

When Are Outside Directors More Effective Monitors? Evidence From Real Activities Manipulation

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Introduction

A large body of the corporate governance literature examines the disciplinary role of outside directors in overseeing the CEO. Although it is certainly a critical factor in effective monitoring, independence alone is not sufficient. Fulfilling the monitoring role also requires a skilled and knowledgeable board (Acharya, Myers, & Rajan, 2011; Adams & Ferreira 2007; Raheja, 2005). The skills and knowledge needed for monitoring vary with the type of CEO activity being monitored. For certain managerial actions that require sufficient firm-specific knowledge and expertise to exercise discipline, board informedness could be at least as critical as board independence. Given the trade-off between informedness and independence, outside directors are not necessarily better monitors than inside directors due to information disadvantages.¹

In this study, we examine whether and to what extent an independent board constrains the CEO from taking real actions to manage financial performance. We refer to real earnings management as the CEO's purposeful intervention in normal business practice in an effort to influence the output of the accounting system (Gunny, 2010; Roychowdhury, 2006).² Relative to accrual-based earnings management, real earnings management is inherently more difficult to detect and requires more firm-specific information to understand because it can involve any real decision that deviates from normal business practice (Cohen, Dey, & Lys, 2008; Lo, 2008). Lo (2008) compares the two earnings management methods and concludes that

managers are willing to engage in real earnings management that is costly to the firm because such actions are harder to detect; with the uncertainty inherent in business environments, there is no benchmark to determine what should have been done under any particular situation . . . (p. 353)

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Therefore, without sufficient firm-specific knowledge, and thus the expertise to identify deviations from normal business practice, outside directors could be ineffective at detecting real earnings management.

A recent study by Armstrong, Core, and Guay (2014) highlights the informational demands of an independent board to perform its monitoring duties by showing that an increase in board independence results in an increase in firm transparency. They interpret their results to indicate that outside directors require transparency to perform the monitoring duties, and that firms can change their corporate transparency to suit the informational demands of a particular board structure. Although it is an implicit assumption in Armstrong et al. (2014) that board informedness plays a critical role in effective monitoring, we provide empirical evidence on its importance and trade-off against board independence in the context of monitoring real earnings management.

Relative to their inside counterparts, outside directors are often less knowledgeable with regard to the day-to-day operations of the firm. In practice, outside directors must largely rely on management to provide them with the information necessary to perform their monitoring duties. Given that timely information transfer across individuals is costly and outside directors are typically busy individuals who have many demands on their time, they may not invest the time and effort necessary to become as informed as the management. To effectively constrain real earnings management, the board likely faces a pronounced trade-off between informedness and independence. It's not clear, *ex ante*, whether the well-documented result that the greater the board independence, the less the accrual-based earnings management (e.g., Klein, 2002; Peasnell, Pope, & Young, 2005) should also apply to the real earnings management context. Our first research objective is to examine whether, in general, board independence is associated with real earnings management. A negative relation would indicate that board independence plays a dominant role in monitoring of real earnings management. By contrast, an insignificant (or even positive) association would suggest that board independence alone is unlikely to be sufficient for effective monitoring of real earnings management.

Furthermore, we explore two cross-sectional predictions regarding the relation between board independence and real earnings management. If board informedness is critical for detecting real earnings management, an independent board should be a more effective monitor of such managerial behavior in firms with lower information acquisition costs. Consistent with insiders' ability to withhold information increasing in outsiders' information acquisition costs, Armstrong et al. (2014) find that the positive effect of increased board independence on firm transparency is attenuated by higher information acquisition costs. Duchin, Matsusaka, and Ozbas (2010) show that adding more outside directors to the board can actually harm firm performance when information acquisition costs are high. Their result indicates that independence only enhances the board's monitoring function when the cost of acquiring information for outside directors is low. Given that board informedness decreases in information acquisition costs and sufficient firm-specific information is required to detect real earnings management, we predict that an independent board is a more effective monitor of real earnings management when information acquisition costs are lower.

Non-CEO inside directors, who are often key members of the management team, can also contribute to board informedness and its monitoring duties. They possess proprietary information about firm operations, competitive position, and investment opportunities, which may enhance board monitoring by providing a non-CEO information source (Coles, Daniel, & Naveen, 2008; Masulis & Mobbs, 2011; Raheja, 2005). They play an important

role in educating outside directors on the firm's activities (Fama & Jensen, 1983). However, despite the information advantage, inside directors may not have the same strong incentives as outside directors to exercise discipline over the CEO. Agency theory predicts that inside ownership is an important mechanism to align the interest of insiders and outside shareholders (Jensen & Meckling, 1976). Rosenstein and Wyatt (1997) argue that the expected benefit of an inside director's expert knowledge outweighs the expected agency costs only when managerial and outside shareholder interests are closely aligned. Based on their findings, we predict that when inside directors hold firm ownership between 5% and 25%, they have stronger incentives to enhance board informedness and monitoring of real earnings management. This would imply that the (negative) relation between board independence and real earnings management is more pronounced when the board has more inside directors with 5% to 25% firm ownership.

We consider two types of real earnings management in our analyses: (a) overproducing inventory to reduce the cost of goods sold, and (b) cutting discretionary expenditures, including R&D, advertising, and SG&A expense (Roychowdhury, 2006). Both activities involve a sacrifice of long-term firm value in exchange for inflated near-term earnings. Board members, especially outside board members, are expected to act in the shareholder's interest and thus, have incentives to constrain these activities. We use board data from Institutional Shareholder Services (ISS; formerly RiskMetrics) to calculate the proportion of outside directors on the board. Our sample consists of 13,414 firm-year observations between 1998 and 2013 with necessary board and real earnings management data.

We fail to find a significant relation between board independence and either measure of real earnings management. To the extent that our proxies for overproduction and manipulation of discretionary expenditures are reasonably accurate, this result implies that an independent board, in general, is not an effective monitor of real earnings management. In the context of real earnings management, informedness is perhaps at least as important as independence for the board to effectively detect and constrain this type of behavior.

Following Duchin et al. (2010), we measure information acquisition costs based on the availability, homogeneity, and accuracy of analysts' earnings forecasts. When we allow the relation between board independence and real earnings management to vary with outsiders' information acquisition costs, we find that more independent boards are more effective monitors of real earnings management when it is less costly for them to become informed about managerial behavior. This is consistent with our hypothesis and reinforces a critical trade-off between independence and informedness when the board performs its monitoring function to discipline the CEO.

Using stock ownership information for each individual director from ISS, we calculate the percentage of non-CEO inside directors who hold 5% to 25% of firm ownership. We find that for boards with more inside directors whose stock ownership falls between 5% and 25%, more independent boards are more effective monitors of real earnings management. This result supports our hypothesis that when inside directors' interests are aligned with outside shareholders, they are more likely to share proprietary information with outside directors and assist them in better understanding the CEO's decisions. Consequently, outside directors are better able to detect and constrain real earnings management.

As a robustness check, we retest our hypotheses for a sample of 302 firms that conduct seasoned equity offerings (SEOs). Cohen and Zarowin (2010) find that SEO firms engage in real earnings management and the decline in post-SEO performance due to real earnings management is more severe than that due to accrual-based earnings management. If SEO firms have strong incentives to inflate earnings through real earnings management (which

is presumably more detrimental to shareholder value), it could be a more powerful setting to address our research questions. In the SEO sample, we again fail to detect a significant relation between board independence and real earnings management. Nevertheless, we continue to show that when outside directors face low information acquisition costs or inside directors have strong incentives to share information in boardrooms, outside directors are more effective at monitoring real earnings management.

We perform two tests to draw causal inferences by taking advantage of a recent regulatory change, which requires all NYSE and NASDAQ firms to have a majority of independent directors on their boards, as an exogenous shock to board structure. Because of this regulatory change, our sample contains firms that had to change their board structure (non-compliant firms) as well as firms for which no change was needed (compliant firms). In the first test, we focus on noncompliant firms and calculate an instrument for the change in board independence following Armstrong et al. (2014). We then use the instrument in place of raw change in board independence to test our hypotheses. In the second test, we run a difference-in-differences regression using noncompliant firms as the treatment group and compliant firms as the control group. The overall tenor of the results across these two tests is the same as that of the main results.

Our article makes several contributions to the literature. First, Armstrong et al. (2014) find that an exogenous increase in board independence leads to an increase in corporate transparency. Their study highlights the informational demand of outside directors to carry out their charge. Although researchers have long argued that the choice of board composition involves a trade-off between independence and informedness, we provide a specific example of board's monitoring activities where the trade-off is evident.³ Our results suggest that oversight of real earnings management requires sufficient firm-specific knowledge, so independence alone is unlikely to be sufficient for outside directors to be effective monitors. Armstrong et al. (2014) view the trade-off between independence and informedness as given and assume that outside directors demand more information to perform their monitoring roles. However, empirical evidence on the importance of informedness and its trade-off against independence for board's monitoring activities is sparse. Our study fills this void.

Second, we uncover a potential source of inside directors' incentive to play the information-providing role in board monitoring. Recent theoretical research has explored the importance of non-CEO inside directors to board monitoring (e.g., Acharya et al., 2011; Adams & Ferreira, 2007; Raheja, 2005). Despite a growing theoretical understanding of the roles of inside directors, there is little empirical evidence on their importance to corporate boards (Masulis & Mobbs, 2011). We contribute to this emerging line of research by linking inside directors' stock ownership to their information-providing role in board monitoring of real earnings management. Our results suggest that non-CEO inside directors, like their outside counterparts, differ in their levels of independence and the incentives to discipline the CEO.

Finally, based on survey evidence, Graham, Harvey, and Rajgopal (2005) find that managers would rather take economic actions that could have negative long-term consequences than make within-GAAP (generally accepted accounting principles) accounting choices to manage earnings. Our study offers a potential explanation for this puzzling piece of evidence. The prevalence of real earnings management in practice could be attributable to outside directors' lack of sufficient knowledge and specialized information to perform their monitoring function, especially given that boards have become more independent over time.

In that regard, our results also shed light on the potential consequences of recent corporate governance reforms that mandate increases in board independence. It appears that in firms where the cost of acquiring information is low for outsiders and firms where insiders have strong incentives to educate and assist outsiders in performing monitoring functions, the mandated increase in board independence should be beneficial. In contrast, in firms where outsiders suffer from severe information disadvantages and are less likely to receive sufficient information sharing from their inside counterparts, the benefit of the mandated increase in board independence may not be justified by its cost.

The remainder of the article is organized as follows. “Hypotheses Development” section provides the rationale for our hypotheses. “Research Design” section describes our research design. “Sample and Descriptive Statistics” section discusses sample selection and descriptive statistics. “Main Results” section and “Additional Tests” section present the main and additional test results, respectively. “Addressing Causality: Change in Board Independence in Response to Regulations Promulgated in 2003” section focuses on addressing endogeneity issues, and “Conclusion” section concludes the study.

Hypotheses Development

Board Independence and Real Earnings Management

The board of directors plays a central role in monitoring the CEO and in designing mechanisms to align his or her incentives with shareholders’ interests. To act as an effective monitor, the board must have sufficient firm-specific knowledge and expertise as well as maintain its objectivity and independence from the CEO. Outside directors have high reputational capital at stake, and are generally believed to bring greater independence in monitoring the CEO’s behavior. This independence carries with it an expectation of superior objectivity in performing the monitoring function. Their diligence in this respect may stem partially from monetary incentives attached to being a board member (Yermack, 2004) but possibly even more importantly from their desire to protect significant personal reputational capital.⁴

A large body of accounting literature examining the relation between board structure and board monitoring of financial disclosure practices supports this line of reasoning, generally concluding that more independent boards are more effective monitors (see, for example, Ajinkya, Bhojraj, & Sengupta, 2005; Frankel, McVay, & Soliman, 2011; Klein, 2002; Krishnan, 2005). However, it is also important to remember that fulfilling the monitoring role requires a skilled and knowledgeable board. Inside directors are valuable sources of firm-specific information (Adams, Hermalin, & Weisbach, 2010; Harris & Raviv, 2008; Raheja, 2005). Although outside directors are more independent of the CEO, they are potentially less informed regarding firm projects than inside directors.

Prior research on the determinants of board structure finds that the proportion of outside directors is smaller at firms with greater information asymmetry between insiders and outsiders, and where firm-specific knowledge is likely to be more important in fulfilling the board’s monitoring function (Boone, Field, Karpoff, & Raheja, 2007; Duchin et al., 2010; Lehn, Patro, & Zhao, 2009; Linck, Netter, & Yang, 2008). A maintained assumption of this literature is that a firm’s information environment is exogenous with respect to its choice of board composition. Armstrong et al. (2014) challenge this assumption and show that firm transparency improves in response to a mandatory increase in board independence. Their results are consistent with a more independent board demanding more information to

perform its monitoring duties. However, large-sample evidence on the importance of board informedness and its trade-off against board independence is limited. Whether an increase in board independence leads to more effective monitoring remains an empirical issue, especially for certain monitoring activities that hinge on a thorough understanding of the firm's day-to-day business.

A substantial amount of work is devoted to understanding the relation between board independence and accrual-based earnings management (e.g., Chen, Cheng, & Wang, 2015; Klein, 2002; Peasnell et al., 2005; Xie, Davidson, & DaDalt, 2003). To detect accrual-based earnings management, outside directors have several channels through which they can obtain the information necessary to discipline the CEO. Apart from board oversight, accrual-based earnings management is also constrained by scrutiny from auditors and regulators, who can assist outside directors in obtaining the information necessary to detect such behavior. Furthermore, Sarbanes-Oxley requires that at least one outside "financial expert" serves on the audit committee. By nature, "financial experts" have the skill to monitor and advise the financial reporting process, and most likely have the expertise to evaluate accrual estimates due to their understanding of GAAP (DeFond, Hann, & Hu, 2005; Dhaliwal, Naiker, & Navissi, 2010; Krishnan & Visvanathan, 2008; McDaniel, Martin, & Maines, 2002). These financial experts could then willingly share this information with the rest of the board.

In contrast, real earnings management is inherently more difficult to detect and requires more firm-specific knowledge and specialized information to understand because it can involve any real decision that deviates from normal business practice (Cohen et al., 2008; Lo, 2008). Although other information intermediaries such as auditors and regulators can assist outside directors in obtaining the information necessary to detect accrual-based earnings management, outside directors receive little help in obtaining the information necessary to understand real decisions.

Given the critical need to have access to firm-specific information, the trade-off between independence and informedness is likely to be more pronounced when the board monitors real earnings management. Ex-ante, we do not offer a directional prediction on the relation between board independence and real earnings management. Instead, we leave it to our empirical analysis to reject the following null hypothesis in favor of either of the two alternatives:

Hypothesis 1 (H1) (null): The proportion of outside directors on the board is not associated with real earnings management.

Board Independence, Real Earnings Management, and Outsiders' Cost of Acquiring Information

Our first cross-sectional hypothesis focuses on outsiders' cost of acquiring information. The effectiveness of board monitoring trades off the inferior information of outside directors against their lower susceptibility to agency problems. Outside directors are more independent from the CEO and have interests closely aligned with shareholders, but they have access to less information or have a higher cost of acquiring information than inside directors. As the cost of acquiring information declines, outside directors become more effective monitors.

Our study is related to Duchin et al. (2010) and Chen et al. (2015), who use recent regulations, which require some firms to increase the number of outside directors, to assess the

effect of independence on board monitoring. Duchin et al. show that when the cost of acquiring information is low (high), firm performance improves (worsens) when outside directors are added to the board. Chen et al. find that only firms with low information acquisition costs experience a significant reduction in accrual-based earnings management when board independence is forced to increase. Both studies conclude that independence matters to the board's monitoring function, but the effectiveness of monitoring also depends on the cost of outside directors becoming informed.

As we discussed in H1, firm-specific knowledge plays a crucial role in monitoring real earnings management. Therefore, board independence is more valuable as the cost of acquiring information is lower. When outside directors face greater information asymmetry resulting from higher information acquisition costs, they are less likely to monitor real earnings management effectively despite their superior objectivity in doing so. Our second hypothesis, stated in alternative form, is as follows:

Hypothesis 2 (H2): Outside directors are more effective at monitoring real earnings management as the cost of acquiring information becomes lower.

Board Independence, Real Earnings Management, and Insiders' Incentives to Share Information

Our second cross-sectional hypothesis focuses on insiders' incentives to share information with outsiders. Conventional wisdom suggests that inside directors may be unwilling to vote against their CEO for fear of retribution or because it may also reflect poorly upon them due to their close relationship with the CEO (Hermalin & Weisbach, 2003). This perspective of dependent insiders implies that the presence of inside directors reduces the effectiveness of board monitoring.

However, prior research often overlooks the information role that non-CEO inside directors can play in board monitoring. These inside directors possess proprietary information about firm operations, competitive position, and investment opportunities, which can enhance the effectiveness of board monitoring by providing a non-CEO information source (Coles et al., 2008; Masulis & Mobbs, 2011; Raheja, 2005).⁵ Inside directors can be particularly helpful in educating outside directors on the firm's activities (Fama & Jensen, 1983).

The key issue is not about inside directors' ability to monitor the CEO; it is about their incentives. Many corporate board studies take the view that all inside directors are equally detrimental and merely reflect greater CEO influence rather than potentially valuable information sources to outside directors. We relax this assumption and examine whether inside directors' incentives to share information with outside directors and maximize shareholder value affects the relation between board independence and real earnings management. One means of identifying whether an inside director is a valuable information source to outside directors and is less influenced by the CEO is to examine his or her inside ownership.

Inside ownership plays an important role in the corporate governance literature. Jensen and Meckling (1976) assert that inside ownership by managers is a powerful incentive for ensuring that the interests of managers and outside shareholders are closely aligned. For firms with sizable proportions of inside ownership, inside directors are likely to be appointed with shareholders' in mind, mitigating the negative consequences of their dependence on the CEO. In line with Jensen and Meckling's argument, Armstrong, Guay, and Weber (2010) point out that inside directors, who typically have large holdings of firm

stocks and options as well as more human capital tied to the firm, may have stronger incentives than outside directors to exert effort and to maximize shareholder value.

Rosenstein and Wyatt (1997) examine the stock-market reaction to appointments of inside managers to corporate boards. They find that the stock price effects of insider appointments vary significantly across levels of inside ownership. Specifically, the average stock price reaction is significantly negative for firms of which inside directors own less than 5% of the firm's common stock and is significantly higher and positive when they own between 5% and 25%. They fail to detect any significant stock price reaction when ownership exceeds 25%. Accordingly, Rosenstein & Wyatt conclude that the expected benefit of an inside director's expert knowledge outweighs the expected agency costs only when managerial and outside shareholder interests are closely aligned.

Armstrong et al. (2014) conclude that their results are consistent with firms altering their corporate transparency to suit the informational demands of a particular board structure. We extend their study by examining potential incentives for non-CEO executives to help fulfill outside directors' informational demands. Specifically, we argue that inside directors whose interests are closely aligned with outside shareholders are more likely to share their proprietary information with outside directors. In light of Rosenstein and Wyatt's (1997) findings, we conjecture that when inside directors hold firm ownership between 5% and 25% (their interests are more likely to be aligned with outside shareholders), outside directors will be better informed and better capable of monitoring real earnings management. Our last hypothesis, stated in alternative form, is formally stated as follows:

Hypothesis 3 (H3): Outside directors are more effective at monitoring real earnings management when more inside directors hold firm ownership between 5% and 25%.

Research Design

Measures of Real Earnings Management

Following Roychowdhury (2006), we consider two types of real activities manipulation: (a) overproducing inventory to reduce the cost of goods sold, and (b) cutting discretionary expenditures (including R&D, advertising, and SG&A).⁶ We estimate the following two models based on the entire Compustat sample with data available to estimate the models.

Production costs (*PROD*) are defined as the sum of cost of goods sold (*COGS*) and the change in inventory (ΔINV). We estimate the normal level of production costs using the following equation:

$$\frac{PROD_t}{Assets_{t-1}} = \alpha_0 + \alpha_1 \left(\frac{1}{Assets_{t-1}} \right) + \alpha_2 \left(\frac{S_t}{Assets_{t-1}} \right) + \alpha_3 \left(\frac{\Delta S_t}{Assets_{t-1}} \right) + \alpha_4 \left(\frac{\Delta S_{t-1}}{Assets_{t-1}} \right) + \varepsilon_t, \quad (1)$$

where $PROD_t$ = cost of goods sold plus the change in inventory from year $t - 1$ to year t ; $Assets_{t-1}$ = total assets at the end of year $t - 1$; S_t = sales in year t ; ΔS_t = change in sales from year $t - 1$ to t

Equation 1 is estimated cross-sectionally for each industry-year with at least 15 observations, where industry is defined as the two-digit Standard Industrial Classification (SIC) code. For each firm-year, we save the residual from the corresponding industry-year

regression. Cohen, Pandit, Wasley, and Zach (2016) suggest that real earnings management models are better specified in many settings when firms are matched on performance. Therefore, we first rank all Compustat firms with the data necessary to estimate Equation 1 into deciles based on return on assets (ROA) for each industry-year. To arrive at our measure of abnormal production costs (denoted RM^{PROD}), we performance-match each firm in our sample by subtracting the median residual of all the firms in the same ROA decile.⁷ Higher abnormal production costs for a given sales level reflect inventory overproduction, which reduces cost of goods sold by spreading fixed costs over a greater number of units, thereby increasing reported earnings. In addition, higher abnormal production costs could also reflect cutting prices or extending more lenient credit terms to increase reported earnings.

Discretionary expenditures ($DISEXP$) are defined as the sum of R&D, advertising, and SG&A expenditures. We estimate the normal level of discretionary expenditures using the following equation:

$$\frac{DISEXP_t}{Assets_{t-1}} = \alpha_0 + \alpha_1 \left(\frac{1}{Assets_{t-1}} \right) + \alpha_2 \left(\frac{S_{t-1}}{Assets_{t-1}} \right) + \varepsilon_t, \quad (2)$$

where $DISEXP_t$ = Research and development expense plus advertising and selling, general and administrative expense in year t .

Equation 2 is estimated cross-sectionally for each industry-year with at least 15 observations. For each firm-year, we save the residual from the corresponding industry-year regression. To arrive at our measure of abnormal discretionary expenditures, we performance-match each firm in our sample by subtracting the median residual of a portfolio of firms based on ROA. We then multiply the difference by -1 (denoted RM^{DISEXP}) so that higher values indicate greater amounts of manipulation of discretionary expenditures to inflate reported earnings.

Measure of Information Processing Costs

We rely on prior studies to develop our proxy for information processing costs. As in Duchin et al. (2010), our measure is based on the availability, homogeneity, and accuracy of analysts' earnings forecasts. If few analysts follow the firm, little information is available to outsiders about the firm. A lack of consensus among analysts and large forecast errors also suggest that it is difficult for outsiders to be informed about the firm. Our proxy for outsiders' cost of becoming informed is an index that combines three analyst forecast properties: (a) the number of Institutional Brokers' Estimate System (I/B/E/S) analysts forecasting earnings per share (EPS) in the last month of the year; (b) dispersion of analyst forecasts, measured as the standard deviation of the most recent earnings forecasts across analysts prior to each quarterly earnings announcement, averaged across four quarters in a given year; and (c) analyst forecast error, measured as the absolute difference between the most recent mean earnings forecast and the actual quarterly earnings, averaged across four quarters in a given year. We scale the three properties of analyst forecasts by total assets to remove the impact of firm size on the number, dispersion, and forecast error. The index ($INFOCOST$) is constructed by summing the firm's percentile rank in the sample for each measure so that the highest index represents firms with the highest information processing costs for outsiders. The variable is then scaled to range from 0 (*lowest information processing costs*) to 1 (*highest information processing costs*).

Hypothesis Testing

To test our first hypothesis (H1), we estimate the following regression:

$$RM_t = \beta_0 + \beta_1 \%OUTSIDER_t + \sum_k \beta_{2,k} Cost\ of\ RM_{k,t} + \sum_l \beta_{3,l} Cost\ of\ AM_{l,t} + \sum_m \beta_{4,m} Governance\ Variables_{m,t} + \sum_n \beta_{5,n} Controls_{n,t} + \varepsilon_t, \quad (3)$$

where, RM_t is RM^{PROD} or RM^{DISEXP} in year t , and $\%OUTSIDER_t$ is the percent of board members who are outsiders in year t . All other variables are defined in the Appendix.

In Equation 3, we are primarily interested in the coefficient on $\%OUTSIDER$, β_1 . If β_1 is significantly different from zero, then we reject the null hypothesis that the proportion of outside directors on the board is not associated with real earnings management. A positive and significant β_1 would indicate that boards with a greater proportion of outside directors are less effective at mitigating real earnings management, while a negative and significant β_1 would indicate that boards with a greater proportion of outside directors are more effective at mitigating real earnings management. Following Zang (2012), we control for the costs of accrual-based and real earnings management in Equation 3, as managers can trade off these two methods based on their relative costs. The general prediction is that real earnings management decreases with its own cost and increases with the cost of accrual-based earnings management (i.e., the substitutive effect).⁸ We measure the costs associated with RM using *Market_Share*, *ZSCORE*, and *ETR*, and the costs associated with AM using *BIG4*, *NOA*, and *CYCLE*. The relation between RM and both *Market_Share* and *ZSCORE* is predicted to be positive because real activities manipulation should be less costly for firms with stronger market position and better financial health. RM is predicted to be negatively related to *ETR* since firms with higher tax rates should find real activities manipulation more costly relative to accruals-based earnings management. RM is predicted to be positively related to *BIG4* because the costs of accruals-based earnings management should increase with higher quality auditors. The relation between RM and *NOA* is predicted to be positive since higher values of *NOA* indicate less accounting flexibility and thus more costly accrual-based earnings management. The relation between RM and *CYCLE* is predicted to be negative since higher values of *CYCLE* indicate more accounting flexibility and thus less costly accrual-based earnings management.

To test our second hypothesis (H2), we augment Equation 3 as follows:

$$RM_t = \gamma_0 + \gamma_1 \%OUTSIDER_MC_t + \gamma_2 INFOCOST_MC_t + \gamma_3 \%OUTSIDER_MC_t \times INFOCOST_MC_t + \sum_k \gamma_{4,k} Cost\ of\ RM_{k,t} + \sum_l \gamma_{5,l} Cost\ of\ AM_{l,t} + \sum_m \gamma_{6,m} Governance\ Controls + \sum_n \gamma_{7,n} Controls_{n,t} + \varepsilon_t, \quad (4)$$

where $\%OUTSIDER_MC_t$ = the percent of board members who are outsiders in year t , centered at the sample mean; $INFOCOST_MC_t$ = proxy for information processing costs following Duchin et al. (2010), centered at the sample mean.

Of particular interest to us is the coefficient estimate for the interaction between $\%OUTSIDER_MC$ and $INFOCOST_MC$, γ_3 . If outside directors are less (more) effective at monitoring real earnings management as the cost of acquiring information becomes higher (lower), we should observe a positive γ_3 . Because Equation 4 involves an interaction between two nonnegative continuous variables, we mean-center $\%OUTSIDER$ and $INFOCOST$ to reduce concerns about multicollinearity.⁹

$$\begin{aligned}
RM_t = & \gamma_0 + \gamma_1 \%OUTSIDER_t + \gamma_2 INSIDER_OWN_t \\
& + \gamma_3 \%OUTSIDER_t \times INSIDER_OWN_t + \sum_k \gamma_{4,k} Cost\ of\ RM_{k,t} \\
& + \sum_l \gamma_{5,l} Cost\ of\ AM_{l,t} + \sum_m \gamma_{6,m} Governance\ Controls + \sum_n \gamma_{7,n} Controls_{n,t} + \varepsilon_t
\end{aligned} \quad , \quad (5)$$

where $INSIDER_OWN_t$ = the number of (non-CEO) insiders with between 5% and 25% ownership (data from ISS) divided by the total number of (non-CEO) insiders.

Of particular interest to us is the coefficient on the interaction between $\%OUTSIDER$ and $INSIDER_OWN$, γ_3 . If inside directors whose interests are closely aligned with outside shareholders are more likely to share their proprietary information with outside directors, and this information improves the effectiveness of outside directors in constraining real earnings management, we should observe a negative γ_3 .¹⁰

Sample and Descriptive Statistics

Sample Selection

We use financial statement data from the Compustat fundamentals annual file and information on board characteristics from ISS (formerly RiskMetrics). Among all nonfinancial and nonutility Compustat firms between 1998 and 2013, we obtain 97,609 and 112,642 firm-year observations with data available to estimate RM^{PROD} and RM^{DISEXP} , respectively.¹¹ Next, we merge the RM measures with ISS, which began collecting information on individual board directors for the S&P 1500 firms in 1996 and began collecting ownership data in 1998. ISS provides 19,151 firm-year observations (2,517 firms) from 1998 to 2013 that are nonfinancial and nonutility firms with the necessary data to calculate the proportion of outside directors. After we eliminate observations without sufficient data to calculate the control variables, our sample to test the three hypotheses consists of 13,414 firm-year observations.

Descriptive Statistics

We report descriptive statistics of the key variables in Table 1. We find that the mean $\%OUTSIDER$ is 71.7%. The 25th percentile of $\%OUTSIDER$ is 62.5%, suggesting that more than 75% of sample firms have boards dominated by outside directors. The mean and median of RM^{DISEXP} (0.041 and 0.058, respectively) and RM^{PROD} (0.130 and 0.119, respectively) are all positive, indicating that both types of real earnings management activities are prevalent in our sample.

As ISS only covers S&P 1500 firms, the descriptive statistics, not surprisingly, show that our sample firms are generally profitable (mean of $ROA = 6.0\%$) and financially healthy (mean of $ZSCORE = 5.043$). Turning to the corporate governance variables, we observe that for over half the firm-years in our sample, the CEO is also the chairman of the board. On average, the boards in our sample are approximately 10% female and approximately 93% of directors serving on the compensation committee are independent.

In untabulated pairwise correlations, we find a positive and significant correlation between RM^{PROD} and RM^{DISEXP} suggesting that firms simultaneously engage in both types of real earnings management. Both RM^{PROD} and RM^{DISEXP} are positively correlated with $\%OUTSIDER$, providing some preliminary evidence that there may be a positive relation between the proportion of outsiders on the board and the level of real earnings management. Furthermore, RM^{PROD} is positively correlated with $INFOCOST$, and RM^{DISEXP} is

Table I. Descriptive Statistics.

Variable	M	Mdn	SD	25%	75%
RM_t^{DISEXP}	0.041	0.058	1.727	-0.147	0.326
RM_t^{PROD}	0.130	0.119	0.201	0.015	0.231
$\%OUTSIDER_t$	0.717	0.750	0.162	0.625	0.857
$INFOCOST_t$	0.496	0.485	0.149	0.374	0.609
$INSIDER_OWN_t$	0.077	0.000	0.226	0.000	0.000
$Market_Share_{t-1}$	0.020	0.005	0.047	0.001	0.018
$ZSCORE_{t-1}$	5.043	3.568	4.960	2.315	5.707
ETR_t	0.309	0.332	0.197	0.213	0.385
$BIG4_t$	0.956	1.000	0.205	1.000	1.000
NOA_{t-1}	0.544	0.419	0.513	0.240	0.670
$CYCLE_{t-1}$	82.006	68.930	69.369	34.142	111.578
$BOARD_SIZE_t$	0.763	0.787	0.122	0.666	0.834
CEO_CHAIR_t	0.569	1.000	0.495	0.000	1.000
$\%FEMALE_t$	0.101	0.100	0.096	0.000	0.167
$COMP_IND_t$	0.933	1.000	0.180	1.000	1.000
ROA_t	0.060	0.063	0.096	0.024	0.107
$SIZE_t$	7.483	7.332	1.460	6.411	8.388
BTM_t	0.497	0.420	0.351	0.261	0.638

Note. This table reports univariate statistics on measures of real earnings management, board independence and various control variables for our sample firms. Our sample consists of 13,414 firm-year observations between 1998 and 2013 with information on board composition from ISS and information to estimate the real earnings management and control variables from Compustat. All variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% level. ISS = Institutional Shareholder Services.

*Statistical significance at 10% levels (two-tailed). **Statistical significance at 5% levels (two-tailed). ***Statistical significance at 1% levels (two-tailed).

negatively correlated with *INSIDER_OWN*, suggesting that overproduction may be used more in settings where information acquisition costs are high, and discretionary expenditures are cut less often in settings where insiders' incentives are aligned with shareholders. However, we suggest that caution be exercised in interpreting these univariate correlation results because they may be driven by omitted correlated variables. Until these variables are controlled for, we cannot convincingly conclude whether or not we are able to reject the null hypothesis that the proportion of outside directors on the board is not associated with real earnings management.

Main Results

We report the results of estimating Equation 3 in Table 2.¹² In both equations (RM^{PROD} and RM^{DISEXP}), we fail to find a significant relation between board independence and real earnings management. Specifically, the coefficient on $\%OUTSIDER$ in the RM^{DISEXP} equation is 0.086 ($p = .509$), and the corresponding coefficient in the RM^{PROD} equation is -0.042 ($p = .153$). Therefore, we are unable to reject the null hypothesis (H1) that the proportion of outside directors on the board is not associated with real earnings management.¹³ Turning to the control variables, across both equations, we find that larger firms are more likely to engage in real earnings management (coefficient on *SIZE* in the RM^{DISEXP} equation is 0.021, $p = .081$; coefficient on *SIZE* in the RM^{PROD} equation is 0.010, $p = .006$), likely because they have more complex business environments that makes real earnings

Table 2. Regressions Analyzing the Relation Between Real Earnings Management and Board Independence.

	Dependent variable = RM_t^{DISEXP}		Dependent variable = RM_t^{PROD}	
	Coefficient	<i>p</i> value	Coefficient	<i>p</i> value
Constant	0.564***	(.002)	0.140***	(.000)
%OUTSIDER _{<i>t</i>}	0.086	(.509)	-0.042	(.153)
Costs associated with RM				
Market_Share _{<i>t-1</i>}	-0.390	(.331)	-0.081	(.549)
ZSCORE _{<i>t-1</i>}	-0.004	(.290)	-0.003***	(.000)
ETR _{<i>t</i>}	0.016	(.846)	0.029***	(.008)
Costs associated with AM				
BIG4 _{<i>t</i>}	0.016	(.833)	-0.007	(.714)
NOA _{<i>t-1</i>}	0.008	(.790)	-0.024***	(.000)
CYCLE _{<i>t-1</i>}	0.000	(.461)	0.000***	(.000)
Governance variables				
BOARD_SIZE _{<i>t</i>}	-0.148	(.318)	-0.025	(.483)
CEO_CHAIR _{<i>t</i>}	-0.039	(.219)	-0.001	(.912)
%FEMALE _{<i>t</i>}	-0.210	(.335)	-0.063	(.203)
COMP_IND _{<i>t</i>}	0.012	(.912)	0.031*	(.091)
Control variables				
ROA _{<i>t</i>}	-0.159	(.356)	-0.422***	(.000)
SIZE _{<i>t</i>}	0.021*	(.081)	0.010***	(.006)
BTM _{<i>t</i>}	-0.082**	(.039)	0.084***	(.000)
Year indicator variables	Yes		Yes	
R ²	.023		.111	

Note. The sample consists of 13,414 firm-year observations between 1998 and 2013 with information on board composition from ISS and information to estimate the real earnings management and control variables from Compustat. The regressions include year indicator variables and are estimated with firm-level clustered standard errors. Two-tailed *p* values are reported in parentheses. All variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% level. RM = real earnings management; AM = accrual-based earnings management; ISS = Institutional Shareholder Services.

*Statistical significance at 10% levels (two-tailed). **Statistical significance at 5% levels (two-tailed). ***Statistical significance at 1% levels (two-tailed).

management easier to implement and more difficult to detect. We find that the coefficient on *Market_Share* is negative. Although not consistent with the prediction that firms with a stronger market position find real earnings management less costly, it is consistent with the coefficient estimate found in Badertscher (2011). However, we suggest that caution be exercised when interpreting the results of the real earnings management cost variables as our sample is substantially different from that in Zang (2012).

To the extent that our measures of RM^{PROD} and RM^{DISEXP} are reasonably accurate, the results reported in Table 2 suggest that in general, more independent boards are not necessarily more effective monitors against real earnings management. However, our second hypothesis predicts that outside directors are more likely to be successful in constraining real earnings management as the cost of obtaining the necessary information to identify the suboptimal business practices becomes lower. We test our second hypothesis (H2) and report the results of estimating Equation 4 in Table 3. We continue to observe an insignificant association between %OUTSIDER_MC and our real earnings management proxies

Table 3. Regressions Analyzing the Impact of Outsiders' Information Processing Costs on the Relation Between Real Earnings Management and Board Independence.

	Dependent variable = RM_t^{DISEXP}		Dependent variable = RM_t^{PROD}	
	coefficient	p value	coefficient	p value
Constant	0.645***	(.001)	0.137***	(.000)
%OUTSIDER_MC _t	0.094	(.469)	-0.035	(.218)
INFOCOST_MC _t	-0.054	(.672)	-0.062	(.123)
%OUTSIDER_MC _t × INFOCOST_MC _t	0.631*	(.096)	0.268**	(.021)
Costs associated with RM				
Market_Share _{t-1}	-0.381	(.339)	-0.073	(.589)
ZSCORE _{t-1}	-0.004	(.256)	-0.003***	(.000)
ETR _t	0.013	(.879)	0.027**	(.015)
Costs associated with AM				
BIG4 _t	0.015	(.844)	-0.008	(.659)
NOA _{t-1}	0.008	(.810)	-0.025***	(.000)
CYCLE _{t-1}	0.000	(.498)	0.000***	(.000)
Governance variables				
BOARD_SIZE _t	-0.151	(.309)	-0.023	(.519)
CEO_CHAIR _t	-0.037	(.240)	0.000	(.979)
%FEMALE _t	-0.208	(.340)	-0.064	(.195)
COMP_IND _t	0.007*	(.944)	0.028*	(.125)
Control variables				
ROA _t	-0.161	(.351)	-0.425***	(.000)
SIZE _t	0.020	(.221)	0.007*	(.065)
BTM _t	-0.077*	(.064)	0.090***	(.000)
Year indicator variables		Yes		Yes
R ²	.023		.113	
p value of F-test ($\gamma_2 = \gamma_3 = 0$)	.096		.001	

Note. The sample consists of 13,414 firm-year observations between 1998 and 2013 with information on board composition from ISS and information to estimate the real earnings management and control variables from Compustat. The regressions include year indicator variables and are estimated with firm-level clustered standard errors. Two-tailed p values are reported in parentheses. All variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% level. RM = real earnings management; AM = accrual-based earnings management; ISS = Institutional Shareholder Services.

*Statistical significance at 10% levels (two-tailed). **Statistical significance at 5% levels (two-tailed). ***Statistical significance at 1% levels (two-tailed).

(RM^{DISEXP} and RM^{PROD}). The main effect of *INFOCOST_MC* is insignificant across both equations, suggesting that the information environment alone is not driving either type of real earnings management (the coefficient on *INFOCOST_MC* is -0.054 , $p = .672$ in the RM^{DISEXP} equation and the coefficient is -0.062 , $p = .123$ in the RM^{PROD} equation). More importantly, we show that the relation between *%OUTSIDER_MC* and *RM* varies with *INFOCOST_MC* in the predicted manner. Specifically, in both equations, the coefficient on the interaction between *%OUTSIDER_MC* and *INFOCOST_MC* is significantly positive ($\gamma_3 = 0.631$, $p = .096$ in the RM^{DISEXP} equation; $\gamma_3 = 0.268$, $p = .021$ in the RM^{PROD} equation). These results provide support for our second hypothesis (H2) and suggest that the effectiveness of outside directors in monitoring real earnings management significantly decreases as information processing costs become higher. As such, the main takeaway of

this cross-sectional analysis is consistent with Duchin et al. (2010) and Chen et al. (2015), which also focus on the interaction effect of board independence and information processing costs on firm value and accrual-based earnings management, respectively.

We provide two additional analyses to convey the economic effects of information cost in our setting. First, we test the overall increase in explanatory power attributable to including *INFOCOST_MC* and $\%OUTSIDER_MC \times INFOCOST_MC$ in our regressions by conducting a joint *F*-test of the null hypothesis that $\gamma_2 = \gamma_3 = 0$. We reject the null hypothesis across both regressions reported in Table 3, *p* value = .096 (0.001) in the RM^{DISEXP} (RM^{PROD}) equation, suggesting that including information cost in our regressions significantly increases the explanatory power of our models. Second, we evaluate the effect of a one standard deviation increase in information cost on the propensity of real earnings management for a firm with an average level of board independence (mean board independence in our sample is 71.7%). We find that a one standard deviation increase in information cost results in a .06 (0.02) increase to RM^{DISEXP} (RM^{PROD}).¹⁴ Collectively, these two results suggest that the information processing cost for outsiders has a significant economic effect on real earnings management through its role in providing outside board members with the information needed to identify and constrain opportunistic real earnings management.

Whether more independent boards are more effective monitors against real earnings management may also depend on inside directors' incentives to share their proprietary information in the boardroom. We test our last hypothesis (H3) and report the results of estimating Equation 5 in Table 4. We continue to show an insignificant main effect of $\%OUTSIDER$ on our real earnings management proxies (RM^{DISEXP} and RM^{PROD}). The main effect of *INSIDER_OWN* is also insignificant across both equations, suggesting that insider ownership alone is not driving these types of real earnings management. However, consistent with our prediction, we show that the relation between $\%OUTSIDER$ and *RM* becomes significantly more negative when insiders' interests are closely aligned with outside shareholders. Specifically, in both equations, the coefficient on the interaction between $\%OUTSIDER$ and *INSIDER_OWN* is significantly negative ($\gamma_3 = -0.897$, *p* = .078 in the RM^{DISEXP} equation; $\gamma_3 = -0.230$, *p* = .031 in the RM^{PROD} equation). These results provide support for our third hypothesis (H3) and suggest that the effectiveness of outside directors in monitoring real earnings management significantly improves when inside directors' interests are closely aligned with outside shareholders.

We assess the economic significance of the results of H3 in two ways. First, a joint *F*-test easily rejects the null hypothesis that $\gamma_2 = \gamma_3 = 0$, *p* value = .035 (0.001) in the RM^{DISEXP} (RM^{PROD}) equation, suggesting that including information regarding how closely insiders' interests are aligned with outside shareholders significantly increases the explanatory power of our models. Second, we find that, for an average firm with 71.7% independent directors on the board, a one standard deviation increase in *INSIDER_OWN* is associated with a drop in the magnitude of 0.10 for RM^{DISEXP} . However, the corresponding drop for RM^{PROD} appears to be less prominent (0.001).

Additional Tests

Reassessing the Hypotheses for SEO Firms

A potential concern about our research design is that we do not explicitly control for the incentive to engage in real earnings management. Within a specific incentive context, one can be more confident in the measures of real earnings management and the power of tests.

Table 4. Regressions Analyzing the Impact of Inside Directors' Firm Ownership on the Relation Between Real Earnings Management and Board Independence.

	Dependent variable = RM_t^{DISEXP}		Dependent variable = RM_t^{PROD}	
	coefficient	p value	coefficient	p value
Constant	0.621***	(.001)	0.122***	(.001)
%OUTSIDER _t	0.020	(.883)	-0.023	(.434)
INSIDER_OWNT _t	0.218	(.663)	0.162	(.101)
%OUTSIDER _t × INSIDER_OWNT _t	-0.897*	(.078)	-0.230**	(.031)
Costs associated with RM				
Market_Share _{t-1}	-0.372	(.356)	-0.082	(.545)
ZSCORE _{t-1}	-0.003	(.373)	-0.003***	(.000)
ETR _t	0.018	(.828)	0.029***	(.009)
Costs associated with AM				
BIG4 _t	0.011	(.885)	-0.007	(.711)
NOA _{t-1}	0.007	(.830)	-0.025***	(.000)
CYCLE _{t-1}	0.000	(.408)	0.000***	(.000)
Governance variables				
BOARD_SIZE _t	-0.126	(.405)	-0.020	(.568)
CEO_CHAIR _t	-0.061*	(.066)	0.000	(.966)
%FEMALE _t	-0.181	(.400)	-0.063	(.199)
COMP_IND _t	0.057*	(.598)	0.032*	(.072)
Control variables				
ROA _t	-0.150	(.382)	-0.421***	(.000)
SIZE _t	0.017	(.276)	0.010***	(.007)
BTM _t	-0.079**	(.045)	0.084***	(.000)
Year indicator variables		Yes		Yes
R ²		.025		.112
p value of F-test ($\gamma_2 = \gamma_3 = 0$)		.035		.001

Note. The sample consists of 13,414 firm-year observations between 1998 and 2013 with information on board composition from ISS and information to estimate the real earnings management and control variables from Compustat. The regressions include year indicator variables and are estimated with firm-level clustered standard errors. Two-tailed p values are reported in parentheses. All variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% level. RM = real earnings management; AM = accrual-based earnings management; ISS = Institutional Shareholder Services.

*Statistical significance at 10% levels (two-tailed). **Statistical significance at 5% levels (two-tailed). ***Statistical significance at 1% levels (two-tailed).

In this section, we reassess our hypotheses for a sample of SEO firms. We choose this setting because prior research shows that SEOs are associated with real earnings management and the decline in post-SEO firm performance due to real earnings management is more severe than that due to accrual-based earnings management (Cohen & Zarowin, 2010). We view this as a powerful setting to check the robustness of our results because SEOs provide strong incentives for the CEO to inflate earnings through real earnings management, which is harmful for long-term shareholder value.¹⁵ Outside directors, acting in the best interest of shareholders, should have strong incentive to monitor and mitigate any opportunistic behavior during the SEO process.

We require SEOs to be common stock issues by U.S. issuers listed on NYSE, NASDAQ, or AMEX and exclude firms for the same reasons described by Cohen and Zarowin (2010). We identify 302 SEO firms in our sample and retest our three hypotheses

Table 5. Retesting the Hypotheses for SEO Firms.

	Dependent variable = RM_t^{DISEXP}				Dependent variable = RM_t^{PROD}			
	coefficient	p value	coefficient	p value	coefficient	p value	coefficient	p value
Constant	-1.109	(.367)	-1.518	(.204)	0.132	(.451)	0.155	(.409)
%OUTSIDER_MC	-0.563	(.564)			-0.222*	(.053)		
INFOCOST_MC	-1.911*	(.076)			-0.216**	(.023)		
INFOCOST_MC × OUTSIDER_MC	3.246*	(.085)			0.767*	(.092)		
%OUTSIDER			-0.576	(.530)			-0.177	(.174)
INSIDER_OWN			1.659	(.648)			0.303	(.305)
INSIDER_OWN × %OUTSIDER			-3.192*	(.087)			-0.384*	(.057)
Costs associated with RM								
Market_Share _{t-1}	0.648	(.787)	0.732	(.755)	-0.633**	(.028)	-0.536**	(.039)
ZSCORE _{t-1}	0.014	(.771)	0.023	(.638)	0.001	(.770)	0.002	(.660)
ETR _t	-0.618	(.187)	-0.472	(.270)	-0.025	(.581)	-0.012	(.786)
Costs associated with AM								
BIG4 _t	0.386	(.551)	0.400	(.587)	0.033	(.496)	0.052	(.259)
NOA _{t-1}	-0.440*	(.055)	-0.382*	(.088)	-0.090***	(.000)	-0.083***	(.000)
CYCLE _{t-1}	0.000	(.893)	0.000	(.942)	0.000	(.497)	0.000	(.716)
Governance variables								
BOARD_SIZE _t	-0.132	(.914)	-0.029	(.980)	0.044	(.731)	0.063	(.621)
CEO_CHAIR _t	-0.055	(.835)	-0.113	(.647)	0.010	(.722)	0.009	(.732)
%FEMALE _t	0.024	(.990)	-0.041	(.982)	0.096	(.558)	0.068	(.683)
COMP_IND _t	0.630	(.371)	0.679	(.320)	0.078	(.304)	0.076	(.363)
Control variables								
ROA _t	-0.061	(.960)	0.077	(.949)	-0.407***	(.001)	-0.401***	(.001)
SIZE _t	0.124	(.282)	0.204*	(.094)	0.012	(.401)	0.020	(.165)
BTM _t	0.304	(.346)	0.144	(.600)	0.056*	(.081)	0.034	(.262)
Year indicator variables								
R ²	Yes		Yes		Yes		Yes	
	.237		.231		.136		.132	

Note. This table reports results of retesting our hypotheses using the 302 SEO firm-years. The regressions include year indicator variables and are estimated with firm-level clustered standard errors. Two-tailed p values are reported in parentheses. All variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% level. RM = real earnings management; AM = accrual-based earnings management; SEO = seasoned equity offering.

*Statistical significance at 10% levels (two-tailed). **Statistical significance at 5% levels (two-tailed). ***Statistical significance at 1% levels (two-tailed).

based on this subsample in Table 5. We again observe an insignificant (unconditional) relation between board independence and RM^{DISEXP} . However, board independence is negatively and significantly correlated with RM^{PROD} (coefficient estimate for %OUTSIDER_MC = -0.222, $p = .053$), suggesting that independent directors are effective monitors of this type of real activity management in firms with average information acquisition costs (because INFOCOST_MC is centered at the sample mean).

Consistent with our main results, we find that coefficients on the interactions between %OUTSIDER_MC and INFOCOST_MC are both significantly positive and the coefficients on the interactions between %OUTSIDER and INSIDER_OWN are both significantly negative in the RM^{DISEXP} and RM^{PROD} models. Thus, we conclude that the results for H2 and H3 continue to hold in the SEO setting where the incentive to engage in real earnings management is strong.

Other Sensitivity Tests

Our main results are robust to three more sensitivity tests (untabulated). First, finding support for both H2 and H3 suggests that both the firm-level information environment and insiders' incentives to share information with outside directors affect the relation between board structure and the level of real earnings management. To ensure that both factors matter incrementally to one another, we run a regression that includes both *INFOCOST* and *INSIDER_OWN* (and all corresponding interactions). Next, the information disadvantage of an independent board could also be related to the absolute number of outsiders on the board, not necessarily the proportion. As such, we include the natural logarithm of the number of outsiders in place of *%OUTSIDER*. Last, directors are classified as insiders (which includes "affiliated" directors) or outsiders. Outsiders are those directors with no material connection to the firm. Insiders are typically current employees of the firm but also include nonemployees with a "material" connection to the firm. We include the proportion of affiliated directors on the board as an additional control variable to control for potential differences between employee insiders and affiliated insiders.

Addressing Causality: Change in Board Independence in Response to Regulations Promulgated in 2003

A Two-Stage Approach

To provide evidence that our results are not driven by endogeneity between board structure and real earnings management decisions, we use a recent regulatory change, which requires firms traded on NYSE and NASDAQ to have a majority (more than 50%) of independent directors on their boards, as an exogenous shock that substantially increased the number of outsiders on the board (Armstrong et al., 2014; Chen et al., 2015; Duchin et al., 2010).¹⁶

We focus on 567 sample firms in 2003 and track their changes in board independence between 2000 and 2004 similar to Armstrong et al. (2014). Of these 567 firms, we identify 469 compliant firms and 98 noncompliant firms, based on whether the firms were already compliant with the new board independence requirement in 2000.¹⁷ Untabulated descriptive statistics show that board size is similar between compliant and noncompliant firms, and there is no evidence to suggest that board size changes substantially for either group. By construction, in 2000, compliant firms have a greater proportion of outside directors on the board than noncompliant firms (the mean percent of outside directors for compliant firms is 70% vs. 36% for noncompliant firms). As of 2004, the percent of outside directors for noncompliant firms is around 57%, which fulfills the new requirement of board independence, but is still less than the percent of outside directors for compliant firms (74%).

To measure the change in board independence in response to the new requirements, we calculate the variable, *MinRequired_Δ%Outsiders* for the 567 sample firms. Specifically, if *%Outsiders* is greater than 50% in 2000, *MinRequired_Δ%Outsiders* equals zero. However, if *%Outsiders* is less than or equal to 50% in 2000, *MinRequired_Δ%Outsiders* equals the minimum number of independent directors required to achieve majority independence, divided by board size. This variable measures the percentage by which firms had to increase their board independence to comply with the new regulations promulgated by NYSE and NASDAQ. The mean of *MinRequired_Δ%Outsiders* is 19% for the noncompliant firms (0% for compliant firms, by construction).

We follow Armstrong et al. (2014) and use *MinRequired_Δ%Outsiders* as an instrument for the endogenous *Δ%Outsiders* variable. In the first-stage model (untabulated), we regress

$\Delta\%Outsiders$ on $MinRequired_ \Delta\%Outsiders$ and contemporaneous changes in (a) the natural logarithm of total assets, (b) research and development expenditures, (c) leverage, (d) the natural logarithm of the number of business segments, (e) the natural logarithm of firm age, (f) return volatility, (g) the natural logarithm of share price, and (h) the book-to-market ratio. We also include the initial value (i.e., as of 2000) of each control variable, and industry fixed effects to control for the possibility that the effect of a change in board structure on firm transparency depends on the initial level of transparency and other features of the initial governance structure. Consistent with non-compliant firms increasing board independence in response to the heightened governance standards, the coefficient on $MinRequired_ \Delta\%Outsiders$ is positive and highly significant. The R^2 is 24.5%, almost identical to that reported in Armstrong et al. (2014).

In the second stage, we calculate the predicted value of $\Delta\%Outsiders$ (denoted $Predicted \Delta\%Outsiders$) and use that in place of $\%OUTSIDER$ in a change specification of Equations 4 and 5.¹⁸ Table 6 summarizes the second stage regression results. In the ΔRM^{DISEXP} equation, we find a significantly positive coefficient on the interaction between $Predicted \Delta\%Outsiders$ and $\Delta INFOCOST$, supporting H2. In the ΔRM^{PROD} equation, we find a significantly negative coefficient on the interaction between $Predicted \Delta\%Outsiders$ and $\Delta INSIDER_OWN$, supporting H3. These results provide some confirming evidence that supports our main conclusions and suggests a casual relation more likely runs from board independence to real activities manipulation.

A Difference-in-Differences Approach

We utilize a difference-in-differences approach as an alternate way of examining the causal relation between board independence and real earnings management. Specifically, we utilize the regulatory change that requires firms traded on NYSE and NASDAQ to have a majority (more than 50%) of independent directors on their boards as the “treatment” event. Noncompliant firms that were required to increase board independence because of this regulation change serve as the treatment group, while the compliant firms that already had majority board independence serve as our control group as the regulation did not require them to take any action. If the increase in board independence leads to a greater reduction of RM in the noncompliant (treatment) firms relative to the compliant (control) firm, this would support the notion of an increase of board independence leading to a reduction in RM. Similar to our main tests, we also investigate how this relation may vary in different information environments.

Our main difference-in-differences regression is as follows:

$$\begin{aligned}
 RM_t = & \eta_0 + \eta_1 NON_COMPLIANT + \eta_2 POST + \eta_3 NON_COMPLIANT \times POST \\
 & + \eta_4 INFO_t + \eta_5 NON_COMPLIANT \times INFO_t + \eta_6 POST \times INFO_t \\
 & + \eta_7 NON_COMPLIANT \times POST \times INFO_t + \sum_k \eta_{8,k} Cost\ of\ RM_{k,t} \\
 & + \sum_l \eta_{9,l} Cost\ of\ AM_{l,t} + \sum_m \eta_{10,m} Governance\ Controls + \sum_n \eta_{11,n} Controls_{n,t} + \varepsilon
 \end{aligned} \quad , \quad (6)$$

where $RM_t = RM^{PROD}$ or RM^{DISEXP} in year t ; $NON_COMPLIANT = 1$ if the firm is labeled “noncompliant” and 0 otherwise; $POST = 1$ for years 2004-2008, 0 for years 1999-2003; $INFO = INFOCOST_MC$ or $INSIDER_OWN$ in year t .

We report the results of estimating Equation 6 in Table 7. The coefficient estimate for $NON_COMPLIANT$ is insignificant across all four specifications, suggesting that there is

Table 6. Regression Analyzing the Relation Between the Change in Real Earnings Management and the Predicted Change in Board Independence (Second-Stage Model).

	Dependent variable = ΔRM_t^{DISEXP}				Dependent variable = ΔRM_t^{PROD}			
	coefficient	p value	coefficient	p value	coefficient	p value	coefficient	p value
Constant	1.040	(.276)	0.996	(.298)	0.029	(.144)	0.031*	(.077)
Predicted $\Delta\%OUTSIDER$	-0.486	(.791)			0.032	(.659)		
$\Delta INFOCOST$	-1.909	(.205)			0.028	(.672)		
$\Delta INFOCOST \times$ Predicted $\Delta\%OUTSIDER$	9.994*	(.092)			-0.235	(.717)		
Predicted $\Delta\%OUTSIDER$			-0.393	(.838)			0.040	(.450)
$\Delta INSIDER_OWN$			0.359	(.269)			-0.055	(.103)
$\Delta INSIDER_OWN \times$ Predicted $\Delta\%OUTSIDER$			2.968	(.199)			-0.468*	(.093)
Costs associated with RM								
$\Delta Market_Share_{t-1}$	-5.498	(.212)	-5.263	(.234)	-0.259	(.245)	-0.273	(.213)
$\Delta ZSCORE_{t-1}$	0.030	(.441)	0.033	(.403)	-0.008*	(.062)	-0.008*	(.061)
ΔETR_t	0.037	(.881)	0.084	(.764)	-0.063*	(.065)	-0.064*	(.076)
Costs associated with AM								
$\Delta BIG4_t$	0.328	(.356)	0.356	(.268)	0.016	(.143)	0.022	(.116)
ΔNOA_{t-1}	-0.464	(.314)	-0.454	(.311)	0.005	(.781)	0.005	(.753)
$\Delta CYCLE_{t-1}$	0.001	(.520)	0.002	(.457)	0.000	(.502)	0.000	(.511)
Control variables								
ΔROA_t	0.380	(.733)	0.144	(.895)	0.241*	(.075)	0.248*	(.071)
$\Delta SIZE_t$	0.363**	(.038)	0.327*	(.052)	0.032	(.277)	0.034	(.258)
ΔBTM_t	-0.359	(.644)	-0.184	(.789)	0.062	(.430)	0.053	(.490)
R ²		.019		.091		.017		.100

Note. The sample consists of 567 firms in 2003 with information on board composition from ISS and information to estimate the real earnings management and control variables from Compustat. Among the 567 firms, 98 are noncompliant firms and 469 are compliant firms. The regressions are estimated with industry-level clustered standard errors. All continuous variables are winsorized at the 1% and 99% level; Δ denotes the change in the respective variable measured over the period 2000 to 2004. Predicted $\Delta\%Outsiders$ is the predicted value of $\Delta\%Outsiders$ in the first-stage model. RM = real earnings management; AM = accrual-based earnings management; ISS = Institutional Shareholder Services.

*Statistical significance at 10% levels (two-tailed). **Statistical significance at 5% levels (two-tailed). ***Statistical significance at 1% levels (two-tailed).

no significant difference in the use of RM between the compliant and non-compliant groups in the preregulation period. This lends further support to the use of compliant firms as our control group. The coefficient estimate for $NON_COMPLIANT \times POST$ is also insignificant across all four specifications, suggesting that in general an increase in board independence for compliant firms does not lead to a significant reduction in RM relative to compliant firms.

However, the coefficient estimates for $NON_COMPLIANT \times POST \times INFOCOST_MC$ are significantly positive in both RM models ($\eta_7 = 2.286$, p value = .079 in the RM^{DISEXP} equation; $\eta_7 = 0.260$, p value = .002 in the RM^{PROD} equation) and the coefficient estimates for $NON_COMPLIANT \times POST \times INSIDER_OWN$ are significantly negative in both RM models ($\eta_7 = -6.208$, p value = .001 in the RM^{DISEXP} equation; $\eta_7 = -0.209$, p value = .039 in the RM^{PROD} equation). These results suggest that the increase in board independence does lead to a decrease in RM activities, but only for firms with lower information

Table 7. Difference-in-Differences Approach: Regression Analyzing the Relation Between Real Earnings Management and Change in Board Independence.

	Dependent variable = RM_t^{DISEXP}				Dependent variable = ΔRM_t^{PROD}			
	coefficient	p value	coefficient	p value	coefficient	p value	coefficient	p value
Constant	-0.138	.763	-0.228	.454	0.181**	.022	0.134*	.064
NON_COMPLIANT	0.147	.169	0.027	.700	0.009	.690	-0.002	.906
POST	-0.270**	.026	-0.319	.425	0.027**	.016	0.018	.184
NON_COMPLIANT × POST	-0.051	.881	0.523	.131	0.013	.410	0.030	.288
INFOCOST_MC	-0.015	.970			-0.101	.157		
NON_COMPLIANT × INFOCOST_MC	-0.358	.655			-0.030	.711		
POST × INFOCOST_MC	-0.502	.511			-0.116	.094		
NON_COMPLIANT × POST × INFOCOST_MC	2.286*	.079			0.260***	.002		
INSIDER_OWN			-0.867	.177			-0.027	.699
NON_COMPLIANT × INSIDER_OWN			1.587*	.091			0.185**	.011
POST × INSIDER_OWN			0.317	.702			0.0386	.470
NON_COMPLIANT × POST × INSIDER_OWN			-6.208***	.001			-0.209**	.039
Control variables including year indicators	Yes		Yes		Yes		Yes	
R ²	.0381		.137		.0484		.134	

Note. The sample consists of 274 firms (2,740 firm-years) with information on board composition from ISS, information to estimate the real earnings management and control variables from Compustat in each year from 1999 to 2008. Among the 274 firms, 43 are noncompliant firms and 231 are compliant firms. The regressions are estimated with industry-level clustered standard errors. *NON_COMPLIANT* is equal to zero if %*OUTSIDER* is greater than or equal to 50% in 2000 and is an indicator variable that equals one if %*OUTSIDER* is less than 50% in 2000. *POST* is an indicator variable that equals one if the fiscal year is 2004, 2005, 2006, or 2007 and zero is the fiscal year is 2000, 2001, 2002, or 2003. All other variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% level. ISS = Institutional Shareholder Services.

*Statistical significance at 10% levels (two-tailed). **Statistical significance at 5% levels (two-tailed). ***Statistical significance at 1% levels (two-tailed).

process costs for outsiders and more inside directors whose interests are aligned with shareholder interests. The difference-in-differences regression analyses provide further support for the causal relation between board independence and real earnings management.¹⁹

Conclusion

In this article, we provide evidence that suggests board informedness may be equally as important as board independence, if not more, in the monitoring of real activities manipulation. In a sample of 13,414 S&P 1500 firms between 1998 and 2013, we fail to detect a significant relation between board independence and real earnings management, suggesting that more independent boards are not always more effective monitors of this type of activity. This is likely because outside directors suffer an informational disadvantage relative to insiders, and may lack the knowledge required to effectively monitor this type of activity.

In cross-sectional analyses, we show that as the firm-level information environment improves, more independent boards become more effective at constraining real earnings

management. Specifically, when outsiders' information processing costs become lower and/or insiders are more willing to share their information with outsiders, more independent boards are more effective monitors against real earnings management. Our results are robust to subsample analyses of SEO firms and to correcting for endogeneity of board structure.

Our empirical evidence provides additional support to prior literature that also suggests outside directors are not able to perform as well when the cost of becoming informed is high (Boone et al., 2007; Duchin et al., 2010; Lehn et al., 2009; Linck et al., 2008). Armstrong et al. (2014) find that an exogenous increase in board independence leads to an increase in corporate transparency, highlighting the informational demand of outside directors to carry out their charge. Although it is an implicit assumption in Armstrong et al. (2014) that board informedness plays a critical role in effective monitoring, we provide empirical evidence on its importance and trade-off against board independence in the context of monitoring real earnings management. Furthermore, this study has implications for well-intentioned corporate governance reforms such as the Sarbanes-Oxley Act. Our results indicate that the reforms should take into account the valuable roles played by knowledgeable inside directors. However, we note that our study only sheds light on the effect of

Appendix Variable Names and Definitions

RM proxies	
RM^{PROD}	Abnormal production costs, measured as the estimated residuals from Equation 1.
RM^{DISEXP}	Abnormal discretionary expenditures, measured as the estimated residuals from Equation 2 multiplied by -1 .
Variables of interest	
$\%OUTSIDER$	The percent of board members who are outsiders in year t .
$INFOCOST$	Measure of the outsider's cost of becoming informed (Duchin, Matsusaka, & Ozbas, 2010). INFOCOST is an index that combines three measures: number of analyst's quarterly forecasts, dispersion of analyst forecasts, and analyst forecast error (all divided by total assets). INFOCOST is constructed by summing the firm's percentile rank in the sample for each measure. The variable is then scaled to range from zero (lowest information processing cost) to one (highest information processing cost).
$INSIDER_OWN$	The number of (non-CEO) insiders with between 5% and 25% firm ownership divided by the total number of (non-CEO) insiders.
Costs associated with RM	
$Market_Share$	The percentage of the firm's sales to total sales of its three-digit Standard Industrial Classification (SIC) industry.
$ZSCORE$	Measure of the financial health computed as: $0.3 \times (\text{Net Income}_{t-1} / \text{Asset}_{t-1}) + 1.0 \times (\text{Sales}_{t-1} / \text{Asset}_{t-1}) + 1.4 \times (\text{Retained Earnings}_{t-1} / \text{Asset}_{t-1}) + 1.2 \times (\text{Working Capital}_{t-1} / \text{Asset}_{t-1}) + 0.6 \times (\text{Market Value}_{t-1} / \text{Total Liabilities}_{t-1})$.
ETR	Tax expense divided by pretax income (excluding special items).
Costs associated with AM	
$Big4$	Indicator variable that equals one if the firm's auditor is one of the Big 4, zero otherwise.

(continued)

Appendix (continued)

NOA	Indicator variable that equals one if net operating assets divided by lagged sales is above the median of the corresponding three-digit SIC industry-year, zero otherwise.
CYCLE	Days receivable plus the days inventory less the days payable at the beginning of the year.
Governance variables	
BOARD_SIZE	The size of the board.
CEO_CHAIR	Indicator variable that equals one if the CEO is also the chairman of the board, zero otherwise.
%FEMALE	The proportion of females on the board.
COMP_IND	The percentage of compensation committee members who are independent.
Control variables	
ROA	Net income divided by total assets.
SIZE	Natural logarithm of total assets.
BTM	Book-to-market ratio.

Note. RM = real earnings management; SIC = Standard Industrial Classification; AM = accrual-based earnings management.

board independence on real activities manipulation; therefore, it may or may not hold for other types of monitoring activities.

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Notes

1. Consistent with this view, an emerging line of research suggests that outside directors are not able to perform as well when the cost of becoming informed is high (Linck et al., 2008; Lehn et al., 2009; Boone et al., 2007; Duchin, Matsusaka, & Ozbas, 2010; Chen et al., 2015).
2. We use real earnings management and real activities manipulation interchangeably in the article.
3. Bushman, Chen, Engel, and Smith (2004) summarize such a trade-off between inside and outside directors as follows: "An important question of board composition concerns the ideal combination of outside and inside members. Outsiders are more independent of a firm's CEO, but are

potentially less informed regarding firm projects than insiders. Insiders are better informed regarding firm projects, but have potentially distorted incentives deriving from their lack of independence from the firm's CEO."

4. Consistent with this view, Srinivasan (2005) finds that outside directors, especially audit committee members, bear significant reputation costs and labor market penalties when their companies experience accounting restatements.
5. For example, Masulis and Mobbs (2011) examine inside directors' outside directorship. They argue that with greater career independence from their CEO, inside directors with outside directorships are less susceptible to CEO influence, making them more valuable sources of firm-specific information for their boards' outside directors.
6. We do not examine abnormal cash flows from operations because, as discussed in Roychowdhury (2006), real activities manipulation can lead to an increase or a decrease in abnormal cash flows from operations and the net effect is ambiguous. For example, overproduction decreases cash flows, whereas cutting discretionary expenditures increases it.
7. When we subtract the mean residual our results remain qualitatively similar.
8. We note that accrual-based earnings management may be viewed as an *ex post* form of earnings management that takes place when firms close their books at the end of the reporting period, while real earnings management is presumably more anticipatory in that production and discretionary expenditures are incurred throughout the period. Accordingly, we model real earnings management as a function of the costs of both earnings management tools, but not by the realized outcome of accrual-based earnings management (Zang, 2012).
9. When interacting two nonnegative variables, the interaction term is oftentimes highly correlated artificially inducing multicollinearity which could reduce the power of our tests and bias against rejecting the null hypothesis. Following Neter, Wasserman, and Kutner (1989) and Aiken and West (1991), we mean-center %OUTSIDER and INFOCOST, which decreases the variance-inflation-factor on the interaction between these two variables from 30.36 to 1.06. Because these variables are mean-centered, the coefficient estimate for %OUTSIDER_MC should be interpreted as the relation between %OUTSIDER and RM at the average level of information processing costs in our sample. Similarly, the coefficient estimate for INFOCOST_MC should be interpreted as the relation between INFOCOST and RM at the mean %OUTSIDER in our sample. The interpretation of the coefficient estimate for the interaction of these two variables is unaffected.
10. Since the variance inflation factor on the interaction between %OUTSIDER and INSIDER_OWN is less than 2.00, we do not mean center these two variables in Equation 5.
11. For the RM^{PROD} model, the average number of observations for each industry-year regression is 112 and the average adjusted- R^2 across models is .88. For the RM^{DISEXP} model, the average number of observations for each industry-year regression is 123 and the average adjusted- R^2 across models is .50.
12. We estimate Equation 3 in the general setting (not for a particular earnings management incentive) because firms have many incentives to engage in real earnings management and we do not want to limit our results to one particular incentive. Although the general setting provides the largest sample size for which we can test our hypothesis, the trade-off is that not investigating a particular earnings management incentive decreases the power of correctly identifying real earnings management. We reassess our hypotheses for a sample of firms with a specific incentive to engage in real earnings management in "Reassessing the Hypotheses for SEO Firms" section.
13. In untabulated analysis, we find a significant negative relation between %OUTSIDER and accrual-based earnings management, confirming Klein (2002)'s result that firms with more independent boards are less likely to engage in accrual-based earnings management.
14. Recall that the mean RM^{DISEXP} and RM^{PROD} in our sample are 0.041 and 0.130, respectively.
15. To provide evidence that we are identifying firms with an incentive to engage in real earnings management, we first compare real earnings management between seasoned equity offering (SEO) firm-years and the rest of the sample. In untabulated results, we find that our real earnings

management proxies are significantly larger in SEO firms relative to non-SEO firms, consistent with Cohen and Zarowin (2010).

16. In February 2002, the Securities and Exchange Commission (SEC) requested that the exchanges heighten their listing standards with respect to governance. In 2002, the NYSE and NASDAQ proposed changes requiring a majority of the board of directors to be independent, and the proposals were approved by SEC in November 2003.
17. A limitation of this analysis is the small sample size. Despite a cleaner setting to test causality, the small sample size may result in reduced statistical power and a bias against finding the results.
18. We do not include changes in other corporate governance variables (board size, CEO duality, percent of female directors, and percent of outside directors on the compensation committee) in the second stage model, because most of the sample firms do not experience significant changes in those board characteristics between 2000 and 2004.
19. To justify a difference-in-differences approach, we need to satisfy the “equal trends” assumption. To do this, we must provide evidence that the trend of RM is similar for our treatment (non-compliant firm) sample and control (compliant firm) sample in the preregulation period. Justifying the “equal trends” assumption provides evidence that the trend in RM for our treatment (noncompliant firm) sample and control (compliant firm) sample would have been similar if the noncompliant firms were not required to increase their board independence following the regulatory change. To justify this assumption, we regress RM on a time trend variable (defined as current year minus 1998), an indicator for noncompliant firms, and their interaction (for the years 1998-2003). The coefficient on the interaction is insignificant for both RM measures, providing evidence that the trend in RM is not significantly different for our treatment and control firms in the preregulation period.

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