The Financial Outcome of Hiring a CEO from Outside the Firm

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Abstract

We investigate the financial result of boards' choices to promote a new CEO from within the firm or hire externally, at large U.S. public firms between 1986 and 2005. This choice theoretically maximizes profits. Additionally, choosing a new CEO from outside the firm influences labor market demand and compensation for top executives. We use the structural self-selection modeling method to determine the performance (total cash flow) boards *would have obtained* by choosing the passed-over type of hire. The method accounts for boards that self-select their hiring source (inside or outside) to maximize profits. The model uses instrument variables that affect the decision to hire externally but are uncorrelated to firm performance. Standard methods are used to address any remaining concerns related to endogeneity, firm fixed effects, and truncation bias. Extensive robustness tests are run. Results are verified by using advanced matching estimators.

Our results show that an economically significant gain is realized, on average, by hiring internally relative to what would have been obtained by hiring externally, whereas an economically significant loss is realized by hiring externally. This result is a) robust to analysis method, performance measure, and model specification, b) holds regardless of the time period, for both S&P 500-size and Forbes 800-size firms, and c) is not significantly changed by removing interim CEOs. Ours tests suggest the loss obtained when hiring externally is not attributable to weak governance or greater risk taking by outside hires to obtain superior performance. Instead, our results suggest that boards are unknowingly missing critical information about external candidates, which results in their decision to hire externally and a subsequent loss of profits. Our result can help explain the major trends in corporate governance and CEO compensation since 1934.

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The Financial Outcome of Hiring a CEO from Outside the Firm

There is little that a board of directors does that is more important than choosing a new CEO. The choice can lead to wealth creation or destruction on a vast scale. Consider the trend of boards in recent decades to hire from outside the firm. Their external choices intensify the labor market demand for executive talent, increase CEOs' bargaining power, and add to rising CEO pay. Is there a shareholder-wealth maximizing explanation for the increase in top five executives' pay from 1.91% of corporate net income in the late 1970s to 9.8% in the early 2000s?[1] If we assume that boards on average maximize total profits when they hire a new CEO externally, the more than 600% increase in CEO pay (in 2005 dollars) since 1980 is fully explainable by boards' efforts to maximize shareholders' wealth (see Edmans and Gabaix (2010), Gabaix and Landier (2008), and Murphy and Zabojnik (2004)). That boards expect greater total profits when they pass over internal candidates to hire externally is well established. The premium paid to hire externally has more than tripled since the 1970s, and the rate of external hiring has nearly tripled, going from 12.7% in the early-1980s to 35% in 2005 (see Murphy and Zabojnik (2007)).[2] Our purpose is to determine directly whether boards realize greater profits by hiring a CEO from their selected source (inside or outside). Our measure is total profits.

We contribute a large-scale comparison of total profit by CEO hiring source and firm circumstances, thereby providing direct evidence of whether external hiring or internal

[1] Bebchuk and Grinstein (2005) report the early 2000 value. We obtain the late 1970s value (1.91%) by following Bebchuk and Grinstein's procedures. However, we use ex post total pay and pay estimation methods appropriate for that period as described by Core, Holthausen and Larcker (1999) and Amacom (1975). Ex post total pay is obtained from proxy statements and the Forbes 800 list of CEO pay.

[2] Also, see abnormal stock return evidence in Borokhovich, Parrino and Trapani (1996) and Huson, Malatesta and Parrino (2004); data on the rate of hiring externally in Huson, Parrino and Starks (2001), Parrino (1997), and Denis and Denis (1995); evidence from institutional investors in Parrino, Sias and Starks (2003); and board practices in Borokhovich, Parrino and Trapani (1996), Weisbach (1988), and Huson, Parrino and Starks (2001).

promotion *results* in a better outcome.[3] Such large-scale comparisons are rare in the literature, and none focus on the period (mid 1980 to 2005) when external hiring increased. Using the largest sample in the literature at the time, Huson, Malatesta and Parrino (2004) (hereafter called HMP2004) investigate CEO appointments from 1971 to 1994.[4] HMP2004 (page 262) show that when controls for hiring circumstances are included, the difference in average operating profit between inside and outside hires is not significant during the time period of their study. This result, however, is not conclusive for our purpose, as operating performance is only a portion of total profits, their sample does not cover the period after 1994, and their analysis does not account for the endogeneity of a board's selection decision and performance.

To determine whether boards actually maximize total profits by their hiring choice (inside or outside), we identify all internal hires and all external hires from Forbes 800-size firms from 1986 to 2005. All of these firms have at least $350 million in assets in the year prior to hiring the new CEO (approximately 99% of Forbes 800 firms are this large). Our measures of total profits include non-operating income as well as operating income.[5] Using only operating income to represent total financial performance is incomplete and could obscure CEOs' total contribution to shareholders. Further, as Larcker, Richardson and Tuna (2007) point out, operating income excludes many items over which a CEO has discretionary power, so using operating income may not capture the full impact of the hiring choice. To capture the major

[3] Huson, Malatesta and Parrino (2004) suggest directly measuring financial performance to understand the outcome of boardss decisions. They note that the results of event studies on turnover are mixed and theoretically ambiguous, while cautioning the stock price reactions to turnover reflect only investor expectations. Indirect evidence, such as the increase in external hiring since the 1970s, cannot be conclusive due to the issue of spurious correlation.

[4] The management literature examines total profits due to hiring externally but focuses on non-diversified firms, which are one-fifth the size of firms studied by Huson, Malatesta and Parrino (2004); see, for instance, Zhang and Rajagopalan (2004).

[5] Research has shown that CEOs impact non-operating income. See, for instance, Weisbach (1995), Berger and Ofek (1999), and Berger, Ofek and Yermack (1997).

dimensions of financial performance, we use three measures: a) cash flow, b) net income, and c) operating income; the first two measure total financial performance.

We use two well established methods to determine the performance boards *would have obtained* by choosing the passed-over type of hire. These methods account for boards that self-select their hiring source (inside or outside) to maximize profits. In this case, self-selection results in an issue of simultaneity first described by Roy (1951) in which the selection choice depends upon expected performance and, conversely, expected performance depends upon the choice. Further, Parrino, Sias and Starks (2003) and Lucier, Wheeler and Habbel (2007) raise the possibility that exogenous forces can influence the source of hire and thus performance. The first method we use to address these concerns is structural self-selection modeling (see Li and Prabhala (2007) and Maddala (1983)). This method has been widely used by labor economists to study wages and the choice to join a union. As in our case, the outcome (wages) and the choice are potentially determined simultaneously. Our structural self-selection model directly estimates the counterfactual performance that would have been obtained from the unselected source. The model uses instrument variables that affect the decision to hire externally but are uncorrelated to firm performance. For instance, the industry percentage of outside hires in the five year prior to the appointment of a new CEO is correlated (p-value < 0.0001) to the type of hire selected but not to future firm performance. The model enables calculation of a) the expected net benefit of the hiring externally (internally) versus internally (externally) as well as b) as the average gain realized after the hiring decision is made. Second, we use treatment effect estimators based on methods of matching to account for the effect of self-selection. The matching methods estimate realized gains and enable analysis of risk. To verify average gains found from the structural self-selection models, we use propensity score matching as well as the econometrically advanced

matching estimator of Abadie and Imbens (2006). All of our analyses use standard methods to address any remaining concerns related to endogeneity, firm fixed effects, and truncation bias.

We begin our analysis by replicating the results of HMP2004, who use operating performance. The remainder of our research focuses on total financial performance. For each hire type, the results are consistent, starting with our sample statistics, using either analysis method: structural self-selection models or matching methods.

We find that hiring internally results in economically greater total financial performance on average (*p*-value <0.001) than would have been obtained from the passed-over external candidates. This result is robust to removing interim CEOs from the sample, if first-year performance is removed, and holds for both Forbes 800-size and S&P 500-size firms. Improved governance (fewer inside directors and smaller boards) significantly improves the gain realized by hiring internally. Further, associated with improved governance at large firms, the gain realized by hiring internally has significantly (*p*-value <0.001) improved from the early to later half of our sample for S&P 500-size firms (firms with total assets greater than $1 billion). The results are robust to the measure of performance (though the gain is larger for total performance measures), model specification, and analysis method.

Hiring externally, however, results in economically *lower* total financial performance on average (*p*-value < 0.001) than would have been obtained from the passed-over internal candidates. This result is robust to analysis method, performance measure, and model specification, including specifications using instrument variables that are, by construction, not correlated to the performance measure. The result holds regardless of the time period, for both S&P 500-size and Forbes 800-size firms. The loss is not significantly changed by removing interim CEOs or by removing first-year performance, although there is evidence that external

hires' loss is greatest in their first year as they learn the job. Further, improved governance is not associated with reduced losses. Finally, risk analysis shows that outside hires deliver a greater risk of losses and a lower chance of superior profits, relative to what the internal candidate would have delivered. Specifically, stochastic dominance tests show that for any given target level of performance inside hires are always more likely to exceed the target than outside hires, all else equal. Overall, our analysis suggests that, given full statistical knowledge, risk-neutral boards would have expected a net benefit in only 13.8% of their decisions to hire externally, not 50%.

What explains the realized loss associated with hiring externally? We first search the literature for a profit-maximizing explanation for a loss when hiring externally.[6] The best-known but untested explanation is given by Hermalin (2005). He predicts a loss for independent boards (fewer inside directors) who eventually obtain a CEO superior to internal candidates by hiring from a more variable external talent pool. The theory a) assumes that the more variable external talent pool provides a greater probability of exceeding high target levels of performance than the internal talent pool and b) requires quick dismissal (enabled by independent boards' lower monitoring cost) of inferior hires during the trial and error interval. The many inferior profitability observations (one for each CEO dismissal) would outweigh the one superior observation, resulting in a realized loss, on average. However, contrary to the theory's assumption we find that inside hires always provide a greater probability of exceeding any target levels of performance including the highest target levels. Thus, we do not find that Hermalin's theory explains the loss realized by hiring externally, so we turn to theories that explain deviations from profit-maximizing behavior (i.e., deviations from rational expectations).

[6] We searched the *Accounting Review*, *American Economic Review*, *Bell Journal of Economics*, *Econometrica*, *Journal of Accounting and Economics*, *Journal of Economic Literature*, *Journal of Finance*, *Journal of Financial Economics*, *Journal of Labor Economics*, *Journal of Political Economy*, *Quarterly Journal of Economics*, *RAND Journal of Economics*, and *Review of Financial Studies*.

Brav and Heaton (2002) build on Merton (1987) and provide two theories to describe deviations from rational expectations (i.e., financial anomalies). Applied to CEOs, the first theory would imply that boards knowingly choose inferior candidates due to agency issues. However, consistent with a long line of literature, our tests suggest external-hire boards are well-governed relative to inside-hire boards and so have few agency issues. This leaves Brav and Heaton's "rational structural uncertainty" (RSU) explanation for financial anomalies. In RSU theory, well-governed boards exhibit rationality by exploiting the information they have to maximize profits but are unaware that they are missing critical information regarding the capabilities of the external candidates.[7] As a result of a lack of information, mistaken decisions to hire externally occur, even though as previously discussed these boards expect their decision to maximize profits. To understand what boards' expectations would have been had they had complete information (i.e., full statistical information such as we present), we compute the ex ante expected net benefit of boards' hiring decisions. Results show that *if* the boards that hired externally had had complete information they would have expected a loss by hiring externally 86.2% of the time, which correlates with the loss subsequently realized.

The "rational structural uncertainty" theory has predictions for boards in situations in which they would have greater opportunity to learn candidates' weaknesses and fit to the firm. These boards' expected net benefit (and realized gain), as computed from full statistical information, should increase as the opportunity to learn increases. Consider boards who hire externally from within the same four-digit standard industry classification (SIC) code industry. These boards are likely to have personally observed the selected candidate, perhaps while negotiating with suppliers. We find the expected and realized loss for these boards' hiring

[7] Fernandez-Araoz (2007) (pages 56-83) provides a list of the challenges faced in assessing the capabilities and fit of external candidates for top executive positions. For instance, senior executives "have very little tolerance for any … kind of thorough evaluation." The capabilities required of CEOs are described in the remainder of his book.

decisions is significantly reduced by comparison to the average for all boards that hire externally. Next, more definitive knowledge of an external candidate's weaknesses would be known by a director who sits on the boards of the hiring firm and the selected candidate's prior firm. We find that these boards expect and realize no loss or gain when hiring externally. Finally, boards that externally hire an executive and then promote to CEO after a few years of observation are likely to know both weaknesses and fit of the candidate; these boards expect and realize a gain (*p*-value < 0.001). Thus, our results conform to predictions consistent with the "rational structural uncertainty" theory of financial anomalies.

Overall, in the time period of our study, we find that boards do not maximize total profits on average by hiring externally (but do when hiring internally). All of our results consistently suggest that boards attend to their fiduciary duty to maximize profits in their hiring decisions. However, boards mistakenly hire externally and realize a loss because they *unknowingly* lack critical knowledge of external candidates' weaknesses and fit to the firm. These mistakes increase labor market demand for CEOs and thus their bargaining power over boards. To quantify the impact, consider that boards hired externally approximately 25% of the time after 1980. Our results suggest that if the board that hired externally had had full statistical information the external hiring rate would have been 3.5%, not 25%. Thus, labor market demand for CEOs was approximately 614% greater than it would have been. As a result, CEOs gained excessive bargaining power over boards. When agents (CEOs) gain excess bargaining power, it is well known that the moral hazard leads to agency problems (Jensen and Meckling (1976)). Thus, our results raise the question of whether the increase in mistaken decisions to hire externally since 1980 has driven the increase in agency problems, excessive risk taking, and regulation since then. Further, all of the major profit-maximizing theories used to explain the

cross-sectional distribution of and the rise in U.S. CEO pay assume rational expectations, directly implying a realized gain, on average, when hiring externally; our results do not support this assumption.[8] Therefore, we find no profit-based explanation for the increase in top executive pay since 1980; we estimate the cost to shareholders at $1.16 trillion in 2005.[9]

The paper proceeds as follows: Section 1 discusses theories of CEO selection. Section 2 discusses the data. Section 3 replicates HMP2004 and provides summary statistics. Section 4 explains our methods. Results for realized gains are given in Section 5, while Section 6 provides tests of theories that potentially explain the average loss realized by selecting externally hired CEOs. Section 7 discusses the financial impact of hiring externally and provides an explanation for trends in governance and CEO pay since 1936. Section 8 concludes.

1. CEO Selection Type and Profit Theory

This section begins by providing a detailed description of the theory of Lucas and Prescott (1974), as it underlies the assumption that boards hire from the profit-maximizing source (inside or outside). Their theory assumes rational expectations, which means (see Brav and Heaton (2002)) that boards essentially have complete knowledge of the fundamental variables (i.e., complete structural information) affecting candidate performance, and they use this knowledge to make optimal statistical decisions that maximize profits (i.e., boards are completely rational).

[8] Frydman and Saks (2010) state that the major theories are based on firm size (Lucas (1978), Rosen (1981), Rosen (1982), Tervio (2008), Gabaix and Landier (2008)), increased risk (Cunat and Guadalupe (2009)), and executives' general skills (Murphy and Zabojnik (2004)). More recently, Edmans and Gabaix (2010) as well as Gayle and Miller (2009) assume rational expectations for labor market demand and additionally suggest that boards have increased CEO pay since 1980 to address moral hazard problems. Our results suggest instead that rational expectations do not hold when hiring externally. Further, based on Jensen and Meckling (1976), our results raise the possibility that the increase in moral hazard problems is largely driven by boards' mistaken decisions to hire externally, giving CEOs excessive bargaining power over owners. Finally, since we are able to replicate HMP2004, our conclusions likely extend back to the 1970s. Specifically, in Sections 3.2 and 5.3 we show the assumption of a realized gain, on average, due to hiring externally is likely not realized where our sample overlaps the sample in HMP2004.

[9] The $1.16 trillion loss is estimated assuming that CEOs' pay increase is driven by profit-maximizing labor market demand and the need for incentives to limit the effects of moral hazard. It is possible that the estimate could change after a theory is developed that accounts for additional economic factors not rigorously pursued previously.

We then discuss alternative theories of the relationship between CEO selection and profit; these theories modify the rational expectations assumption.

1.1 Profit Maximization when Completely Rational Boards Have Complete Structural Information

Applied to CEO selection, the theory of Lucas and Prescott (1974) assumes: a) boards have a depth of experience in their environment, so their expectations are based upon the true probability distribution of expected performance (i.e., complete structural information), b) these probabilities are stable with time, c) boards' knowledge is equally precise for internal and external candidates, and d) boards rationally maximize profits. Applying Lucas and Prescott's theory to CEOs leads to our prediction that boards expect the type of candidate selected to deliver greater total profits than the passed-over candidate type and to our null hypotheses (one for each candidate type) that this expectation is realized, on average, all else equal.

This prediction from the theory of Lucas and Prescott (1974) is used in all models of CEO compensation that assume boards hire from the source that is expected to maximize profits. See, for instance, models of CEO compensation in Gayle and Miller (2009), Edmans, Gabaix and Landier (2009), Gabaix and Landier (2008), and Rosen (1982).[10] We next discuss alternative theories based on modifications of the assumptions used in Lucas and Prescott.

1.2 Profit Maximization When Boards Have Complete but Imprecise Information

Hermalin (2005) assumes that boards are completely rational and have complete structural knowledge, but they estimate the ability of external hires with less precision than that of internal

[10] Boards' expectations for greater profits from the selected candidate type than the passed-over type is also used to provide a rational interpretation of empirical facts such as the widespread use of peer groups to establish a CEO's compensation (see Bizjak, Lemmon and Naveen (2008)).

hires. Specifically, the theory assumes that external hires provide a greater probability of superior performance than internal candidates. In this theory, boards that have a lower monitoring cost (i.e., independent boards, those with a lower percentage of inside directors) can identify the true ability of CEOs soon after hiring them and so dismiss low-ability CEOs at a low cost. Due to an assumed greater probability of superior performance by external hires, these boards quickly (by trial and error) obtain an externally hired CEO that is superior to the best internal candidate while largely escaping the downside risk (thorough dismissals). In essence, boards can more quickly obtain an option value by hiring externally than they can by hiring internally. Due to the low performance of the dismissed candidates, the theory predicts a realized loss (relative to hiring internally), on average, due to hiring externally for boards with the lowest monitoring cost, although they eventually end up with a superior CEO.

1.3 Profits When Boards Have Complete Structural Information but Do Not Act Rationally

Boards that have complete structural information may not maximize firm profits if there are agency issues (i.e., boards may not be completely rational). Thus, contrary to predictions based on rational expectations, agency theory predicts suboptimal profits if weakly governed boards knowingly hire suboptimal candidates. These suboptimal hiring decisions could, for instance, occur due to pressure from the media or unexpected new regulations. Agency theory predicts that boards with the weakest governance (based on a long line of literature, weak governance is associated with a large board size and high percentage of inside directors) realize the smallest gain.[11] Therefore, if governance is systematically less effective in boards of a particular hiring type, the gain realized by hiring that type would be less than the gain obtained by boards of the

[11] Yermack (1996) provides evidence that due to agency issues, small boards effectively manage firms to create more wealth for shareholders than large boards. The agency issues addressed by independent boards are discussed by authors such as Hermalin (2005) as well as Linck, Netter and Yang (2009).

opposite hiring type; in the extreme, a loss would be realized by weak boards.

Following Brav and Heaton (2002), we classify the agency issues as a "behavioral" explanations for anomalous profits. In their classification, anomalous profits (i.e., profits inconsistent with rational expectations) occur for behavioral reasons when boards have complete structural information but fail to rationally process the information to maximize firms' profits.

1.4 Profits When Rational Boards Lack Complete Structural Information

The "rational structural uncertainty" theory of Brav and Heaton (2002) provides a second explanation for anomalous profits due to boards' hiring source. This theory 1) maintains the assumption that boards completely and rationally process available information to maximize profits, but 2) relaxes the assumption that boards have complete knowledge of the fundamental variables affecting candidate performance. The first assumption holds if boards are well governed, as perfect governance results in complete rationality. The second assumption means that well governed boards are not aware that they do not know critical information.[12] Thus, their decisions, though optimal given incomplete fundamental information, result in mistakes that produce anomalous profits. Applied to our case, this fundamental information would more likely be missing for external candidates. Boards usually rely on search firms for information on these candidates and limited short interviews (by comparison to the years spent evaluating internal candidates). Further, Fernandez-Araoz (2007) (page 241) points out that most search firms have an economic incentive to downplay knowledge of external candidates' weaknesses. In this situation, boards could be unaware that they lack relevant knowledge (of external candidates' weaknesses or fit to the firm). Mistaken decisions to hire externally then occur, which generate a

[12] If completely rational boards knew there was critical information missing (i.e., an information asymmetry) in their assessment of external candidates relative to internal candidates, they would again have complete structural information. According to the theory of information asymmetry, there would then be a discount in pay for outside hires; however, Murphy and Zabojnik (2007) show that externally hired CEOs command a pay premium.

financial anomaly (i.e., profits that are less than would be obtained by hiring internally). In this case, our predictions from the "rational structural uncertainty" theory are a) if well governed boards in our sample had been given complete structural information (i.e., full statistical information), they would have expected a loss when hiring externally, and b) if boards are in a position to naturally obtain the complete structural information needed to make value-maximizing decisions, they can expect a gain and then will subsequently realize the gain, on average, whether they hire internally or externally.

2. Data

Stock market data is obtained from the University of Chicago's Center for Research in Security Prices (CRSP). Accounting data is obtained from Compustat. Firms are identified by Compustat's "gvkey" variable. Governance variables and board characteristics are obtained from Compact Disclosure.

The CEO dataset covers all U.S. public firms from 1986 through 2005. The database is created by merging CEO information from the Forbes 800 annual list of CEOs, Compact Disclosure, and ExecuComp. In the process of merging these databases and tracking CEOs through time, CEOs are identified by their last name, first name, middle name, surname, and age. As part of this process, we account for common misspellings of names and the many ways that each database spells each CEO's name. More than 10,000 name variants were hand checked. These procedures enable tracking of all public firm CEOs over the 1986 to 2005 period, from the first time they are listed as an officer to the last time they appear in the dataset as an officer.

Two types of CEO appointments are identified: inside and outside hires. Inside hires are defined as CEOs who were an officer of the hiring firm in the year prior to their appointment; in addition, once promoted to CEO they have officer responsibilities only at one firm. Outside hires

are CEOs who a) have no history as an officer at the hiring firm, b) have a prior history as an officer at another public firm, and c) after their first two years as CEO have officer responsibilities at only one firm.[13],[14]

Panel A of Table 1 shows descriptive statistics for Forbes 800-size firms, which are defined as having total assets greater than $350 million (in 2005 dollars) in the year prior to the CEO's appointment. The analysis primarily focuses on these large firms to ensure that results are driven by economically important companies. This subset has 2,338 internally promoted CEOs at 1,660 firms and 559 outside hire CEOs at 496 firms. Panel B shows descriptive statistics for S&P 500-size firms. These firms have total assets greater than $1 billion in the year prior to the CEO's appointment ($1 billion is approximately the first percentile of total asset value for S&P 500 firms in our sample period).

Insert Table 1 here.

3. Replication of Prior Research and Summary Statistics

3.1 Replication

In this section we replicate the results found for external hires in HMP2004. The tests use our data for CEO appointments from 1986 to 1994 because this overlaps their sample period (1971 to 1994). Forbes 800-size firms are used to emulate HMP2004's use of Forbes 800 firms. In the first column of Table 2, Panels A and B show the univariate tests results using their measure of

[13] Our procedures for identifying inside and outside CEO hires are similar to Cremers and Grinstein (2009). Like them, we use Compustat's "gvkey" to identify firms. However, they use proxy statements to determine a CEO's employment history and thus whether the CEO came from within or outside the firm. Because our database covers all public firms and begins in 1986, which is before proxies are downloadable (1992), we use a CEO's employment history, as given in the Forbes 800 dataset, Compact Disclosure, and ExecuComp, to determine a CEO's employment history prior to being appointed CEO.

[14] Our method of identifying external hires excludes those from non-public firms. Thus, our sample focuses on the external hires that increase labor market demand for CEOs at public firms (public firms that externally hire from non-public firms reduce demand for CEOs from other public firms). The sample also satisfies the data requirement for all our tests, therefore keeping our sample consistent across tests.

change in operating income return on assets (OROA) from one year before (-1) appointment to three full years after appointment (+3):

$$\text{OROA}(-1,+3) = \text{OROA}_{\text{third full year after appointment}} - \text{OROA}_{\text{one year before appointment}} \quad (1)$$

where OROA equals operating income divided by average total assets. Just like HMP2004, the results show that external hires significantly outperform inside hires in the 1986 to 1994 period. The difference in average OROA(-1,+3) is 0.0135 (p-value<0.05); the difference in median OROA(-1,+3) is even greater. In unreported regression results, OROA(-1,+3) is modeled as a function of an outside hire indicator variable and the determinants of performance discussed in Section 4.3. Like HMP2004, we find the outside hire indicator variable is positive but not significant. Thus, our conclusions are the same as HMP2004 using data that overlaps their sample period, measures, and methods. However, in the remainder of Section 3 and in Section 5, we show that HMP2005's conclusions are reversed after accounting for econometric, sampling, and measurement issues.

Insert Table 2 here.

3.2 Summary Statistics

We first define our primary measure of total financial performance. To begin, we use cash flow as given by Kaplan and Zingales (1997). Then cash flows are scaled by total assets to enable a) cross-sectional comparison of firm performance and b) estimation of the CEO's ability to efficiently use all assets. Therefore, cash flow return on assets is:

$$\text{CFROA}_t = (\text{NI}_t + \text{amortization and depreciation}_t) / \text{average total assets}_t \quad (2)$$

where NI is income before extraordinary items (Compustat variable data18), amortization and depreciation is data14, and average total $assets_t$ = (Total $assets_t$ + Total $asets_{t-1}$) / 2; total assets is data6. To remove firm fixed effects and capture all years of tenure, we compute CFperf (the change in CFROA since the year prior to appointment):

$$\text{CFperf} = \text{Average(industry adjusted CFROA)}_{\text{over a CEO's tenure}} - \text{industry adjusted CFROA}_{\text{year prior to appointment}} \quad (3)$$

Industry adjustment is used to remove year and industry fixed effects. Thus, equation (3) gives our primary measure of a CEO's total financial performance.

The second column of Table 2 shows that externally hired CEOs provide significantly less (p-value < 0.05) cash flow performance (CFperf) than inside hires. If we redo our replication of HMP2004 using CFROA(-1,+3), the univariate analysis shows no significant difference between the performances of inside and outside hires, while the regression analysis shows that externally hired CEOs significantly underperform insiders.

The remaining columns of Table 2 reveal a strong pattern in the year *before* hire. Almost all characteristics of the firms hiring externally differ significantly (p-value < 0.01) from inside hire firms. These results (and unreported results for S&P 500-size firms) are consistent with having structural differences between firms that hire inside versus outside, which results in self-selection by boards. However, these results are only suggestive, so we now proceed to discuss methods appropriate for analyzing theories of CEO selection involving self-selection and structural differences.

4. Methods for Estimating the Realized Gain and Expected Benefit Due to Promoting Internally Versus Hiring Externally

To test the predictions from the theories discussed in Section 1, we require a method to estimate the expected performance of the counterfactual / passed-over inside or outside candidate. With this estimate, we can calculate 1) whether the board's choice is profit maximizing ex ante by determining whether the expected profits from the chosen inside (outside) hire exceeds the expected profit from the not-chosen outside (inside) candidate, and 2) whether the choice is profit maximizing ex post, or whether the realized profit from the choice exceeds the expected profit from the alternate choice not taken. The result of the first calculation is called the expected net benefit of one hiring source over another; the second is called the realized gain.

Two primary methodological issues must be addressed. The first issue is raised by both the sample statistics just discussed and the theories of Section 1. The theories assume that boards do not randomly select candidates from inside or outside of the firm. Instead, boards select the candidate from the source that is expected to maximize future profits. Therefore, the method chosen must account for the endogeneity of the selection decisions when estimating expected net benefits and realized gains; otherwise, causality cannot be established.

The second issue occurs when computing the expected net benefit and the realized gain. The computations require the performance that would have been obtained by hiring from the source not selected. The issue is that we cannot roll back time and observe the counterfactual performance that would have been obtained by hiring the alternative type (inside or outside) of candidate. Because this counterfactual performance is unobservable, special assumptions are required to estimate it.

One of two special assumptions is commonly made. Following Lee (1978) and Heckman (1979), one can assume that unobservable variables influencing boards' selection decisions can be accounted for by the inverse Mills ratio. In this case, the method of structural self-selection

modeling is appropriate for testing our hypotheses. We prefer this method because the theories of CEO selection admit the possibility that private (i.e., unobservable) information affects boards' selection decisions. Alternatively, one can assume that boards' selection decisions are random and so not influenced by private information, conditional on observable pre-decision variables (i.e., unconfounded). This assumption could violate the very theories we test unless it can be shown that boards are likely not using private information to make selection decisions. Therefore, methods based on the "unconfounded" assumption (primarily the matching estimator of Abadie and Imbens (2006) but also propensity score matching) are used in robustness tests when we find the "unconfounded" assumption is likely true.

4.1 Structural Self-Selection Model

Li and Prabhala (2007) provide an overview of self-selection models applied to corporate finance. Citing a line of literature (see, for instance, Campa and Kedia (2002)), they suggest that these models incorporate and control for unobservable private information that influences corporate decisions, such as the decision to hire internally or externally. Further, these models allow both endogeneous and exogenous variables to influence self-selection. Finally, the models allow for differences in the ability of the self-selected type (inside or outside hire) to manage firms by specifying separate outcomes for firms by hiring type.

We follow the notation of Li and Prabhala (2007) in defining our structural self-selection model. The complete model is as follows:

$$C = OH \equiv W_i = Z_i\gamma + \delta(P_{OH,i} - P_{IH,i}) + \eta_i > 0 \quad (4)$$

$$C = IH \equiv W_i = Z_i\gamma + \delta(P_{OH,i} - P_{IH,i}) + \eta_i \leq 0 \quad (5)$$

$$P_{OH,i} = X_{OH,i}\beta_{OH} + \varepsilon_{OH,i} \quad (6)$$

$$P_{IH,i} = X_{IH,i}\beta_{IH} + \varepsilon_{IH,i} \quad (7)$$

where C is an element of (OH, IH), OH is 1 if the firm hires externally, IH = 0 if the firm hires internally, and P stands for profits for CEO i.

The selection model given in (4) and (5) incorporates the expected outcome gain $\delta(P_{OH,i} - P_{IH,i})$ in the selection decision. The selection model also allows for the exogenous variables, Z, to enter the selection decision. These exogenous variables affect the selection decision but are uncorrelated to profits. Equations (6) and (7) are the separate outcome equations for firms that hire externally and internally. These two equations cannot be estimated directly by ordinary least squares (OLS) because self-selection can cause $\varepsilon_{OH,i}$ and $\varepsilon_{IH,i}$ to be correlated with η_i. Further, the net outcome gain in the selection model cannot be directly estimated, because we cannot observe what profits would have been if the alternate type of candidate had been chosen (time cannot be rolled backward).

Lee (1978) derives a consistent estimate of the parameters for structural self-selection models assuming that the errors $\{\varepsilon_{OH,i}, \varepsilon_{IH,i}, \eta_i\}$ are trivariate normal. The approach requires two steps. First, equations (6) and (7) are substituted into the selection equation to obtain a reduced form choice equation:[15]

$$W_i = Z_i\gamma + X_i\xi + \eta_i^* \quad . \quad (8)$$

Consistent parameters for this equation are estimated using probit analysis. In the second step, consistent estimates of the parameters in the outcome equations are obtained by OLS with a

[15] A key step to obtaining the reduced form is to set $X_i=X_{OH,I}=X_{IH,I}$, as boards are assumed to have X_i information regardless of hiring type. All of the mathematical steps are given in Lee (1976).

variable (the inverse Mills ratio) added to each regression to adjust for the potential correlation between $\varepsilon_{OH,i}$, $\varepsilon_{IH,i}$, and η_i. The equations for expected performance follow (for further details, see Madalla (1983) and Lee (1978)):

$$E(P_{OH,i}) = X_{OH,i}\beta_{OH} + \pi_{OH}\lambda_{OH}(.) \quad (9)$$

$$E(P_{IH,i}) = X_{IH,i}\beta_{IH} + \pi_{IH}\lambda_{IH}(.) \quad (10)$$

where

$$\lambda_{OH}(.) = \frac{\phi(Z_i\gamma + X_{OH,i}\xi)}{\Phi(Z_i\gamma + X_{OH,i}\xi)}, \text{ and } \lambda_{IH}(.) = \frac{-\phi(Z_i\gamma + X_{IH,i}\xi)}{1-\Phi(Z_i\gamma + X_{IH,i}\xi)}.$$

The cumulative distribution of the standard normal function is denoted by Φ; the standard normal density function is denoted by ϕ.

We can now estimate the realized gain and the expected net benefit for each hiring choice. For firms that hire externally:

$$\text{Realized gain}_{OH,i} = P_{OH,i} - E(P_{IH,i}) \quad (11)$$

$$\text{Expected net benefit}_{OH,i} = E(P_{OH,i}) - E(P_{IH,i}) \quad . \quad (12)$$

Equation (11) is the difference in profits between externally hiring a CEO and the expected profits that would have been obtained by hiring internally. Equation (12) is the difference in expected profits from hiring externally versus internally. For firms that hire internally:

$$\text{Realized gain}_{IH,i} = P_{IH,i} - E(P_{OH,i}) \quad (13)$$

$$\text{Expected net benefit}_{IH,i} = E(P_{IH,i}) - E(P_{OH,i}) \quad . \quad (14)$$

4.2 Truncation Bias, Fixed Effects, and Remaining Endogeneity Concerns

Truncation bias could occur if inside and outside hires have differing tenures and could also occur due to the database coverage. We address this issue by averaging each industry-adjusted profit measure (the primary measure used is cash flow) over all years of a CEO's tenure. To remove time-invariant firm fixed effects, we use the "difference of differences" approach. To implement the approach, the profit measure, P, is computed as the average industry-adjusted profit for a CEO over his tenure minus the industry-adjusted profit in the year before he was hired (for example, see equation 3). This difference is used in the computation of expected net benefit and realized gain to give a difference of the differences. The same difference measure of industry-adjusted profits is used when matching techniques are employed in robustness tests, which again gives a difference of differences. Finally, to address remaining endogeneity concerns, we follow Wintokia, Linck and Netter (2008) and lag all independent variables (excluding the private information variables).

4.3 Specification of Independent Variables in the Structural Self-Selection Model

To estimate the structural self-selection model, the variables determining selection (Z and X) and the variables determining outcomes (X) must be specified and make sense economically. Li and Prabhala (2007) as well as Abadie and Imbens (2006) emphasize the importance of identifying these variables to establish causality. Therefore, we examine research on the determinant of profits and CEO selection choice to choose the independent variables. Ideally we would begin with an economic theory that would guide our selection of variables. However, Larcker, Richardson and Tuna (2007) point out that no such theory exists for profits and we find no theory that explains CEO selection; thus we rely on an extensive review of the literature to aid in the selection of the variables.

To select the variables (X) that determine total profits, we start with the Barber and Lyon (1996) model of expected operating performance, a component of total profits. Their model includes lagged performance, firm size, and industry, so we account for these variables. Opler and Titman (1994) also model operating performance. We follow their use of industry-adjusted values of the variables to account for year and industry fixed effects. Wintokia, Linck and Netter (2008) provide a model of total profits (net income / total assets). Their variables include firm size, market-to-book (to proxy for growth opportunities), the standard deviation of stock returns over the prior year (to proxy for risk), firm age (to proxy for intangibles such as bench strength and goodwill), and financial leverage. Based on insight from Hermalin and Weisbach (1998), Wintokia, Linck and Netter (2008) show that when enough performance lags are included as independent variables, governance variables (board size and percentage of inside directors) become insignificant; that is, governance variables are endogenously determined and become insignificant. Therefore, our performance model includes as independent variables both the lagged year value of performance and the average value of performance over the three years prior to hire. The lagged performance variables account for the effect of governance on performance.[16] Finally, capital investment, research and development, advertising, pricing power, and total asset turnover (to measure managerial efficiency) are included to capture the broad areas that accounting usually finds significant.

The selection equation includes all of the just-mentioned determinants of performance. In addition, we include variables (Z) that affect selection but not our industry-adjusted performance measures. The first two variables are a) year dummies to capture the increased focus on corporate governance over time (Hermalin (2005)) and b) industry dummies since it has been

[16] On the other hand, Larcker, Richardson and Tuna (2007) focus on the effect of governance variables on future stock return and operating income, so they do not include lagged performance as an independent variable.

shown that various industries have differing propensities to hire externally (Cremers and Grinstein (2009) and Parrino (1997)). Since our performance measure is detrended by year and industry, by construction these two selection variables are not correlated to performance. For robustness, we capture time and industry trends with the lagged five year percentage of externally hired CEOs a) over all industries and b) within the hiring firm's industry. This provides an economic interpretation of the time and industry dummies, but cuts the sample period by 25%. Next, for reasons described above, the governance variables we have chosen are not correlated to subsequent performance. Hiring source selection, however, has been show to be influenced by governance variables. Specifically, the percentage of inside directors influences the selection source, since this determines whether insiders control the board (Weisbach (1988)), and the number of directors influences selection by capturing board efficiency (Yermack (1996)). Finally, we include two variables likely to predict a forced turnover: e) the Denis and Kruse (2000) measure of the change in operating income return on assets prior to hiring the CEO, and f) the Coughlan and Schmidt (1985) measure of excess return over the value-weighted market.[17] Arguably, all of the selection variables except the ones related to time and industry trends could influence performance. Therefore, for robustness our main results are rerun using all of the selection variables, except time and industry trend variables, as determinants of performance.

4.4 Matching Methods Used for Robustness Checks and Analysis of Risk

As previously mentioned, for robustness we use the matching estimator method of Abadie and Imbens (2006) as well as the propensity score matching method. For a detailed description of the propensity score matching method, see Villalonga (2004); for a precise technical discussion of

[17] We control for forced turnover in the selection model but not the performance model, as HMP2004 (page 268) show no significant relationship between forced turnover and subsequent operating performance.

the matching estimator method, see Colak and Whited (2007). The advantage of these matching methods is that they make no parametric assumptions about the distributions of the variables and can be used to analyze both level and variability (i.e., risk) of performance. However, there are two disadvantages. First, these approaches cannot ascertain whether hiring from a given source causes a realized gain unless it can be shown that the hiring decision is unconfounded (i.e., private information is not significant). Second, these matching methods do not allow estimation of expected net benefits, which is required to test predictions from Brav and Heaton (2002). For the above reasons, we use matching methods only when a) we can show that the hiring decision is likely "unconfounded" and b) for risk analysis.

5. Results: Realized Gain by Hiring Type

This section estimates the gain realized by boards that choose to hire externally versus promote internally. To begin, results from the probit model used in estimating the structural self-selection model are discussed. This is followed by results from the structural model. The models are then used to find the realized gain by hiring type. The section concludes with robustness tests involving alternative financial performance measures, model specifications, and matching methods. The matching methods are also used to analyze for excessive risk taking.

5.1 Probit Sample Selection Model

Probit analysis in Table 3 shows the determinants (previously discussed in Section 4.3) of a board's choice for appointing a new CEO: promote from within the firm or hire externally.[18] All variables (excluding the year and industry fixed effects) are measured in the year prior to hire to avoid possible endogeneity concerns. The results show that three independent variables

[18] Throughout the analysis, all years and industries that have only one type of hire (internal or external) are grouped into one fixed effect.

determining performance (firm age, the standard deviation of stock returns, and advertising) significantly determine the selection choice. Older firms hire internally, possibly due to greater depth of talent from more established procedures to train executives. Firms with more variable stock returns tend to hire externally, perhaps to address risk issues or in response to greater external pressure. Also, more advertising is associated with more external hiring. As expected from prior research, the selection model also shows that external hiring is associated with 1) a decline in operating performance, 2) negative excess return over the market return, 3) a lower percentage of board seats held by officers of the firm (i.e., more independent boards), 4) smaller boards (i.e., boards with greater control over the firm), 5) year (there is an increase over time; data available upon request), and 6) some industries. Overall, the model has high explanatory power; 71 percent of the selection choices are classified correctly.

Insert Table 3 here.

5.2 Structural Self-Selection Model Estimates

Table 4 presents the estimates from applying the structural self-selection model to Forbes 800-size firms and S&P 500-size firms. The sign and significance of variables for inside hires are consistent with prior research results. A comparison of the signs and significance of coefficients for inside and outside hires shows differences in how the two types of CEOs manage assets. Generally, few of the performance determinants are significant for outside-hire CEOs, whereas most are significant for inside-hire CEOs. Further, many of the signs on the variables are different for outside and inside hires. These results suggest that inside- and outside-hire CEOs manage assets differently.

The influence of boards' private information on firm performance is captured by the inverse Mills ratio, which also accounts for bias due to self-selection. The inverse Mills ratio is

not significant for Forbes 800-size firms; however, it is significant for S&P 500-size firms that hire externally. The results suggest that private information influences boards of S&P 500-size firms, thereby improving their selection of externally hired CEOs.

Insert Table 4 here.

5.3 Realized Gain by Hiring Type for Forbes 800-Size and S&P 500-Size Firms

Table 5 reports the average gain realized by hiring externally or internally using equations (11) and (13). Estimation of these equations uses the structural self-selection models results shown in Table 4. As predicted by the theory of Lucas and Prescott, boards of both Forbes 800-size and S&P 500-size firms that hire internally realize a significant gain (p-value < 0.001) in average cash flow performance relative to the performance that would have been obtained by hiring externally. The results are also economically significant. For example, the average realized gain for S&P 500-size firms is 0.65 percentage points in cash flow performance. By comparison, aggregate cash flow return on assets (defined in equation 2 and aggregated by total asset weighting) for S&P 500 firms in our time period is 5.2%. Thus, the gain realized by hiring internally is more than 12.5% of aggregate cash flow return on assets for S&P 500 firms.

However, our results for externally hired CEOs do not support the theory of Lucas and Prescott. The data *rejects* (p-value < 0.001) the hypothesis that boards realize a gain, on average, by hiring externally for both Forbes 800-size firms and S&P 500-size firms. For large S&P 500-size firms, the average realized loss is 1.32 percentage points, which is more that 25% of the aggregate cash flow return on assets for S&P 500 firms.

Insert Table 5 here.

To understand whether a realized loss due to hiring externally is pervasive, Table 6 shows results using subsamples. First, we investigate whether the loss has significantly decreased

over our sample period due to improvements in governance; see, for instance, evidence of improvement in Hermalin (2005) or Linck, Netter and Yang (2009). Subsamples 1 to 4 show no significant change in the loss realized by hiring externally in the 1986 to 1995 period as compared to the later 1996 to 2005 period. This is not to say that intense efforts to improve governance at S&P 500 firms are without effect. S&P 500-size firms that hire internally have enjoyed a significant (p-value < 0.001) increase in the gain they realize over the time period of our study. The fifth subsample excludes the first year of a CEO's tenure. This first year can be affected by bath taking (Pourciau (1993)) and could drive the loss realized by hiring externally. However, the outside hires' realized loss is nearly the same (1.58 percentage point loss) as it is (2.00 percentage point loss) when first-year performance is included.[19] Inside hires' realized gain is also virtually the same. The sixth sample examines cash-flow performance in just the first year of tenure. Row 6 shows that performance differences between inside and outside hires are magnified in the first year of tenure. External hires' larger loss in their first year hints they spend time learning the job (ramping up), whereas internal hires are ready to execute well prepared plans. A final concern is that interim CEOs, who by our definition have only one-year tenure, could be driving the results. The seventh sample presents results without the interim CEOs. Excluding these CEOs from the sample has virtually no effect on the loss realized by hiring externally. Overall, the subsample results suggest that the loss realized by hiring externally and the gain realized by hiring internally are pervasive.

Insert Table 6 here.

[19] The realized losses (1.58 and 2.00) are not significantly different.

5.4 Robustness to Alternative Performance Measures, Exclusion Variables, and Model Specification

Panel A of Table 7 shows the robustness of our result to alternative financial performance measures on Forbes 800-size firms. The first row of the table shows realized gain using industry-adjusted operating income return on assets. As was previously mentioned, operating income excludes many items over which a CEO has discretion, so using it may not capture the full impact of the hiring choice. In line with this reasoning, the average realized loss by outside hires and the realized gain by inside hires, though significant (p-value < 0.001), are about half the magnitude found when using the cash flow total financial performance measure (see Table 5). The second, and total, financial performance measure is industry-adjusted net income return on assets. The results using this measure are shown in row 2. Again, each realized gain (or loss) shown is not different from what is seen in Table 5 for Forbes 800-size firms.

Insert Table 7 here.

Panel B Table 7 first considers alternative exclusion variables in the structural self-selection model specification. First, we exclude only the time and industry fixed effects because, as was mentioned previously, they are by construction (the performance measure is detrended by the industry median performance each year) not correlated to the performance measure. Row 3 shows the results of rerunning the model using time and industry fixed effects as the only variables in the probit model that are excluded from the outcome equations. The results are not significantly different from the results shown in Table 5 for Forbes 800 size firms. To provide economic understanding to the exclusion of time and industry dummies we next replace them with two variables measured in the year prior to hire: 1) the trailing five year percentage of outside hires among all public firms (to account for time trends in external hiring) and 2) the

trailing five year percentage of outside hires within the hiring firm's industry. These two variables capture time and industry trends without causing changes in the firm's detrended future performance. Row 4 again shows that the results are not significantly different from the results shown in Table 5 for Forbes 800 size firms. Thus we find no evidence that the exclusion variables used in any specification of our structural self-selection model are significantly correlated to future performance (i.e., outcomes).

Row 6 of Panel B in Table 7 investigates a structural self-selection model that uses an expanded selection model. In addition to the selection variables shown in Table 3, the expanded model includes a) the Shumway (2001) bankruptcy predictor variable and b) two additional forced turnover predictor variables based on the algorithm of HMP2004. The performance determinants remain the same as those shown in Table 4. Row 6 shows that the results are nearly identical in magnitude to, and are not statistically different from, the results shown for Forbes 800-size firms in Table 5. These findings suggest that our results are robust to the measure of financial performance, the model of structural performance used, and the selection model specification. To confirm this conclusion (and analyze risk), we use matching techniques that make few parametric assumptions about model form or variable distributions.

5.5 Matching Method Verification of Realized Gains and Analysis of Risk

As previously mentioned (Section 4.4), propensity score matching methods and the matching estimator of Abadie and Imbens (2006) are appropriate if the assumption (unconfoundedness) underlying these methods applies. The assumption is correct when private information does not significantly influence the selection decision. In other words, the inverse Mills ratio is insignificant. Table 4 shows that the inverse Mills ratio is not significant for Forbes 800-size firms. Therefore, it is likely that we can assume the hiring decision (inside or outside) is

unconfounded for Forbes 800-size firms, conditional on the set of observable pre-decision variables show in Table 3.[20] In short, the assumptions for inference from matching methods apply to Forbes 800-size firms. So we use matching methods to verify the realized gains (losses) previously found for Forbes 800-size firms and, as previously mentioned, analyze risk.

The results in Panel A of Table 8 verify that the realized gains (losses) obtained by using matching methods on Forbes 800-size firms are not meaningfully different from those found using the structural self-selection model in Table 5. Likewise, results are not meaningfully different when we check all realized losses in Tables 5 to 7 using the matching estimator of Abadie and Imbens (2006), whether or not the inverse Mills ratio is significant.

Panel B of Table 8 shows an analysis of risk. Since there is no evidence of bias using either matching method, we use the propensity score method to match inside hires one-to-one with outside-hire CEOs. The results show that a) the variability (risk) of outside hires' realized gains is significantly greater (p-value < 0.05) than what inside candidates would have had, and b) inside hires' performance first order stochastically dominates outside hires'. The results mean that outside-hire CEOs delivered lower performance, on average, with greater risk of inferior performance and no greater chance of superior performance by comparison to what an inside hire would have likely delivered. In short, outside-hire CEOs deliver lower performance while taking excessive risks by comparison to what inside candidates would have delivered.

We conclude that our finding of a realized loss, on average, due to hiring externally is robust to a) using either parametric or non-parametric estimation methods, b) time period, c) exclusion of first-year performance and interim CEOs, d) the measure of financial performance, e) reasonable changes to the specification of the structural self-selection model, and f)

[20] The significant inverse Mills ratios in Tables 4 to 7 indicate that the unconfounded assumption is not always satisfied for other samples, such as S&P 500-size firms.

adjustment for risk. We proceed to test theories that might explain a realized loss by boards that hire externally.

Insert Table 8 here.

6. Tests of Theories that Could Explain a Realized Loss when Hiring Externally

6.1 Hermalin (2005)'s Profit Maximizing Option Theory

Hermalin (2005) assumes outside hires have more variable performance and that independent boards have a lower cost to monitor, which leads to the prediction (see Section 1.2) that the most independent boards (low percentage of inside directors) experience the largest realized loss, on average. This prediction applies over time and in cross section. Hermalin observes (among others) that there has been a significant increase in board independence since the mid 1980s. Thus, Hermalin's option theory predicts that the realized loss due to hiring externally should be larger in the later half of our sample. However, recall that Table 6 in rows 1 to 4 shows that from the earlier to later half of our sample period there is no significant change in the loss realized due to hiring externally. The cross-sectional prediction is that the realized loss should be greatest for boards with the lowest percentage of inside directors. However, Panel A of Table 9 (rows 3 and 4) shows no significant difference in the loss realized by boards in the upper and lower quartile of percent of inside directors. Finally, Hermalin's option theory assumes that outside hires' more variable performance results in a greater probability of superior performance than could be expected from internal candidates, thus making the option value of an external hire greater than an internal hire. However, our results do not support this assumption; inside hires' performance first order stochastically dominates outside hires (See Section 5.5). Therefore, our results do not support the real option theory of external-hire performance. To our knowledge, Hermalin's is the

only theory assuming rational expectations that predicts a realized loss when hiring a CEO externally (the rest predict a gain); thus, we turn to alternative explanations for the loss.

Insert Table 9 here.

6.2 Agency Theory (A Behavioral Explanation)

Tests of agency theory are given in Table 2 as well as in Table 9. For agency theory to explain a realized loss by boards that externally hire, these firms should have weaker governance. Table 2 shows that in fact boards of firms that hire externally are significantly (p-value < 0.01) smaller (i.e., more effective boards) and are significantly (p-value < 0.01) more independent (have a lower percentage of inside directors). Recall that board effectiveness and independence have long been shown to reduce agency problems.

To investigate further, Panel A of Table 9 in rows 1 and 2 investigates the realized loss experienced by firms in the upper quartile of board size versus the lower quartile (among external-hire firms). Rows 3 and 4 similarly investigate realized loss for boards in the upper and lower quartile of independence. Contrary to the prediction of agency theory, among boards that hire externally, the largest boards have significantly smaller losses than small boards have, while the effect of board independence is not significant. On the other hand, for inside hires, more effective and more independent boards have a strong positive effect on realized gains, which is in line with agency predictions.

Panel C addresses the possibility that the above difference in results for inside and outside hires is due to systematic differences in incentive schemes for these boards. Since hand collecting pay data on the 28,557 directors involved is prohibitively expensive, we instead investigate whether there is evidence that boards intentionally hire substandard candidates externally. Panel C shows that these boards hire from firms that have significantly greater cash

flows (typically by 1.0 percentage point; *p*-value < 0.01) and that are significantly larger (typically by $1.2 billion, *p*-value < 0.01). Further, 25.6% of the hires have prior CEO experience. The Panel C results suggest that, if anything, boards' incentive schemes cause them to select what appear to be better external candidates than are available internally. Thus, consistent with prior literature, our evidence uniformly suggests that well-governed boards hire externally expecting to obtain better performance than they could internally (even though we show this expectation is not realized). Overall, our tests suggest that behavioral theories are unlikely to explain the loss realized by hiring externally.

6.3 Theory of Financial Anomalies Where Boards Are Unaware They Lack Critical Knowledge on External Candidates (but Not Internal Candidates)

The "rational structure uncertainty" (RSU) theory of financial anomalies suggests that well governed boards select the hiring source to optimize profits but do not realize their decisions to hire externally are based upon incomplete fundamental information. That external-hire boards are likely well governed, relative to inside-hire boards, was established in the previous section. Therefore, according to the RSU theory of financial anomalies, a realized loss from hiring externally would occur if boards do not know they lack critical information about weakness of external candidates relative to the needs of the firm. On the other hand, boards would have this information about internal candidates due to their exposure to them over time. That boards are unaware they lack critical information on just external candidates would consistently explain all of our prior test results, including the realized loss by external hires, the gain realized by internal

hires, the lack of significant change over our sample period in the loss realized by hiring externally, and that larger boards realize a smaller loss when hiring externally.[21]

Table 10 provides specific tests of the theory of anomalies for Forbes 800-size firms. Given that well-governed boards realize a loss by hiring externally, the theory first predicts that *if* boards had full statistical information, they would *expect* a loss due to hiring externally. Expectations using all statistical information (our full dataset) can be estimated using equations (12) and (14). Row 1 of Panel A shows the results for Forbes 800-size firms. Given full statistical information, boards would expect a *negative* net benefit of 1.95 percentage points (*p*-value < 0.001) in cash flow performance due to hiring externally, compared to the performance that would have been obtained by hiring internally. This expected loss is not statistically different from the realized loss (2.00 percentage points) previously documented in Table 5 for external hires. Further, the results show that boards that hire externally can expect a net benefit only 13.8% of the time.[22] On the other hand, boards that hire internally are likely to have all critical structural information. The results in row 1 show that these boards expect a positive net benefit of 1.44 percentage points (*p*-value < 0.001), given full information. This expected value is not significantly different from the realized gain (1.47 percentage points) for internal hires at Forbes 800-size firms. Further, boards hiring internally can expect a net benefit 84.7% of the

[21] The last point could be explained by the fact that for outside-hire firms, board size is 87.9% correlated (*p*-value <0.001) with the number of directors from outside the firm. These outside directors are more likely than inside directors to have worked with external candidates and so know their weaknesses; thus, as board size increases, external hiring decisions would improve. Explanations for the remaining points are available upon request.

[22] An expected net benefit 13.8% of the time contrasts with the realization of a gain 42.6% of the time, as is shown in row 1 of Table 5. However, our full-information estimation of expectations (13.8%) assumes boards are risk neutral (i.e., desire a 50% chance of a gain) when hiring externally. There is a long literature suggesting that boards expect significantly greater profits when hiring externally, relative to internal candidates, due to the greater risks involved and the need to motivate internal executives; see, for instance, Hermalin (2005), a brief survey of the literature in HMP2004, and Agrawal, Knoeber and Tsoulouhas (2004). So, assume external hire boards desire a 70%, not 50%, chance of a realized gain (i.e., a realized gain 0.53 standard deviations from zero). In this case of minor risk aversion, only 12.3% of boards that hire externally realize their desired gain, not 42.6%.

time. Since we have already seen that external-hire boards are well governed (see the previous section), these results provide strong confirmation of the first prediction of RSU theory.

Insert Table 10 here.

The second prediction of RSU theory is that boards in a position to naturally know the critical information needed to make value-maximizing decisions expect and realize a gain whether they hire internally or externally. The remainder of Table 10 provides tests of this prediction. The first set of tests is shown in Panel A, rows 2 and 3. These tests investigate boards more likely to have personal knowledge of the externally hired CEO prior to hire, due to fortuitous circumstances. This knowledge would provide these boards with more of the critical information that other boards do not realize they lack when hiring externally. In the first of these tests, we consider external hires from the same four-digit SIC code industry. Boards could meet these candidates at suppliers or at trade shows. The size of the average expected net loss due to hiring externally in this situation (1.26 percentage points) is significantly (p-value < 0.05) smaller than the expected net loss for all outside hires shown in row 1 (1.95 percentage points); the same pattern is observed for realized losses (available upon request).

A more refined test of personal knowledge is provided in row 3. In this sample, at least one board member at the hiring firm is on the board of the selected external candidate's prior firm while that candidate was employed there. These boards could have complete knowledge of both the externally hired CEO and internal candidates' abilities before making the hiring decision. In this case, the results show an insignificant net expected loss of only 0.18 percentage points due to hiring externally (the same is observed for realized losses). The role of knowledge is supported, although these boards could still be unaware that they are missing critical

information on the fit of the external candidate to the firm, which would limit the gain obtained by hiring externally. This issue is addressed next.

The final set of test results regarding the second prediction is shown in Panel B. Here we select a sample of externally hired executives whom the board observes for one or more years before promoting them to CEO.[23] Logically, given enough time, the board will obtain complete information on the outside hire and his/her fit to the firm (its culture, personnel, et cetera). The results for these seasoned "hybrid" hires, compared to our standard sample of 559 outside hires (who are at a firm less than one year before being appointed to CEO), are shown in rows 1 and 2 of Panel B. If the hybrid hire is employed for one to two years before being promoted, the expected net benefit is a positive 0.91 percentage points but is not significant compared to the 559 outside hires. If the board has three or more years to observe the hybrid hire, they obtain an expected net benefit of 1.58 percentage points (p-value < 0.001) compared to the 559 outside hires, which is not significantly different from what boards expect by hiring internally. Further, for these hybrid hires, the realized gain is 1.30 percentage points, which is not significantly different from the expected net benefit of 1.58 percentage points. These results consistently support the RSU theory of financial anomalies and are verified by using expected utility theory (see Appendix A).[24]

6.4 Summary of Tests to Explain the Loss Realized by Hiring Externally

Overall, our tests consistently support the "rational structure uncertainty" theory of financial anomalies as an explanation for the loss realized when hiring externally. Alternative theories

[23] In prior tests these executives were classified as inside hires.

[24] Our test results also reject the "winner's curse," as described by Kagel and Levin (1986), as an explanation for the realized loss due to hiring externally. Their theory assumes boards have complete information, which is inconsistent with the tests in this section. Further, if there is a winner's curse, the size of the loss is predicted to be independent of the quality of boards' private information. This prediction is rejected; see Table 10, row 1 versus row 3. Row 1 analyzes boards not likely to have private information, whereas Row 3 analyzes boards likely to have superior private information.

(Hermalin's option theory, agency theory, and winner's curse) are rejected. Further, we find that boards that hire externally select candidates, often CEOs (25.6%), from better firms (larger size and greater cash flows). These facts suggest boards intend to choose superior external candidates without realizing that had they had full information they would have expected a loss. Finally, all of our results consistently suggest that the loss due to hiring externally occurs because responsible boards (i.e., boards with good governance) are unaware they lack critical information about external but not internal candidates.

7. Discussion

7.1 How Could Boards Not Know They Lack Critical Information When Hiring Externally?

Information to answer this question can be found in Fernandez-Araoz (2007) (pages 250-251). He points out that a) several of the largest executive search firms have "deep conflicts of interest" as the search firm's income depends on placing an external candidate, b) search firms without this agency conflict still require exceptional expertise to attain a successful placement of an external candidate (note, however, their measures of success probably do not account for many of the methodological issues identified in this research), and c) seasoned partners often land placement assignments, but the searches are conducted by inexperienced staff. Boards would be unaware of the impact of these issues for three reasons. First, few directors observe the long-term results from hiring externally enough times to develop a complete understanding of what information they can expect to miss. Second, almost all professional and academic reports are based on indirect evidence, which uniformly reinforces the impression that externally hired CEOs are superior to internal candidates. Third, the relevant prior research using direct evidence

attributes the most rigorous results, which are in line with ours, to a low sample size.[25] Finally, Merton (1987) points out that anomalies persist until documented and even then take years to correct; ours is the first to identify this anomaly.

7.2 The Financial Consequences of Decisions to Hire Internally versus Externally

When boards decide to hire externally, there is both a direct and an indirect effect on financial performance. Directly, boards that hire externally realize a loss of approximately 25.4% in cash flows (see Section 5.3) by passing over internal candidates. Indirectly, there are losses due to excess labor market demand. These losses are large compared to what stockholders would have gained assuming boards' expectations for profits by hiring externally had been realized. Recall (see the introduction) that the top five executives' pay has increased from 1.91% of net income in the late 1970s to 9.8% in the early 2000s. If expectations had been realized, this increase would be fully explained by value maximizing labor market demand, but our tests show that hiring externally actually reduces profits, on average, compared to what internal candidates would have delivered. So, none of the increase in top executive pay level is explained by increased profits.[26] Thus, top executives have claimed approximately 7.89% of corporate cash flows and market value (market value equals the present value of future cash flows), or $1.16 trillion in 2005, at shareholders' expense.

A wealth transfer of $1.16 trillion is not the only cost of mistaken decisions to hire externally. Grossman and Hart (1983) and Arrow (1971) suggest that losses can occur due to

[25] HMP2004 (page 263) show inside hires significantly improve average operating performance (p-value <0.10) following forced turnovers while outside hires do not. HMP2004 attribute this aberrant outcome to a low sample size (118 forced turnover events).

[26] We ignore the increase in pay due to increased risk of forced turnover since Peters and Wagner (2009) state that "much of the time-series variation in CEO pay is explained by covariates other than turnover risk." Specifically, using their numbers we calculate that increased risk of forced turnover accounts for 2.96% of the increase in average CEO pay since 1980 if governance is ignored (available upon request). If governance is accounted for, the effect of increased turnover risk on the level of pay over time is not significant (see Peters and Wagner (2009), Table IV, column 9.)

moral hazard. Intuitively at least one *unseen* hazard (so incentives have not been given to boards to mitigate this hazard) has resulted from boards' mistaken belief in the superiority of external hires since 1980. Top executives seek a high profile, thinking the path to their success is easily found by switching firms or threatening to switch. To attract external attention and greater pay, they take imprudent and costly risks (see, for instance, Dow and Raposo (2005)).[27] Now, due to the more than 600% increase in CEO pay since 1980, imprudent risk taking must be largely addressed with incentive pay and regulations. Before 1980, when external hiring was infrequent, imprudent risk taking was mainly tempered by a CEO's personal need for the firm to survive, so imprudent risk taking and all the associated costs to contain imprudent risk taking were either zero or much smaller than today.

7.3 An Explanation for Trends in Corporate Governance and CEO Compensation Since 1934

Frydman and Saks (2010) show that the observed trends in corporate governance since 1934 "pose a challenge to several common explanations for the rise in executive pay since 1980." Our explanation for these trends has two parts.

First, due to the increase in external hiring that began in the 1980s, job opportunities outside the firm for CEOs enable them to gain, by luck, (Section 6.3; shows that 86.2% of boards' external hiring decisions have a negative expected benefit in the 1986 to 2005 period) bargaining power in their relationship with owners. Jensen and Meckling (1976) theory predicts a concurrent increase in agency problems, including excessive pay, which is observed by Bebchuk and Fried (2003), among others. To attempt to control the increase in agency problems, rational boards could a) become more diligent by becoming more independent, b) increase pay

[27] Dow and Raposo theorize that CEOs choose "overly dramatic" projects while neglecting more prudent and profitable but less dramatic projects. CEOs make this choice to raise their compensation.

for performance, and c) increase all forms of incentive pay. Regulations could also result from attempts to control increased agency problems. All of these have been tried since the early 1980s (Frydman and Saks (2010); Hermalin (2005)).

On the other hand, the type of financial anomaly we document is characterized by boards seeking to make decisions to maximize *expected* profits, as assumed by the theory of Hermalin and Weisbach (2010), among others. In their theory, increased CEO bargaining power coupled with an exogenous increase in regulation leads to increased CEO pay, especially at large firms. Without bargaining power, however, CEO pay is changed little by firm size or regulations. In our explanation, CEOs' increased bargaining power and subsequent increased regulation occur due to an increase in anomalous decisions to hire externally. Before the 1980s, external hiring was infrequent though boards still mistakenly hired externally in the 1970s (See Sections 3.2 and 5.3 where our sample overlaps HMP2004's sample period) and so owners would still have had nearly all of the bargaining power.[28] Correspondingly, Frydman and Saks (2010) show a weak relationship between CEO pay level and firm size between 1934 and 1975, with a slight increase starting in the mid-1970s. After 1980, external hiring increased; and research then shows (see Frydman and Saks (2010), among others) a strong positive relationship between CEO pay levels, firm size, and increased regulation. To summarize, given exuberant external hiring, our findings can help to consistently explain these major trends in corporate governance and CEO compensation since 1934.

8. Conclusions

This paper investigates whether boards improve their firms' profits by their choice to either hire

[28] In a statics framework, the increase in the quantity of outside hires cannot be due to an increased supply of outside candidates; otherwise, the pay for outside hires would have decreased. We assume there is no reduction in the supply of inside candidates.

externally or promote a new CEO internally. Although there are widespread expectations for greater profits from hiring externally, our evidence suggests that in fact boards can expect internal candidates to deliver greater profits than outsiders in almost all (86.2%) cases where boards have historically hired externally. Further, expectations for greater profits are likely to be realized by boards that pass over external candidates to hire internally.

Our results indicate that rational boards unknowingly lack critical information on the weaknesses of external but not internal candidates, so internal candidates are often passed over to hire a less capable external candidate for CEO. Logically, the resulting anomalous increase in labor market demand for CEOs increases their bargaining power over owners, which theoretically leads to a) agency problems such as excessive risk taking and market instability, b) increased executive pay, and c) increased regulation that diminishes its intended effect.

Appendix A:

Verification of Our Explanation for the Loss Realized by Hiring Externally

We verify our explanation of results for boards that hire externally by using expected utility theory. In line with this theory, our evidence suggests these externally hiring boards have a positive utility for profits, as their firms' average (median) cash flow return on assets is 3.47% (4.64%) (p-value < 0.001). Also in line with expected utility theory, all of our theories of CEO selection assume that boards have a positive expected utility for net profits (expected profits due to hiring externally less the expected profits from hiring internally). However, the predictions from expected utility theory using the assumptions of the "rational structural uncertainty" (RSU) theory differ from predictions made using the assumptions of our other theories. The difference occurs because a key assumption of expected utility theory is "that probabilities of the various outcomes arising from any chosen alternative are objectively known" (see Mas-Colell, Whinston

and Green (1995), page 168). Since boards could only make subjective estimates of these probabilities, we follow Mas-Colell, Whinston and Green (1995) and assume that boards operate "as if they held probabilistic beliefs … revealed by their choice behavior." In other words, decision makers have full statistical information. RSU theory, however, assumes decision makers do not have complete statistical information. Instead, decision makers are unaware that they lack complete information, so they make mistakes (note: we have no measure of the actual information that boards lack, as it is not captured by statistics). These mistakes are avoided only if boards are in unusual situations in which they naturally acquire the missing critical information.

Applied to selecting a CEO from outside the firm, RSU theory says boards will mistakenly believe they are hiring outside to obtain greater net profits when in fact objective probability information (i.e., full statistical information) would show that they can expect a net loss. Therefore, RSU theory predicts that boards' expected utility for net profits is negative when estimated using full statistical information. This prediction holds because these boards are mistakenly expecting positive net profits when they hire externally. In contrast, all theories except RSU assume boards have compete information, so these theories predict boards have a positive expected utility for net profits when estimations use full statistical information.

Given full statistical information, boards' expected utility for net profits can be modeled using equations (4) and (5) with expected profits as follows:

$$W_i = Z_i\gamma + \delta(EP_{OH,i} - EP_{IH,i}) + \eta_i \qquad (15)$$

where W_i is 1 for outside hires, 0 for inside hires; Z_i are the exogeneous variables described in Section 4.3; and $EP_{OH,i}$ and $EP_{IH,i}$ are given by equation (9) and (10). The coefficients on Z allow

for the possibility that exogenous forces, such as unexpected regulations or agency issues, cause boards to hire externally; in this case, expectations for net profits may not impact the hiring decision. The coefficient on expected net profits, δ, gives boards' expected utility for net profits based on full statistical information.

Consistent parameters for equation (15) can be estimated using a probit model. Estimates of δ using full statistical information are shown in the last column of Table 10. As is implied by RSU theory, the first row shows that boards' expected utility for net profits is negative (*p*-value < 0.001) for Forbes 800-size firms. The remaining rows show that for boards in circumstances in which they are likely to naturally acquire missing critical information (i.e., conditions become closer to those assumed with rational expectations), expected utility for net profits becomes positive (*p*-value < 0.001). Thus, tests based on expected utility theory verify our previous results and findings.

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Table 1
Sample description

The sample is for CEO appointments at U.S. firms from 1986 to 2005. The full "**Regression sample of CEOs in Forbes 800-size firms"** is all observations for CEOs whose type (inside hire or outside hire) is identified and whose firms have all the variables used in Table 3. **Inside hires** are CEOs who were an officer of the hiring firm in the year prior to their appointment. Once promoted to CEO, inside hires only have officer responsibilities at their firm. Officers are identified by using Compaq Disclosure's list of officers for all public firms or by using the Forbes 800 yearly list of CEOs starting in 1970. **Outside hires** a) have no history as an officer at the hiring firm, b) have a prior history as an officer at another public firm, and c) after their first two years as CEO only have officer responsibilities at their firm. **Observed years of tenure** is the number of years that a CEO is observed in our dataset. **Firm age** is the number of years the firm has been listed on CRSP in the year that the CEO is hired. All monetary variables are in 2005 U.S. dollars.

Panel A: Regression sample of CEOs in Forbes 800-size firms (i.e,. U.S. public firms with total assets > $350 million in the year prior to the CEO's appointment)		
	Insides hires	Outside hires
Number of CEOs	2,338	559
Observed years of tenure (average)	4.4	3.5
Number of firms	1,660	496
Firm age in year (average)	21.9	18.3
Number of firm-year observation	10,251	1,937
Panel B: Regression sample of CEOs in S&P 500-size firms (i.e,. U.S. public firms with total assets > $1,000 million in the year prior to the CEO's appointment)		
Number of CEOs	1,468	318
Observed years of tenure (average)	4.6	3.7
Number of firms	1,020	281
Firm age in years (average)	26.0	22.3
Number of firm-year observation	6,776	1,184

Table 2
Replication of HMP2004 and sample statistics

The sample for all tests except the replication is Forbes 800-size firms from 1986 to 2005; this sample and the type of hire (**Insides hires** and **Outside hires)** are defined in Table 1. "**Replication of HMP2004 using operating income"** uses appointments between 1986 and 1994; the performance measure is the change in operating income return on total assets (OROA) since the year prior to CEO k's appointment as defined in HMP2004; see equation (1). **CFROA** (**Cash Flow Return on Assets**) = (net income + amortization and depreciation) /average total assets (See equation 2). "**Change in industry-adjusted CFROA since the year prior to appointment**" equals the average of industry-adjusted CFROA over CEO k's tenure minus industry-adjusted CFROA in the year prior to CEO k's appointment (see equation 3). Industry is defined by the Fama-French 49 industries. **Total assets** is Compustat variable data6 in millions of dollars (**M**). **Sales** is data12 in millions of dollars. **Market-to-book** equals the market value of total assets / book value of total assets = (total assets – book equity – deferred taxes + market value of equity)/average total assets = (data6-data60-data74+data25*data199)/ average total assets. If data74 is missing, it is set to 0; this allows inclusion of banks (see Nagel (2009)). **Leverage** equals long term debt / total assets = data9/data6. **Pricing power** equals net income/sales = data237/data12. **Total asset turnover** equals sales/total assets = data12/data6. "**% officers of firm on BOD"** is the percentage of board seats held by officers of the firm. "**Number of directors"** is the number of directors on the board of directors. **Std. Dev.** stands for standard deviation. The *t*-test (median sign-test) is used to detect a significant difference in the average (median) value of a variable for inside and outside hires. All tests for significant differences are shown in Panel B; *** *p*-value < 0.01, ** *p*-value < 0.05; * *p*-value < 0.10. All monetary variables are in 2005 U.S. dollars.

Panel A: Firms that externally hire a CEO

			Variables measured in the year prior to appointment								
	Replication of HMP2004 using operating income	Change in industry - adjusted CFROA since the year prior to appointment	Total assets ($M)	Sales ($M)	CFROA	Market-to-book	Leverage	Pricing power	Total asset turnover	% officers of firm on BOD	# of board members
Average	0.0209	-0.0162	5,230	3,649	0.0527	1.746	0.2689	-0.0631	1.020	29.6	9.22
Std. Dev.	0.0679	0.1125	16,348	7,796	0.0991	1.775	0.2286	0.7558	0.843	24.1	3.50
25th percentile	-0.0171	-0.0485	622	486	0.0135	1.019	0.0835	-0.0141	0.445	14.3	7
50th percentile	0.0220	-0.0088	1,271	1076	0.0579	1.260	0.2406	0.0275	0.890	25.0	9
75th percentile	0.0589	0.0194	3,754	3,143	0.1017	1.787	0.3865	0.0695	1.324	33.3	11
Sample size	105	559	559	559	559	559	559	559	559	559	559
Panel B: Firms that promote internally to CEO											
Average	0.0073**	-0.0039**	9,545***	4,921**	0.0745***	1.703	0.2346***	0.0201***	0.971	33.5***	10.01***
Std. Dev.	0.0623	0.0808	47,739	13,427	0.0903	1.454	0.1996	0.4192	0.767	24.4	3.93
25th percentile	-0.0202	-0.0255	687	545	0.0284	1.056	0.0788	0.0155	0.404	18.2	8
50th percentile	0.0021***	-0.0026***	1,648***	12,91**	0.0776***	1.266	0.2069***	0.0522***	0.860	26.7***	10***
75th percentile	0.0319	0.0140	4,639	3,816	0.1197	1.807	0.3349	0.0989	1.321	40.0	12
Sample size	574	2,338	2,338	2,338	2,338	2,338	2,338	2,338	2,338	2,338	2,338

Table 3
Probit sample selection model for CEO hiring source: Outside hire versus internal promotion

The sample is Forbes 800-size firms; in this sample, **Insides hires** and **Outside hires** are defined in Table 1. This table provides the results of a probit sample selection model estimated as described by Heckman (1979). The **dependent variable** for the probit selection model is 1 if an outside hire is appointed, 0 otherwise. Excluding the year and industry dummies, all independent variables are measured in the year prior to hire or the three years prior to hire. Variables are "**industry-adjusted"** by subtracting off the industry median value using all Compustat firms. Industry is defined by the Fama-French 49 industry classifications. **Age of the firm** is the number of years since the firm was listed on CRSP. **Capital expenditures / average total assets** = data128/average total assets; if data128 is missing it is set to 0. **R&D / average total assets** = data46/average total assets; if data46 is missing, it is set to 0. **Advertising / average total assets** = data45/data6; if data45 is missing, it is set to 0. "**Operating income return on assets"** (OITA) is operating income / total assets = data12/data6. "**Change in operating income return on assets"** is OITA in the year before hire minus OITA 3 years before hire. "**Excess return over the market in the year prior to hire"** is the trailing year stock return of the firm less the trailing year value weighted return of all stocks in CRSP. **Year fixed effects** are indicated by **D[YYYY**], where YYYY is the year. The remaining variables are defined in Table 2. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. All monetary variables are in 2005 U.S. dollars.

Dependent variable:	Outside=1; Inside=0	
	Coefficient	*p*-value
Industry-adjusted value in the year prior to hire of:		
Ln(Total assets)	0.0079	0.753
Cash flow return on assets (CFROA)	0.0258	0.968
Market-to-book	0.0380	0.109
Leverage	0.2369	0.128
Standard deviation of stock returns	1.6700***	0.001
Ln(Age of the firm)	-0.0936***	0.007
Capital expenditure / total assets	-0.8770	0.123
R&D / total assets	0.3941	0.659
Advertising / total assets	1.6291*	0.079
Pricing power	0.0075	0.903
Total asset turnover	0.0649	0.212
Average of industry-adjusted CFROA over the 3 years prior to hire	-1.0881	0.156
Change in operating income return on assets (over years -1 to -3)	-0.7057*	0.097
Excess return over the market return in the year prior to hire	-0.0027***	0.000
% of board seats held by officers of the firm in the year prior to hire	-0.0079***	0.000
Number of directors in the year prior to hire	-0.0338***	0.001
Intercept	-0.9141**	0.018
Fama-French 48 industry fixed effects	Yes	
Year fixed effects	Yes	
Pseudo R-squared	0.1522	
Number of outside hires	559	
Sample size (i.e. number of CEOs)	2,897	

Table 4
Determinants of the change in cash flow performance since the year prior to appointment using a structural self-selection model of inside- and outside-hire CEOs' performance

The samples, Forbes 800-size firms and S&P 500-size firms, are defined in Table 1, as are **Insides hires** and **Outside hires**. The **dependent variable, cash flow performance,** equals the average of industry-adjusted CFROA over CEO k's tenure minus industry-adjusted CFROA in the year prior to CEO k's appointment (see equation 3). Cash flow return on assets (CFROA) is defined in equation (2). Private information that affects self-selection of the hiring source is accounted for by the **inverse Mills ratio** (computed from the sample selection model in Table 3) as shown in equations (9) and (10). The remaining variables are defined in Table 3. Variables are "**industry-adjusted**" by subtracting off the industry median value using all firms in Compustat. Industry is defined by the Fama-French 49 industry classifications. Standard errors are corrected for firm level clustering (Petersen (2009)) when computing significance; *p*-values are given in parentheses below each reported coefficient; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.[29] All monetary variables are in 2005 U.S. dollars.

	Forbes 800-size firms		S&P 500-size firms	
	Outside hires	Inside hires	Outside hires	Inside hires
Inverse Mills ratio	0.0127	-0.0151	0.0311***	-0.0019
	(0.440)	(0.240)	(0.014)	(0.901)
Industry-adjusted value in the year prior to hire of:				
Ln(Total assets)	-0.0007	0.0020**	-0.0003	0.0013
	(0.796)	(0.041)	(0.931)	(0.263)
Cash flow return on assets	-0.9034***	-0.6932***	-0.8648***	-0.7219***
	(4.7E-10)	(<1.E-300)	(4.9E-15)	(2.5E-07)
Market-to-book	-0.0044	0.0037**	0.0047**	0.0047**
	(0.187)	(0.038)	(0.047)	(0.039)
Leverage	0.0116	-0.0125	0.0063	-0.0216
	(0.533)	(0.291)	(0.752)	(0.242)
Standard deviation of stock returns	-0.0154	-0.1171**	0.0515	-0.1486***
	(0.874)	(0.013)	(0.568)	(0.009)
Ln(Age of the firm)	0.0092*	0.0074***	0.0055	0.0055**
	(0.099)	(4.5E-04)	(0.242)	(0.029)
Capital expenditure / total assets	-0.0758	-0.0032	0.0667	-0.0202
	(0.344)	(0.907)	(0.340)	(0.390)
R&D / total assets	-0.0903	-0.1538**	-0.1402	-0.2287**
	(0.473)	(0.031)	(0.447)	(0.026)
Advertising / total assets	0.0440	0.0797	0.0664	0.1374***
	(0.603)	(0.141)	(0.378)	(0.006)
Pricing power	-0.0013	-0.0204**	0.0280**	-0.0297*
	(0.845)	(0.034)	(0.030)	(0.051)
Total asset turnover	-0.0049	0.0088***	-0.0044	0.0021
	(0.634)	(0.009)	(0.678)	(0.662)
Average of industry-adjusted CFROA over the 3 years prior to hire	0.6847***	0.3641***	0.5236***	0.4369***
	(4.6E-06)	(1.8E-07)	(6.2E-05)	(1.6E-04)
Intercept	-0.0374	-0.0126***	-0.0590***	-0.0076***
	(0.111)	(0.001)	(0.003)	(0.074)
Adjusted *R*-squared	0.250	0.303	0.297	0.320
Sample size	559	2,338	318	1,468

[29] Standard errors are virtually identical to those reported and conclusions are the same if we correct for heteroscedasticity and the fact that the inverse Mills ratio is an estimated variable; these results are available upon request.

Table 5
Comparison of the cash flow performance realized by hiring from the board's chosen source (inside or outside) relative to the cash flow performance that would have been realized by hiring from the alternative source (i.e., realized gain)

The samples, Forbes 800-size firms and S&P 500-size firms, are defined in Table 1, as are **Insides hires** and **Outside hires**. **Cash flow performance** equals the average of industry-adjusted CFROA over CEO k's tenure minus industry-adjusted CFROA in the year prior to CEO k's appointment (see equation 3). The structural self-selection model solved in Table 4 and discussed in Section 4 is used to estimate realized gain in cash flow performance. Private information that affects self-selection of the hiring source is accounted for by the **inverse Mills ratio** (computed as shown in equations (9) and (10)) using the sample selection model shown in Table 3. **Realized gain** for an outside hired CEO is given in equation (11) and is the actual performance of the outside CEO minus the counterfactual performance (i.e., the expected performance of an inside hire given that an outsider was hired). The realized gain for an inside hired CEO is given in equation (13) and is the actual performance of the inside hired CEO minus the counterfactural performance (i.e., the expected performance of an outside hire given that an insider was hired). Realized gains are winsorized at the 0.5% and 99.5% levels; results are not meaningfully changed by winsorizing. Average realized gains significantly different from zero are determined using the t-statistic. Significance differences from 50% for the percent of firms that realize a gain are obtained by using the signed rank test. *P*-values are given in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.[30] All monetary variables are in 2005 U.S. dollars.

	Sample size		Average realized gain		% of firms that realize a gain		Inverse Mills ratio	
Chosen source:	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside
1) Forbes 800-size firms	559	2,338	-0.0200***	0.0147***	42.6***	69.2***	0.0127	-0.0154
period = 1986-2005			(6.1E-07)	(2.1E-28)	(2.2E-06)	(7.7E-67)	(0.4395)	(0.2297)
2) S&P 500-size firms	318	1,468	-0.0132***	0.0065***	46.2***	56.6***	0.0311**	-0.0019
period = 1986-2005			(0.0008)	(1.5E-05)	(0.0063)	(1.1E-07)	(0.0141)	(0.9005)

[30] We will show in Table 7 that the results are robust to using only time and industry trends as exogenous selection variables (i.e. instrument variables). By construction these variables are not correlated to our firm performance measure, which has time and industry trends subtracted out (See equation 3).

Table 6
Realized cash flow performance gain results by time period and results with first year performance and interim CEOs excluded

The samples, Forbes 800-size firms and S&P 500-size firms, are defined in Table 1, as are **Insides hires** and **Outside hires**. **Cash flow performance** equals the average of industry-adjusted CFROA over CEO k's tenure minus industry-adjusted CFROA in the year prior to CEO k's appointment (see equation 3). The structural self-selection model discussed in Section 4 is used to estimate realized gain in cash flow performance for the samples listed. Private information that affects self-selection of the hiring source is accounted for by the **inverse Mills ratio** (computed as shown in equations (9) and (10)) using the sample selection model shown in Table 3. The determinants of cash flow performance used in the structural self-selection model are the same as in Table 4. **Realized gain** for an outside hired CEO is given in equation (11) and is the actual performance of the outside CEO minus the counterfactual performance (i.e., the expected performance of an inside hire given that an outsider was hired). The realized gain for an inside hired CEO is given in equation (13) and is the actual performance of the inside hired CEO minus the counterfactural performance (i.e., the expected performance of an outside hire given that an insider was hired). Realized gains are winsorized at the 0.5% and 99.5% levels; results are not meaningfully changed by winsorizing. Average realized gains significantly different from zero are determined using the t-statistic. Significance differences from 50% for the % of firms that realize a gain are obtained by using the signed rank test. *P*-values are given in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. All monetary variables are in 2005 U.S. dollars.

	Sample size		Average realized gain		% of firms that realize a gain		Inverse Mills ratio	
Sample	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside
1) Forbes 800-size firms	138	899	-0.0186**	0.0158***	38.4**	61.6***	-0.0123	-0.0277**
period = 1986-1995			(0.0233)	(2.69E-12)	(0.0262)	(4.3E-15)	(0.6049)	(0.0478)
2) Forbes 800-size firms	421	1,439	-0.0197***	0.0148***	43.9***	66.1***	0.0411**	-0.0015
period = 1996-2005			(1.5E-05)	(1.25E-15)	(0.0001)	(2.5E-35)	(0.0174)	(0.9329)
3) S&P 500-size firms	78	535	-0.0123*	-0.0025	38.5**	44.9***	0.0037	-0.0411***
period = 1986-1995			(0.0673)	(0.2947)	(0.0242)	(0.0068)	(0.7985)	(0.0007)
4) S&P 500-size firms	240	933	-0.0125***	0.0128***	47.1*	65.9***	0.0317**	0.0307*
period = 1996-2005			(0.0072)	(5.3E-10)	(0.0967)	(9.1E-25)	(0.0420)	(0.0831)
5) First year excluded	406	1,816	-0.0158***	0.0097***	41.4***	59.0***	0.0052	-0.0348***
Forbes 800-size firms			(0.0003)	(3.0E-11)	(2.5E-05)	(2.0E-14)	(0.6877)	(0.0046)
period = 1986-2004								
6) First year only	559	2,338	-0.0287***	0.0181***	42.6***	72.2***	0.0359*	0.0055
Forbes 800-size firms			(1.6E-09)	(1.0E-35)	(1.6E-08)	(1.7E-98)	(0.0765)	(0.6820)
period = 1986-2005								
7) Interim CEOs excluded	408	1,826	-0.0213***	0.0111***	36.0***	61.4***	0.0141	-0.0260**
Forbes 800-size firms			(9.8E-08)	(8.4E-20)	(2.6E-10)	(1.7E-25)	(0.1907)	(0.0110)
period = 1986-2005								

Table 7
Robustness to alternative financial performance measures, choice of exclusion variables, and alternative model specification

Samples are drawn from Forbes 800-size firms, which are defined in Table 1, as are **Insides hires** and **Outside hires**. **Change in operating income return on assets** equals the average of industry-adjusted operating income return on assets (data13/data6) over CEO k's tenure minus industry-adjusted operating income return on assets in the year prior to CEO k's appointment. Changes for the other performance measures are similarly defined. **Net income return on assets** is data237/data6. **Realized gain** and the **Inverse Mills ratio** are defined in Table 6. The structural self-selection model in which **The only exclusion variables are time and industry dummies** uses all the variables shown in Table 3 for the Probit model while the outcome equation specification includes all the variables in that Probit model except the time and industry dummies. The structural self-selection model in which **The only exclusion variables are five year a) industry % and b) all industry % outside hires prior to the hire date** uses all the variables shown in Table 3 for the Probit model; however, the time dummies are replaced with the 5 year percentage of outside hires in all industries prior to the hire years. Also the industry dummies are replaced with the five year percentage of outside hires in the hiring firm's Fama-French 48 industry prior to the hire date. The outcome equation specification uses all the variables in the Probit equation except the exclusion variables just given. The structural self-selection model that uses **An expanded selection model specification** is the same as the structural self-selection model shown in Tables 3 and 4 with the following variables added to the selection model of Table 3: a) the Shumway (2001) (page 122) bankruptcy predictor variable computed using market and accounting variables and b) two forced turnover variables based on the algorithm of HMP2004. The first forced turnover variable is set to 1.0 if the departing CEO's age is less than 61 and in the year of departure the Shumway bankruptcy predictor variable is in the decile of firms most likely to go bankrupt; otherwise the forced turnover variable is set to 0. The second forced turnover variable is the same as the first except that the change in operating income return on assets (over years -1 to -3; defined in Table 3) is in the worst performing decile of firms in the year of departure. Realized gains are winsorized at the 0.5% and 99.5% levels; results are not meaningfully changed by winsorizing. Average realized gains significantly different from zero are determined using the *t*-statistic. In Panel B, the performance measure is the same cash flow performance measure used in Tables 2 through 6. Significance differences from 50% for the % of firms that realize a gain are obtained by using the signed rank test. *P*-values are given in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. All monetary variables are in 2005 U.S. dollars.

	Sample size		Average realized gain		% of firms that realize a gain		Inverse Mills ratio	
	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside
Panel A: Performance measure (industry-adjusted)								
1) Change in operating income return on assets	560	2,340	-0.0096***	0.0084***	43.2***	59.4***	0.0015	-0.0182**
			(0.0006)	(6.2E-15)	(2.7E-05)	(2.0E-19)	(0.8768)	(0.0315)
2) Change in net income return on assets	560	2,345	-0.0210***	0.0163***	43.6***	70.4***	0.0148	-0.0154
			(9.4E-07)	(1.5E-31)	(2.9E-06)	(5.5E-76)	(0.3810)	(0.2385)
Panel B: Choice of exclusion variables and model specification								
3) The only exclusion variables are time and industry dummies	559	2,338	-0.0188***	0.0155***	43.8***	71.1***	-0.0112	-0.0297**
			(2.2E-06)	(5.7E-32)	(1.3E-05)	(1.6E-79)	(0.5304)	(0.0416)
4) The only exclusion variables are five year a) industry % and b) all industry % outside hires prior to the hire date	506	1,902	-0.0182***	0.0136***	43.3***	66.5***	0.0208	-0.0339
			(1.6E-05)	(7.4E-19)	(0.0001)	(8.3E-49)	(0.6028)	(0.3817)
6) An expanded selection model specification	531	2,153	-0.0192***	0.0152***	43.3***	69.5***	0.0133	-0.0017
			(3.3E-06)	(1.2E-27)	(1.2E-05)	(3.0E-63)	(0.4572)	(0.8865)

Table 8
Matching method check on the structural self-selection model results and analysis of risk

The sample consists of 2,897 CEOs at Forbes 800-size firms (U.S. public firms with total assets > $350 million in the year prior to the CEO's appointment); this sample is defined in Table 1. In Panel A the figures reported are treatment effects used to check the structural self-selection model results in Table 5, Row 1. The realized gain due to treatment for firms that hire from outside equals the cash flow performance realized by hiring externally minus the performance of inside hire(s) at matched firm(s). In a similar manner, the realized gain due to treatment for firms that hire from inside equals the performance realized by hiring internally minus the performance of outside hire(s) at matched firm(s). The average treatment effect is calculated using the "difference of differences" in cash flow performance at matched firms. Cash flow performance is defined in Table 6 and equation (3). Propensity score matching is accomplished using the method of Dehejia and Wahba (2002) with replacement. We also use the matching estimator of Abadie and Imbens (2006) with replacement and account for bias as described in Abadie and Imbens (2004). The variables used in matching are the same as are used in the probit model of Table 3. To satisfy the requirement of the propensity score method for inferring causality, firms are sorted into 10 groups based on their propensity score. *P*-values are reported in parenthesis based on the *t*-test; ** and *** denote significance at the 5% and 1% levels, respectively. In Panel B the *F*-test is used to determine significant differences in the standard deviation of realized gains between inside and outside hired CEOs. All monetary variables are in 2005 U.S. dollars.

Panel A: Treatment effect

	Average realized gain due to treatment	
Matching method	Firms that hire from outside	Firms that hire from inside
1) Propensity score matching method using replacement	-0.0240*** (0.0008)	0.0159*** (0.0001)
2) Matching estimator method of Abadie and Imbens (2006)	-0.0242*** (2.2E-08)	0.0138*** (0.0010)

Panel B: Risk analysis of outside hires using propensity score matching

	Sample size	Average realized gain	Standard deviation of realized gain	Stochastic dominance (performance measure is realized gain)
Outside hires	556	-0.0170	0.1231	Inside hires' performance first order
Matched inside hires	556	0.0071***	0.1122**	stochastically dominate outside hires'

Table 9
Test of the Hermalin (2005) option theory and of agency theory

Samples are drawn from Forbes 800-size firms, which are defined in Table 1, as are **Insides hires** and **Outside hires.** Cash flow performance equals the average of industry-adjusted CFROA over CEO k's tenure minus industry-adjusted CFROA in the year prior to CEO k's appointment (see equation 3). The structural self-selection model discussed in Table 4 (and Section 4) is used to estimate realized gain in cash flow performance for the samples listed. Private information that affects self-selection of the hiring source is accounted for by the **inverse Mills ratio** (computed as shown in equations (9) and (10)) using the sample selection model shown in Table 3. **Realized gain** for an outside hired CEO is given in equation (11) and is the actual performance of the outside CEO minus the counterfactual performance (i.e., the expected performance of an inside hire given that an outsider was hired). The realized gain for an inside hired CEO is given in equation (13) and is the actual performance of the inside hired CEO minus the counterfactual performance (i.e., the expected performance of an outside hire given that an insider was hired). Realized gains are winsorized at the 0.5% and 99.5% levels; results are not meaningfully changed by winsorizing. The **% of inside directors** is the percentage of the board composed of the firm's executives. **Change in CFROA: Old firm – new firm** = Industry-adjusted CFROA at the hiring firm in the year before hire minus the industry-adjusted CFROA at the outside hire's previous firm in there last year there. **Change in Total Assets: Old firm – new firm** is similarly defined using industry-adjusted total assets ($millions). Total assets and CFROA (cash flow return on assets) are defined in Table 2. Average realized gains significantly different from zero are determined using the *t*-statistic. Significance differences from 50% for the % of firms that realize a gain are obtained by using the signed rank test. *P*-values are given in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. All monetary variables are in 2005 U.S. dollars.

	Sample size		Average realized gain		% of firms that realize a gain		Inverse Mills ratio	
	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside
Panel A: Board size and independence								
1) # of directors >= 75% percentile	196	1,033	-0.0107*	0.0041**	49.0	55.2***	0.0297**	0.0235
			(0.0753)	(0.0242)	(0.1886)	(0.0018)	(0.0162)	(0.2841)
2) # of directors <= 25% percentile	153	519	-0.0215**	0.0245***	45.1**	72.3***	-0.0049	0.0075
			(0.0207)	(7.6E-11)	(0.0210)	(1.1E-23)	(0.8804)	(0.7474)
3) % of inside directors >= 75th percentile	170	901	-0.0246***	0.0136***	42.4***	65.5***	0.0075	-0.0256
			(0.0066)	(7.5E-10)	(0.0007)	(5.5E-20)	(0.8340)	(0.1255)
4) % of inside directors <= 25th percentile	153	385	-0.0292***	0.0352***	39.9***	78.4***	-0.0188	-0.0002
			(0.0024)	(2.6E-13)	(0.0060)	(9.2E-29)	(0.3309)	(0.9938)

Panel B: The quality of externally hired CEOs

	Change in CFROA: Old firm – new firm	Change in Total Assets: Old firm – new firm	% who have prior CEO experience
Mean	0.012*	11,747***	25.6
Median	0.010***	1,242***	
Sample size	542	559	559

Table 10
Test for a financial anomaly that would be caused by boards who are unaware they are missing critical information

Samples are drawn from Forbes 800-size firms, which are defined in Table 1, as are **Insides hires** and **Outside hires.** Cash flow performance equals the average of industry-adjusted CFROA over CEO k's tenure minus industry-adjusted CFROA in the year prior to CEO k's appointment (see equation 3). The structural self-selection model discussed in Table 4 (see also Section 4) is used to estimate expected net benefit in cash flow performance for the samples listed. **Expected net benefit** for an outside hired CEO is given in equation (12) and is the expected performance of the outside CEO minus the counterfactual performance (i.e., the expected performance of an inside hire given that an outsider was hired). The expected net benefit for an inside hired CEO is given in equation (14). Expected net benefits are winsorized at the 0.5% and 99.5% levels; results are not meaningfully changed by winsorizing. The **Full statistical information expected utility for net profits with an outside hire** is measured by δ in equation (15) of Appendix A using a probit model. The **Full statistical information expected utility for net profits with a hybrid hire** is measured by δ in an equation similar to (15), but expected net profit equals ($EP_{\text{hyprid hire,i}} - EP_{OH,i}$) instead of ($EP_{OH,i} - EP_{IH,i}$). Directors are called **common** if they are on the board of the hiring firm and were on the board of the selected candidate's prior firm when the candidate was an officer there. An average expected net benefit significantly different from zero is determined using the *t*-statistic. Significance differences from 50% for the % of firms that can expect to benefit are obtained by using the signed rank test. *P*-values are given in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. All monetary variables are in 2005 U.S. dollars.

	Sample size		Average expected net benefit		% of firms that can expect to benefit		Full statistical information expected utility for net profits with an outside hire
	Outside	Inside	Outside	Inside	Outside	Inside	
Panel A: Outside and inside hires							
1) Forbes 800-size firms	559	2,338	-0.0195***	0.0144***	13.8***	84.7***	-71.95***
			(3.0E-54)	(1.3E-239)	(5.5E-102)	(<1.0E-300)	(06.1E-138)
2) External hire from the same 4 digit SIC industry as the hiring firm	117	2,338	-0.0126**	0.0114***	39.3**	53.8***	-6.01***
			(0.0169)	(2.3E-21)	(0.0221)	(1.0E-06)	(3.0E-6)
3) Directors are common to hiring firm and the external hire's previous firm	101	2,338	-0.0018	0.0206***	48.5***	77.3***	-7.97***
			(0.5831)	(4.7E-215)	(0.8178)	(2.4E-242)	(2.8E-5)
Panel B: Outside and hybrid (hired from outside but seasoned before promotion to CEO) hires							Full statistical information expected utility for net profits with a hybrid hire
	Outside	Hybrid	Outside	Hybrid	Outside	Hybrid	
1) Hybrid hire that is seasoned for 1 to 2 years	559	56	0.0038*	0.0091	50.4	57.1	4.55**
			(0.0967)	(0.1094)	(0.3696)	(0.2338)	(0.0139)
2) Hybrid hire that is seasoned for 3 or more years	559	155	-0.0345***	0.0158***	12.9***	72.9***	11.96***
			(7.0E-79)	(8.9E-12)	(1.7E-106)	(2.8E-12)	(9.8E-20)