

Which Skills Matter in the Market for CEOs?

Evidence from Pay for CEO Credentials

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Abstract

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 on a large sample of CEOs for a panel of S&P 1,500 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.

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), Tervio (2008), Edmans, Gabaix, and Landier (2009), and 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, Murphy and Wruck (2012) 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.

In order 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 on a large sample of CEOs to identify *specific* CEO characteristics that on an *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, Li, and Qiu (2011), and 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 hope to make progress on understanding who runs corporations and why, and whether it matters for CEO pay and as importantly, shareholder value.²

¹Murphy and Zábojník (2007) show that, while little more than one CEO out of ten used to be appointed from outside the firm in the 1970s, that number has risen to about four in ten over the last decade. Cremers and Grinstein (2011) 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.

²As such, we follow the suggestion of Bertrand (2009) to "[b]uild some more systematic quantitative, large sample, analysis on the CEO search process, how boards measure, identify and evaluate 'talent', and on the role played by third

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 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 1,500 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 record, as well as their outside reputation, 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 parties such as the media."

³Gabaix and Landier (2008) and Tervio (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, Gabaix, and Landier (2009) and Baranchuk, MacDonald, and Yang (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 *prior* to the 1970s (Frydman and Saks (2010)), but consistently positive thereafter. And while 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 larger firms.

⁴Bertrand and Schoar (2003) and Graham, Li and Qiu (2009) document evidence that executive fixed effects explain a large fraction of the total variation in firm performance and pay, respectively. Bennedsen, Perez-Gonzalez, and Wolfenzon (2006) examine changes in firm performance around CEO deaths.

⁵See, 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 (Danes, Nair, and Kornhauser (2005), Chang, Dasgupta, and Hilary (2010), and Pan (2010)). While 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.

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 CEOs' career track record based on how fast they cleared the bar for their first CEO job, 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) and Kremers (1993)).⁷ *Selective College*, the schooling signal, measures the quality of the CEO's educational background and 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 (1973)).⁸ Where it helps expositionally, 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, which credentials matter the most, and 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 about 5% for *Press* and *Fast-Track Career*, to about 2% for *Selective College*, and an implied dollar pay premium of up to \$280,000 for CEOs who are one

⁶This 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, Klebanov, and Sorensen (2011), which we denote as *Good Press*. We also consider ratios of these finer press counts to control for firm-related press.

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

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

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 twenty times larger than the average, and an implied premium of up to about \$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 The performance impact of different credentials follows the same pecking order of the pay premium, with reputational and labor market credentials having the largest impact.

We probe the external validity of our proxies in two more ways. First, we show that the credentials

⁹These 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.

¹⁰Consistent 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.

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

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, for example, Caroli and van Reenen (2001)). Second, we offer evidence that credentials indeed 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 about 1/4 of the variation in CEO fixed effects estimated from regressions of total pay as in Bertrand and Schoar (2003) and Graham, Li and Qiu (2011) (which achieve an R^2 of about 75%), a vast improvement over previously used biographical CEO characteristics, such as age and MBA, whose R^2 is only 1/20 (and incremental R^2 of about 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, Perez-Gonzalez, and Wolfenzon (2008).

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 non-random 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, Ferreira, and Matos (2012) measures of CEO general human capital and for measures of CEO power and connections which include the GIM index of Gompers, Ishii, and Metrick (2003), board size and independence, and CEO education and corporate networks (see Bebchuk, Fried, and Walker (2002)).¹⁵

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

¹³To 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 US counterparts (see Ellison, Glaeser, and Ker (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)).

¹⁴Results for a nearest-neighbor matching estimator (Abadie and Imbens (2007)) and a standard Heckman (1979) selection analysis confirm our baseline estimates, suggesting that selection on observables and the non-random nature of our CEO succession sample are not to blame.

¹⁵In 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)

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, Murphy, and Wruck (2012) 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, 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 Section 3, we lay out our empirical strategy and present our core results. Section 4 interprets our pay for credentials results, and Section 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 *Internet Appendix C*, 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 Tervio (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

and Malmendier and Tate (2011), 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.

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

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 – that is, 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 – that is, 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 Tervio (2008). Edmans, Gabaix, and Landier (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. While 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

¹⁷Baranchuk, MacDonald, and Yang (2008) add endogenous firm size and focus on the effect of product market conditions.

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 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 1,500 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 *Internet Appendix C*. 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 in order 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 dataset with measures that reflect publicly-observable signals of CEO skills based on the quality of CEOs' educational and professional track record, as well as their outside reputation, 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.

¹⁸ExecuComp roughly covers S&P 1,500 firms. Parrino (1997), Huson, Parrino, and Stark (2001) and Huson, Malatesta, and Parrino (2004) use Forbes surveys; Jenter and Kanaan (2006) also use ExecuComp, but only study departing CEOs for the 1993-2001 period.

¹⁹We 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.

2.1.1 Measure of credentials based on press coverage

The first proxy, *Press*, is a reputational signal which 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 *prior* to CEO appointment. The choice of pre-appointment press is important in order to mitigate 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 prior to the transition. The newspapers considered and the search criteria are analogous to previous studies in the literature and listed in *Internet 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 reputation 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. *Internet 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*.

²⁰Milbourn (2003) considers all ExecuComp firms as we do, but only covers a six-year period (1993-1998). Rajgopal, Shevlin, and Zamora (2006) consider a nine-year time period (1993-2001), but focus only on S&P 500 firms. Likely due to these differences, in our sample the median CEO gets about 7 mentions in the press in a year. This is in line with previous studies, but somewhat lower than Rajgopal, Shevlin, and Zamora. However, when we consider only the S&P 500 subsample, we are closer to their median number of articles (13 in our sample vs. 11 in theirs).

A second concern is that *Press* might simply reflect coverage of the firm rather than the CEO. In order 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 *Internet 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, Klebanov, and Sorensen (2011). *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* and *Good Press* proxies are novel to the literature. The standard approach is to verify whether 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* 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 record based on how fast they cleared the bar for their first CEO job.²² This 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) and Kremers (1993)). Thus, more talented executives will

²¹See also Demerjian, Lev B. I. and McVay (2012) for a novel measure of CEO ability.

²²In 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.

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 *Internet Appendix C* 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, Tate, and Yan (2011) and 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 ability.

2.1.3 Measure of credentials based on education 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 (1973)). 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)

²³Support for this measure comes from the evidence by sociologists and work by Kaplan, Klebanov, and Sorensen (2011) that the selection process of corporate elites in the US has been relatively meritocratic. See also Friedman and Tedlow (2003) for a comprehensive review of the literature, and Capelli and Hamori (2005) for evidence.

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. While the schooling proxy has been used previously in the literature (see, for example, Perez-Gonzalez (2008) and 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 dataset. Panel A summarizes successor type for each year, and Panel B contains the three sub-periods covered by our sample, which are the first and second half of the 1990's and first half of the 2000's. 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 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 reputation and career ones.

Where it helps exposition, we also use our proxies jointly by aggregating them into a single CEO Talent Factor, whose annual average 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

²⁴The 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 percent of the cases.

²⁵Studies 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, Parrino, and Starks (2001) and Huson, Malatesta, and Parrino (2004) have 1,316 and 1,344 CEO successions, respectively, between 1971 and 1994. Murphy and Zbojnik (2007) have 2,783 appointments between 1970 and 2005, which is a larger, but significantly less detailed dataset than ours.

²⁶These 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, Parrino, and Starks (2001) who report 23.4% of forced to total turnovers for the 1989-1994 period). Murphy and Zbojnik (2007) and Huson, Parrino, and Starks (2001) report that during the 1970s and 1980s, outside hires accounted for only 15% to 17% of all CEO replacements, less than half as large as our figures since 1998.

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 such a way that leans more heavily on proxies that more accurately reflect latent CEO abilities. The values of the factor loadings are obtained 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 sub-samples.²⁹ 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.

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, $\text{CEO } pay_{ijt}$, 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 upon, and thus represent the closest empirical counterpart to theory.³⁰ The key explanatory variable is *CEO Credentials* as proxied

²⁷In our context, the difference between each of our proxy variables and latent CEO abilities is measurement error. It is well known that in the presence of classic measurement error, OLS estimates will be attenuated (see Wooldridge (2002)). Black and Smith (2006) conclude that OLS estimates may actually be biased upward despite attenuation.

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

²⁹Pairwise 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 contains summary statistics for both the outgoing CEO and her successor, as well as some firm 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 about negative 28%, consistent with Kaplan and Minton (2008) and Jenter and Kanaan (2006).

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

iteratively 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 on their definitions are in *Internet Appendix C*. Finally, we include year effects and 48 (Fama-French) industry fixed effects. Since there can be multiple CEO appointments over our sample period for any one firm, we assess statistical significance using clustered standard errors adjusted for non-independence 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 his prior position to the full list of firm-level controls. By including this additional control we address the potential concern that CEO pay in his 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 the same firm and adding controls for alternative stories, such as CEO power and connections.

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

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 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 CEO's pay in his 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 his prior position.³² Our estimates imply an empirical sensitivity of first-year total CEO pay to credentials ranging from about 0.5 for *Press* and *Fast-Track Career* to about 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 percent higher total pay. Given our semi-log specification of (1), we can write the implied expected change in dollar compensation as:

$$\frac{dE(\text{CEO pay})}{d\text{CEO Credentials}} = \frac{d \exp\{\alpha + \beta * \text{CEO Credentials}_{it} + \gamma * \text{Controls}_{ijt} + \delta_t\}}{d\text{CEO Credentials}}. \quad (2)$$

³²While not reported, we continue to control for CEO's prior pay in the estimations summarized in Tables 4, 5, and 6.

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 $\frac{dE(\text{CEO pay})}{d\text{Press}} = E(W) * \beta = \$5.2M * 0.544 = \$2.8M$. Therefore, an improvement from the worst to the best *Press* credential carries an initial pay premium of about \$2.8M, which is certainly economically significant at more than half of the sample mean. The effect of an improvement in the *Career* credential is quantitatively similar. The schooling credential’s effect is of about \$1M, which is still economically significant at around one fifth 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 piece-wise 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 about 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 about \$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 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

³³In Columns (1), (4), and (7), we report results for piece-wise 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 his 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 squared term.

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

³⁵As 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 his 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.

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 about 1 for *Press* and *Fast-Track Career* to about 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. While still positive, the credentials premium is small and insignificant for the smallest firms, consistent 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 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, while the bold line represents median OROA for new CEOs with better reputational credentials (top quartile of CEO Talent Factor), and the thin line represent median OROA for bottom-quartile CEOs. The OROA "smile" suggests that, on average, CEO turnover follows a pe-

³⁶Yet 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 (2011)), 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.

riod of deteriorating firm performance which 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) 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 appointing 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 Perez-Gonzalez (2006) for a similar approach in the context of family successions).

In Column (1), 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 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, Malatesta, and Parrino (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 about

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

³⁸These 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)).

0.05 for *Press* and *Fast-Track Career* to about 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 between 1.7% and 2.5%. This estimate of CEO impact is in line with the 1.7% impact of CEO deaths in Bennedsen, Perez-Gonzalez, and Wolfenzon (2006).

Finally, Column (8) considers ROA in a specification that adds appointment CARs and an interaction term between them and the CEO Talent Factor (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 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, 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 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, while 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, which 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 of an order of magnitude smaller than on pay.

4.2 Additional Validation of Credentials Proxies

We probe the external 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, Murphy, and Pierce (1993)), growth opportunities (Harford (2005)), organizational capital (Caroli and Van Reenen (2001)), and product market competition (Guadalupe (2007)). As 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 in Columns (5) and (6), for which the sensitivity of total CEO pay to credentials increases by about 0.34 on impact, which is an economically significant effect and corresponds to a cumulative dollar effect of about \$320,000 higher premium per credentials decile.

Second, we offer additional evidence validating our hypothesis that credentials 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) and Graham, Li and Qiu (2011)), this regression achieves an R^2 of about 75%, suggesting that relatively time-invariant CEO characteristics explain a large portion of total variation in CEO pay. An important and still open question, however, is how this unobserved CEO heterogeneity should be interpreted and to what extent

³⁹An 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.

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

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, for example, in Bertrand and Schoar (2003), and a CEO general human capital factor based on Custodio, Ferreira, and Matos (2012). 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).

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 suggest 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, Perez-Gonzalez, and Wolfenzon (2008).

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, Murphy, and Wruck (2012) 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 sub-sample 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 sub-partitions 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) 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 about 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. 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

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

⁴¹All 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).

⁴²Results of additional analysis by broad industry groups reported in Table A.5 show that the rising credentials premium is not confined to any one particular industry, as 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.

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 controls for permanent unobserved characteristics of firms that might bias our baseline cross-sectional specification due to the initial non-random 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) through (3), we report results for our baseline specification in changes, while results for the specification with firm fixed effects are in Columns (4) to (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 as the credentials premium remains significant at about \$100,000 even for CEOs with above-median tenure.⁴³

Finally, to further corroborate the validity of our baseline estimates we address the residual endogeneity concern that unobserved firm characteristics, say for example, productivity shocks that are

⁴³The magnitude of our estimates lends support to values of approximately 1/3 that are commonly used to calibrate the empirical 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.

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 UK CEOs (collected from *BoardEx*) as instruments for the characteristics of their US counterparts and construct industry-wide (FF-48) averages of CEO credentials calculated for firms that are headquartered in the United Kingdom (see Ellison, Glaeser, and Ker (2010)). The identifying assumption behind this approach is that to the extent that the same industries in the U.S. and the U.K. share common fundamental factors, such as technology and barriers to entry, changes in the observed CEO credentials rankings across industries in the U.K. should be predictive of those in the U.S., but are orthogonal to any endogenous industry inter-dependencies present in the U.S. data that arise from reverse causality.⁴⁵ Results are in Columns (7) to (11), 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, *Internet Appendix E* gives details of the following additional robustness checks: 1) Using a nearest-neighbor matching estimator (Abadie and Imbens (2007)) and a standard Heckman (1979) selection approach, to address

⁴⁴For an instrument to be valid, it must be exogenous and satisfy the exclusion restriction. In other words, we need variables that are potentially correlated to CEO credentials (relevancy condition) but affect any given CEO's pay only through its effect on CEO credentials (exclusion restriction), i.e., variables that are orthogonal to (unobserved) firm characteristics.

⁴⁵We include industry fixed effects in order 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, for example, 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.

⁴⁶Turning to the first stage estimates, all the instruments are positively and statistically significantly related to their respective credential proxy 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 sizeable fraction of incremental variation in their respective credentials proxies, thus lessening the possibility that weak instruments contaminate our inference.

selection on observables and the non-random 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*, and to screening the tone of each article to reflect positive personal traits of the CEO based on Kaplan, Klebanov, and Sorensen (2011) and only counting articles that contain mention of such traits, or *Good Press*); and 3) adding controls for alternative stories, such as Custodio, Ferreira, and Matos (2012) measures of CEO general human capital and measures of CEO power and connections which include the GIM index of Gompers, Ishii, and Metrick (2003), board size and independence, and CEO education and corporate networks (see Bebchuk, Fried, and Walker (2002)). Our results survive this entire battery of checks.

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.

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Table 1
Sample Distribution by Year

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: 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 prior to succession; Fast-Track Career, the age of CEO when he took his 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 using principal component analysis from Press, Fast-Track Career, and Selective College (de-meaned values using sample average are shown). 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.

Panel A: Sample Distribution by Year

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
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 Sub-Period

Period	Number of successions (% firms)	Number of forced successions	Number of outsiders appointed	Average Press	Median Age of First CEO Job	Median College Rank	Average Talent Score
1993-95	131 (9.2%)	28 (21.8%)	40 (30.5%)	4.2	53	3	-0.16
1996-00	199 (11.5%)	53 (26.9%)	73 (36.7%)	6.8	50	3	-0.09
2001-05	162 (10.3%)	45 (27.2%)	64 (39.0%)	10.2	49	3	0.14

Table 2
Summary Statistics

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 between 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 prior to succession; Fast-Track Career, which is the age of CEO when he took his first CEO job; 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 Appendix C for additional details on the three measures of CEO credentials and for definitions of the controls.

Panel A: Pairwise Correlations Among CEO Credentials

	Press	Fast-Track Career	Selective College	
A.1: All Successions [N=2,195]				
Press	1.000			
Fast-Track Career	0.144***	1.000		
Selective College	0.075***	0.065***	1.000	
A.2: All Successions, Top Quartile Press [N=548]				
Press	1.000			
Fast-Track Career	0.243***	1.000		
Selective College	0.137***	0.182***	1.000	

Panel B: Average CEO Credentials by Succession Type

	All N=2195	Type of Succession		
		Forced N=581	Outside N=810	Inside N=1385
B.1: Outgoing CEO				
CEO Credentials:				
Press	7.2	7.7	6	7.4
Age of First CEO Job (years)	49	46	48	49
Selective College (rank)	2.4	2.6	2.4	2.4
B.2: Successor CEO (standard deviation)				
CEO Credentials:				
Press	7.9 (19.9)	10.8	9.1	6.9
Age of First CEO Job (years)	49 (6.6)	45	48	50
Selective College (rank)	2.9 (1.4)	3.2	2.9	2.9
CEO Pay:				
Total CEO Pay (tdc1, \$M)	5.2 (6.4)	6.4 (7.1)	7.1 (7.8)	4.1 (5.4)
Total CEO Pay (log tdc1, \$000)	7.8 (1.1)	7.8	7.9	7.6
B.3: Firm Variables (year prior to transition)				
Size (log total assets, \$mil)	7.4 (1.8)	7.3	7.1	7.6
Firm Stock Return	-14.1% (45.1%)	-28.3%	-21.4%	-10.1%
Industry Stock Return (EW)	13.9% (33.2%)	13.0%	14.7%	13.4%
Industry-Adjusted OROA	0.014 (0.20)	-0.022	-0.015	0.023
GIM index	9 (2.7)	9	9	9
Board Independence	65% (17%)	64%	66%	64%

Table 3

Pay for CEO Credentials: Baseline Regression Analysis

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), (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), (8)); and a specification that further adds CEO (log) total pay in the job prior to each appointment (Columns (3), (6), (9)). Variable definitions are in Appendix C. Robust clustered standard errors adjusted for non-independence of observations by firm are reported in parentheses. Levels of significance are denoted by ***, **, and * for statistical significance at the 1%, 5%, and 10% level, respectively. Implied sensitivity is evaluated at the sample mean of pay.

	Dependent variable: log total annual compensation; appointment year only									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
	Baseline	More Firm Controls	Control for Prior Pay	Baseline	More Firm Controls	Control for Prior Pay	Baseline	More Firm Controls	Control for Prior Pay	
<i>CEO Credentials:</i>										
Press	0.544*** (0.097)	0.516*** (0.095)	0.419*** (0.124)	0.459*** (0.168)	0.454*** (0.172)	0.547*** (0.191)	0.201** (0.088)	0.225** (0.113)	0.261** (0.131)	
Fast-Track Career										
Selective College										
<i>Firm, Succession, & CEO Controls:</i>										
Stock Return _{t-1}	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)	
Firm Size	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)	
CEO Age	-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)	
Insider Succession	-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)	
Forced Succession	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)	
CEO Prior Pay			0.151*** (0.043)			0.104*** (0.036)			0.219*** (0.073)	
More Firm Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Industry F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
R 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-Credential Sensitivity (\$000 pay-1% Credentials):										
Press	28.4									
Fast-Track Career	24.0									
Selective College	10.5									

Table 4
Pay for CEO Credentials: Convexity

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 piecewise-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 piecewise 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), (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), (8)); and a specification that further adds CEO (log) total pay in the job prior to each appointment (Columns (3), (6), (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 Appendix C. Robust clustered standard errors adjusted for non-independence of observations by firm are reported in parentheses. Levels of significance are denoted by ***, **, and * for statistical significance at the 1%, 5%, and 10% level, respectively. Implied sensitivity is evaluated at the sample mean of total CEO pay.

	Dependent variable: log total annual compensation; appointment year only								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Baseline	More Firm Controls	Control for Prior Pay	Baseline	More Firm Controls	Control for Prior Pay	Baseline	More Firm Controls	Control for Prior Pay
Press (<50%)	0.146 (0.161)	0.293* (0.172)	0.041 (0.200)	0.166 (0.215)	0.171 (0.222)	0.271 (0.380)	0.024 (0.158)	0.106 (0.161)	0.043 (0.199)
Press (50%<X<90%)	2.968*** (0.252)	2.780*** (0.286)	2.070*** (0.353)	1.785** (0.741)	1.751** (0.882)	1.910** (0.963)	1.118** (0.495)	1.097*** (0.413)	1.091** (0.464)
Press (>90%)	13.198*** (2.028)	10.678*** (2.458)	9.996*** (3.450)	11.620** (4.867)	13.139** (5.384)	14.445** (6.809)			
Fast-Track Career (<50%)									
Fast-Track Career (50%<X<90%)									
Fast-Track Career (>90%)									
Selective College (<50%)									
Selective College (>50%)									
Firm, Succession, & CEO Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
More firm controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R 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-Credential Sensitivity for CEOs in Top Credential Bracket (\$000 pay-1% Credentials):									
Press	689.9								
Fast-Track Career				607.4					
Selective College							58.4		

Table 5
Pay for CEO Credentials: Complementarity with Firm Size

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 piecewise-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), (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), (8)); and a specification that further adds CEO (log) total pay in the job prior to each appointment (Columns (3), (6), (9)). Variable definitions are in Appendix C. Robust clustered standard errors adjusted for non-independence of observations by firm are reported in parentheses. Levels of significance are denoted by ***, **, and * for statistical significance at the 1%, 5%, and 10% level, respectively. Implied sensitivity is evaluated at the sample mean of total CEO pay.

	Dependent variable: log total annual compensation; appointment year only								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Baseline	More Firm Controls	Control for Prior Pay	Baseline	More Firm Controls	Control for Prior Pay	Baseline	More Firm Controls	Control for Prior Pay
Press* Small Firm	0.148 (0.198)	0.178 (0.198)	0.060 (0.186)						
Press*Medium Firm	0.560***	0.531***	0.744**						
Press*Large Firm	1.139***	1.145***	1.006***						
	(0.243)	(0.240)	(0.228)						
Fast-Track Career* Small Firm				0.098 (0.111)	0.088 (0.119)	0.053 (0.153)			
Fast-Track Career*Medium Firm				0.362**	0.467***	0.433***			
Fast-Track Career*Large Firm				(0.164)	(0.173)	(0.140)			
				1.473***	1.127**	1.706***			
				(0.382)	(0.470)	(0.348)			
Selective College* Small Firm							0.093 (0.120)	0.018 (0.121)	0.028 (0.099)
Selective College*Medium Firm							0.138 (0.131)	0.102 (0.111)	0.064 (0.120)
Selective College*Large Firm							0.474**	0.468**	0.645**
							(0.194)	(0.203)	(0.287)
Firm, Succession, & CEO Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
More firm controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry F.E.	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-Credential Sensitivity for Large Firms (\$000 pay-1% Credentials):									
Press									
Fast-Track Career				77.0					
Selective College									24.8

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

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 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). In order 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 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 Appendix C. Robust clustered standard errors adjusted for non-independence of observations by executive are reported in parentheses. Levels of significance are denoted by ***, **, and * for statistical significance at the 1%, 5%, and 10% level, respectively.

	(1) Appoint- ment CARs	(2) ROA	(3) OROA	(4) OROS	(5) ROE	(6) Stock Returns	(7) Cash Flows	(8) ROA-CARs Correlation
Dependent Variable: Long-Term Firm Performance (3 years average after- 1 year before)								
<i>CEO Credentials:</i>								
[1] Press	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] Fast-Track Career	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] Selective College	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] CEO Talent Factor	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, & Other CEO Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1771	871	891	887	814	776	718	871
Implied Performance-Credential Sensitivity (% return-10% Credentials):								
CEO Talent Factor		0.3	0.4	0.4	0.5			

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

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 employ the CEO Talent Factor - which is a factor extracted using principal component analysis on the three measures of CEO credentials (Press, Fast-Track Career, and Selective College) - in a piecewise-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). In order 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 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 Appendix C. Robust clustered standard errors adjusted for non-independence of observations by executive are reported in parentheses. Levels of significance are denoted by ***, **, *, and * for statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Appointment CARs	ROA	OROA	OROS	ROE	Stock Returns	Cash Flows
Dependent Variable: Long-Term Firm Performance (3 years average after- 1 year before)							
<i>CEO Credentials:</i>							
CEO Talent Factor* 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*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*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, & Other CEO Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1771	871	891	887	814	776	718
Implied Performance-Credential Sensitivity for Large Firms (% return-10% Credentials):							
CEO Talent Factor*Large Firm		0.6	0.5	0.6	1.0		

Table 8
Interpreting Pay for CEO Credentials
Industry Shocks

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 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)-(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)-(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 as proxied by 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)-(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 by industry median selling, general, and administrative expenses (SG&A). Columns (7)-(8) report results for domestic competition shocks, which are defined as a dummy that equals one in those industry-years with large decreases in industry Herfindhal index (HHI). Columns (9)-(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 value of one for increases that are one standard deviation or more above the sample mean. Variable definitions are in Appendix C. Robust clustered standard errors adjusted for non-independence of observations by firm are reported in parentheses. Levels of significance are denoted by ***, **, *, and * for statistical significance at the 1%, 5%, and 10% level, respectively. Implied sensitivity is evaluated at the sample mean of total CEO pay.

	Dependent variable: log total annual compensation; all ExecuComp										
	Technology		Growth Opportunities		Organizational Capital		Domestic Competition		Foreign Competition		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Firm FE	CEO FE	Firm FE	CEO FE	Firm FE	CEO FE	Firm FE	CEO FE	Firm FE	CEO FE	Firm FE	CEO FE
CEO Talent Factor	0.150*	0.199*	0.200**	0.152**	0.158*	0.162*	0.243***	0.202**	0.230*	0.277**	
	(0.085)	(0.113)	(0.088)	(0.089)	(0.093)	(0.086)	(0.071)	(0.080)	(0.129)	(0.140)	
CEO Talent Factor*											
Industry Shock _{t-1}	0.074	0.084	0.119**	0.113*	0.343***	0.318***	0.117**	0.114**	0.445**	0.074	
	(0.065)	(0.078)	(0.059)	(0.059)	(0.105)	(0.119)	(0.053)	(0.055)	(0.226)	(0.186)	
CEO Talent Factor*											
Industry Shock _{t-2}	0.184***	0.159**	0.020	0.023	0.233**	0.144	0.114**	0.129***	0.298*	0.117	
	(0.062)	(0.073)	(0.053)	(0.056)	(0.094)	(0.105)	(0.046)	(0.050)	(0.179)	(0.225)	
CEO Talent Factor*											
Industry Shock _{t-3}	0.174**	0.217**	0.033	0.006	0.149*	0.108	0.059	0.063	0.007	0.227**	
	(0.072)	(0.087)	(0.054)	(0.057)	(0.083)	(0.097)	(0.051)	(0.055)	(0.118)	(0.111)	
Firm, Succession, & CEO Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm F.E.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	No
CEO F.E.	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry F.E.	No	Yes	No	Yes	No	Yes	No	Yes	No	No	Yes
R 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	

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

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, which 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)-(10). The measure of CEO credentials - CEO Talent Factor - is a factor extracted 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 to 2000 and 2001 to 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)-(2) report results for the overall trend in CEO pay. Columns (3)-(4) report results for the trend in CEO pay in the sub-sample of outside CEO appointments. Columns (5)-(6) examine the trend at the top of the distribution of pay and reports results of quantile regressions for CEOs whose total compensation is in the 95th percentile of the empirical distribution of CEO pay. Columns (7)-(8) report results for the trend in the equity component of CEO pay. Variable definitions are in Appendix C. Robust clustered standard errors adjusted for non-independence of observations by firm are reported in parentheses. Levels of significance are denoted by ***, **, and * for statistical significance at the 1%, 5%, and 10% level, respectively.

	Panel A: Dependent variable is log total annual compensation; all ExecuComp							
	Trend in CEO pay		Trend for Outside CEOs		Trend for top 5% CEO pay		Trend in CEO equity pay	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Trend	Interactions	Trend	Interactions	Trend	Interactions	Trend	Interactions
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)
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)							
	Trend in CEO pay		Trend for Outside CEOs		Trend for top 5% CEO pay		Trend in CEO equity pay	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Trend	Interactions	Trend	Interactions	Trend	Interactions	Trend	Interactions
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)
I ₂₀₀₁₋₂₀₀₅		0.698*** (0.238)		1.214*** (0.397)		0.295*** (0.089)		0.364 (0.271)
Firm, Succession, & CEO Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 10

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

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)-(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 R² and joint excluded instrument significance (F-test statistic). Variable definitions are in Appendix C. Robust clustered standard errors adjusted for non-independence of observations by firm are reported in parentheses. Levels of significance are denoted by ***, **, and * for statistical significance at the 1%, 5%, and 10% level, respectively.

	Dependent variable: log total annual compensation; All ExecuComp										
	Baseline OLS, Δlog(tdc1)			Firm FE			UK Instrument		Labor Market Shocks, Δlog(tdc1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Press	0.204*** (0.043)			0.351*** (0.041)					0.371** (0.136)		
Fast Track Career		0.393*** (0.144)			0.274** (0.129)		0.554** (0.271)			0.517*** (0.178)	
Selective College			0.115** (0.044)			0.139*** (0.052)		0.261** (0.124)			0.243* (0.131)
Firm, Succession, & 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											
							0.135*** (0.002)				
UK Fast-Track Career											
UK Selective College								0.115*** (0.034)			
Press Shock									0.275*** (0.023)		
Fast-Track Career Shock										0.272*** (0.016)	
Selective College Shock											0.169** (0.082)
Firm, Succession & CEO Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Industry FE							19.5%	10.1%	10.8%	10.5%	9.5%
R ²							3.1%	1.1%	4.6%	4.3%	0.9%
Shea Partial R ²							77.7***	21.24***	115.1***	116.8***	8.09***
F-test of excl. instruments											

Figure 1
Pay for CEO Credentials: New CEOs' Pay and Press Coverage

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 Appendix C.

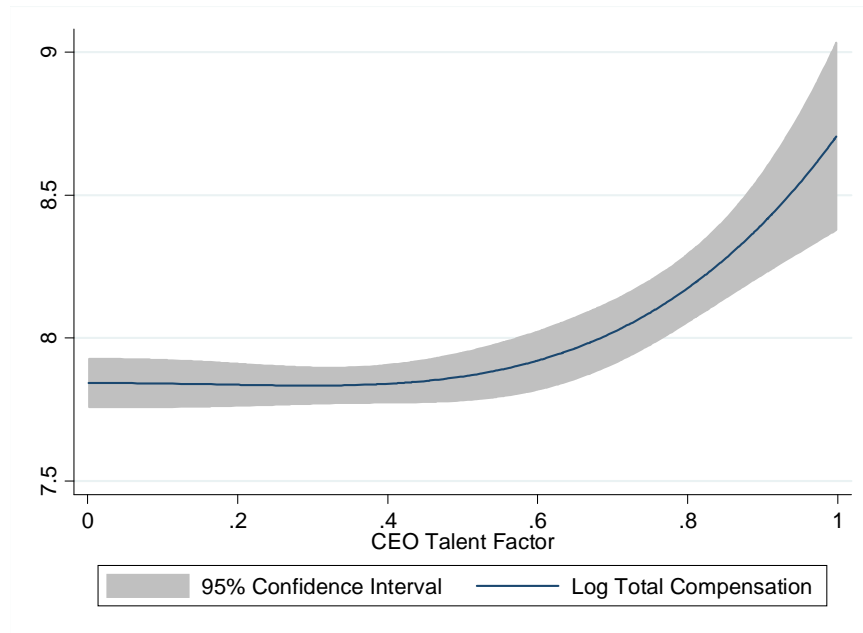


Figure 2
CEO Credentials and Firm Performance

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 sub-sample of successions involving newly-appointed CEOs in the bottom (top) quartile of the CEO Talent Factor. Variable definitions are in Appendix C.

