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The impact of CEO reappointments on firm innovation

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Abstract

This paper examines the effect of the appointment of boomerang CEOs on subsequent firm performance from the perspective of innovation, measured with the number of patents, patent citations, patents per R&D dollar spent, and citations per patent. The multiple analysis performed find no strong empirical support for the hypothesis of boomerang CEOs being positively associated with the quantity and quality of future innovations; the results actually suggest a negative association between boomerang CEOs and firm innovation performance, which, however, necessitates of deeper understanding. Results are instead positive and significant when looking at the case of new inside founder CEOs—i.e., candidate CEOs who already have a role in the company and that are also founders of such company—which are associated with more, influential patents. Further, innovation quality appears to be positively associated with CEO overconfidence Lastly, the results suggest that bigger firms with a higher availability of money not only invest more in R&D, but the investments result in higher innovation performance overall.

Keywords: *Innovation*, *CEO turnover*, *Patents*, *Patent citations*, *Boomerang CEO*

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1. Introduction

CEO replacement is one of the most important events that firms experience and has long-term effects on the performance of such firms (Bertrand, 2009). Management theory has in fact largely agreed that a CEO is the key person responsible in setting the organizational strategy, structure, and environment (Farkas & Wetlaufer, 1996). It follows that the consequences of CEO replacement have attracted considerable attention, but while much is known about different types of CEO succession, little is known about what happens when the firm rehires a former CEO.

The purpose of this research is to contribute to the recently expanding literature on CEO turnover by examining the topic from the perspective of firm innovation performance. Specifically, the study aims to examine the effects of reappointed former CEOs on innovation. Whenever a CEO contract approaches its expiration date, the board of directors can take the decision to reappoint the former CEO, appoint another member as CEO, or hire an external CEO new to the company. The event of the appointed CEO being a former CEO of the same company returning to its position gives life to what is known as the "Boomerang CEO" phenomenon (Fahlenbrach, 2007). To my knowledge little to no research has been conducted on the topic and investigating the relation between such comebacks and firm innovation would be of interest to further understand matters of CEO successions. Is the comeback of a CEO a positive event or not for the innovation performance of a company? Was the decision to not reelect the once current CEO a mistake? And what can companies learn from this?

Examining the innovation performance implications of these boomerang CEOs is both theoretically important and practically relevant. First, from a managerial perspective, this can help understand the degree to which CEOs increase firm value by reallocating resources and improving investment strategies and can thus guide boards of directors in their decisions regarding CEO turnovers. Second, it helps to deepen the knowledge regarding the impact of boomerang CEOs on firm performance by adding arguments to conflicting views. On one hand, hiring a former CEO may be the best option since former CEOs are generally acquainted with the firm and its industry, potentially facilitating a smooth transition. On the other hand, rehiring a former CEO could also have negative effects on firm performance, as this may introduce outdated managerial practices and beliefs which can slow down the innovation process. (Bingham et al., 2019)

To analyze the implications of hiring a boomerang CEO, the paper makes use of different ordinary least square regressions, operated on data coming from US 1500 firms. After the lack of empirical evidence supporting the argument of boomerang CEOs being associated with positive innovation outcome, the main finding is that founder CEOs—defined as the founder of a company that acquires the CEO position a few years after the founding—are associated with overall greater quantity and quality of innovation, measured in terms of number of patents approved, overall patent citations, patents per R&D dollar spent, and citations per patent.

This research adds to the literature on changes in performance subsequent to a CEO turnover. Specifically, the study complements the existing literature that investigates the consequences of CEO succession on firm performance by introducing the point of view of innovation and concentrating on the effects of a specific case of former CEO reappointment.

The paper is arranged as follows. Section 2 is dedicated to the discussion of related literatures about CEO succession and the development of the research hypothesis. Section 3 explains the sample construction and the methodology used in this paper. Section 4 presents the empirical analysis and its results. The related robustness tests are reported in section 5, while Section 6 contains the conclusions and limitations of the study along with further research suggestions.

2. Theoretical background and hypothesis development

The literature on CEO succession is quite broad, with many studies focusing primarily on the difference between internal (inside succession) and external (outside succession) candidates CEO. Internal candidate CEOs are individuals who already have a role in the company, perhaps as a board member, while external candidates are individuals who are entering the company for the first time to assume the role of CEO (Helmich & Brown, 1972). Internal candidates have company-specific human capital that an external CEO may lack (Barney, 1991). They have received their training within the company and are more familiar with internal operations than external candidates (Erkens et al., 2014). In addition, they often have tacit knowledge of existing capabilities at the corporate level, which makes them better able to identify and pursue opportunities that fit the company's mission and strengths, enabling them to implement strategic change more effectively than external successors (Bingham et al., 2019).

This paper focuses on inside succession in a specific case: the reappointment of a former CEO, also known as Boomerang CEO (Fahlenbrach et al., 2007), and analyzes the impact that such a reappointment can have on firm innovation. In the literature, the concept of Boomerang CEO is interpreted in different ways: Boomerang CEOs are both former CEOs who served on the company's board after their mandate (Fahlenbrach et al., 2007) and former CEOs who left the company after their mandate and later made a comeback (Bingham et al., 2019). Both individuals have not only firm-specific work experience but also firm-specific CEO experience, which reduces the cost and time required to acquire knowledge and skills that are peculiar to the CEO position in a given firm (Bingham et al., 2019). For simplicity, we refer to the CEOs belonging to these boomerang categories as inside Boomerang CEOs and outside Boomerang CEOs respectively.

Although a better understanding of the Boomerang CEO phenomenon is worthwhile for scholars interested in CEO succession, there is little research on the topic. To my knowledge, Fahlenbrach et al. (2007) are the first to conduct an empirical study on Boomerang CEOs. They analyze the determinants and valuation consequences of hiring inside Boomerang CEOs and conclude that such a succession is more likely if the CEO had a good stock market performance during his first term and if the company performed particularly poorly after his replacement. While the market reacts negatively to the rehiring announcement—likely due to a lack of hope for a performance improvement—the results indicate that both the accounting and stock market performance improve relative to a control group which underwent outside succession, suggesting that firms that rehire their former CEO hire the best available candidate under the circumstances (i.e., poor firm performance).

On the other hand, Bingham et al. (2019) examine the market performance consequences of hiring outside Boomerang CEOs and find that these CEOs perform significantly worse than others and that this effect is particularly strong for companies in dynamic industries. This is likely due to the fact that CEOs returning to their firms often face business conditions that are different from those of their first mandate, and if they are unable to adapt quickly, their firm-specific skills may become core rigidities. The opposite can be true in stable industries, where CEOs' skills can still be of great use in achieving positive results. So, as can be seen, the key to good performance seems to be for the former CEOs to keep up to date with the workings of the industry and, more importantly, the workings of the company, and to develop their skills and knowledge, which is undoubtedly easier if they are still part of the company after their mandate, for example as members of the board.

Here, however, I focus on firm *innovation* performance. You et al. (2020) consider innovation as one of the main intervening variables through which CEOs affect firm performance, yet the above studies report nothing about the interaction effects between CEO reappointments and firm innovation, which may be the drivers of positive performance. The only study I am aware of that attempts to establish a link between the two elements was conducted by Bereskin and Hsu (2014). Their results suggest that new CEOs are generally associated with significantly higher quantity and quality of future innovations, as measured by R&D expenditures, number of patents issued, and patent citations received, and that this effect is also significantly related to New Inside CEOs. However, the structure of their research does not explicitly account for reappointment, making it impossible to distinguish between inside successors and Boomerang CEOs. Nevertheless, this outline proves to be a useful starting point for my investigation. Drawing on Bereskin and Hsu (2014) and following the conclusions of the studies cited above, I develop my hypothesis:

H1.: Inside Boomerang CEOs are associated with positive innovation outcome.

3. Sample and methodology

3.1 Sample construction

This paper aims to extend Bereskin and Hsu (2014) to measure the impact of Boomerang CEOs on firm innovation by further differentiating their sample and adding a new dependent variable, BoomerangCEO. To empirically test my hypothesis, I created a panel of firm-year data from a variety of sources.

First, following the lead of Bereskin and Hsu (2014) and Erkens et al. (2014), I began constructing the CEO sample by identifying 2,176 chief executive officers over the period 1992-2021 from the ExecuComp database, which includes the S&P 1500. In this sample, I identified 126 potential CEO reappointments based on the entire ExecuComp universe. To verify that the identified CEO turnovers unambiguously relate to CEO reappointments, i.e., are related to a Boomerang CEO, I conducted a manual search on Bloomberg based on executive and company names, and when unsuccessful, I also conducted manual research on multiple filings to ensure the reappointment. This reduced the number of Boomerang CEOs to 73. Given the specificity of this research, I removed from the sample all CEOs associated with the finance, insurance, and real estate industries—i.e., all companies with a SIC code between 6,000 and 7,000—as the probability of these industries to produce patents or to invest in R&D activities is slim.

My final sample of CEOs consists of 502 CEOs, of which 19 CEO reappointments for 19 unique firms. The sample size in terms of Boomerang CEOs is consistent with other studies conducted on specific events: e.g., Hayes and Schaefer (1999) used sample of 29 CEOs between 1979-1994 for their study on sudden CEO deaths.

Second, because the study measures innovation based on patent counts, patent citations, R&D expenditures, and other variables based upon these, I obtain the necessary data from different sources. I obtained patent data from the NBER patent dataset, which contains detailed information on all U.S. patents issued by U.S. public firms between January 1976 and December 2006, and I updated these data with the WRDS patent database, which contains information from January 2011 to December 2019. The two databases were created by merging multiple datasets themselves, a process that inevitably resulted in the omission of some observations where the presence of missing values did not allow for matching.

Finally, I obtained financial and accounting data for U.S. public companies from the CRSP/Compustat Merged database and CEO compensation data from the ExecuComp database.

The complete database used for this research is the result of the combination of all the above datasets. Once again, the merging process inevitably resulted in the omission of some observations where the data did not allow for matching. More observations were then dropped as a consequence of variable construction. The result is a database with 8,692 firm year observations for 567 CEOs during the years 1992-2021.

3.2 Research design and variables

This study is an extension of Bereskin and Hsu's (2014) study on "The Effect of New CEOs on Innovation." I use the same variables as the authors, with some limitations due to data sourcing and the presence of missing data in the sourced databases. Since the focus of the study is on firm innovation, I use a set of proxies based on patent counts, patent citations, and R&D expenditures to account for this. Patent-based measures are commonly employed to measure firms' technological progress because firms do not always disclose the details of their R&D projects and their R&D expenditures do not necessarily reflect innovation performance (Jensen, 1993). In addition, patent citations are used because the value of patent counts as a sole indicator of innovation is severely limited by the variance in the significance of individual patents, making patent counts a noisy indicator of innovation (Hall et al., 2005).

Contrary to Bereskin and Hsu (2014), the proxies for firms' innovation performance are calculated on an annual base instead of a 3-year and 5-year base due to the limited availability of Boomerang CEO data of sufficient time length. I used the following proxies for firm j's innovation performance in year t, where J denotes the total number of firms in firm j's industry in year t:

$$Counts_{j,t} = ln\left(1 + \sum Counts_{j,t}\right) \tag{1}$$

$$Cites_{j,t} = ln\left(1 + \sum \frac{Cites_{j,t}}{Avg\ Cites_{J,t}}\right) \tag{2}$$

These proxy values represent the logarithm of one plus the sum of patents or citations for each year; this is done to remove skewness. $Counts_{j,t}$ is the total number of approved patents of firm j filed in year t. $Cites_{j,t}$ is the total adjusted number of citations received by all patents filed by firm j in year t. Measuring the number and citations from the year the patent was filed allows us to accurately attribute the patents to the CEO who was running the company at the time. Specifically, $Cites_{j,t}$ is measured using the fixed effects approach adopted by Hall et al. (2001), in which the total of citations received by each patent is "re-scaled" by the average number of citations received by other patents in the same cohort to eliminate any problem with systematic changes over time in a patent's propensity to be cited. In this case, in order to remove all year, industry and year-industry effects, the number of citations received by a given patent is divided by the corresponding year-industry mean.

Following Bereskin and Hsu (2014), I consider two dimensions of innovation performance—innovation productivity and innovation influence. Innovation productivity is defined as the efficiency with which firms transform R&D expenditures into patents and measures the average number of R&D dollars spent per patent. The variable is built by taking the logarithm of one plus the cumulative R&D expenditure of the previous 2 years. This is done to account for the lag between R&D expenditure and possible R&D outcomes which is proven to be around 1~2 years (Lee et al., 2014). On the other hand, innovation Influence reflects how influential firm j's patents are on average and is measured by the number of total adjusted citations received by each firm's patents issued in year t scaled by the mean number of patents issued in year t by all firms in the same industry—the higher the value for influence, the higher is the value attributed to firm j's patents. In particular, Bereskin and Hsu (2014) state that these two measures "may be more value-relevant than patent counts and citations because they measure firm's innovation performance from efficiency and quality perspectives". The two variables are measured as follows:

$$Productivity_{j,t} = \frac{ln\left(1 + \sum_{1=r}^{2} RD_{j,t-2,t}\right)}{Counts_{j,t}} \tag{3}$$

$$Influence_{j,t} = \frac{Cites_{j,t}}{\left(\frac{Counts_{j,t}}{Counts_{J,t}}\right)} \tag{4}$$

Among such proxies, as in Bereskin and Hsu (2014), is then a list of other useful variables. First, I introduce the explanatory variables. $\mathrm{NewInternal}_{j,t}$ is a dummy variable equal to 1 for firm j in year t if an internal CEO is elected in that firm-year and 0 otherwise; $\mathrm{BoomerangCEO}_{j,t}$, is a dummy variable equal to 1 for firm j in year t if a boomerang CEO is elected in that firm-year and 0 otherwise; Founder is a dummy variable equal to 1 if the CEO is a founder of the company and 0 otherwise; and Overconfident has a value of 1 if the CEO holds stock options that are in the money in year t and 0 otherwise. $\mathrm{OptionComp\%}_{j,t}$ represents the percentage of the total compensation paid in stock options to the CEO.

Second, control variables are added. $\mathrm{RD}_{j,t-2t}$ represents the cumulative sum of the firm's annual R&D expenses over the previous 2 years; $\mathrm{MtoB}_{j,t}$ is the market-to-book ratio of each firm at the end of year t; $\mathrm{LogAssets}_{j,t}$ is the logarithm of the firm's total assets; $\Delta\mathrm{Earnings}_{t}$ is the difference in firm j's scaled earnings in year t, and $\Delta\mathrm{Earnings}_{j,t-1}$ is the lagged difference in firm j's scaled earnings. Table 1 provides the summary statistics of the innovation measures. More about variables construction can be found in Appendix A.

Table 1: Descriptive Statistics

This table provides descriptive statistics for the variables used in this paper, divided into: innovation measures, explanatory variables, and control variables. The variables are built following the process presented in Appendix A. For some of the variables are also reported both nominal and logarithmic values useful for the evaluation of the economic effects of the different elements.

Statistic	N	Mean	St. Dev.	Min	Max
Innovation measures					
Count	3,176	64.422	147.861	1	819.1
ln(Count)	3,176	2.802	1.576	0.693	6.709
Cites	3,119	69.629	175.679	0	1,214.235
ln(Cites)	3,119	2.737	1.684	0	7.103
$Productivity$	2,574	3.896	2.622	0	14.862
$Influence$	3,117	12.414	18.969	0	112.698
Explanatory variables					
BoomerangCEO	8,692	0.015	0.12	0	1
Founder	8,693	0.055	0.227	0	1
New Internal	8,693	0.987	0.113	0	1
OptionComp%	8,538	1.677	3.904	0	30.296
Overconfidence	8,576	0.833	0.373	0	1
Control variables					
$\Delta\mathrm{Earnings}_{t}$	4,676	-0.016	0.275	-1.413	1.159
$\Delta\mathrm{Earnings}_{t-1}$	4,676	-0.015	0.278	-1.473	1.141
MtoB	3,708	3.736	5.236	-11.774	38.006
LogAssets	4875	7.6	1.721	3.024	12.072
$\mathrm{RD}_{j,t-2t}$	4056	6.968	4.522	0	17.196

After the construction of the variables and the calculation of the related values, all continuous variables have then been winsorized by 1% and 99% to limit outliers. As visible in Table 1, all innovation measures together with the R&D variable present a high standard deviation due to the differences between industries and also between bigger and smaller companies in the same industry. This is fixed for both counts and citations by making use of logarithmic values and will also be mitigated in the later regressions by adding industry fixed effects and year fixed effects.

4. Empirical Analysis

The hypothesis I'm trying to analyze is that Boomerang CEOs tend to contribute in a higher measure to the innovation of a company, measured by proxies related to R&D expenditure, patent counts and patent citations. To do this, I regress the firm's innovation measures on the probability of Boomerang CEOs, CEO-related factors, and other control variables:

$$\begin{aligned} Innovation_{j,t} = {} & Intercept + \beta_1 BoomerangCEO_{j,t} + \beta_2 NewInternal \\ & + \beta_3 Founder + \beta_4 Overconfidence_{j,t} + \beta_5 OptionComp\%_{j,t} \\ & + \beta_6 RD_{j,t-2t} + \beta_7 MtoB_{j,t} + \beta_8 LogAssets_{j,t} + \beta_9 \Delta Earnings_{j,t} \\ & + \beta_{10} \Delta Earnings_{j,t-1} + Industry_{j,t} + Year_{j,t} \end{aligned} \tag{5}$$

where $Innovation_{j,t}$ is measured with all innovation proxies: $Counts_{j,t}$, $Cites_{j,t}$, $Productivity_{j,t}$, and $Influence_{j,t}$.

Table 2 reports the results of the OLS regression that examines the effects of Boomerang CEOs (and the additional variables described above) on the innovation measures using available firm-year observations, year fixed-effects, firm fixed-effects and standard errors clustered by industry. Here it's possible to note that, among new inside CEOs, boomerang CEOs are positively associated with patent counts and influence and negatively associated with patent citations and productivity with results being significant only for patent citations. These findings thus do not confirm the positive effects of Boomerang CEOs on innovation performance and do not support H1.

The opposite is true when looking at the effect of the appointment of a new inside CEO on firm performance. In this case, the CEO succession event is positively associated with all innovation measures and, despite only influence being significant, if we consider this variable as being of higher importance than patent counts and patent citations, it is possible to suppose that the election of a new inside CEO is associated with positive innovation outcome. Specifically, we can infer that new inside CEOs are capable of producing patents widely considered of high value.

Following the same line of thought, the positive effect of hiring a new inside CEO appears to be of higher intensity when looking at the effect of the appointment of a founder CEO on firm performance. In this case, the CEO succession event is significantly positively associated with patent counts and patent citations. In terms of economic magnitude, the estimates suggest that Founder CEOs raise patent counts and patent citations by 22.61% and

Table 2: Determinants of innovation output, productivity, and influence

This table provides the results of an ordinary least square regression for the quantity and quality of innovation. The dependent variables are: the sum of patents filed by each CEO over the next three and five years ($Count^3$ and $Count^5$); the patent citations received by such patents over the next three and five years ($Cites^3$ and $Cites^5$); three-year and five-year innovation productivity ($Productivity^3$ and $Productivity^5$); and three-year and five-year innovation influence ($Influence^3$ and $Influence^5$). Industry-clustered standard errors are provided in parentheses below the coefficient values. Significance levels are indicated by *, **, and *** denote significance levels at 5%, 1% and 0.1% levels, respectively.

	Innovation output			
	Count	Cites	Productivity	Influence
BoomerangCEO	0.076 (0.353)	-1.227*** (0.451)	-0.039 (0.864)	5.450 (4.411)
NewInternal	0.261 (0.422)	0.139 (0.509)	0.542 (1.034)	9.453* (4.979)
Founder	0.351** (0.139)	0.550*** (0.166)	-0.786** (0.340)	0.542 (1.622)
Overconfidence	0.044 (0.102)	-0.108 (0.122)	-0.089 (0.250)	-2.811** (1.193)
OptionComp	-0.004 (0.007)	-0.003 (0.008)	0.033* (0.017)	-0.038 (0.081)
$RD_{t-2,t}$	0.224** (0.100)	0.362*** (0.119)	0.419* (0.244)	2.262* (1.165)
MtoB	0.009* (0.005)	0.010 (0.006)	-0.013 (0.012)	0.038 (0.058)
LogAssets	0.431*** (0.043)	0.486*** (0.051)	-0.697*** (0.105)	0.985** (0.500)
$\Delta Earnings_t$	0.187* (0.102)	0.189 (0.122)	-0.394 (0.250)	2.050* (1.193)
$\Delta Earnings_{t-1}$	0.204** (0.100)	0.149 (0.120)	-0.423* (0.245)	0.010 (1.172)
Intercept	-1.975** (0.980)	-1.745 (1.171)	7.146*** (2.401)	-6.366 (11.446)
N	1,500	1,475	1,500	1,475
Adjusted R^2	0.744	0.683	0.468	0.810

* p<0.05 ** p<0.01 *** p<0.001

38.3% respectively. Founder CEOs are instead significantly negatively associated with productivity indicating that the election of a founder CEO generally lowers productivity by 3.06%. This suggests that new inside CEOs that are also founders of the company have the tendency to allocate resources less efficiently to research projects, yet they still manage to generate more, valuable, patents—as reflected by patent counts and citations. The positive influence measure also confirms this last point despite being insignificant.

The positive effect of a founder CEO on innovation is reasonable when considering that, because they developed the vision and structure of the company, founders have the highest level of firm-specific and industry-specific knowledge (Nelson, 2003) which make them capable of innovating more effectively and efficiently. Moreover, founder CEOs are believed to have a strong emotional or financial commitment to the company (Fahlenbrach et al., 2007). Therefore, as a result of such commitment, they are expected to enthusiastically devote energy and time to grow their company and to solve their company's problems, more than any other type of leader (Nelson, 2003), which can explain their positive effect on innovation despite the not-so-optimal resource allocation.

Further, Cumulative R&D expenditures show positive, significant results across all innovation variables. This shows that most investments tend to transform into widely recognized innovative output. Also, considering that $\mathrm{RD}_{j,t-2,t}$, is the log of the sum of the firm's R&D expenditures 2 years previous to the application for a patent, this suggests this time period to be the possible optimal timeframe to measure the results of R&D investments on patents as proposed by Lee et al. (2014).

Additionally, large firms with more assets (LogAssets) are significantly positively associated with more patents and patent citations yet are also significantly negatively associated with the productivity dimension. This indicates that bigger firms with a higher availability of money and that thus invest more in R&D, not always do so in the most efficient way. However, the possibility to invest in a variety of projects results in the generation of more patents which are deemed to be influential as expressed by the positive and significant measure of influence.

I also find significant evidence of the use of option compensation being positively associated with innovation productivity. This suggests that the interests of new inside CEOs are better aligned with shareholders and that they allocate resources wisely. This can provide, in smaller measure, new evidence of the impact of compensation structure on innovation strategies. However, the effect on influence is small, negative and not significant. Furthermore, our finding that current and lagged changes in profitability ($\Delta\mathrm{Earnings}_{j,t}$ and $\Delta\mathrm{Earnings}_{j,t-1}$) are positively associated with future innovation could be mechanical, to the degree that increased R&D expenditures and other expenses that increase future innovation would also increase current profitability.

Finally, it’s interesting to note that, Overconfidence is significantly negatively related to patent citations, productivity and influence. This could be in line with the idea of Overconfident CEOs being more likely to engage in higher levels of innovation output—i.e., produce more patents—because they are optimistic of their firms’ investment prospects (Hirshleifer et al., 2012). Specifically, a sign of what could be interpreted as such CEOs being overly optimistic is shown by the influence dimension. According to the results, overconfident CEOs produce patents that are significantly not influential, suggesting that their pursuit of ambitious projects generally fails at generating more revolutionary inventions possibly showing instead the tendency of Overconfident CEOs to overinvest. An Overconfident CEO in fact lowers productivity and influence by -0.35% and -10.95% respectively (Bereskin and Hsu, 2014).

5. Robustness Tests

5.1 Growth in innovation following the appointment of a new CEO

Unobserved industry or firm characteristics could be the reason undermining the significance of the results for innovation performance of boomerang CEOs. This constitutes an endogeneity concern that I address by examining growth in innovation performance following the appointment of a new CEO. This way, all persistent industry- and firm-level components will be removed. To do this, in line with what proposed by Bereskin and Hsu (2014), I redefine the dependent variables as follows:

$$\Delta Counts_{j,t} = Counts_{j,t} - Counts_{j,t-n} \tag{6}$$

$$\Delta Cites_{j,t} = Cites_{j,t} - Cites_{j,t-n} \tag{7}$$

$$\Delta Productivity_{j,t} = Productivity_{j,t} - Productivity_{j,t-n} \tag{8}$$

$$\Delta Influence_{j,t} = Influence_{j,t} - Influence_{j,t-n} \tag{9}$$

The reconstruction of the variables allows to go back in time and analyze the change in firm innovation brought by the new inside CEOs with respect to the innovation created by their predecessors. For this reason, due to the lack of data regarding predecessor CEOs, the sample used in this regression is smaller.

Table 3 shows that results are similar when examining growth in levels of innovation output (i.e., patent counts, patent citations, productivity and influence) as dependent variables in Equation (1). Specifically, the coefficients for boomerang CEO and founder CEO maintain now similar signs but have lost all levels of significance across all dimensions, while new inside CEOs now show significance also in the productivity dimension. This indicates that, despite the positive or negative results of the first regression, when controlling for incremental differences in innovation between CEOs of the same company, these appear not to be impactful.

The biggest differences are seen in the coefficients of the other explanatory variables of interest—$\mathrm{Overconfidence}$, $\mathrm{OptionComp\%}$, $\mathrm{RD}_{t-2,t}$ and MtoB. Looking at the measure for overconfidence, it appears now as if the optimism that characterizes overconfident CEOs can actually make a difference when considering increments in innovation productivity between previous CEOs and their successors. Overconfident CEOs still show inefficient allocation of R&D resources to patent projects; however, this seems to not affect patent quality, as the influential dimension of their patents is now positive and highly significant. This is in line with the literature suggesting that overconfidence helps CEOs exploit innovative growth opportunities and achieve greater innovative success (Hirshleifer et al., 2012). Next, $\mathrm{OptionComp\%}$, i.e., the percentage of the total compensation paid in stock options to the CEO, is now significant for influence, suggesting a possible negative relation between innovation and this form of executive compensation. Further, firms with more growth options—as estimated with the market-to-book ratio MtoB—are positively and significantly

Table 3: Robustness to unobserved firm characteristics

This table provides the results of an ordinary least square regression for the growth in quantity and quality of innovation. It examines the incremental difference between the innovation created by the new inside CEOs and the one of their predecessors to rule out potential endogeneity due to unobserved firm characteristics. All variables are defined as in Table 2. Industry-clustered standard errors are provided in parentheses below the coefficient values. Significance levels are indicated by *, **, and *** denote significance levels at 5%, 1% and 0.1% levels, respectively.

	Innovation output			
	ΔCounts	ΔCites	ΔProductivity	ΔInfluence
BoomerangCEO	-0.466 (0.566)	-0.772 (0.624)	0.076 (0.681)	-7.045 (5.688)
NewInternal	0.007 (0.059)	0.041 (0.065)	0.237*** (0.077)	1.259** (0.589)
Founder	-0.130 (0.209)	-0.239 (0.230)	0.134 (0.254)	-1.990 (2.100)
Overconfidence	0.098 (0.083)	0.139 (0.092)	-0.275*** (0.104)	3.723*** (0.836)
OptionComp	-0.010 (0.007)	-0.011 (0.007)	-0.004 (0.008)	-0.182*** (0.066)
$RD_{t-2,t}$	-0.080 (0.086)	-0.054 (0.095)	0.070 (0.111)	0.775 (0.867)
MtoB	-0.012** (0.005)	-0.010* (0.006)	0.019*** (0.006)	-0.002 (0.052)
LogAssets	0.231*** (0.039)	0.276*** (0.043)	0.080 (0.053)	0.442 (0.395)
$\Delta Earnings_t$	-0.030 (0.085)	-0.055 (0.094)	-0.008 (0.108)	-0.528 (0.858)
$\Delta Earnings_{t-1}$	0.029 (0.084)	0.002 (0.093)	0.013 (0.106)	-0.687 (0.844)
Intercept	-1.092** (0.445)	-1.099** (0.490)	0.023 (0.559)	-4.985 (4.471)
N	1,262	1,262	1,129	1,262
Adjusted R^2	0.312	0.300	0.258	0.073

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

associated with innovation productivity, confirming that innovation activities are concentrated in growth firms (Bereskin and Hsu, 2014). Lastly, all levels of significance regarding $RD_{t-2,t}$ have been lost; but this is mainly due to the construction of the variable.

Table 3 thus generally demonstrates additional robustness of the earlier results to persistent firm-level components, also strengthening the significance of coefficients previously devoid of it. However, it suggests that, when controlling for incremental differences in innovation between CEOs, the supposed differences in innovation impact lose significance, thus suggesting firm/industry characteristics to be the main drivers of innovation.

5.2 Industry Characteristics

Recognizing the possibility of more frequent CEO replacements in bad industry conditions, following Bereskin and Hsu (2014), I conduct a second robustness test controlling for each firm's industry median level of innovation in year t using the following industry-adjusted innovation measures:

$$Adj\_Counts_{j,t} = Counts_{j,t} - Median\left(\{Counts_{i,t}\}_{i=1,\ldots,J}\right) \tag{7}$$

$$\text{Adj\_Cites}_{j,t} = \text{Cites}_{j,t} - \text{Median}\left(\{\text{Cites}_{i,t}\}_{i=1,\ldots,J}\right) \tag{8}$$

$$\text{Adj\_Productivity}_{j,t} = \text{Productivity}_{j,t} - \text{Median}\left(\{\text{Productivity}_{i,t}\}_{i=1,\ldots,J}\right) \tag{9}$$

$$\text{Adj\_Influence}_{j,t} = \text{Influence}_{j,t} - \text{Median}\left(\{\text{Influence}_{i,t}\}_{i=1,\ldots,J}\right) \tag{10}$$

This approach controls for potential industry-year characteristics and reflects the relative innovation measures for each firm.

Once again, Table 4 shows that results are similar and comparable with the prior findings of Table 2 when examining the adjusted dimensions as dependent variables in Equation (1), suggesting that results hold even when controlling for the industry's time-varying level of innovation. The coefficients for boomerang CEO are of similar sign and insignificant except for patent counts, further attesting the rejection of H1, while the coefficients for founder CEOs are still highly significant, with the addition of innovation influence being now also significant. This confirms what stated before of founders having the tendency to allocate resources less efficiently, still managing to generate more, valuable, patents.

Table 4 thus still confirms, and strengthens, the earlier results of the first OLS regression with respect to industry-year characteristics.

6. Conclusion

This paper examines the influence of CEO succession on innovation performance in the special case of inside successions during the sample period 1992-2021. Specifically, the aim of the paper is to analyze the case of inside boomerang CEOs to study the impact that such a reappointment can have on firm innovation performance.

The regressions results suggest that boomerang CEOs tend to have a negative impact on the innovation performance of their company. However, empirical support is found only in the cases of patent counts and patent citations, deemed as being less accurate measures of innovation performance, thus leaving the topic open to further and deeper investigation. On the other side, I find strong empirical support for the notion that new inside founder CEOs increase a firm's innovation output. After controlling for both CEO replacement and industry conditions, I present evidence consistent with new inside founder CEOs being related to more, valuable patents as reflected by the positive coefficients for patent counts, citations and

Table 4: Robustness to industry-adjusted dependent variables

This table provides the results of an ordinary least squares regression for the quantity and quality of innovation, as in Table 2. The dependent variables are here adjusted for the median values of the industry to which each firm belongs. All variables are defined as above. Industry-clustered standard errors are provided in parentheses below the coefficient values. Significance levels are indicated by *, **, and *** denote significance levels at 5%, 1% and 0.1% levels, respectively.

	Innovation output			
	Adj_Counts	Adj_Cites	Adj_Productivity	Adj_Influence
BoomerangCEO	-1.176*** (0.415)	-0.153 (0.362)	0.295 (0.665)	2.327 (3.197)
NewInternal	0.008 (0.468)	0.238 (0.409)	-0.027 (0.751)	12.830*** (3.609)
Founder	0.832*** (0.152)	0.412*** (0.133)	-1.061*** (0.244)	2.522** (1.175)
Overconfidence	-0.149 (0.112)	-0.049 (0.098)	0.122 (0.180)	-1.207 (0.865)
OptionComp%	0.005 (0.008)	0.004 (0.007)	0.030** (0.012)	0.012 (0.059)
$RD_{t-2,t}$	0.334*** (0.109)	0.214** (0.096)	-0.100 (0.176)	2.479*** (0.844)
MtoB	0.004 (0.005)	0.003 (0.005)	-0.001 (0.009)	-0.013 (0.042)
LogAssets	0.380*** (0.047)	0.299*** (0.041)	-0.347*** (0.075)	0.576 (0.362)
$\Delta Earnings_t$	0.039 (0.112)	-0.021 (0.098)	-0.095 (0.180)	2.055** (0.865)
$\Delta Earnings_{t-1}$	-0.045 (0.110)	-0.045 (0.096)	-0.176 (0.177)	0.688 (0.849)
Intercept	-2.660** (1.076)	-2.820*** (0.940)	1.439 (1.725)	-12.971 (8.295)
N	1,475	1,475	1,475	1,475
Adjusted R^2	0.289	0.341	-0.019	-0.073

* p<0.05 ** p<0.01 *** p<0.001

influence. This further confirms the concept of founders being capable of innovating more effectively and efficiently thanks to their higher level of firm-specific and industry-specific knowledge (Nelson, 2003). Moreover, I find that relatively overconfident CEOs to be associated with lower levels of productivity and influence hinting at the tendency for these CEOs to overspend unjustifiably; the result on influence is however reversed when controlling for persistent industry- and firm-level components.

Finally, the results support the idea that bigger firms with a higher availability of money can, and do not only invest more in R&D, but the investments result in the generation of positive innovation.

My empirical investigation has a few interesting implications. First, CEO replacement seems to be an effective strategic mechanism for investors and management to boost firm's innovation. Second, I find that the replacement of a CEO with a founder of the company may dramatically increase the firm's pace of innovation.

One strong limitation of this study is the lack of carefully collected data coming from the NBER patent dataset and the WRDS patent database, which resulted in the drop of many observations. For this reason, further research could repeat the study by building a different database—which would also benefit the research community. Other elements which could be further analyzed are the different ways in which founder CEOs bring more innovation to the firm, or on the impact of different categories of new inside CEOs that have not been analyzed in this paper—e.g., the difference between the impact of new inside CEOs that were previously chairman of the board of directors and new inside CEOs that were not. The results would be of interest for decision makers when faced with the choice of electing a new CEO.

References

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. Journal of Management, 17(1), 99–120. https://doi.org/10.1177/014920639101700108

Bereskin, F., & Hsu, P.-H. (2014b, April 14). Bringing in Changes: The Effect of New CEOs on Innovation. Working Paper. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1684329

Bingham, C. B., Hendricks, B., Howell, T., & Kolev, K. D. (2019). Boomerang CEOs: What Happens When the CEO Comes Back? Academy of Management Proceedings, 2019(1), 10550. https://doi.org/10.5465/ambpp.2019.10550abstract

Erkens, M., Gan, Y., & Stolowy, H. (2014). Welcome back? Economic consequences of CEO reappointments. Working Paper. Available at: https://www.efmaefm.org/

Fahlenbrach, R., Minton, B. A., & Pan, C. H. (2007). The Market for Comeback CEOs. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.968670

Fahlenbrach, R. (2009). Founder-CEOs, Investment Decisions, and Stock Market Performance. Journal of Financial and Quantitative Analysis, 44(2), 439–466. https://doi.org/10.1017/s0022109009090139

Fahlenbrach, R., Minton, B. A., & Pan, C. H. (2011). Former CEO Directors: Lingering CEOs or Valuable Resources? Review of Financial Studies, 24(10), 3486–3518. https://doi.org/10.1093/rfs/hhr056

Farkas, C. M., & Wetlaufer, S. (1996, May 1). *The Ways Chief Executive Officers Lead*. Harvard Business Review. https://hbr.org/1996/05/the-ways-chief-executive-officers-lead

Lee, H., Baek, C., & Lee, J. (2014). Analysis on Time Lag Effect of Firm's R&D Investment. *Journal of Technology Innovation*, *22*(1), 1–22. https://doi.org/10.14383/SIME.2014.22.1.001

Hall, B., Jaffe, A., & Trajtenberg, M. (2001). *The NBER Patent Citations Data File: Lessons, Insights and Methodological Tools*. https://people.brandeis.edu/~ajaffe/Copy%20final%20of%20hall-jaffe-traj.pdf

Hall, B. H., Jaffe, A., & Trajtenberg, M. (2005). Market Value and Patent Citations. The RAND Journal of Economics, 36(1), 16–38. https://www.jstor.org/stable/1593752

Hambrick, D. C., & Mason, P. A. (1984). Upper Echelons: The Organization as a Reflection of Its Top Managers. Academy of Management Review, 9(2), 193–206. https://doi.org/10.5465/amr.1984.4277628

Helmich, D. L., & Brown, W. B. (1972). Successor Type and Organizational Change in the Corporate Enterprise. Administrative Science Quarterly, 17(3), 371. https://doi.org/10.2307/2392150

Hirshleifer, D., et al. (2012). “Are Overconfident CEOs Better Innovators?” *The Journal of Finance*, vol. 67, no. 4, 19 July 2012, pp. 1457–1498, 10.1111/j.1540-6261.2012.01753.x.

Nelson, T. (2003). The persistence of founder influence: management, ownership, and performance effects at initial public offering. Strategic Management Journal, 24(8), 707–724. https://doi.org/10.1002/smj.328

Wasserman, N. “Founder-CEO Succession and the Paradox of Entrepreneurial Success.” *Organization Science*, vol. 14, no. 2, 2003, pp. 149–172, www.jstor.org/stable/4135157#metadata_info_tab_contents. Accessed 17 Sept. 2022.

You, Y., Srinivasan, S., Pauwels, K., & Joshi, A. (2020). How CEO/CMO characteristics affect innovation and stock returns: findings and future directions. Journal of the Academy of Marketing Science, 48(4). https://doi.org/10.1007/s11747-020-00732-4

Appendix A: Variable Construction

BoomerangCEO	Dummy variable equal to 1 for firm-years for which a Boomerang CEO is elected and 0 otherwise. This information is retrieved from the ExecuComp database and manually double-checked through Bloomberg and, eventually, firms' filings.
Newinternal	Dummy variable equal to 1 for firm-years for which the elected CEO already had a role in the company prior to its election and 0 otherwise. The information is retrieved from the ExecuComp database.
Founder	Dummy variable equal to 1 for firm-years for which the CEO is also founder of the company and 0 otherwise. The information is retrieved from the ExecuComp database.
$\mathbf{Counts_{j,t}}$	$\text{Counts}_{j,t} = \ln\left(1 + \sum \text{Counts}_{j,t}\right)$ Logarithm of one plus the total number of approved patents of firm j filed in year t; this is done to remove skewness. is the total number of approved patents of firm j filed in year t.
$\mathbf{Cites_{j,t}}$	$\text{Cites}_{j,t} = \ln\left(1 + \sum \frac{\text{Cites}_{j,t}}{\text{Avg Cites}_{J,t}}\right)$ Logarithm of one plus the total adjusted number of citations received by all patents filed by firm j in year t. To eliminate any problem with systematic changes over time in a patent's propensity to be cited, the measure is adjusted by "re-scaling" by the average number of citations received by other patents in the same cohort following the fixed effects approach adopted by Hall et al. (2001).
Productivity	$\text{Productivity}_{j,t} = \frac{\ln\left(1 + \sum_{1=r}^{2} \text{RD}_{j,t-2,t}\right)}{\text{Counts}_{j,t}}$ Measures the efficiency with which firms transform R&D expenditures into patents by calculating the average number of R&D dollars spent per patent. The variable is built by taking the logarithm of one plus the cumulative R&D expenditure of the previous 2 years.
Influence	$\text{Influence}_{j,t} = \frac{\text{Cites}_{j,t}}{\left(\frac{\text{Counts}_{j,t}}{\text{Counts}_{J,t}}\right)}$ Measures how influential firm j's patents are on average measured by the number of total adjusted citations received by each firm's patents issued in year t scaled by the mean number of patents issued in year t by all firms in the same industry.
Overconfidence	Dummy variable equal to 1 for firm-years for which the CEO holds stock options that are in the money in year t and 0 otherwise. The information is retrieved from the ExecuComp database.
OptionComp%	Percentage of the total compensation paid in stock options to the CEO. The information is retrieved from the ExecuComp database.
$\mathbf{RD_{j,t-2,t}}$	$= \log\left(\sum_{1=r}^{2} \text{RD}_{j,t-2,t}\right)$ Log of the sum of the firm's R&D expenditures the previous 3 years. The information is retrieved from the CRSP/Compustat Merged database.

MtoB	$$= \frac{\text{Market Value}}{\text{Tot Assets} - \text{Tot Liabilities}}$$ Market value of firm j over the book value of firm j at end of year t. The information is retrieved from the CRSP/Compustat Merged database.
LogAssets	Log of the firm's total assets. The information is retrieved from the CRSP/Compustat Merged database.
$\mathbf{\Delta Earnings_t}$	$$= \left(\frac{\text{Income}_t}{\text{Sales}_{t-1}}\right) - \left(\frac{\text{Income}_{t-1}}{\text{Sales}_{t-2}}\right)$$ Difference in firm j's scaled earnings. The information is retrieved from the CRSP/Compustat Merged database where the variable revt is used as Income in the formula.
$\mathbf{\Delta Earnings_{t-1}}$	$$= \left(\frac{\text{Income}_{t-1}}{\text{Sales}_{t-2}}\right) - \left(\frac{\text{Income}_{t-2}}{\text{Sales}_{t-3}}\right)$$ Difference in firm j's lagged earnings. The information is retrieved from the CRSP/Compustat Merged database where the variable revt is used as Income in the formula.