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Which Skills Matter in the Market for CEOs? Evidence from Pay for CEO Credentials

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Market-based theories predict that differences in CEO skills lead to potentially large differences in pay, but it is challenging to quantify the CEO skill premium in pay. In a first step toward overcoming this empirical challenge, we code detailed biographical information for a large sample of CEOs for a panel of S&P 1500 firms between 1993 and 2005 to identify specific reputational, career, and educational credentials that are indicative of skills. Newly appointed CEOs earn up to a 5% or \$280,000 total pay premium per credential decile, which is concentrated among CEOs with better reputational and career credentials, those with the very best credentials, and those who run large firms. Consistent with the unique economic mechanism of market-based theories, CEO credentials have a positive impact on firm performance. The performance differential for newly appointed CEOs is up to 0.5% per credential decile and is also concentrated among CEOs with better reputational and career credentials and those at large firms. Credentials are positively correlated with unobserved CEO heterogeneity in pay and performance, which further validates our hypothesis that boards use them as publicly observable signals of otherwise hard-to-gauge CEO skills. In all, our results offer direct evidence in support of market-based explanations of the overall rise in CEO pay.

Keywords: finance; corporate finance; management determinants of CEO pay; market for CEO talent; CEOs and firm performance

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1. Introduction

Anecdotal accounts of executive search consultants and a growing theory literature emphasize the importance of the labor market for CEOs, especially over the last two decades (see Gabaix and Landier 2008; Terviö 2008; Edmans et al. 2009; Murphy and Zábojník 2004, 2007).¹ The central tenet of this literature is that there are fundamental differences in CEOs' productive abilities, or "skills," and that even small differences in skills may lead to large differences in CEO pay. However, measuring CEO skills empirically is a major challenge, the existing literature on the CEO labor market is mostly theoretical, and previous empirical studies

of the determinants of CEO pay have traditionally emphasized firm and industry characteristics that are only indirectly related to CEO skills (see Jensen et al. 2011 for a survey). Thus, we have to date virtually no evidence on whether differences in CEO skills are in fact an important empirical determinant of CEO pay.

To fill this gap in the literature, we take competitive sorting theories of the CEO labor market closer to the data. We code detailed biographical information for a large sample of CEOs to identify specific CEO characteristics that on a priori grounds are indicative of skills, which is our key innovation with respect to the standard fixed effects approach in the literature on managerial traits (see Bertrand and Schoar 2003, Graham et al. 2012, Coles and Li 2011). We derive from first principles the implications of these CEO skill proxies for pay and then measure their effects empirically. To sharpen the interpretation of the economic mechanism behind our results, we also examine the impact of our proxies on firm performance. To the best of our knowledge, ours is the first attempt at providing direct estimates of the impact of CEO skills on pay and firm performance. By doing so, we

¹ Murphy and Zábojník (2007) show that, although few more than one CEO of 10 was appointed from outside the firm in the 1970s, that number has risen to approximately four in 10 over the last decade. Cremers and Grinstein (2014) show that cross industry differences in the incidence of outside CEO appointments are related to several pay practices, such as benchmarking and pay for luck, but not to higher levels of CEO pay. Kaplan and Rauh (2010) study the determinants of the level of CEO pay as compared to other superstar labor markets. Gabaix and Landier (2008) emphasize that the relation between the level of CEO pay and firm size is consistent with the talent view.

hope to make progress on understanding who runs corporations and why, and whether it matters for CEO pay and, as importantly, shareholder value.²

In summary, we make two main contributions. First, we quantify the CEO skill premium in pay and evaluate which skills carry a higher pay premium. Existing studies of the CEO labor market have mostly focused on the relation between CEO pay and firm size under the assumption that there are differences in CEO skills, but have not derived direct estimates of the skill premium in pay.³ Second, we quantify the returns to CEO skills for shareholders, which had not been examined in the literature for which the standard approach is to use either executive fixed effects or shocks, such as deaths or illnesses, to gauge the performance impact of CEOs.⁴ Our estimates for firm performance are of an order of magnitude smaller than those for pay, which is consistent with the key insight of competitive assignment models of the CEO labor market that even small differences in CEO skills should lead to large differences in pay but not in firm performance.⁵

To overcome the measurement hurdle, i.e., that CEO talent is by its very nature hard to quantify, we code detailed biographical information for a large panel of nearly 4,000 CEOs of S&P 1500 firms from 1993 to 2005. We construct measures that reflect publicly observable signals of CEO skills based on the quality of CEOs' educational and professional track records, as well as their outside reputations, to which we refer

as CEO credentials. The premise of our approach is that boards of directors and their search consultants evaluate CEO skills by relying at least in part on information contained in resumes or the business press. This premise is broadly consistent with anecdotal accounts of the search process for top executives, in which it is common practice for potential candidates to submit their resumes and have their qualifications and career background evaluated in depth, and with the well-replicated finding in labor economics that employers use publicly observable employee characteristics, such as educational credentials, as a screening device for talent (see Altonji and Pierret 2001).

We summarize salient features of each CEO's resume into three measures of credentials. *Press*, the reputational signal, measures outside perceptions of CEO skills as recognized by the extent of coverage in the business press.⁶ *Fast-Track Career*, the labor market signal, measures the quality of the CEOs career track records based on how fast they cleared the bar for their first CEO jobs, which is a signal of skills according to competitive sorting theories of firm hierarchy, because the CEO job has the most impact and involves the most responsibility (see Rosen 1982, Kremer 1993).⁷ *Selective College*, the schooling signal, measures the quality of the CEOs' educational backgrounds and provides a signal of skills based on theories of education where employees invest in costly acquisition of educational credentials to send a signal about their skills to potential employers (Spence 1974).⁸ Where it helps expositively, we also use our proxies jointly by aggregating them into a single CEO talent factor. The three proxies display significant positive cross correlation, which supports their external validity and is consistent with the notion that they capture a common underlying talent factor.

In our baseline regressions, we ask whether there is a credentials premium in CEO pay and which credentials

² As such, we follow the suggestion of Bertrand (2009, pp. 24–25) to focus on “building a more systematic and quantitative analysis using a large sample size on the CEO search process; understanding how boards measure, identify, and evaluate ‘talent’; and gaining further insight on the role played by third parties such as the media.”

³ Gabaix and Landier (2008) and Terviö (2008) show that the positive relation between the level of CEO pay and firm size is consistent with competitive sorting models of the CEO labor market. Edmans et al. (2009) and Baranchuk et al. (2011) add endogenous managerial effort and firm size and argue that their model can explain the relation between incentive pay and firm size and the recent increase in pay–firm size relation, respectively. Some have argued that the pay–size relation is actually tenuous before the 1970s (Frydman and Saks 2010) but consistently positive thereafter. Although this positive relationship is consistent with a talent story, it is also consistent with a rent-extraction story since it is possible that such issues are more severe at large firms.

⁴ Bertrand and Schoar (2003) and Graham et al. (2012) document evidence that executive fixed effects explain a large fraction of the total variation in firm performance and pay, respectively. Bennedsen et al. (2006) examine changes in firm performance around CEO deaths.

⁵ See, for example, Gabaix and Landier (2008). There is another related strand of the literature on the CEO labor market that examines the link between pay and measures of CEO talent based on firm performance (Daines et al. 2005, Chang et al. 2010, Pan 2014). Although our approach is complementary to theirs, an advantage of relying on biographies rather than firm performance to measure CEO talent is that we can derive estimates of the impact of CEO skills not only on pay, but also on firm performance.

⁶ This proxy is constructed by counting the year-prior number of major business newspapers articles containing the CEO's name (as in Milbourn 2003). In robustness tests, we ensure that the number of articles is not merely a reflection of CEO infamy by screening for the tone of each article and netting out negative press coverage, or *Bad Press*, from *Press*. We also address the concern that the article count may simply reflect luck or characteristics of the firm that previously employed the CEO by only counting articles that reflect positive personal traits of each CEO based on Kaplan et al. (2012), which we denote as *Good Press*. We also consider ratios of these finer press counts to control for firm-related press.

⁷ This proxy is constructed as a function of the age at which the executive first took a CEO job (see Kaplan et al. 2012 for supporting evidence). We ensure that *Fast-Track Career* does not simply reflect common circumstances of the first CEO job (see Malmendier et al. 2011, Schoar 2007) by using a cohort-adjustment aimed at capturing only variation beyond factors common across the same-age cohort of executives.

⁸ This proxy is constructed by using Barron's rankings of college selectivity.

matter the most, and we describe key cross-sectional features of the relation between pay and credentials. Robustly across our three proxies, CEOs with better credentials earn significantly higher total compensation in their first year of appointment, with an empirical sensitivity of first-year total pay per credentials decile ranging from approximately 5%, for *Press* and *Fast-Track Career*, to approximately 2% for *Selective College*, and an implied dollar pay premium of up to \$280,000 for CEOs who are one decile higher in the credentials distribution.⁹ The relation between pay and credentials is convex in credentials, with an empirical sensitivity of first-year total pay to credentials among CEOs ranked in the top decile of the credentials distribution up to 20 times larger than the average, and an implied premium of up to approximately \$700,000 for each percentile improvement in credentials. It is also complementary with firm size, with a sensitivity that more than doubles with respect to the average for CEOs at firms in the top size tercile, with a premium of up to \$770,000 for each extra credential decile. These results indicate that firms rely on CEO credentials in their compensation decisions, and that more current reputational and labor market credentials matter more than lagging school rankings.

In an attempt to sharpen our inference, we next examine the link between CEO credentials and firm performance. According to market-based theories, the economic mechanism behind the credentials pay premium is the competitive assignment of CEOs to firms, which has the so-called assortative matching property. The intuition is that the pay premium arises since CEOs with better credentials are expected to have a more positive impact on firm performance, and the premium is larger for larger firms since CEO skills complement firms' physical assets. Thus, CEOs with better credentials should have a bigger performance impact at larger firms, which ultimately also leads to the convexity in the pay premium.¹⁰ Consistent with these unique predictions and for a wide array of operating performance metrics, we document that there is a reliably positive performance impact of CEO credentials, with estimates of the sensitivity of operating returns to credentials ranging between 0.5% and 0.3% per credentials decile, and with the impact concentrated among large firms.¹¹

⁹ These estimates are robust to using several alternative definitions of the proxies, including firm- and industry-adjustments. We also document that there is a trend toward appointing CEOs with better credentials over time.

¹⁰ Consistent with another implication of market-based theories, results of a probit analysis of CEO appointments show that larger firms are more likely to appoint CEOs with better credentials.

¹¹ The performance impact does not appear to be driven by the pursuit of riskier strategies; as we document in the appendix, CEOs with better credentials are actually more likely to cut expenditures, shed excess capacity, cut leverage, increase cash, and increase firm focus.

The performance impact of different credentials follows the same pecking order as the pay premium, with reputational and labor market credentials having the largest impact.

We probe the validity of our proxies in two more ways. First, we show that the credentials pay premium increases significantly after industry shocks that are likely to increase the performance impact of CEO skills, such as the arrival of growth opportunities (see, e.g., Caroli and Van Reenen 2001). Second, we offer evidence that credentials indeed serve as proxy for otherwise hard-to-observe skills by showing that they are positively correlated with unobserved CEO heterogeneity in pay and performance. In fact, our proxies can explain up to approximately 25% of the variation in CEO fixed effects estimated from regressions of total pay as in Bertrand and Schoar (2003) and Graham et al. (2012) (which achieve an R^2 of approximately 75%), a vast improvement over previously used biographical CEO characteristics, such as age and MBA, which achieve an R^2 of only 5% (and an incremental R^2 of approximately 20%).¹² In all, this evidence supports a market-based view of CEO credentials. Our approach helps to make progress on the important question of how managerial effects are best interpreted and suggests that to a large extent they reflect talent, which is also confirmed by the fact that our estimates are in line with the 1.7% impact of CEO deaths in Bennedsen et al. (2006).

Our baseline results are robust to considering several batteries of alternative specifications, including a fixed effects estimation that compares CEOs with different skills operating the same firm.¹³ By looking at changes in pay over time within firms, this specification controls for permanent unobserved characteristics of firms that might bias our baseline cross-sectional specification due to the initial nonrandom selection of CEOs with different credentials into different firms.¹⁴ The results are also robust to adding controls for alternative stories. In particular, we control for the Custodio et al. (2013) measures of CEO general human capital and for measures of CEO power and connections that include

¹² We have qualitatively analogous findings for CEO fixed effects analysis of firm performance.

¹³ To lessen residual endogeneity concerns about omitted time-varying firm characteristics, we also consider an instrumental variables (IV) approach and present results for two sets of instruments that use characteristics of UK CEOs to capture exogenous variation in the characteristics of their U.S. counterparts (see Ellison et al. 2010) and that exploit CEO labor market shocks by capturing variation in the relative demand for talented CEOs across industries, an approach that is widely employed in the labor literature (see Katz and Murphy 1992).

¹⁴ Results for a nearest-neighbor matching estimator (Abadie and Imbens 2011) and a standard Heckman (1979) selection analysis confirm our baseline estimates, suggesting that selection on observables and the nonrandom nature of our CEO succession sample are not to blame.

the GIM index of Gompers et al. (2003), board size and independence, and CEO education and corporate networks (see Bebchuk et al. 2002).¹⁵

Finally, we assess the implications of our results for the recent academic and policy debate on why CEO pay has increased so much (see Jensen et al. 2011 for a recent survey). We document that there was a large upward trend in pay over the 1990s and 2000s for CEOs at the top of the credentials ladder, but no trend for those with the worst credentials. The rising credentials premium does a particularly good job at explaining the overall upward trend in pay among newly appointed CEOs and outside hires and at the very top of the distribution of pay, suggesting that the premium can also help to explain the increasing gap between the most and least highly paid CEOs. In contrast to the standard criticism that boards do not prudently reward and monitor CEOs, this evidence indicates that a rising CEO talent premium may have contributed to the overall rise in pay.

Our paper is organized as follows. Section 2 delineates our testable hypotheses and describes the data, including our measures of credentials. In §3, we lay out our empirical strategy and present our core results. Section 4 interprets our pay-for-credentials results, and §5 provides robustness tests. Section 6 concludes.

2. Testable Hypotheses and Data

In this section, we briefly lay out the predicted effect of CEO credentials on pay and firm performance. In Online Appendix C (available as supplemental material at <http://dx.doi.org/10.1287/mnsc.2014.2024>), we formally derive the hypotheses from a competitive sorting model of the CEO labor market based on recent work by Gabaix and Landier (2008) and Terviö (2008).¹⁶ The core intuition is as follows: CEOs have observable characteristics, such as their credentials, that are indicative of their expected productive skills, or “talent,” and are matched to firms competitively. The marginal impact of a CEO’s talent is assumed to increase with the value of the assets under his

control. The best CEOs go to run the bigger firms, which maximizes their impact. Thus, according to these market-based theories, the economic mechanism behind the credentials pay premium is the competitive assignment of CEOs to firms, which has the so-called assortative matching property. The intuition is that the pay premium arises since CEOs with better credentials are expected to have a more positive impact on firm performance, and the premium is larger for larger firms since CEO skills complement firms’ physical assets. Thus, CEOs with better credentials should have a bigger performance impact at larger firms, which ultimately also leads to the convexity in the pay premium. Hypotheses 1 and 2 summarize these predictions:

HYPOTHESIS 1 (CREDENTIALS PREMIUM IN CEO PAY). *CEOs with better credentials receive higher total compensation. The relation between CEO pay and credentials is convex in that the credentials premium is increasing in credentials. In addition, there is a complementarity between pay for credentials and firm size, in that the credentials premium is increasing in firm size.*

HYPOTHESIS 2 (PERFORMANCE IMPACT OF CEO CREDENTIALS). *CEOs with better credentials are more likely to benefit shareholders; i.e., there is a positive impact of CEO credentials on firm performance. In addition, CEOs with better credentials are more likely to benefit shareholders if they run larger firms; i.e., the performance impact of CEO credentials is more positive for larger firms.*

Some closely related recent papers have enriched the competitive sorting framework of Gabaix and Landier (2008) and Terviö (2008). Edmans et al. (2009) add endogenous managerial effort and examine the implications for the relation between different metrics of incentive pay and firm size. One of their results is about the dollar value of incentives (or “dollar-dollar” incentives), which they show should be proportional to total pay and, thus, should display the same scalings with size and CEO talent as total pay. Although our main focus is on the determinants of total pay rather than the structure of pay, in robustness analysis we consider the relation between our CEO credentials proxies and measures of dollar incentives.¹⁷ Edmans and Gabaix (2011) add endogenous risk choices and show that firms with higher risk choose less-talented CEOs but pay more. Thus, their model predicts a negative relation between firm risk and CEO talent, a prediction we address by examining the relation between credentials and firm risk-taking policies. It also highlights the need for us to include variables that

¹⁵ In addition, CEOs with better credentials are subject to more aggressive performance-related board monitoring, which is inconsistent with them having more power to extract rents from captive boards. We also address the work of Khurana (2002) and Malmendier and Tate (2009), which might suggest that CEOs with better credentials are “hyped up” CEOs who initially attract boards’ attention, and thereby pay for credentials is simply an indication of temporary luck that will ultimately lead to disappointing performance. We address this alternative interpretation in two ways. We document that the pay for credentials relation is not temporary, but instead is sustained over the CEO’s entire career. In addition, we show evidence of a positive long-term impact of CEO on firm performance.

¹⁶ See Sattinger (1979, 1993) for an earlier treatment of optimal assignment models of the labor market.

¹⁷ Baranchuk et al. (2008) add endogenous firm size and focus on the effect of product market conditions.

control for firm risk, which we do in our baseline and robustness analysis.

2.1. Data

To test Hypotheses 1 and 2, we overcome the measurement hurdle that CEO talent is by its very nature hard to quantify and code detailed biographical information for a large panel of nearly 4,000 CEOs of S&P 1500 firms. Our starting point is to construct a database of the CEO labor market that contains detailed information on CEO successions. For details on variable definitions, see the appendix. We hand-collect our CEO succession data for the universe of all firms in ExecuComp from 1993 to 2005.¹⁸ We recognize a turnover for each year in which the identified CEO changes, which gives us a first sample of 2,357 candidate CEO succession events. We then search the Factiva news database to collect information about the circumstances around each succession. We exclude 67 successions that are directly related to a takeover and 95 successions involving interim CEOs. The final sample contains 2,195 CEO succession events for a total of 20,904 firm-year observations.¹⁹

We supplement this data set with measures that reflect publicly observable signals of CEO skills based on the quality of CEOs' educational and professional track records, as well as their outside reputations, to which we refer as CEO credentials. We summarize salient features of each CEO's resume into three measures of credentials. We detail these measures next.

2.1.1. Measure of Credentials Based on Press Coverage. The first proxy, *Press*, is a reputational signal that captures external parties' perceptions of CEO reputation. We construct *Press* by counting the number of articles containing the CEO's name and company affiliation that appear in the major U.S. and global business newspapers in the calendar year before CEO appointment. The choice of preappointment press is important in mitigating simultaneity concerns, as well as the concern that the press count might be capturing characteristics of the current firm employing the CEO, rather than CEO characteristics. In robustness tests, we

also consider an average of the annual press count in the three years before the transition. The newspapers considered and the search criteria are analogous to previous studies in the literature and listed in Online Appendix A. Our text search uses both the CEO's last name and company name (e.g., Akers and International Business Machines or IBM). We include an article only once, irrespective of how many times the CEO's name appears in the article. We classify CEOs with larger values of press coverage as more reputable.

With respect to the literature, we construct our reputational measure for a significantly larger cross section of firms and longer time-series.²⁰ For robustness, we develop a novel approach to overcome two potential concerns with *Press*. First, not all press is necessarily good press, and thus we screen articles to only include nonnegative press coverage. To screen for each article's tone, we check whether it includes words with a negative connotation. Online Appendix A contains a list of the precise words we use. The list was compiled by randomly sampling 50 CEOs and reading articles about them. We then return to our full sample and count the number of articles containing the CEO's name, company affiliation, and any of the words with a negative connotation that appear in the major U.S. and global business newspapers. This gives us a proxy for *Bad Press*, which we can use to construct *Press–Bad Press*.

A second concern is that *Press* might simply reflect coverage of the firm rather than the CEO. To ensure that the number of articles is not merely a reflection of luck or characteristics of the previous employer, we again screen the tone of each article to reflect positive personal traits of the CEO. The word list described in Online Appendix A was also compiled by randomly sampling 50 CEOs and reading articles about them, as well as based on the CEO abilities that are shown to matter in Kaplan et al. (2012). *Good Press* is a count of the number of articles that contain the CEO's name, company affiliation, and any of these positive words. We also consider ratios of *Press–Bad Press* and *Good Press* to the total *Press* count, which measure the share of good press in total press and are more likely reflect a CEO's own reputation rather than a firm's.

Our *Bad Press* and *Good Press* proxies are novel to the literature. The standard approach is to verify whether

¹⁸ ExecuComp roughly covers S&P 1500 firms. Parrino (1997) and Huson et al. (2001, 2004) use Forbes surveys; Jenter and Kanaan (2006) also use ExecuComp but only study departing CEOs for the 1993–2001 period.

¹⁹ We classify each CEO turnover according to whether it was forced or voluntary, and whether the incoming CEO is an insider or an outsider to the firm. We follow standard criteria in the literature that began with Parrino (1997) to classify forced turnovers, which is necessary since CEOs are rarely openly fired from their positions. We classify as outsiders those successor CEOs who had been with their firms for one year or less at the time of their appointments. All other new CEOs are classified as insiders. Finally, for each succession we determine exact announcement dates, which are the earliest dates of the news about the incumbent CEO departure and successor CEO appointment.

²⁰ Milbourn (2003) considers all ExecuComp firms as we do but only covers a six-year period (1993–1998). Rajgopal et al. (2006) consider a nine-year time period (1993–2001) but focus only on S&P 500 firms. Likely because of these differences, in our sample the median CEO gets approximately seven mentions in the press in a year. This is in line with previous studies, but somewhat lower than Rajgopal et al. (2006). However, when we consider only the S&P 500 subsample, we are closer to their median number of articles (13 in our sample versus 11 in theirs).

the Press variable is highly correlated with (*Press–Bad Press*) and *Good Press* only for a small, randomly selected sample of CEOs. Our strategy allows us to construct the *Good Press* and *Bad Press* for the entire sample so as to test directly their role in the CEO labor market. Another advantage of our approach is that we can offer a large sample validation of simple count measures (e.g., *Press*) typically used in the literature. The good news for the previous literature is that in our large sample, *Press–Bad Press* and *Good Press* are highly correlated with *Press* (0.9 and 0.6, respectively) since few negative articles ultimately appear in print.²¹

2.1.2. Measure of Credentials Based on Career Track Record. Our second proxy, *Fast-Track Career*, is the labor market signal and measures the quality of CEOs' career track records based on how fast they cleared the bar for their first CEO jobs.²² The intuition for why this variable is a signal of skills is based on competitive sorting theories of firm hierarchy where more talented individuals are assigned to those jobs, like CEO, that have the most impact and involve the most responsibility (see Rosen 1982, Kremer 1993). Thus, more talented executives will spend less time on the corporate ladder and sooner clear the CEO hurdle. A related spin would be that the hurdle for appointing a young CEO is higher since younger executives have less experience.²³

To construct this proxy, we collect detailed information about the complete career histories of CEOs from several standard biographical sources, such as *Dun & Bradstreet Reference Book of Corporate Managements* and *Marquis Who's Who in Finance and Industry* (see the appendix for the complete list of sources we used). Given the evidence of higher job mobility over the last two decades, an important concern with this proxy is that it might simply capture a cohort-effect, with younger cohorts of executives being able to get their first CEO job sooner, or common circumstances of the first CEO job (see Malmendier et al. 2011, Schoar 2007). To address this concern, we use a cohort-adjusted version of our measure where we divide our sample of CEOs into three age cohorts and here define *Fast-Track Career* as the difference between age of the first CEO job and median first CEO job age in that age cohort. Ultimately, this refined proxy classifies executives that got their first CEO job sooner than other executives in their age cohort as a more positive signal of ability.

²¹ See also Demerjian et al. (2012) for a novel measure of CEO ability.

²² In our analysis, we define *Fast-Track Career* as $1 - F(\text{Age of First CEO Job})$ such that a greater value of *Fast-Track Career* indicates that the CEO was actually younger when he first became a CEO.

²³ Support for this measure comes from the evidence by sociologists and work by Kaplan et al. (2012) that the selection process of corporate elites in the United States has been relatively meritocratic. See also Friedman and Tedlow (2003) for a comprehensive review of the literature, and Capelli and Hamori (2005) for evidence.

2.1.3. Measure of Credentials Based on Educational Track Record. Our third proxy, *Selective College*, is the schooling signal and measures the quality of the CEO's educational background. This variable provides a signal of skills based on theories of education where employees invest in costly acquisition of education credentials to send a signal about their skills to potential employers (Spence 1974). Using the same sources employed to collect career histories, we compile information on CEO academic histories and college attendance. We use Barron's *Profiles of American Colleges* (1980) rankings to sort CEOs into six groups depending on the selectivity of their undergraduate institution. Barron's assigns colleges to one of the following six bins: Most Competitive, Highly Competitive, Very Competitive, Competitive, Less Competitive, or Noncompetitive.

Thus, our proxy is defined as a numerical rank that takes values between 1 (worst) and 6 (best) depending on Barron's ranking of the undergraduate institution.²⁴ We verify that our results are robust to classifying CEOs with missing college information as less selective college CEOs, since CEOs are arguably more likely to disclose their alma mater when they attended prominent colleges. Since there are no available comprehensive rankings of foreign undergraduate institutions, in our main analysis we exclude these CEOs and classify them as less selective college CEOs in robustness tests. Although the schooling proxy has been used previously in the literature (see, e.g., Pérez-González 2006, Palia 2000), our study is, to the best of our knowledge, the first to employ it for a large cross section of CEOs as a signal of CEO abilities.

Table 1 presents an overview of our CEO succession data set. Panel A summarizes successor type for each year, and panel B contains the three subperiods covered by our sample, which are the first and second halves of the 1990s and first half of the 2000s. We are able to give a more comprehensive picture of the CEO labor market than previous studies since our sample includes a more detailed collection and larger cross section of firms.²⁵ These statistics suggest that the nature of the CEO labor market has changed significantly over the last decades. Both the likelihoods that a turnover is forced and that

²⁴ The top three classifications in Barron's (1980) are "Most Competitive," "Highly Competitive," and "Very Competitive," which include 33, 52, and 104 undergraduate institutions, respectively. We were able to find information on the college attended in 95% of the cases.

²⁵ Studies covering earlier periods use Forbes Compensation Surveys, which roughly include S&P 500 and S&P MidCap 400 firms. Denis and Denis (1995) cover a sample of 908 CEO successions between 1985 and 1988. Huson et al. (2001) and Huson et al. (2004) have 1,316 and 1,344 CEO successions, respectively, between 1971 and 1994. Murphy and Zábojník (2007) have 2,783 appointments between 1970 and 2005, which is a larger, but significantly less detailed, data set than ours.

Table 1 Overview of CEO Succession Sample

Year	Number of successions (% firms)	Number of forced successions	Number of outsiders appointed	Successor CEOs' credentials			
				Average press	Median age of first CEO job	Median college rank	Average CEO talent factor
Panel A: Sample distribution by year							
1993	110 (9.6%)	22 (20.0%)	31 (28.1%)	4.0	53	3	−0.09
1994	125 (8.1%)	31 (24.8%)	38 (30.4%)	6.1	53	3	−0.12
1995	158 (10.0%)	32 (20.5%)	52 (32.9%)	2.9	52	3	−0.21
1996	155 (9.5%)	45 (29.0%)	52 (33.5%)	5.3	51	3	−0.16
1997	185 (11.1%)	46 (24.9%)	63 (34.1%)	2.7	51	3	−0.06
1998	186 (10.8%)	49 (26.3%)	74 (39.8%)	9.0	51	3	−0.10
1999	224 (12.5%)	67 (29.9%)	85 (38.0%)	6.4	50	3	−0.05
2000	244 (13.6%)	59 (24.2%)	93 (38.1%)	9.5	49	3	−0.09
2001	173 (10.4%)	49 (28.3%)	67 (38.7%)	9.7	49	3	−0.03
2002	195 (11.8%)	68 (34.9%)	77 (39.5%)	13.2	49	3	0.06
2003	166 (9.9%)	40 (24.1%)	65 (34.3%)	10.2	49	3	0.20
2004	152 (9.8%)	37 (24.3%)	62 (40.8%)	7.4	48	3	0.22
2005	122 (9.5%)	30 (24.6%)	51 (41.8%)	10.2	48	3	0.27
Total	2,195 (10.5%)	575 (26.2%)	810 (36.9%)	7.9	50	3	0.00
Panel B: Annual averages by subperiod							
1993–1995	131 (9.2%)	28 (21.8%)	40 (30.5%)	4.2	53	3	−0.16
1996–2000	199 (11.5%)	53 (26.9%)	73 (36.7%)	6.8	50	3	−0.09
2001—2005	162 (10.3%)	45 (27.2%)	64 (39.0%)	10.2	49	3	0.14

Notes. The sample consists of 2,195 CEO successions between 1993 and 2005 for firms whose CEOs are covered by the ExecuComp database. This table presents an overview of the data set by showing the number and the frequency of forced, voluntary, and outside successions in the sample as well as the annual average of the three measures of CEO credentials, which are as follows: *Press*, the number of articles containing the CEO's name and company affiliation that appear in the major U.S. and global business newspapers in the calendar year before succession; *Fast-Track Career*, the age of the CEO at the start of the first CEO job; and *Selective College*, the standing in the Barron's (1980) rankings of the undergraduate institution attended by the CEO. *CEO Talent Factor* is extracted by using principal component analysis from *Press*, *Fast-Track Career*, and *Selective College* (the demeaned values using the sample average are shown). The classification of each succession into forced or voluntary is based on the Factiva news database search following Parrino (1997). Successions are classified as internal when incoming CEOs were hired by the firm earlier than a year before succession, and external otherwise. Successions due to mergers and spin-offs are excluded.

the new CEO comes from outside the firm increase over time and are higher than in previous decades.²⁶ In addition, boards have increasingly appointed CEOs with better credentials, especially for the case of the reputational and career ones.

Where it helps exposition, we also use our proxies jointly by aggregating them into a single CEO talent factor, whose annual averages are also reported in Table 1. Another advantage of this variable is that it helps to address potential measurement error and imperfect proxies issues that arise from the fact that our credentials measures are likely to be noisy.²⁷ We

use factor analysis²⁸ to combine the underlying proxies with weights chosen in a way that leans more heavily on proxies that more accurately reflect latent CEO abilities. The values of the factor loadings are obtained by using data for the entire ExecuComp sample and are 0.638 for *Press*, 0.646 for *Fast-Track Career*, and 0.465 for *Selective College*. Pairwise correlations between the proxies are shown in panel A of Table 2 for different subsamples.²⁹ The three proxies display significant

in the presence of classic measurement error, ordinary least squares (OLS) estimates will be attenuated (see Wooldridge 2002). Black and Smith (2006) conclude that OLS estimates may actually be biased upward despite attenuation.

²⁸ See Harman (1976) for details on factor analysis. Joreskog and Goldberger (1975) is an early study, and Heckman et al. (2006) and Black and Smith (2006) are more recent papers using factor analysis to address measurement error. We offer details on why this approach is effective in Online Appendix B.

²⁹ Pairwise correlations between the talent factor and the underlying credentials are 0.354 for *Press*, 0.506 for *Fast-Track Career*, and 0.216 for *Selective College*. Panel B of Table 2 contains summary statistics for both the outgoing CEO and the successor CEO, as well as some firm

²⁶ These trends and the overall frequency of forced (2.8%) and voluntary (10.4%) CEO turnovers in our sample are in line with recent studies (e.g., see Huson et al. 2001, who report 23.4% of forced to total turnovers for the 1989–1994 period). Murphy and Zábojník (2007) and Huson et al. (2001) report that, during the 1970s and 1980s, outside hires accounted for only 15%–17% of all CEO replacements, less than half as many as shown by our figures since 1998.

²⁷ In our context, the difference between each of our proxy variables and latent CEO abilities is measurement error. It is well known that

positive cross correlation, which supports their external validity and is consistent with the notion that they capture a common underlying talent factor.

3. Empirical Strategy and Baseline Results

To assess the relation between CEO credentials and pay (Hypothesis 1), we employ the following baseline empirical specification:

$$\ln(\text{CEO Pay}_{ijt}) = \alpha + \beta * \text{CDF}(\text{CEO Credentials}_{it}) + \gamma * \text{Controls}_{ijt} + \delta_t + \varepsilon_{ijt}, \quad (1)$$

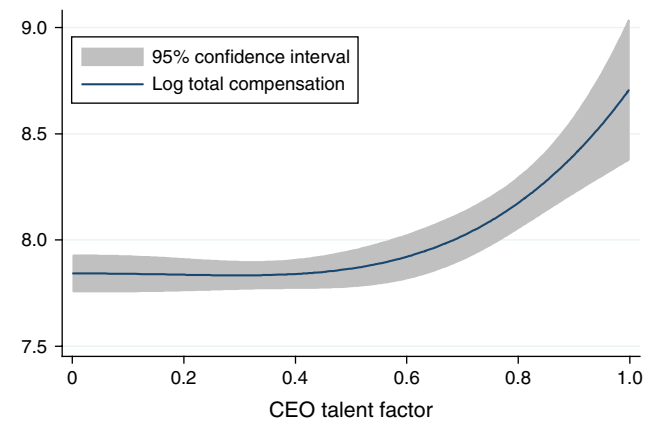
where executive i works at firm j in year t , and the dependent variable, CEO Pay_{ijt} , is the natural logarithm of total CEO pay. In our baseline analysis, we consider only newly appointed CEOs, whose credentials are more likely to be a useful external signal of ability since they do not yet have a performance record at the new job. In addition, appointment-year pay is closest to contractual pay set by boards at the time the initial terms of the pay packages are contracted, and thus represent the closest empirical counterpart to theory.³⁰ The key explanatory variable is *CEO Credentials* as measured interatively by *Press*, *Fast-Track Career*, and *Selective College*. To facilitate intuitive interpretation of the economic significance and allow for comparison between the coefficient estimates of the three proxies, we follow Aggarwal and Samwick (1999) and construct the cumulative distribution functions (CDFs) of our proxies.

We include controls for firm, CEO, and succession characteristics, such as firm size, CEO age, and inside succession, that have been found to be important covariates of pay in previous studies. The role of firm size in the CEO labor market is an important implication of competitive models such as ours. Previous research also suggests that CEO pay and turnover rates are a function of CEO age. Our controls also include observables that are likely to be selection variables, such as prior performance. All measures are at calendar year-end, and details of their definitions are in the appendix. Finally, we include year effects and 48 (Fama–French) industry fixed effects (Fama and French 1997). Since there can be multiple CEO appointments over our sample period for any one firm, we assess statistical significance using clustered standard errors adjusted

characteristics. Outgoing CEOs tend to rank lower than successor CEOs in terms of their credentials. Panel B.3 shows that average stock returns in the 12 months before a forced CEO turnover are approximately -28% , consistent with Kaplan and Minton (2012) and Jenter and Kanaan (2006).

³⁰ We complement this baseline analysis with estimates of Equation (1) for the entire ExecuComp sample, which includes years subsequent to CEO appointments.

Figure 1 Pay for CEO Credentials: New CEOs' Pay and Talent Factors



Notes. This figure plots the logarithm of total CEO pay (tdc1) against the distribution of the CEO talent factor quantiles for newly appointed CEOs from 1993 to 2005. Variable definitions are in the appendix.

for nonindependence of observations by firm. We will use our estimates of β to derive an implied dollar sensitivity of CEO pay to credentials.

As a first robustness check, we consider two more inclusive specifications. One includes more firm characteristics that are omitted from our baseline specification and may be correlated to both pay and credentials, thus confounding our inference.³¹ Another adds CEO pay in the CEO's prior position to the full list of firm-level controls. By including this additional control, we address the potential concern that CEO pay in the prior position may also be considered a signal of CEO ability and, as such, raises the question of whether credentials are an informative signal of CEO ability over and above prior pay. In additional robustness checks, we consider several alternative specifications, which include a fixed effects estimation that compares CEOs with different skills operating in the same firm and adding controls for alternative stories, such as CEO power and connections.

3.1. Baseline Analysis of Pay for CEO Credentials
Consistent with Hypothesis 1, univariate evidence plotted in Figure 1 shows that the relation between (the logarithm of) total pay of newly appointed CEOs and the CEO talent factor is flat for relatively low credentials and then increasing and convex as credentials rise. Table 3 presents results of our baseline regression analysis, which is aimed at quantifying the CEO skill premium in pay and evaluating which skills carry a

³¹ The additional firm-level controls are capital structure, liquidity and payout policy (leverage, dividend payout, and cash holdings), additional performance measures (Tobin's Q, return on assets (ROA), and cash flow), controls for investment and operating decisions (sales growth, research and development (R&D), and capital expenditures), and controls for firm risk (cash flow volatility, stock return volatility, and the number of diversifying mergers and acquisitions (M&As)).

Table 2 Summary Statistics

Panel A: Pairwise correlations among CEO credentials				
	<i>Press</i>	<i>Fast-Track Career</i>	<i>Selective College</i>	
A.1: All successions [<i>N</i> = 2,195]				
<i>Press</i>	1.000			
<i>Fast-Track Career</i>	0.144	1.000		
<i>Selective College</i>	0.075	0.065	1.000	
A.2: All successions, top quartile press [<i>N</i> = 548]				
<i>Press</i>	1.000			
<i>Fast-Track Career</i>	0.243	1.000		
<i>Selective College</i>	0.137	0.182	1.000	
Panel B: Average CEO credentials by succession type				
		Type of succession		
	All [<i>N</i> = 2,195]	Forced [<i>N</i> = 581]	Outside [<i>N</i> = 810]	Inside [<i>N</i> = 1,385]
B.1: Outgoing CEO				
CEO credentials				
<i>Press</i>	7.2	7.7	6	7.4
<i>Age of First CEO Job</i> (years)	49	46	48	49
<i>Selective College</i> (rank)	2.4	2.6	2.4	2.4
B.2: Successor CEO (standard deviation)				
CEO credentials				
<i>Press</i>	7.9 (19.9)	10.8	9.1	6.9
<i>Age of First CEO Job</i> (years)	49 (6.6)	45	48	50
<i>Selective College</i> (rank)	2.9 (1.4)	3.2	2.9	2.9
CEO pay				
<i>Total CEO Pay</i> (tdc1, \$M)	5.2 (6.4)	6.4 (7.1)	7.1 (7.8)	4.1 (5.4)
<i>Total CEO Pay</i> (log tdc1, \$000)	7.8 (1.1)	7.8	7.9	7.6
B.3: Firm variables (year prior to transition)				
<i>Size</i> (log total assets, \$mil)	7.4 (1.8)	7.3	7.1	7.6
<i>Firm Stock Return</i>	−14.1% (45.1%)	−28.3%	−21.4%	−10.1%
<i>Industry Stock Return</i>	13.9% (33.2%)	13.0%	14.7%	13.4%
<i>Industry-Adjusted OROA</i>	0.014 (0.20)	−0.022	−0.015	0.023
<i>GIM Index</i>	9 (2.7)	9	9	9
<i>Board Independence</i>	65% (17%)	64%	66%	64%

Notes. The sample consists of 2,195 CEO successions between 1993 and 2005 for firms whose CEOs are covered by the ExecuComp database. This table reports summary statistics of the key variables used in our analysis. Panel A shows pairwise correlations among our three measures of CEO credentials. Panel B shows summary statistics for CEO credentials, firm characteristics, and other CEO controls by CEO succession type. The three measures of CEO credentials are *Press*, which is the number of articles containing the CEO's name and company affiliation that appear in the major U.S. and global business newspapers in the calendar year before succession; *Fast-Track Career*, which is the age of the CEO upon taking the first CEO job; and *Selective College*, which is the standing in the Barron's (1980) rankings of the undergraduate institution attended by the CEO. Classification of each succession into forced or voluntary is based on the Factiva news database search following Parrino (1997). Successions are classified as internal when incoming CEOs were hired by the firm earlier than a year before succession, and external otherwise. See the appendix for additional details on the three measures of CEO credentials and for definitions of the controls.

higher pay premium. We estimate Equation (1), where the log of total dollar CEO compensation is regressed iteratively on our three measures of credentials, controlling for firm, CEO, and succession characteristics. In columns (1), (4), and (7), we report results for each of the three measures of credentials in this baseline specification, while results with the more inclusive set of firm-level controls are in columns (2), (5), and (8), and results that also include controls for the CEO's pay in the CEO's prior position are in columns (3), (6), and (9).

The estimates show that total compensation of newly appointed CEOs is positively and significantly associated with our three credentials measures, in both the baseline specification and in those with additional controls. The magnitude of the coefficient estimate for each measure is stable across specifications, suggesting that CEO credentials are not simply picking up observable characteristics of the newly employing firm or CEO's pay in the prior position.³² Our estimates imply

³² Although we do not report it, we continue to control for CEO's prior pay in the estimations summarized in Tables 4–6.

Table 3 Pay for CEO Credentials: Baseline Regression Analysis

Dependent variable: Log total annual compensation, appointment year only									
	(1) Baseline	(2) More firm controls	(3) Control for prior pay	(4) Baseline	(5) More firm controls	(6) Control for prior pay	(7) Baseline	(8) More firm controls	(9) Control for prior pay
CEO credentials									
<i>Press</i>	0.544*** (0.097)	0.516*** (0.095)	0.419*** (0.124)						
<i>Fast-Track Career</i>				0.459*** (0.168)	0.454*** (0.172)	0.547*** (0.191)			
<i>Selective College</i>							0.201** (0.088)	0.225** (0.113)	0.261** (0.131)
Firm, succession, and CEO controls									
<i>Stock Return_{t-1}</i>	0.122** (0.056)	0.036 (0.054)	0.119 (0.074)	−0.033 (0.048)	−0.081 (0.054)	0.047 (0.078)	0.145** (0.058)	0.081 (0.054)	0.174*** (0.057)
<i>Firm Size</i>	0.379*** (0.017)	0.410*** (0.019)	0.344*** (0.031)	0.425*** (0.015)	0.410*** (0.019)	0.378*** (0.024)	0.393*** (0.018)	0.411*** (0.019)	0.308*** (0.036)
<i>CEO Age</i>	−0.013*** (0.005)	−0.016*** (0.005)	−0.016*** (0.005)	−0.019*** (0.007)	−0.026*** (0.008)	−0.021** (0.010)	−0.011** (0.005)	−0.010** (0.004)	−0.010** (0.004)
<i>Insider Succession</i>	−0.365*** (0.051)	−0.268*** (0.049)	−0.110 (0.082)	−0.481*** (0.059)	−0.425*** (0.076)	−0.101 (0.079)	−0.147 (0.109)	−0.167 (0.120)	−0.105 (0.083)
<i>Forced Succession</i>	0.076 (0.062)	0.073 (0.061)	0.081 (0.092)	0.127* (0.070)	0.055 (0.074)	0.169* (0.091)	0.063 (0.071)	0.054 (0.074)	0.108 (0.139)
<i>CEO Prior Pay</i>			0.151*** (0.043)			0.104*** (0.036)			0.219*** (0.073)
More firm controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>R</i> ² (%)	32.7	35.5	39.7	41.1	42.4	46.8	44.1	46.9	51.3
Observations	2,122	2,122	1,052	1,828	1,828	968	1,779	1,779	892
Implied pay—credentials sensitivity (\$000 pay—1% credentials)									
<i>Press</i>	28.4								
<i>Fast-Track Career</i>				24.0					
<i>Selective College</i>							10.5		

Notes. This table reports estimates of OLS regressions of total CEO pay on measures of CEO credentials from 1993 to 2005 for newly appointed CEOs. The dependent variable is the logarithm of total pay (tdc1). We iteratively employ the three measures of CEO credentials—*Press*, *Fast-Track Career*, and *Selective College*—each in three different specifications: a baseline specification with year and (Fama–French 48) industry fixed effects, as well as controls for firm, successions, and other CEO characteristics that have been shown in previous research to affect total CEO pay (columns (1), (4), and (7)); a specification that adds firm (book) leverage, dividend payout, Tobin's Q, ROA, cash flow, cash holdings, sales growth, R&D, capital expenditures, stock returns and cash flow volatilities, and the number of diversifying M&As (columns (2), (5), and (8)); and a specification that further adds CEO (log) total pay in the job before each appointment (columns (3), (6), and (9)). Variable definitions are in the appendix. Robust clustered standard errors adjusted for nonindependence of observations by firm are reported in parentheses.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Implied sensitivity is evaluated at the sample mean of pay.

an empirical sensitivity of first-year total CEO pay to credentials ranging from approximately 0.5 for *Press* and *Fast-Track Career* to approximately 0.2 for *Selective College*. This evidence suggests that better credentials carry a pay premium for CEOs, as per Hypothesis 1, and that more current reputational and labor market credentials matter much more than lagging school rankings.

How economically important is our finding of pay for credentials? Our estimates imply that CEOs who are one decile higher in the distribution of credentials earn up to 5% higher total pay. Given our semilog

specification of (1), we can write the implied expected change in dollar compensation as

$$\frac{dE(\text{CEO Pay})}{d\text{CEO Credentials}} = (d \exp\{\alpha + \beta * \text{CEO Credentials}_{it} + \gamma * \text{Controls}_{ijt} + \delta_i\}) \cdot (d\text{CEO Credentials})^{-1}. \quad (2)$$

Using our estimates in Table 3 and the average first-year CEO pay of \$5.2 million, we can calculate the dollar comparative static for going from the worst to the best of each of our credentials. For example, the dollar effect

of *Press* is given by $dE(\text{CEO Pay})/d\text{Press} = E(W) * \beta = \$5.2 \text{ M} * 0.544 = \2.8 M . Therefore, an improvement from the worst to the best *Press* credential carries an initial pay premium of approximately \$2.8 M, which is certainly economically significant at more than half of the sample mean. The effect of an improvement in the *Fast-Track Career* credential is quantitatively similar. The *Selective College* credential's effect is approximately \$1 M, which is still economically significant at approximately 20% of the sample mean.

Next, we examine the cross-sectional features of pay for CEO credentials—convexity and complementarity with firm size—from Hypothesis 1. We consider a variant of our baseline framework that includes a piecewise linear specification of the credentials measures. Table 4 presents results of our test of convexity, with the full set of controls included in the estimation but unreported.³³ The estimates imply that the relation between total compensation of newly appointed CEOs and each of our three credentials measures is highly convex, with an empirical pay-to-credentials sensitivity of more than 10 for *Press* and *Fast-Track Career* and approximately 1 for above-median CEOs based on *Selective College*³⁴ for newly appointed CEOs whose credentials are in the top 10%. These estimates imply that, for the top-decile CEOs, each percentile improvement in the credentials distribution carries a premium of up to approximately \$690,000. These sensitivities are negligible, albeit still positive, for CEOs with poorer credentials, consistent with a “superstar effect” à la Rosen (1981).

Table 5 presents the results of our test of complementarity with firm size. Here we use each of the three credentials measures interacted with dummies for firm-size terciles to test whether there is heterogeneity in the relation between the talent premium and firm size.³⁵ The relation between pay and CEO credentials is significantly more positive for larger firms (middle

and top terciles), with an empirical sensitivity of total pay to credentials for newly appointed CEOs at firms in the top size tercile ranging from approximately 1 for *Press* and *Fast-Track Career* to approximately 0.5 for *Selective College*. In dollar terms, the credentials premium implied is up to \$77,000 per credential percentile for CEOs running larger firms. Although still positive, the credentials premium is small and insignificant for the smallest firms, consistent with the complementary relation between credentials and firm size in Hypothesis 1.

4. Interpreting Pay for CEO Credentials

In an attempt to sharpen our inference, we next examine whether the link between CEO credentials and firm performance is as predicted in Hypothesis 2. These performance tests help to clarify the economic mechanism behind the credentials pay premium, which for market-based theories is due to the fact that it is efficient for more talented CEOs to run larger firms since CEO skills complement firms' physical assets. Thus, if boards rely on credentials as proxies for productive abilities, CEOs with better credentials should have a positive impact on firm performance and more so at larger firms. Another advantage of this analysis is that it quantifies the returns to CEO skills for shareholders.³⁶

4.1. Analysis of Firm Performance

Univariate evidence on the relation between CEO credentials and firm operating performance is plotted in Figure 2. The figure plots sample median operating returns on assets (OROA) over the period from four years before to four years after CEO succession for our entire succession sample. The dotted line represents median OROA for the entire sample, whereas the bold line represents median OROA for new CEOs with better reputational credentials (top quartile of CEO talent factor), and the thin line represents median OROA for bottom-quartile CEOs. The OROA “smile” suggests that, on average, CEO turnover follows a period of deteriorating firm performance that tends to be reversed subsequently. A striking feature that emerges is that the smile is an artifact of averaging out performance in a sample that pools CEOs with good credentials together with relatively less accomplished ones.

Table 6 presents results of our regression analysis of firm performance. We estimate a version of Equation (1)

³³ In columns (1), (4), and (7), we report results for piecewise linear splines of each of the three measures of credentials in the baseline specification, while results for the specification with the fuller set of firm-level controls are in columns (2), (5), and (8), and results for the specification that also controls for the CEO's pay in the CEO's prior position are in columns (3), (6), and (9). In additional tests reported in Table A.3, which appears in Online Appendix D, we show that the results are robust to using an alternative specification that includes our continuous measures and their squared term.

³⁴ This coarser variable does not allow for a richer spline.

³⁵ As above, in columns (1), (4), and (7), we report results for interactions of each of the three measures of credentials in the baseline specification, while results for the specification with the fuller set of firm-level controls are in columns (2), (5), and (8), and results for the specification that also controls for CEO's pay in the CEO's prior position are in columns (3), (6), and (9). In additional tests reported in Table A.3, we show that the results are robust to using an alternative specification that includes our continuous measures and their interaction with firm size.

³⁶ Yet another advantage of these performance tests is that we can distinguish between interpretations based on talent versus those based on hype (Khurana 2002 and Malmendier and Tate 2009), which would consider CEOs with better credentials as charismatic, “hyped up” CEOs who attract attention initially but subsequently underwhelm. If credentials are an indication of temporary hype, we should see disappointing subsequent performance.

Table 4 Pay for CEO Credentials: Convexity

Dependent variable: Log total annual compensation, appointment year only									
	(1) Baseline	(2) More firm controls	(3) Control for prior pay	(4) Baseline	(5) More firm controls	(6) Control for prior pay	(7) Baseline	(8) More firm controls	(9) Control for prior pay
<i>Press</i> (< 50%)	0.146 (0.161)	0.293* (0.172)	0.041 (0.200)						
<i>Press</i> (50% < <i>X</i> < 90%)	2.968*** (0.252)	2.780*** (0.286)	2.070*** (0.353)						
<i>Press</i> (> 90%)	13.198*** (2.028)	10.678*** (2.458)	9.996*** (3.450)						
<i>Fast-Track Career</i> (< 50%)				0.166 (0.215)	0.171 (0.222)	0.271 (0.380)			
<i>Fast-Track Career</i> (50% < <i>X</i> < 90%)				1.785** (0.741)	1.751** (0.882)	1.910** (0.963)			
<i>Fast-Track Career</i> (> 90%)				11.620** (4.867)	13.139** (5.384)	14.445** (6.809)			
<i>Selective College</i> (< 50%)							0.024 (0.158)	0.106 (0.161)	0.043 (0.199)
<i>Selective College</i> (> 50%)							1.118** (0.495)	1.097*** (0.413)	1.091** (0.464)
Firm, succession, and CEO controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
More firm controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>R</i> ² (%)	36.4	40.9	46.1	45.8	49.8	54.2	46.1	50.5	53.3
Observations	2,122	2,122	1,052	1,828	1,828	968	1,779	1,779	892
Implied pay—credentials sensitivity for CEOs in top credential bracket (\$000 pay–1% credentials)									
<i>Press</i>	689.9								
<i>Fast-Track Career</i>				607.4					
<i>Selective College</i>							58.4		

Notes. This table reports estimates of OLS regressions of total CEO pay on measures of CEO credentials from 1993 to 2005 for newly appointed CEOs. The dependent variable is the logarithm of total pay (tdc1). We iteratively employ the three measures of CEO credentials—*Press*, *Fast-Track Career*, and *Selective College*—in a piece-wise linear specification that uses splines of the underlying measures to allow for heterogeneity in pay for CEO credentials depending on different ranges of the distribution of CEO credentials. We present results for the piece-wise linear splines of the CEO credentials variables each in three different specifications: a baseline specification with year and (Fama–French 48) industry fixed effects, as well as controls for firm, successions, and other CEO characteristics that have been shown in previous research to affect total CEO pay (columns (1), (4), and (7)); a specification that adds firm (book) leverage, dividend payout, Tobin's *Q*, ROA, cash flow, cash holdings, sales growth, R&D, capital expenditures, stock returns and cash flow volatilities, and the number of diversifying M&As (columns (2), (5), and (8)); and a specification that further adds CEO (log) total pay in the job before each appointment (columns (3), (6), and (9)). All specifications include year and (Fama–French 48) industry fixed effects, as well as controls for firm, successions, and other CEO characteristics that have been shown in previous research to affect total CEO pay. Variable definitions are in the appendix. Robust clustered standard errors adjusted for nonindependence of observations by firm are reported in parentheses.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Implied sensitivity is evaluated at the sample mean of total CEO pay.

where now the dependent variables are changes around CEO successions in various industry-adjusted measures of stock returns and long-term operating firm performance. The changes in these measures are regressed iteratively on our three measures of credentials as well as on the CEO talent factor and controls.³⁷ We test whether there are significant differences in firm operating performance before and after CEO successions for firms that appoint CEOs with superior credentials

versus firms that appoint relatively less accomplished CEOs. The advantage of this approach, which is akin to difference in differences, is that we can estimate CEO impact in a setting that explicitly controls for time-invariant differences in firm characteristics that may affect performance (see Pérez-González 2006 for a similar approach in the context of family successions).

In column (1) of Table 6, we examine short-run cumulative abnormal returns (CARs) around CEO appointments to examine whether investors anticipate subsequent performance improvements. Investor reaction to CEO appointments is significantly more positive when they involve CEOs with better credentials. The

³⁷ To control for mean-reversion, we include in all specifications prior performance measured as average annual performance in the three years before transition.

Table 5 Pay for CEO Credentials: Complementarity with Firm Size

Dependent variable: Log total annual compensation, appointment year only									
	(1) Baseline	(2) More firm controls	(3) Control for prior pay	(4) Baseline	(5) More firm controls	(6) Control for prior pay	(7) Baseline	(8) More firm controls	(9) Control for prior pay
<i>Press</i> × <i>Small Firm</i>	0.148 (0.198)	0.178 (0.198)	0.060 (0.186)						
<i>Press</i> × <i>Medium Firm</i>	0.560*** (0.211)	0.531*** (0.206)	0.744** (0.295)						
<i>Press</i> × <i>Large Firm</i>	1.139*** (0.243)	1.145*** (0.240)	1.006*** (0.228)						
<i>Fast-Track Career</i> × <i>Small Firm</i>				0.098 (0.111)	0.088 (0.119)	0.053 (0.153)			
<i>Fast-Track Career</i> × <i>Medium Firm</i>				0.362** (0.164)	0.467*** (0.173)	0.433*** (0.140)			
<i>Fast-Track Career</i> × <i>Large Firm</i>				1.473*** (0.382)	1.127** (0.470)	1.706*** (0.348)			
<i>Selective College</i> × <i>Small Firm</i>							0.093 (0.120)	0.018 (0.121)	0.028 (0.099)
<i>Selective College</i> × <i>Medium Firm</i>							0.138 (0.131)	0.102 (0.111)	0.064 (0.120)
<i>Selective College</i> × <i>Large Firm</i>							0.474** (0.194)	0.468** (0.203)	0.645** (0.287)
Firm, succession, and CEO controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
More firm controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R ² (%)	35.4	41.5	44.9	43.3	48.8	52.8	45.1	50.7	55.5
Observations	2,122	2,122	1,052	1,828	1,828	968	1,779	1,779	892
Implied pay–credentials sensitivity for large firms (\$000 pay–1% credentials)									
<i>Press</i>	59.5								
<i>Fast-Track Career</i>				77.0					
<i>Selective College</i>							24.8		

Notes. This table reports estimates of OLS regressions of total CEO pay on measures of CEO credentials from 1993 to 2005 for newly appointed CEOs. The dependent variable is the logarithm of total pay (tdc1). We iteratively employ the three measures of CEO credentials—*Press*, *Fast-Track Career*, and *Selective College*—in a piece-wise linear specification that uses interactions of the underlying measures with three dummies for small, medium, and large firms to allow for heterogeneity in pay for CEO credentials depending on different ranges of the distribution of firm size. We present results for the interaction of the CEO credentials variables each in three different specifications: a baseline specification with year and (Fama–French 48) industry fixed effects, as well as controls for firm, successions, and other CEO characteristics that have been shown in previous research to affect total CEO pay (columns (1), (4), and (7)); a specification that adds firm (book) leverage, dividend payout, Tobin's Q, ROA, cash flow, cash holdings, sales growth, R&D, capital expenditures, stock returns and cash flow volatilities, and the number of diversifying M&As (columns (2), (5), and (8)); and a specification that further adds CEO (log) total pay in the job prior to each appointment (columns (3), (6), and (9)). Variable definitions are in the appendix. Robust clustered standard errors adjusted for nonindependence of observations by firm are reported in parentheses.

** and *** denote statistical significance at the 5% and 1% levels, respectively. Implied sensitivity is evaluated at the sample mean of total CEO pay.

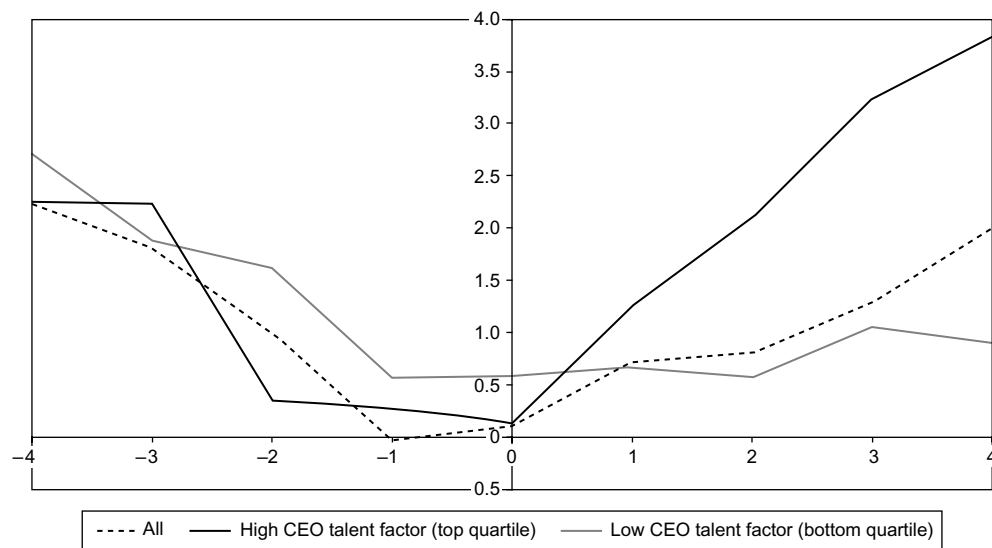
positive impact of credentials is in contrast to findings of previous studies that tend to find insignificant average returns for CEO appointments (e.g., Huson et al. 2004), suggesting that the average effect masks significant cross-sectional heterogeneity. Columns (2)–(7) report our main results, with long-term operating performance measured by net income to assets (ROA), operating return on assets (OROA), operating return on sales (OROS), return on equity (ROE), stock market returns, and cash flows, respectively.³⁸ For every

performance measure, we uncover estimates of the sensitivity of operating performance to CEO credentials that are positive and strongly statistically significant, with a sensitivity of first-year total CEO pay to credentials ranging from up to approximately 0.05 for *Press* and *Fast-Track Career* to approximately 0.03 for *Selective College*. These estimates imply that replacing the CEO of median talent in our sample with the most talented CEOs would have a positive impact on firm performance of 1.7%–2.5%. This estimate of CEO impact is in line with the 1.7% impact of CEO deaths in Bennedsen et al. (2006).

Finally, column (8) of Table 6 considers ROA in a specification that adds appointment CARs and an interaction term between them and the CEO talent factor

³⁸ These measures address the potential concern with announcement CARs that an anticipated positive impact of credentials does not necessarily imply a realized positive impact, since investors might irrationally overreact (Khurana 2002).

Figure 2 CEO Credentials and Firm Performance



Notes. This figure plots median industry-adjusted operating return on assets (OROA) around CEO succession events from 1993 to 2005. The dotted line refers to the entire sample, while the thin (bold) line is for the subsample of successions involving newly appointed CEOs in the bottom (top) quartile of the CEO talent factor. Variable definitions are in the appendix.

(estimate of the interaction term reported) to allow for heterogeneity in the predictive power of short-term CARs depending on CEO credentials. Here we see that the investors' reaction is a better predictor of subsequent long-term performance for CEOs with better credentials, suggesting that credentials are in fact an informative signal of future performance. In additional results reported in Table A.4 of Online Appendix D, we have examined firm policies in an attempt to further clarify the economic mechanism behind the credentials pay premium pay and understand what it is exactly that CEOs with superior credentials manage to do better than their less-accomplished peers. Our estimates show that CEOs with better credentials are significantly more likely to cut capital and M&A expenditures, shed excess capacity (divest existing divisions), cut leverage and increase internal financing (cash), and increase firm focus, suggesting that the performance improvements are reflective of standard turnaround and reorganization skills rather than greater risk taking.

Next, we assess the cross-sectional features of the performance impact of CEO credentials from Hypothesis 2. Table 7 presents results of our test of complementarity with firm size. For brevity, we use the CEO talent factor to summarize the three proxies, and we interact it with dummies for firm-size terciles to test whether the performance impact of credentials varies systematically across firms of different sizes. The performance impact of CEO credentials is significantly more positive for larger firms (middle and top terciles), with an empirical sensitivity of performance to credentials of up to 0.1 for newly appointed CEOs at firms in the top size tercile. Again, although still positive, the impact is

small and insignificant for the smallest firms. In all, consistent with Hypothesis 2 and for a wide array of operating performance metrics, we document a reliably positive performance impact of CEO credentials that is concentrated among large firms. Reputational and labor market credentials have the largest impact. Also consistent with market-based theories, the impact of credentials on performance is an order of magnitude smaller than on pay.

4.2. Additional Validation of Credentials Proxies

We probe the validity of our proxies in two more ways. First, we show that the credentials pay premium increases significantly after industry shocks that are likely to increase the performance impact of CEO skills. We consider several industry shocks, which include shocks to technology (Juhn et al. 1993), growth opportunities (Harford 2005), organizational capital (Caroli and Van Reenen 2001), and product market competition (Guadalupe 2007). Because it is not obvious why potential omitted variables would have a stronger systematic effect on the credentials premium across various industry groups over time, cross industry contrasts should further limit the risk of spurious correlation and, as such, help to corroborate a talent interpretation of our baseline estimates.³⁹ Results are reported in Table 8, which shows that pay for credentials increases robustly in response to these industry shocks. The estimates are particularly strong for shocks to organizational capital

³⁹ An additional advantage of considering industry shocks is that we estimate specifications with fixed effects that capture either within-firm or within-CEO variation around the shocks.

Table 6 Interpreting Pay for CEO Credentials: Baseline Analysis of Long-Term Firm Performance

Dependent variable: Long-term firm performance								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Appointment CARs	ROA	OROA	OROS	ROE	Stock returns	Cash flows	ROA–CARs correlation
CEO credentials								
[1] <i>Press</i>	0.023** (0.011)	0.045*** (0.016)	0.047*** (0.017)	0.045*** (0.016)	0.051** (0.025)	0.094*** (0.033)	0.203** (0.094)	0.346** (0.148)
[2] <i>Fast-Track Career</i>	0.020** (0.008)	0.038** (0.018)	0.044** (0.020)	0.041** (0.019)	0.046** (0.023)	0.090** (0.042)	0.183** (0.081)	0.323*** (0.086)
[3] <i>Selective College</i>	0.009** (0.004)	0.028** (0.013)	0.024** (0.011)	0.029** (0.014)	0.032** (0.016)	0.057** (0.027)	0.105* (0.059)	0.101 (0.154)
[4] <i>CEO Talent Factor</i>	0.018** (0.009)	0.034*** (0.013)	0.042*** (0.015)	0.044** (0.020)	0.049** (0.024)	0.098*** (0.039)	0.205** (0.099)	0.403*** (0.155)
Firm, succession, and other CEO controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,771	871	891	887	814	776	718	871
Implied performance–credentials sensitivity (% return–10% credentials)								
<i>CEO Talent Factor</i>		0.3	0.4	0.4	0.5			

Notes. This table reports estimates of OLS regressions of measures of long-term operating firm performance on measures of CEO credentials from 1993 to 2005 for newly appointed CEOs. All dependent variables in columns (2)–(7) are changes in industry-adjusted long-term operating firm performance, which are calculated as the difference between average annual industry-adjusted performance in the three years subsequent to the CEO appointment and annual industry-adjusted performance in the year prior to the transition (appointment years are excluded). We iteratively employ the three measures of CEO credentials—*Press*, *Fast-Track Career*, and *Selective College*—as well as the CEO talent factor, which is a factor extracted by using principal component analysis. All specifications include year and (Fama–French 48) industry fixed effects, as well as the same controls for firm, successions, and other CEO characteristics as in the baseline regression analysis of CEO pay (Table 3). To control for mean-reversion, all specifications also include average annual performance in the three years before transition. The dependent variable in column (1) is short-run cumulative abnormal returns (CARs) around CEO appointments. Abnormal returns are calculated by using the capital asset pricing model (CAPM). The (–2, +2) window of analysis is relative to actual announcement dates of CEO appointments (in days), where $t = 0$ is the day of the announcement. The dependent variables in columns (2)–(7) are net income to assets (ROA), operating return on assets (OROA), operating return on sales (OROS), return on equity (ROE), stock market returns, and cash flows, respectively. Column (8) adds appointment CARs and an interaction term between appointment CARs and the CEO talent factor to the specification in column (2) and reports the estimate of the interaction term. Variable definitions are in the appendix. Robust clustered standard errors adjusted for nonindependence of observations by executive are reported in parentheses.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

in columns (5) and (6), for which the sensitivity of total CEO pay to credentials increases by approximately 0.34 on impact, which is an economically significant effect and corresponds to a cumulative dollar effect of an approximately \$320,000 higher premium per credentials decile.

Second, we offer additional evidence validating our hypothesis that credentials act as proxy for otherwise hard-to-observe skills. To that end, we run a version of regression (1) that adds executive fixed effects, drops the credentials proxies, and uses the entire ExecuComp panel.⁴⁰ Consistent with standard findings in the literature on managerial traits (Bertrand and Schoar 2003, Graham et al. 2012), this regression achieves an R^2 of approximately 75%, suggesting that relatively time-invariant CEO characteristics explain a large portion of total variation in CEO pay. Important and still-open questions, however, are how this unobserved CEO heterogeneity should be interpreted and to what extent

managerial traits reflect CEO skills. After saving the “first-stage” estimates of the implied CEO fixed effects from regression (1), we run a “second-stage” regression where the estimated fixed effects are the dependent variable, and the explanatory variables are our CEO credentials proxies as well as several CEO characteristics that have been previously examined in the literature, which include an MBA degree dummy and CEO age (used, e.g., in Bertrand and Schoar 2003) and a CEO general human capital factor based on Custodio et al. (2013). We find that our three credentials measures all display a strong, statistically significant, and positive correlation with unobserved CEO heterogeneity in pay, which is consistent with credentials picking up otherwise hard-to-observe skills. In addition, we ask how much of the variation in CEO pay fixed effects we can explain with our CEO talent proxies. The answer is quite a bit, up to 25%. This constitutes a significant improvement over the other previously used characteristics, which, also consistent with standard findings in the literature, have only limited explanatory power (given by an R^2 of 5% in our regression).

⁴⁰ In unreported results available upon request, we replicate this executive fixed effects analysis for firm performance, which yields qualitatively similar conclusions.

Table 7 Interpreting Pay for CEO Credentials: Long-Term Firm Performance Impact and Complementarity with Firm Size

	Dependent variable: Long-term firm performance						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Appointment CARs	ROA	OROA	OROS	ROE	Stock returns	Cash flows
CEO credentials							
CEO Talent Factor \times Small Firm	0.003 (0.013)	0.017 (0.019)	0.019 (0.019)	0.010 (0.023)	0.001 (0.003)	0.027 (0.050)	0.088 (0.191)
CEO Talent Factor \times Medium Firm	0.017** (0.009)	0.035** (0.017)	0.040 (0.033)	0.043** (0.020)	0.065** (0.028)	0.082* (0.048)	0.147* (0.085)
CEO Talent Factor \times Large Firm	0.023** (0.011)	0.056*** (0.021)	0.054*** (0.019)	0.057** (0.026)	0.101** (0.046)	0.140** (0.067)	0.213** (0.106)
Firm, succession, and other CEO controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,771	871	891	887	814	776	718
Implied performance–credentials sensitivity for large firms (% return–10% credentials)							
CEO Talent Factor \times Large Firm		0.6	0.5	0.6	1.0		

Notes. This table reports estimates of OLS regressions of measures of long-term operating firm performance on measures of CEO credentials from 1993 to 2005 for newly appointed CEOs. All dependent variables in columns (2)–(7) are changes in industry-adjusted long-term operating firm performance, which are calculated as the difference between average annual industry-adjusted performance in the three years subsequent to the CEO appointment and annual industry-adjusted performance in the year before the transition (appointment years are excluded). We employ the CEO talent factor, which is a factor extracted by using principal component analysis on the three measures of CEO credentials (*Press*, *Fast-Track Career*, and *Selective College*), in a piece-wise linear specification that uses interactions of the underlying measures with three dummies for small, medium, and large firms to allow for heterogeneity in the performance impact of CEO credentials depending on different ranges of the distribution of firm size. All specifications include year and (Fama–French 48) industry fixed effects, as well as the same controls for firm, successions, and other CEO characteristics as in the baseline regression analysis of CEO pay (Table 3). To control for mean-reversion, all specifications also include average annual performance in the three years prior to transition. The dependent variable in column (1) is short-run cumulative abnormal returns (CARs) around CEO appointments. Abnormal returns are calculated by using the capital asset pricing model (CAPM). The (–2, +2) window of analysis is relative to actual announcement dates of CEO appointments (in days), where $t = 0$ is the day of the announcement. The dependent variables in columns (2)–(7) are net income to assets (ROA), operating return on assets (OROA), operating return on sales (OROS), return on equity (ROE), stock market returns, and cash flows, respectively. Column (8) adds appointment CARs and an interaction term between appointment CARs and the CEO talent factor to the specification in column (2) and reports the estimate of the interaction term. Variable definitions are in the appendix. Robust clustered standard errors adjusted for nonindependence of observations by executive are reported in parentheses.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

In all, this evidence supports a market-based view of CEO credentials. Our approach helps to make progress on the important question of how managerial effects are best interpreted and suggests that to a large extent they reflect talent, which is also confirmed by the fact that our estimates are in line with the 1.7% impact of CEO deaths in Bennedsen et al. (2006).

5. Assessing Pay for CEO Credentials

What is there to learn from our analysis about fundamental current issues in executive compensation? In this section, we show evidence of a rising credentials premium in CEO pay over the last two decades and argue that this finding offers a novel perspective over key stylized facts of the overall trend on CEO pay (see Jensen et al. 2011 for a recent detailed discussion of these well-established trends). The results presented in Table 9 consider these trends in turn for the entire ExecuComp sample and for a subsample of freshly appointed CEOs, respectively. For any given stylized fact, we present first estimates of specifications with time trend indicator variables that refer to three subpartitions of our overall time period, 1993–1995, 1996–2000,

and 2001–2005. We then present results for specifications that add interactions of these time dummies with our CEO talent factor variable to explore differential trends depending on the level of CEO credentials.⁴¹

Estimates for the time dummies in column (1) of Table 9 replicate the well-known result that there was a strong upward trend in CEO pay over the 1990s and 2000s. Column (2) shows that the upward trend was approximately twice as large in magnitude for CEOs at the top of the credentials ladder relative to those at the bottom. Strikingly, looking at the results for recently appointed CEOs in panel B, there is no significant trend for CEOs with the lowest credentials. Thus, especially among newly appointed CEOs, a rising premium for CEO credentials can help to explain the overall trend. Columns (3) and (4) show that the trend was somewhat more pronounced among outside hires and that a rising credentials premium does a particularly good job at explaining the overall trend among these CEOs.

⁴¹ All specifications include firm fixed effects, as well as controls for the same set of firm, successions, and other CEO characteristics that are included in our baseline specification (Table 3).

Table 8 Interpreting Pay for CEO Credentials: Industry Shocks

Dependent variable: Log total annual compensation, all ExecuComp										
	Technology		Growth opportunities		Organizational capital		Domestic competition		Foreign competition	
	(1) Firm FE	(2) CEO FE	(3) Firm FE	(4) CEO FE	(5) Firm FE	(6) CEO FE	(7) Firm FE	(8) CEO FE	(9) Firm FE	(10) CEO FE
<i>CEO Talent Factor</i>	0.150* (0.085)	0.199* (0.113)	0.200** (0.088)	0.152** (0.089)	0.158* (0.093)	0.162* (0.086)	0.243*** (0.071)	0.202** (0.080)	0.230* (0.129)	0.277** (0.140)
<i>CEO Talent Factor</i> × <i>Industry Shock_{t-1}</i>	0.074 (0.065)	0.084 (0.078)	0.119** (0.059)	0.113* (0.059)	0.343*** (0.105)	0.318*** (0.119)	0.117** (0.053)	0.114** (0.055)	0.445** (0.226)	0.074 (0.186)
<i>CEO Talent Factor</i> × <i>Industry Shock_{t-2}</i>	0.184*** (0.062)	0.159** (0.073)	0.020 (0.053)	0.023 (0.056)	0.233** (0.094)	0.144 (0.105)	0.114** (0.046)	0.129*** (0.050)	0.298* (0.179)	0.117 (0.225)
<i>CEO Talent Factor</i> × <i>Industry Shock_{t-3}</i>	0.174** (0.072)	0.217** (0.087)	0.033 (0.054)	0.006 (0.057)	0.149* (0.083)	0.108 (0.097)	0.059 (0.051)	0.063 (0.055)	0.007 (0.118)	0.227** (0.111)
Firm, succession, and CEO controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
CEO FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
<i>R</i> ² (%)	71.7	73.7	71.3	72.7	68.1	71.3	68.7	71.7	69.6	73.9
Observations	6,167	6,167	12,747	12,747	12,747	12,747	12,747	12,747	6,124	6,124

Notes. This table reports estimates of OLS regressions of total CEO pay on a measure of CEO credentials and its interaction with a variety of industry-wide economic shocks from 1993 to 2005 for all CEOs in ExecuComp. The dependent variable is the logarithm of total pay (tdc1). The measure of CEO credentials—CEO talent factor—is a factor extracted by using principal component analysis from *Press*, *Fast-Track Career*, and *Selective College*. All specifications include year and either firm (columns (1), (3), (5), (7), and (9)) or CEO (columns (2), (4), (6), (8), and (10)) fixed effects, as well as controls for firm, successions, and other CEO characteristics that have been shown in previous research to affect total CEO pay. Columns (1) and (2) report results for technology shocks, which are defined as a dummy that equals one in those industry-years with high growth in the intensity of investment in information technology (IT) capital. Columns (3) and (4) refer to industry shocks to growth opportunities, which are defined as a dummy that equals one in those industry-years with high growth opportunities measured as the first principal component of changes in seven industry growth variables (median ROA, profitability, asset turnover, R&D, capital expenditures, sales growth, and employee growth) (Harford 2005). Columns (5) and (6) report results for organizational capital shocks, which are defined as a dummy that equals one in those industry-years with high growth in organizational capital as proxies of industry median selling, general, and administrative expenses (SG&A). Columns (7) and (8) report results for domestic competition shocks, which are defined as a dummy that equals one in those industry-years with large decreases in the industry Herfindhal–Hirschman index (HHI). Columns (9) and (10) report results for foreign competition shocks, which are defined as a dummy that equals one in those industry-years with large increases in import penetration. For each of these shocks variables, we take the industry median of the absolute value of the change in the variable over the year. We then rank (z-score) each industry-year shock relative to the 10-year time-series of shock observations for the industry. The shock dummy variable takes the value of one for increases that are one standard deviation or more above the sample mean. Variable definitions are in the appendix. Robust clustered standard errors adjusted for nonindependence of observations by firm are reported in parentheses.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Implied sensitivity is evaluated at the sample mean of total CEO pay.

Since outside hires are those that are typically most active in the CEO labor market, this result lends further support to a labor market interpretation of our findings. Columns (5) and (6) use quantile regression analysis to examine the trend at the very top of the distribution of pay. The results show that the overall trend was even more pronounced at the top, and that is exactly where the rise in the credentials premium was also most pronounced. Finally, columns (7) and (8) show that the upward trend was more pronounced for the equity component of CEO pay, especially among recently appointed CEOs and that again is where the credentials premium rose the most.⁴²

⁴² Results of additional analysis by broad industry groups reported in Table A.5 of Online Appendix D show that the rising credentials

Overall, this evidence broadly suggests that a rising talent premium offers an important and novel perspective over key recent stylized developments in CEO pay.

5.1. Robustness Checks

Our baseline results (Table 3) are robust to considering several batteries of alternative specifications, including a fixed effects estimation that compares CEOs with different skills operating the same firm. By looking at changes in pay over time within firms, this specification

premium is not confined to any one particular industry, because it holds significantly for manufacturing, services, and hi-tech. However, it appears to offer less of a compelling explanation for the overall upward trend in retail and regulated industries.

Table 9 Assessing Pay for CEO Credentials: Implications for Stylized Facts of Trend in CEO Pay

	Trend in CEO pay		Trend for outside CEOs		Trend for top 5% CEO pay		Trend in CEO equity pay	
	(1) Trend	(2) Interactions	(3) Trend	(4) Interactions	(5) Trend	(6) Interactions	(7) Trend	(8) Interactions
Panel A: Dependent variable is log total annual compensation, all ExecuComp								
Observations	[12,747]	[12,747]	[2,583]	[2,583]	[12,747]	[12,747]	[12,747]	[12,747]
$I_{1996-2000}$	0.323*** (0.027)	0.198*** (0.043)	0.354*** (0.098)	0.078 (0.175)	0.426*** (0.036)	0.224* (0.123)	0.262*** (0.045)	−0.010 (0.076)
$I_{2001-2005}$	0.508*** (0.034)	0.389*** (0.050)	0.526*** (0.123)	0.229 (0.202)	0.497*** (0.054)	0.385*** (0.080)	0.498*** (0.068)	0.238*** (0.083)
CEO Talent Factor × $I_{1996-2000}$		0.251*** (0.072)		0.446** (0.234)		0.452** (0.214)		0.452*** (0.122)
CEO Talent Factor × $I_{2001-2005}$		0.201** (0.088)		0.364* (0.219)		0.281** (0.134)		0.219* (0.124)
Panel B: Dependent variable is log total annual compensation, recently appointed CEOs (tenure ≤ 2)								
Observations	[3,138]	[3,138]	[1,136]	[1,136]	[3,138]	[3,138]	[3,138]	[3,138]
$I_{1996-2000}$	0.256*** (0.067)	0.004 (0.109)	0.301* (0.154)	−0.173 (0.182)	0.397*** (0.110)	0.151 (0.110)	0.277*** (0.069)	−0.027 (0.111)
$I_{2001-2005}$	0.383*** (0.078)	0.096 (0.113)	0.519** (0.257)	−0.208 (0.207)	0.422*** (0.126)	0.394*** (0.072)	0.502*** (0.105)	0.207* (0.117)
CEO Talent Factor × $I_{1996-2000}$		0.551** (0.234)		0.846** (0.338)		0.624*** (0.201)		0.504** (0.226)
CEO Talent Factor × $I_{2001-2005}$		0.698*** (0.238)		1.214*** (0.397)		0.295*** (0.089)		0.364 (0.271)
Firm, succession, and CEO controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes. This table reports estimates of OLS and quantile regressions of total CEO pay on a measure of CEO credentials and its interaction with time trend indicator variables from 1993 to 2005 for all CEOs in ExecuComp (panel A) and for recently appointed CEOs in ExecuComp, who are defined as those CEOs with tenure of two years or less (panel B). The dependent variable is the logarithm of total pay (tdc1) in columns (1)–(8) and the logarithm of equity pay in columns (9) and (10). The measure of CEO credentials—CEO talent factor—is a factor extracted by using principal component analysis from *Press*, *Fast-Track Career*, and *Selective College*. The time trend indicator variables are dummies that take value of one in years 1996–2000 and 2001–2005, respectively. All specifications include firm fixed effects, as well as controls for firm, successions, and other CEO characteristics that have been shown in previous research to affect total CEO pay. Columns (1) and (2) report results for the overall trend in CEO pay. Columns (3) and (4) report results for the trend in CEO pay in the subsample of outside CEO appointments. Columns (5) and (6) examine the trend at the top of the distribution of pay and report results of quantile regressions for CEOs whose total compensation is in the 95th percentile of the empirical distribution of CEO pay. Columns (7) and (8) report results for the trend in the equity component of CEO pay. Variable definitions are in the appendix. Robust clustered standard errors adjusted for nonindependence of observations by firm are reported in parentheses.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

controls for permanent unobserved characteristics of firms that might bias our baseline cross-sectional specification because of the initial nonrandom selection of CEOs with different credentials into different firms.

5.1.1. Firm Fixed Effects. Results of a CEO pay regression analysis with firm fixed effects are reported in Table 10. In columns (1)–(3), we report results for our baseline specification in changes, while results for the specification with firm fixed effects are in columns (4)–(6). The estimates in changes confirm that there is a significant pay-to-credentials sensitivity, suggesting that time-invariant unobserved firm heterogeneity is unlikely to be driving our results. The results for specifications with firm fixed effects offer additional supporting evidence that total CEO compensation remains positively and significantly associated with credentials throughout CEO tenure.

In unreported results available upon request, we also consider a specification that adds an interaction term between CEO credentials and CEO tenure to allow for heterogeneity in pay for credentials depending on CEO tenure. This richer specification shows that the sensitivity of pay to credentials declines significantly over the CEO's tenure, consistent with our talent interpretation since presumably boards observe additional private and public signals of CEO abilities, including firm performance subsequent to the CEO appointment. However, the sensitivity is not a purely temporary phenomenon because the credentials premium remains significant at approximately \$100,000 even for CEOs with above-median tenure.⁴³

⁴³ The magnitude of our estimates lends support to values of approximately 33% that are commonly used to calibrate the empirical

Table 10 Identifying Pay for CEO Credentials: Firm Fixed Effects and Instrumental Variables (IV) Estimates

Dependent variable: <i>Log total annual compensation, All ExecuComp</i>											
	Baseline OLS, $\Delta \log(\text{tdc1})$			Firm FE			UK instrument		Labor market shocks, $\Delta \log(\text{tdc1})$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
<i>Press</i>	0.204*** (0.043)			0.351*** (0.041)					0.371** (0.136)		
<i>Fast Track Career</i>		0.393*** (0.144)			0.274** (0.129)		0.554** (0.271)			0.517*** (0.178)	
<i>Selective College</i>			0.115** (0.044)			0.139*** (0.052)		0.261** (0.124)			0.243* (0.131)
Firm, succession, and CEO controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	No	No	Yes	Yes	No	No	No
R^2 (%)	12.6	12.1	12.0	66.4	66.3	66.3	43.9	33.5	12.8	12.5	12.1
Observations	12,903	12,710	12,547	12,970	12,968	12,747	5,663	5,367	12,903	12,710	12,547
First-stage estimation											
<i>UK Fast-Track Career</i>							0.135*** (0.002)				
<i>UK Selective College</i>								0.115*** (0.034)			
<i>Press Shock</i>									0.275*** (0.023)		
<i>Fast-Track Career Shock</i>										0.272*** (0.016)	
<i>Selective College Shock</i>											0.169** (0.082)
Firm, succession, and CEO controls							Yes	Yes	Yes	Yes	Yes
Year FE							Yes	Yes	No	No	No
Industry FE							Yes	Yes	No	No	No
R^2 (%)							19.5	10.1	10.8	10.5	9.5
Shea partial R^2 (%)							3.1	1.1	4.6	4.3	0.9
F -test of excl. instruments							77.7***	21.24***	115.1***	116.8***	8.09***

Notes. This table reports estimates of OLS (columns (1)–(6)) and instrumental variables (columns (7)–(11)) regressions of total CEO pay on a measure of CEO credentials from 1993 to 2005 for all CEOs in ExecuComp. The dependent variable is the logarithm of total pay (tdc1). We iteratively employ the three measures of CEO credentials—*Press*, *Fast-Track Career*, and *Selective College*—each in four different specifications that all control for year-fixed effects and for firm, successions, and other CEO characteristics that have been shown in previous research to affect total CEO pay. Columns (1)–(3) present baseline OLS estimates for a specification in changes. Columns (4)–(6) are OLS estimates with firm fixed effects. Columns (7) and (8) report IV estimates with (Fama–French 48) industry fixed effects, where *Fast-Track Career* and *Selective College* are instrumented by industry-UK variables. Columns (9)–(11) report IV estimates, where *Press*, *Fast-Track Career*, and *Selective College* are instrumented by CEO labor market shocks. The bottom panel lists these variables with their respective coefficients in the first-step estimation. The panel also reports IV estimation diagnostic statistics for Shea partial R^2 and joint excluded instrument significance (F -test statistic). Variable definitions are in the appendix. Robust clustered standard errors adjusted for nonindependence of observations by firm are reported in parentheses.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Finally, to further corroborate the validity of our baseline estimates, we address the residual endogeneity concern that unobserved firm characteristics, e.g., for productivity shocks that are unrelated to CEO talent but are time-varying, may be correlated with CEO credentials, thus still potentially leading to selection bias in our results. To this end, we use an instrumental variables approach.⁴⁴ We consider characteristics of

distribution of CEO talent (e.g., Gabaix and Landier 2008). In unreported results, we use an approach analogous to theirs and fit an empirical Pareto distribution to our credentials proxies, which delivers estimates of the Pareto exponent ranging between 0.28 and 0.33.

⁴⁴ For an instrument to be valid, it must be exogenous and satisfy the exclusion restriction. In other words, we need variables that

UK CEOs as instruments for the characteristics of their U.S. counterparts and construct industry-wide (Fama–French 48) averages of CEO credentials calculated for firms that are headquartered in the United Kingdom (see Ellison et al. 2010). The identifying assumption behind this approach is that, to the extent that the same industries in the United States and the United Kingdom share common fundamental factors, such as technology and barriers to entry, changes in the observed CEO credentials rankings across industries in the United Kingdom should be predictive of those in the United

are potentially correlated to CEO credentials (relevancy condition) but affect any given CEO's pay only through their effect on CEO credentials (exclusion restriction), i.e., variables that are orthogonal to (unobserved) firm characteristics.

States but are orthogonal to any endogenous industry interdependencies present in the U.S. data that arise from reverse causality.⁴⁵ Results are in columns (7)–(11) of Table 10, with the bottom panel displaying estimated coefficients for the instruments in the first-stage regression and IV estimation diagnostic statistics for joint excluded instrument significance (F -test statistic) and Shea partial R^2 .⁴⁶ The IV estimates suggest that time-varying unobserved firm heterogeneity is unlikely to be driving our OLS estimates, which may actually be downward biased by this source of endogeneity.

5.1.2. Additional Robustness Checks. Our baseline results are robust to three batteries of additional checks. In particular, Online Appendix D gives details of the following additional robustness checks: (1) using a nearest-neighbor matching estimator (Abadie and Imbens 2011) and a standard Heckman (1979) selection approach to address selection on observables and the nonrandom nature of our CEO succession sample; (2) using alternative definitions of each of the main proxies (especially using a measure that nets out negative press coverage, or *Bad Press*, from *Press*, screening the tone of each article to reflect positive personal traits of the CEO based on Kaplan et al. (2012), and only counting articles that contain mention of such traits, or *Good Press*); and (3) adding controls for alternative stories, such as measures of CEO general human capital (Custodio et al. 2013) and measures of CEO power and connections that include the GIM index of Gompers et al. (2003), board size and independence, and CEO education and corporate networks (see Bebchuk et al. 2002). Our results survive this entire battery of checks.

⁴⁵ We include industry fixed effects to insure that we are not simply capturing average time-invariant differences across industries, but rather changes over time by industry. We also show robustness to using a second set of instruments that capture cross industry variation in the relative demand for talented CEOs, an approach that is widely employed in the labor literature (see, e.g., Katz and Murphy 1992). To capture this exogenous variation, we construct CEO labor market shocks as weighted annual changes in average CEO credentials among all ExecuComp firms in each year, with weights reflecting the industry-specific CEO labor market share. In particular, weights are defined as the share of firms in any given (Fama–French 48) industry group in 1990 with respect to the total number of firms in Compustat. If demand for CEO credentials increases (decreases) nationally in any given year, industries that employ a larger share of CEOs will experience a positive (negative) relative shock to the demand for high-credentials CEOs. Given that shocks capture annual changes in credentials, we estimate a specification in changes, rather than levels.

⁴⁶ Turning to the first-stage estimates, we find that all the instruments are positively and statistically significantly related to their respective credentials proxies and have strong predictive power, especially for the press and career credentials. In fact, the relatively large Shea partial R^2 and F -test statistics suggest that the instruments explain a sizable fraction of incremental variation in their respective credentials proxies, thus lessening the possibility that weak instruments contaminate our inference.

6. Conclusion

This paper argues that focusing on the labor market for CEOs can augment our understanding of the empirical determinants of top executive pay and firm performance. To that end, we document reliable evidence of pay for several CEO credentials, which include reputational, career, and educational components. We show that the credentials premium is larger for the most accomplished CEOs and for larger firms, and that the performance impact of credentials is also bigger for larger firms, which are all consistent with competitive sorting models of the market for CEOs. The premium is robust to controlling for firm fixed effects and several standard determinants of pay. In sum, our work offers the first direct attempt at quantifying the impact of CEO skills on pay and performance. Our evidence indicates that sorting considerations in the CEO labor market are an important determinant of CEO pay and that a rising CEO talent premium may have contributed to the overall rise in pay.

Supplemental Material

Supplemental material to this paper is available at <http://dx.doi.org/10.1287/mnsc.2014.2024>.

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Appendix. Variable Definitions

The variables used in this paper are either hand-collected or extracted from five major data sources: ExecuComp, Compustat, the Center for Research in Security Prices (CRSP), Investor Responsibility Research Center (IRRC), and BoardEx. For each data item, we indicate the relevant source in square brackets. The specific variables used in the analysis are defined as follows.

CEO Credentials Proxies

- *Press*: the number of articles containing the CEO’s name and company affiliation that appear in the major U.S. and global business newspapers in the calendar year before

succession. For the analysis of the entire ExecuComp sample, we use a one-year-lagged count, which was measured as of fiscal year end prior. We also construct *Bad Press* and *Good Press*. *Bad Press* is the number of articles containing the CEO's name, company affiliation, and any of the words with a negative connotation that appear in the major U.S. and global business newspapers in the calendar year before succession. *Good Press* is the number of articles containing the CEO's name, company affiliation, and any of the words with a positive connotation about CEO talent that appear in the major U.S. and global business newspapers in the calendar year before succession. Our text search uses both the CEO's last name and company name. Online Appendix A contains the detailed list of newspapers used in our Factiva search as well as the list of the negative and positive words used to construct *Bad Press* and *Good Press*, respectively. All specifications use the cumulative distribution function of *Press*, $CDF(Press)$. [Factiva searches]

- *Fast-Track Career*: To ease comparison with the other proxies (since lower age of first CEO job represents a better job market credential), all specifications define *Fast-Track Career* as the complement to one of the cumulative distribution functions of *Age of First CEO Job*, $1 - CDF(Age\ of\ First\ CEO\ Job)$. We use a cohort-adjusted version of *Age of First CEO Job* where we divide our sample of CEOs into three age cohorts and define *Fast-Track Career* as a function of the difference between age of the first CEO job and median first CEO job age in the age cohort. [Dun & Bradstreet Reference Book of Corporate Managements (various years); Standard & Poor's Register of Corporations, Directors and Executives (various years); Marquis Who's Who in Finance and Industry (various years); Biography Resource Center by Thomson Gale; Lexis-Nexis, Factiva, and Web searches]

- *Selective College*: a numerical rank that takes values between 1 and 6 based on Barron's Profiles of American Colleges (1980) rankings of the undergraduate institution attended by the CEO. In Barron's (1980) rankings, colleges are assigned one of the following six ranks: Most Competitive, Highly Competitive, Very Competitive, Competitive, Less Competitive, or Noncompetitive. All specifications use the cumulative distribution function of *Selective College*, $CDF(Selective\ College)$. [Dun & Bradstreet Reference Book of Corporate Managements (various years); Standard & Poor's Register of Corporations, Directors and Executives (various years); Marquis Who's Who in Finance and Industry (various years); Biography Resource Center by Thomson Gale; Lexis-Nexis, Factiva, and Web searches]

- *CEO Talent Factor*: linear combination of *Press*, *Fast-Track Career*, and *Selective College*, with weights calculated by using factor analysis for the entire ExecuComp sample. The values of the factor loading are as follows: 0.646 for *Fast-Track Career*, 0.638 for *Press*, and 0.465 for *Selective College*.

- *Press Splines*: *Press* ($< 50\%$) equals $CDF(Press)$ if $0.00 \leq CDF(Press) < 0.5$ and 0.5 if $CDF(Press) \geq 0.5$; *Press* ($50\% < X < 90\%$) equals $CDF(Press) - 0.5$ if $0.5 < CDF(Press) < 0.9$, 0.0 if $CDF(Press) \leq 0.5$, and 0.4 if $CDF(Press) \geq 0.9$; *Press* ($> 10\%$) equals $CDF(Press) - 0.9$ if $0.9 < CDF(Press) < 1.0$, 0.0 if $CDF(Press) \leq 0.9$, where $CDF(Press)$ is the cumulative distribution function of *Press*.

- *Fast-Track Career Splines*: *Fast-Track Career* ($< 50\%$) equals $CDF(Fast-Track\ Career)$ if $0.00 \leq CDF(Fast-Track\ Career) < 0.5$

and 0.5 if $CDF(Fast-Track\ Career) \geq 0.5$; *Fast-Track Career* ($50\% < X < 90\%$) equals $CDF(Fast-Track\ Career) - 0.5$ if $0.5 < CDF(Fast-Track\ Career) < 0.9$, 0.0 if $CDF(Fast-Track\ Career) \leq 0.5$, and 0.4 if $CDF(Fast-Track\ Career) \geq 0.9$; *Fast-Track Career* ($> 10\%$) equals $CDF(Fast-Track\ Career) - 0.9$ if $0.9 < CDF(Fast-Track\ Career) < 1.0$, 0.0 if $CDF(Fast-Track\ Career) \leq 0.9$, where $CDF(Fast-Track\ Career)$ is the cumulative distribution function of *Fast-Track Career*.

- *Selective College Splines*: *Selective College* ($< 50\%$) equals $CDF(Selective\ College)$ if $0.00 \leq CDF(Selective\ College) < 0.5$ and 0.5 if $CDF(Selective\ College) \geq 0.5$; *Selective College* ($X > 50\%$) equals $CDF(Selective\ College) - 0.5$ if $0.5 < CDF(Selective\ College) \leq 1.0$, 0.0 if $CDF(Selective\ College) \leq 0.5$ where $CDF(Selective\ College)$ is the cumulative distribution function of *Selective College*.

- *Size-Adjusted Press*: calculated by subtracting median *Press* of a control group of firms with similar firm size. The control groups are created by dividing ExecuComp firms into deciles based on firm size. The yearly median *Press* of the relevant group of firms is then used as the control for each firm-year observation (see Barber and Lyon 1996).

- *Industry-Adjusted Press*, *Fast-Track Career*, and *Selective College*: calculated by subtracting the median of (Fama–French 48) industry and year of the respective measure.

Instrumental Variables for CEO Credentials

- *Geographic Instruments* (*Average State Press*, *Average State Fast-Track Career*, *Average State Selective College*): mean of the respective credential proxy among all firms whose headquarters are located in the firm's same state in each year, excluding those firms that are in the firm's same (Fama–French 48) industry group. All specifications use the cumulative distribution function (CDF) of the underlying instrumental variable.

- *Industry-UK Instruments* (*Average UK Industry Fast-Track Career*, *Average UK Industry Selective College*): mean of the respective credential proxy among all UK firms that are in the same (Fama–French 48) industry group. *Selective College* for the United Kingdom is defined based on the list of the most prestigious (so-called "ancient") such institutions, which we complement with those institutions that are consistently ranked in the top 10 based on the most popular publications (*The Times* and *The Guardian*). The included institutions are as follows: University of Cambridge, University of Oxford, University of St Andrews, London School of Economics, University College London, and Durham University. All specifications use the cumulative distribution function (CDF) of the underlying instrumental variable. [BoardEx, Worldscope]

- *CEO Labor Market Shocks* (*Press Shock*, *Fast-Track Career Shock*, *Selective College Shock*): weighted annual change of the average of the respective credential proxy among all ExecuComp firms in each year with respect to the previous year, excluding those firms that are in the firm's same (Fama–French 48) industry group, with weights reflecting the industry-specific CEO labor market share. In particular, weights are defined as the share of firms in any given (Fama–French 48) industry group in 1990 with respect to the total number of firms in Compustat. All specifications use the cumulative distribution function (CDF) of the underlying instrumental variable.

CEO Pay and Turnover

- *CEO Pay*: log total compensation (tdc1), which is defined as the sum of short-term compensation (salary and bonus) and long-term compensation (long-term incentive plans, restricted stock, and stock appreciation rights), deflated by the Consumer Price Index(CPI) in 1990. [ExecuComp]

- *Insider*: dummy that equals zero when successor CEOs have been with their firms for one year or less at the time of their appointments, and one for all other new CEOs. [Factiva searches].

- *Forced*: dummy defined as in Parrino (1997). It equals one for CEO departures for which the press reports that the CEO has been fired, forced out, or retired/resigned because of policy differences or pressure. It equals zero for departing CEOs age 60 and above. All departures for CEOs below age 60 are reviewed further and classified as forced if either the article does not report the reason as death, poor health, or the acceptance of another position (including the chairmanship of the board); or the article reports that the CEO is retiring but does not announce the retirement at least six months before the succession. [Factiva searches]

Firm Performance

- *Announcement CARs for CEO Appointments*: cumulative abnormal returns (CARs) to the appointing firm's stock for trading days (−2, +2) relative to the date of the first article covering the news of a new CEO appointment. Abnormal returns are calculated by using the capital asset pricing model (CAPM) and standard event study methodology (see MacKinlay 1997 for a detailed review). We use the market model and CRSP equally weighted return as the market return to estimate the market model parameters from event day −210 to event day −11. [CRSP]

- *ROA*: ratio of operating income after depreciation (item 178) to book value of assets (item 6). Industry-adjusted ROA is calculated by subtracting the median of (Fama–French 48) industry and year ROA. [Compustat].

- *OROA*: ratio of net income (item 172) to the book value of assets (item 6). Industry-adjusted OROA is calculated by subtracting the median of (Fama–French 48) industry and year OROA. [Compustat]

- *OROS*: ratio of net income (item 172) to sales (item 12). Industry-adjusted OROS is calculated by subtracting the median of (Fama–French 48) industry and year OROS. [Compustat]

- *ROE*: ratio of net income (item 172) to common equity (item 60). Industry-adjusted ROE is calculated by subtracting the median of (Fama–French 48) industry and year ROE. [COMPSTAT]

- *Stock Returns*: annual stock return (fiscal year-end). [Compustat]

- *Tobin's Q*: ratio of the market value of assets to the book value of assets (item 6). Market value of assets is the book value of assets plus the market value of common equity less the sum of the book value of common equity (item 60) and balance sheet deferred taxes (item 74). [Compustat]

Firm Controls and Policies

- *Size*: log of the book value of assets (item 6), deflated by CPI in 1990. Small Firm, Medium Firm, and Large Firm are three dummies that take a value of one for firms in the bottom, intermediate, and top tercile of the sample firm size distribution. [Compustat]

- *Capital Expenditures*: capital expenditures (item 128) over total assets at the beginning of the fiscal year (item 6). [Compustat]

- *M&As*: total number of takeover bid offers that are classified as mergers (successful and unsuccessful) and are announced in a given year. To be included in the count, we require that the merger is material to the acquirer, as standard in the literature, and limit the sample to deals whose value is at least \$1 million and at least 1% of the market value of the assets of the acquirer. Finally, we require that the target is a U.S. public or private firm, or a subsidiary, division, or branch of a U.S. firm and that the acquirer controls less than 50% of the shares of the target prior to the acquisition announcement and obtains 100% of the target shares as a result of the transaction. [SDC Platinum, U.S. Mergers and Acquisitions database]

- *Divestitures*: total number of asset sales, such as sales of divisions, branches, and product lines (successful and unsuccessful) that are announced in a given year [SDC Platinum, U.S. Mergers and Acquisitions database]

- *Diversifying M&As*: total number of takeover bid offers that are classified as mergers and involve a target in the same (three-digit SIC code) industry (successful and unsuccessful) and are announced in a given year [SDC Platinum, U.S. Mergers and Acquisitions database]

- *Leverage (book)*: long-term debt (item 9) plus debt in current liabilities (item 34) over the book value of assets (item 6). [Compustat]

- *Cash Holdings*: cash (item 1) over book value of assets (item 6). [Compustat]

- *Dividend Payouts*: dividends (item 21) over book value of assets (item 6). [Compustat]

- *R&D*: ratio of R&D expenditures (item 46, or 0 is missing) over book value of assets (item 6). [Compustat]

- *Cash Flow*: sum of earnings before extraordinary items (item 18) and depreciation (item 14) over book value of assets (item 6). [Compustat]

- *Sales Growth*: log of the ratio of sales (item 12) in year t to sales in year $t - 1$. [Compustat]

- *Stock Return Volatility*: standard deviation of stock returns, calculated by using monthly stock market returns over the prior year. [CRSP]

- *Cash Flow Volatility*: standard deviation of cash flow, calculated by using data over the prior five years. [Compustat]

Industry Shocks

For each of the following industry shocks variables, we take the (Fama–French 48) industry median of the absolute value of the change in the variable over the year. We then rank (z-score) each industry-year shock relative to the 10-year time-series of shock observations for the industry. The shock dummy variable takes a value of one for increases that are one standard deviation or more above the sample mean.

- *Technology Shocks*: change in the intensity of investment in information technology (IT) capital. Industry IT intensity in year t is its stock of IT capital relative to other capital. Following Stiroh (2002), we define IT capital as seven classes of computer hardware (mainframe computers, personal computers, direct access storage devices, computer printers, computer terminals, computer tape drives, and computer storage devices) and three classes of software (prepackaged, custom, and own-account software). Investment expenditure

in each of the 61 classes is converted into a capital stock by using the standard perpetual inventory method. [Bureau of Economic Analysis (BEA) Fixed Reproducible Tangible Wealth (FRTW)]

- *Growth Opportunities Shocks*: the first principal component of changes in seven industry growth variables (median ROA, profitability, asset turnover, R&D, capital expenditures, sales growth, and employee growth) (Harford 2005). [Compustat]

- *Organizational Capital Shocks*: change in selling, general, and administrative expenses (SG&A) (item 189). [Compustat]

- *Domestic Competition Shocks*: change in Herfindahl–Hirschman index (HHI) of sales of all firms in the same industry, where the HHI index is computed using all firms in Compustat. [Compustat]

- *Foreign Competition Shocks*: change in import penetration, which is defined as total value of annual imports divided by the sum of total import and domestic production. [Feenstra et al. 2002]

CEO Controls

- *CEO Age*: current age of the CEO (years since year of birth). [ExecuComp and *Dun & Bradstreet Reference Book of Corporate Managements* (various years); *Standard & Poor's Register of Corporations, Directors and Executives* (various years); *Marquis Who's Who in Finance and Industry* (various years); Biography Resource Center by Thomson Gale; Lexis-Nexis, Factiva, and Web searches]

- *CEO Tenure*: number of years in office as a CEO at the current firm. [ExecuComp and *Dun & Bradstreet Reference Book of Corporate Managements* (various years); *Standard & Poor's Register of Corporations, Directors and Executives* (various years); *Marquis Who's Who in Finance and Industry* (various years); Biography Resource Center by Thomson Gale; Lexis-Nexis, Factiva, and Web searches]

- *MBA*: dummy that equals one if the CEO has an MBA degree. [*Dun & Bradstreet Reference Book of Corporate Managements* (various years); *Standard & Poor's Register of Corporations, Directors and Executives* (various years); *Marquis Who's Who in Finance and Industry* (various years); Biography Resource Center by Thomson Gale; Lexis-Nexis, Factiva, and Web searches]

- *Past CEO Position*: dummy variable that takes a value of one if a CEO held a CEO position at another publicly traded company prior to the current position. [BoardEx]

- *Past Number of Jobs*: number of different positions a CEO held at publicly traded firms prior to the current position. All specifications use the cumulative distribution function (CDF) of *Past Number of Jobs*. [BoardEx]

- *Past Number of Industries*: number of (Fama–French 48) industries where a CEO worked prior to the current position. All specifications use the cumulative distribution function (CDF) of *Past Number of Industries*. [BoardEx]

- *CEO General Ability Factor*: factor extracted by using principal component analysis from the three underlying experience proxies, *Past CEO position*, *Past Number of Jobs*, and *Past Number of Industries* (Custodio et al. 2013). [BoardEx]

- *CEO Human Capital Factors*, #1 (“Experience”) and #2 (“Talent”): the first two principal components extracted by using our three CEO credentials proxies (*Press*, *Fast-Track Career*, and *Selective College*) jointly with the three CEO lifetime work experience proxies (*Past CEO Position*,

Past Number of Jobs, and *Past Number of Industries*). [*Dun & Bradstreet Reference Book of Corporate Managements* (various years); *Standard & Poor's Register of Corporations, Directors and Executives* (various years); *Marquis Who's Who in Finance and Industry* (various years); Biography Resource Center by Thomson Gale; Lexis-Nexis, Factiva, and Web searches; BoardEx]

Governance and Connections Controls

- *GIM Index* (≥ 11): dummy variable that takes a value of one for firms with 11 or more of the 24 antitakeover provisions included in the GIM index of Gompers et al. (2003). [IRRC]

- *Board Size*: total number of directors on the board in a given firm-year. [IRRC]

- *Board Independence*: dummy variable that takes a value of one for firms whose ratio of the number of independent directors to the overall number of directors in a given firm-year above median (> 0.67). [IRRC]

- *CEO Education Network*: number of education ties of the CEO, as measured by the number of individuals (top executives and directors) in BoardEx who attended the same school of the CEO. All specifications use the cumulative distribution function (CDF) of *CEO Education Network*. [BoardEx]

- *CEO Corporate Network*: number of corporate ties of the CEO as measured by the sum of Current Employment Network and Prior Employment Network. Current Employment Network is the number of individuals in BoardEx who currently serve in another common publicly traded company with the CEO. Prior Employment Network is the number of individuals in BoardEx who served in at least one common publicly traded company with the CEO in the past, excluding prior roles in the company in question. All specifications use the cumulative distribution function (CDF) of *CEO Corporate Network*. [BoardEx]

- *CEO Number of Outside Directorships*: number of major outside directorships held by the CEO [IRRC/Risk Metrics].

- *Board–CEO Ties*: number of prior education and professional connections between the CEO and the independent directors, defined as in Fracassi and Tate (2012). [BoardEx]

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