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PRODUCT MARKET COMPETITION AND CEO PAY BENCHMARKING

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Abstract

This paper examines the impact of product market competition on the benchmarking of a CEO's compensation to their counterparts in peer companies. Using a large sample of US firms, we find a significantly greater effect of CEO pay benchmarking in more-competitive industries than in less-competitive industries. Using three proxies for managerial talent that have been used by Albuquerque, De Franco and Verdi (2013), we find that CEO benchmarking is more pronounced in competitive markets wherein managerial talent is more valuable. This suggests that pay benchmarking and product market competition are complements. The above results are not due to industry homogeneity.

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1. Introduction

Most US corporations use peer companies to assist in setting the pay of their CEOs, an approach that is often called "compensation or pay benchmarking." For example, the pharmaceutical company Eli Lilly & Co. in its 2016 proxy statement's Compensation Discussion and Analysis section (page 28) states that "Compensation opportunities should be *competitive with our peer groups* and reflect the level of job impact and responsibilities. *Retention of talent* is an important factor in the design of our compensation and benefit programs (emphasis added)."[1] Under this approach, CEO pay will be affected by the firm's compensation relative to their peer group. Bizjak, Lemmon, and Naveen (2008; henceforth, referred to as BLN) find that compensation benchmarking is undertaken in order to hire and retain valuable human talent. Albuquerque, De Franco and Verdi (2013; henceforth, referred to as ADV) find that compensation benchmarking is undertaken as a reward for unobserved managerial talent. We extend this literature by examining the impact of product market competition on CEO pay benchmarking.

The effect of product market competition on the benchmarking of CEO pay is ambiguous. Product market competitiveness and CEO pay benchmarking can be complements. If as suggested by the above papers (BLN and ADV) that compensation benchmarking is undertaken for valuable human talent, then this talent might be more valuable in more competitive industries (see. Jung and Subramanian, 2017) wherein products and services are non-differentiated compared to non-competitive environments. Furthermore, talent may be more

[1]The Compensation Committee of the board of directors along with an outside compensation consultant used the CEO pay of other drug companies of similar size (Abbot, Abbvie, Allergan, Amgen, AstraZeneca, Baxter, Biogen, Bristol-Myers Squibb, Celgene, Gilead, GlaxoSmithKline, Hoffman-La Roche, Johnson & Johnson, Medtronic, Merck, Novartis, Pfizer, and Sanofi-Aventis) as a reference point for setting their own CEO's 2015 compensation. http://www.sec.gov/Archives/edgar/data/59478/000005947816000331/proxy2016.htm.

valuable in competitive markets where poor management is more likely to result in financial ruin compared to a non-competitive environment. Accordingly, more competitive industries would have more CEO pay benchmarking than in less competitive industries. We call this hypothesis the *complement hypothesis.* Moreover, it might be more important to attract and retain talented managers in a non-competitive market since firms in this industry can earn abnormal profits (and sometimes at the expense of their rivals.) In such a case, more competitive industries would have lower levels of CEO pay benchmarking than in less competitive industries. Accordingly, we call this hypothesis the *substitution hypothesis.*

We test these two opposing hypotheses using a large sample of ExecuComp firms for the years 1992-2012. We find the following results. First, we find a significantly greater effect of CEO pay benchmarking in more-competitive industries than in less-competitive industries. Second, we use three talent variables that has been used previously by ADV, namely, market capitalization, abnormal accounting performance, and abnormal stock return performance, respectively. We find that CEO talent is valued more highly in more competitive markets. Third, we also show that our results are robust to different measures of competition which account for ease of entry to and exit from an industry. Finally, we examine an alternative explanation for our results. Competitive industries may have more competition for managerial talent since those industries are more homogeneous. It may be easier for board of directors to monitor and better able to filter the effects of industry shocks upon outcome. Consequently, such firms are more likely to retain and reward managerial talent since it is easier to ascertain the causes of success in homogeneous industries. We find no evidence that our results are due to industry homogeneity.

This paper proceeds as follows. Section 2 explains the related literature and Section 3 explains the testable hypotheses relating compensation benchmarking and product market

competition. Section 4 describes our data and variables. Our empirical results are reported in Section 5, and conclusions in Section 6.

2. Related literature

2.1 Literature for CEO talent

The standard principal-agent model of Holmstrom (1979), Holmstrom and Milgrom (1987, 1992) did not have a role for CEO ability or talent. The growing literature that does include CEO talent has its roots in seminal papers by Lucas (1978) and Rosen (1981). In these papers, compensation for the most talented managers is high as they manage large firms where the manager's marginal product is high. In a competitive assignment model, Gabaix and Landier (2008) and Tervio (2008) suggest that more talented CEOs are matched to firms with larger market values and therefore have to be compensated with a higher level of pay. In these models there is no moral hazard and therefore no incentive effect of CEO pay. In a moral hazard framework, Himmelberg and Hubbard (2000) find that CEOs of large firms (namely, more talented CEOs) have a positive pay relationship with aggregate stock market returns. Edmans, Gabaix and Landier (2009), and Baranchuk, MacDonald and Yang (2011) find that in equilibrium, higher-ability CEOs will be matched to larger firms with higher pay levels and pay-performance sensitivities.

Bertrand and Mullainathan (2001) find that CEO pay varies with shocks that are not under the CEO's control, a phenomenon they call 'pay for luck'. However, Oyer (2004), Falato, Li, and Milbourn (2009), and Eisfeldt, and Kuhnen (2013) show that industry or market shocks can be correlated with the value of the outside option to CEO talent. In order to retain talented CEOs within the firm, one would have to offer a higher pay. Some industry studies have examined whether CEOs with different skills and talent are compensated differently. Due to

political constraints on CEO pay, Joskow, Rose and Shepard (1993) and Joskow, Rose and Wolfram (1996) find that regulated utilities have low pay-performance sensitivities and levels. Palia (2000) finds that regulated utilities attract CEOs with a lower-quality education (proxied by the ranking of educational institution s/he graduated from) and are offered lower pay levels and sensitivities than CEOs of manufacturing firms.

In sum, this strand of literature find that CEOs with different skills are compensated differently, but does not explore how product market competition impact on the relationship between talent and pay.

2.2 Literature on product market competition

CEO pay is designed to minimize managerial agency costs such as managerial slack and/or suboptimal investments. But even early scholars like Smith (1776) and Hicks (1935) understood that product market competition could discipline managers.[2] Our work is related to this literature, which we describe below. That said, none of these papers focus on compensation benchmarking.

In a competitive product market, where compensation contracts are not allowed to be affected by product market completion, Hart (1983) and Scharfstein (1988) demonstrate that product competition affects the level of managerial slack. When managerial income is dependent on product market competition, then an increase in competition can make managers work hard in order to avoid the firm being liquidated. Schmidt (1997) shows that this makes it cheaper to give the manager a stronger pay sensitivity. On the other hand, a reduction in profits caused by increasing competition may lower the value of cost reductions and result in a lower

benefit of high managerial effort. Hermalin (1992) shows that in this case it would be optimal to have a lower pay sensitivity. Graziano and Parigi (1998) find that increasing competition stemming from a low degree of product market differentiation reduces the manager's effort level and piece-rate. Allowing for entry and exit of firms, Raith (2003) demonstrates that if competition increases due to a reduction in entry costs, each firm produces less output, and managers are optimally given lower pay incentives. If product substitutability causes some firms to exit, each surviving firm makes higher output and managers are optimally given higher pay incentives. Baggs and De Bettignies (2007) isolate the agency effect of competition that is present in firms with agency costs from the direct pressure of competition that is present in all firms. They suggest a positive effect of compensation on incentives, an affect which is even stronger in firms with agency costs. In contrast to the above literature, a number of theoretical papers (Vickers 1985, Fershtman and Judd 1987, Sklivas 1987, and Fumas 1992), has shown that precommitment to managerial incentive contracts can alter the strategic competition between rivals.

The above literature relates the impact of managerial pay to the firm's own performance. Another set of literature examines the empirical relationship between product market competition and the sensitivity of managerial compensation to relative firm performance (RPE). [3] Aggarwal and Samwick (1999) find that firms in industries where outputs are strategic complements, it is optimal to place a greater weight on rival firm performance relative to own firm performance. Similarly, Joh (1999) finds that Japanese firms have a more positive effect of

[2]Smith (1776) states: "Monopoly is a great enemy to good management"; Hicks (1935) states "The best of all monopoly profits is a quiet life."

[3] While not examining RPE, Kedia (1999) finds firms that are strategic substitutes (complements) have a lower (higher) pay for performance sensitivity. Cunat and Guadalupe (2005) find that higher competition increases the pay-performance sensitivity of British CEOs, when there was a sharp appreciation of the pound in 1996.

industry performance on the firm's compensation when it operates in a more competitive and fast-growing industry than in a less competitive and slow-growing industry. Karuna (2007) finds that CEO incentives are higher when industry market size is higher and entry costs of investing in plant and equipment are lower. Vrettos (2013) finds that the sensitivity of CEO pay to peer-group performance is negative (positive) when products are substitutes (complements).

The above empirical literature has focused on the impact of product market competition on the CEO's incentive pay. Instead, we focus on the impact of product market competition and CEO pay benchmarking.

3. Relationship between CEO pay benchmarking and product market competition

BLN examine a sample of ExecuComp firms from 1992 to 2005 and find that benchmarking is an efficient contracting mechanism by which market wages are used to retain valuable human talent.[4] ADV examine ExecuComp firms from 2006 to 2008 and finds that the selection of peer firms mostly represents compensation for unobserved managerial talent. In doing so, they verify that their talent proxy variables are related to future firm performance.

Both BLN and ADV have found that compensation benchmarking is undertaken to retain and attract managerial talent. But this literature ignores the impact of product market competition upon monitoring managerial effort and evaluating firm performance. However, it seems reasonable that it is harder to attract managerial talent

[4] Faulkender and Yang (2010) and Biszjak, Lemmon and Nguyen (2011) find that benchmarking is undertaken for opportunistic behavior. In doing so, they examine a sample of companies whose fiscal years end in 2006 and/or 2007, when the SEC forced the companies to disclose the names of the peer group. They find that a company is more likely to be chosen as a peer group member if its CEO has a higher compensation. Similar to BLN, we do not allow the company to pick its peer, and instead use industry and size matches. Therefore our results do not suffer from the opportunistic behavior effect.

in industries whose product markets are highly competitive since competition limits the pay levels with the CEO in an environment whereby earning abnormal profits is difficult. Moreover, managerial talent might be more valuable in more competitive environments wherein products and services are non-differentiated compared to non-competitive environments. Accordingly, more competitive industries would have higher levels of CEO pay benchmarking than in less competitive industries, making them complements. We call this hypothesis the *complement hypothesis.* However, it might be more important to attract and retain talented managers in a non-competitive market since firms in this industry can earn abnormal profits (and sometimes at the expense of their rivals.) In such a case, product market competitiveness and CEO pay benchmarking are substitutes. Under this hypothesis, more competitive industries would have lower levels of CEO pay benchmarking than in less competitive industries. Accordingly, we call this hypothesis the *substitution hypothesis.*[5]

In this paper, we test the implications of the two mutually exclusive hypotheses on the relationship between product markets and CEO pay benchmarking.

[5] Interestingly, Cremers, Nayar and Peyer (2008) find that product market competition and the market for corporate control are substitutes as firms in competitive industries have more takeover defenses. They argue that information is less costly to obtain in competitive markets, making monitoring more effective. Giroud and Mueller (2010) find that firms in non-competitive industries experience a drop in operating profits with the passage of a state's business association laws, whereas firms in competitive industries experience no significant effect. Giroud and Mueller (2011) find that weak governance results in lower firm value only in non-competitive industries. No such effect is found for firms in competitive industries. Chhaochharia et.al (2012) find that firms in non-competitive industries experience a larger improvement in operational efficiency after the approval of the Sarbanes-Oxley Act than firms in competitive industries. Accordingly, it might be easier for Board of Directors to ascertain as to whether superior performance is due to skill or luck. If so, it might indicate that it is easier for boards to reward CEOs for superior performance and that we should expect CEO compensation to reflect greater pay for relative performance sensitivity in competitive industries.

4. Data and variables

We use a large panel data set of US CEO compensation data obtained from ExecuComp for the years 1992 to 2012. For stock return data we use CRSP, and for accounting data we use Standard and Poor's Compustat. Table 1 defines each of the variables used in our study.

*** Table 1***

To test our hypothesis we wish to examine how the change in CEO pay is related to our proxies for *Pay Benchmarking* and *Performance Benchmarking* as a function of the level of competition within the industry. In particular, we are estimating the following regression using OLS. The t-statistics are computed based on robust standard errors that incorporate firm-level clustering.

$$\textit{Change in CEO Pay} = a_o + a_1 \textit{Pay Benchmarking} + a_2 \textit{Performance Benchmarking} + a_3 \textit{Control Variables} + \varepsilon \quad (1)$$

We expect that a_1 should be greater (lower) for industries with high competition compared to those firms in industries with low competition if the complement hypothesis (substitute hypothesis) holds.[6] We will separately estimate equation (1) for high and low competitive industries. Below we present detailed definitions for both the dependent and independent (as well as the additional control) variables and how we define high and low competitive industries.

CEO pay: We begin by using as our proxy for the dollar value of CEO pay levels ExecuComp's *tdc1* variable, which is defined as the sum of salary, bonus, value of restricted stock granted, total value of stock options granted (using Black-Scholes), and long-term incentive payouts during the fiscal year. As in BLN, our dependent variable is defined as the current fiscal year's pay less the previous fiscal year's pay (*Δtdc1)*. For robustness tests, we also

examine the natural logarithm of the difference between the current and previous fiscal year's pay *log(Δtdc1)* and the logarithm of the ratio of current fiscal year's tdc1 to the total compensation of the previous fiscal year. The latter is analogous to using the percentage change in total compensation as the dependent variable.

Pay benchmarking: We follow the algorithm of BLN in defining relative pay. They define the firm's peer group as those firms in the same three-digit SIC code and the same size group.[7] Each industry is divided into two size groups, large and small firms. Large size firms are those with sales greater than the median of the three-digit SIC industry classification. Otherwise, the firms are in the small size group. Peer groups are defined annually, when we calculate the relative pay of the CEO compared to her peer group. As in BLN, relative pay is defined by the cumulative density function (or the percentile rank) of the CEO's compensation compared to other firms in her peer group. Let us denote this measure as *relpay*, which is the difference between the median pay of the peer group and the pay of the CEO at the beginning of the fiscal year. Hence, *relpay* equal to 100(%) implies that the particular CEO has the lowest pay in her peer group. On the other hand, *relpay* equal to 1(%) implies that the particular CEO has the highest pay in her peer group. In order for a firm to be included in the sample, the peer group had to have at least two firms with compensation data in a given year. According to BLN and the concept of peer benchmarking, if a CEO's total compensation is below the median in the previous fiscal year (i.e., *relpay* >0), then the board of directors are more likely to increase the compensation than if the CEO is paid more than the median of the peer group (when *relpay* < 0).

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[6] According to the argument in footnote 5, it may also be true that a_2 should also be greater for industries with high competition compared to those firms in industries with low competition.

[7] Note that this is exactly the definition used by the compensation committee of Eli Lily, as was explained in the Introduction of this paper. Please also see footnote 1.

Performance benchmarking or relative performance evaluation: Our proxy for performance benchmarking is the relative performance ranking of the firm compared to its peer group when using the change in the market value of equity as our performance measure (*relperf*). It is based on the cumulative density function (or the percentile rank) of the firms performance compared to other firms in her peer group and has been used by BLN. The relative performance measure, *relperf,* equals to one-percentile when the particular CEO has the lowest performance in her peer group in that fiscal year, and conversely, *relperf* equal to 100th percentile when that particular CEO has the highest performance in her peer group in that fiscal year. In order for a firm to be included in the sample, the peer group had to have at least two firms with change in market value data in a given year. Note that *relpay* is defined such that the *lowest* paid CEO relative to her peers has the highest percentile rank while *relperf* is defined such that *highest* performing CEO or firm has the highest percentile rank. We do this so that it is easier to interpret the regression coefficients. We expect that if there is peer benchmarking, the coefficient of *relpay* should be positive, implying CEOs receiving the lowest pay relative to her peers receive the greatest raise. Similarly, if there is relative performance benchmarking, the coefficient for *relperf* should be positive, implying CEOs of firms that perform the best among her peers should receive the greatest raise.

Product market competition: We calculate the Herfindahl-Hirschman Index (*herf*), defined as the sum of the squared market share of each firm in the industry for each fiscal year. Industry is defined at the three-digit SIC level. In section 5.5, we provide alternative definitions for product market competition and summarize the results of our regression estimates for Equation (1) under these alternative proxies.

Control variables: We include a comprehensive set of control variables in our regressions. First, we expect compensation to vary with firm size. For this reason, *size* is included to avoid the possibility that our explanatory variables might proxy for firm size. Size is measured by the natural logarithm of sales, denoted by *lsales*. Further, BLN show that the change in pay levels is positively related to the change in sales. Accordingly, we include as a control variable *Δsales,* defined as the change in this fiscal year sales less the previous year's sales. BLN also find that the change in pay is related to the change in accounting profitability. Therefore, we include as control variables *Δni,* defined as the difference between the net income of the current fiscal year and the net income of the previous fiscal year. We also include the number of years the CEO has served in her office (*tenure).* While the above control variables include all the control variables used by BLN, we also include four additional variables that might impact CEO pay. The first additional control variable is *dyield*, defined as the ratio of the total dividends paid to the common stock capitalization at the end of the fiscal year peer. Dividend payments may be used to reduce manager's control of resources and subject the firm to the external monitoring by the market (Jensen 1986). The second variable is the average CEO wages in the industry (*mtdc1*), defined as the means pay of the CEO in the same industry at the three-digit SIC level (where the sample does not include the company). The third variable is the age of the CEO (*age),*[8] and the fourth variable is the number of firms in the industry (*numfirms*).

Table 2 provides summary statistics for each of these variables with winsorizing at the one-percent level. The summary statistics for our dollar variables are in nominal dollars. However, when we ran the cross-sectional regressions, all dollar variables are denominated in 2012 dollars. In order to ensure that the change in compensation reflects the same CEO, we

[8] See for example, Murphy (1986), Barro and Barro (1990), Gibbons and Murphy (1992) and Palia (2001).

require that *tenure* must equal to at least two years. This convention is identical to that used by BLN. We have complete compensation information to calculate the total dollar compensation for 16,996 firm-year observations. The mean *tdc1* is $6.41 million while the median level of compensation is $3.53 million. The average change in compensation is $226 thousand, while the median change is approximately $87 thousand. Given that we have an unbalanced set of firm-years, we find that the average firm has a mean and median rank of approximately 66 for both relative pay (*relpay*) and relative performance (*relperf*) when compared to their peer group. The average size of the firm as measured by the natural logarithm of annual sales (*lsales*) is $7.46 million, and the average changes in sales from one year to the next (*lsales*) is $285 million. The average Herfindahl-Hirschman Index (*herf*) is 2694, and the average change in net income (Δni) is $21.7 million. The average tenure (*tenure*) of a CEO is 9.12 years and the average age (*age*) of the CEO is approximately 57 years. Our sample has an average dividend yield (*dyield*) of 1%. The average compensation for a CEO in any industry (*mtdc1*) is $6.03 million. Table 3 provides the correlation matrix of our key variables. We observe that none of our independent variables have a high correlation with each other, suggesting low evidence of multicollinearity.

Tables 2 and 3

5. Empirical Results

5.1 Effect of Benchmarking on Pay

We begin our empirical analysis by examining the effect of pay and performance benchmarking on CEO pay. We replicate the regression specification of BLN, the results of which are in Table 4. In model (1), we use BLN's independent variables. We find a regression coefficient of 15.15 on the pay benchmarking variable *relpay*. This suggests that CEOs receive pay increases that are related to the difference between the pay of the CEO and the pay of the

median firm in the peer group, and shows strong evidence for pay benchmarking. Moving from the first percentile to the 100th percentile of pay relative to the peer group median is associated with a total compensation inflation-adjusted increase of $1.5 million, compared to a $3.6 million increase in CEO pay that BLN found.

Table 4

We next examine the impact of performance benchmarking on CEO pay. We find a smaller regression coefficient of 6.38 on the performance benchmarking variable *relperf.* This suggests that CEOs receive pay increases are related to the difference between the performance of the CEO with that of the median firm in the peer group, and shows strong evidence for performance benchmarking. Moving from the first percentile to the 100th percentile of performance relative to the peer group median is associated with an increase in inflation-adjusted total compensation of $0.64 million. Consistent with BLN, we find that the economic effect of CEO pay benchmarking is much larger than the economic effect of performance benchmarking. Among the control variables, we find that increase in sales (*Δsales*) and increases in net income (*Δni*) result in a higher increase in CEO pay. There is a negative association between change in total compensation and tenure of the CEO.

In model (2) w add four additional variables (namely, *dyield*, *mtdc1*, *age,* and *numfirms*) that were not included in BLN. We still find that the pay benchmarking is positively related to pay increases, as moving from the first percentile to the 100th percentile of pay relative to the peer group median is associated with an inflation-adjusted increase in compensation of $1.71 million. Similarly, moving from the first percentile to the 100th percentile of performance relative to the peer group median is associated with an increase in inflation-adjusted compensation of $0.82 million. Once again, the economic effect of CEO pay benchmarking is much larger than

the economic effect of performance benchmarking. The CEO pay of the median firm in the industry (not including the firm being examined) is positively related to increases in pay. The number of firms in the industry is positively related to increases in pay.

5.2 Effect of product market competition on pay benchmarking

We now examine our main hypothesis that product market competition has a significant impact on pay benchmarking. If as suggested by BLN and ADV that pay benchmarking is undertaken for retaining and attracting valuable managerial talent, then this talent might be more valuable in more competitive industries. Therefore more competitive industries would have more CEO pay benchmarking than less competitive industries, making them complements.

To test this hypothesis, we divide our sample into two groups of product market competition. The industries in a given year that have a Herfindahl-Hirschman Index (*herf*) in the bottom-half are regarded as high-competition. Note that product market competition declines as *herf* increases. The industries in the top-half of the Herfindahl-Hirschman Index for a given fiscal year are regarded as low-competition industries. If the complement hypothesis is correct, we should see that a CEO's compensation is more sensitive with respect to relative pay in high-competition industries when compared to low-competition industries.

The results of such an analysis are given in Table 5. In columns (1) and (4) we show the regression results for high-competition industries, and in columns (2) and (5) we show the regression results for low-competition industries. By splitting the sample into two groups of

industries (high- and low-competition), we allow for a fully flexible regression specification wherein all the control variables are allowed to be different across the two groups of industries.[9]

Table 5

Compare the regression coefficients in columns (1) and (2). In the high-competition industries, we find a regression coefficient of 24.39 on the pay benchmarking variable *relpay*. Moving from the first percentile to the 100th percentile of pay relative to the peer group median is associated with an inflation-adjusted increase in compensation of $2.44 million. In the low-competition industries we find a regression coefficient of 12.55 which translates into an increase of $1.26 million in compensation. Columns (3) shows that the inflation-adjusted difference of $1.18 million between the high-competition and the low-competition industries is statistically significant at the one-percent level. We next include the four control variables that were not included in BLN. These results are given in columns (4), (5) and (6). Once again we find that high-competition industries have a larger pay benchmarking effect than low-competition industries. Specifically, column (6) shows an inflation-adjusted difference of $1.09 million between the high-competition industries and the low-competition industries which is statistically significant at the one-percent level. These results show that product market competition has a strong complementary impact on CEO pay benchmarking.

Although not the focus of our study, we next examine the impact of product market competition on the performance benchmarking variable *relperf*. For the high-competition industries of models (1) and (4), we find regression coefficients of 15.01 and 15.63, respectively.

[9]One could estimate a more restrictive regression specification wherein all control variables but *relpay* and *relperf* are assumed to be same across the two groups of firms and include interaction variables between *relpay* and a dummy variable for high-competition industries, and between *relperf* and a dummy variable for high-competition industries. But the interaction terms might be picking up the differential effect of the other independent variables (dividend yield, r&d, etc.) on high- and low-competition industries. Accordingly, we correctly estimate the fully flexible regression specification.

This suggest that moving from the first percentile to the 100th percentile of performance to the peer group median is associated with an inflation-adjusted increase in total compensation of $1.51 million and $1.57 million, respectively. For the low-competition industries of models (2) and (5), we find regression coefficients of 4.22 and 5.61, respectively. This suggest that moving from the first percentile to the 100th percentile of performance to the peer group median is associated with an inflation-adjusted increase in total compensation of $0.42 million and 0.56 million, respectively. This translates to a statistically significant differential impact of approximately $1.1 million between high-competition and low-competition industries.[10]

To summarize, we find strong evidence of a higher level of pay benchmarking in more competitive product markets when compared to less competitive product markets. This positive relationship between product market competition and pay benchmarking is consistent with the complement hypothesis and against the substitution hypothesis.

5.3 Are the results on the effect of product market competition on pay benchmarking due to industry homogeneity?

However, there could be another explanation for our results. Competitive industries may have more competition for managerial talent since those industries are more homogeneous. It may be easier for board of directors to monitor and better able to filter the effects of industry shocks upon outcome. Consequently, such firms are more likely to retain (reward) or fire managerial talent since it is easier to ascertain the causes of success in homogeneous industries. Additionally, it is easier for a talented manager to leave to serve a rival since managerial talent might be more transferable to other firms in homogenous industries. Parrino (1997) find that

[10] We also used the 10-K text-based classification of product market categories of Hoberg and Phillips (2016). We find similar results although the statistical significance for differences between less-competitive and more-competitive markets is weaker.

homogeneous industries are more likely to fire CEOs of poorly performing firms because the board of directors of such firms is better able to ascribe the cause of firm failure to the CEO and to the relative ease of finding the CEO's replacement. We hence check if the level of industry homogeneity is the rationale for why we are finding that more competitive firms have larger pay and performance benchmarking than less competitive firms.

We follow Parrino (1997) and use as our proxy for industry homogeneity the mean partial correlation of firms within a three-digit SIC industry, holding constant the return on the equally-weighted market index. We estimate the partial correlation coefficient of each firm using monthly returns between 1992 and 2012. A firm was included in the calculation of the partial correlation if it had at least 72 months of data. We calculated the mean partial correlation coefficient for those industries which had at least four firms. We then perform the analysis of Table 4 but with the inclusion of a new control variable, the mean partial correlation coefficient of the industry, denoted as *parcorr*. Table 6 summarizes these results. We find that our basic results Table 4 are not affected by the inclusion of *parcorr* as an additional control variable. Moreover, the coefficient for *parcorr* is not statistically significant in any of the specifications, suggesting that industry homogeneity does not impact the positive relationship between product market competition and pay benchmarking.

Table 6

5.4 Are the results on the effect of product market competition on pay benchmarking robust to eliminating extreme values of CEO pay?

The results in Table 5 used the change in CEO pay from last year to this year as the dependent variable (Δ*tdc1*). But this dependent variable Δ*tdc1* might be skewed due to some extreme observations despite our winsorizing this variable at 1%. Accordingly, we take the natural logarithm of Δ*tdc1*, and use it as the dependent variable (log(Δ*tdc1*)) in the more

comprehensive regression specification of Table 5. Using the logarithm transformation, we mitigate the effect, if any, of extreme values of CEO pay. The results of such an analysis are given in Table 7, models 1 - 3. Once again we find strong evidence that CEO benchmarking is larger in more competitive product markets than in less competitive product markets. This suggests that our main results on product market competition and benchmarking is not dependent on a specific definition of CEO pay.

Alternatively, we use as our dependent variable the logarithm of the ratio of current fiscal year's tdc1 to the total compensation of the previous fiscal year. The latter is analogous to using the percentage change in total compensation as the dependent variable. The results of the regression using this dependent variable are summarized in Table 7, models 4 - 6. As in models 1 – 3, we again find strong evidence that CEO benchmarking is larger in more competitive product markets than in less competitive product markets when our dependent variable is the natural logarithm of the ratio of current fiscal year's tdc1 to the total compensation of the previous fiscal year. This again suggests that our main results on product market competition and benchmarking is not dependent on a specific definition of CEO pay.

Table 7

5.5 Are the results on the effect of product market competition on pay benchmarking robust to endogenous industry structure?

In the previous analysis, we proxied for industry competition with the Herfindahl-Hirschman Index (*herf*) at the three-digit SIC code level. But concentration ratios such as *herf* might not capture the true level of product competitiveness, when industry structure is

endogenously determined due to entry and exit of firms (see, for example, Raith 2003; Karuna 2007). Accordingly we create three alternative definitions of competition to take into account the ease or difficulty of entry or exit from an industry. The first is based on market size. The greater the market size as measured by total annual industry sales, the greater the inducement for market entry of competitors. Consequently, high-competition is defined as firms in industries with total industry sales greater than the median. Otherwise, the firms are classified as firms in low-competition industries. Industry sales is defined as the logarithm of firm sales at the three-digit SIC code level. The second measure of competition is the price-cost margin ratio. High-competition firms are defined as those with price-cost margins lower than equal to the median price-cost margin. Otherwise, the firms are classified as firms in low-competition industries. Price-cost margins of an industry is defined as the mean of the ratio of net income plus depreciation plus interest expense to sales of firms in the industry for a given year. The third definition of competition is based on the ratio of fixed investment to assets. High-competition is defined as the group of firms in industries with entry costs lower than or equal to that of the median entry costs of the industry. Otherwise, the firms are classified as firms in low-competition industries. Entry cost of an industry is defined as the mean of the ratio of net property, plant and equipment to total assets of all the firms in the industry for a given year. We repeat the more comprehensive regression model of Table 5, the results of which are given in Table 8. For ease of explanation we do not report the results on the control variables and year dummies.

Table 8

In Panel A, we find a statistically significantly higher level of pay benchmarking in industries with a greater market size than in industries with a smaller market size. In Panel B, we

find a statistically significantly higher level of pay benchmarking in industries with lower price-cost margins than in industries with high price-cost margins. Finally, we find a marginally higher level of pay benchmarking in industries with low fixed-asset entry costs cost than in industries with high fixed-asset entry costs, although this relationship is statistically insignificant. In summary, we find that the higher level of CEO pay benchmarking is driven by industries with a larger market size or low price-cost margins, results consistent with the *complement hypothesis*.

5.6 Effect of talent on the relationship between product market competition and pay benchmarking

We examine whether CEO talent is behind the *complement hypothesis* between product market competition and benchmarking. In order to do so, we use three variables that has been used by ADV to proxy for talent.[11] Consistent with Rosen's (1982) and Gabaix and Landier's (2008) argument that larger firms have talented CEOs who are paid more, ADV stipulates the first talent proxy variable to be firm size. It is defined as the natural logarithm of the lagged average market capitalization of the firm over two lagged years. The other talent variables are direct constructs of abnormal performance. Specifically, the second talent proxy variable is the industry-adjusted ROA at the three-digit SIC level over two lagged years. The third talent proxy variable is the average abnormal stock return performance over the equally-weighted market portfolio over lagged two years.

We split our sample into high-talent (low-talent) based on whether the firm is above the median value (below or equal to the median value) of the talent proxy variable. We repeat the regressions of Table 4 for four sub-samples; high-competition and high-talent, low-competition

and high-talent, high-competition and low-talent, and low-competition and low-talent, respectively. Panel A of Table 9 shows the results for talent proxied by natural logarithm of the firm's market value of equity, Panel B of Table 9 shows the results for talent proxied by abnormal ROA, and Panel C of Table 9 shows the results for talent proxied by abnormal stock return performance. For brevity we do not report the control variables.

Table 9

In Panel A, we find the highest regression coefficient of 36.25 on the pay benchmarking variable *relpay* for the high-talent and high-competition sub-sample, which is both economically and statistically significantly higher than the regression coefficient of 21.16 for the high-talent and low-competition sub-sample. Similarly, the regression coefficient of 18.78 on the performance benchmarking variable *relperf* for the high-talent and high-competition sub-sample, is both economically and statistically significantly higher than the regression coefficient of 7.940 for the high-talent and low-competition sub-sample. We also find the regression coefficient of 11.82 on the pay benchmarking variable for the low-talent and high-competition sub-sample, which is both economically and statistically significantly higher than the regression coefficient of 6.32 for the low-talent and low-competition sub-sample. Similarly, we find a regression coefficient of 10.21 on the performance benchmarking variable for the low-talent and high-competition sub-sample, is economically but not statistically different than the regression coefficient of 2.94 for the low-talent and low-competition sub-sample. Note that the pay and performance benchmarking regression coefficients are greater for high-competition versus low-competition across talent categories. Within the high-competition sub-sample (or low-

[11] ADV also uses the extent of media coverage of the CEO and the firm as a proxy variable for talent. We do not include this variable as we do not have such data. Additionally, so as to conserve our sample, we use averages over two years rather than three years.

competition sub-sample), we also find that high-talent is rewarded more than low-talent executives. Additionally, the high-talent and high-competition sub-sample has the largest pay and performance benchmarking regression coefficients which are statistically significantly greater than corresponding regression coefficients for the low-talent and low-competition sub-sample. These results are strongly supportive of CEO talent being an important factor in the complementary relationship between product market competition and benchmarking.

In Panel B, we examine the results for talent proxied by abnormal ROA. Once again we find that the high-talent and high-competition sub-sample has the largest pay and performance benchmarking regression coefficients which are statistically significantly greater than corresponding regression coefficients for the high-talent and low-competition sub-sample. The results are positive but statistically significantly weaker across the two low-talent sub-samples. Within the high-competition sub-sample, we also find that high-talent is rewarded more than low-talent executives. Additionally, the high-talent and high-competition sub-sample has the largest pay and performance benchmarking regression coefficients which are statistically significantly greater than corresponding regression coefficients for the low-talent and low-competition sub-sample. In Panel C, we examine the results for talent proxied by abnormal stock return performance. We find that the high-talent (low-talent) and high-competition sub-sample has pay and performance benchmarking regression coefficients which are statistically significantly greater than corresponding regression coefficients for the high-talent (low-talent) and low-competition sub-samples.

In summary, the results of Table 9 show that pay benchmarking is higher in more competitive markets than in less competitive markets because of the higher returns to executive talent in more competitive product markets.

6. Conclusions

The previous literature has found that compensation benchmarking is undertaken for retaining and attracting managerial talent. This paper extends this literature by examining the impact of product market competition on the benchmarking of CEO pay. If as suggested, compensation benchmarking is undertaken for valuable human talent, then this talent might be more valuable in more competitive industries wherein products and services are non-differentiated and where poor management is more likely to result in financial ruin compared to non-competitive environments. On the other hand, it might be more important to attract and retain talented managers in a non-competitive market since firms in this industry can earn abnormal profits (and sometimes at the expense of their rivals.) Consequently, this paper tests whether product markets and CEO pay benchmarking are complements or substitutes.

Using a large sample of firms for the years 1992-2012, we find a significantly greater effect of CEO pay benchmarking in more-competitive industries than in less-competitive industries. In addition, using talent proxies previously used in the literature, we find that CEO talent is valued more highly in more competitive markets. We also find that our results are robust to other proxies of competition such as market size and price-cost margins. This suggests that product markets and CEO pay benchmarking are complements. Future research might examine if the pay of the board of directors is also affected by the product markets that the firm operates in.

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Table 1: Variable definitions

Variable	Definition
tdc1	CEO's total compensation: salary, bonus and other annual payouts including granted options, restricted stock and long-term incentive payouts
Δtdc1	Difference in *Δtdc1* between current and previous fiscal year
relpay	Relative ranking of total compensation of the CEO of a given industry and a given size group for the previous fiscal year
relperf	Relative ranking of the firm's performance as measured by the change in shareholder value for a given industry, size group, and fiscal year
herf	Herfindahl-Hirschman Index at the three-digit SIC code level for the fiscal year
lsales	Natural logarithm of sales in a given fiscal year
Δsales	Difference in sales between current and previous fiscal year
Δni	Difference in net income between current and previous fiscal year
dyield	Current fiscal year dividend yield
tenure	Number of years the executive been Chief Executive Officer
mtdc1	Average pay level of the CEO in the same industry at the three-digit SIC code level, where industry is defined to exclude the company
age	Age of CEO
numfirms	Number of firms in the same industry at the three-digit SIC code level

Table 2: Descriptive statistics

tdc1 is the CEO's total compensation: salary, bonus and other annual payouts including granted options, restricted stock and long-term incentive payouts; *Δtdc1,* the difference in the total compensation of the current fiscal year and the total compensation of the previous fiscal year; *relpay* is the inverse relative ranking of total compensation of the CEO of a given industry and given size group for a given fiscal year; *relperf* is the relative ranking of the firm's performance as measured by *Δmv* for a given industry, size group and a given fiscal year; *herf* is the Herfindahl-Hirschman Index; *lsales* is the logarithm of sales of the previous fiscal year; *Δsales* is the difference between the sales of the current fiscal year and the sales of the previous fiscal year; *Δni* is the difference between the net income of the current fiscal year and the net income of the previous fiscal year; *dyield* is the dividend yield; *tenure* is the number of years that the CEO is in office; *mtdc1* is the average CEO compensation for all firms in the same industry and size group; *age* is the age of the CEO; and *numfirms* is the number of firms in the three-digit industry size group for each fiscal year. All dollar variables are denominated in 2012 dollars.

Variable	N	Mean	Median	Std. Dev.
tdc1[a]	16,996	$6,404.7	$3,528.6	$14,237.3
Δtdc1[a]	16,996	$226.3	$86.77	$4,835.4
relpay	16,996	65.94	66.67	30.13
relperf	16,996	65.90	66.67	30.14
herf	16,996	2694.2	2178.3	1891.9
Δsales[b]	16,996	$284.8	$55.9	$1,416.2
lsales	16,996	$7.46	$7.37	$1.55
Δni[b]	16,996	$21.7	$7.76	$454.4
dyield	16,996	0.01	0.01	0.02
tenure	16,996	9.12	6.83	7.17
mtdc1[a]	16,996	$6,030.5	$5,102.4	$3,968.7
age	16,996	56.60	57	6.91
numfirms	16,996	25.51	13	28.63

[a] $thousands, and [b] $millions, respectively.

Table 3: Correlation matrix

relpay is the inverse relative ranking of total compensation of the CEO of a given industry and given size group for a given fiscal year; *relperf* is the relative ranking of the firm's performance as measured by *Δmv* for a given industry, size group and a given fiscal year; *herf* is the Herfindahl-Hirschman Index; *lsales* is the logarithm of sales of the previous fiscal year; *Δsales* is the difference between the sales of the current fiscal year and the sales of the previous fiscal year; *Δni* is the difference between the net income of the current fiscal year and the net income of the previous fiscal year; *dyield* is the dividend yield; *tenure* is the number of years that the CEO is in office; *mtdc1* is the average CEO compensation for all firms in the same industry and size group; *age* is the age of the CEO; and *numfirms* is the number of firms in the three-digit industry size group for each fiscal year.

	Δtdc1	*relpay*	*relperf*	*lsales*	*Δsales*	*Δni*	*herf*	*tenure*	*Dyield*	*mtdc1*	*age*	*numfirms*
Δtdc1	1.00	0.10	0.07	0.02	0.11	0.11	0.00	-0.01	-0.02	0.04	-0.01	-0.01
relpay	0.10	1.00	0.24	-0.03	-0.03	-0.01	0.39	0.04	0.01	-0.01	0.03	-0.32
relperf	0.07	0.24	1.00	0.13	0.09	0.09	0.39	-0.01	-0.06	-0.06	0.03	-0.32
lsales	0.02	-0.03	0.13	1.00	0.24	0.06	0.14	-0.11	0.17	0.12	0.12	-0.25
Δsales	0.11	-0.03	0.09	0.24	1.00	0.30	0.05	0.01	-0.05	0.12	0.03	-0.04
Δni	0.11	-0.01	0.09	0.06	0.30	1.00	0.00	0.01	-0.07	0.04	0.02	0.01
herf	0.00	0.39	0.39	0.14	0.05	0.00	1.00	0.01	-0.04	-0.04	0.06	-0.58
tenure	-0.01	0.04	-0.01	-0.11	0.01	0.01	0.01	1.00	-0.08	0.00	0.41	0.01
dyield	-0.02	0.01	-0.06	0.17	-0.05	-0.07	-0.04	-0.08	1.00	-0.14	0.10	-0.05
mtdc1	0.04	-0.01	-0.06	0.12	0.12	0.04	-0.04	0.00	-0.14	1.00	-0.04	0.04
age	-0.01	0.03	0.03	0.12	0.03	0.02	0.06	0.41	0.10	-0.04	1.00	-0.11
numfirms	-0.01	-0.32	-0.32	-0.25	-0.04	0.01	-0.58	0.01	-0.05	0.04	-0.11	1.00

Table 4: CEO pay benchmarking

This table reports the OLS regression results for sample firms over the period 1992-2012. The dependent variable is *Δtdc1,* the difference in the total compensation of the current fiscal year and the total compensation of the previous fiscal year. The independent variables are: *relpay* is the inverse relative ranking of total compensation of the CEO of a given industry and given size group for a given fiscal year; *relperf* is the relative ranking of the firm's performance as measured by the change in market value for a given industry, size group and a given fiscal year; *lsales* is the logarithm of the sales of the previous fiscal year; *Δsales* is the difference between the sales of the current fiscal year and the sales of the previous fiscal year; *Δni* is the difference between the net income of the current fiscal year and the net income of the previous fiscal year; *tenure* is the number of years that the CEO is in office; *dyield* is the dividend yield; *mtdc1* is the average CEO compensation for all firms in the same industry after abstracting the firm's contribution to the average; *age* is the age of the CEO; *numfirms* is the number of firms in the three-digit industry-size group for each fiscal year. Year dummies are included but their coefficients are not reported. *t*-statistics are computed based on robust standard errors that incorporate firm-level clustering and are reported in parentheses. Data is winsorized at the 1% level. [a], [b] and [c] denotes significance at 1%, 5% and 10% level, respectively. All dollar variables are in constant 2012 dollars.

	(1)	(2)
intercept	-1383.6[a]	-2159.3[a]
	(-4.63)	(-5.82)
relpay	15.15[a]	17.07[a]
	(11.42)	(12.19)
relperf	6.38[a]	8.23[a]
	(4.83)	(5.79)
lsales	-3.10	30.16
	(-0.15)	(1.35)
Δsales	0.240[a]	0.225[a]
	(4.86)	(4.60)
Δni	0.844[a]	0.817[a]
	(4.96)	(4.80)
tenure	-11.04[a]	-10.38[a]
	(-3.09)	(-2.65)
dyield		-2021.0
		(-1.49)
mtdc1		0.030[a]
		(2.60)
age		-2.32
		(-0.59)
numfirms		7.94[a]
		(7.41)
R^2	0.043	0.045
n	16,996	16,996

Table 5: CEO pay benchmarking and product market competition

This table reports the OLS regression results for sample firms over the period 1992-2012. The dependent variable is *Δtdc1,* the difference in the total compensation of the current fiscal year and the total compensation of the previous fiscal year. High-competition is defined as the group of firms in industries with a Herfindahl-Hirschman Index below or equal to the median Herfindahl-Hirschman Index in each given year. Otherwise, the firms are classified as firms in low-competition industries. The independent variables are: *relpay* is the inverse relative ranking of total compensation of the CEO of a given industry and given size group for a given fiscal year; *relperf* is the relative ranking of the firm's performance as measured by the change in market value for a given industry, size group and a given fiscal year; *lsales* is the logarithm of the sales of the previous fiscal year; *Δsales* is the difference between the sales of the current fiscal year and the sales of the previous fiscal year; *Δni* is the difference between the net income of the current fiscal year and the net income of the previous fiscal year; *tenure* is the number of years that the CEO is in office; *dyield* is the dividend yield; *mtdc1* is the average CEO compensation for all firms in the same industry after abstracting the firm's contribution to the average; and *age* is the age of the CEO; *numfirms* is the number of firms in the three-digit industry-size group for each fiscal year. Year dummies are included but their coefficients are not reported. *t*-statistics are computed based on robust standard errors that incorporate firm-level clustering and are reported in parentheses. Data is winsorized at the 1% level. [a], [b] and [c] denotes significance at 1%, 5% and 10% level, respectively. All dollar variables are in constant 2012 dollars.

	High-competition	Low-competition	difference	High-competition	Low-competition	difference
	(1)	(2)	(3)	(4)	(5)	(6)
intercept	-2564.4[a]	-1246.0[a]		-3431.1[a]	-1422.8[a]	
	(-5.79)	(-2.94)		(-6.28)	(-2.73)	
relpay	24.39[a]	12.55	11.84[a]	24.91[a]	14.00[a]	10.91[a]
	(12.10)	(6.65)	(4.29)	(11.88)	(7.03)	(3.77)
relperf	15.01[a]	4.22[b]	10.79[a]	15.63[a]	5.61[a]	10.02[a]
	(6.92)	(2.38)	(3.85)	(7.05)	(3.00)	(3.58)
lsales	91.64[a]	-41.29		104.57[a]	-20.67	
	(3.25)	(-1.29)		(3.30)	(-0.61)	
Δsales	0.215[a]	0.255[a]		0.205[a]	0.245[a]	
	(2.81)	(4.15)		(2.69)	(3.96)	
Δni	0.685[a]	0.934[a]		0.666[a]	0.916[a]	
	(3.03)	(4.02)		(2.94)	(3.93)	
tenure	-11.11[c]	-9.24		-13.38[b]	-7.21	
	(-1.83)	(-2.17)		(-2.01)	(-1.54)	
dyield				-42.47	-4879.3[b]	
				(-0.02)	(-2.14)	
mtdc1				0.036[c]	0.010	
				(1.65)	(0.70)	
age				3.360	-6.405	
				(0.54)	(-1.19)	
numfirms				4.83[a]	19.83[a]	
				(3.41)	(2.92)	
R^2	0.060	0.041		0.061	0.043	
n	8502	8494		8502	8494	

Table 6: Are our results affected by industry homogeneity?

This table reports the OLS regression results for sample firms over the period 1992-2012. The dependent variable is *Δtdc1,* the difference in the total compensation of the current fiscal year and the total compensation of the previous fiscal year. High-competition is defined as the group of firms in industries with a Herfindahl-Hirschman Index below or equal to the median Herfindahl-Hirschman Index in each given year. Otherwise, the firms are classified as firms in low-competition industries. The independent variables are: *relpay* is the inverse relative ranking of total compensation of the CEO of a given industry and given size group for a given fiscal year; *relperf* is the relative ranking of the firm's performance as measured by the change in market value for a given industry, size group and a given fiscal year; *lsales* is the logarithm of the sales of the previous fiscal year; *Δsales* is the difference between the sales of the current fiscal year and the sales of the previous fiscal year; *Δni* is the difference between the net income of the current fiscal year and the net income of the previous fiscal year; *tenure* is the number of years that the CEO is in office; *dyield* is the dividend yield; *mtdc1* is the average CEO compensation for all firms in the same industry after abstracting the firm's contribution to the average; and *age* is the age of the CEO; *numfirms* is the number of firms in the three-digit industry-size group for each fiscal year; *parcorr* is the average partial correlation coefficient for an industry index in a two-factor model that also includes a market return index. Year dummies are included but their coefficients are not reported. Year dummies are included but their coefficients are not reported. *t*-statistics are computed based on robust standard errors that incorporate firm-level clustering and are reported in parentheses. Data is winsorized at the 1% level. [a], [b] and [c] denotes significance at 1%, 5% and 10% level, respectively. All dollar variables are in constant 2012 dollars.

	High-competition	Low-competition	difference	High-competition	Low-competition	difference
	(1)	(2)	(3)	(4)	(5)	(6)
intercept	-2611.1[a]	-1305.2[a]		-3461.4[a]	-1716.6[a]	
	(-5.88)	(-2.74)		(-6.30)	(-3.03)	
relpay	24.73[a]	13.45[a]	11.28[a]	25.15[a]	15.06[a]	10.01[a]
	(12.08)	(6.52)	(3.88)	(11.90)	(6.94)	(3.33)
relperf	15.12[a]	4.88[b]	10.25[a]	15.59[a]	6.10[a]	9.49[a]
	(6.92)	(2.53)	(3.52)	(6.99)	(3.04)	(3.16)
lsales	99.15[a]	-50.40		106.5[a]	-27.20	
	(3.24)	(-1.42)		(3.25)	(-0.73)	
Δsales	0.211[a]	0.259[a]		0.203[b]	0.253[a]	
	(2.75)	(3.78)		(2.67)	(3.64)	
Δni	0.666[a]	0.959[a]		0.649[a]	0.945[a]	
	(2.94)	(3.77)		(2.86)	(3.71)	
tenure	-10.88[c]	-8.71[b]		-12.63[c]	-8.65[c]	
	(-1.80)	(-2.21)		(-1.88)	(-1.92)	
dyield				-1025.9	-4155.1[c]	
				(-0.49)	(-1.85)	
mtdc1				0.03	-0.01	
				(1.44)	(-0.57)	
age				2.46	-1.56	
				(0.40)	(-0.27)	
numfirms				4.76[a]	20.88[a]	
				(3.41)	(3.03)	
parcorr	-208.45	282.27		264.28	437.67	
	-0.62	0.78		(0.69)	(1.21)	
R^2	0.062	0.043		0.063	0.044	
n	8410	7075		8410	7075	

Table 7: Are our results affected by a different definition of CEO compensation?

This table reports the OLS regression results for sample firms over the period 1992-2012. The dependent variable is for models 1 – 3 is log(*Δtdc1*), the log of the difference in the total compensation of the current fiscal year and the total compensation of the previous fiscal year. The dependent variable is for models 4 – 6 is log(*tdc1/tdc1m*), the log of the one + the percentage change in the total compensation between the current fiscal year and the total compensation of the previous fiscal year. We denote the compensation of the previous fiscal year as *tdc1m.* .High-competition is defined as the group of firms in industries with a Herfindahl-Hirschman Index below or equal to the median Herfindahl-Hirschman Index in each given year. Otherwise, the firms are classified as firms in low-competition industries. The independent variables are: *relpay* is the inverse relative ranking of total compensation of the CEO of a given industry and given size group for a given fiscal year; *relperf* is the relative ranking of the firm's performance as measured by the change in market value for a given industry, size group and a given fiscal year; *lsales* is the logarithm of the sales of the previous fiscal year; *Δsales* is the difference between the sales of the current fiscal year and the sales of the previous fiscal year; *Δni* is the difference between the net income of the current fiscal year and the net income of the previous fiscal year; *tenure* is the number of years that the CEO is in office; *dyield* is the dividend yield; *mtdc1* is the average CEO compensation for all firms in the same industry after abstracting the firm's contribution to the average; and *age* is the age of the CEO; *numfirms* is the number of firms in the three-digit industry-size group for each fiscal year. Year dummies are included but their coefficients are not reported. *T*-statistics are computed based on robust standard errors that incorporate firm-level clustering and are reported in parentheses. Data is winsorized at the 1% level. [a], [b] and [c] denotes significance at 1%, 5% and 10% level, respectively. All dollar variables are in constant 2012 dollars.

	log(*Δtdc1*),			*log(tdc1/tdc1m)*		
	High-competition	Low-competition	Difference	High-competition	Low Competition	Difference
	(1)	(2)	(3)	(4)	(5)	(6)
intercept	1.69[a]	2.53[a]		-0.5167[a]	-0.1647[b]	
	(5.02)	(7.42)		(-7.17)	(-2.52)	
relpay	0.010[a]	0.003[a]	0.007[a]	0.0048[a]	0.0025[a]	0.0023[a]
	(9.24)	(2.78)	(4.31)	(17.75)	(9.65)	(6.30)
relperf	0.014[a]	0.007[a]	0.006[a]	0.0027[a]	0.0008[a]	0.0020[a]
	(12.92)	(6.54)	(4.05)	(11.14)	(3.24)	(5.68)
lsales	0.239[a]	0.181[a]		0.0120[a]	-0.0048	
	(11.74)	(8.60)		(2.90)	(-1.31)	
Δsales	0.0001	0.0001[a]		0.0000	0.0000[a]	
	(2.20)	(3.05)		(1.42)	(3.97)	
Δni	0.001[a]	0.001[a]		0.0001[a]	0.0001[a]	
	(4.85)	(5.27)		(4.38)	(3.54)	
tenure	-0.013[a]	-0.022[a]		-0.0027[a]	-0.0021[a]	
	(-2.71)	(-4.72)		(-3.05)	(-3.16)	
dyield	-4.61[a]	-7.72[a]		-0.0731	-1.0243[a]	
	(-3.61)	(-4.61)		(-0.28)	(-3.41)	
mtdc1	0.000[b]	0.000[a]		0.0000	0.0000	
	(2.42)	(3.62)		(-0.72)	(0.08)	
age	-0.005	-0.006		0.0006	-0.0013	
	(-0.94)	(-1.44)		(0.69)	(-1.59)	
numfirms	0.003[a]	0.015[a]		0.0007[a]	0.0037[a]	
	(3.33)	(3.42)		(3.53)	(4.45)	
R^2	0.093	0.067		0.099	0.056	
n	8502	8494		8492	8484	

Table 8: CEO pay benchmarking with endogenous market structure

This table reports the OLS regression results for sample firms over the period 1992-2012. The dependent variable is *Δtdc1,* the difference in the total compensation of the current fiscal year and the total compensation of the previous fiscal year. Competition is defined in three different ways. In Panel A, high-competition is defined as firms in industries with total industry sales greater than the median. Otherwise, the firms are classified as firms in low-competition industries. In Panel B, high-competition is defined as of firms in industries with price-cost margins lower or equal to that of the median. Otherwise, the firms are classified as firms in low-competition industries. Price-cost margins of an industry is defined as the mean of the ratio of net income plus depreciation plus interest expense to sales of firms in the industry for a given year. In Panel C, high-competition is defined as a group of firms in industries with entry costs lower or equal to that of the median. Otherwise, the firms are classified as firms in low-competition industries. Entry cost of an industry is defined as the mean of the ratio of property, plant and equipment to total assets of all the firms in the industry for a given year. Control variables are the same as in Table 4 but are not reported. Year dummies are included but their coefficients are not reported. *t*-statistics are computed based on robust standard errors that incorporate firm-level clustering and are reported in parentheses. Data is winsorized at the 1% level. [a], [b] and [c] denotes significance at 1%, 5% and 10% level, respectively. All dollar variables are in constant 2012 dollars.

	High-competition	Low-competition	difference
	(1)	(2)	(3)
Panel A: Market size			
relpay	24.13[a]	16.53[a]	7.60[a]
	(12.16)	(7.69)	(2.60)
relperf	17.03[a]	3.85[b]	13.18[a]
	(7.51)	(1.84)	(4.27)
Panel B: Price-cost margin			
relpay	19.83[a]	14.77[a]	5.06[c]
	(8.51)	(8.01)	(1.88)
relperf	8.48[a]	7.34[a]	1.14
	(3.92)	(3.78)	(0.39)
Panel C: Entry costs			
relpay	18.68[a]	15.30[a]	3.38
	(9.42)	(8.16)	(1.24)
relperf	10.49[a]	5.22[a]	5.27[c]
	(4.79)	(2.82)	(1.84)

Table 9: CEO talent, compensation benchmarking, and product market competition

This table reports the OLS regression results for sample firms over the period 1992-2012. The dependent variable is *Δtdc1,* the difference in the total compensation of the current fiscal year and the total compensation of the previous fiscal year. High-competition is defined as the group of firms in industries with a Herfindahl-Hirschman Index below or equal to the median Herfindahl-Hirschman Index in each given year. Otherwise, the firms are classified as firms in low-competition industries. We use the three talent variables of Albuquerque, De Franco and Verdi (2013). The first is firm size, defined as the log of the average market capitalization of the firm over lagged two years. The second is the industry-adjusted ROA at the three-digit SIC level over lagged two years. The third is the average abnormal stock return performance over the value-weighted market portfolio over lagged two years. High-talent (low-talent) is based on whether the firm is above the median value (below or equal to the median value) of the talent proxy variable for a given year. Control variables are the same as in Table 4 but are not reported. Year dummies are included but their coefficients are not reported. *t*-statistics are computed based on robust standard errors that incorporate firm-level clustering and are reported in parentheses. Data is winsorized at the 1% level. [a], [b] and [c] denotes significance at 1%, 5% and 10% level, respectively. All dollar variables are in constant 2012 dollars.

	Pay benchmarking (*relpay)*			Performance benchmarking (*relperf*)		
	High-competition	Low-competition	difference	High-competition	Low-competition	difference
Panel A: Talent proxied by size						
High-talent	36.25[a] (10.11)	21.16[a] (5.81)	15.09[a] (2.95)	18.78[a] (5.38)	7.94[b] (2.16)	10.84[b] (2.19)
Low-talent	11.82[a] (6.80)	6.32[a] (3.64)	5.51[b] (2.24)	10.21[a] (5.22)	2.94[b] (2.00)	7.28 (1.47)
Panel B: Talent proxied by ROA						
High-talent	31.78[a] (10.24)	15.10[a] (5.73)	16.68[a] (3.96)	18.24[a] (5.57)	5.59[b] (2.09)	12.28[a] (2.83)
Low-talent	16.27[a] (6.24)	13.48[a] (4.53)	2.90 (0.76)	11.58[a] (4.25)	6.36[b] (2.33)	5.22 (1.20)
Panel C: Talent proxied by stock returns						
High- talent	23.40[a] (7.17)	12.79[a] (4.33)	10.61[b] (2.41)	16.23[a] (4.85)	6.45[b] (2.33)	9.77[b] (2.25)
Low talent	27.01[a] (10.44)	15.67[a] (5.81)	11.40[a] (3.03)	15.44[a] (4.87)	4.46[c] (1.66)	10.98[b] (2.53)