The Impact of Leaders: A Global Study on the Value of CEOs*

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Abstract

This paper presents strong evidence that existing studies overestimate the impact of CEOs on the performance of the firms they lead. Ours is a comprehensive study of more than $3,692$ CEOs in $2,103$ firms in 22 countries, and for the period $1991-2019$. Our objective is to assess the direct impact of CEOs on firm results—measured as Total Shareholder Return and ROIC—after controlling for global, country, industry, and firm effects. Like the previous literature, we find that a CEO dummy explains 2 percent of the variability of stock returns, and 12 percent of the variability in firms' return on invested capital. However, we show that such relationship is driven by CEOs having an average impact that is economically unimportant, with some CEOs positively affecting performance, and some others destroying value. In fact, analyzing results for the best and worst performing firms, we find that CEOs only improve value in good companies, but destroy value in underperforming firms. Additionally, there is no firm or CEO characteristic (except for CEO tenure) that systematically explains their impact on performance: characteristics such as gender, age, and compensation do not make a difference. This suggest that firms hire top executives for reasons different from their inherent ability to contribute to performance, so CEOs end up doing well only if their firms do well, but not vice versa.

Keywords: corporate governance, firm value, leadership

JEL classification: F3, F4, G3, M1

I Introduction

In an increasingly competitive world, companies try to find new ways to grow and remain profitable. We attribute the success of companies, relative to similar firms in the same industry and country, to firm choices very often driven by leadership skills. Similarly, corporate failures are also considered leadership failures. That is why companies spend millions of dollars developing their leadership teams, making sure that they select the right individuals to manage the business, and paying high salaries to top executives to ensure that they attract the best talent possible. The dominant belief, both in the real world and academia, is that there is a significant relationship between CEOs and performance. We lack a comprehensive study that assesses the sign of such relationship, that is whether CEOs create or destroy value, and whether such impact depends on the global, legal, and institutional environment where they operate.

In the real world, good performance is associated to effective leadership. In a 2014 article in Forbes,[1] Monster Beverage was listed as one of America's best-managed companies, after assessing how much its current management (and in particular its CEO Rodney Sacks) had contributed. The Economist ("*How Netflix Became a Billion-dollar Titan*") attributed to its Chief Content Officer the right decisions that led to the company's dominance in the streaming industry.[2] Conversely, corporate underperformance and failure are usually the result of bad leadership practices. In April 2013, when Apple plunged below USD400 a share, a campaign with the headline "*Tim Cook Should Go*" ensued. Earlier, an article in TheStreet had claimed, "*If Steve Jobs Were Alive, He Would Fire Tim Cook.*"[3]

Accordingly, the academic literature has identified a positive relationship between leadership and performance. The standard empirical strategy is to identify a sample of firms (ideally over time) and CEOs, and to measure the impact of each individual CEO on specific metrics of value (Return on Assets, Tobin's Q, Return on Sales, etcetera). Two similar econometric methods are normally used: either ANOVA analyses where the R-squared in cross-sectional or panel regressions measures the marginal contribution of industry, firm, and leadership effects; or through variance decomposition studies which avoid the problem of a pre-specified linear model. Another approach to measuring the value of top executives is to qualify the CEO's personal leadership skills. These papers first identify a sample of companies and assess the quality of leadership, sometimes with objective measures, but mostly through surveys among employees to assess whether, for example, "*My leader fosters collaboration among work groups*," or, "*My supervisor insists on only the best performance.*" Afterwards, the researchers qualify and quantify the leaders' characteristics from the survey and relate these to measures of company performance.[4] By the most part, the evidence presented in the literature is that

[1] Liyan Chen. "America's Best-Managed Companies," Forbes, Dec. 29, 2014, https://www.forbes.com/sites/liyanchen/2014/12/10/americas-best-managed-companies/#f99a24712766.

[2] "How Netflix Became a Billion-dollar Titan," The Economist, July 4, 2018, https://www.economist.com/graphic-detail/2018/07/04/how-netflix-became-a-billion-dollar-titan.

[3] https://www.thestreet.com/story/11722893/1/if-steve-jobs-were-alive-he-would-fire-tim-cook.html.

[4] For example: Wiengarten et al. (2014). When analyzing the importance of leadership on firm value, traditionally the leadership literature has focused on assuming that a mediating variable is directly related to performance, and subsequently analyzes the impact of leadership characteristics on such mediating variable. Example of such mediating variables are organizational performance, motivation, risk-taking, culture, adoption of best practices, employee satisfaction, and speed of job completion. Measurement of the CEO impact on performance is not a straightforward task due to a variety

CEOs explain between 4 percent and 15 percent of firm performance. Because such valuation effects exceed by far their compensation, the conclusion is, therefore, that top executives create value.

There are three important problems with this strand of the literature. The first problem is that explaining variability does not imply positive impact. In fact, it is well possible that CEOs *destroy*–not create–value. There are noteworthy exceptions, of course. Bandiera et al. (2020) confirm that the more managers *lead*, the higher the company's accounting profitability and revenues. They also show that, whenever the job market for CEOs is deep enough, companies hire top executives who match their needs (for either a leader or a manager), so the CEO is more impactful when there is a match between their skill and the company. However, their result is also relative, so that leaders cause higher profitability and revenues than managers. Alas, the alternative interpretation of their results is that managers destroy more value than leaders.

The second problem is that the literature is focused on samples that include either US companies only, or firms from very few countries. Therefore, isolating global and country effects, and their interaction with leadership characteristics, is very difficult. In a sample of firms from a single country, the variability of the dependent variable is lower. Consequently, the relative explanatory power of firm and CEO characteristics is higher. Additionally, the survey-based literature suffers a severe variable-measurement problem, and the causality between CEO decisions and firm value is not well established. Bennedesen et al. (2020), for instance, study the impact of hospitalizations of Danish CEOs on performance, and show that a 10-day hopsital stay reduces firm opearting profitability by 5.8 percent from its mean. This result is in fact an indication a positive effect of having a CEO versus not having one, but it is focused on a single country.

This takes us to the third problem. The previous results, while confirming the value of top executives, are consistent with an alternative hypothesis: that the impact of top executives on value is purely random, or at most non-systematic. Fitza (2014, 2017) has shown that the typical methodological choices used in CEO effect studies lead to misattributing random variations in firm performance to the CEO effect. His arguments imply that the CEO effect is much smaller than what has been previously estimated and in fact nearly indistinguishable from chance. The literature that moves away from the ANOVA-type of analysis indeed finds that the impact of CEOs is almost negligible. Gabaix and Landier (2008) find that the dispersion of CEO talent distribution appeared to be extremely small at the top. They report that if one ranks CEOs by talent and replace the CEO number 250 by the number one CEO, the value of their firm will increase by only 0.016 percent. Tervio (2008) also finds that implied differences in managerial ability are small and make relatively little difference to shareholder value. In their study of management styles, Bertrand and Schoar (2003) find that the median impact of a CEO on the firm's return on assets is zero. Therefore, the *halo effect* (the tendency to attribute good performance to good leadership only ex-post, see Rosenzweig, 2014), or *the romance of leadership* (our tendency to overweight the causal role of leaders in influencing and changing our institutions and societies, see Meindl and Ehrlich, 1987) induces boards of directors to hire CEOs

of factors implying complex interdependency (Blettner et al., 2012). Firm performance is shown to be positively related to the number of hours CEOs work (Bandiera et al., 2015), career and educational achievements (Falato et al., 2015), general ability and execution skills (Kaplan et al., 2012), CEO humility (Ou et al., 2018), their cultural heritage (Nguyen et al., 2018) and CEO reputation (Milbourn, 2003; et al., 2015).

with previous, proven good track records, even if the causality between CEO skill and performance is spurious.

Our paper has three objectives:

The first objective is to measure the impact of CEOs on performance by quantifying their actual contribution to value, and not to variance of results. We do so by estimating a panel regression using a large dataset consisting of 3,692 CEOs operating 1in 2,103 firms. The diversity and number of observations allows us to identify distinctive effects depending on the level of development of the country, age of the firm, and CEO characteristics such as gender, for example. Subsequently, in many of our companies there are two or more CEOs, and 354 CEOs change companies during the sample period.

Our second objective is to reject the hypothesis that CEO effects are unsystematic. To do so, we estimate our panel regressions with firm- and CEO-random effects, as well as with an interaction effect between firms and CEOs. If CEOs do not affect performance and the only variability in firm performance is driven by firm characteristics (what Bandiera et al., 2020 call *horizontal differentiation hypothesis*), the interaction effect will absorb the entire impact of the CEO, and the CEO-random effect will turn insignificant. Such empirical strategy also allows to discriminate between a *vertical differentiation hypothesis*, where the performance of the firm is entirely determined by differences in CEO skill, and a *matching hypothesis* where companies recruit the CEO that can yield the best performance given the firm's specific characteristics.

Our final objective is to incorporate the impact of global, country, and industry effects into the analysis, so as to be able to quantify the CEO effect more accurately. The influence of global factors on corporate performance is least discussed in the literature, especially outside of financial circles. But they can make a big difference. The dismal performance of the corporate sector in the first months of 2020 is to a very large extent due to a global pandemic. Country effects are also important. Depending on the countries where they operate, global companies must be intuitively aware of political risks. Chinese trade policies severely impact profit margins of firms that manufacture (or purchase inputs) in China, and who wins national elections in the United States influences stock market cycles, oil prices, interest rates, and geopolitical imbalances, and thus affects corporations worldwide. Within countries, different policies and regulations, but also infrastructure investment and talent attraction, correlate with individual stock market returns. That is why we use a sample of firms from 22 countries (to identify, not only the different performance of CEOs by country, but also to control for country-specific variables), 17 industry groups, and for the period $1990 - 2019$ (controlling for country and industry effects, year-fixed effect capture the impact of global factors).

The paper proceeds in three stages. In the first stage we replicate the results in the previous literature. To that end, we perform ANOVA analyses by estimating panel regressions with Total Shareholder Returns (TSR) and Return On Invested Capital (ROIC) as endogenous variables, and controlling for year-, country-, and industry-fixed effects. We also estimate the impact of firm- and CEO-random effects. While our choice of countries and industries is exhaustive, the selection of firms and CEOs is not: we only consider publicly-traded firms, with CEO information available in the Bureau Van Dijk / Orbis database. Therefore random effects are more appropriate. We find that global and country factors explain 5 percent and 15 percent of the variance of ROIC and TSR, respectively, and that firm-random effects can explain 24 percent of the variance in ROIC, and 16 percent of the variance in TSR. Consistent with other authors, we find that the CEO-effect is responsible for 13 percent of the variance in ROIC, and 2 percent of the variance in stock returns. The R-squared for CEOs in developing economies is larger (16 percent vs. 13 percent) in ROIC regressions, but larger in developed than in developing economies (2 percent vs. 0 percent) in TSR regressions. It is also larger in small and medium–relative to large companies. We also show that the impact of CEOs has been declining over time.

We go beyond the individual ANOVA estimates and separate the firm- and CEO-effects into two components. Across firms, performance differences can be attributed to the relative performance of a particular company within its industry. For example, automobile companies have suffered a negative −23 percent cumulative return between September 2018 and July 2020, compared to an overall market performance of +115 percent. However, Tesla's performance during the same period is a staggering +524 percent, and Chinese electric car manufacturer Nio has yielded +149 percent.[5] Within the automotive industry, electric car manufactures perform much better, irrespective of their individual firm characteristics. That is why we interact the firm-random effect with the industry-fixed effect.

Similarly, CEOs performance in a particular company may be always good (or bad) irrespective of CEO skill. This may lead us to wrongly attribute positive impact to the CEO factor. Therefore, in order to test the individual impact of top executives, we interact the CEO- and firm-random effects. If the performance of CEOs is random and only depends on the companies they lead, the interaction should capture the entire magnitude of the CEO effect. Indeed, we uncover important differences depending on the country where the CEO operates. In developed economies, the largest part of the effect of the CEO on ROIC is due to the interaction term, while the entire impact of the CEO on TSR is concentrated in the pure-CEO effect, with the R-squared of the interaction being zero. We interpret these results as stock markets valuing changes in CEO even if their actual impact on performance is not necessarily CEO-specific. Consistent with this result, we find that, for CEOs who change companies during the sample period, their power to explain ROIC and TSR is largely driven by their interaction with the firm-random effect. The result in developing economies are different: CEOs have a significant impact on ROIC, but the R-squared of their impact on shareholder returns is zero.

The previous results, based on the traditional methodology of identifying the contribution of different factors to the regressions' R-square, confirms that part of the variance in firm results can be attributed to CEOs. In the second step of our econometric analysis we identify the sign of such relationship. To that end, we estimate the individual coefficient of each CEO/firm result relationship in panel regressions as the ones above. We then compute the mean and median coefficients by subgroups of firms and CEOs, computing statistical significance with both parametric and non-parametric methods. We test three hypothesis, following Bandiera et al. (2020). Under the *Horizontal Differentiation Hypothesis*, companies hire CEOs for reasons unrelated to their skill. Therefore, CEOs tend to perform well in well-performing companies, but poorly in underperforming companies. The reason is that performance is different across firms, but not across CEOs. In the other extreme, the *Vertical Differentiation Hypothesis* posits that CEOs are the only determinant of performance, thus good CEOs

[5] Data from Refinitiv/Datastream. The automobile industry and market performance refer to the return of the S&P500 Automobile index, and the S&P500 Composite index, respectively.

will increase the value of the firms where they operate, and bad CEOs will destroy value. Finally, the *Matching Hypothesis* considers that firms optimally choose their CEOs, and that CEOs–because of individual and firm characteristics–perform better in certain companies, and worse in others. To the extent that the labor market for top executives is efficient, a match between firm needs and CEO characteristics will result in optimal performance.

Despite the inferences drawn in our R-square analyses, we find that the mean coefficient in ROIC regressions is insignificantly different from zero (the median is significant at the one-percent level). By country, we find that CEOs on developed economies add 6.2 percent to ROIC (significant at the five-percent level) while CEOs on developing economies reduce ROIC by 18.9 percent (significant at the five-percent level). The impact of CEOs on ROIC is concentrated in small- and medium-size companies. Additionally, the contribution of the average CEO to the stock returns of their company is -0.2 percent per year (-0.1 percent in median). The differences between developing and developed economies are also striking: in developed countries, CEOs detract -0.2 percent to annual stock returns; in developing countries, their impact is not significant. These results are concentrated among the larger firms in the sample. Also, and in contrast with the R-squared results, the interaction terms are not significant in any of our analysis, providing support to the hypothesis that a CEO-firm interaction captures the *Fitza (2014, 2017) effect*, that is, the spurious correlation between CEOs and performance. Therefore, CEOs help explain the stock price performance of their company, but in the average case such impact is negative. These results are consistent with firm performance depending on global factors as well as country, industry, and firm characteristics, but not with CEO skills, that is, in line with the *Horizontal Differentiation Hypothesis.*

A good way to test how CEOs impact performance is to classify firms ex-ante into successful and unsuccessful, analyzing them the performance of their CEOs. Using the firm-random effects previously estimated, we create two groups of firms, corresponding to the firms in the top-five and bottom-five percentiles. The top firms are star firms because their ROIC and stock market performance is superior, with the bottom firms underperforming severely. Note that *Horizontal Differentiation* implies that CEOs are hired for non-performance related reasons, and that CEOs perform well in good firms, and perform poorly in low-performance companies. Conversely, if there is vertical differentiation among CEOs, CEO skill would help firms irrespective of their performance. In a cross-section of firms, both well- and bad-performing CEOs would be working for both well- and bad-performing companies. Finally, in a well-functioning labor market for top executives, firms find their optimal CEO and they increase performance, irrespective of whether the firm is a well-performing company is not. We find that the average CEO-random effect in star firms is highly positive and significant. In contrast, it is highly negative and significant in the bottom, underperforming firms. These results are important: clearly, firms do not hire the right CEO because in the worst-performing firms we do not find that CEOs create value. Additionally, only in good companies do CEOs have a positive impact. This is strong evidence in favor of *Horizontal Differentiation* whereby, independent of CEO characteristics, CEO perform well in good companies, and underperform in bad companies. The idea that CEOs can add value to high performing companies, but cannot do much to help low performing companies, is very close to the quote from Warren Buffett: "*When a management with a reputation for brilliance tackles a business with a reputation for bad economics, it is the reputation of the business that remains* *intact.*"[6] It seems as if Buffett had the intuition, and this paper finds supporting empirical evidence.

Finally, the third part of our analysis tries to uncover differences in CEO performance depending on firm and individual CEO characteristics. In general, and except for the impact of CEO tenure on performance, do not find any systematic determinant of the performance of CEOs. This suggests, once again, that firm performance is driven by firm characteristics and external conditions, but not by the skills of their top executive. We conclude that, using international evidence, our paper is not able to document that CEOs do create value. All our results are consistent to restricting the sample only to CEOs who change companies, and also to excluding US companies from the study.

Our paper is close to Bandiera et al (2020), who characterize CEOs as either leaders of managers through a CEO behavior index that assigns a value of 0 to managers, and a value of 1 to leaders. They measured the behavior of 1114 CEOs in six countries parsing granular CEO diary data through an unsupervised machine learning algorithm. Their study identified two types of CEO behaviors: 'managers' and 'leaders.' Managers focus on one-to-one meetings with core functions, while leaders focus on multi-function, high-level meetings with core functions. Importantly, Bandiera et al. (2020) conclude that corporate institutions with leaders are, on average, more productive than firms with managers, and this difference becomes apparent when CEOs are hired. They show, in a sample of more than 3,000 firms from 6 countries, that a one-standard deviation increase in the CEO behavior index is associated with an increase of 7 percent in sales, controlling for firm characteristics. Interestingly, they report that 17 percent of the variance in the index is driven by country and industry characteristics. Bandiera et al. (2020) are able to reject the null hypothesis that CEOs adjust their behaviors to the companies that hire them. They also confirm the hypothesis of vertical differentiation among firms, where some hire a leader and some hire a manager. Instead, they find evidence consistent with horizontal differentiation of CEOs with matching frictions–meaning that some firms end up hiring the wrong CEO because of a short supply of top executives, especially in some countries.

Similarly, Bertrand and Schoar (2003) constructed a manager-firm matched dataset that allowed them to track the same top managers cross different firms over time using Forbes 800 files from 1969 to 1999. They find that CEOs make a difference in results. However, the magnitude is not stellar: the authors calculate that individual CEOs only contribute to between 2 and 4 percent of total performance. In two related papers, Bennedsen et al (2007) and Bennedsen et al (2020) use the natural experiements of a sudden CEO death or his/her hospitalization respectively to measure the impact of CEOs on performance. Our paper contributes to this literature by measuring the CEO effect in an international context and therefore including a very important omitted variable ignored in previous studies.

The paper is organized as follows. In Section II we describe our dataset and sample construction process. Sections III and IV report the R-squared coefficients of our panel regressions, first without and then with interactions between industry, firm, and CEO effects. In Section V we compute and report the individual CEO coefficients and analyze the differences in CEO performance depending on the countries where they operate. Subsequently, in Section VI we analyze which firm and CEO characteristics determine whether CEOs create value or not. Section VII studies the impact of CEOs in top-performing firms, and also in underperforming companies. We provide some robustness tests

[6] Connors (2010), p. 143.

in Section VIII, and Section IX concludes.

II Sample Construction

A CEO Data

We start by collecting a sample of CEOs and companies from Bureau Van Dijk / Orbis database, which provides detailed information about both public and private companies. Our sample period spans the years 1990 to 2019, and for each top/senior executive, the database lists the name of the executive's position, their date of appointment, and the company's denomination and International Securities Identification (ISIN) number. This original sample includes 45,418 observations, but we remove those that do not record the date of appointment of the senior executive (29,367 observations). Van Dijk / Orbis identified the top executive with several denominations, some of them sometimes ambiguous. We restrict our sample to only those executive/company pairs where the top executive is explicitly characterized as "Chief Executive Officer", "Group Executive Officer", "Acting Chief Executive Officer", "President (Chief Executive Officer)", "CEO" and others which include the terms "Executive Officer". These account for 47 percent of the sample. Denominations such as "President", "Managing Director", and local denominations such as "Presidente" and "Geschaftsfuhrer" are disregarded because of their ambiguity. For each CEO in our sample, we know the date of their appointment, and the date they leave the job. We consider that those CEOs that do not have a departure date by the end of 2019 remain in the position by the end of the sample period. Some appointments date back to before 1990.

Orbis provides us with personal information regarding the CEO, and in particular their date and place of birth, country of nationality and residence, educational background, and compensation (both salary and bonus). These data are not available for all CEOs, as we will explain later.

In parallel, we collect from Datastream/Refinitiv the list of all Datastream codes and ISINs for their entire sample of countries and in the period 1990 to 2019. We use this sample to match Van Dijk / Orbis CEO data with company data. For each company and year, we then have information regarding the identity of the CEO. However ours is an unbalanced panel, because for some companies we have information about the standing CEO for certain subperiods only. In years where a firm experienced a CEO succession, the firm year was attributed to the CEO in office for the majority of the year.[7] Finally, we restrict the sample to CEOs for whom we know their appointment date. This has two implications for our study: our sample includes a company for the full sample period as long as we have information about at least the appointment of one CEO during that time. Consequently, in some firm-years in the sample there is no identifiable CEO. Additionally, we also eliminate from the sample firms for which there is only once CEO during the entire sample period and we do not know when the CEO was appointed–meaning that the CEO was appointed before 1990, but we do not know when. We decided to drop this observations because, after some analysis of the databse, in some cases Bureau Van Dijk / Orbis will not report a previously appointed CEO and will assume that the current one has been there since 1990.

[7] Our results are robust to excluding the transition years from the sample.

Datastream/Refinitiv only records publicly traded companies information. Additionally, and to allow identification of country- and firm-specific effects, we restrict the sample only to countries where we have at least five companies. We additionally eliminate those company codes (ISIN) that do not correspond to the primary listing of the company. For each observation, we also collect identifiers such as geographic description of the company and industry group. We also exclude financial companies. Table 1 reports descriptive statistics by country. In our final sample, we have 2,103 companies from 22 countries.

[Include Table 1 here]

Not surprisingly, most of our companies are from United States (1,000), Switzerland (129), Germany (127), and Netherlands (111). Being all publicly traded, some of the companies in our sample are small (less than one million USD in Total Assets), while some others are very large, including companies such as Kraft Foods and Monsanto (United States); Syngenta (Switzerland); Hyundai Corporation (South Korea). The largest company in our sample is Electricité De France (EDF, USD212 billion of average Total Assets throughout the sample period). The median company in our sample has USD185 million in Total Assets, and revenues of USD145 million. Table 1 also reports average Total Revenues, Return on Invested Capital, and Tobin's Q by country.[8] We provide more details about variable construction in the next sections.

[Include Table 2 here]

Table A describes the characteristics of the CEOs in our sample, by country. Out of 3,692 executives, we have information about 328 female CEOs. They represent 8.8 percent of the total. The largest percent of female CEOs in the sample is Finland (25 percent), and France (18 percent). In median, CEOs are 57 years old, they have 3 years of experience in the company, and a total compensation (salary and bonus of USD3.4 million). CEOs tend to be older (younger) in Spain and Japan (Poland, Marshall Islands, Sweden). Although the compensation data is sparse, salaries and bonus are higher in median in the United States (median total compensation of USD4 million) as well as Italy, Switzerland, and France. CEOs are paid the least in Poland (USD22,076) and Finland (USD 157,725).

In the next Section we explain how we construct our explanatory variables and other details about the dataset.

B Company Data

For each company/year combination, we obtain accounting and stock price information from Worldscope (accessible through Datastream/Refinitiv). Accounting data include operating income and other income statement items, as well as financial structure and other balance sheet items.

Our two endogenous variables are Return on Invested Capital (ROIC) and stock returns. ROIC is a standard metric of shareholder value creation based on accounting data and its variations (Return

[8] Tobin´s Q is computed as Total Assets (Worldscope item #WC02999) minus Total Shareholders Equity (Worldscope item #WC03995) plus Market Capitalization, all divided by Total Assets. Variable is expressed in US dollars.

on Capital Employed, Return on Net Assets) are used by many companies as forward-looking key performance indicator.

$$ROIC_{it} = \frac{NI_{it} + IE_{it} \times (1-t)}{E_{it} + D_{it}} \tag{1}$$

where NI is the company's net income (Worldscope item #WC01751), IE is the interest expense (Worldscope item #WC01251), t is the tax rate on debt (Worldscope item #WC08346), E represent Total Capital (total investment in the company, Worldscope item #WC03998). It is the sum of common equity, preferred stock, minority interest, long-term debt, non-equity reserves and deferred tax liability in untaxed reserves. Total Debt D includes short-term debt and the current portion of long-term debt (Worldscope item #WC03051). Note that, as the book value of equity E_{it} approaches its market value, $ROIC_{it}$ approaches the firm's cost of capital.

We compute stock returns as total shareholder returns (inclusive of dividends) as follows:

$$r_{it} = \frac{DY_{it} \times P_{it} + P_{it} - P_{it-1}}{P_{it-1}} \tag{2}$$

where DY represents the dividend yield, and P is stock price in US dollars.

Both variables are winsorised at the 5 *percent* level by country.

In Table 3 we report the number of observations by country and CEO group with available data, and for each of the dependent variables. The observations with ROIC data available are described in Panel A of Table 3. Our unbalanced panel consists of 27,928 company-CEO-year observation. Our final sample with ROIC data characterizes companies 2,148 CEOs in 1,218 companies. These companies operate in 17 industry groups and 22 countries. Out of all CEOs, 100 (or about 4.6 percent) change company during the sample period (fewer than in the overall sample). More than 91 percent of the sample comes from developing economies;[9] 22.5 percent of companies are small and medium enterprises.[10]

[Include Table 3 here]

To give an idea of the time dispersion of the companies and CEOs, we report the number of observations before and after 2010. While the sample period span the years 1990 to 2019, 91 percent of the CEOs and 84 percent of the companies are present in the sample after 2010.

Panel B of Table 2 displays the number of observations for which we have total shareholder return data available. In this case the number of observations increases to 45,429, corresponding to 3,692 CEOs in 2,103 companies and 22 countries. Also, 9.6 percent of CEOs change companies during the sample period. Other sample characteristics remain similar to the ROIC sample.

[9] A country is classified as developed or developing following the categorization by the United Nations.

[10] To classify firms by size, we collect, for each firm in the sample, the number of employers between 1990 and 2019. Based on the OECD definition, firms with fewer than 250 employees are classified as small and medium, and large otherwise.

III Decomposing the sources of value

A Econometric model

In order to compare the importance of global, country, industry, firm, and CEO effects on our metric of performance, we run regressions using fixed and random effects, in a panel data model. Our approach is similar to Wasserman et al. (2010), who identify the incremental explanatory power of individual CEOs in a sample of 531 companies—all U.S. firms—from 42 industries over a period of 19 years. They find that 14.9 percent out of the 49 percent variance in Return on Assets, and 13.5 out of the 67 percent variance in Tobin's Q, are due to CEO-specific characteristics. Moreover, the explanatory power of year-fixed effects on ROA and Tobin's Q is 2.6 percent and 5.2 percent respectively.

The study of Wasserman assumes away the importance of country factors, as all firms are based in the United States. Additionally, and because the impact of CEOs is measured through fixed effects, the study does not take into account the non-random nature of the sample. In this case, random effects are more appropriate. Finally, the main methodological issue in this and similar papers is that they measure incremental R^2 from adding independent variables to the regression sequentially (year, industry, company, and top executive, in this order). Unfortunately, in these type of models the incremental R^2 depends on the order in which the independent variables are added. Therefore, a variance decomposition model is more appropriate.

For each observation of company i in year t, with CEO s, we propose a mixed model with regressions of the following type:

$$y_{its} = \alpha + Y_t + C_j + I_g + \widetilde{\omega}_i + \widetilde{\eta}_s + \varepsilon_{its} \tag{3}$$

where α is the intercept, j denotes the firm's country of nationality, g is the firm's industry group. Therefore, Y_t, C_j and I_g are respectively year-, country-, and industry-fixed effects. Because firms and CEOs in the sample do not include the full universe, we need to estimate random, instead of fixed effects for firms and CEOs. Therefore, $\widetilde{\omega}_i$ and $\widetilde{\eta}_s$ are firm-, and CEO-random effects. Finally, ε_{its} is an error term.

The endogenous variables–as described in the previous sections–are shareholder returns and return on capital. Total shareholder returns are forward looking and therefore capture the valuation effect of CEOs since the time they are appointed. However, ROIC is based on accounting data which tracks past performance, and we assume that the impact of contemporaneous firm, industry, and global factors is captured with a one year lag. Therefore we estimate our regressions with r_{it} and $ROIC_{it+1}$ as dependent variables.

In our model, the coefficients of year-fixed effects represent global factors. Any systemic, time-variant effect on the dependent variable will be captured here. To avoid multicollinearity, we express all year-effects relative to the first year of the sample period, 1990. Similarly, country-fixed effects are all relative to the United States.

To estimate equation (3), we must therefore use a mixed model. Mixed models are used when both fixed and random effects are presented.[11] In general, let us consider the following model:

$$\begin{aligned} \mathbf{y_i} &= \mathbf{X_i}\boldsymbol{\beta} + \mathbf{Z_i}\mathbf{b_i} + \boldsymbol{\epsilon_i}, \\ \mathbf{b_i} &\sim \mathcal{N}(\mathbf{0}, \boldsymbol{\Psi}), \quad \boldsymbol{\epsilon_i} \sim \mathcal{N}(\mathbf{0}, \sigma^2\mathbf{I}). \end{aligned} \tag{4}$$

where $\mathbf{y_i}$ is the vector of observed values for the i^{th} observation, $\mathbf{X_i}$ and $\mathbf{Z_i}$ refer to the design matrix of fixed and random effects respectively, $\boldsymbol{\beta}$ and $\mathbf{b_i}$ present the fixed and random effects effects respectively. Since the error term ($\boldsymbol{\epsilon_i}$) and the random effects are meant to be iid parameters, the total variation of the model is:

$$\begin{aligned} Var(\mathbf{y_i}) &= Var(\mathbf{X_i}\boldsymbol{\beta} + \mathbf{Z_i}\mathbf{b_i} + \boldsymbol{\epsilon_i}) \\ &= Var(\mathbf{X_i}\boldsymbol{\beta}) + Var(\mathbf{Z_i}\mathbf{b_i}) + Var(\boldsymbol{\epsilon_i}) \end{aligned} \tag{5}$$

where $Var(\mathbf{Z_i}\mathbf{b_i})$ is simply the sum of the variation of each random effect in the model as they are also considered independent from each other. In mixed models marginal R^2 is defined as the ratio of the variation of fixed effects over total variation in model,

$$R^2_{marginal} = \frac{\sigma_f^2}{\sigma_f^2 + \Sigma_{l=1}^{u}\sigma_l^2 + \sigma_\epsilon^2}, \tag{6}$$

where the term $\Sigma_{l=1}^{u}\sigma_l^2$ refers to the random variance (partitioned by level l) and σ_f present the variation of the fixed effects in the model. The conditional R^2 is sum of the random and fixed effects variation over the total variation in the model, given by

$$R^2_{conditional} = \frac{\sigma_f^2 + \Sigma_{l=1}^{u}\sigma_l^2}{\sigma_f^2 + \Sigma_{l=1}^{u}\sigma_l^2 + \sigma_\epsilon^2}. \tag{7}$$

Decomposing the variation of the fixed effects in the model is not that much straightforward since the parameters are not independent. Let us consider three different fixed effects in the model presented by f_1 (year), f_2 (country) and f_3 (industry). Therefore:

$$\begin{aligned} \sigma_f^2 &= Var(f_1 + f_2 + f_3) \\ &= Cov(f_1 + f_2 + f_3, f_1 + f_2 + f_3) \\ &= \underbrace{Var(f_1) + Cov(f_1, f_2) + Cov(f_1, f_3)}_{F_1} \\ &+ \underbrace{Var(f_2) + Cov(f_1, f_2) + Cov(f_2, f_3)}_{F_2} \\ &+ \underbrace{Var(f_3) + Cov(f_1, f_3) + Cov(f_2, f_2)}_{F_3}. \end{aligned} \tag{8}$$

[11] Anova models deal with the average of individuals through different factors and do not consider the variability in data. Mixed models consider this variability in their model, and their advantage becomes more important when the number of observations are not equivalent for each subject. The performance of the Anova model is also not as strong as mixed models over the longitudinal or clustered data. In our case, an analysis including a nested random effect that groups CEOs into companies, in addition to a random effect for the individual CEOs, allows us to account for not only random variation across different CEOs, but also potential random variation arising from the way CEOs are placed in the companies. The outperformance of mixed model in dealing with missing data and outliers is also another reason for which we decided to use this model.

Here we consider F_1, F_2 and F_3 as the variation of f_1, f_2 and f_3, respectively. Therefore, for each fixed effect, the reported R-squared computed as in (6) takes into account the potential correlations with the other two. In that sense, we are providing results corresponding to our fixed effects that are analogous to a simultaneous ANOVA estimation, as in Crossland and Hambrick (2007) and Mackey (2008).

B Results

The estimation results are in Table 4. Panel A presents the R-squared coefficients when $ROIC_{t+1}$ is the endogenous variable, and Panel B uses total shareholder returns r_{it}. The mixed model is able to explain 46 percent of the variance of ROIC, and 34 percent of the return variance. Most of the variation in both cases comes from the random effects (firm and CEO).

With regards to ROIC variance, firm-random effects are the most important, explaining 24 percent. This finding hides however sizeable differences across subsamples. It is interestingly larger in developed than in developing countries (25 percent vs. 20 percent), and for larger relative to smaller firms (22 percent vs. 11 percent). The impact of firm-specific factors increases over time from the first to the second subperiod in the sample. The firm effect is large, and of the same magnitude, among CEOs who change companies (25 percent).

[Include Table 4 here]

Global effects tend to be small, ranging between 1 percent and 5 percent in some subsamples. The impact of country characteristics is larger, especially in developing economies and in larger companies, and in companies with high Tobin's Q ratio. This is consistent with stable firms in developing markets to be more exposed to regulatory and country-specific risks. Finally, industry characteristics are more important in developed economies (R-squared of 5 percent) than in developing economies (3 percent), and have a larger impact among large enterprises (3 percent) than among small and medium firms (2 percent).

Total Return regressions (Panel B) show in contrast that global and country effects explain up to 15 percent of the variance of this variable. This is more than the impact of industry (1 percent). The importance of global effects is much larger in developing economies, where they explain 30 percent of the variance in returns. However, country effects lack any explanatory power in these countries. Global effects are also larger among large companies, relative to small and medium. This is intuitive given that larger firms tend to be also more internationally exposed. It is very interesting to highlight the higher importance of global and country factors in the first subperiod of the sample (before 2010) relative to the later subperiod. As a confirmation of the process of deglobalization in the world economy, we find that country and global factors explain 12 percent of the variance in stock returns before 2010, but only 71 percent after 2010. These results are similar when ROIC is the dependent variable. Once firm and CEO impact are taking into account, industry-fixed effects have same explanatory power as in the ROIC regressions, and it is about 1 percent in magnitude for all subgroups of firms.

Firm-random effects are responsible for 16 percent of the variance in stock returns. The difference between developed and developing countries is striking, for in developed countries the regression R-squared is 17 percent, vs. 2 percent in developing economies. Firm-effects are more important in large firms, after year 2010, and among higher-Tobin's Q firms.

With respect to CEOs, they explain 3 percent of the variance of ROIC in the overall sample. However, R-squared is of magnitude in developing countries (7 percent), and large companies (10 percent), and it is larger in the first part of the sample (18 percent vs 10 percent). It is worth noting that CEOs do not explain any of the variance of ROICs in small and medium enterprises, and especially in developed economies. By Tobin's Q, the explanatory power of CEOs on ROIC is higher among companies in the lowest quartiles.

When we use Total Shareholder Returns as the dependent variable, we show an explanatory power of 2 percent for CEOs. Consistent with the previous results, CEOs are more important in developed economies–relative to developing countries–and in small companies–relative to large companies). At most, CEOs explain 4 percent of stock return variance in small and medium enterprises in developed countries. The impact of the top executive is also larger for companies with higher Tobin's Qs. After 2010, CEOs have no impact on stock price performance.

In both panels of Table 3 we displays results for the subsample of companies with CEO changes during the sample period. These observations are important because the identification of the CEO effect is easier. Indeed, the variance of ROIC and TSR explained by CEOs among the subsample of CEOs who change firms is 12 percent and 8 percent, respectively. Even these figures are much more modest than the ones reported by Wasserman et al. (2010).

Our preliminary results can be summarized as follows. The CEO factor is significant at explaining firm value, and such impact is in addition to firm and industry characteristics. CEOs explain 2 percent of the variance in a firm's stock market performance, and 13 percent of the accounting performance. We also quantify the importance of global and country factors (especially for stock returns), which are as sizable as the CEO effect itself. Finally, firm characteristics independent of leadership decisions are most important at explaining firm outcomes.

In the next Section we try to shed some light on the interaction between firm characteristics and CEO impact in performance.

IV Does the Value of the CEO Reflect Firm Characteristics?

A Econometric Analysis

Bandiera et al. (2020) recognize that an explanation for the relationship between top executive behavior and performance is that such behavior can be explained by firm characteristics. The authors rule out this hypothesis in three ways. First they show that, after controlling for firm characteristics such as size and public status, their leadership-style index is still significant at explaining firm sales. They also confirm, using accounting data prior to the CEO's appointment, that productivity trends before cannot predict the type of CEO that gets hired.

Finally, they also formulate a simple assignment theoretical model with vertical (across firms) and horizontal (across CEOs) differentiation, and matching of firms and CEOs depending on firm and CEO styles. Their prediction is that, when there is a shortage of CEOs of a particular type (in their case, leaders), then the scarce type is correctly assigned. Therefore the productivity (revenues) of firms run by the abundant type (managers) is lower. If there is horizontal differentiation, then among managers productivity should be the result of two distributions: one driven by the performance of manager–CEOs who are hired by companies who need a manager, and then perform accordingly to the company's needs; and another one driven by managers who end up in companies in need for a leader, and which therefore perform worse. Their non-parametric estimation of the density functions for both type of CEOs confirms the dual distribution for managers, and is thus consistent with horizontal differentiation. The model is also estimated parametrically, and they conclude that there is a significant valuation impact of a mismatch between CEOs and firms, suggesting that some CEO types ("leaders") have a positive impact on performance.

The results in Bandiera et al. (2020) are thoroughly obtained, yet the process is cumbersome. First and foremost, their sample is a cross-section of companies and they are therefore unable to track the performance of the previous CEO, as well as the reason for the turnover–which could be voluntary due to retirement for instance. More importantly, their model calibration shows that, when m-type CEOs (managers) are assigned to l-type firms (firms which perform better with an l-type CEO than with an m-type CEO), there is no significant difference in productivity with an l-type CEO correctly assigned to an l-type firm.[12] So while their results are consistent with vertical differentiation of CEOs, they are also consistent with CEOs of random skill whose performance is high whenever they work for high-productivity firms.

In this Section we try to disentangle the two hypothesis with our panel of firms and CEOs. To do so, we estimate regressions of the form:

$$y_{its} = \alpha + Y_t + C_j + I_g + \widetilde{\omega}_i + \widetilde{\eta}_s + I_g : \widetilde{\omega}_i + \widetilde{\omega}_i : \widetilde{\eta}_s + \varepsilon_{its} \tag{9}$$

where α is the intercept, j denotes the firm's country of nationality, g is the firm's industry group and the symbol : denotes interaction. Therefore, Y_t, C_j and I_g are respectively year-, country-, and industry-fixed effects. Because firms and CEOs in the sample do not include the full universe, we need to estimate random, instead of fixed effects for firms and CEOs. Therefore, $\widetilde{\omega}_i$ and $\widetilde{\eta}_s$ are firm-, and CEO-random effects. With respect to (3), we estimate two additional interactions modelled as random effects. The first interaction (between industries and firms, $I_g : \widetilde{\omega}_i$) takes to capture the within-industry variability in firm performance. To see this, suppose that we consider the Pharmaceutical industry. In certain times (for example around a global health crisis) pharmaceutical companies outperform the market. The fixed effect I_g would then measure the abnormal performance for that particular industry. However, within the pharmaceutical industry, a particular group of firms (for instance those specialized in vaccines) would outperform other firms in the industry. The interaction firm-industry, therefore, measures the firm-specific performance that is driven by the firm's belonging to a particular subclass of outperforming firms within the industry.

The second interaction ($\widetilde{\omega}_i : \widetilde{\eta}_s$) measures the matching between firms and CEOs. Suppose a first scenario ("Horizontal Differentiation") with two firms and two CEOs. One of the firms is a *good* firm, and generates a high return; the second firm is a *bad* firm, and generates a much lower return ceteris

[12] Formally, they cannot rule the hypothesis that their parameter A is significantly different from zero.

paribus. Let us further suppose that the skill of CEOs does not affect firm performance, and their allocation to either the good or the bad firm is driven by non-performance related characteristics (such as affiliation with the board and nationality). Note that, in this situation, whenever one CEO is hired by the *good* company, on average they will generate a better performance than in the *bad* firm. In a random-effects panel regression as in (9), the firm effect $\widetilde{\omega}_i$ would be significant, and the CEO effect $\widetilde{\eta}_s$ would be insignificant. However, the interaction $\widetilde{\omega}_i : \widetilde{\eta}_s$ would turn significant as well because in two of the possible interactions returns would be high, and in the other two possible interactions, returns would be low.

The interaction term captures the possibility of perfect matching between CEOs and companies. Suppose a second scenario with two firms (good and bad) whose performance depends additionally on who runs the firm ("Matching Firm-CEO") . There are two CEOs with a particular skill, but such that, for the first CEO, such skill only helps the first firm, and damages the other; the reverse is true for the second CEO. This reflects a situation similar to Bandiera et al. (2020) with both vertical and horizontal differentiation. In this case, the firm effect $\widetilde{\omega}_i$ would be significant. However, unlike the previous case, both the CEO effect $\widetilde{\eta}_s$ and the interaction $\widetilde{\omega}_i : \widetilde{\eta}_s$ would be significant as well.

Finally, let us assume that firm performance is driven by other characteristics in addition to the identity of its top executive. However, there are two types of CEOs, *good* and *bad* ("Vertical Differentiation") who can impact firm performance. *Good* CEOs always improve performance; *bad* CEOs never do. Obviously, the mixed model would help identify such situation since, in this case, the firm effect $\widetilde{\omega}_i$ would still be significant because some companies would perform better than others. Additionally, and while the CEO effect $\widetilde{\eta}_s$ would be significant, the interaction $\widetilde{\omega}_i : \widetilde{\eta}_s$ would not. These testable hypotheses are summarized in Table B below.

	Firm Effect	CEO Effect	Interaction Effect
Horizontal Differentiation	Significant	Insignificant	Significant
Matching Firm-CEO	Significant	Significant	Significant
Vertical Differentiation	Significant	Significant	Insignificant

Table B. Testable Hypotheses

We show our results in the next Section.

B Results

Results of the mixed model estimation with interactions is presented in Table 5. As usual, Panel A presents results for ROIC, and Panel B presents results for Total Shareholder Return. The difference with Table 4 is on the interaction terms only.

[Include Table 5 here]

Panel A shows that, with respect to the results in Table 3, the explanatory power of CEOs is consistent with the *Matching Firm-CEO* hypothesis except for two subsamples: developing countries, where the 16 percent explanatory power of CEOs is fully captured by the interaction term; and in small and medium companies, where 19 percent R-squared comes also from the interaction. In these subgroups of firms, our results are consistent with horizontal differentiation and therefore with CEOs performing well in good companies, irrespective of their individual skill.

The variance decomposition of Total Shareholder Returns is however consistent with *Vertical Differentiation* and therefore with a CEO-specific skill, in the full sample as well as in most subsamples. Only among small and medium firms we do find that the explanatory power of CEOs is due to the interaction, and it is therefore consistent with *Horizontal Differentiation.* Such effect is concentrated among small and medium firms in developed economies.

For the particular case of CEOs who change companies during the sample period, the results are consistent with matching firms and CEO qualities: half of the explanatory power of the CEO random effect is due to the interaction with the firm effect (4 percent out of the 8 percent identified in Table 4). If firms hire CEOs efficiently, it is reasonable that we find a better matching among firms whose CEO changes.

Overall, our results can be summarized as follows. CEOs matter and they have a significant impact on the variance of both ROIC and stock returns. When looking at accounting performance, there is evidence of good companies hiring well-performing CEOs. When we analyze the impact of top executives on shareholder returns, the evidence is that there are good CEOs who have a significant impact on the performance of their companies, irrespective of the quality of the firm itself.

Why are results for ROIC and TSR different? We attribute such differences to three factors. First of all, ROIC is an accounting figure and thereby backward looking, possibly taking into account decisions made by previous CEOs and with already outdated strategies—even if we consider $ROIC_{t+1}$ as endogenous variable. In contrast, stock prices are forward looking and measure expectations of performance. In fact, the correlation between ROIC and shareholders' returns tends to be small (Jacobson, 1987). Second, shareholder returns price risk, while ROIC does not take into account the risk of the assets. Risk is an important aspect of performance that CEOs impact (Bernile et al., 2017, Cain and McKeon, 2016). Finally, the magnitude of the R-squared coefficients that we report in this section are greatly determined by the variance in the left-hand-side variable.

Therefore, in the next section we analyze the magnitude of the fixed and random effects, rather than their explanatory power. This will also allow us to measure the sign of such relationship.

V Do CEOs Create or Destroy Value?

The ANOVA approach based on identifying the marginal R-squared of factors poses two main problems. The first issue is that R-squared is positively related to the variance of the right-hand side variable. This could explain the difference in results depending on the endogenous variable. It is also a reason why the firm-random effect is larger than the industry-fixed effect–we have data from more than $2,000$ companies, but only from 17 industries.

The second problem is that the explanatory power captured by the R-squared does not reflect either the magnitude or the sign of the relationship, and only the relative contribution of each factor to the variance of the dependent variable. In that sense, for instance, CEOs could create, but also destroy value, and both be associated to a large and positive R-squared.

In this Section we try to address these issues, exploiting the richness of our dataset. We perform three experiments: first we estimate average effects per factor. Then we plot kernel densities. Finally we compute bootstrap significance levels.

A The magnitude of the CEO Impact

In this Section, we report mean and median coefficients for global, country, industry, firm, and CEO effects, as well as their interactions, based on estimates from the regressions in (9). Our objective is to measure the impact on performance of these factors and to find consistent patterns across subsamples of firms and CEOs.

In order to assess the significance of such coefficients, we estimate significance levels for average coefficients from a standard t-test, and a Wilcoxon-sum test for median coefficients. Additionally, and to test for differences between coefficients, we have computed significance levels based on bootstrapping estimates. More details about the bootstrap estimates are provided in Appendix A. These significance levels are reported in Tables A and B in the Appendix.

The point coefficients estimated in (9) can be interpreted as the marginal effect of each factor. In the case of country, industry, and firm, the estimates for each observation are relative to the impact of a randomly chosen US firm in the healthcare industry. In the case of the CEO-random effect, it measures the marginal impact of the CEO relative to the period before they joined the company. Besides, the magnitude of the coefficient can be interpreted in percentage points.

Results corresponding to ROIC are in Table 6; results corresponding to TSR are in Table 7. In both Tables, Panel A reports means and Panel B reports medians. We present the firm and CEO coefficients in total, as well as excluding the interaction with industry and firm effects, respectively.

[Include Table 6 here]

[Include Table 7 here]

The previous section has shown that the CEO factor explain 12 percent of the variance in firm´s ROIC, and it contributes to explaining about 2 percent of the variance in stock returns. Tables 6 and 7 display the mean and median CEO coefficients and the results are complementary: in ROIC regressions they are not significantly different from zero on average, and amount to $+3.34$ percent in median (significant at the one-percent level, see Table 6); in TSR regressions, the mean coefficient is negative (-0.2 percent, significant at the one-percent level, see Table 7), as well as the median (-0.16% percent, significant at the one-percent level, see Table 6). Note as well that, because the CEO/Firm interaction coefficients are not significantly different from zero (the difference between the "CEO" and "Overall CEO" effects is zero), any impact of the CEO variable is driven by vertical differentiation, that is by CEOs of skill increasing the performance of the firms that hire them, as discussed in Section IV.B.

When we split the sample by firm size, we find that the significant impact of CEOs on ROIC is concentrated among small and medium companies (average coefficient of 0.287, significant at the 1 percent level, median coefficient of 0.253,significant at the 1 percent level). For large firms, coefficients are negative and insignificant, both in mean and medians. The difference in coefficients between large and small/medium companies is also significant at the one-percent level. This result is consistent with the results by size when TSR is the explanatory variable: the negative impact of CEOs on performance is concentrated among large firms (average coefficient of -0.0028, significant at the one-percent level; median coefficient of -0.0021, also significant at the one percent level), with differences between large firms and the rest being significant at the one-percent level as well. Therefore, the impact of CEOs on the accounting performance of their firms is positive, and the impact of CEOs on stock price returns is negative. Such impacts are declining in firm size, so the positive impact on ROIC is concentrated among small and medium firms, and the negative impact on TSR is concentrated on large companies.

The subsample of observations coming from developing countries (which represents less than 10 percent of the overall sample) yields results that are different from the overall sample. CEOs in developing countries generate a negative impact on ROIC (average coefficient of -0.1889, significant at the five-percent level; median coefficient of -0.3444, significant at the one-percent level), and such effect is significantly different from the impact on ROIC in developed economies. The CEO effect on TSR is however not significant.

Most of the significance in the coefficients above is concentrated in the pure CEO effect, not in the interaction with the firm-random effect. Our interpretation is that these results provide consistent evidence that CEOs possess individual skills that are not necessarily related to the firms they lead–in other words, we find evidence of vertical differentiation among CEOs which is independent of horizontal differentiation among firms). However, such skill is sometimes detrimental to performance, especially when we use shareholder returns as a measure.

With regards to the coefficients of the country and industry factors, note that they are estimated in reference to a particular country (USA) and industry (Healthcare), therefore they are more difficult to interpret in the cross-section. Global effects are not significant overall, and the coefficients for pre- and post-2010 observations show that, controlling for everything else, ROIC has decreased throughout the sample period.

Overall, we complement our results in the previous Section by showing that (1) the impact of CEOs on accounting performance is not significant in the full sample, and driven by a few extreme CEOs with impact in ROIC (as shown by the significance of the median coefficient). Additionally, (2) both the average and the median CEO have a negative impact on shareholders' returns.

In the next section we provide graphical evidence on the shape of the distribution of coefficients by performing a kernel density estimation.

B Kernel Densities

In order to provide a visual evidence of the determinants of firm value, we have performed a kernel estimation of the density function of the regression coefficients, that fits the distribution of ROIC and total shareholders returns. [13] We estimate the kernel functions for all of our fixed- and random-

[13] The general form of the kernel density estimator is:

$$\widehat{f}_\lambda(x) = \frac{1}{n_\lambda} \sum_{i=1}^{n} N\left(\frac{x - x_i}{\lambda}\right) \tag{10}$$

effects, as well as for the interactions CEO-firm, and firm-industry. Results are displayed in Figure 1. The two graphs correspond to the kernel densities in the ROIC and Total Return regressions.

[Include Figure 1 here]

To facilitate the interpretation of the graphs, we also display boxplots of the effects, where the bands highlight the first and third quartile, and the median effect within. The Figure helps explain the results in the previous sections. The variance of the CEO-random effect coefficients, as well as its interaction with the firm-random effect have a large standard deviation are centered around zero. This explains why the R-squared in the panel regressions is large, despite us being able to reject that the average coefficient is zero. However, the variance of CEO-random effect coefficients is much smaller, thus its explanatory power is small. However the average coefficient is significantly negative. Likewise for the CEO-firm interaction. The presence of outliers in both cases explain the differences between mean and median coefficients.

For the entire sample, in the ROIC regressions only the industry- and country-fixed effects are clearly positive. These distributions are also negatively skewed, which suggest that their positive impact is affected by a few negative extreme values. The firm-fixed effect is negative, as well as the interaction between company and industry. In the Total Return regressions results are very similar in that only industry and country effects are large.

C Discussion

We have found so far that analyses of CEO impact based on the explanatory power of CEO-dummies on performance measures are misleading because they depend on the variability of the value impact across CEOs. In fact, we have found that the average impact of CEOs on firms' ROIC is not significantly different from zero. At the same time, the variability in CEO skill is related to the variability in ROIC because some CEOs have a positive impact, and some CEOs a negative one. For stock returns, the variability in CEO impacts is low, and it is negative on average. Being our previous results consistent with some CEOs destroying value, the question is—why do companies hire such senior executives. One explanation is that CEO skill is measured by the performance of the companies they run, even if both are not related. Specifically, CEOs' reputation is built over time through their track record, and the quality of a CEO is therefore associated to the performance of the companies they lead. The track record of CEOs determines how the market establishes their quality. Hamori and Koyuncu (2013) have shown that increasingly, companies recruit CEOs with a proven track record.[14] In Hermalin and

where $N(\cdot)$ is the kernel function, that we specify to be standard normal, λ is the bandwidth parameter, n is the sample size, and x_i is the ith observation. The kernel density minimizes the mean integrated sqared error η_λ:

$$\eta_\lambda = \int_x \left\{ E(\left(\hat{f}_\lambda(x) - f(x)\right)^2 \right\} dx + \int_x Var\left(\hat{f}_\lambda(x)\right) dx \qquad (11)$$

where λ is the one that minimizes the eestimated mean-integrated square error:

$$\widehat{\eta}_\lambda = \frac{1}{4}\lambda^4 \left(\int_t t^2 N(t)dt\right)^2 \int_x \left(f''(x)\right)^2 dx + \frac{1}{n\lambda}\int_t (N(t))^2\, dt \qquad (12)$$

[14]See also Kaplan et al (2012).

Weisbach (2003), a firm's performance arguably provides a signal of the CEO's ability to manage the firm.

Therefore, when the impact of leadership is overstated (Meindl et al., 1985, Meindl and Ehrlich, 1987), companies hire CEOs with good track records (Khurana, 2002). Very often this is the result of investor myopia. Gao et al. (2017) provide evidence consistent with this hypothesis. Stein (1988 and 1989) describes a theory of myopia and an explanation for why public firm investors might be myopic (i.e., put more weight on current versus future earnings when valuing a firm compared with private-firm investors). Hamori and Koyuncu (2013) refer to a study by Booz & Co., who analyze CEO succession practices at the world's biggest public companies. The report shows that almost 20 percent of both incoming and departing CEOs at such companies in 2008 had had CEO experience at another corporation, almost twice the average percentage for the 11 years studied. It seems that companies tend to hire CEOs with prior experience because they are increasingly unwilling to take the risk of hiring executives with no previous job-specific experience. Indeed, Hamori and Koyuncu (2013) find that CEOs with experience actually perform worse than those without experience.

After bad performance, companies replace the existing CEO with one with a positive track record–that is, one coming from a good-performing firm. That CEO turnover follows negative performance has been extensively shown in the literature: see Weisbach (1988); Kaplan and Minton (1994); Parrino (1997); Huson et al. (2001); Engel et al. (2003), Lel and Miller (2008). Indeed, the firing decision after underperformance may not even be related to the CEO skill, as Jenter and Kanaan (2015) have shown. Upon replacement, the new CEO will not necessarily improve the company's performance. However, if the underperformance of the company was driven by firm-, industry- or country-conditions that do not change with executive turnover, the new CEO is more likely to underperform as well. Suppose on the contrary a firm that outperforms the market, and the CEO is not replaced. Even if the CEOs impact is insignificant, their track record will allow them to stay in the job–and again, the company will be more likely to display positive performance. Interestingly, Crossland and Chen (2013) show that the firm performance-dismissal sensitivity is greater in countries where managerial discretion was high, where performance measures were informative, and where there was a well-developed CEO labor market.

An important implication of the statements above is that the "CEO factor" will be correlated with performance. Since CEOs with good track record tend to end up in good firms, and because these firms keep on performing well, their track record becomes self-fulfilling. On the contrary, bad-track record CEOs they will tend to leave the population of senior executives and be replaced with new ones with no track record whatsoever. To the extent that the market for CEOs with good track record is unlimited (that is, to the extent that the ratio of good firms is the total population is big enough), we will observe that the average CEO is associated with good performance. This is so because good firms (the majority) do not replace CEOs, and bad firms hire from a random sample of candidates. In contrast, when the percent of good firms in the population is low, CEO turnover will be high, and each individual CEO will be more likely associated with negative performance. Consequently, in the population performance would be explained by firm-specific characteristics. However, and interestingly, it will also be related to the identity of the CEO.

The previous discussion assumes that the supply of CEOs is unlimited. However, if the supply of senior executives is restricted in a particular country, we will observe that, because of their track record, good-performing companies will keep their CEOs. However, bad performing companies will not be able to replace them and these companies will continue their bad performance. Consequently, good companies and bad companies will be perfectly matched with good CEOs and bad CEOs respectively. Controlling for firm-specific effects, CEOs would not explain performance.

VI Which CEOs Create More Value? Performance and Firm and CEO Characteristics

We have shown so far that CEOs have a different impact on firm performance depending on the time period, the country where they operate, and the size of the firm. In this section we shed more light on the relationship between firm characteristics and CEO impact. Again, we estimate the average and median coefficients of fixed and random effects in panel regressions. Tables 7 and 8 report the magnitude of the coefficients as well as their significance. We also display the significance of the differences across subsamples., based on a boostraping estimation as detailed in Appendix A.

For simplicity, in this Section we will focus on Total Shareholder Returns regressions, as our findings for ROIC are similar and consistent. We also analyze primarily the results of the CEO effect without interaction with firm-random effects, as the impact of the interaction is, as shown previously, only marginal.

A Firm and CEO Characteristics

The set of firm specific characteristics are firm size (Total Assets), Tobin's Q, Total Debt to Assets, Gross Goodwill to Assets, and Firm Age. We compute, for each firm and year in our sample, the Tobin's Q as:

$$q = \frac{\text{Total Assets}_t - \text{Total Equity}_t + \text{Market Value}_t \times 1000}{\text{Total Asset}_t},$$

where Total Assets, Total Equity and Market Value correspond to Worldscope codes WC02999, WC03995 and MV. We also calculate leverage ratios, as Total Debt (Worldscope item WC03255) divided by Total Assets (Worldscope item WC02999). Finally, and to measure the acquisition activity of companies, we also compute the ratio of Gross Goodwill (Worldscope item WC02502) as a percent of Total Assets.[15]

[Include Table 8 here]

We acknowledge that Tobin's Q, leverage and goodwill may be endogenous choices driven by the identity of the CEO itself. Bertrand and Schoar (2003), for instance, find a style factor in corporate financial policies. Bernile et al (2017) show that CEOs past experience with tragedies and catastrophes impact their managerial decisions, including leverage and acquisition activity. Similarly, Cain and McKeon (2016) show that CEOs' risk propensity (measured by whether they possess a private pilot

[15] Because Gross Goodwill is before impairments, it is possible that it exceeds the firm's Total Assets.

license) lead riskier firms. Yim (2013) provide evidence that, because acquisitions result in a higher compensation for the CEOs, younger CEOs will try to pursue acquisitions more often. When the CEO has previous experience in the industry, firms make better acquisitions (Custódio and Metzger, 2013). Similarly, corporate decisions trigger CEO turnover and compensation, as shown by Lehn and Zhao (2006) and Harford and Schonlau (2013). Our objective is not to assess or justify causality, but rather to identify firm characteristics that condition the extent to which CEOs can affect performance.

We additionally classify firms depending on age. We compute firm age as the difference between the current date and the firm's date of incorporation (Worldscope item WC18273). With respect to CEO-specific information, we have data on four variables of interest: CEO gender and age, years of experience in the firm, and total compensation. All these variables are available in Orbis-Bureau van Dijk. CEO age is recorded in the year of appointment of the CEO to the relevant firm. Years of experience in the firm (tenure) takes into account the date the CEO is appointed in their role (which may have happened before the first year in the sample, 1990), and computed as the difference in years between the appointment date, and the first year the CEO appears in the sample firm. Total compensation, as described earlier, includes both fixed salary and bonus for the year, computed as an average of all the years in which the CEO is in that position in the firm during the sample period.

Table 8 displays the regression results of cross-sectional regressions using the individual CEO-random (total effect including the interaction with the firm-random effect), estimated with country- and industry-fixed effects. Both Firm's Total Assets and CEO compensation are expressed in USD million. We specify Model 2 as an alternative to the full model, excluding compensation data for which its availability is scarce.

B CEO Characteristics: Results

In all model specifications, CEO tenure is significant at the one-percent level except for Model 1 in Panel A, and it is positively related to the valuation impact of CEOs. In economic terms, a one-standard deviation increase in CEO tenure (4.79 years) increases the CEO impact on ROIC by 10.7 percent per year (based on Model 2), and the CEO impact on shareholders' return by 0.38 percent per year. This result is consistent with John et al. (2014), who show that average returns, and therefore the probability of rehiring, are increasing in the experience of film directors, which supports that ability is revealed over time.

CEO gender is not significant at explaining CEO impact except for two specifications in the ROIC regressions, and only at the 10 percent level or better. As shown earlier, the literature is ambiguous. While investors tend to perceive female CEOs as less competent compared to their male counterparts (Lee and James, 2007), Leslie et al. (2017) find that women can sometimes receive a compensation premium which is related to an expectation of better performance. At the same time, Gupta et al. (2020) show that female CEOs have a higher probability of being dismissed as compared to men. We reject the hypothesis that gender is related to performance. Results for CEO age are similar, being significant at the 10 percent level in two specifications in TSR regressions. In Model 1, a one-standard deviation increase in CEO age (8.64 years) reduces the impact of CEOs on stock returns by 0.08 percent, so also the economic effect is negligible.

Finally, we find an significant relationship between compensation and CEO impact only on ROIC in Model 1. Beware the lack of observations on compensation data and therefore the reduction in the sample size in Module 1. A one-standard-deviation increase in CEO compensation (USD5.33 million) increases CEO impact on ROIC by 21.2 percent per year (significant at the one-percent level. In principle, differences in incentives should drive firm results. Jensen and Murphy (1990), Hall and Liebman (1998), and Bertrand and Schoar (2003), among others, find that companies where the CEO is paid more perform better. Difference in sensitivity between pay and performance are dependent on country characteristics. Fernandes et al. (2013) for instance, find that the link between them is tighter in the US than in other countries. Core et al. (1999) show that CEOs earn greater compensation when governance structures are less effective. Consequently, in countries with weaker governance rules, better-paid CEOs do not necessarily perform better. In a study of superstar CEOs, Malmendier and Tate (2009) find that award-winning CEOs underperform subsequent to obtaining such compensation awards, and such effect is stronger in firms with weak corporate governance. We find results consistent with these when we remove from the sample the US observations, and give therefore more weight to countries with weaker governance systems. Table 13 in the Appendix shows that, for non-US CEOs, a one standard deviation increase in total compensation (USD2.58 million when we exclude US data) reduces the impact of CEOs on stock returns by 0.07 percent.

Note that, in our paper, addressing the causality between pay and performance is not possible. We can only highlight differences in CEO impact on performance, depending on their level of pay, and controlling for country, industry, and firm characteristics. Overall, Table 8 shows that CEO compensation is positively related to firm's ROIC (only in one specification), but insignificantly related to shareholders' returns. In conclusion, even after controlling for differences in country, industry, and firm characteristics, we do not find evidence of a relationship between top executive pay and firm performance. Perhaps more detailed information about CEO pay (in addition to the data provided by Orbis) would shed some light at the international level.

In conclusion, there does not seem to be a consistent relationship between CEO impact and CEO characteristics. We next analyze the relationship between CEO impact and firm-specific variables.

C Firm Characteristics: Results

Among the firm characteristics that we consider, only firm's age appears to be significant, and in ROIC regressions only. A one-standard deviation increase in firm's age (51.6 years) reduces the impact of CEOs on performance by 17.5 percent. This would suggest that the firm's growth opportunities, and therefore Tobin's Q, should also affect the impact of the CEO. However Tobin's Q is significant only in univariate regressions (Model 10), vanishing after controlling by size and age.

None of the other variables appear significant. Intuitively, financial flexibility (lower leverage ratios) provide CEOs with more discretion to implement value-increasing decisions. However, Table 8 shows that the positive impact of CEOs on performance is not significantly related to the firm's leverage ratio. Our results are consistent with Strebulaev and Yang (2013), who study zero-debt firms in the US and show that these firms are typically companies with longer CEO tenures. As we have shown, these CEOs then to also have a smaller impact on performance.

Companies that grow through acquisitions tend to accumulate goodwill, and therefore the ratio of Goodwill to Total Assets is a good measure of a firm's propensity to engage in mergers and acquisitions. The literature on the relationship between CEO characteristics and M&A activity is ample (see Graham et al., 2013), therefore the mediating variable between CEOs and firm performance, depending on firms' acquisition frequency is not considered in our analysis below. Our previous results suggest that firms who are frequent acquirors do not necessarily hire CEOs with acquisition skills, but instead that the performance of a CEO in an acquisition, and therefore their impact on firm value, impacts CEO turnover and compensation (Lehn and Zhao, 2006). In fact, our regression results in Table 8 do not identify any relationship between the firm's acquisition intensity and CEO impact.

As with CEO characteristics, our cross-sectional regressions do not identify a systematic relationship between firm characteristics and ability of CEOs to impact performance.

VII Star Firms and Star CEOs

In their study of Superstar CEOs, Malmendier, U., and G. Tate (2009) analyze the performance of winners of CEO awards between 1975 and 2020. Their paper provides evidence on the change in compensation and performance before and after the Superstar award. Interestingly, after the recognition of their status, CEOs compensation increases, but their companies underperform both in terms of stock returns and ROA (Return On Assets). In this Section, we analyze whether the best-performing firms are able to attract the best performing CEOs.

If CEO skill does not impact performance in a systematic way, then there should not be any relationship between firm performance and CEO skill. Therefore, under the *Horizontal Differentiation hypothesis* (see Section III), CEOs are hired for non-performance related reasons, and we should find that CEOs perform well in good firms, and perform poorly in low-performance companies. Conversely, if there is clear differentiation among CEOs (*Vertical Differentiation*), CEO skill would help firms irrespective of their performance. In a cross-section of firms, both well- and bad-performing CEOs would be working for both well- and bad-performing companies. Finally, in a well-functioning labor market for top executives, firms find their optimal CEO and they increase performance, irrespective of whether the firm is a well-performing company is not. The latter hypothesis is not supported by the data: as Section V.A has shown, some CEOs contribute positively to stock returns but the average CEO destroys value.

In order to complement our previous results, in this Section we analyze the performance of CEOs on top-performing, and bottom-performing companies. We proceed as follows. Using the regression results in Section IV.B, we rank firms in our sample using the firm-random total effects, that is, using the individual firm-random effect as well as the interaction with the industry fixed-effect.[16]. We then select the top five and bottom 5 companies. Table 9 provides descriptive statistics of these subsamples, while Table 10 reports the CEO-random effects and other characteristics for these firms. Note that, because some companies employ more than one CEO during the sample period, the number of CEOs in each group is not 5 percent of the total number of senior executives. Also, given that we classify firms depending on their performance, we have two sets of top- and bottom-CEOs depending on whether we use ROIC or returns as performance metrics. Using the TSR sample for example, the 253 CEOs of the top-performing firms include more women than on the average company (16.6 percent vs. 8.96

[16] We have performed the same analysis using only the firm-random effect, and the results are qualitatively similar.

percent). In these companies, CEOs tend to be younger, and get paid more.[17] The gender distribution of CEOs in the bottom firms is not different from the whole sample. However, this sample includes more CEOs with pay below the median than in the whole sample.

[Include Table 9 here]

Table 10 presents the performance results for top and bottom companies, as well as for the total sample. As usual, we report different results for ROIC (Panel A) and TSR (Panel B). In each panel, significance levels are based on a test of differences with the complete sample. Since results in both panels are similar, our interpretation refers to shareholder returns only. Top firms display a significantly higher fix-random effect than the rest, with stock returns of 17.31 percent on average, and 15.13 percent in median. Conversely, firms in the bottom-5 percent display negative and significant effects (-31.96 in mean, -27.66 in median). The firm-random effects are consistent with the absolute returns in both groups of firms. Table 10 also reports the CEO coefficients. In top performing firms, CEOs have a positive and significant impact (mean and median coefficients of 0.0025and 0.0035, both significantly different from the total sample at the 5 percent level or better. In the worst performing firms however, the CEO impact is significantly negative (-0.0119 and -0.0076). These results are important: clearly, firms do not hire the right CEO because in the worst-performing firms we do not find that CEOs create value. Additionally, only in good companies do CEOs have a positive impact. This is strong evidence in favor of *Horizontal Differentiation* whereby, independent of CEO characteristics, CEO perform well in good companies, and underperform in bad companies.

[Include Table 10 here]

We are also able to shed light on the CEO characteristics that matter for performance in extreme firms. For instance, our results suggest that the overperformance of CEOs in top companies is driven by female CEOs (remember that they are more frequent in this group of firms) relative to male CEOs. Conversely, the underperformance of CEOs in the worst-performing companies is mostly due to male CEOs (also because in this group the percent of female CEOs is very small). We also find that the age of the CEO is not related to the performance of star firms. Interestingly as well, we do not find that CEOs who are paid more perform better, either in top or bottom firms. However, when CEO compensation is below median, their performance is in line with the quality of the company. This is consistent with a lack of salary differences among CEOs because of performance, and also consistent with the results in Section 8.

In conclusion, this Section finds evidence that CEOs tend to follow the performance of their firms. They perform well in well-performing companies, and the reverse. Because we do not find that CEOs contribute to value in firms in need (the bottom-5 percent of companies), nor we find that CEO value impact is distributed evenly across firms of different types, our results are consistent with CEOs not contributing to firm value in a systematic way.

[17] The percentages of old and young, and the percentages of high and low compensation do not add up to 100 percent because age and compensation data are missing for a number of observations in the sample.

VIII Robustness Tests

A Only CEOs Who Change Companies

Our sample of more than 2,103 companies and 3,692 CEOs (for which we have stock returns data) includes companies where the CEO does not change during the entire sample period. This would suggest that differentiating between CEO and firm effects in such companies is difficult to identify, unless there is either a prior or posterior CEO in the same firm. Our identification strategy goes by additionally including in the sample both CEOs who change companies during the sample period. Table 3 shows indeed that 100 CEOs out of 2,148 in the ROIC sample, and 354 out of 3,692 CEOs in the Total Return sample, change firms during the sample period. Appendix Table A2 shows additionally that these CEOs correspond to 62 firms in the ROIC sample, and 129 firms in the Total Return sample. Most of these observations come from developed economies and large companies.

[INCLUDE TABLE 11 HERE]

It is important to note that, if anything, our previous results understate the impact of CEOs and firm-specific characteristics. However, analyzing only companies with changing CEOs would introduce an endogeneity bias in our results because the reason for the CEO turnover can be in fact a lack of performance.

For robustness, in Appendix Tables A3 and A4 we report R-squared coefficient similar to the ones in Tables 6 and 7. These results confirm our previous findings. The explanatory power of CEOs on ROIC is higher than on shareholder returns. For the subsample of CEOs changing firms the explanatory power in both cases is explained more by the interaction with the industry-random effect. The impact of CEOs is larger in developed, relative to developing economies, and in large companies, relative to small.

We present the results of our regressions as in (3) and (9) in Tables 11 and 12. On average, CEOs add 2.09 percent on average to a company's annual ROIC, and reduce 0.5 percent the firm's stock return. However, the impact on ROIC is not significant either in developed or developing economies, and is concentrated among small and medium size firms. The difference in CEO coefficient between small and medium firms, and the rest, is significantly different from zero at the 5 percent level. In Table 6, the CEO impact on ROIC is positive, but not significant.

[INCLUDE TABLE 12 HERE]

The negative impact of CEOs on shareholder returns (Table 12) is particularly significant in developed countries, and among large firms. The difference in CEO coefficient between large firms and the rest is significantly different from zero at the 5 percent level.

[INCLUDE TABLE 13 HERE]

Table 13, at last, displays results of cross-sectional regressions with CEO impact as the endogenous variables, and firm and CEO characteristics as explanatory variables. Our main results below hold, namely the significance of CEO tenure and firm age, especially in ROIC regressions. We uncover a positive relationship between firm leverage an the CEO impact on stock returns, so a one-standard deviation increase in leverage (16.6 percent) increases CEO impact by 1.6 percent per year approximately. Alas, the number of observations is much lower in these regressions.

B Excluding the US

Our second robustness test replicates the previous econometric analyses eliminating US firms from the sample. US companies account for 47.5 percent of the firms in our sample, and 37.4 percent of the CEOs. Therefore they could be driving the results, an in particular our findings for developing economies

[Include Table 14 here]

Tables A5, A6 and A7 in the Appendix provide descriptive statistics about the subsample of non-US firms, as well as the R-squared results similar to the ones in Tables 6. and 7. In Table 14 we display the results of our cross-sectional regressions of CEO effects on firm and CEO characteristics. The main difference with the results for the entire sample is that, excluding the US data, CEO compensation has a significant effect on CEO impact: it increases the impact of CEOs on ROIC (only significant at the 10 percent level), and reduces the impact of CEOs on stock returns (significant at the one-percent level).

IX Conclusions

Our paper presents strong evidence that the impact of CEOs on the value of their firms does not depend on firm and individual CEO characteristics, but also on more macro variables such as country and industry factors. Ours is a comprehensive study of $3,692$ CEOs in $2,103$ firms in 22 countries, and for the period $1991-2019$. Our objective is to assess the direct impact of CEOs on firm performance–measured as Total Shareholder Return and ROIC–after controlling for global, country, industry, and firm effects. The CEO-random effect explains 2 percent of the variance of stock returns, and 13 percent of the variance in firm's return on invested capital. In the case of stock returns (the most relevant measure in our study, as it is forward looking and not based on accounting measures) we find that global, country, and industry effects explain respectively 11 percent, 4 percent, and 1 percent respectively. In that regard, the CEO effect is much smaller than all other effects outside of the company's control. We also find that firm choices and variables (location, strategy, culture) are the ones with the largest impact on firm value (an R-squared of 24 percent in ROIC regressions, 16 percent in TSR regressions).

The previous results are based on measuring the R-squared of different factors in panel regressions where each observation correspond to a year-country-firm-CEO combination. The problem with such model is that it is subject to the criticism in Fitza (2014, 2017) that it leads to misattributing random variations in firm performance to the CEO effect. Therefore, in the second part of the paper, we estimate average coefficients by CEO, and for each of the effects cited above. In this way we can measure, not whether CEOs impact the variance of firm stock prices and return on investment, but also the sign of such impact.

The econometric model allows us to test three hypothesis on the relationship between CEOs and firm value. The horizontal differentiation hypothesis posits that CEOs do not impact performance; however, since companies are of different qualities, any CEO will perform well in a good-performing company, and any CEO will perform badly in a bad-performing company. The vertical differentiation hypothesis assumes that, irrespective of firm quality, there are well- and bad-performing CEOs. Consequently, a well-performing CEO will always increase the performance of their company. Finally, the matching hypothesis argues that some top executives only perform well in certain companies, and there must be an efficient labor market that matches good CEOs with the companies where they can perform well.

Overall, we find evidence consistent with horizontal differentiation, that is, firm performance being determined by firm characteristics. CEOs have a positive impact on performance in good firms, but destroy value in underperforming firms, which indicates that there are no systematic characteristics that make a CEO create value. We confirm this result in two ways. First we show that top executives have a significant positive impact in the top-performing firms (those in the top-five percent of ROIC and TSR performance). Additionally, CEOs negatively impact performance in the worst-performing firms (the bottom-five percent). In fact the latter result is important, because if CEOs could effectively contribute to positive performance, underperforming companies would hire the best CEOs. Second, we show in cross-sectional regressions that variables that in the literature traditionally predict CEO performance (CEO compensation and gender, firm size and growth opportunities) are not significantly related to the CEO skill.

The average contribution to CEOs to ROIC is positive but insignificant, while the average impact of CEOs on stock prices is negative and significant. Also, the variability of these effects is different: the variance of the impacts on ROIC is large, and very small in the case of TSR. This helps us explain the results in the literature based on ANOVA analyses that obtain a large explanatory power of CEO effects on measures of firm performance. R-squared coefficients tend to be high if the standard deviation of the fixed/random effects is high. But this does not mean that CEOs create value. As the TSR regression coefficients show, it is indeed the opposite: on average, CEOs destroy value.

The impact of the top executive is determined by external conditions, such as the industry and country where the firm operates. We find that CEOs have a significant impact in developed economies, but much less in developing economies. Whenever the CEO impact effect is significant in developing economies, it is more negative than in developed countries. This result is important, and it would suggest that in countries with sophisticated labor markets for CEOs and effective governance rules, CEOs are less detrimental to performance.

Our paper is the first to measure the impact of CEOs with a large sample of companies, industries, and countries. Our study lack data on some variables of interest that could shed light on which type of CEOs do impact firm value. These variables have been identified by the leadership literature (see Liu et al., 2018 for a good review): leadership style, functional background, personality attributes like humility, narcissism, and overconfidence, etcetera. Most of the papers in this literature either focus on accounting metrics of performance such as Return on Assets (ROA), use a very small sample of US companies, measure leadership attributes through surveys and not from hard data, or all of the three at the same time. A natural follow-up for this paper would be to assess the impact of such individual characteristics of the CEO on firm performance.

Our follow-up work will also identify the country characteristics that make CEOs more impactful, and in particular corporate governance and regulation, the market for talent, quality of the education system and the competitiveness of the country. We are also interested in understanding which decisions CEOs make that do impact value positively and negatively.

X Appendix A

Our significance tests in Tables 5 and 6 are based on standard t-tests for means, and Wilcoxon tests for medians. To check the robustness of our results, we have also decided to bootstrap the coefficients by subsamples. For each of the endogenous variables (ROIC an Total Return) we randomly selected a sample of n firms, and estimated the model in (9). We then repeated this procedure $2,000$ times.

The statistics that is of interest in a bootstrap sample is noted by $s({x^*}_p)$, where p refers to the p^{iem} bootstrap sample that is noted by x^*. Usually, to compute confidence intervals in a bootstrap estimation, we should start by computing bootstrap percentiles. Let $\hat{\theta}^* = s(x^*)$, and $\hat{G}$ be the cumulative distribution of $\hat{\theta}^*$. The $1-2\alpha$ percentile interval is defined by the α and $1-\alpha$ percentile of $\hat{G}$:

$$[\hat{G}^{-1}(\alpha), \hat{G}^{-1}(1-\alpha)] \tag{13}$$

We compute BC_a confidence intervals, which are based on percentiles of the bootstrap distribution, but that correct certain deficiencies of the percentile model. This model is based on two numbers $\hat{a}$ and $\hat{z}_0$, called *accelerator* and *bias correction* (See Efron and Tibshirani, 1994). The confidence interval is then:

$$[\hat{\theta}^{*(\alpha_1)}, \hat{\theta}^{*(\alpha_2)}], \tag{14}$$

where:

$$\begin{aligned} \alpha_1 &= \Phi(\hat{z}_0 + \frac{\hat{z}_0 + z^{(\alpha)}}{1-\hat{a}(\hat{z}_0 + z^{(\alpha)})}) \\ \alpha_2 &= \Phi(\hat{z}_0 + \frac{\hat{z}_0 + z^{(1-\alpha)}}{1-\hat{a}(\hat{z}_0 + z^{(1-\alpha)})}). \end{aligned} \tag{15}$$

The value for the bias correction $\hat{z}_0$, is

$$\hat{z}_0 = \Phi^{-1}(\frac{\#\{\hat{\theta^*}(b) < \hat{\theta}\}}{B}), \tag{16}$$

where B refers to the total number of bootstrap replications. Therefore this value is obtained by the proportion of the number of bootstrap replication with estimated value less than original estimated value of $\hat{\theta}$.

For the accelerator, we use the Jackknife model. Let $\mathbf{x}_{(i)}$ denote the original database without ${i^{th}}^{iem}$ point, $\hat{\theta}_{(.)} = \sum_{i=1}^{n} \frac{\hat{\theta}_{(i)}}{n}$, then the accelerator used in our model is defined by

$$\hat{a} = \frac{\sum_{i=1}^{n}(\hat{\theta}_{(.)} - \hat{\theta}_{(i)})^3}{6(\sum_{i=1}^{n}(\hat{\theta}_{(.)} - \hat{\theta}_{(i)})^2)^{\frac{3}{2}}}. \tag{17}$$

We provide significance levels for tests that the corresponding coefficient is zero for different values of α.

Table A displays the mean and median coefficients as well as their significance level computed in this way.

References

Adams, R.B., Almeida, H. and Ferreira, D. (2005), "Powerful CEOs and their impact on corporate performance," The Review of Financial Studies, 18(4), 1403-1432.

Adams, R., M. Keloharju, and S. Knüpfer (2018), "Are CEOs born leaders? Lessons from traits of a million individuals," Journal of Financial Economics 130, 392–408.

Bandiera, O., A. Prat, S. Hansen, and R. Sadun, (2020), "CEO Behavior and Firm Performance," Journal of Political Economy 128, no. 4: 1325-1369.

Bandiera, O., L. Guiso, A. Prat, and R. Sadun (2015), "Matching Firms, Managers, and Incentives," Journal of Labor Economics 33, 623–681.

Bandiera, O., R. Lemos, A. Prat, and R. Sadun (2018), "Managing the Family Firm: Evidence from CEOs at Work," The Review of Financial Studies 31, 1605–1653.

J. Labor Econ. 36 (S1): S371–S409.

Bennedsen, M., K. M. Nielsen, F. Pérez-González, and D. Wolfenzon (2007), "Inside the Family Firm: The Role of Families in Succession Decisions and Performance. *Quarterly Journal of Economics* 122 (2): 647–91.

Bennedsen, M., F. Pérez-González, and D. Wolfenzon (2020), "Do CEOs Matter? Evidence from Hospitalization Events." The Journal of Finance 75, p1877-1911.

Bernile, G., V. Bhagwat, and P. R. Rau (2017), "What Doesn't Kill You Will Only Make You More Risk-Loving: Early-Life Disasters and CEO Behavior," The Journal of Finance 72, 167-206.

Bertrand, M., and S. Mullainathan (2001), "Are CEOs Rewarded for Luck? The Ones Without Principals Are," The Quarterly Journal of Economics 116, 901–932.

Bertrand, M., and A. Schoar (2003), "Managing with Style: The Effect of Managers on Firm Policies," The Quarterly Journal of Economics 118, 1169–1208.

Bugeja, M., Z. P. Matolcsy, and H. Spiropoulos (2012), "Is there a gender gap in CEO compensation?," Journal of Corporate Finance 18, 849–859.

Cain M.D. And S.B. McKeon (2016), "CEO Personal Risk-Taking and Corporate Policies," Journal of Financial and Quantitative Analysis 51, 139-164.

Custódio, C., M. A. Ferriera, and P. Matos (2013), "Generalists Versus Specialists: Lifetime Work Experience and Chief Executive Officer Pay," 2013. Journal of Financial Economics.

Core J.E., Holthausen R.W., Larcker D.F. (1999), "Corporate governance, chief executive officer compensation, and firm performance," Journal of Financial Economics 51(3), 371-406.

Crossland C., and D.C. Hambrick (2007), "How national systems differ in their constraints on corporate executives: A study of CEO effects in three countries," Strategic Management Journal 28(8), 767 - 789.

Cunnings Ian, and Ian Finlayson, (2015), “Mixed Effects Modelling and Longitudinal Data Analysis,” in Luke Plonsky, Advancing Quantitative Methods in Second Language Research, pp. 159-178.

Custódio C. and D. Metzger (2013), “How Do CEOs Matter? The Effect of Industry Expertise on Acquisition Returns,” Review of Financial Studies 26, 2008-2047

Davidson, R., Dey, A. and Smith, A. (2015), “Executives’"off-the-job" behavior, corporate culture, and financial reporting risk,” Journal of Financial Economics, 117(1), 5-28

Efron B., and R.J. Tibshirani (1994), “An Introduction to the Bootstrap,” 2nd edition, Springler, 452 pp.

Falato, A., D. Li, and T. Milbourn (2015), “Which Skills Matter in the Market for CEOs? Evidence from Pay for CEO Credentials,” Management Science 61, 2845–2869.

Fahlenbrach, R. (2009), “Founder-CEOs, Investment Decisions, and Stock Market Performance,” Journal of Financial And Quantitative Analysis 44, 439-466

Fernandes, N., Ferreira, M.A., Matos, P. and Murphy, K.J., (2013), “Are U.S. CEOs Paid More? New International Evidence,” Review of Financial Studies 26, 323-367.

Fee, C. Edward, and Charles J. Hadlock (2003), “Raids, Rewards, and Reputations in the Market for Managerial Talent,” Review of Financial Studies 16, 1315–1357.

Fitza, M. A. (2014), “The use of variance decomposition in the investigation of CEO effects: How large must the CEO effect be to rule out chance?,” Strategic Management Journal 35, 1839–1852.

Fitza, M. A. (2017), “How much do CEOs really matter? Reaffirming that the CEO effect is mostly due to chance,” Strategic Management Journal 38, 802–811.

Gabaix, X., and A. Landier (2008), “Why Has CEO Pay Increased So Much?,” Quarterly Journal of Economics 123, 49–100.

Graham, J., C. Harvey, and M. Puri (2013), “Managerial attitudes and corporate actions, (No. w22435). Journal of Financial Economics 109, 103–121.

Hambrick, D.C. and T.J. Quigley (2014). “Toward more accurate contextualization of the CEO effect on firm performance,” Strategic management journal, 35(4), 473-491

Harford H. and R.J. Schonlau (2013), “Does the director labor market offer ex post settling-up for CEOs? The case of acquisitions,” Journal of Financial Economics 110, 18-36.

Hoobler, J. M., C.R. Masterson, S.M. Nkomo, and E.J. Michel (2018), “The Business Case for Women Leaders: Meta-Analysis, Research Critique, and Path Forward,” Journal of Management 44, 2473–2499.

Jacobson, R. (1987), “The Validity of ROI as a Measure of Business Performance.” American Economic Review 77 (3): 470

Jensen M.C., and K.J Murphy (1990), "Performance Pay and Top-Management Incentives," Journal of Political Economy 98(2), 225-264.

John, K., S. A. Ravid, and J. Sunder (2017), "Managerial ability and success: Evidence from the career paths of film directors," Journal of Corporate Finance 44, 425–439.

Kaplan, S.N., M.M. Klebanov, and M. Sorensen (2012). "Which CEO characteristics and abilities matter?," The Journal of Finance, 67(3), 973-1007

Khurana, R. (2002), "Searching for a Corporate Savior: The Irrational Quest for Charismatic CEOs." Princeton, NJ: Princeton University Press.

Klein, F. B., P. Chaigneau, and C. E. Devers (2019), "CEO Gender-Based Termination Concerns: Evidence From Initial Severance Agreements," Journal of Management, 014920631988742.

Lee, P. M., and E. H. James (2007), "She'-e-os: gender effects and investor reactions to the announcements of top executive appointments," Strategic Management Journal 28, 227–241.

Lehn K. M., and M. Zhao (2006), "CEO Turnover After Acquisitions: Are Bad Bidders Fired?," The Journal of Finance 41, 1759-1811.

Leslie, L. M., C. F. Manchester, and P. C. Dahm (2017), "Why and When Does the Gender Gap Reverse? Diversity Goals and the Pay Premium for High Potential Women," Academy of Management Journal 60, 402–432.

Li, W., Y. Lu, S. Makino, and C.-M. Lau (2017), "National power distance, status incongruence, and CEO dismissal," Journal of World Business 52, 809–818.

Mackey, A. (2008), "The effect of CEOs on firm performance," Strategic Management Journal, 29(12), 1357-1367.

Malmendier, U., and G. Tate (2009), "Superstar CEOs," Quarterly Journal of Economics, 124(4), 1593-1638.

Meindl, J. R., and S. B. Ehrlich (1987), "The Romance of Leadership and the Evaluation of Organizational Performance," Academy of Management Journal 30, 91–109.

Meindl, J. R., S. B. Ehrlic, and J. M. Dukerich (1985), "The Romance of Leadership," Administrative Science Quarterly 30, 78.

Milbourn, Todd T. (2003), "CEO reputation and stock-based compensation," Journal of Financial Economics 68, 233–262.

Nguyen, D. D., J. Hagendorff, and A. Eshraghi (2018), "Does a CEO's Cultural Heritage Affect Performance under Competitive Pressure?," The Review of Financial Studies 31, 97–141.

Ou, A. Y., D. A. Waldman, and S. J. Peterson (2018), "Do Humble CEOs Matter? An Examination of CEO Humility and Firm Outcomes," Journal of Management 44, 1147–1173.

Pinheiro, José C., and Douglas M. Bates, (2000), “Linear Mixed-Effects Models”, in Mixed-Effects Models in S and S-Plus, pp. 3-270.

Quigley, T. J., and S. D. Graffin (2017), “Reaffirming the CEO effect is significant and much larger than chance: A comment on Fitza (2014),” Strategic Management Journal 38, 793–801

Rosenzweig, P. (2014), “The Halo Effect: . . . and the Eight Other Business Delusions That Deceive Managers” (New York: Free Press)

Stein, J. C. (1988), “Takeover Threats and Managerial Myopia,” Journal of Political Economy 96, 61–80.

Stein, J. C. (1989), “Efficient Capital Markets, Inefficient Firms: A Model of Myopic Corporate Behavior,” Quarterly Journal of Economics 104, 655–669.

Strebulaev I.A. and B. Yang (2013), “The Mistery of Zero-Leverage Firms,” Journal of Financial Economics 109, 1-23.

Terviö, M. (2008), “The Difference That CEOs Make: An Assignment Model Approach,” American Economic Review 98, 642–668.

Wasserman, N., N. Nohria, and B. Anand. “When Does Leadership Matter? A Contingent Opportunities View of CEO Leadership,” Chap. 2 in Handbook of Leadership Theory and Practice, edited by Nitin Nohria and Rakesh Khurana. Harvard Business Press (2010).

Yim, S. (2013), “The Acquisitiveness of Youth: CEO age and Acquisition Behavior,” Journal of Financial Economics 108, 250-273.