE	No	No	Yes	No	No	No
Firm FE	No	No	No	Yes	No	No
MISPRICING×3-Year FE	No	No	No	No	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sample end-year	2009	2009	2009	2009	2009	2006
Observations	11244	11244	11225	11166	11244	8695



**Table 6**  
**Determinants of Board Independence**

This table presents the results of cross-sectional regressions designed to assess the determinants of board independence. For each firm's executive, I use the first year in which that executive becomes the firm's CEO. In column 1, the dependent variable is a dummy set to 1 when independent directors account for more than half of the board; in column 2, the dependent variable is the continuous measure of the fraction of board directors that are independent. Robust standard errors are given in parentheses. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

	Fraction of Independent Directors $\geq 0.50$ 1	Fraction of Independent Directors 2
BOARD_SIZE	-0.0039 (0.0053)	0.0008 (0.0022)
GINDEX	0.0156*** (0.0039)	0.0100*** (0.0017)
ln(ASSETS)	0.0157* (0.0081)	0.0095*** (0.0036)
LEVERAGE	0.0484 (0.0572)	0.0196 (0.0271)
R&D_ASSETS	0.4453** (0.1801)	0.1925** (0.0775)
INSTIT_OWN	0.2934*** (0.0574)	0.1562*** (0.0256)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	1983	1983

**Table 7**  
**Board Independence: Controlling for Other Interactions**

This table presents results from regressions that assess the effect of several firm characteristics that possibly confound the effect of board independence. Non-fundamental movements in stock returns are measured by MISPRICING (mutual fund hypothetical sales). Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. The dummy variable INDEPENDENT (INDEP.) is set to 1 when independent directors account for more than half of the board. The regressions also include MISPRICING, FUNDAMENTAL, and ROA, where fundamental movements in stock returns are measured as residuals ( $v$ ) from the estimation of equation (1). FE = fixed effects. MISPRICING is divided by its standard deviation to facilitate the interpretation of the coefficients. Standard errors (in parentheses) are clustered at the firm level. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

<i>Interaction Variable:</i>	CEO_TURNOVER							
	BOARD_ SIZE 1	GINDEX 2	ln(ASSETS) 3	LEVERAGE 4	R&D_ ASSETS 5	INSTIT_ OWN 6	All 7	All 8
MISPRICING × INDEP.	-0.0239*** (0.0089)	-0.0262*** (0.0092)	-0.0249*** (0.0090)	-0.0239*** (0.0089)	-0.0235*** (0.0088)	-0.0233** (0.0092)	-0.0249** (0.0099)	-0.0254** (0.0114)
MISPRICING × BOARD_SIZE	-0.0005 (0.0014)						-0.0012 (0.0018)	-0.0008 (0.0022)
MISPRICING × GINDEX		-0.0012 (0.0008)					-0.0015* (0.0008)	0.0001 (0.0014)
MISPRICING × ln(ASSETS)			0.0025 (0.0024)				0.0054* (0.0031)	0.0014 (0.0038)
MISPRICING × LEVERAGE				0.0210 (0.0159)			-0.0041 (0.0193)	0.0279 (0.0240)
MISPRICING × R&D_ASSETS					-0.0481 (0.0434)		-0.0486 (0.0480)	-0.0551 (0.0731)
MISPRICING × INSTIT_OW						-0.0040 (0.0147)	-0.0141 (0.0170)	-0.0050 (0.0208)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Firm FE	No	No	No	No	No	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11244	9649	11244	11244	11244	11244	9649	9609

**Table 8**  
**Change in Listing Rules and CEO Turnover Sensitivity to Stock Mispricing**

This table presents regression results for equation (3) that assesses the impact of the change in listing rules, which mandated that the majority of a firm's board members be independent directors. Non-fundamental movements in stock returns are measured by MISPRICING (mutual fund hypothetical sales), and fundamental movements in stock returns are measured as residuals ( $v$ ) from the estimation of equation (1). The indicator variable TREAT is set to 1 for firms that had, in 1999, a board that comprised directors of which fewer than half were independent (and is set to 0 otherwise); AFTER is a dummy set to 1 for years after 2001 (in the case of control firms) and starting in the first year of compliance (in the case of treated firms); otherwise, it is set to 0. Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. In column 6, I estimate the regression on the matched sample described in footnote 5. The regressions include all of equation (3)'s terms, though only TREAT×AFTER, MISPRICING×TREAT×AFTER, FUNDAMENTAL×TREAT×AFTER, ROA×TREAT×AFTER are reported for brevity. FE = fixed effects. MISPRICING, FUNDAMENTAL, and ROA are divided by their standard deviation to facilitate the interpretation of the coefficients. Standard errors (in parentheses) are clustered at the firm level. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

	INDEP.		CEO_TURNOVER			
	1	2	3	4	5	6
TREAT×AFTER	0.1839*** (0.0107)	-0.0114 (0.0296)	-0.0113 (0.0304)	0.0024 (0.0326)	-0.0144 (0.0338)	-0.0197 (0.0321)
MISPRICING×TREAT×AFTER		-0.0528** (0.0209)	-0.0507** (0.0214)	-0.0518** (0.0224)	-0.0558** (0.0247)	-0.0446* (0.0240)
FUNDAMENTAL×TREAT×AFTER		-0.0439* (0.0256)	-0.0491** (0.0245)	-0.0563** (0.0236)	-0.0464** (0.0229)	-0.0411* (0.0246)
ROA×TREAT×AFTER		-0.0280 (0.0178)	-0.0285 (0.0182)	-0.0423** (0.0196)	-0.0099 (0.0216)	-0.0218 (0.0214)
Year FE	Yes	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	No
Firm FE	Yes	No	No	No	Yes	Yes
Industry FE×Year FE	No	No	No	Yes	No	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Matched sample	No	No	No	No	No	Yes
Observations	7213	7219	7219	7201	7213	7086

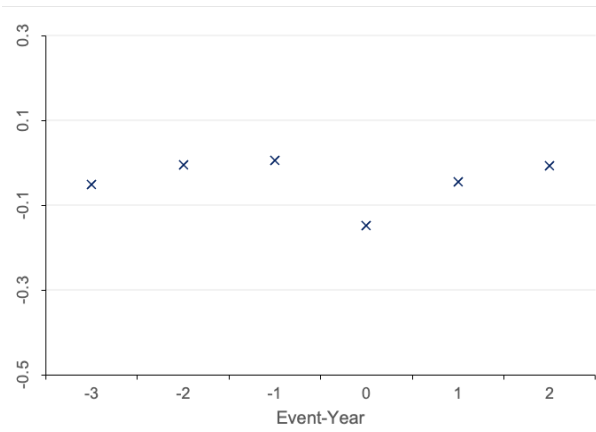
**Table 9**  
**Channels: Opacity and Career Concerns**

This table presents results from regressions designed to assess the effect of independent directors' access to information about the firm (OPACITY) and independent directors' career concerns (CAREER\_CONCERNS, denoted C.C.) on the CEO turnover-mispricing sensitivity. Non-fundamental movements in stock returns are measured by MISPRICING (mutual fund hypothetical sales), and fundamental movements in stock returns are measured as residuals ( $v$ ) from the estimation of equation (1). OPACITY and C.C. represent a dummy variable that is equal to 1 if the opacity or the career concerns measure is greater than the median, and is set to 0 otherwise. The opacity index is an index calculated as the first component principal of minus the number of analysts, the standard deviation of analysts' forecasts, and analysts' average forecast error. The career concerns index is an index calculated as minus the first component principal of directors' average number of years until re-election, average director age, and average director number of seats. Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. Regressions are estimated on firm-year observations for which more than half the board is independent and also include the terms FUNDAMENTAL, ROA, OPACITY, and C.C.. FE = fixed effects. MISPRICING, FUNDAMENTAL, and ROA are divided by their standard deviation to facilitate the interpretation of the coefficients. Standard errors (in parentheses) are clustered at the firm level. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

	CEO_TURNOVER									
	1	2	3	4	5	6	7	8	9	10
MISPRICING	-0.0113** (0.0054)	-0.0131** (0.0058)	-0.0125** (0.0060)	-0.0058 (0.0047)	-0.0066 (0.0050)	-0.0056 (0.0056)	-0.0046 (0.0058)	-0.0059 (0.0062)	-0.0035 (0.0065)	-0.0005 (0.0382)
MISPRICING×OPACITY	0.0019 (0.0060)	0.0027 (0.0063)	0.0018 (0.0071)				-0.0010 (0.0058)	0.0000 (0.0062)	-0.0016 (0.0070)	-0.0004 (0.0085)
MISPRICING×C.C.				-0.0107* (0.0057)	-0.0124** (0.0059)	-0.0136** (0.0067)	-0.0106* (0.0058)	-0.0126** (0.0061)	-0.0144** (0.0069)	-0.0153** (0.0069)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	No
Industry FE×Year FE	No	Yes	No	No	Yes	No	No	Yes	No	No
Firm FE	No	No	Yes	No	No	Yes	No	No	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MISPRICING×Controls	No	No	No	No	No	No	No	No	No	Yes
Observations	9589	9561	9463	9829	9799	9724	9526	9497	9403	9403

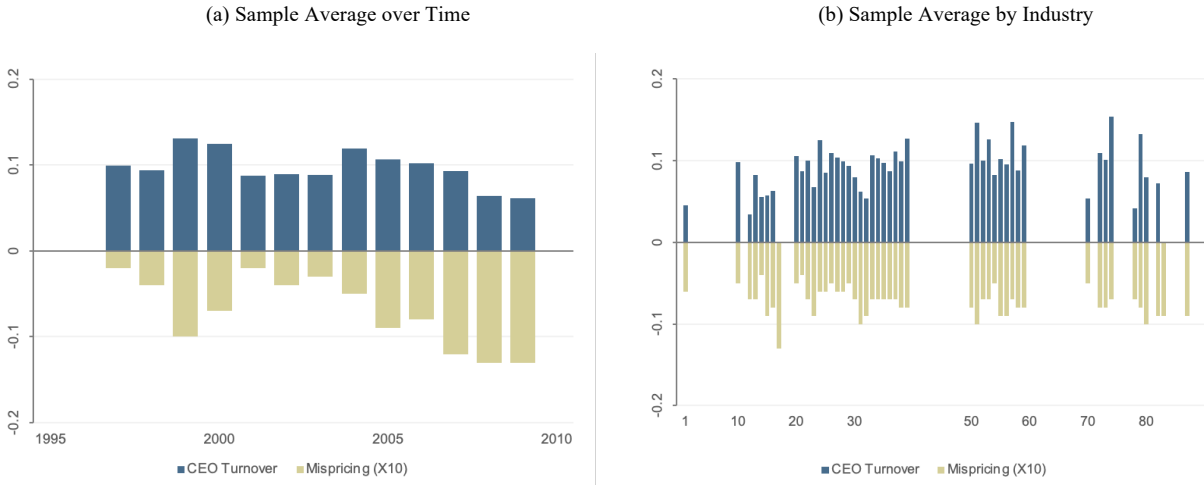
**Figure 1**  
**Returns around Severe Mispricing Events in the Sample**

This figure presents cumulative average abnormal returns around the first severe mispricing event (i.e., MISPRICING in the 10th percentile) experienced by firms in the sample. Yearly stock returns are regressed on the event dummy and its leads and lags. The regression includes time fixed effects to control for aggregate shocks. The figure shows the cumulative coefficients in event-year.



**Figure 2**  
**Sample Average of CEO Turnover and Mispricing over Time and by Industry**

This figure presents the sample average of CEO\_TURNOVER and MISPRICING (before dividing by its standard deviation) over time and by industry (SIC2).



## INTERNET APPENDIX for

# “Do Directors Respond to Stock Mispricing? Evidence from CEO Turnovers”

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Table A.5	Controlling for the CEOs' Actions and Their Interaction with Stock Mispricing

**Table A.1**  
**Controlling for Analysts' Long-Term Growth Forecast**

This table presents the regressions of 12-month stock returns and CEO turnover on MISPRICING, controlling for analysts' long-term forecast about the firm. Analysts' long-term forecast (LT\_FORECAST) are measured as analysts' median long-term growth forecast at the beginning of the fiscal year. Analyst data is from I/B/E/S. Non-fundamental movements in stock returns are measured by MISPRICING. ROA is the firm's return on assets. Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. Fundamental movements in stock returns are measured as residuals ( $v$ ) from the estimation of equation (1). FE = fixed effects. MISPRICING, FUNDAMENTAL, and ROA are divided by their standard deviation to facilitate the interpretation of the coefficients. Standard errors are displayed in parentheses. Standard errors are clustered at the firm level. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

	RETURN_12M		CEO_TURNOVER	
	1	2	3	4
MISPRICING	0.0457*** (0.0062)	0.0477*** (0.0071)	-0.0086** (0.0040)	-0.0088** (0.0045)
FUNDAMENTAL			-0.0182*** (0.0031)	-0.0127*** (0.0031)
ROA	0.0988*** (0.0055)	0.1364*** (0.0097)	-0.0153*** (0.0033)	-0.0259*** (0.0057)
LT_FORECAST	0.0097*** (0.0010)	0.0083*** (0.0014)	-0.0010** (0.0004)	-0.0013** (0.0006)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes
Observations	10533	10433	10533	10433



**Table A.2**  
**Independent Directors' Insider Trading**

This table presents the coefficient on MISPRICING for nine regressions that relate insider purchases to stock mispricing driven by mutual fund outflows. Each cell of the table represents the coefficient estimated from a separate regression. PURCHASE is a dummy variable that equals 1 if the insider is a purchaser of the firm stock in the year. Fraction of Purchases (FRAC\_PURCHASE) represents the fraction of shares purchased by the insider over the total number of shares she traded in the year. Value of Shares Purchased (VAL\_PURCHASE) is the market value of the shares purchased by the insider over the year. Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. FE = Fixed Effects. MISPRICING is divided by its standard deviation to facilitate the interpretation of the coefficients. Standard errors (in parentheses) are clustered at the firm level. \*, \*\*, and \*\*\* indicate statistical significance at (respectively) the 10%, 5%, and 1% levels.

	P(PURCHASE>0) 1	FRAC_ PURCHASE 2	ln(VAL_ PURCHASE) 3	N
<i>Main officers</i>	-0.0153*** (0.0056)	-0.0150*** (0.0055)	-0.1771*** (0.0656)	12,709
<i>Independent directors</i>	-0.0237*** (0.0050)	-0.0228*** (0.0049)	-0.2499*** (0.0559)	20,821
<i>Independent directors during the tenure of CEOs replaced following price pressure</i>	-0.0297* (0.0158)	-0.0305** (0.0155)	-0.3094* (0.1741)	1,799
Firm FE	Yes	Yes	Yes	
Year FE	Yes	Yes	Yes	
Controls	Yes	Yes	Yes	

**Table A.3**  
**Independent Directors, CEO Turnover, and Labor Market for Director Seats**

This table describes the evolution of the difference in the average number of seats across directors involved in a CEO turnover and matched directors. Directors that do and do not experience a CEO turnover are matched by 15-year age bracket, (two-digit) industry-adjusted RoA quartile, asset quartile, mispricing quartile, and number of seats at other firms. The dependent variable is the difference between the number of seats for a turnover director and the average number of seats for matched control directors. OWN\_SEAT is a dummy variable that equals 1 if director  $i$  holds a seat at the focal firm in year  $t$ , and 0 otherwise. FE = fixed effects. Standard errors (in parentheses) are clustered at the firm level. \*, \*\*, and \*\*\* indicate statistical significance at (respectively) the 10%, 5%, and 1% levels.

	$\Delta$ OTHER_SEATS (Indep. Directors) 1	$\Delta$ OWN_SEAT (Indep. Directors) 2	$\Delta$ OWN_SEAT (Non-Indep. Directors) 3
$T+1$	0.0203*** (0.0069)	0.0084 (0.0100)	-0.1090*** (0.0138)
$T+2$	0.0324*** (0.0079)	0.0242** (0.0121)	-0.1528*** (0.0168)
$T+3$	0.0352*** (0.0079)	0.0215 (0.0132)	-0.1424*** (0.0172)
Director-Firm FE	Yes	Yes	Yes
Event Year FE	Yes	Yes	Yes
Observations	24595	24595	11365

**Table A.4**  
**Cost of CEO Replacement: Inside vs. Outside Successions**

This table presents results from the estimation of equation (2), split by type of CEO replacement. Data on CEO turnover and replacement type are from Eisfeldt and Kuhnen (2013). Non-fundamental movements in stock returns are measured by MISPRICING (mutual fund hypothetical sales). ROA is the firm's return on assets. Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. Fundamental movements in stock returns are measured as residuals ( $v$ ) from the estimation of equation (1). FE = fixed effects. MISPRICING, FUNDAMENTAL, and ROA are divided by their standard deviation to facilitate the interpretation of the coefficients. Standard errors (in parentheses) are clustered at the firm level. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

	CEO Turnover					
	All 1	All 2	Insider 3	Insider 4	Outsider 5	Outsider 6
MISPRICING	-0.0075** (0.0036)	-0.0099** (0.0041)	-0.0080** (0.0035)	-0.0085** (0.0041)	-0.0008 (0.0021)	-0.0026 (0.0025)
FUNDAMENTAL	-0.0131*** (0.0029)	-0.0086*** (0.0029)	-0.0056** (0.0028)	-0.0033 (0.0027)	-0.0115*** (0.0018)	-0.0079*** (0.0019)
ROA	-0.0072** (0.0030)	-0.0163*** (0.0049)	-0.0023 (0.0028)	-0.0115** (0.0049)	-0.0059** (0.0024)	-0.0091** (0.0037)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9047	8965	8202	8113	7161	7082

**Table A.5**  
**Controlling for the CEOs' Actions and Their Interaction with Stock Mispricing**

This table presents the regressions of CEO Turnover on MISPRICING, controlling for CEO stock purchases and firm share repurchases. CEO\_STOCK\_PURCHASE is a dummy variable that equals one if the CEO purchased the stock on his own account, and zero otherwise. SHARE\_REPURCHASE is a dummy variable that equals one if the firm repurchased shares, and zero otherwise. Non-fundamental movements in stock returns are measured by MISPRICING. ROA is the firm's return on assets. Controls are firm size (log of assets), fraction of institutional ownership, leverage, board size, CEO tenure, and a dummy variable indicating whether or not the CEO is also chairman of the board. Fundamental movements in stock returns are measured as residuals ( $v$ ) from the estimation of equation (1). FE = fixed effects. MISPRICING is divided by its standard deviation to facilitate the interpretation of the coefficients. Standard errors are displayed in parentheses. Standard errors are clustered at the firm level. \*\*\*, \*\*, and \* indicate statistical significance at (respectively) the 1%, 5%, and 10% levels.

	CEO Turnover			
	CEO Stock Purchase		Share Repurchase	
	1	2	3	4
MISPRICING	-0.0095** (0.0038)	-0.0091** (0.0039)	-0.0094** (0.0038)	-0.0094** (0.0041)
CEO action	-0.0062 (0.0089)	-0.0101 (0.0132)	0.0019 (0.0062)	0.0017 (0.0089)
MISPRICING× CEO action		-0.0034 (0.0088)		-0.0002 (0.0061)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	11244	11244	11244	11244