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# CEO Pay and the Market for CEOs

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**Abstract**

Competitive sorting models of the CEO labor market (e.g., Edmans, Gabaix and Landier (2009)) predict that differences in CEO productive abilities, or "talent", should be an important determinant of CEO pay. However, measuring CEO talent empirically represents a major challenge. In this paper, we document reliable evidence of pay for CEO credentials and argue that the evidence is consistent with models of the CEO labor market. Our main finding is that boards' compensation decisions reward several reputational, career, and educational credentials of CEOs, with newly-appointed CEOs earning a 5 percent ($280,000) total pay premium for each decile improvement in the distribution of these credentials. Consistent with boards using credentials as publicly-observable signals of CEO abilities, we show that pay for credentials displays key cross-sectional features predicted by theory, such as convexity in credentials and complementarity with firm size. Our main finding is robust to a battery of identification tests that address selectivity and endogeneity concerns, including instrumental variables estimates and controlling for firm and CEO fixed effects. We also show that credentials capture variation in CEO human capital that is different from lifetime work experience, and are positively related to long-term firm performance and board monitoring, which helps to distinguish our results from alternative stories based on CEO general human capital, hype, and entrenchment. Overall, our findings suggest that sorting considerations in the CEO labor market are an important determinant of CEO pay. Our results also suggest that the rise in CEO pay over the last decades may owe at least in part to a rise in the CEO talent premium.

# 1 Introduction

Public corporations invest considerable resources in the search for top executive talent. Recent theories, such as Edmans, Gabaix, and Landier (2009), Gabaix and Landier (2008), and Tervio (2008), argue that competition for *talent* in the CEO labor market is an important determinant of CEO pay. However, while some recent empirical studies point to an increased importance of the labor market for CEOs over the last two decades,[1] we know relatively little about whether differences in CEO productive abilities are an important *empirical* determinant of CEO pay. That is, the existing literature on the CEO labor market is mostly theoretical, the evidence we do have is indirect, and ultimately we know relatively little about the extent to which differences in CEO abilities matter for pay. In order to fill this gap, we explore the empirical relation between several observable CEO credentials and pay – which we denote as pay for CEO credentials – and examine whether this relation is consistent with theory. We develop and test the cross-sectional implications of a stylized competitive assignment model of the market for CEOs. If observed credentials provide valuable signals of CEOs' productive abilities, then we expect that pay packages should reward credentials. Theory also suggests that pay for credentials should be convex in credentials and complementary with firm size. Most importantly, better credentials should be positively associated with firm performance. We explore these predictions using a large hand-collected sample of 2,195 CEO successions between 1993 and 2005.

The critical step is to construct measures of CEO credentials that plausibly reflect public information available to boards at the time they make pay decisions. We consider three such measures of credentials based on each CEO's resume: her industry reputation, labor market status, and educational pedigree. First, the CEO reputational signal, *Press*, measures outside perceptions of CEO abilities and is constructed by counting the number of articles containing the CEO's name that appear in the major business newspapers in the year *prior* to the CEO's appointment (as in Milbourn (2003)). The basic idea is that to have been previously recognized by the business press should be perceived by boards as a good signal. Second, the labor market signal, *Fast-Track Career*, measures the quality of the CEO's career record and is defined as the age at which the executive first took a CEO job. Intuitively, if the market for CEOs is at least in part meritocratic (see Kaplan, Klebanov, and Sorensen (2011) for evidence of such), the younger an executive is when she gets her first CEO job, the more positive is the signal of her abilities. Third, the schooling signal, *Selective College*, measures the quality of CEO educational background and is constructed using Barron's rankings of the selectivity of the CEO's undergraduate

[1] Murphy and Zábojník (2007) show that there is a significant trend toward more external hires over the last three decades, which has been accompanied by an upward trend in pay.

college. Based on signaling models of education (Spence (1973)), we expect attendance at more selective colleges to be a stronger signal about CEO abilities.

We further refine these basic definitions of *Press* and *Fast-Track Career* to address any concern that they might capture variation unrelated to reputational or market signals. One concern is that *Press* might reflect bad press. 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*. A second concern is that the article count simply reflects luck or characteristics of the firm that previously employed the CEO. We address this by screening the tone of each article to reflect only positive personal traits of the CEO based on Kaplan, Klebanov, and Sorensen (2011) and only count articles that contain mention of such traits, which we denote as *Good Press*.[2] Finally, 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.

Our three measures of *Press*, *Fast-Track Career* and *Selective College* provide a unique opportunity to assess whether and why CEO credentials matter for CEO pay. The main finding of our study is that there is reliable evidence of pay for CEO credentials for newly-appointed CEOs. In particular, we show that across our three measures, CEOs with better credentials earn significantly higher total compensation. Our estimates imply an empirical sensitivity of first-year total CEO pay per credentials decile ranging from about 5% for *Press* and *Fast-Track Career* to about 2% for *Selective College*. These estimates are also economically significant – CEOs who are one decile higher in the credentials distribution earn about a $280,000 premium.[3] Results for a nearest-neighbor matching estimator (Abadie and Imbens (2007)) and a standard Heckman (1979) selection analysis confirm these baseline estimates, suggesting that selection on observables and the non-random nature of our CEO succession sample are not to blame. Since theory predicts that total compensation should be increasing in CEO talent, the positive relation between pay and CEO credentials offers a first indication consistent with boards' relying on credentials as signals of CEO productive abilities.

Next, we document key cross-sectional features of pay for CEO credentials – convexity and complementarity with firm size – and argue that they are consistent with models of the labor market for CEO talent. We first use a piece-wise linear specification to allow for heterogeneity in the relation between total CEO pay and credentials at different levels of the credentials distribution. We show that there is a

[2] We also consider ratios of these finer press counts to control for firm-related press.

[3] In a battery of robustness checks, we show that these estimates are robust to alternative definitions of the proxies, as well as adjustments at the firm and industry level.

convex relation between pay and credentials that is statistically and economically significant. For the top decile of the credentials distribution for *Press* and *Fast-Track Career*, we estimate an empirical sensitivity of first-year total CEO pay to credentials over twenty times larger than the average, a similar result also holds for *Selective College*. Among these top-ranked CEOs, the implied premium is the equivalent of about $600,000 for each percentile improvement in the distribution of credentials. We also document a complementary relation between pay for CEO credentials and firm size. For newly-appointed CEOs at firms in the top tercile of the size distribution, we estimate an empirical sensitivity of total pay to credentials more than double the average for *Press*, *Fast-Track Career* and *Selective College*. In dollar terms, this premium is the equivalent of up to $770,000 for each percentile increase. Both convexity and complementarity are consistent with our theory that predicts that more talented CEOs be matched to larger firms where they are more valuable. This complementarity ultimately leads to proportionally larger rewards for more talented CEOs, which Rosen (1981) coins the "superstar effect".

We develop three main batteries of identification tests to show that our results are not biased by selectivity and endogeneity issues that arise from the non-random sorting on unobservable CEO and firm characteristics. In addition to dealing with measurement error, we address endogeneity issues by estimating a specification in changes, controlling for firm and CEO fixed effects, and combining firm fixed effects with an instrumental variable (IV) approach. We use the information contained in the three proxies jointly to address measurement error by constructing a single CEO Talent Factor as a linear combination of the three proxies.[4] This factor delivers an estimated pay premium in line with our baseline estimates. Our first identification test uses a specification in changes, rather than levels, which gives estimates that are very close to our baseline ones. Second, we estimate specifications with firm fixed effects using the entire ExecuComp panel. By looking at changes over time, these specifications control for permanent unobserved characteristics of firms that might bias our simpler cross-sectional specification due to the initial selection of CEOs with different credentials into firms that differ along unobservable dimensions. We also address the potential concern that credentials are simply picking up unobservable CEO traits that are not necessarily related to talent by presenting results for specifications with CEO fixed effects that examine how pay for credentials changes in response to several industry shocks, including 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)), that on an a priori ground we would expect should increase the returns to CEO talent. Industry shocks allow us to estimate a specification with CEO fixed effects that examines time-series variation in the cross-sectional

[4] Factor loadings are derived using data for the entire ExecuComp sample.

estimates of pay of credentials and, thus, derive estimates of the *change* in the credentials premium that control for time-invariant unobservable CEO characteristics. Our finding of a significant premium for CEO credentials holds robustly across specifications with either firm or CEO fixed effects.

Finally, although our specifications with either firm or CEO fixed effects control for time-invariant unobserved firm or CEO characteristics, to further corroborate the validity of our baseline estimates we address the residual endogeneity concern that time-varying firm characteristics, say for example productivity shocks that are unrelated to CEO talent, may be correlated with CEO credentials, thus still potentially leading to selection bias in our results. To lessen any fear that CEO credentials are correlated with time-varying unobserved or omitted factors, we use an approach that combines firm fixed effects and instrumental variables. IV estimates with firm fixed effects insure that our source of identification is from time-series changes rather than purely cross-sectional variation. We present results for three sets of instruments that exploit different sources of exogenous variation in CEO credentials: geographic instruments (see, for example, Becker, Cronqvist, and Fahlenbrach (2010)), which measure average CEO credentials for all firms in the state where a firm is headquartered; instruments that use characteristics of UK CEOs to capture exogenous variation in the characteristics of their US counterparts (see, for example, Ellison, Glaeser, and Ker (2010)); and instruments that exploit exogenous variation in the relative demand for talented CEOs across-industries, an approach that is widely-employed in the labor literature (see, for example, Katz and Murphy (1992)). Robustly across these different sets of instruments we document evidence of a significant credentials premium, suggesting that unobserved heterogeneity is not driving our results. Overall, the first part of our analysis suggests that boards rely on several CEO credentials in making compensation decisions of newly-appointed CEOs, and that more current reputational and market signals tend to be relied upon more as compared to the more lagging school ranking.

In the second part of our analysis, we assess the importance of our findings for the literature and validate a talent interpretation of pay for credentials by ruling out alternative explanations, including CEO lifetime experience, hype, and CEO power. We argue that there is much to learn from our analysis about fundamental issues in executive compensation. In particular, 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). First, we replicate in our sample the well-known result that, even after controlling for firm, succession, and other CEO characteristics, there was a strong upward trend in CEO pay over the 1990s and 2000s. We then show 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, for recently-appointed CEOs there is no significant trend among those with the lowest credentials. Thus, especially among newly appointed CEOs, a rising premium for CEO credentials can help to explain the overall trend. The rising premium does a particularly good job at explaining the overall trend among outside hires and at the very top of the distribution of pay. Finally, when we repeat the analysis by broad industry groups, we see that a rising talent premium is especially relevant for understanding the stylized developments in CEO pay for the manufacturing, services, and hi-tech sectors.

Turning to alternative stories, Murphy and Zábojník (2007) and Custodio, Ferreira, and Matos (2011) show evidence of a premium to general CEO human capital. To the extent that our baseline specification does not control for these other features of CEO human capital, a potential concern with our results is that pay for credentials may simply be a reflection of pay for (omitted) CEO general human capital. Using standard measures of CEO general human capital based on CEO lifetime experience (whether the new CEO previously held a CEO position, the number of different positions held in the past by the new CEO, and the number of different industries the new CEO has worked in the past), we show that credentials and general experience are clearly distinct, though both important, features of CEO human capital. In fact, we replicate the results of the previous literature in our sample, as robustly across the different controls there is a significant premium for general CEO human capital. However, controlling for this premium does not meaningfully change the relation between total CEO pay and credentials of newly-appointed CEOs, which remains positive and strongly statistically significant, with an implied sensitivity of about 0.4 in percentage terms. In addition, we show evidence consistent with a substitutes relation between credentials and general experience in pay, in that the positive relation between pay and credentials is significantly stronger for CEOs that have less work experience or less general human capital. Overall, our evidence shows that both lifetime work experience and credentials represent important, though distinct, features of CEO human capital that carry an equally significant premium in CEO pay.

The work of Khurana (2002) and Malmendier and Tate (2011) might suggest that CEOs with better credentials are "hyped up" CEOs who initially attract boards' attention and pay for credentials is simply an indication of temporary luck that will ultimately lead to disappointing performance. We address this concern in two ways. First, we document that the pay for credentials relation is not temporary, but instead is sustained over the CEO's entire career. Second, we assess whether credentials bear the hallmark of hype by exploring whether they ultimately lead to subpar *or* superior long-term firm performance. We analyze a wide array of operating performance measures subsequent to CEO appointments and document that firms run by CEOs with superior credentials perform significantly better in the long term.

Our estimates of the sensitivity of operating returns to CEO credentials range between 2% and 3%, in line with the 1.7% impact of CEO deaths in Bennedsen, Perez-Gonazalez, and Wolfenzon (2008).[5] Lastly, we document that CEOs with better credentials are more likely to cut expenditures, shed excess capacity, cut leverage, increase cash, and increase firm focus. Overall, this evidence is inconsistent with myopic, hyped-up CEOs intent on milking their firms, but rather consistent with a talent view of CEO credentials as initial signals used by boards to learn about CEO turnaround abilities and subsequent firm performance.[6]

Next, we consider and refute a CEO power view (see Bebchuk, Fried, and Walker (2002)) whereby credentials are proxies of CEOs' power in setting their own pay and pay for credentials is a reflection of entrenchment or a combination of entrenchment and CEO connections.[7] We show that our estimates of the credentials premium are robust to controlling for both internal and external firm governance (including the GIM index of Gompers, Ishii, and Metrick (2003), board size and independence) and for CEO education and corporate networks, and are significantly higher for firms with better governance and those that hire external CEOs, both inconsistent with a power story. Finally, CEOs with better credentials are subject to significantly more aggressive performance-related board monitoring, which is consistent with a talent story whereby it is more effective for boards to more closely tie the threat of dismissal to performance for more talented CEOs. This result is again inconsistent with credentials being a proxy for powerful CEOs extracting rents from captive boards.

In conclusion, our paper is most closely related to recent work by Edmans, Gabaix, and Landier (2009) and others on competitive sorting models of the CEO labor market. To date, this literature has been mostly theoretical. Our contribution is to bring these models closer to the data by developing new measures of CEO credentials and documenting their empirical relation with pay. Thus, our study offers the first direct empirical evidence consistent with competitive sorting models of CEO pay.[8] Our evidence

[5] Also contrary to investors' hype, we show that investors' initial reaction to CEO appointment announcements predicts subsequent operating performance significantly better for CEOs with better credentials.

[6] While we can clearly refute CEO hype as an explanation for our results, our findings are not inconsistent with the actual evidence in Malmendier and Tate (2011). They find that CEOs tend to underperform subsequent to receiving a business award. In contrast to our career and schooling proxies, which are well-understood to be "hard" labor market signals and for which there is sound evidence that they matter for earnings of employees below the executive level (see Farber and Gibbons (1996) and Altonji and Pierret (2001) for evidence in the labor literature), awards are typically ex post recognitions and thus, represent "soft" signals which are more likely to be subject to hype issues.

[7] Gabaix and Landier (2008) and Edmans, Gabaix, and Landier (2009) emphasize that the relation between CEO pay and firm size is consistent with the talent view. However, Frydman and Saks (2010) find that the empirical pay-size relation is actually weak prior to the 1980s even though firms grew at roughly the same rate from the 1980s onward. Bebchuk and Fried (2003) argue that the recent thirty years of the pay-size relation is consistent with a rent-extraction story.

[8] There is also a related literature that links CEO traits to pay. Graham, Li and Qiu (2009) and Coles and Li (2011) present evidence that CEO fixed-effects matter for pay. Garvey and Milbourn (2003, 2006), Milbourn (2003), and Rajgopal, Shevlin, and Zamora (2006) link CEO pay, pay-performance sensitivities, and the lack of relative performance evaluation to

strongly suggests that the growth in the high CEO talent market is an important factor behind recent trends in CEO pay, consistent with Murphy and Zábojník (2007). Our evidence is complementary to recent work by Kaplan, Klebanov, and Sorensen (2011), who link several CEO traits to firm performance but not pay.[9] Overall, our results have important implications for the recent policy debate on CEO pay and suggest that the relation between pay and credentials is in fact consistent with optimal contracting. In contrast to the standard criticism of boards not prudently rewarding and monitoring CEOs, our evidence indicates that their compensation decisions are meritocratic.[10]

The remainder of the paper is organized as follows. Section 2 outlines a simple competitive assignment model of the labor market for CEOs and develops its testable implications. Section 3 describes our new CEO succession dataset and our empirical measures of CEO credentials. Section 4 outlines our empirical strategy and presents our main results on pay for CEO credentials. Section 5 examines the implications of our findings for key stylized facts of CEO pay and also considers alternative interpretations. Section 6 contains a battery of additional robustness checks and Section 7 concludes.

## 2 Model and Empirical Predictions

In this section, we develop a simple model of the CEO labor market. Our model is based on recent work by Gabaix and Landier (2008) and Tervio (2008) and illustrates how equilibrium factors in the CEO labor market affect shareholders' optimal CEO pay decisions. CEOs have observable productive abilities, 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 the bigger firms, which maximizes their impact. We start with a simple benchmark case where incentive considerations do not matter and later introduce effort. Our analysis of this standard framework is aimed at developing new testable predictions for the link between CEO talent and pay that can be used to assess empirically whether boards' pay decisions rely on CEO credentials as signals of CEO talent.[11]

executive characteristics such as age, wealth, and media cites.

[9] Baranchuk, MacDonald, and Yang (2011) add endogenous managerial effort and firm size to the model of Gabaix and Landier (2008) and show that their model can explain the recent increase in pay-firm size relation.

[10] Our results are silent about other aspects of the policy debate on CEO pay, such as, for example, whether the level of CEO pay is excessive in an absolute sense or relative to the pay of non-executive employees.

[11] See Sattinger (1979, 1993) for an earlier treatment of optimal assignment models of the labor maket and Himmelberg and Hubbard (2000) and Oyer (2004) for other models emphasizing the role of the CEO labor market.

## 2.1 Setup

There is a continuum of firms and potential CEOs. Firms differ in their size, $k$, and CEOs differ in their productive abilities (talent), $a$. Let $S(k)$ and $T(a)$ denote the density functions of firms with respect to size and CEOs with respect to talent, respectively. Thus, $\int_{k_1}^{k_2} S(x)\,dx$ will be the number of firms with size between $k_1$ and $k_2$. For simplicity, we assume that both density functions take the Pareto (exponential) form of $T(a) = a^{-\alpha}$ and $S(k) = k^{-\beta}$, with $\alpha \geq 1$ and $\beta \geq 1$. There is evidence that a Pareto distribution with coefficient $\beta \simeq 1$ fits the empirical firm size distribution well in the U.S. (Gabaix and Landier (2008)). Both Gabaix and Landier and Tervio (2008) show that the key insights of our analysis generalize to a broader class of density functions for the distribution of CEO talent.

The profits of a firm of size $k$ that hires a CEO of ability $a$ are given by revenues net of CEO pay: $\pi(a,k) = ak - w(a)$, where $w$ is CEO pay. Shareholders, via the board of directors, decide which CEO to hire by maximizing profits net of CEO pay. We next derive the optimal allocation of CEO talent across firms and the equilibrium level of CEO pay, $w^*(a)$, as implied by the assumptions of a competitive labor market for CEO talent and profit-maximizing behavior.

## 2.2 Optimal Matching and CEO Pay Decisions

A competitive equilibrium in the CEO labor market consists of a compensation function, $w(a)$, specifying the market pay of a CEO of talent $a$, and a matching function, $k(a)$, specifying the size of a firm run by a CEO of talent $a$, such that shareholders of each firm maximize profits and the CEO labor market clears, giving each firm a CEO.

### 2.2.1 Optimal Matching

In equilibrium, more talented CEOs work for larger firms. Technically, this competitive equilibrium is referred to as positive assortative matching. A sufficient condition for such matching is that CEO talent and firm assets are complements in that a talented CEO has a larger impact on her firm's profits when she has more assets under her control. This condition is satisfied in our model since the mixed partial derivative of firm revenues with respect to assets and CEO talent, $\frac{\partial^2 \pi}{\partial a \partial k} = 1$, is positive. Intuitively, if there are two firms with size $k_1 > k_2$ and two CEOs with talent $a_1 > a_2$, the net surplus is higher by putting CEO 1 at the helm of firm 1, and CEO 2 at the helm of firm 2. Formally, this is expressed as: $a_1 k_1 + a_2 k_2 > a_2 k_1 + a_1 k_2$, which always holds given that $(k_1 - k_2)(a_1 - a_2) > 0$.

Since positive assortative matching is efficient in our model, CEO labor market clearing delivers the

optimal assignment function of CEO and firms via $k(a)$. In fact, the market clearing condition requires that if $k$ is the size of a firm run in equilibrium by a CEO with ability $a$, then the number of firms of size greater than $k$ has to be equal to the number of CEOs with ability greater than $a$. Thus, competition in the CEO labor market implies that $\int_k^\infty x^{-\beta}dx = \int_a^\infty x^{-\alpha}dx$. Using this equation, we can derive the equilibrium matching function, $k(a) = \phi a^{\frac{1-\alpha}{1-\beta}}$, where $\phi = \left(\frac{\beta-1}{a-1}\right)^{\frac{1}{1-\beta}}$. It is immediately clear that in equilibrium, firm size is a strictly increasing function of CEO talent since $\frac{\partial k(a)}{\partial a} > 0$.

### 2.2.2 Equilibrium CEO Pay

Profit maximization by shareholders implies that optimal CEO pay satisfies the following FOC:

$$\frac{\partial w(a)}{\partial a} = k.$$

Thus, profit-maximizing shareholders trade off the marginal cost (higher pay) with the marginal benefit (higher revenues) of hiring a more talented CEO. Combining this equation with the equilibrium matching function, $k(a)$, allows us to derive an implicit equation for equilibrium CEO pay, $\frac{\partial w(a)}{\partial a} = \phi a^{\frac{1-\alpha}{1-\beta}}$. Integrating this with respect to CEO talent, we obtain the following equilibrium CEO pay rate (up to a constant of integration equal to the pay of the least productive CEO and with $\theta = \phi\frac{1-\beta}{2-\alpha-\beta}$) of:

$$w(a) = \theta a^{\frac{1-\alpha}{1-\beta}+1}. \tag{1}$$

Clearly, equilibrium CEO pay is a strictly increasing function of CEO talent, i.e., $\frac{\partial w(a)}{\partial a} > 0$. But, is equilibrium CEO pay a convex function of CEO talent, reminiscent of Rosen's (1981) so-called superstar effect? The answer to this question is yes. To see this, consider that given equation (1), a sufficient condition for $\frac{\partial^2 w(a)}{\partial a^2} > 0$ is that $\frac{\partial k(a)}{\partial a} > 0$, which is exactly what the efficient allocation of CEO talent (assortative matching) implies. Thus, efficient sorting in the CEO labor market implies that more talented CEOs are matched to larger firms where they are more valuable, leading to convex rewards for CEO talent. This complementarity between CEO talent and firm size also leads to rewards for CEO talent that are larger for larger firms, i.e., $\frac{\partial^2 w(a)}{\partial a \partial k} > 0$. In summary, our model makes the following testable predictions for the joint variation of CEO talent and CEO pay:

**Prediction T1 (Talent Premium in CEO Pay)**: CEOs with more productive abilities receive

higher total compensation.

**Prediction T2 (Cross-Sectional Properties of the Talent Premium)**: The relation between CEO pay and productive abilities is convex, in that the talent premium in increasing in talent. In addition, there is a complementarity between pay for talent and firm size, in that the talent premium is increasing in firm size.

### 2.2.3 Shareholder Returns

An obvious question is how large is the impact of CEO talent on shareholder value? The answer to this will prove important to distinguish empirically between talent and hype explanations for our results. As in Gabaix and Landier (2008) and Tervio (2007), we study the following counterfactual. We consider a firm that at no additional cost can replace its current CEO with ability $a_0$ with a more talented CEO of ability $a_1 > a_0$. We abstract from the additional wage cost of hiring a more talented CEO, and first focus on gross profits in order to derive an upper bound on the impact of CEO talent differences. Annual shareholder returns subsequent to CEO appointment, $Ret$, are given by

$$Ret\left(a_1, a_0\right) = \frac{\pi\left(a_1, k\right) - \pi\left(a_0, k\right)}{\pi\left(a_0, k\right)} = \frac{a_1}{a_0}.$$

Some interesting features of this expression immediately obtain. First, shareholder returns are increasing in the talent of the incoming CEOs given the fact that $Ret' > 0$. However, given that $Ret'' = 0$, we see that although it is optimal for shareholders to set convex pay, shareholder returns need not be a convex function of CEO talent. In other words, although superstar pay is consistent with shareholder maximization, shareholder returns are less sensitive to CEO talent than they are to pay. That said, our model makes the following testable prediction for the joint variation of CEO talent and firm performance:

**Prediction T3 (Firm Performance)**: Appointments of CEOs with more productive abilities are more likely to benefit shareholders – that is, the impact of CEO appointments on shareholder value is more likely to be positive for relatively more talented incoming CEOs.

### 2.2.4 Equilibrium CEO Effort

In order to help distinguish empirically between talent and CEO power explanations for our results, we develop implications for board monitoring by introducing effort as in standard multitask, moral hazard models (Holmstrom and Milgrom (1992)). We assume that CEOs differ not only with respect to their talent, $a$, but also with respect to their effort, $e$. Effort is distributed independently from talent and $E\left(e\right)$

denotes the density functions of CEOs with respect to effort, which for simplicity we assume to take the Pareto (exponential) form of $E(e) = e^{-\varepsilon}$. The profits of a firm of size $k$ that hires a CEO of ability $a$ willing to put in effort $e$ are given by revenues net of CEO pay: $\pi(a, e, k) = aek - w(a, e)$. This section shows that incentive devices aimed at increasing effort are more valuable to firms that hire more talented CEOs. Thus, we offer a sorting-rationale for incentive provision.

In equilibrium, it is efficient for firms that hire more talented CEOs to make them work harder. Technically, this is again positive assortative matching. A sufficient condition for such is that CEO talent and effort are complements in the sense that a talented CEO has a larger impact on firm profits when she works harder and this is satisfied in our model since the mixed partial derivative of firm revenues with respect to CEO talent and effort, $\frac{\partial^2 \pi}{\partial a \partial e} = k$, is positive. For any given firm, if there are two CEOs with talent $a_1 > a_2$ and two possible contracts that induce effort $e_1 > e_2$, the net surplus is higher by offering to CEO 1 the contract that induces effort 1, and to CEO 2 the contract that induces effort 2. Formally, this is expressed as $a_1 k e_1 + a_2 k e_2 > a_2 k e_1 + a_1 k e_2$, which obtains since $(e_1 - e_2)(a_1 - a_2) > 0$.

Since positive assortative matching is efficient in our model, the assumption of CEO labor market clearing delivers the optimal assignment function of CEO talent and effort, $e(a)$. In fact, the CEO labor market clearing condition requires that, if $e$ is effort in equilibrium by a CEO with ability $a$, then the number of CEOs with effort greater than $e$ has to be equal to the number of CEOs with ability greater than $a$. Thus, competition in the CEO labor market implies that $\int_e^\infty x^{-\varepsilon} dx = \int_a^\infty x^{-\alpha} dx$. Using this equation, we can derive the equilibrium matching function, $e(a) = \eta a^{\frac{1-\alpha}{1-\varepsilon}}$, where $\eta = \left(\frac{\varepsilon - 1}{a - 1}\right)^{\frac{1}{1-\varepsilon}}$. Clearly, equilibrium effort is a strictly increasing function of CEO talent, i.e., $\frac{\partial e(a)}{\partial a} > 0$. In this sense, it is efficient to offer to more talented CEOs contracts that induce higher effort. This is the case since shareholders that hire more talented CEOs also derive the most value from their effort. Thus, they benefit the most from an incentive provision such as performance-based dismissals. With this, our model makes the following testable prediction for the joint variation of CEO talent and CEO turnover:

**Prediction T4 (CEO Turnover)**: Boards should more aggressively monitor talented CEOs – that is, the sensitivity of turnover to performance is increasing in CEO talent.

# 3 Data

To assess the empirical relation between CEO pay and credentials, we construct a database of the CEO labor market that contains detailed information on CEO successions, as well as three empirical proxies

for CEO reputational, career, and schooling credentials at the time the initial terms of the compensation contract are set by the board. This section details how we construct the dataset and the collection process for each of our variables. Details on variable definitions are in *Appendix C*.

### 3.1 Selection of the CEO Successions Sample

We hand-collect our CEO succession data for the universe of all firms in the ExecuComp from 1993 to 2005. ExecuComp contains information on the top executives of all S&P 1500 firms. We recognize a CEO turnover for each year in which the identified CEO changes (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). This 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.

We classify each CEO turnover according to whether it was forced or voluntary and whether the incoming CEO is an insider or an outsider to the firm. Here we follow standard criteria in the literature that began with Parrino (1997). Departures for which the press reports state that the CEO has been fired, forced out, or retired/resigned due to policy differences or pressure are classified as *forced*. All other departures for CEOs age 60 above are classified as *not forced*. All departures for CEOs below age 60 are reviewed further and classified as forced if either the article does not report the reason as death, poor health, or the acceptance of another position (including the chairmanship of the board), or the article reports that the CEO is retiring, but does not announce the retirement at least six months before the succession.[12] This careful classification scheme 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 incumbent CEO departure and successor CEO appointment.

Table 1 presents an overview of our CEO succession dataset with descriptive statistics on total and forced turnover. 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.

[12] The cases classified as *forced* can be reclassified as voluntary if the press reports convincingly explain the departure as due to previously undisclosed personal or business reasons that are unrelated to the firm's activities.

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 than has been standard.[13] These statistics suggest that the nature of the CEO labor market has changed significantly with respect to the 1970s and 1980s. 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.

These two trends are particularly evident when viewed across the sub-periods in Panel B, which first shows that the frequency of forced turnover is higher in the later part of our sample. Forced turnovers represent about 22 percent of all turnovers in the 1993 to 1995 sub-period and about 27 percent in the following sub-periods, an increase of almost 25%. Irrespective of the sub-samples, forced turnovers are higher than in previous decades. For example, Huson, Parrino, and Starks (2001) report that forced turnovers represented only about 10 percent of all turnovers in the 1970's, and about 17% in the 1980's. Panel A shows that there is significant time-variation in both forced and voluntary turnover. Forced turnover (percentage of firms with forced CEO turnovers) is as low as 1.9% in 1993 and as high as 4.1% in 2002. These trends and the overall frequency of forced (2.8%) and voluntary (10.4%) CEO turnovers in our sample are in line with recent studies (e.g., see Huson, Parrino, and Starks (2001) who report 23.4% of forced to total turnovers for the 1989-1994 period).

Panel B shows a second important trend in the CEO labor market: the percentage of outside successions increases monotonically across the three sub-periods. The increasing prevalence of filling CEO openings through external hires rather than through internal promotions suggests that there has been a material change in the CEO selection process in the 1990s. About 30% of the departing CEOs in the 1993 to 1995 sub-period are replaced by executives who have been employed at the firm for one year or less. In contrast, the frequency of outside appointments is about 40% percent in the 2000 to 2005 sub-period. Moreover, as shown in Panel A, while there is some time-variation (a peak of 41.8% in 2005 and a dip of 34.3% in 2003), the frequency of outside hires has been consistently around 40% since 1998. These figures are even more striking if contrasted against earlier decades. Murphy and Zabojnik (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.

It is tempting to attribute this outsider trend to the higher incidence of forced turnovers. However,

[13] Studies covering earlier periods use Forbes Compensation Surveys, which roughly include S&P 500 and S&P MidCap 400 firms. Denis and Denis (1995) cover a sample of 908 CEO successions between 1985 and 1988. Huson, 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 Zabojnik (2007) have 2,783 appointments between 1970 and 2005, which is a larger, but significantly less detailed dataset than ours.

this is not the case since the trend holds for both voluntary and forced successions. While not reported, we find that the percentage of voluntary (forced) successions in which an outsider is appointed increased from about 30 (33) percent in the first sub-period to about 38 (44) percent in the last subperiod. Finally, notice that the percentage of outside hires over 2001 to 2005 in our data is higher than the 32.7% figure reported by Murphy and Zabojnik (2007). This is because their sample only includes S&P 500 and S&P MidCap 400 firms, which tend to rely more on inside hires (32.8% in our sample).

### 3.2 Construction of Proxies for CEO Credentials

Our key explanatory variables are measures of CEO credentials that can plausibly represent publicly observable signals of CEO abilities. We construct three main empirical proxies for reputation, labor market, and schooling credentials. The first proxy, *Press*, is a reputational signal based on the number of articles containing the CEO's name and company affiliation that appear in the major US and global business newspapers in the calendar year *prior* to the CEO appointment. We expect that previous recognition by the business press should be perceived by boards as a good signal about CEO reputation. The second, *Fast-Track Career*, is a labor market signal based on the speed with which an executive becomes CEO. Intuitively, if the market for CEOs is at least in part meritocratic, the younger an executive is when she gets her first CEO job, the more positive a signal boards should take about her productive abilities. The third, *Selective College*, is a schooling signal based on the selectivity of the CEO's undergraduate college. Based on signalling models of education (Spence (1973)), we expect attendance of more selective colleges to be a better signal about CEO abilities. We detail these measures next.

Our reputational signal, *Press*, is intended to capture 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-specific 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 *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.[14] 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. *Appendix A* contains a list of the precise words we use. The list was compiled by randomly sampling 50 CEOs and reading articles about them. We then return to our full sample and count the number of articles containing the CEO's name, company affiliation, and any of the words with a negative connotation that appear in the major U.S. and global business newspapers. This gives us a proxy for *Bad Press*, which we can use to construct *Press – Bad Press*.

A second concern is that *Press* might simply reflect coverage of the firm rather than the CEO. 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 using the word list in *Appendix A*. The list 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 (0.9 and 0.6, respectively) with *Press* since few negative articles apparently appear in print. Our second proxy for CEO talent, *Fast-Track Career*, is also novel to the literature and is intended to capture a labor market signal about CEO abilities. We conjecture that whether CEOs have a faster career path to the top might constitute a valuable signal of their abilities. If the selection process of corporate elites is meritocratic, the executive's age as of her first CEO

[14] Milbourn (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).

appointment should be indicative of her talent. The intuition is that more talented executives will need to spend less time on the corporate ladder and will 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.[15]

To construct our labor market signal, we collect detailed information about the complete career histories of CEOs from the following sources: (1) Dun & Bradstreet Reference Book of Corporate Managements (various years); (2) Standard & Poor's Register of Corporations, Directors and Executives; (3) Marquis Who's Who in Finance and Industry; (4) Biography Resource Center by Thomson Gale; (5) Lexis-Nexis, Factiva, and (6) various web searches. Given the evidence of higher job mobility over the last two decades, an important concern with this *Fast-Track Career* 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.

Our third and final proxy is a schooling signal based on CEO educational background. Using the same five sources employed to collect information on career histories, we compile information on CEO academic histories and college attendance. We use Barron's *Profiles of American Colleges* (1980) rankings to sort CEOs into six groups depending on the selectivity of their undergraduate institution. Barron's assigns colleges to one of the following six bins: Most Competitive, Highly Competitive, Very Competitive, Competitive, Less Competitive, or Noncompetitive. Thus, our proxy is defined as a numerical rank that takes values between 1 (worst) and 6 (best) depending on Barron's ranking of the undergraduate institution.[16] 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

[15] The motivation 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.

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

(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.

In summary, we use three measures of CEO credentials, based on CEO reputation, career, and educational background. An advantage of having multiple proxies is that we can validate them by checking their pairwise correlations. Panel A of Table 2 displays pairwise correlations among our variables for different sub-samples of our dataset. The correlations are positive and all statistically significant, suggesting that indeed the variables may capture signals of CEO abilities. However, the correlations are far from one, suggesting that they likely capture different CEO abilities and are noisy. The difference between each of our proxy variables and latent CEO abilities is measurement error.[17]

Panel B contains summary statistics for both the outgoing CEO and her successor, as well as some firm characteristics. These are additionally sorted by whether the departing CEO is forced out, and whether the incoming CEO is an insider or outsider. Particularly for outside hires and forced successions, outgoing CEOs tend to rank lower than successor CEOs in terms of our credentials measures. For example, for outside successions, the median outgoing CEO has 6 press articles (5 good articles) versus 9 articles (7 good articles) for the median outside successor and has a somewhat worse schooling record (2.4 vs. 2.9). For forced successions, the median outgoing CEO got his first CEO job at age 46 and has a schooling rank of 2.6, while the median successor CEO got his first CEO job at age 45 and has a schooling rank of 3.2. Moreover, among successor CEOs, outside hires have higher press coverage (9 vs. 7 articles), and were younger when they got their first CEO job (48 years old vs. 50) as compared to inside hires. These differences are even larger when considering incoming CEOs after forced successions.[18]

Finally, Panel B.3 shows that average stock returns in the 12 months before a forced CEO turnover are about negative 28%. The average equally-weighted (2-SIC) industry return before forced turnovers is also lower than before voluntary turnovers. This is consistent with the results in Kaplan and Minton (2008) and Jenter and Kanaan (2006) that CEO dismissals are more common in underperforming firms and industries. Panel B.3 also shows that our sample firms are relatively large, and tend to have outsider-dominated boards (65% of the directors on the median board are outsiders). However, firm size and governance characteristics are not statistically significantly different from the median firm in ExecuComp.

[17] Later we develop a simple empirical strategy that directly addresses the classic problem of noisy proxies and measurement error (see Wooldridge (2002)).

[18] These univariate results are consistent with Prediction T3.

# 4 Empirical Strategy and Main Findings

Our research setting allows us to implement direct tests of the relation between CEO pay and credentials and the economic mechanisms behind this relation. In particular, we assess a talent interpretation, which suggests that credentials serve as valuable signals of CEO productive abilities for boards' pay decisions. This section outlines our empirical strategy and then reports the results of the main analysis of pay for CEO credentials, the cross-sectional analysis to test for whether pay for credentials is consistent with the predictions of competitive sorting models of the CEO labor market, and identification tests to address potential biases from measurement error, endogenous selection, and unobserved firm and CEO heterogeneity.

## 4.1 Empirical Strategy

Our baseline empirical specification is as follows:

$$\ln(CEO\ pay_{ijt}) = \alpha + \beta * CEO\ Credentials_{it} + \gamma * Controls_{ijt} + \delta_t + \varepsilon_{ijt}, \tag{2}$$

where executive $i$ works at firm $j$ in year $t$, the dependent variable, $CEO\ pay_{ijt}$, is the natural logarithm of total CEO pay. In our baseline analysis, we consider only newly-appointed CEOs whose credentials are more likely to be a valuable 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 the predictions of our model.[19] The key explanatory variable is *CEO Credentials* as proxied iteratively by *Press*, *Fast-Track Career*, and *Selective College*. To facilitate intuitive interpretations of the economic significance of the results, we follow Aggarwal and Samwick (1999) and construct the cumulative distribution functions (CDFs) of our proxies.

In our baseline specification 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 *Appendix C*.

[19] To address alternative explanations of our results, later we complement this baseline analysis with estimates of equation (2) for the entire ExecuComp, which includes years subsequent to CEO appointments.

Finally, all our specifications include year effects and 48 (Fama-French) industry fixed effects. We assess statistical significance using clustered standard errors adjusted for non-independence of observations by executive. We will use our estimates of $\beta$ to derive an implied dollar sensitivity of CEO pay to credentials.

We also consider two more inclusive specifications. In one of them we address the potential concern that other firm characteristics that are omitted from our baseline specification may be correlated to both pay and credentials, thus confounding our inference. In order to address this concern, we saturate our baseline specification with additional firm-level controls for capital structure, liquidity and payout policy (leverage, dividend payout, and cash holdings), additional performance measures (Tobin's Q, ROA, and cash flow), and controls for investment and operating decisions (sales growth, R&D, and capital expenditures). We also consider a second additional specification that 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 our baseline tests, estimates of pay for credentials are derived from equation (2) using ordinary least squares (OLS). However, we also address directly the potential identification issues of measurement error and imperfect proxies that arise from the fact that our credential proxies are likely to be noisy.[20] In order to address the fundamental identification problem that arises when using proxy variables, we pursue a strategy aimed at combining our different proxies to obtain more reliable estimates. In particular, we estimate the following more general model:

$$\ln(CEO\ pay_{ijt}) = \alpha + \beta * CEO\ Talent^{*}_{it} + \gamma * Controls_{ijt} + \delta_t + \varepsilon_{ijt}, \tag{3}$$

where all variables are the same as in (2) except for $CEO\ Talent^{*}_{it}$, which we now treat as a latent CEO talent variable. Since we do not measure CEO talent directly, we specify the following classic measurement error equation:

$$CEO\ Credentials_{kit} = CEO\ Talent^{*}_{it} + u_{kjt},$$

where $u_{kjt}$ is measurement error that we assume is uncorrelated with both $CEO\ Talent^{*}_{jt}$ and $Controls_{ijt}$.[21]

[20] 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.

[21] Observe that by including a rich set of controls, we are likely to exacerbate the attenuation bias because the controls explain a portion of $CEO\ Talent^{*}_{it}$ but none of the error term (see Griliches and Hasuman (1986)).

We estimate this more general specification using factor analysis.[22] Intuitively, factor analysis allows us to aggregate our multiple measures of credentials into a single CEO Talent or T-Factor, which is a linear combination of the underlying measures with weights chosen in such a way that leans more heavily on proxies that more accurately reflect latent CEO abilities. To implement the model, we first derive the CEO T-Factor using our three proxies, *Press*, *Fast-Track Career*, and *Selective College*. After obtaining the factor loadings using data for the entire ExecuComp sample,[23] we estimate equation (2) using OLS with the CEO T-Factor included as the main explanatory variable. This factor analysis approach has several advantages: it is intuitive, easy to implement, and generates a simple one-dimensional variable that ranks CEOs based on a summary measure of their credentials.

Finally, there is a second important set of identification issues stemming from unobserved firm and CEO heterogeneity that may affect both pay and our credentials measures due to the non-random sorting of firms and CEOs. We address these issues in three distinct ways: estimating a specification in changes, controlling for firm and CEO fixed effects, and combining firm fixed effects with an instrumental variable (IV) approach. First, we estimate equation (2) in changes, rather than levels, as:

$$\Delta \ln(CEO\ pay_{ijt}) = \alpha + \beta * \Delta\ CEO\ Credentials_{it} + \gamma * \Delta\ Controls_{ijt} + \delta_t + \varepsilon_{ijt},$$

where changes in each variable are defined with respect to its respective value in the year prior to transition. For credentials, this specification considers changes between the credentials of the incoming CEO and those of the outgoing CEO. Differencing ensures that time-invariant firm effects are not biasing our results. Second, to address unobserved firm heterogeneity we estimate equation (2) with firm fixed effects using the entire ExecuComp panel. By looking at changes over time, these specifications control for permanent unobserved characteristics of firms that might bias our simpler cross-sectional specification due to the initial selection of CEOs with different credentials into firms that differ along unobservable dimensions. We also address the potential concern that credentials are simply picking up unobservable CEO traits that are not necessarily related to talent by analyzing how pay for credentials changes in response to several industry shocks, including 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)), that on an a priori ground we would expect should increase the returns to CEO talent. Industry shocks allow us to estimate a specification with CEO fixed effects

[22] See 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 *Appendix B*.

[23] The values of the factor loading are 0.646 for *Fast-Track Career*, 0.638 for *Press*, and 0.465 for *Selective College*.

that examines time-series variation in the cross-sectional estimates of pay of credentials and, thus, derive estimates of the *change* in the credentials premium that control for time-invariant unobservable CEO characteristics. 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.

Finally, although our specifications with either firm or CEO fixed effects control for time-invariant unobserved firm or CEO characteristics, to further corroborate the validity of our baseline estimates we need to address the residual endogeneity concern that time-varying firm characteristics, say for example productivity shocks that are unrelated to CEO talent, may be correlated with CEO credentials, thus still potentially leading to selection bias in our results. To lessen any fear that CEO credentials are correlated with time-varying unobserved or omitted factors, we use an approach that combines firm fixed effects and instrumental variables. IV estimates with firm fixed effects insure that our source of identification is from time-series changes rather than purely cross-sectional variation. For 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., a variables that are orthogonal to (unobserved) firm characteristics. We propose three sets of instrumental variables, based on three distinct sources of exogenous variation. First, we consider a set of geographic instruments (see, for example, Becker, Cronqvist, and Fahlenbrach (2010)), which measure average CEO credentials for all firms in the state where a firm is headquartered, excluding those firms that are in the same (FF-48) industry groups. To the extent that changes in local factors drive the demand for CEO talent, we expect that these instruments should be correlated with any given local CEO's credentials, but should otherwise be unlikely to capture firm-specific characteristics since we are excluding firms in the same industry.

However, one may be concerned that local shocks may be correlated with industry shocks, thus making the exclusion restriction unlikely to hold. Our second set of instruments directly addresses this concern by considering (FF-48) industry-wide averages of CEO credentials calculated for firms that are headquartered in the United Kingdom (see, for example, Ellison, Glaeser, and Ker (2010)). This approach uses characteristics of UK CEOs as instruments for the characteristics of their US counterparts. The identifying assumption 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.

A residual potential concern with this second set of instruments is that average CEO credentials in each industry may have an independent effect on CEO pay, perhaps because they proxy for competition for CEO talent, and thus the exclusion restriction may again not hold. Our third and final set of instruments addresses this concern by considering 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 instruments as weighted-averages of 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.

### 4.2 Baseline Analysis of Pay for CEO Credentials

We now present our main findings. Before discussing regression results, we plot evidence of pay for CEO credentials for newly-appointed CEOs in Figure 1. The figure plots the relationship between (the logarithm of) total pay of newly-appointed CEOs and *Press*.[24] What emerges is a pattern that is strikingly consistent with a talent interpretation of boards' pay for credentials decisions: the relation between CEO pay and reputational credentials is flat for relatively low credentials, and then increasing and convex, as predicted by competitive assignment models of the CEO labor market (Predictions T1 and T2).

Table 3 presents results of our baseline regression analysis as well as of the two more inclusive specifications with additional firm-level controls and CEO's pay in his prior position. We estimate equation (2), where the log of total dollar CEO compensation is regressed iteratively on our three measures of credentials, controlling for firm, CEO, and succession characteristics and include firm size, performance in the year prior to succession, and dummies that take the value of one, respectively, if the incoming CEO is an insider and whether the succession involves a forced departure of the outgoing CEO. All specifications include year and industry fixed effects. In Columns (1), (4), and (7), we report results for each of the three measures of credentials in this 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). The estimates in Table 3 show that total compensation of newly-appointed CEOs is positively and significantly associated

[24] *Fast-Track Career* and *Selective College* deliver qualitatively similar results.

with our three credentials measures, and this is the case both in 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 constitute an informative signal over and above observable characteristics of the newly employing firm or CEO's pay in his prior position. Depending on which measure is used, 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 predicted by our model.

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 (2), we can write the implied expected change in dollar compensation as:

$$\frac{dE(CEO\ pay)}{dCEO\ Credentials} = \frac{d\exp\{\alpha + \beta * CEO\ Credentials_{it} + \gamma * Controls_{ijt} + \delta_t\}}{dCEO\ Credentials}. \tag{4}$$

Using our estimates in Table 3 and the average 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 as:

$$\begin{aligned}
\frac{dE(CEO\ pay)}{dPress} &= E(W) * \beta = E(W) * 0.544 = \$2.8M \\
\frac{dE(CEO\ pay)}{dFast\ Track\ Career} &= E(W) * \beta = E(W) * 0.459 = \$2.4M \\
\frac{dE(CEO\ pay)}{dSelective\ College} &= E(W) * \beta = E(W) * 0.201 = \$1.1M.
\end{aligned}$$

Therefore, an improvement of one decile (10%) in *Press* carries an initial pay premium of about \$280,000, which is certainly economically significant. Overall, the positive relation between pay and CEO credentials offers a first indication consistent with boards' relying on credentials as signals of CEO talent since theory predicts that total compensation should be increasing in CEO talent. Next, we further corroborate this talent interpretation of the evidence by considering our model's second prediction.

### 4.3 Cross-Sectional Variation in Pay for CEO Credentials

In this section, we document key cross-sectional features of pay for CEO credentials – convexity and complementarity with firm size – and argue that they are as predicted by our model (Prediction T2). We consider a variant of our baseline framework that includes a piece-wise linear specification of the credentials measures. We use this specification to examine if pay for credentials is stronger for CEOs in the highest brackets of the empirical distribution of each of the credentials measures and for larger firms.

Table 4 presents results of our test of convexity in pay for credentials. The full set of controls are included in the estimation but unreported. In 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 CEO's pay in his prior position are in Columns (3), (6), and (9). The estimates in Table 4 show that the relation between total compensation of newly-appointed CEOs and each of our three credentials measures is positive and convex. Our estimates for newly-appointed CEOs whose credentials are in the top 10% imply 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*, which is a coarser variable that does not allow for a richer spline). The magnitude of these coefficient estimates for any given measure is quite stable across specifications. Using the same dollar comparative statics calculation as in (4), these estimates imply that for the top-decile CEOs, each percentile improvement in the credentials distribution carries a premium of $600,000. In contrast to these large sensitivities at the top of the distribution of credentials, our coefficient estimates imply negligible, albeit positive, sensitivities for CEOs with poorer credentials. Taken together, this cross-sectional feature of the empirical pay-credential relation is consistent with a talent interpretation from competitive sorting models predicting that compensation is increasing and convex in CEO talent a lá Rosen's (1981) "superstar effect" and our Prediction T2.

Testing the second part of Prediction T2, Table 5 presents results of the analysis of cross-sectional variation with firm size. Here we use piece-wise linear versions of 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. 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). The results show that the positive relation between pay and CEO credentials is significantly stronger for larger firms (middle and top terciles). In other words, there is a complementary relation between pay for credentials and firm size. For newly-appointed CEOs at firms in the top size tercile, we estimate an empirical sensitivity of total pay to credentials ranging from about 1 for *Press* and *Fast-Track Career* to about 0.5 for *Selective College*, with coefficient estimates for each measure that are little changed across specifications. In dollar terms, the credentials premium implied is $77,000 per credential percentile for CEOs running larger firms. While still positive, the credentials premium is small and insignificant for the smallest firms (bottom tercile).

This evidence suggests that better credentials carry a much higher pay premium for CEOs who run larger firms. This result supports a talent interpretation that boards relying on credentials as signals of productive abilities find it efficient for more talented CEOs to be matched to larger firms, leading to a complementary relation between pay for talent and firm size.

### 4.4 Identification Issues: Firm and CEO Fixed Effects and Instrumental Variables (IV) Estimates

This section shows that measurement error and unobserved firm and CEO heterogeneity are not driving our results. To address measurement error, we use the information from our three credential measures jointly, rather than iteratively, and aggregate the three proxies into a single CEO Talent Factor. To address unobserved firm heterogeneity, we analyze a specification in changes of pay and CEO credentials, rather than levels, that differences out firm effects and a specification with long-term pay for CEO credentials for the full ExecuComp that controls for time-invariant unobservable firm characteristics by including firm fixed effects. Finally in order to address potentially time-varying unobservable firm characteristics, we use an instrumental variables (IV) approach.

Results for these first three sets of identification tests are reported in Table 6. In Columns (1) and (2), we report results for the CEO Talent Factor and our baseline specification in levels and changes, respectively, while results for the specification with firm fixed effects for the entire ExecuComp are in Columns (3) and (4), and results for the instrumental variables (IV) analysis with firm fixed effects are in Columns (5), (6), and (7). The bottom panel displays for each column estimated coefficient for the instruments in the first-stage regression and IV estimation diagnostic statistics for joint excluded instrument significance (F-test statistic) and instrument over-identification restrictions (p-values of Hansen J-statistic). The estimate for the Talent Factor in Column (1) confirms our main finding that there is a significant positive relation between pay of newly-appointed CEOs and their credentials. The sensitivity of pay for credentials decile implied by the factor estimates is about $250,000, which is in line with our baseline estimates. Also estimates in changes from Column (2) confirm that there is a significant pay-to-credentials sensitivity of about $220,000, suggesting that time-invariant unobserved firm heterogeneity is unlikely to be driving our results.

The results for specifications with firm fixed effects in Columns (3) and (4) offer additional evidence that time-invariant unobserved firm heterogeneity is unlikely to be driving our results. The estimates in Column (3) reveal that total CEO compensation remains positively and significantly associated with credentials throughout CEO tenure and imply a long-term sensitivity of total CEO pay to credentials of

about 0.29, which is economically significant and correspond to about $130,000 premium per credentials decile. Column (4) reports results for a specification that adds an interaction term between the CEO Talent Factor and CEO tenure to allow for heterogeneity in pay for credentials depending on CEO tenure. Here we see 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.[25]

The IV estimates with firm fixed effects in Columns (5), (6) and (7) suggest that time-varying unobserved firm heterogeneity is also unlikely to be driving our OLS estimates which may actually be downward biased by this source of endogeneity. The estimates refer to the CEO Talent Factor instrumented in turn by three different sets of geographic, industry-UK, and CEO labor market variables, which are listed in the bottom panel with their respective first-stage regression coefficients. Robustly across the three different sets of instruments, the IV estimates reveal that total CEO compensation remains positively and significantly associated with credentials and imply a long-term sensitivity of total CEO pay to credentials of at least 0.41, which is economically significant and correspond to about $220,000 premium per credentials decile. The fact that the IV estimates are somewhat larger than their OLS counterparts suggests that unobserved firm heterogeneity may actually lead to OLS estimates that are biased downward and, thus, understate pay for credentials. Turning to the first stage regression estimates in the bottom panel, all the instruments are positively and statistically significantly related to the Talent Factor and have strong predictive power as the large $R^2$ suggests that the instrumental set explains a sizeable fraction of the variation in the Talent Factor thus lessening the possibility that weak instruments contaminate our inference. An advantage of using multiple instruments is that the overidentifying restrictions can be tested using different sources of variation in the Talent Factor. Robustly across the three sets of instruments, the Hansen-Sargan overidentification test cannot reject the joint null hypothesis that the instruments are valid (for example, in Column (7) the Hansen J-statistic has a p-value of 0.24) and the classic F-test for the joint significance of the excluded instruments shows that they are highly significant jointly, lending further support to our choice of instruments.

Results for our final battery of identification tests are reported in Table 7, which shows that pay for

[25] The 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.

credentials increases significantly in response to several industry shocks, including shocks to technology (Juhn, Murphy, and Pierce (1993), growth opportunities (Harford (2005)), organizational capital (Caroli and Van Reenen (2001)), and domestic and foreign product market competition (Guadalupe (2007)). Since theory suggests that these shocks should increase the returns to CEO talent, the evidence from industry shocks lends further support to a talent interpretation of pay for credentials. 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. An additional advantage of considering industry shocks is that we estimate specifications with CEO fixed effects that controls for time-invariant unobservable CEO characteristics. As it is not obvious why potential unobserved CEO characteristics would have a stronger systematic effect on the credentials premium across various industry groups over time, the evidence of significant pay for credentials in these specifications further limit the risk that credentials are simply picking up unobservable CEO traits that are unrelated to talent.

# 5 Assessing and Interpreting Pay for CEO Credentials

Above, we document reliable evidence of a first-year sensitivity of CEO pay to credentials of about 0.5, which increases for CEOs with better credentials and those who run larger firms. These results suggests that boards rely on several CEO credentials in making compensation decisions of newly-appointed CEOs, and that more current credentials, such as the reputational and market ones are most important. However, these findings leave two major questions still open. First, why are the findings important? In order to address this question, we assess whether our analysis offers useful insights into the key stylized facts of the recent growth in CEO pay. Second, are these findings the results of a well functioning CEO labor market, or are there alternative explanations at play, such as CEO lifetime work experience, hype, CEO power and connections? A less benevolent interpretation of our findings is that CEOs with apparent high ability are simply executives that perhaps have more generalist skills, or those that are initially hyped up, but whose hype will fade over time as her firm ultimately underperforms. Alternatively, perhaps these CEOs wield their power and use their firms' resources to manage their own press and milk their firms. Lastly, perhaps these CEOs are better connected and can extract higher rents because of their education or corporate ties. We take up each of these in turn.

### 5.1 Assessing Pay for CEO Credentials: Implications for Stylized Facts of Trend in CEO Pay

Is pay for credentials an important new result? If so, how does it contribute to the literature? What is there to learn from our analysis about fundamental 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 Panels A and B of Table 8 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. All specifications include firm fixed effects, as well as controls for the same set of firm, successions, and other CEO characteristics that are included in our baseline specification (Table 3).

Estimates for the time dummies in Column (1) replicate the well-known result that, even after controlling for firm, succession, and other CEO characteristics, 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. Column (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) to (8) use quantile regression analysis to examine the trend at the top and a 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. These results are the time-series counterpart of the "superstar effect" we documented in Table 4 and lend further support to Prediction T2 of our model. Finally, Columns (9) and (10) show that the upward trend was more pronounced for the equity component of CEO pay, especially among recently-appointed CEOs and that again that's where the credentials premium rose the most.

Panel C repeats the analysis by broad industry groups, with Columns (1) and (2) reporting results for the manufacturing sector, Columns (3) and (4) for retail, Columns (5) and (6) for services, Columns (7) and (8) for hi-tech sectors (such as biotech, computing, computer equipment, electronics, medical equipment, pharmaceuticals, software), and Columns (9) and (10) for regulated sectors (financials and utilities). The results show that the upward trend in CEO pay holds across the board of a wide array of different industrial sectors, though the trend in the 1990s was more pronounced in hi-tech and services, while regulated had a stronger rise in the 2000s. 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. Overall, this evidence broadly suggests that a rising talent premium offers an important and novel perspective over key recent stylized developments in CEO pay.

### 5.2 Talent vs. Lifetime Work Experience: Pay for Credentials and Generalist CEO Human Capital

In this section, we show that pay for CEO credentials is not a reflection of other important characteristics of CEO human capital that have been previously recognized in the literature, such as previous experience of the CEO and generalist vs. specialist features of his human capital. Murphy and Zábojník (2007) and Custodio, Ferreira, and Matos (2011) show evidence that there is a trend toward appointing more generalist CEOs among publicly traded firms in the U.S. in the last decades. In addition, these papers present evidence of a premium to generalist CEO human capital. To the extent that our baseline specification does not control for these other features of CEO human capital, a potential concern with our results is that pay for credentials may simply be a reflection of pay for (omitted) CEO general human capital.

The results in Table 9 show that pay for credentials and generalist experience are clearly distinct, though both important, features of CEO human capital. Columns (1) to (3) present estimates for a specification that adds controls for standard measures of CEO general human capital based on CEO lifetime experience: whether the new CEO previously held a CEO position, the number of different positions held in the past by the new CEO, and the number of different industries the new CEO has worked in the past. Column (4) shows results when we control for a measure that aggregates these lifetime experience variables into a CEO General Ability Factor extracted using principal component analysis from the three underlying experience proxies as in Custodio, Ferreira, and Matos (2011)). Here we see that we can replicate the results of the previous literature in our sample, as robustly across the different controls there is a significant premium for general CEO human capital. However, controlling

for this premium does not meaningfully change the relation between total CEO pay and credentials of newly-appointed CEOs, which remains positive and statistically significant, with an implied sensitivity of about 0.4 in percentage terms. These estimates of the credentials premium are a bit lower but little changed in therms of their economic significance with respect to a specification without CEO lifetime experience controls (Column (4) of Table 6).

Columns (5) to (7) offer additional analysis of the relation between pay for credentials and pay for general human capital. Here, rather than taking CEO credentials and CEO lifetime work experience as two separate groups of variables, we present results for specifications that includes two CEO Human Capital Factors, "Experience" and "Talent," which are the first two principal components extracted from using our three CEO credentials proxies jointly with the three CEO lifetime work experience proxies. The fact that factor analysis gives us two orthogonal principal components, one of which is more highly correlated with the experience proxies and the other which is more correlated with the credentials proxies, offers additional evidence supporting the notion that credentials and work experience pick up different characteristics of CEO human capital. Estimates in Column (5) show that both the "Experience" and the "Talent" factors are significantly positively associated with total CEO pay, suggesting that there is both a CEO credentials premium and a CEO general human capital premium in pay. In addition, Columns (6) and (7) show evidence consistent with a substitutes relation between credentials and general experience in pay. Here we consider interactions between the two CEO Human Capital Factors to allow for heterogeneity in pay for CEO credentials depending on CEO experience and viceversa. We find that the positive relation between pay and credentials is significantly stronger for CEOs that have less work experience or less general human capital. Viceversa, the premium to general human capital is significantly higher for CEOs with less credentials. This evidence suggests that boards' pay decisions load relatively more heavily on credentials when hiring CEOs with shorter work histories, which presumably offer fewer other observable signals of CEO ability. Overall, based on this evidence we conclude that both lifetime work experience and credentials represent important, though distinct, features of CEO human capital and both carry an equally significant premium in CEO pay.

### 5.3 Talent vs. Hype: Pay for Long-Term Credentials, Firm Performance and Corporate Policies

In this section, we use the predictions of our competitive sorting model to distinguish between interpretations based on talent versus those based on hype. While a talent interpretation considers CEO credentials valuable signals of CEO abilities, the hype view (Khurana (2002) and Malmendier and Tate

(2011)) 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 and a disappearing pay-for-credentials premium. By contrast, if credentials are signals of productive abilities, premium pay for credentials should remain significant in the long-run and be associated with superior long-term operating performance (see Prediction T3). Examining long-term pay for credentials and the relation between credentials and long-term operating firm performance allows us to distinguish between the two alternative stories.

Overall, long-term features of pay for credentials in Table 6 appear more consistent with a talent story of boards learning from multiple signals of CEO abilities rather than being the decision of passive boards hypnotized by CEO hype. There we saw that the sensitivity of pay to credentials declines significantly over the CEO's tenure, but it is not a purely temporary phenomenon as the hype story predicts. Before presenting the results of our formal tests of the relation between credentials and long-term firm operating performance, we plot univariate evidence 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 *Press*),[26] and the thin line represent median OROA for bottom-quartile CEOs. The OROA "smile" suggests that, on average, CEO turnover follows a period 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.

Panel A of Table 10 presents results of our regression analysis of long-term operating firm performance. We estimate a version of equation (2) where now the dependent variables are changes around CEO successions in various industry-adjusted measures of long-term operating firm performance. The changes in these measures are regressed on the CEO Talent factor and controls. In 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. In Columns (1), we examine short-run cumulative abnormal returns (CARs) around CEO appointments and see that investors anticipate subsequent performance improvements, which corresponds to them reacting more favorably to the news of successions that involve incoming CEOs with better credentials. 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

[26] We uncover qualitatively similar results using *Fast-Track Career* and *Selective College*, as well as when we measure performance using OROS and ROA.

return on sales (OROS), return on equity (ROE), stock market returns, and cash flows, respectively.

For every performance measure, we uncover estimates of the sensitivity of shareholder returns to CEO credentials that are positive and strongly statistically significant, ranging between 2% and 3%.[27] Finally, Column (8) examines 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. The latter result is inconsistent with investors overreacting to the appointment of a CEO with better credentials and suggests that credentials are in fact an informative signal of future performance.

Overall, our estimates of the credentials premium for shareholder returns are consistent with models of competitive sorting in the CEO market (Prediction T3), rather than CEO hype which predict that the performance impact of CEO talent should be an order of magnitude smaller than the pay impact. To buttress these performance results, Panel B of Table 10 presents results of our regression analysis of actual CEO decisions. We estimate a version of equation (2), where now the dependent variables are changes around CEO successions in various industry-adjusted firm policies, which are regressed on the CEO Talent factor and our standard controls. We report results on investment policy in Columns (1)-(3), financial policy in Columns (4)-(6), and on organizational strategy in Columns (7) and (8). Our estimates show that CEOs with better credentials are significantly more likely to cut capital and M&A expenditures, shed excess-capacity (existing divisions), cut leverage and increase internal financing (cash), and increase firm focus. Overall, this evidence is inconsistent with myopic, hyped-up CEOs intent on milking their firms, and instead consistent with a talent view that credentials are signals of CEO turnaround abilities reflected in long-term performance.

### 5.4 Talent vs. CEO Power: Pay for Credentials, CEO Connections, and Firm Governance

In this section, we use the predictions of competitive sorting models to distinguish between a talent interpretation and one based on CEO power (Bebchuk and Fried (2003)). If credentials are proxies for CEO power in setting their own pay, then pay for credentials is actually a reflection of entrenchment issues and thereby we should see significantly higher premiums for firms with worse governance and even more so if their CEOs are more connected (e.g., Fracassi and Tate (2011)). Also, if better credentials proxy for power, then we should see weaker board monitoring of these CEOs. By contrast, if credentials

[27] Our estimates are in line with the 1.7% impact of CEO deaths in Bennedsen, Perez-Gonazalez, and Wolfenzon (2008).

are signals of productive abilities, we should see higher premiums at better governed firms to go along with the better firm performance documented above. In addition, Prediction T4 suggests that we should see tougher board monitoring of CEOs with better credentials.

Columns (1)-(6) of Table 11 presents results of our analysis of the impact of firm governance and CEO networks on pay for credentials. Column (1) presents estimates for a specification that adds controls for standard measures of firm governance, the GIM Index, board size, and board independence, and Column (2) shows a specification that also adds controls for standard measures of CEO networks, the intensity of CEO education and corporate ties. Here we see that the relation between total CEO pay and credentials of newly-appointed CEOs remains positive and statistically significant after controlling for firm governance and CEO connections, with an implied sensitivity of about 0.5 in percentage terms. These estimates are little changed with respect to a specification without governance and CEO connections controls (Column (4) of Table 6). Columns (3)-(6) individually add interactions between the CEO Talent Factor and the three governance variables (Columns (3), (5), and (6)) to allow for heterogeneity in pay for CEO credentials depending on the quality of firm governance, as well as interactions between the Talent Factor, the GIM index, and CEO connections to explore whether governance issues have a differential impact on pay for credentials depending on CEO networks, since the evidence in Fracassi and Tate (2011) suggests that governance issues are particularly important for firms whose CEOs are well-connected. We find that the positive relation between pay and credentials is significantly stronger for firms with better governance and for externally-hired CEOs which are obviously the least likely to be entrenched. In addition, we do not find any evidence of stronger effects of governance on pay for credentials depending on CEO connections. Overall, these results are inconsistent with an entrenchment view of more accomplished CEOs.

Columns (7) and (8) present results of the relation between credentials and board monitoring. All specifications are for probit regressions of the likelihood of forced CEO turnover on measures of CEO credentials for the entire ExecuComp, where the dependent variable is a dummy that takes value of one in any given firm-year when a forced CEO turnover occurs.[28] We present estimates for two different subsamples of underperforming firms, which are defined as firms whose performance in the prior year was below median (Column (7)) and in the bottom quintile (Column (8)) of performance in their industry, respectively. CEOs with better credentials are subject to significantly more aggressive board monitoring as measured by the likelihood of being fired if they underperform, an effect that interestingly is monotonic

[28] We run a standard cross-sectional probit regression (e.g., Jenter and Kanaan (2006)): $Prob\,(Forced\ CEO\ Turnover_{jt}) = \alpha + \beta_1 * Firm\ Return_{jt} + \beta_2 * Firm\ Return_{jt} * CEO\ Credentials_{jt} + \beta_3 * Firm\ Return_{jt} * Controls_{jt} + \beta_4 * CEO\ Credentials_{jt} + \beta_5 * Controls_{jt} + \varepsilon_{jt}$, where $Controls_{jt}$ include firm size, CEO age, tenure, and insider dummy, and all specifications include year and (Fama French 48) industry dummies.

in the strength of underperformance. This result is inconsistent with credentials being a proxy for powerful CEOs who extract higher rents from captive boards, and consistent with a talent story whereby tying the threat of dismissal more closely to performance is more effective for more talented CEOs (Prediction T4 of our model). In summary, the evidence in Table 11 is inconsistent with a power interpretation and more in line with our CEO labor market view of pay for credentials.

# 6 Additional Robustness Checks

We conduct several additional tests to confirm that our main result is robust. In particular, we offer additional evidence that selection issues are unlikely to be driving our results and implement robustness checks for each of the credentials measures used in our baseline regression analysis in Table 3.

## 6.1 Matched Sample and Heckman Analyses

We address two additional selection concerns. First, a selection story would attribute pay for credentials to the ability of CEOs with better credentials to "cherry pick" prospective firms that are easier to turn around. Cherry picking is indicative of a broader range of issues related to selection on observable firm characteristics that arise due to the non-random assignment of CEOs to firms. Economically, this selection issue reflects the endogeneity of CEO succession decisions. For example, since large firms are more likely to hire talented CEOs based on our model, it might be that part of the credentials premium is simply due to CEOs with better credentials being appointed to run larger firms. Panel 1.A of Table 12 presents results of a matched-sample analysis that addresses this first selection concern. Here, we use a nearest-neighbor matching estimator (Abadie and Imbens (2007)). Ideally, we would like to compare CEO pay of a firm that appoints a CEO with good credentials to the same firm's pay had it appointed a CEO with worse credentials. Since the counterfactual is not observed, we construct a hypothetical one by estimating a first-stage probit regression of the likelihood that a firm appoints a CEO with good credentials (top quartile of the CEO Talent Factor) using a specification that includes observable pre-transition firm characteristics (size, performance, and forced turnover) related to cherry picking.

First-stage estimation results are reported in Column 2. There is a significant and positive relation between the likelihood of appointing a CEO with good credentials and firm size. Forced turnovers are also more likely to be associated with subsequent appointments of CEOs with better credentials. By contrast, controlling for these variables, we find a negative but statistically insignificant relation with pre-transition firm performance and the likelihood of appointing a talented CEO. Column 1 reports results of the second

stage, where we take the difference between total CEO pay for successions involving CEOs with good credentials (the treated group) and matched successions with the closest predicted probability of involving CEOs with good credentials (the control group). We estimate a pay-credential sensitivity of 0.6, which remains significant and in line with our baseline results, suggesting that the endogeneity of CEO selection is unlikely to be driving our main finding.

Panel 1.B of Table 12 addresses a second selection concern that our baseline estimates for newly-appointed CEOs may be driven by the non-random selection of firms into the CEO appointment sample. Since firm characteristics, such as size and performance, are significant determinants of the likelihood of a CEO succession, our sample is clearly not randomly selected from the ExecuComp population and thereby our previous estimates may suffer from sample selection bias. We address this issue using a standard Heckman (1979) selection approach that estimates pay for CEO credentials jointly in a system of two equations that adds a probit regression of CEO succession likelihood for the entire ExecuComp sample. The first-stage selection equation includes an indicator variable for CEO death or retirement, which clearly should affect the likelihood of a succession but not the subsequent pay of the new CEO, and is thus excluded from the second-stage. Using a standard two-step procedure based on the probit estimates in Column 3, we construct estimated inverse Mills ratios and use them to augment our baseline pay equation (2) in the second step. The standard errors in the second stage regression are corrected for the fact that the inverse Mills ratio is estimated (Wooldridge (2002)).

Column 4 reports results of the first-stage probit regression. Not surprisingly, firms whose CEO died recently or reached "retirement" age are significantly more likely to experience a CEO succession, and so are larger and underperforming firms. Column 3 reports results for the Heckman two-step selection model of total CEO pay. The inverse Mills ratio has a significant positive coefficient, confirming that sample selection is a relevant concern in our study and tends to increase pay. However, even after controlling for the inverse Mills ratio, there is a positive and significant relation between pay and CEO credentials. Finally, the two-step procedure leads estimates of the sensitivity of pay for credentials that are a bit larger than our OLS ones (Column 4 of Table 6). Thus, non-random selection of the CEO succession sample is unlikely to be driving our main finding.

### 6.2 Additional Controls and Different Definitions of the CEO Credentials Proxies

Turning to Panel 2 of Table 12, the results in Rows (1)-(4) address the potential concern that *Press* might capture variation unrelated to CEO reputation, such as bad press or simply coverage of the firm. We show that our results are robust to using a measure that nets out negative press coverage, or *Bad*

*Press*, from *Press* (Row (1)). A second concern is that the article count might simply reflect luck or characteristics of the firm that previously employed the CEO, which we address by screening the tone of each article to reflect positive personal traits of the CEO based on Kaplan, Klebanov, and Sorensen (2011) and only count articles that contain mention of such traits, or *Good Press* (Row (3)). Notably, the sensitivity of pay to this refined measure or reputation is even larger than our baseline estimate for the total press count. Next, we show that our results are robust to using (*Press* - *Bad Press*)/*Press* (Row (2)) and *Good Press*/*Press* (Row (4)). These ratios measure the share of good press out of total press and more likely reflect CEO personal reputation rather than firm characteristics. We also address the concern that *Press* may reflect firm size, by showing robustness to a firm-adjusted *Press* measure that subtracts from the total *Press* count for each CEO the median *Press* of CEOs at firms with similar size (Row (6)). Finally, Row (5) shows robustness to using an average of *Press* in the three years prior to appointment.

Row (7) addresses the concern that *Fast-Track Career* is mechanically correlated with age for CEOs whose current appointment is also their first CEO job (797 successions). Excluding these CEOs only strengthens our results. Rows (8) and (9) show that our sensitivity estimates for *Selective College* are robust to using a dummy approach that only classifies as selective those colleges that are in the top Barron's rank and to including CEOs that did not attend college or attended a foreign institutions as least selective, as done by Perez-Gonzalez (2006). In the last battery of checks, we show that our baseline estimates for each of the three credentials proxies are robust to using industry-adjusted measures (Row (10)) to address the concern that there may be common industry factors correlated with our proxies. We also show that the estimates are robust to controlling for graduate education using a dummy for whether CEOs have an MBA (Row (11)), which addresses the standard finding that MBA education is related to pay (Murphy and Zábojník (2007), Frydman (2005)). Finally, we show that our baseline estimates are robust to controlling for size in a less parametric way which includes polynomials up to the 3rd order of the size variable (Row (12)) and to including controls for firms' headquarter location to address the potential concern that local CEO labor market factors ma be driving our results (Raw (13)).

# 7 Conclusion

This paper argues that focusing on the labor market for CEOs can augment our understanding of the empirical determinants of top executive pay. To that end, we have documented reliable evidence of pay for several CEO credentials, which include reputational, career, and educational ones. We have shown

that the credentials premium is larger for the most accomplished CEOs and for larger firms, which is consistent with competitive sorting models of the market for CEOs. Finally, the premium remains significant in years subsequent to appointment, is robust to controlling for firm and CEO fixed effects as well as using an instrumental variable (IV) approach to address endogeneity, and is larger for firms with better governance. In addition, credentials carry a significant performance premium for shareholders. Overall, these results strongly support an interpretation of pay for credentials based on the market for CEO talent and are inconsistent with alternative stories based on CEO lifetime experience, hype, or entrenchment. In sum, our work represents the first direct evidence that sorting considerations in the CEO labor market are an important determinant of CEO pay. Our results have important implications for the recent debate on the rise in CEO pay and suggest that a rising CEO talent premium may have contributed to the recent rise in CEO pay. There are, of course, other important aspects of the policy debate on CEO pay about which our results are silent. For example, some have decried the level of CEO pay as being excessive in an absolute sense or relative to the pay of non-executive employees. An interesting avenue for future research would be to explore these issue by considering the interplay between credentials and differences in responsibility along the corporate hierarchy.

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# 8 Appendix A: Details on the Article-Based Proxies

To construct our Press, Bad Press, and Good Press proxies, we include the following publications in our search:

BusinessWeek, Dow Jones News Service, Financial Times, Forbes, Fortune, International Herald Tribune, Los Angeles Times, The Economist, The New York Times, The Wall Street Journal, The Wall Street Journal Asia, The Wall Street Journal Europe, The Washington Post, USA Today.

Our Bad Press proxy is the total count of articles containing the following keywords:

scandal or investigat* or (cut w/2 jobs) or resign* or (force* w/3 quit) or dismiss* or demote* or demotion or accuse* or critici* or allegation* or indict* or arrest* or guilty or fraud or litigation or abrasive or excessive pay or overpaid or perquisites or (force* w/3 step down) or under fire or under scrutiny or under pressure or law suit or class action or in trouble.

Our Good Press proxy is the total count of articles containing the following keywords:

leader or leadership or reputable or recognition or distinguished or good reputation or great reputation or huge reputation or visionary or skillful or personable or talent* or aggressive or flexible or adaptable or respectful or fair or integrity or focused or organizer or planner or calm or doer or brainpower or communicator or creative or motivational or enthusiasm or enthusiastic or persisten* or attentive or proactive or tenacity or work* hard or thinker or long hours or persuasive or team play* or teamwork or coaching out or listener or persuas* or persuade or moves fast.

# 9 Appendix B: Factor Analysis and Measurement Error

Factor analysis allows us to combine our various proxies of CEO talent to obtain a more reliable measure of the latent CEO talent variable (our discussion is based on Black and Smith (2006), but see Harman (1976) for details on factor analysis). Formally, suppose that across all CEOs $E\left(CEO\ Talent_{it}^{*}\right)=0$, which is a harmless normalization that keeps notation simple. Let $T=\left(T_{1},...,T_{k}\right)$ be a K-vector of noisy signals of CEO talent, such that for a CEO with talent $CEO\ Talent_{it}^{*}$, the value of each signal is $T_{ki}=CEO\ Talent_{i}^{*}+u_{ki}$ with $E\left(T_{ki}\right)=0$, $E\left(u_{kit}^{2}\right)=\sigma_{k}^{2}$, $E\left(u_{kj}u_{kh}\right)=0$, $\forall j\neq h$, $E\left(u_{kj}u_{lj}\right)=0$, $\forall k\neq k$, and $E\left(CEO\ Talent_{it}^{*}u_{ki}\right)=0$ and the time subscripts are omitted to save on notation. We construct a measure of CEO talent by taking a linear combination of the signals. Define $\widehat{T}=\sum_{k=1}^{K}\tau_{k}T_{k}$ (where there is no need for an intercept term because the expected value of $CEO\ Talent_{i}^{*}$ is normalized to zero). We select the $\tau_{k}$'s to minimize the expected squared distance between $\widehat{T}$ and $CEO\ Talent^{*}$, or

$$min_{\tau,...,\tau_{k}}E\left(CEO\ Talent^{*}-\widehat{T}\right)^{2}.$$

The necessary conditions for minimization are

$$Var\left(CEO\ Talent^{*}\right)-\sum_{l=1}^{K}\tau_{l}Var\left(CEO\ Talent^{*}\right)-\tau_{k}\sigma_{k}^{2}=0,\qquad\forall k$$

or $1-\sum_{l=1}^{K}\tau_{l}-\tau_{k}r_{k}=0$, $\forall k$, where $r_{k}=\sigma_{k}^{2}/Var(CEO\ Talent^{*})$ is the noise-to-signal ratio. For $k=1$ and $k=l$, we have that $\tau_{l}=\tau_{1}\frac{r_{1}}{r_{l}}$. Thus, we may solve for $\tau_{1}$ to obtain $\tau_{1}=\frac{r_{1}^{-1}}{1+\sum_{l=1}^{K}r_{l}^{-1}}$.The remaining $\tau$'s have similar formulae. Thus, $\tau_{k}$ decreases in the variance of the idiosyncratic error $u_{k}$, so that signals that more accurately reflect latent CEO talent receive more weight in the forecast.

# 10 Appendix C: Variable Definitions

The variables used in this paper are either hand-collected or extracted from five major data sources: EXECUCOMP, COMPUSTAT, CRSP, IRRC, BoardEx. For each data item, we indicate the relevant source in square brackets. The specific variables used in the analysis are defined as follows:

*CEO Credentials Proxies:*

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

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

- Selective College: is a numerical rank that takes values between 1 and 6 based on Barron's *Profiles of American Colleges* (1980) rankings of the undergraduate institution attended by the CEO. In Barron's (1980) rankings, colleges are assigned one of the following six ranks: Most Competitive, Highly Competitive, Very Competitive, Competitive, Less Competitive, or Noncompetitive. All specifications use the cumulative distribution function of Selective College, CDF(Selective College). [Dun & Bradstreet Reference Book of Corporate Managements (various years); Standard & Poor's Register of Corporations, Directors and Executives;

Marquis Who's Who in Finance and Industry; Biography Resource Center by Thomson Gale; Lexis-Nexis, Factiva, and web searches]

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

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

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

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

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

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

*Instrumental Variables for CEO Credentials:*

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

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

- CEO labor market instruments (Average Labor Market Press, Average Labor Market Fast-Track Career, Average Labor Market Selective College): weighted-average of the respective credential proxy among all

ExecuComp firms in each year, excluding those firms that are in the firm's same (Fama-French 48) industry group, with weights reflecting the industry-specific CEO labor market share. In particular, weights are defined as the share of firms in any given (Fama-French 48) industry group in 1990 with respect to the total number of firms in Compustat. All specifications use the cumulative distribution function (CDF) of the underlying instrumental variable.

*CEO Pay and Turnover:*

- CEO pay: log total compensation (TDC1), which is defined as the sum of short-term compensation (salary and bonus) and long-term compensation (long-term incentive plans, restricted stock, and stock appreciation rights), deflated by CPI in 1990. [EXECUCOMP]
- Insider: dummy which equals zero when successor CEOs has been with their firms for one year or less at the time of their appointments, and one for all other new CEOs. [Factiva searches]
- Forced: dummy defined as in Parrino (1997). It equals one for CEO departures for which the press reports that the CEO has been fired, forced out, or retired/resigned due to policy differences or pressure. It equals zero for departing CEOs above and including age 60. All departures for CEOs below age 60 are reviewed further and classified as forced if either the article does not report the reason as death, poor health, or the acceptance of another position (including the chairmanship of the board), or the article reports that the CEO is retiring, but does not announce the retirement at least six months before the succession. [Factiva searches]

*Firm Performance:*

- Announcement CARs for CEO Appointments: cumulative abnormal return to the appointing firm's stock for trading days (-2, +2) relative to the date of the first article covering the news of a new CEO appointment. Abnormal returns are calculated using the capital asset pricing model (CAPM) and standard event study methodology (see MacKinlay (1997) for a detailed review). We use the market model and CRSP equally-weighted return as the market return to estimate the market model parameters from event day -210 to event day -11. [CRSP]
- ROA: ratio of operating income after depreciation (item 178) to book value of assets (item 6). Industry-adjusted ROA is calculated by subtracting the median of (Fama-French 48) industry and year ROA. [COMPUSTAT]
- OROA: ratio of net income (item 172) to the book value of assets (item 6). Industry-adjusted OROA is calculated by subtracting the median of (Fama-French 48) industry and year OROA. [COMPUSTAT]
- OROS: ratio of net income (item 172) to sales (item 12). Industry-adjusted OROS is calculated by subtracting the median of (Fama-French 48) industry and year OROS. [COMPUSTAT]
- ROE: ratio of net income (item 172) to common equity (item 60). Industry-adjusted ROE is calculated by subtracting the median of (Fama-French 48) industry and year ROE. [COMPUSTAT]
- Stock returns: annual stock return (fiscal year-end). [COMPUSTAT]
- Tobin's Q: ratio of the market value of assets to the book value of assets (item 6). Market value of assets is the book value of assets plus the market value of common equity less the sum of the book value of common equity (item 60) and balance sheet deferred taxes (item 74). [Compustat]

*Firm Controls & Policies:*

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

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

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

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

- Diversifying M&As: total number of takeover bid offers that are classified as mergers and involve a target in the same (3-SIC) industry (successful and unsuccessful) and are announced in a given year [SDC Platinum, U.S. Mergers and Acquisitions database]

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

- Cash holdings: cash (item 1) over book value of assets (item 6). [COMPUSTAT]

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

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

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

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

*Industry Shocks:*

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

- Technology shocks: change in the intensity of investment in information technology (IT) capital. Industry IT intensity in year $t$ is its stock of IT capital relative to other capital. Following Stiroh (2002), we define IT capital as seven classes of computer hardware (mainframe computers, personal computers, direct access storage devices, computer printers, computer terminals, computer tape drives, and computer storage devices) and three classes of software (pre-packaged, custom, and own-account software). Investment expenditure in each of the 61 classes are converted into a capital stock using standard perpetual inventory method. [Bureau of Economic Analysis (BEA) Fixed Reproducible Tangible Wealth (FRTW)]

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

- Organizational capital shocks: change in selling, general, and administrative expenses (SG&A) (item 189). [COMPUSTAT]

- Domestic competition shocks: change in Herfindahl-Hirschman index (HHI) of sales of all firms in the same industry, where the HHI index is computed using all firms in Compustat. [COMPUSTAT]

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

*CEO Controls:*

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

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

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

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

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

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

- CEO General Ability Factor: factor extracted using principal component analysis from the three underlying experience proxies, Past CEO position, Past Number of Jobs, and Past Number of Industries. (Custodio, Ferreira, and Matos (2011)) [BoardEx]

- CEO Human Capital Factors, #1 ("Experience") & #2 ("Talent"): the first two principal components extracted from using our three CEO credentials proxies (Press, Fast-Track Career, and Selective College) jointly with the three CEO lifetime work experience proxies (Past CEO position, Past Number of Jobs, and Past Number of Industries). [Dun & Bradstreet Reference Book of Corporate Managements (various years); Standard & Poor's Register of Corporations, Directors and Executives; Marquis Who's Who in Finance and Industry; Biography Resource Center by Thomson Gale; Lexis-Nexis, Factiva, and web searches; BoardEx]

*Governance & Connections Controls:*

- GIM-index ($\geq$11) dummy variable that takes value of one for firms with 11 of more of the 24 antitakeover provisions includes in the GIM index of Gompers, Ishii, and Metrick (2003). [IRRC].

- Board size: total number of directors on the board in a given firm-year. [IRRC]
- Board independence: dummy variable that takes value of one for firms whose ratio of the number of independent directors to overall number of directors in a given firm-year above median (larger than 0.67). [IRRC]
- CEO Education Network: number of education ties of the CEO, as measured by the number of individuals (top executives and directors) in BoardEx who attended the same school of the CEO at the same time. All specifications use the cumulative distribution function (CDF) of CEO Education Network. [BoardEx]
- CEO Corporate Network: number of corporate ties of the CEO as measured by the sum of Current Employment Network and Prior Employment Network. Current Employment Network is the number of individuals in BoardEx who currently serve in another common publicly traded company with the CEO. Prior Employment Network is the number of individuals in BoardEx who served in at least one common publicly traded company with the CEO in the past, excluding prior roles in the company in question. All specifications use the cumulative distribution function (CDF) of CEO Corporate Network. [BoardEx]

**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. 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 | Number of forced successions | Number of outsiders appointed | Percent Firms with successions | Percent Firms with forced successions | Percent Firms with outsiders appointed |
|---|---|---|---|---|---|---|
| 1993 | 110 | 22 (20.0%) | 31 (28.1%) | 9.6% | 1.9% | 2.7% |
| 1994 | 125 | 31 (24.8%) | 38 (30.4%) | 8.1% | 2.0% | 2.5% |
| 1995 | 158 | 32 (20.5%) | 52 (32.9%) | 10.0% | 2.0% | 3.3% |
| 1996 | 155 | 45 (29.0%) | 52 (33.5%) | 9.5% | 2.7% | 3.1% |
| 1997 | 185 | 46 (24.9%) | 63 (34.1%) | 11.1% | 2.8% | 3.8% |
| 1998 | 186 | 49 (26.3%) | 74 (39.8%) | 10.8% | 2.8% | 4.2% |
| 1999 | 224 | 67 (29.9%) | 85 (38.0%) | 12.5% | 3.7% | 4.7% |
| 2000 | 244 | 59 (24.2%) | 93 (38.1%) | 13.6% | 3.3% | 5.2% |
| 2001 | 173 | 49 (28.3%) | 67 (38.7%) | 10.4% | 2.9% | 4.0% |
| 2002 | 195 | 68 (34.9%) | 77 (39.5%) | 11.8% | 4.1% | 4.6% |
| 2003 | 166 | 40 (24.1%) | 65 (34.3%) | 9.9% | 2.4% | 3.9% |
| 2004 | 152 | 37 (24.3%) | 62 (40.8%) | 9.8% | 2.2% | 3.7% |
| 2005 | 122 | 30 (24.6%) | 51 (41.8%) | 9.5% | 2.3% | 3.9% |
| Total | 2195 | 575 (26.2%) | 810 (36.9%) | 10.5% | 2.8% | 3.9% |

**Panel B: Annual Averages by Sub-Period**

| Period | Number of successions | Number of forced successions | Number of outsiders appointed | Percent Firms with successions | Percent Firms with forced successions | Percent Firms with outsiders appointed |
|---|---|---|---|---|---|---|
| 1993-95 | 131 | 28 (21.8%) | 40 (30.5%) | 9.2% | 2.0% | 2.8% |
| 1996-00 | 199 | 53 (26.9%) | 73 (36.7%) | 11.5% | 3.1% | 4.2% |
| 2001-05 | 162 | 45 (27.2%) | 64 (39.0%) | 10.3% | 2.8% | 4.0% |

**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: CEO Credentials by Succession Type**

| | | Type of Succession | | |
|---|---|---|---|---|
| | All | Forced | Outside | Inside |
| | N=2195 | N=581 | N=810 | N=1385 |
| B.1: Outgoing CEO | | | | |
| *CEO Credentials:* | | | | |
| Press | 7.2 | 7.7 | 6 | 7.4 |
| Fast-Track Career (years) | 49 | 46 | 48 | 49 |
| Selective College (rank) | 2.4 | 2.6 | 2.4 | 2.4 |
| B.2: Successor CEO | | | | |
| *CEO Credentials:* | | | | |
| Press | 7.9 | 10.8 | 9.1 | 6.9 |
| Fast-Track Career (years) | 49 | 45 | 48 | 50 |
| Selective College (rank) | 2.9 | 3.2 | 2.9 | 2.9 |
| *CEO Pay:* | | | | |
| Total CEO Pay (log tdc1, $000) | 7.8 | 7.8 | 7.9 | 7.6 |
| B.3: Firm Variables (year prior to transition) | | | | |
| Size (log total assets, $mil) | 7.4 | 7.3 | 7.1 | 7.6 |
| Firm Stock Return | -14.1% | -28.3% | -21.4% | -10.1% |
| Industry Stock Return (EW) | 13.9% | 13.0% | 14.7% | 13.4% |
| Industry-Adjusted OROA | 0.014 | -0.022 | -0.015 | 0.023 |
| GIM index | 9 | 9 | 9 | 9 |
| Board Independence | 65% | 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, and capital expenditures (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 executive 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) Baseline | (2) More Firm Controls | (3) Control for Prior Pay | (4) Baseline | (5) More Firm Controls | (6) Control for Prior Pay | (7) Baseline | (8) More Firm Controls | (9) Control for Prior Pay |
| *CEO Credentials:* | | | | | | | | | |
| Press | 0.544*** | 0.509*** | 0.419*** | | | | | | |
| | (0.089) | (0.092) | (0.118) | | | | | | |
| Fast-Track Career | | | | 0.459*** | 0.467*** | 0.547*** | | | |
| | | | | (0.167) | (0.171) | (0.189) | | | |
| Selective College | | | | | | | 0.201** | 0.246** | 0.261** |
| | | | | | | | (0.089) | (0.110) | (0.131) |
| *Firm, Succession, & CEO Controls:* | | | | | | | | | |
| Stock Return$_{t-1}$ | 0.122** | 0.038 | 0.119 | -0.033 | -0.079 | 0.047 | 0.145** | 0.137*** | 0.174*** |
| | (0.055) | (0.049) | (0.078) | (0.048) | (0.055) | (0.078) | (0.059) | (0.045) | (0.058) |
| Firm Size | 0.379*** | 0.397*** | 0.344*** | 0.425*** | 0.410*** | 0.378*** | 0.393*** | 0.406*** | 0.308*** |
| | (0.016) | (0.017) | (0.031) | (0.015) | (0.019) | (0.023) | (0.018) | (0.023) | (0.036) |
| CEO Age | -0.013*** | -0.016*** | -0.016*** | -0.019*** | -0.026*** | -0.021** | -0.011** | -0.010** | -0.010** |
| | (0.005) | (0.004) | (0.005) | (0.007) | (0.009) | (0.009) | (0.005) | (0.004) | (0.004) |
| Insider Succession | -0.365*** | -0.285*** | -0.110 | -0.481*** | -0.424*** | -0.101 | -0.147 | -0.157 | -0.105 |
| | (0.048) | (0.047) | (0.088) | (0.059) | (0.076) | (0.082) | (0.109) | (0.110) | (0.083) |
| Forced Succession | 0.076 | 0.053 | 0.081 | 0.127* | 0.063 | 0.169* | 0.063 | 0.138 | 0.108 |
| | (0.063) | (0.058) | (0.091) | (0.071) | (0.074) | (0.090) | (0.070) | (0.098) | (0.139) |
| CEO Prior Pay | | | 0.151*** | | | 0.104*** | | | 0.219*** |
| | | | (0.043) | | | (0.036) | | | (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% | 34.5% | 39.7% | 41.1% | 41.4% | 46.8% | 44.1% | 46.5% | 51.3% |
| Observations | 2,122 | 2,122 | 1,052 | 1,828 | 1,828 | 968 | 1,779 | 1,779 | 1,779 |
| 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 pice-wise linear splines of the CEO credentials variables each in three different specifications: a baseline specification with year- and (Fama-French 48) industry-fixed effects, as well as controls for firm, successions, and other CEO characteristics that have been shown in previous research to affect total CEO pay (Columns (1), (4), (7)); a specification that adds firm (book) leverage, dividend payout, Tobin's Q, ROA, cash flow, cash holdings, sales growth, R&D, and capital expenditures (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 executive 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) Baseline | (2) More Firm Controls | (3) Control for Prior Pay | (4) Baseline | (5) More Firm Controls | (6) Control for Prior Pay | (7) Baseline | (8) More Firm Controls | (9) Control for Prior Pay |
| Press (<50%) | 0.146 | 0.321* | 0.041 | | | | | | |
| | (0.157) | (0.171) | (0.199) | | | | | | |
| Press (50%<X<90%) | 2.968*** | 2.886*** | 2.070*** | | | | | | |
| | (0.240) | (0.285) | (0.342) | | | | | | |
| Press (>90%) | 13.198*** | 11.304*** | 9.996*** | | | | | | |
| | (1.900) | (2.427) | (3.575) | | | | | | |
| Fast-Track Career (<50%) | | | | 0.166 | 0.333 | 0.271 | | | |
| | | | | (0.213) | (0.324) | (0.382) | | | |
| Fast-Track Career (50%<X<90%) | | | | 1.785** | 1.488** | 1.910** | | | |
| | | | | (0.747) | (0.744) | (0.964) | | | |
| Fast-Track Career (>90%) | | | | 11.620** | 11.295** | 14.445** | | | |
| | | | | (4.874) | (4.561) | (6.809) | | | |
| Selective College (<50%) | | | | | | | 0.024 | 0.099 | 0.043 |
| | | | | | | | (0.158) | (0.165) | (0.189) |
| Selective College (>50%) | | | | | | | 1.118*** | 1.033** | 1.091** |
| | | | | | | | (0.377) | (0.432) | (0.446) |
| 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% | 40.3% | 46.1% | 45.8% | 49.1% | 54.2% | 46.1% | 49.9% | 53.3% |
| Observations | 2,122 | 2,122 | 1,052 | 1,828 | 1,828 | 968 | 1,779 | 1,779 | 1,779 |
| 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, and capital expenditures (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 executive 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) Baseline | (2) More Firm Controls | (3) Control for Prior Pay | (4) Baseline | (5) More Firm Controls | (6) Control for Prior Pay | (7) Baseline | (8) More Firm Controls | (9) Control for Prior Pay |
| Press* Small Firm | 0.148 | 0.170 | 0.060 | | | | | | |
| | (0.199) | (0.192) | (0.286) | | | | | | |
| Press*Medium Firm | 0.560*** | 0.490** | 0.744** | | | | | | |
| | (0.180) | (0.222) | (0.296) | | | | | | |
| Press*Large Firm | 1.139*** | 1.019*** | 1.006*** | | | | | | |
| | (0.237) | (0.235) | (0.323) | | | | | | |
| Fast-Track Career* Small Firm | | | | 0.098 | 0.122 | 0.053 | | | |
| | | | | (0.111) | (0.117) | (0.153) | | | |
| Fast-Track Career*Medium Firm | | | | 0.362** | 0.410** | 0.433*** | | | |
| | | | | (0.164) | (0.179) | (0.144) | | | |
| Fast-Track Career*Large Firm | | | | 1.473*** | 1.485** | 1.706*** | | | |
| | | | | (0.382) | (0.741) | (0.355) | | | |
| Selective College* Small Firm | | | | | | | 0.093 | 0.007 | 0.028 |
| | | | | | | | (0.120) | (0.121) | (0.099) |
| Selective College*Medium Firm | | | | | | | 0.138 | 0.061 | 0.064 |
| | | | | | | | (0.130) | (0.119) | (0.120) |
| Selective College*Large Firm | | | | | | | 0.474** | 0.447** | 0.645** |
| | | | | | | | (0.192) | (0.192) | (0.285) |
| 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% | 41.0% | 44.9% | 43.3% | 48.1% | 52.8% | 45.1% | 50.1% | 55.5% |
| Observations | 2,122 | 2,122 | 1,052 | 1,828 | 1,828 | 968 | 1,779 | 1,779 | 1,779 |
| Implied Pay-Credential Sensitivity for Large Firms ($000 pay-1% Credentials): | | | | | | | | | |
| Press | 59.5 | | | | | | | | |
| Fast-Track Career | | | | 77.0 | | | | | |
| Selective College | | | | | | | 24.8 | | |

**Table 6**
**Identifying Pay for CEO Credentials: Firm Fixed Effects and Instrumental Variables (IV) Estimates**

This table reports estimates of OLS (Columns (1)-(4)) and Instrumental Variables (Columns (5)-(7)) regressions of total CEO pay on a measure of CEO credentials from 1993 to 2005. 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 firm [except for Columns (1)-(2) which include (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)-(2) present baseline OLS estimates for newly appointed CEOs in specifications in levels and changes, respectively. Columns (3)-(4) are OLS estimates with firm fixed-effects for all CEOs in ExecuComp, with Column (4) adding an interaction term with CEO tenure to allow for heterogeneity in pay for CEO credentials depending on CEO tenure. Columns (5)-(7) report the IV estimates, where the CEO Talent Factor is instrumented in turn by three different sets of geographic, industry-UK, and CEO labor market variables. The bottom panel lists these variables with their respective coefficients in the first-step estimation. The panel also reports IV estimation diagnostic statistics for joint excluded instrument significance (F-test statistic) and instrument over-identification restrictions (p-values of Hansen J-statistic). 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. Implied sensitivity is evaluated at the sample mean of total CEO pay.

| **Dependent variable: log total annual compensation** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Appointment year only** | | **All ExecuComp** | | **Instrumental Variables Analysis** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| | Baseline | Baseline $\Delta$ log(tdc1) | Firm F.E. | Interaction with CEO Tenure | Geographic Instruments | UK-Industry Instruments | Labor Market Instruments |
| CEO Talent Factor | 0.470*** | 0.419*** | 0.289*** | 0.448*** | 0.424** | 0.496** | 0.413*** |
| | (0.099) | (0.151) | (0.051) | (0.077) | (0.193) | (0.251) | (0.109) |
| CEO Talent Factor* CEO Tenure | | | | -0.018*** | | | |
| | | | | (0.006) | | | |
| Firm, Succession, & CEO Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year F.E. | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm F.E. | No | No | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | 41.3% | 26.4% | 70.1% | 67.5% | 71.1% | 81.8% | 72.5% |
| Observations | 1,771 | 1,369 | 12,747 | 12,747 | 12,732 | 6,238 | 12,747 |
| **First-stage Estimation (IV Analysis) - Dependent variable: CEO Talent Factor** | | | | | | | |
| Average State Press | | | | | 0.047*** | | |
| | | | | | (0.012) | | |
| Average State Fast-Track Career | | | | | 0.037*** | | |
| | | | | | (0.010) | | |
| Average State Selective College | | | | | 0.071*** | | |
| | | | | | (0.020) | | |
| Average UK Industry Fast-Track Career | | | | | | 0.032** | |
| | | | | | | (0.014) | |
| Average UK Industry Selective College | | | | | | 0.094*** | |
| | | | | | | (0.018) | |
| Average Labor Market Press | | | | | | | 0.159*** |
| | | | | | | | (0.053) |
| Average Labor Market Fast-Track Career | | | | | | | 0.491*** |
| | | | | | | | (0.170) |
| Average Labor Market Selective College | | | | | | | 0.169** |
| | | | | | | | (0.082) |
| $R^2$ | | | | | 75.2% | 82.1% | 82.8% |
| F-test of excl. instruments | | | | | 7.52*** | 8.79*** | 21.4*** |
| Hansen J-statistic (p-value) | | | | | 0.52 | 0.54 | 0.24 |
| Implied Pay-Credential Sensitivity ($000 pay-1% Credentials): | | | | | | | |
| CEO Talent Factor | 24.6 | 21.9 | 12.7 | | 22.1 | 24.8 | 21.7 |
| CEO Talent Factor*(Tenure=1 ($\geqslant$5)) | | | | 24.2 (9.6) | | | |

## Table 7
## Identifying Pay for CEO Credentials: Industry Shocks and CEO Fixed Effects

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 executive 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) Firm FE | (2) CEO FE | (3) Firm FE | (4) CEO FE | (5) Firm FE | (6) CEO FE | (7) Firm FE | (8) CEO FE | (9) Firm FE | (10) CEO FE |
| CEO Talent Factor | 0.150** | 0.199** | 0.200*** | 0.152** | 0.158*** | 0.162** | 0.243*** | 0.202** | 0.230*** | 0.277** |
| | (0.074) | (0.085) | (0.060) | (0.067) | (0.056) | (0.069) | (0.060) | (0.080) | (0.087) | (0.141) |
| 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 |
| | (0.062) | (0.068) | (0.045) | (0.042) | (0.084) | (0.087) | (0.050) | (0.055) | (0.172) | (0.182) |
| 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 |
| | (0.058) | (0.066) | (0.044) | (0.041) | (0.078) | (0.080) | (0.044) | (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** |
| | (0.066) | (0.069) | (0.046) | (0.040) | (0.075) | (0.076) | (0.050) | (0.055) | (0.121) | (0.112) |
| Firm, Succession, & CEO Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm F.E. | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| CEO F.E. | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Year F.E. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry F.E. | No | Yes | No | Yes | No | Yes | No | Yes | 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 |
| Implied Effect of Industry Shocks on Pay-Credential Sensitivity ($000 pay-1% Credentials): | | | | | | | | | | |
| CEO Talent Factor | 15.7 | | 5.2 | | 31.9 | | 10.2 | | 32.7 | |

## Table 8

## 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 top decile of the empirical distribution of CEO pay, and Columns (7)-(8) report results for CEOs in the top quintile. Columns (9)-(10) 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 executive are reported in parentheses. Levels of significance are denoted by ***, **, and * for statistical significance at the 1%, 5%, and 10% level, respectively.

| | **Trend in CEO pay** | | **Trend for Outside CEOs** | | **Trend for top 10% CEO pay** | | **Trend for top 5% CEO pay** | | **Trend in CEO equity pay** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) Trend | (2) Interactions | (3) Trend | (4) Interactions | (5) Trend | (6) Interactions | (7) Trend | (8) Interactions | (9) Trend | (10) Interactions |
| **Panel A: Dependent variable is log total annual compensation; all ExecuComp** | | | | | | | | | | |
| Observations | [12,747] | [12,747] | [2,583] | [2,583] | [12,747] | [12,747] | [12,747] | [12,747] | [12,747] | [12,747] |
| $I_{1996-2000}$ | 0.323*** | 0.198*** | 0.354*** | 0.078 | 0.431*** | 0.295*** | 0.426*** | 0.224* | 0.262*** | -0.010 |
| | (0.025) | (0.039) | (0.078) | (0.131) | (0.035) | (0.066) | (0.036) | (0.123) | (0.048) | (0.071) |
| $I_{2001-2005}$ | 0.508*** | 0.389*** | 0.526*** | 0.229 | 0.566*** | 0.477*** | 0.497*** | 0.385*** | 0.498*** | 0.238*** |
| | (0.029) | (0.043) | (0.090) | (0.142) | (0.041) | (0.066) | (0.054) | (0.080) | (0.062) | (0.078) |
| CEO Talent Factor* $I_{1996-2000}$ | | 0.251*** | | 0.446** | | 0.291*** | | 0.452** | | 0.452*** |
| | | (0.061) | | (0.203) | | (0.104) | | (0.214) | | (0.112) |
| CEO Talent Factor* $I_{2001-2005}$ | | 0.201*** | | 0.364* | | 0.227** | | 0.281** | | 0.219* |
| | | (0.039) | | (0.215) | | (0.093) | | (0.134) | | (0.126) |
| **Panel B: Dependent variable is log total annual compensation; recently appointed CEOs (tenure≤2)** | | | | | | | | | | |
| Observations | [3,138] | [3,138] | [1,136] | [1,136] | [3,138] | [3,138] | [3,138] | [3,138] | [3,138] | [3,138] |
| $I_{1996-2000}$ | 0.256*** | 0.004 | 0.301* | -0.173 | 0.450*** | 0.318*** | 0.397*** | 0.151 | 0.277*** | -0.027 |
| | (0.053) | (0.083) | (0.155) | (0.169) | (0.064) | (0.048) | (0.110) | (0.110) | (0.072) | (0.114) |
| $I_{2001-2005}$ | 0.383*** | 0.096 | 0.519*** | -0.208 | 0.543*** | 0.518*** | 0.422*** | 0.394*** | 0.502*** | 0.207* |
| | (0.060) | (0.089) | (0.169) | (0.189) | (0.086) | (0.052) | (0.126) | (0.072) | (0.093) | (0.124) |
| CEO Talent Factor* $I_{1996-2000}$ | | 0.551*** | | 0.846*** | | 0.297*** | | 0.624*** | | 0.504** |
| | | (0.160) | | (0.325) | | (0.093) | | (0.201) | | (0.213) |
| CEO Talent Factor* $I_{2001-2005}$ | | 0.698*** | | 1.214*** | | 0.256*** | | 0.295*** | | 0.364 |
| | | (0.179) | | (0.355) | | (0.091) | | (0.089) | | (0.234) |
| Firm, Succession, & CEO Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm F.E. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year F.E. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

## Table 8 (Continued)
## Assessing Pay for CEO Credentials: Implications for Stylized Facts of Trend in CEO Pay
## Analysis by Industry

This table reports estimates of OLS regressions of total CEO pay on a measure of CEO credentials and its interaction with time trend indicator variables by broad industry groups 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. 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 manufacturing sector (SIC codes between 2000 and 3999). Columns (3)-(4) report results for the retail sector (SIC codes between 5000 and 5999). Columns (5)-(6) report results for the services sector (SIC codes between 7000 and 7999). Columns (7)-(8) report results for the high-tech sectors (such as biotech, computing, computer equipment, electronics, medical equipment, pharmaceuticals, software, which correspond to the following 3-SIC codes: 283, 357, 366, 367, 381, 382, 383, 384, 737, 873, and 874 (Loughran and Ritter (2004)). Columns (9)-(10) report results for regulated sectors (financials and utilities, SIC codes between 6000 and 6999 and between 4900 and 4999). 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.

| **Panel C: Dependent variable is log total annual compensation; all ExecuComp** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Manufacturing** | | **Retail** | | **Services** | | **High-Tech** | | **Regulated** | |
| | (1) Trend | (2) Interactions | (3) Trend | (4) Interactions | (5) Trend | (6) Interactions | (7) Trend | (8) Interactions | (9) Trend | (10) Interactions |
| Observations | [5,628] | [5,628] | [1,354] | [1,354] | [855] | [855] | [1,684] | [1,684] | [1,561] | [1,561] |
| $I_{1996-2000}$ | 0.300*** | 0.165*** | 0.305*** | 0.242* | 0.474*** | 0.145 | 0.442*** | 0.098 | 0.440*** | 0.404*** |
| | (0.028) | (0.045) | (0.067) | (0.124) | (0.144) | (0.221) | (0.082) | (0.146) | (0.052) | (0.133) |
| $I_{2001-2005}$ | 0.477*** | 0.358*** | 0.514*** | 0.457*** | 0.450*** | 0.055 | 0.504*** | 0.211 | 0.718*** | 0.616** |
| | (0.033) | (0.051) | (0.079) | (0.138) | (0.159) | (0.216) | (0.096) | (0.146) | (0.087) | (0.28) |
| CEO Talent Factor* | | | | | | | | | | |
| $I_{1996-2000}$ | | 0.277*** | | 0.246 | | 0.679** | | 0.703*** | | 0.097 |
| | | (0.073) | | (0.169) | | (0.313) | | (0.242) | | (0.237) |
| CEO Talent Factor* | | | | | | | | | | |
| $I_{2001-2005}$ | | 0.171** | | 0.207 | | 0.711** | | 0.692*** | | 0.375 |
| | | (0.084) | | (0.188) | | (0.346) | | (0.259) | | (0.765) |
| Firm, Succession, & CEO Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm F.E. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year F.E. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

## Table 9
## Interpreting Pay for CEO Credentials: Talent or Lifetime Work Experience?
## Variation with Generalist vs. Specialist CEO Human Capital

This table reports estimates of OLS regressions of total CEO pay on measures of CEO credentials and CEO lifetime work experience from 1993 to 2005 for newly appointed CEOs. The dependent variable is the logarithm of total pay (tdc1). 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. Columns (1)-(4) present results for our main measure of CEO credentials - CEO Talent Factor - which is a factor extracted using principal component analysis from Press, Fast-Track Career, and Selective College, when we control iteratively for three different proxies of CEO lifetime work experience (Columns (1)-(3)) and for a CEO General Ability Factor - which is a factor extracted using principal component analysis from the three underlying experience proxies (Custodio, Ferreira, and Matos (2011)). Column (5) presents results for a specification that includes two CEO Human Capital Factors (#1, "Experience" and #2, "Talent"), which are the first two principal components extracted from using our three CEO credentials proxies jointly with the three CEO lifetime work experience proxies. Columns (6)-(7) consider interactions between the two CEO Human Capital Factors to allow for heterogeneity in pay for CEO credentials depending on CEO experience and viceversa. To do so, we run our baseline regression separately in the sub-sample of newly appointed CEOs with low experience (those CEOs whose Human Capital Factor #1, "Experience," is below median; Column (6)) and newly appointed CEOs with low credentials (those CEOs whose Human Capital Factor #2, "Talent," is below median; Column (7)), respectively. 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

| **Dependent variable: log total annual compensation; appointment year only** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Controlling for CEO Work Experience** | | | | | **Interactions** | |
| | (1) | (2) | (3) | (4) | (5) | (6) Low Experience CEOs Only | (7) Low Credentials CEOs Only |
| *CEO Credentials:* | | | | | | | |
| CEO Talent Factor | 0.394*** | 0.378*** | 0.372*** | 0.373*** | | | |
| | (0.099) | (0.101) | (0.102) | (0.101) | | | |
| CEO Human Capital Factor #2 ("Talent") | | | | | 0.341*** | 0.599*** | |
| | | | | | (0.116) | (0.162) | |
| *CEO Work Experience:* | | | | | | | |
| Past CEO position | 0.174** | | | | | | |
| | (0.070) | | | | | | |
| Past number of jobs | | 0.323*** | | | | | |
| | | (0.097) | | | | | |
| Past number of industries | | | 0.373*** | | | | |
| | | | (0.096) | | | | |
| CEO General Ability Factor | | | | 0.374*** | | | |
| | | | | (0.096) | | | |
| CEO Human Capital Factor #1, ("Experience") | | | | | 0.287*** | | 0.400** |
| | | | | | (0.080) | | (0.171) |
| Firm, Succession, & 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 |
| $R^2$ | 42.5% | 42.9% | 42.7% | 42.9% | 43.1% | 44.7% | 44.3% |
| Observations | 1,818 | 1,818 | 1,818 | 1,818 | 1,818 | 909 | 909 |

## Table 10
## Interpreting Pay for CEO Credentials: Talent or Hype?
## Analysis of Long-Term Firm Performance and CEO Decisions

Panel A of 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 a measure of CEO credentials - CEO Talent Factor - which is a factor extracted using principal component analysis from Press, Fast-Track Career, and Selective College. 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. Implied sensitivity is evaluated with respect to the sample mean of the respective operating performance measure in the year prior to the transition.

**Panel A: Analysis of Long-Term Firm Performance (3 years average after- 1 year before)**

| | (1) Appoint-ment CARs | (2) ROA | (3) OROA | (4) OROS | (5) ROE | (6) Stock Returns | (7) Cash Flows | (8) ROA-CARs Correlation |
|---|---|---|---|---|---|---|---|---|
| *CEO Credentials:* | | | | | | | | |
| CEO Talent Factor | 0.018** | 0.034*** | 0.042*** | 0.044** | 0.049** | 0.098*** | 0.205** | 0.403*** |
| | (0.009) | (0.012) | (0.014) | (0.020) | (0.024) | (0.039) | (0.099) | (0.152) |
| 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 |
| $R^2$ | 7.5% | 11.2% | 9.7% | 8.7% | 9.1% | 15.7% | 7.2% | 16.2% |
| Observations | 1771 | 871 | 891 | 887 | 814 | 776 | 718 | 871 |
| Implied Performance-Credential Sensitivity (% mean return-1% Credentials): | | | | | | | | |
| CEO Talent Factor | | 2.0 | 2.9 | 2.1 | 1.9 | 1.5 | 0.8 | |

**Table 10 (Continued)**
**Interpreting Pay for CEO Credentials: Talent or Hype?**
**Analysis of Long-Term Firm Performance and CEO Decisions**

Panel B of this table reports estimates of OLS regressions of measures of firm policies on measures of CEO credentials from 1993 to 2005 for newly appointed CEOs. All dependent variables in Columns (1)-(8) are changes in industry-adjusted firm policies, which are calculated as the difference between average annual industry-adjusted firm policy in the three years subsequent to the CEO appointment and annual industry-adjusted policy in the year prior to the transition (appointment years are excluded). We employ a measure of CEO credentials - CEO Talent Factor - which is a factor extracted using principal component analysis from Press, Fast-Track Career, and Selective College. 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 firm policy in the three years prior to transition. The dependent variables in Columns (1)-(8) are capital expenditures, the number of M&A transactions the firm has completed as an acquirer, the number of divestiture transactions completed by the firm, book leverage, cash holdings, dividends, the number of diversifying M&A transactions the firm has completed as an acquirer, respectively. 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.

**Panel B: Analysis of CEO Decisions (3 years average after- 1 year before)**

| | Investment Policy | | | Financial Policy | | | Organizational Strategy | |
|---|---|---|---|---|---|---|---|---|
| | (1) CAPEX | (2) M&As | (3) Divestitures | (4) Leverage | (5) Cash Holdings | (6) Dividends | (7) Diversifying M&As | (8) R&D |
| *CEO Credentials:* | | | | | | | | |
| CEO Talent Factor | -0.013** | -0.141*** | 0.101** | -0.042*** | 0.038*** | -0.005** | -0.083** | 0.003 |
| | (0.006) | (0.053) | (0.049) | (0.016) | (0.012) | (0.002) | (0.032) | (0.008) |
| 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 |
| $R^2$ | 22.5% | 19.4% | 19.2% | 17.3% | 7.1% | 25.4% | 22.7% | 8.4% |
| Observations | 878 | 878 | 878 | 878 | 878 | 763 | 878 | 878 |

## Table 11
## Interpreting Pay for CEO Credentials: Talent or Power?
## Variation with Governance and Evidence from Board Monitoring Decisions

This table reports estimates of OLS regressions of total CEO pay on a measure of CEO credentials from 1993 to 2005 for newly appointed CEOs (Columns (1)-(6)), and estimates of probit regressions of the likelihood of forced CEO turnover on a measure of CEO credentials from 1993 to 2005 for the entire ExecuComp (Columns (7)-(8)). The dependent variable is the logarithm of total pay (tdc1) in Columns (1)-(6) and a dummy variable that takes value of one in any given firm-year when a forced CEO turnover occurs for Columns (7)-(8). In all specifications we employ a measure of CEO credentials - CEO Talent Factor - which is a factor extracted using principal component analysis from Press, Fast-Track Career, and Selective College, and 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. Column (1) presents baseline estimates for a specification that includes controls for firm governance characteristics that include the GIM Index of anti-takeover defenses (Gompers, Ishii, and Metrick (2003)), board size, and board independence. Column (2) adds controls for CEO education and corporate connections. Columns (3)-(4) iteratively add interactions between the CEO Talent Factor and the GIM index as well as their interactions with the CEO connections variables to allow for heterogeneity in pay for CEO credentials depending on the quality of firm governance and the intensity of CEO connections. Columns (5)-(6) consider interactions with other governance variables. Columns (7)-(8) present estimates of forced CEO turnover likelihood for different sub-samples of underperforming firms, which are defined as firms whose performance in the prior year was below median (Column (7)), or in the bottom quintile (Column (8)) of performance in their industry. 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.

| | **Dependent variable: log total annual compensation; appointment year only** | | | | | | **Analysis of Forced CEO Turnover** | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | | | | | | | Underperforming CEOs | |
| | | | | | | | Below Median | Bottom Quintile |
| CEO Talent Factor | 0.520*** | 0.503*** | 0.804*** | 0.804*** | 0.121 | 0.761*** | 0.023*** | 0.071*** |
| | (0.130) | (0.112) | (0.295) | (0.295) | (0.150) | (0.132) | (0.007) | (0.027) |
| *Governance & CEO Connections:* | | | | | | | | |
| CEO Education Network | | 0.223 | | | | | | |
| | | (0.138) | | | | | | |
| CEO Corporate Network | | 0.541*** | | | | | | |
| | | (0.114) | | | | | | |
| Talent Factor*GIM(⩾11) | | | -0.777*** | -0.800* | | | | |
| | | | (0.388) | (0.434) | | | | |
| Talent Factor*GIM(⩾11)*Education Network | | | | -0.095 | | | | |
| | | | | (0.405) | | | | |
| Talent Factor*GIM(⩾11)*Corporate Network | | | | 0.384 | | | | |
| | | | | (0.461) | | | | |
| Talent Factor*Board Independence | | | | | 0.507*** | | | |
| | | | | | (0.181) | | | |
| Talent Factor*Inside Appointment | | | | | | -0.504*** | | |
| | | | | | | (0.133) | | |
| Governance Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Network Controls | No | Yes | No | Yes | No | No | No | No |
| Firm, Succession, & 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 |
| $R^2$ | 41.2% | 40.1 | 49.5% | 48.9% | 43.4% | 42.3% | 18.6% | 20.2% |
| Observations | 1,325 | 1,094 | 662 | 594 | 1,325 | 1,325 | 6,373 | 2,549 |

**Table 12**
**Pay for CEO Credentials: Additional Robustness Tests**
**Matched Sample and Heckman Selection Analyses**

This table reports results of matched-sample analysis of pay for CEO credentials from 1993 to 2005 for newly appointed CEOs (Panel A) and joint estimation of pay for CEO credentials and CEO succession likelihood (Heckman selection analysis) for the entire ExecuComp (Panel B). In both panels, the dependent variable of the second stage estimation is the logarithm of total pay (tdc1). In Panel 1.A, the measure of CEO credentials is a dummy that takes value of one for CEOs whose credentials are in the top quartile of the CEO talent factor, which is a factor extracted using principal component analysis from Press, Fast-Track Career, and Selective College. Column 2 reports the results of the first-stage probit regression used to construct the control sample, which is done using a nearest-neighbor propensity score match with the same controls for firm, succession, and CEO characteristics as in the main regression analysis (Table 3, some coefficients omitted for brevity), and (Fama-French 48) industry-, and year fixed effects. Column 1 reports the difference between the treatment and the (matched) control group, bias-adjusted to account for differences between the propensity scores of newly appointed CEOs in the top quartile of the CEO talent factor and their nearest match. In Panel 1.B, the measure of CEO credentials is the CEO talent factor. Column 4 reports results of the first-stage probit regression of the likelihood that a firm in ExecuComp undergoes a CEO succession in a given year. Column 3 reports results for a Heckman two-step selection model of total CEO pay, where the first-stage selection equation is given by the probit estimates from Column 4. In addition to the same controls as in the main regression analysis (Table 3, some coefficients omitted for brevity, forced turnover omitted from the first-stage), and (Fama-French 48) industry-, and year fixed effects, the first-stage selection equation includes an indicator variable for whether there was a retirement (CEO age$\geq$ 65) or death of the CEO in the two years prior to the current fiscal year. This variable is excluded from the second-stage regression. 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.

| **Dependent variable: log total annual compensation; appointment year only** | | | |
|---|---|---|---|
| **Panel 1.A : Matched Sample Analysis [Selection of CEO Talent Factor]** | | | |
| Second-Stage Estimates | (1) | Selection Equation | (2) |
| CEO Talent Factor | 0.601*** | Firm Size | 0.062*** |
| (Top Quartile Dummy) | (0.135) | | (0.009) |
| | | Prior Firm Performance | -0.023 |
| | | | (0.028) |
| | | Forced Succession | 0.130*** |
| | | | (0.040) |
| | | Firm, Succession, | |
| | | & CEO Controls | Yes |
| | | Year F.E. | Yes |
| | | Industry F.E. | Yes |
| Treated Obs. | 431 | $R^2$ | 12.6% |
| Control Obs. | 424 | Observations | 1,771 |
| **Panel 1.B : Heckman Selection Analysis [Selection of Appointment Sample]** | | | |
| Second-Stage Estimates | (3) | Selection Equation | (4) |
| CEO Talent Factor | 0.545*** | Deceased or Retired CEO | 0.374*** |
| | (0.110) | [Excluded Variable] | (0.059) |
| Inverse Mills Ratio | 0.438*** | Firm Size | 0.032*** |
| | (0.112) | | (0.010) |
| | | Prior Firm Performance | -0.267*** |
| | | | (0.047) |
| | | CEO age | 0.028*** |
| | | | (0.004) |
| Firm, Succession, | | | |
| & CEO Controls | Yes | | |
| Year F.E. | Yes | Year F.E. | Yes |
| Industry F.E. | Yes | Industry F.E. | Yes |
| | | $R^2$ | 15.6% |
| Observations | 1,771 | Observations | 12,747 |

**Table 12 (Continued)**
**Pay for CEO Credentials: Additional Robustness Tests**
**Additional Controls and Different Definitions of CEO Credentials Proxies**

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 series of robustness tests. 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 executive are reported in parentheses. Levels of significance are denoted by ***, **, and * for statistical significance at the 1%, 5%, and 10% level, respectively.

| **Panel 2: Dependent variable: log total annual compensation; appointment year only** | | | | |
|---|---|---|---|---|
| | | (1) Press | (2) Fast-Track Career | (3) Selective College |
| [1] | Press-Bad Press | 0.614*** | | |
| | | (0.100) | | |
| [2] | (Press-Bad Press)/Press | 0.411** | | |
| | | (0.181) | | |
| [3] | Good Press | 0.828*** | | |
| | | (0.167) | | |
| [4] | Good Press/Press | 0.870*** | | |
| | | (0.260) | | |
| [5] | Past 3 Yrs Mean Press | 0.561*** | | |
| | | (0.112) | | |
| [6] | Firm Size-Adjusted Press | 0.524*** | | |
| | | (0.086) | | |
| [7] | First CEO job is not current CEO appointment | | 0.520** | |
| | | | (0.204) | |
| [8] | Selective is Most Competitive Colleges Only (33 Institutions) | | | 0.190*** |
| | | | | (0.070) |
| [9] | Includes no college & foreign institutions | | | 0.172** |
| | | | | (0.078) |
| [10] | Industry-Adjusted | 0.526*** | 0.430*** | 0.181** |
| | | (0.090) | (0.158) | (0.089) |
| [11] | Controlling for MBA | 0.546*** | 0.435*** | 0.201** |
| | | (0.089) | (0.164) | (0.089) |
| [12] | Controlling for higher ($3^{rd}$) order firm size splines | 0.550*** | 0.515*** | 0.200** |
| | | (0.093) | (0.176) | (0.089) |
| [13] | Controlling for headquarter location (state) fixed effects | 0.512*** | 0.535*** | 0.191** |
| | | (0.095) | (0.179) | (0.095) |

**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 Press quantiles for newly-appointed CEOs from 1993 to 2005. Variable definitions are in Appendix C.

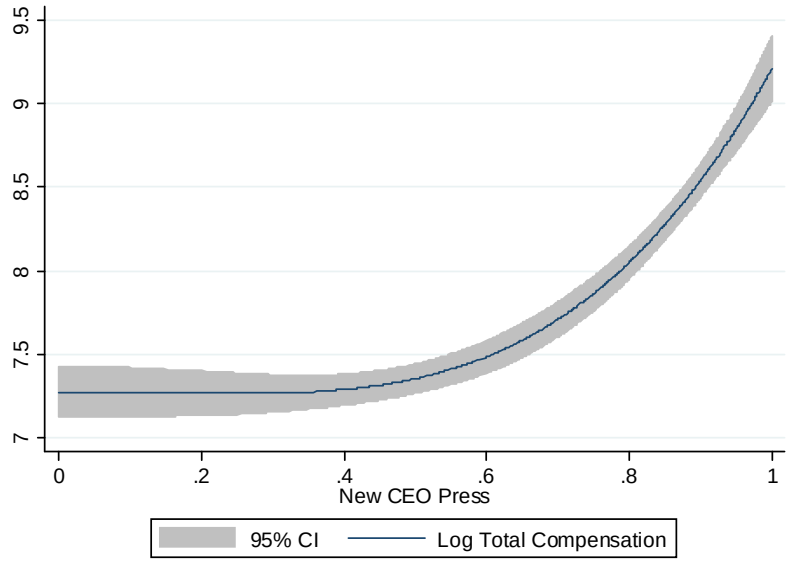


**Figure 2**
**CEO Credentials and Firm Performance**

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 top (bottom) quartile of Press. Variable definitions are in Appendix C.