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Do CEOs Matter? Evidence from Hospitalization Events

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ABSTRACT

Using variation in firms' exposure to their CEOs resulting from hospitalization, we estimate the effect of chief executive officers (CEOs) on firm policies, holding firm-CEO matches constant. We document three main findings. First, CEOs have a significant effect on profitability and investment. Second, CEO effects are larger for younger CEOs, in growing and family-controlled firms, and in human-capital-intensive industries. Third, CEOs are unique: the hospitalization of other senior executives does not have similar effects on the performance. Overall, our findings demonstrate that CEOs are a key driver of firm performance, which suggests that CEO contingency plans are valuable.

IN THIS PAPER, WE USE variation in firms' exposure to their chief executive officer (CEO) resulting from hospitalization to estimate the effect of CEOs on firm performance. The basic premise behind this test is that hospitalizations affect managers' ability to perform their jobs as they are physically away from the office or convalescing from a medical condition. Econometrically, this test is attractive because it allows us to assess how firm outcomes change as firms' exposure to their CEO varies, holding the firm-CEO match constant.

To investigate this issue empirically, we use firm, CEO, and hospitalization data from 12,753 Danish firms from 1996 to 2012. Denmark provides a

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near-ideal setting to run our analysis for four reasons. First, reliable financial information is available for the universe of limited liability firms. Second, firms are required to report the name of their CEO to government agencies. Third, and importantly for our purposes, detailed information about individuals' hospitalizations (e.g., length and diagnosis) is available from the National Patient Registry (NPR), and such data can be matched with CEO and firm records. Lastly, given that more than 95% of hospitals spending in Denmark are financed through general government expenditures, this setting mitigates concerns that CEO hospitalizations may affect the performance directly as a result of increased medical bills.[1]

We find that CEOs have an economically and statistically large effect on firm performance. In particular, firms underperform when their chief executives are hospitalized but otherwise exhibit similar performance as other firms. Our results indicate that a 10-day hospital stay reduces firm operating profitability by 5.8% from its mean (or by 0.5 percentage points).

To shed additional light on the magnitude of the above effect, we first examine the relation between hospitalization length and absence days, a more direct measure of firm exposure to the CEO. This evidence indicates that even short hospitalization spells lead to prolonged absences from the workplace. For example, while an employee with no hospitalizations is absent an average of seven days per year, the number of absences increases to 39 days per year when an employee is hospitalized from four to six days.

We next examine whether our main result captures a "pure" CEO effect or the combined effect of the chief executive's absence and the organizational response to this absence. We find no unusual behavior in terms of hiring or firing of senior managers around CEO hospitalizations. That is, in terms of aspects of the organization that we can observe, there does not seem to be a large response to CEO hospitalizations, which suggests that our test is able to isolate the CEO effect.

In addition to profitability, we examine the effect of CEO hospitalizations on other corporate and financial outcomes. We show that, following a CEO hospitalization event, firm investment and asset growth decrease, while the likelihood of financial distress increases. These results further support the view that CEOs have a meaningful effect on their organizations.

We next try to replicate our main tests for non-CEO senior managers. We find that the magnitude of the effect is about half that for CEOs. These results highlight the importance of CEOs relative to other senior employees, and justify the attention that chief executives receive in both the media and the academic literature (see survey by Bertrand (2009)).

When we analyze individual, firm, and industry settings in which CEOs are particularly valuable, we find that CEO effects are larger for younger and highly educated CEOs. We also find that CEO effects are significant in settings in which the value of managerial discretion is high (i.e., in rapidly growing environments and in industries with highly educated employees), and that

[1] Source: stats.oecd.org based on data from 2005 to 2009.

large CEO effects obtain in firms with concentrated power such as family firms and firms with no boards.

In additional analysis, we show that CEO turnover probability is higher after hospitalizations. While it is possible that convalescing CEOs voluntary leave their position, another interpretation of this result is that CEO turnover events represent a *revealed preference* test of the basic premise of this paper. Specifically, if CEO hospitalizations undermine managers' productive potential, then the firm's owners or the board of directors act on this information by replacing the CEO.

Finally, despite the sharp effect of hospitalizations on managerial turnover, we show that the hospitalization results presented in this paper are not driven by those firms that replace their CEOs. In particular, we show that the effects of CEO hospitalizations hold in the subsample of firms that do not experience a managerial turnover.

Taken together, our results demonstrate that CEOs are valuable for the organizations they lead. As such, our paper is consistent with a growing line of research in economics and finance that stresses the unique contribution of managers to firm outcomes (Bertrand and Schoar (2003), Pérez-González (2006), Bennedsen et al. (2007), Bloom and Van Reenen (2007), Bloom et al. (2013), among others).

We address several challenges to our identification strategy. The first is that, while we claim that causality runs from hospitalization length to firm performance, it could be the case that superior performance causes shorter hospitalizations. For example, if the presence of the CEO is more valuable during periods of higher profitability, this may lead executives of superior-performing firms to try to leave the hospital as soon as possible. To address this concern, we instrument the length of a CEO's hospital stay using the fraction of lengthy hospital stays per medical condition for the entire country. Using this instrumental variable (IV) approach, we show that our previous results continue to hold.

The second identification challenge is that hospitalizations can coincide with periods of poor performance without causing them. First, to the extent that some illnesses are stress-related, hospitalizations may be triggered by poor firm performance. In this case, firms on a downward performance trajectory would be more likely to have a hospitalized CEO. We address this concern by focusing on the subsample of diagnoses that medical research identifies as not being stress-related. Our results continue to go through. In addition, we find no relation between future hospitalization and current performance. Second, it could be the case that CEOs wait for the right moment to seek treatment, choosing to do so when performance is poor, perhaps because firm activity and demands on the CEO are lower. We address this concern by restricting the sample to only the deadliest diseases for which CEOs are unlikely to wait to seek treatment. We again find similar results.

Our results extend this literature in several important dimensions. First, we provide an estimate of the value of CEOs using firm-CEO fixed effects. These empirical specifications allow us to isolate the consequences of shifting

a CEO's effort or effective supply, holding constant the firm's demand for his or her services. As a result, we are able to overcome an important concern facing studies that use managerial fixed effects to proxy for CEO traits, namely, that managerial fixed effects are the result of endogenous decisions that capture both demand and supply forces (Fee, Hadlock, and Pierce (2013)). Our results, however, suggest that managerial fixed effects are not driven entirely by demand forces. This result is important as a growing literature in finance uses managerial fixed effects as key determinants of a wide variety of corporate policies (Bertrand and Schoar (2003), Frank and Goyal (2007), Graham, Li, and Qiu (2012), among others).

Second, hospitalizations affect a large number of CEOs whose observable characteristics are close to the average CEO in the sample. Previous studies in this literature use CEO deaths (Johnson et al. (1985), Fee, Hadlock, and Pierce (2013), among others)), which tend to occur rarely and in older firms, with older CEOs. As a result, our findings are more likely to be representative of the average CEO on the average firm in the economy. Furthermore, we show that CEO hospitalizations do not trigger large organizational changes, whereas CEO deaths are typically followed by the hiring of non-CEO senior executives. Thus, CEO hospitalization events better isolate CEO effects from performance changes brought about by a new management team. In addition, our empirical strategy based on hospitalization events allows us to assess the magnitude of the shock needed to affect performance by analyzing variation in the length of hospitalization stays. Empirically, we show significant effects for firms whose CEOs are hospitalized for five or more days, but insignificant effects for shorter hospitalizations.

Third, our results speak to the specific way in which CEOs contribute to firm value. CEOs may set the firm's long-term strategy and make critical decisions to steer the direction of the firm. In addition, they may be involved in the day-to-day running of the firm. While our results do not speak to the former, we find support for the day-to-day involvement of the CEO in the business, as firm profitability and investment are affected immediately after CEO hospitalizations. Our results also allow us to distinguish between two theories on the role of a CEO. In the first, it is important to have a CEO, but anyone in the CEO position would perform the tasks associated with this position equally well. In the other, CEOs differ in their ability to manage firms. The fact that the decline in performance around hospitalizations varies with the age, education, and tenure of the CEO strongly suggests that CEOs differ in their ability to manage firms.

Fourth, our results provide novel insights on the value of CEO succession plans and other contingency plans. Our analysis documents both the settings in which CEO hospitalizations affect firm performance and the policies that those contingency plans may target. For example, our results show that CEOs systematically influence firm outcomes when they are young or when the firm is in a high-growth environment, suggesting that succession plans may be particularly valuable in those settings. Similarly, our results on family firms

and firms without a corporate board highlight the importance of planning in organizations in which power is concentrated.

Fifth, we contribute to the CEO turnover literature by providing systematic country-wide evidence that CEO hospitalizations, even relatively short hospital stays, lead to a drastic increase in the probability of observing a CEO turnover event. This effect obtains when we control for variables that capture firm and industry conditions as well as when we instrument the length of the hospitalization.[2]

In our analysis, we rely on the population of limited liability firms in Denmark. The typical firm in our sample therefore is a medium-sized, nonlisted corporation. We show that the negative impact of CEO hospitalization on firm performance holds for all firm size quartiles. Even so, we acknowledge that the external validity of our results may be stronger for private firms than for large publicly traded companies in other countries.[3]

The rest of the paper is organized as follows. Section I describes the data. Section II examines the impact of CEO hospitalizations on performance. Section III tests for the uniqueness of the value of CEOs. Section IV assesses the cross-sectional determinants of CEO effects. Section V investigates the impact of CEO hospitalizations on turnover events. Finally, Section VI concludes.

I. Data and Summary Statistics

A. Data

To analyze the impact of CEO hospitalizations on firm performance, we use the following firm and individual data:

(1) *Firm financial information*. Financial data come from *Experian* and the *Statistical Business Register* (SBR) at Statistics Denmark.

Experian assembles data from the financial statements and management information that all limited liability firms in Denmark are required to file with the Ministry of Economics and Business Affairs. Firms are required to disclose the value of total assets, as well as operating and net income. While most of the firms in *Experian* are privately held, external accountants audit firm financials in compliance with Danish corporate law. Critically, for our purposes, *Experian* includes the unique firm-level identifier issued by the Danish Commerce and Companies Agency (the CVR number), which serves as the firm identifier in all interactions with the Danish authorities. Inclusion of the CVR number allows us to match *Experian* data with other data sources.

[2] For related turnover studies, see Weisbach (1988), Parrino, (1997), Huson, Malatesta, and Parrino (2001), and Jenter and Kanaan (2015), among others.

[3] Pan, Wang, and Weisbach (2015) provide an alternative approach for learning about the value of CEOs in large publicly traded companies. They develop a Bayesian learning model of CEO ability based on stock return volatility. They find that about one-quarter of total stock return volatility at the time of CEO turnover can be linked to uncertainty about CEO ability.

We supplement *Experian*'s financial information with revenue and employment information from SBR, which is assembled by Statistics Denmark, a Danish government entity under the Ministry of Economics that is responsible for data collection for a large number of economic variables. Merging *Experian* and SBR data allow us to focus on those limited liability firms with actual employment and sales records, and to exclude from the analysis shell companies that are otherwise difficult to identify using *Experian* financials alone.

(1) *Management data*. To identify firms' CEOs, we rely on three data sources: (a) *Experian*, (b) Erhvervs- og Selskabsstyrelsen (ES), a data set assembled by the Danish Commerce and Companies Agency, and (c) the Integrated Database for Labour Market Research (IDA database) at Statistics Denmark. *Experian* reports the names of firms' top executives but does not contain individual identifiers. To merge the names reported in *Experian* with other data sources, we use the ES data set, which contains the Danish Personal Identification number (CPR) for all managers of limited liability firms. Under Danish corporate law, firms are required to file with ES any change in the CEO position within two weeks of its occurrence. Lastly, we use the employment information from the IDA database to verify that CEOs are indeed registered as employees in the reporting firms.

(2) *Hospitalization data*. Data on hospitalizations come from the NPR at Statistics Denmark. NPR registers all public hospital interactions in the country and contains individual CPR identifiers, the duration of each hospital stay, and the primary medical diagnosis of patients based on the World Health Organization's classification of diseases.[4]

(3) *Additional data*. We obtain a more direct measure of a firm's exposure to its CEO from a novel survey on employee absences in a sample of 2,600 private firms. The data set covers all firms with more than 250 employees as well as a sample of firms with 10 to 250 employees. For each firm, the survey includes the number of days absent for each employee. The data cover from the period 2007 to 2012.

We obtain board membership information from *Experian*. We use these data to detect the presence of a board and to identify family firms as those in which at least three members of the board are related by blood or marriage.

We use the IDA database to identify non-CEO senior managers using a variable for an employee's position in the firm. We also use this data set to identify new managers and those leaving the firm. The IDA database also contains information on age and education levels.

ES contains dates for every step in the bankruptcy process, which we use to identify financial distress. This data set also contains dates for major corporate events such as acquisitions, spin-offs, etc.

[4] See http://www.who.int/classifications/icd/.

B. Sample Selection

Experian data are available for limited liability firms, sole proprietorships, partnerships, etc. Because of our interest in the role of CEOs in larger organizations, we focus on limited liability firms. There are two types of limited liability firms in Denmark: aktieselskab (A/S) and anpartsselskab (ApS). ApS corporations are smaller and likely to be informal in their organizational structure as they are not legally required to have a formal board of directors. We keep both types in our sample, but to focus on larger firms, we require a minimum of (a) 20 or more employees and (b) 5 million USD or more in assets. We retain any firm that meets all requirements for at least one year during the period 1996 to 2012.[5] As is standard in the literature, we focus on nonfinancial, nonutility, and nongovernment-owned entities. We arrive at a final panel of 12,753 firms with 133,219 firm-year observations over the period from 1996 to 2012.

C. Summary Statistics

Table I reports summary statistics for the full sample of firms (column (1)), for "event" firms (column (2)), and for "nonevent" firms (column (3)). Event firms are those whose CEO was hospitalized at least one day during the sample period. Of the 12,753 firms in the sample, we classify 5,337 as event firms and 7,416 as nonevent firms. Table I also reports the difference in means across the two groups (column (4)).

To assess firm performance in the absence of stock price information, we follow the CEO turnover literature and use operating return on assets (OROA).[6] OROA is a natural proxy for performance as it compares cash flows from operations to the value of assets, and it is not distorted by capital structure decisions. The average OROA for event and nonevent firms is 8.6% and 8.5%, respectively. The difference across groups is not statistically significant at conventional levels. We also report net income to assets, which is 5.2% for event firms and 5.1% for nonevent firms. Again, the difference across groups is insignificant.

To determine whether event firms differ in terms of their industry patterns, we further report industry-adjusted OROA values, where we classify industries using four-digit codes from the Classification of Economic Activities in the European Community (NACE). We find that industry-adjusted OROAs are indistinguishable from zero for both event and nonevent firms, as well as for the resulting difference across groups.

Mean sales across all sample firms is 118 million Danish Kroner (2008 DKK values), or approximately 23.1 million USD, mean assets is 20.6 million DKK, or 4 million USD, and mean number of employees is 29. These results reflect the fact that our sample consists of small and medium-sized nonlisted firms. Since this is the most typical organizational structure in the world, our analysis is

[5] Eliminating these size cutoffs does not affect the results.

[6] See Denis and Denis (1995), Huson, Malatesta, and Parrino (2004), Pérez-González (2006), Bennedsen et al. (2007), and many others. OROA is measured as the ratio of earnings before interest and taxes (EBITs) to the book value of total assets.

Table I
Summary Statistics

This table presents firm characteristics for nonfinancial, nonutility, nongovernment-owned limited liability firms in Denmark between 1996 and 2012. Firms are classified as *event* firms (column (2)) in cases in which their CEO was hospitalized at least one day during the sample period according to data from Statistics Denmark, and as *nonevent* firms (column (3)) otherwise. *OROA* is operating income (Primært resultat) to book value of assets. *Net income to assets* is the ratio of net income (Årets resultat) to book value of assets. *Industry-adjusted OROA* is the difference between OROA and the average of its four-digit NACE (European industry classification system) benchmark. *Sales* (omsætning) is the value of sales in 2008 Danish Kroner (DKK) in millions. *Ln assets* is the natural logarithm of the total book value of assets in millions (2008 DKK). *Ln(Number of employees)* is the natural logarithm of the total number of employees. *Investment rate* is the rate of growth of total assets. *Firm age* is calculated using the earliest of the year of establishment, registration, or the firm's bylaws. *CEO age* is based on information from the Danish Civil Registration System. Standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	All	Event Firms	Nonevent Firms	Difference
Variable	(1)	(2)	(3)	(4)
Operating return on assets (OROA)	0.0856	0.0860	0.0853	0.0007
	(0.0008)	(0.0012)	(0.0012)	(0.0017)
Net income to assets	0.0517	0.0522	0.0513	0.0009
	(0.0007)	(0.0010)	(0.0009)	(0.0013)
Industry Adj. OROA	0.0000	0.0002	−0.0001	0.0003
	(0.0008)	(0.0012)	(0.0011)	(0.0016)
Sales in M real DKK	118.3283	112.4806	123.6975	−11.2169
	(5.3979)	(6.9520)	(8.1527)	(10.7140)
Ln(Assets)	3.0263	3.0326	3.0204	0.0122
	(0.0118)	(0.0175)	(0.016)	(0.0237)
Ln(Number of employees)	3.3521	3.3623	3.3428	0.0195
	(0.0091)	(0.0133)	(0.0124)	(0.0182)
Investment rate	0.0343	0.0308	0.0375	−0.0066***
	(0.0007)	(0.0010)	(0.0010)	(0.0014)
Firm age	25.90	27.63	24.31	3.32***
	(0.19)	(0.29)	(0.25)	(0.39)
CEO age	51.12	52.51	49.84	2.66***
	(0.07)	(0.11)	(0.1)	(0.15)
Number of firms	12,753	5,337	7,416	
Number of firm-years	133,219	63,768	69,451	

likely relevant beyond the institutional setting of Denmark. However, with fewer than 200 publicly traded firms in the country, the number of CEO health shocks is too small to analyze this subset of firms separately. Hence, whether our results are valid in large publicly traded companies is an open question.

We find that event and nonevent firms are comparable in terms of size. Table I shows that there are no significant differences in sales, assets, and number of employees across these two groups.

Firm age reveals that event firms are older than their nonevent peers. Specifically, event firms have been in business for nearly 28 years on average, whereas nonevent firms have been active for approximately 24 years. While this

difference is relatively small (3.3 years), it is significant at the 1% level. We also find that event firms are managed by older CEOs (older CEOs are both more likely to be hospitalized and more likely to manage older firms). The average CEO age for firms in the sample is 51.1 years. When we look at event firms and nonevent firms separately, we find that average CEO age is 52.5 and 49.8, respectively, with the difference of 2.7 years significant at the 1% level.

Table I also shows that investment is higher for nonevent firms. The average investment rate for event firms is 3.1%, compared to 3.8% for their nonevent peers. The difference is statistically significant at the 1% level. Note that since Table I shows mean values for all firm-years of event firms, this difference may be the result of CEO hospitalization events, an issue we investigate below.

In Table II, we present hospitalization data for the CEOs in the sample, broken down by the CEO's main medical condition and the length of the CEO's hospital stay. Of the 133,219 firm-year observations in our sample, we identify 9,363 firm-years in which a CEO was hospitalized at least one day and 2,945 cases in which the CEO experienced a hospital stay of five or more days. These numbers represent 7.0% and 2.2% of the total number of firm-years, respectively. For the econometrician investigating whether CEOs affect firm performance, these hospitalization events, while unfortunate, are valuable for at least two reasons. First, they are significantly more frequent than other CEO shocks previously explored in the literature. CEO deaths (Johnson et al. (1985), Fee, Hadlock, and Pierce (2013), among others), for example, occur rarely. In our sample, they comprise only 0.2% of firm-years. Second, as Table II shows, hospitalization length varies widely across primary medical diagnoses. For example, the fraction of neoplasm-related hospitalizations leading to 10-day or longer stays is 35.7%, while the same fraction for genitourinary-related illnesses system is only 10.3%. Below, we use this variation in hospitalization length by diagnoses as an instrument for CEO's individual hospitalization length.

II. CEO Hospitalization Events and Firm Performance

A. Univariate Tests

To provide initial evidence on the impact of CEOs on firm performance, in Table III, we examine mean operating profitability ratios as a function of the number of hospitalization days for the firm's chief executive. As measures of operating profitability, we employ OROA (column (1)), industry-adjusted OROA (column (2)), net income ratio (column (3)), and industry-adjusted net income ratio (column (4)). We report univariate measures of profitability in Panel A, tests for differences in means in Panel B, and median analysis in Panel C.

Mean profitability ratios show that firms with no CEO hospitalizations and those whose CEOs experienced short hospital stays perform similarly. More specifically, the mean OROA reported in the first row of Panel A is 8.6% for firms with no hospitalization events and 8.0% for firms with CEOs who experienced a one-day hospital stay. While the difference of 0.6% reported in the first

Table II

Number of Days of Hospital Stay and Medical Conditions

This table presents hospitalization data for CEOs of nonfinancial, nonutility, nongovernment-owned limited liability firms in Denmark between 1996 and 2012. Data are classified by medical condition (main sickness) based on the *International Classification of Diseases* of the World Health Organization. Hospital data are constructed based on records from Statistics Denmark, which reports the number of days that an individual was hospitalized.

	Numbers of Observations	Length of Hospital Stays in Days				
		1	2 to 4	5 to 9	10 to 19	over 20
Medical Condition	(1)	(2)	(3)	(4)	(5)	(6)
All firm-years	133,219					
No hospital stay	123,856					
Hospital stay	9,363	3,648	2,770	1,534	866	545
Certain infectious and parasitic diseases	241	73	78	47	32	11
Malignant neoplasm	810	163	186	172	132	157
Disorders of the thyroid gland	9	3	3	2	1	0
Endocrine, nutritional, and metabolic diseases	140	36	46	39	15	4
Diseases of the blood and blood forming organs and disorders of the immune mechanism	38	8	9	8	4	9
Mental and behavioral disorders	40	18	13	6	2	1
Diseases of the nervous system	275	110	81	47	18	19
Diseases of the eye and adnexa	81	22	35	20	3	1
Diseases of the ear and mastoid process	65	30	24	8	3	0
Diseases of the circulatory system	1,908	550	543	405	267	143
Diseases of the respiratory system	472	163	154	84	47	24
Diseases of the digestive system	1,073	449	327	165	91	41
Diseases of the genitourinary system	526	176	194	102	34	20
Pregnancy, childbirth, and the puerperium	11	10	1	0	0	0
Diseases of the skin and subcutaneous tissue	152	52	56	23	14	7
Diseases of the musculoskeletal system and connective tissue	759	293	218	144	72	32
Congenital malformations, deformations, and chromosomal abnormalities	34	15	7	8	4	0
Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	753	434	216	67	19	17
Factors influencing health status and contact with health services	898	557	253	51	24	13
Injury, poisoning, and certain other consequences of external causes	1,032	475	311	131	73	42
Missing diagnosis	46	11	15	5	11	4

Table III

Number of Days of Hospital Stay and Firm Performance: Means and Medians

This table presents average performance measures as a function of the number of days that a firm's CEO stayed in the hospital in a given year (Panel A), differences in means (Panel B), and results from quantile (median) regressions (Panel C). Performance measures include: (a) OROA: operating return on assets (column (1)), the ratio of operating income to total assets, (b) Industry-adjusted OROA (column (2)): the difference between a firm's OROA and the average of its four-digit NACE (European industry classification system) industry benchmark, (c) NI/Assets (column (3)): net income over assets, and (d) Ind. Adj. NI/Assets (column (4)): Industry-adjusted net income over assets, the difference between a firm's net income to assets ratio and the average of its four-digit NACE benchmark. Industry averages are calculated using firm-year observations in which a CEO was not hospitalized. Hospital days data are constructed based on hospitalization records from Statistics Denmark, which reports the number of days that an individual was hospitalized and reported as sick in a year. Standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

		OROA	Ind. Adj. OROA	NI/Assets	Ind. Adj. NI/Assets
	Firm-Years	(1)	(2)	(3)	(4)
Panel A: By Length of Hospital Stay					
All firm-years	133,219	0.0856	0.0000	0.0517	0.0000
		(0.0008)	(0.0008)	(0.0007)	(0.0007)
0 days	123,855	0.0862	0.0006	0.0522	0.0005
		(0.0008)	(0.0008)	(0.0007)	(0.0007)
1 day	3,648	0.0802	−0.0046	0.0486	−0.0028
		(0.0028)	(0.0027)	(0.0024)	(0.0023)
2 to 4 days	2,770	0.0807	−0.0044	0.0476	−0.0037
		(0.0030)	(0.0029)	(0.0026)	(0.0025)
5 to 9 days	1,535	0.0701	−0.0150	0.0370	−0.0143
		(0.0038)	(0.0037)	(0.0032)	(0.0031)
10 to 19 days	866	0.0764	−0.0105	0.0458	−0.0067
		(0.0049)	(0.0047)	(0.0043)	(0.0042)
At least 20 days	545	0.0632	−0.0247	0.0310	−0.0226
		(0.0069)	(0.0069)	(0.0059)	(0.0059)
0 to 4 days, all firms	129,711	0.0859	0.0003	0.0520	0.0003
		(0.0008)	(0.0008)	(0.0007)	(0.0007)
0 to 4 days, event firms	60,822	0.086697	0.000908	0.052817	0.001052
		(0.0012)	(0.0012)	(0.0010)	(0.0010)
At least 5 days	2,946	0.0707	−0.0155	0.0385	−0.0136
		(0.0030)	(0.0029)	(0.0025)	(0.0025)
Panel B: Differences in Means					
1 vs. 0 days		−0.0060**	−0.0052*	−0.0036	−0.0033
		(0.0027)	(0.0027)	(0.0023)	(0.0023)
At least 5 vs. 0 to 4 days		−0.0153***	−0.0158***	−0.0135***	−0.0139***
		(0.0029)	(0.0029)	(0.0025)	(0.0025)
At least 5 vs. 0 to 4 days, event firms		−0.0160***	−0.0164***	−0.0144***	−0.0146***
		(0.0029)	(0.0028)	(0.0025)	(0.0024)

(*Continued*)

Table III—*Continued*

Panel C: Median Analysis				
1 vs 0 days, median	−0.0004	−0.0016	0.0001	−0.0001
	(0.0018)	(0.0018)	(0.0015)	(0.0015)
At least 5 vs. 0 to 4 days, median	−0.0103***	−0.0126***	−0.0086***	−0.0087***
	(0.0020)	(0.0020)	(0.0017)	(0.0017)
At least 5 vs. 0 to 4 days, median, event firms	−0.0108***	−0.0131***	−0.0088***	0.0089***
	(0.0021)	(0.0020)	(0.0017)	(0.0016)

row of Panel B is statistically significant at the 5% level, the difference after adjusting for industry profitability is significant only at the 10% level (first row of Panel B) and the first row of Panel C shows no significant differences in the medians. In columns (3) and (4), we report results based on net income to assets. These results confirm the similarity in profitability for firms with CEOs who experience no hospitalization stay and a one-day hospitalization stay. Similarly, firms whose CEOs were hospitalized for two to four days exhibit profitability ratios that are comparable to firms whose CEOs experienced a one-day hospitalization stay or no hospitalization.

In contrast, firms whose CEOs were hospitalized at least five days consistently underperform their peers. Mean OROA is 7.0%, 7.6%, and 6.3% for firms with CEOs hospitalized for 5 to 9, 10 to 19, and 20 or more days, respectively. More informatively, mean industry-adjusted OROA is −1.5%, −1.1%, and −2.5% relative to the industry norm. As a group, firms with CEOs who were hospitalized at least five days underperform their industry benchmarks by 1.6%. The second row of Table III, Panel B, shows that compared to firms with CEOs who experienced fewer than four hospitalization days, this underperformance is significant at the 1% level.

Interestingly, the third row of Panel B shows that the underperformance of firms with CEOs who experienced hospital stays of at least five days is not explained by nonhospitalization firm comparisons. In other words, focusing on within-firm changes in operating profitability among event firms (i.e., those with at least one hospital event), we obtain a performance difference of −1.6%, −1.6%, −1.4%, and −1.5% for OROA, industry-adjusted OROA, net income to assets, and industry-adjusted net income to assets, respectively, relative to the same firms during times when their CEO is healthy. Economically, these performance differences imply reductions in operating profitability of 17% to 19% from the mean level.

In Table III, Panel C, we report results from univariate quantile (median) regression analysis that tests whether the differences in operating performance that we document are explained by outliers. Using median analysis, we find support for the three main patterns highlighted above. First, firms with CEOs who had brief hospital stays are indistinguishable from nonevent firms in terms of operating performance. Second, firms whose CEOs experienced hospitalizations of at least five days significantly underperform. Third, such

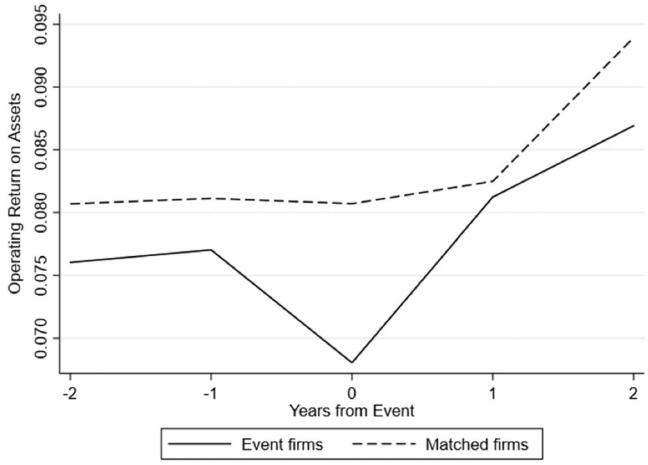

Figure 1. OROA for event and matched samples. This figure plots the average operating return on assets (OROA), defined as operating income over book value of assets, for events firms and a sample of matched firms. Event firms are defined as those with a CEO hospitalization of at least five days. We match each event firm with a nonevent firm in the same industry that is in the same industry quintile the year prior to the hospitalization in terms of OROA, age, and assets.

underperformance is not explained by industry effects and holds even when we focus on within-firm comparisons.

B. Hospitalization Events and Firm Profitability: Matching Subsample and Regression Analysis

B.1. Event and Matching Nonevent Firms

In Figure 1, we plot the OROA of firms with CEOs who experienced a five-day or longer hospitalization stay. We compare this group with similar nonevent firms. Specifically, for each event firm, we select one firm in which the CEO is never hospitalized, the firm is in the same industry, and is in the same industry quintile the year prior to the hospitalization in terms of OROA, age, and assets. Figure 2 plots the difference together with the confidence interval.

As can be seen in Figures 1 and 2, OROA is significantly lower for event firms in the year of the hospitalization. Profitability recovers quickly, however, as it is similar for both subsamples by the first year after hospitalization. Figure 1 also shows that both subsamples follow similar trends prior to the hospitalization shock, which supports a causal interpretation of our results.

B.2. Multivariate Analysis

In Table IV, we turn to multivariate analysis to investigate the impact of hospitalization events on firm profitability using first firm and then firm-CEO fixed-effects specifications.

Table IV

The Effect of CEO Hospitalization on Firm Performance

This table examines the effect of CEO hospitalization on firm operating performance. In columns (1) to (5), the dependent variable is *operating return on assets* (OROA), the ratio of operating income to total assets. In column (6), the dependent variable is net income to total assets. Hospital days data are constructed based on records from Statistics Denmark, which reports the number of days that an individual was hospitalized in a given year. *N days of hospital stay, t*, is the number of days a CEO was hospitalized in a given year. *N days of hospital stay, t*−1, *is* the number of days a CEO was hospitalized in the prior year. *N days of hospital stay btw 1 and 4*, *N days of hospital stay btw 5 and 9*, *and N days of hospital stay at or above 10* are indicator variables equal to 1 if a given CEO experienced a hospital stay in the range indicated or 0 otherwise. Firm controls include (a) *Ln(Assets in real DKK)*, the natural logarithm of the lagged value of total assets (in DKK millions), (b) *CEO age dummies* for every five-year bin of CEO age, and (c) *Firm age dummies* for every five-year bin of firm age, calculated using the earliest of the year of establishment, registration, or the firm's bylaws. Each column repeats results of a separate fixed effect regression using firm fixed effects (columns (1) and (2)), and firm-CEO fixed effects (columns (3) to (6)). Clustered (firm) standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	OROA	OROA	OROA	OROA	OROA	Income/Assets
	(1)	(2)	(3)	(4)	(5)	(6)
N. days at hospital, t	−0.00059***	−0.00050***	−0.00050***	−0.00050***		−0.00037***
	(0.00012)	(0.00011)	(0.00011)	(0.00011)		(0.00009)
N. days at hospital, t−1				−0.00016		
				(0.00010)		
N. days of hospital stay btw 1 and 4					−0.00240	
					(0.00174)	
N. days of hospital stay btw 5 and 9					−0.00617*	
					(0.00325)	
N. days of hospital stay at or above 10					−0.00983***	
					(0.00352)	
Firm controls	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes	Yes
Firm/Firm-CEO FE	Firm	Firm	Firm-CEO	Firm-CEO	Firm-CEO	Firm-CEO
R^2	0.00030	0.05347	0.05574	0.05576	0.05564	0.04279
Number of firm-years	133,219	133,063	133,063	133,063	133,063	133,063

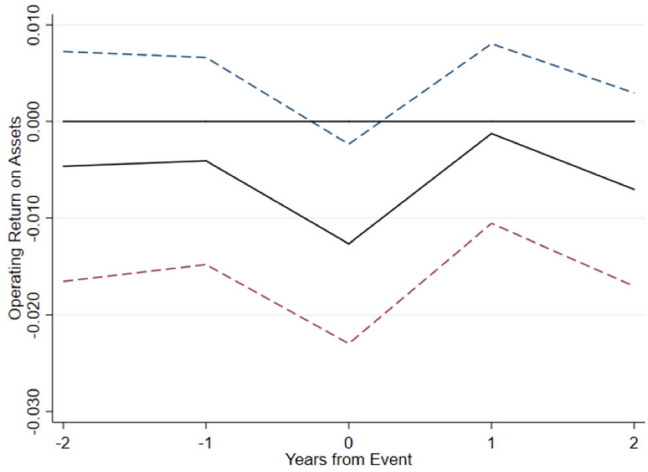

Figure 2. Difference in OROA between event and matched firms. This figure plots the difference in average operating return on assets (OROA) between event firms and matched firms. The dashed lines represent 95% confidence intervals. Event firms are defined as those with a CEO hospitalization of at least five days. We match each event firm with a nonevent firm in the same industry that is in the same industry quintile the year prior to the hospitalization in terms of OROA, age, and assets. (Color figure can be viewed at wileyonlinelibrary.com)

As a benchmark for analysis, in column (1), we report the effect of the number of days that a CEO spends in the hospital on profitability (OROA) without firm or year controls but with firm fixed effects. The estimated coefficient is −0.0006, significant at the 1% level. This estimate implies that a 10-day hospitalization leads to a decline in OROA of 0.6 percentage points, or 7% relative to mean profitability levels.

Column (2) shows that the estimated coefficient on the number of days a CEO spends in the hospital decreases slightly with the inclusion of firm controls and year fixed effects. The firm-level controls include firm size (log of lagged assets), CEO age (five-year bins), and firm age (five-year bins, where the year the firm is founded is calculated using the earliest of the year of establishment, registration into the business register, and the year in which the bylaws were approved).

The evidence presented in Table IV, columns (1) and (2), shows that when firm time-invariant characteristics and observable time-varying controls are held constant, CEO hospitalizations affect firm profitability. However, firm fixed effects specifications do not allow us to determine whether the results are driven by CEO turnover events, which compare outgoing and incoming CEOs, or by within-CEO variation in CEO exposure that results from hospitalizations. A large literature emphasizes the importance of CEO turnover events and of CEO fixed effects in explaining changes in firm outcomes.[7] In this paper,

[7] For changes in performance around turnover events, see Johnson et al. (1985), Denis and Denis (1995), Huson, Malatesta, and Parrino (2004), Pérez-González (2006), and Bennedsen et al.

in contrast, we seek to estimate the effect of changing CEO productivity on performance, holding firm-CEO matches constant, which is an economically relevant relation that is unexplored in the literature. To this end, we rely on firm-CEO fixed effects specifications.

In Table IV, column (3), we show that after controlling for firm-CEO fixed effects, CEO hospitalizations negatively affect profitability. The effect is statistically significant at the 1% level and in terms of magnitude is virtually unchanged relative to the firm fixed effects specifications. However, the economic interpretation of the result is distinct. Relative to a given CEO-firm match, firm performance declines whenever a CEO is hospitalized. This result provides striking evidence on the direct impact of CEOs on the organizations they lead.

The above finding also overcomes concerns that the correlation between managerial effects and firm performance is driven solely by demand and not supply effects (Fee, Hadlock, and Pierce (2013)). The concern is that CEO fixed effects are observed by the board of directors and other market participants, in which case CEOs may be hired precisely because of their known traits, making it empirically difficult to separate the effect of CEOs on firm performance that results from demand (firm) or supply (CEO) forces. Our evidence demonstrates that changing managerial supply of effort resulting from hospitalizations significantly influences firm outcomes.

In Table IV, columns (4), we test whether CEO hospitalization effects last beyond the year in which these shocks occur. The results show that lagged hospitalization does not have a significant effect on firm performance. This result is consistent with Figures 1 and 2 that show that performance the year after the shock is statistically indistinguishable for event firms and their nonevent counterparts.

In Table IV, column (5), we examine the effect of hospital stays of different lengths using indicator variables. Specifically, we use dummy variables that indicate whether the CEO had a hospital stay between one to four days, five to nine days, or 10 or more days. The results confirm that short hospitalization events (hospital stays of one to four days) do not have a meaningful effect on firm performance. In contrast, longer hospitalizations are correlated with economically and statistically significant effects on profitability. In particular, hospital stays of five to nine days lead to a decline in OROA of 0.6% (significant at the 10% level) relative to the profitability of the same firm in years in which the same CEO is not hospitalized. For hospital stays of 10 or more days, OROA drops by almost a full percentage point (significant at the 1% level). Using net income over assets as the profitability measure leads to qualitatively similar results as shown in column (6).

(2007), among others. For the importance of CEO fixed effects on firm outcomes, see Chevalier and Ellison (1999), Bertrand and Schoar (2003), Frank and Goyal (2007), and Graham, Li, and Qiu (2012), among others.

C. Causality

One concern with the interpretation of our main results is that hospitalizations may coincide with periods of poor performance without causing them. For example, to the extent that some illnesses are stress-related, hospitalizations may be triggered by poor performance, in which case firms on a downward performance trajectory may be more likely to have a hospitalized CEO.

We address this potential explanation of our results in Table V, Panel A. In the model in column (1), we include the hospitalization length in year $t+1$ in our standard regression. We find that the coefficient of this variable is small and not statistically different from zero, suggesting that performance in the year prior to hospitalization is not correlated with the number of hospitalization days. In column (2), we drop the current hospitalization length and obtain essentially the same result. Thus, to the extent that poor performance is at least partly detectable in the prior year, these results cast doubt on the reverse causality explanation. In addition, Figure 1 shows no differential pre-event trend in OROA between firms with a five-day or longer hospitalization and their matched firms. In columns (3) and (4), we exclude from the standard regression firm-years in which the CEO is hospitalized for a condition that is potentially triggered by anxiety or stress. Specifically, in column (3), we drop "Mental and behavioral disorders" and "Diseases of the nervous system," while in column (4), we drop a larger set of conditions identified by medical research as being potentially caused by stress (Hurst, Jenkins, and Rose (1976)). The coefficients on the number of hospitalization days are almost identical to those obtained in our standard regression, and they continue to be highly significant (at the 1% level). The fact that the coefficient using only conditions not likely to be influenced by anxiety or stress is almost identical to that in our benchmark regression suggests that our results are unlikely to be explained by poor performance causing hospitalizations.

Hospitalizations may also coincide with periods of poor performance if CEOs postpone treatment to years of poor firm performance. Given that our data are annual, this potential explanation is unlikely as it would require that a CEO waits a considerable amount of time to get treated. Nevertheless, we address this concern formally by focusing on deadlier conditions for which it is unlikely that CEOs would wait to seek treatment. In column (1) of Table V, Panel B, we estimate our standard model using only those hospitalization events for which the condition is below the median in terms of survival probability. We use information on medical conditions and deaths for the entire Danish population to estimate these survival probabilities. We find that the estimate for number of hospitalization days is unchanged and remains highly significant. In column (2), we estimate the same model but using only malignant neoplasm (cancer), a condition for which prognosis worsens with treatment delay. We again obtain a negative coefficient that is highly significant. These results suggest that our results are unlikely to be driven by CEOs choosing their hospitalization to coincide with periods of poor firm performance.

Table V

Alternative Specifications and Subsamples by Medical Condition

This table examines the effect of CEO hospitalization events on operating return on assets (OROA), the ratio of operating income to total assets. Panels A, B, and C address different challenges to the identification strategy. N *days of hospital stays, t and t+1*: the numbers of days a CEO was hospitalized in a given year and in the following year. In Panel A, column (1) includes current and future hospitalization, column (2) includes only future hospitalization, column (3) omits mental and nervous-related diagnoses, and column (4) omits stress-related diagnoses. In Panel B, column (1) shows results for CEO hospitalization events focusing on diagnoses with below-median survival rates, and column (2) shows results for CEO hospitalization events focusing on cancer-related diagnoses (malignant neoplasm). All regressions in Panel C are estimated using 2SLS-IV using the fraction of patients who spend at least 10 days at the hospital for a given medical condition (99 diagnosis) between 1995 and 2012 for the entire Danish population as an instrument. In columns (1) to (2), *N* days at hospital and *t* is instrumented, while in column (3), the indicator variable for whether the CEO spent more than 10 days at the hospital is instrumented. Firm controls include *Ln(Assets in real DKK)*, the natural logarithm of the lagged value of total assets (in DKK millions), *CEO age dummies* for every five-year bin of CEO age, and *Firm age dummies* for every five-year bin of firm age, calculated using the earliest of the year of establishment, registration, or the firm's bylaws. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Does Poor Performance Cause Future Hospitalizations?

	All Conditions	All Conditions	Exclude Mental and Nervous	Exclude All Stress Related
	(1)	(2)	(3)	(4)
N. days at hospital, *t*	−0.00051***		−0.00054***	−0.00043***
	(0.00011)		(0.00011)	(0.00014)
N. days at hospital, *t*+1	−0.00015	−0.00013		
	(0.00012)	(0.00012)		
Firm controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm-CEO FE	Yes	Yes	Yes	Yes
Medical conditions included	All	All	All except mental and nervous	All except stress related
R^2	0.05577	0.05555	0.05579	0.05513
Observations	133,063	133,063	132,748	129,300

Panel B: Do CEOs Choose to Enter the Hospital When Firm Performance Is Poor?

	Nondeadly	Cancer Only (Malignant Neoplasm)
	(1)	(2)
N. days at hospital, *t*	−0.00054***	−0.00078***
	(0.00013)	(0.00026)
Firm controls	Yes	Yes
Year FE	Yes	Yes
Firm-CEO FE	Yes	Yes
Medical conditions included	Below median survival	Neoplasms
R^2	0.05603	0.0554
Observations	129,387	124,209

(*Continued*)

Table V—*Continued*

Panel C: Does Firm Performance Cause Hospital Length?			
	All Conditions IV-2SLS	All Conditions IV-2SLS	All Conditions IV-2SLS
	(1)	(2)	(3)
N. days at hospital, t	−0.00167***	−0.00092***	
	(0.00024)	(0.00023)	
Stayed at hosp. 10 days or more, t			−0.03103***
			(0.00812)
Firm controls	No	Yes	Yes
Year FE	No	Yes	Yes
Firm-CEO FE	Yes	Yes	Yes
IV-2SLS	Yes	Yes	Yes
R^2		0.05563	0.05156
Observations	133,097	132,941	133,097

One last concern is that a firm's current performance may affect the length of the CEO's hospitalization stay. To the extent that patients have some discretion over the number of days they spend at the hospital, it could be the case that CEOs of highly performing firms strive to go back to work sooner. Under this alternative explanation, performance would cause hospitalization length. To overcome this concern, we use exogenous variation in the length of CEOs' hospital stays. We argue that the fraction of lengthy hospital stays per medical condition for the entire Danish population is a plausible instrument for the intensity of a CEO's medical shock. To test this idea empirically, we first compute the fraction of patients who spend at least 10 days in the hospital between 1996 and 2012 for each medical condition.[8] We next use this variable to predict the length of hospital stays in days, and whether the CEO experiences a 10-day or longer hospitalization. We then use a two-stage least-squares IV (2SLS-IV) specification to test for the impact of hospitalizations on performance.

As predicted, country-wide variables are strong predictors of CEOs' time spent hospitalized. The value of the univariate first-stage F-test is over 70. Using this first-stage variation, the results in Table V, Panel C, confirm that CEO hospitalization events have a negative effect on operating profitability. The IV estimates reported in columns (1) and (2) are larger than those obtained using ordinary least squares (OLS). Analysis based on the 10-day hospital stay indicator variable shown in column (3) yields similar conclusions. As is common with 2SLS-IV specifications, the standard errors are substantially larger than those obtained using OLS because IV estimates rely on a fraction of the variation to generate the estimates of interest. As a result, we cannot

[8] Medical conditions represented by 99 diagnosis based on the *International Classification of Diseases* of the World Health Organization.

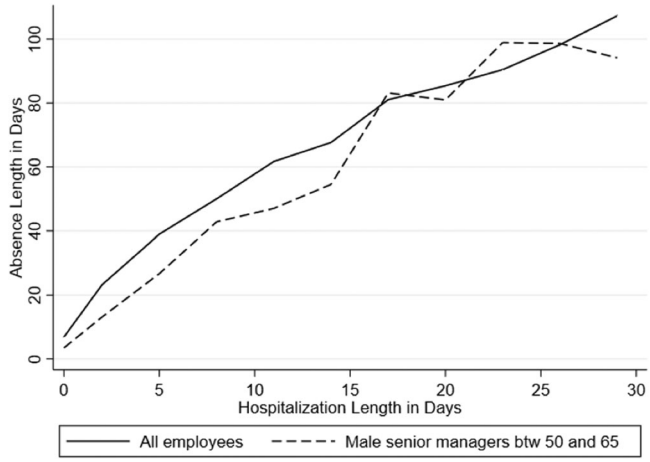

Figure 3. Absent days and hospitalization days. This figure plots the average number of absent days conditional on hospitalization length for (i) all employees and (ii) all male senior managers between 50 and 65 years of age for firms included in the Statistics Denmark survey of absenteeism in the period 2007 to 2012.

reject the hypothesis that the OLS fixed effect estimates are different from those reported in this alternative specification.

Overall, our results indicate that CEO hospitalizations lead to a large and significant decline in profitability. These findings provide novel evidence that variation in firms' exposure to their CEOs affects firm performance after controlling for firm-CEO fixed effects, which is a new result in the literature. Moreover, we demonstrate that our results are robust to the inclusion of a battery of controls and the use of specifications consistent with a causal interpretation of the relationship between firms' exposure to their CEOs and firm performance.

D. Interpreting the Magnitude of the Effect

In this section, we present evidence to assess the economic magnitude of our main effect. First, we report the relation between hospitalization days and absence days, a more direct measure of a firm's exposure to its CEO. Hospitalizations are typically accompanied by a period of convalescence, and as a result, the CEO is away from the firm for a longer period than the hospitalization stay alone. To get a sense of the relation between hospitalization length and absence days, we employ a novel data set assembled by Statistics Denmark on the absences of employees of 2,600 Danish firms. We plot this relation in Figure 3 for all employees and for male senior managers between 50 and 65 years of age. The second group is comparable in terms of position, gender, and age to our CEOs.[9] The figure shows that while the average employee

[9] Unfortunately, the match with our sample is poor, so we are unable to report absence days for CEOs in our sample.

Table VI
The CEO Hospitalization and Deaths Events

This table compares the effect of CEO hospitalizations lasting at least 10 days (columns (1) and (2)) with the effect of CEO deaths (columns (3) and (4)) on operating return on assets (OROA), the ratio of operating income to total assets. *At least 10 days hospitalized*, *t*, is an indicator taking the value of 1 if a CEO has been hospitalized at least 10 days in year *t* and 0 otherwise. *CEO death*, *t*, is an indicator variable that takes the value 1 if the CEO died in year *t* and 0 otherwise. Firm controls include *Ln(Assets in real DKK)*, the natural logarithm of the lagged value of total assets (in DKK millions), *CEO age dummies* for every five-year bin of CEO age, and *Firm age dummies* for every five-year bin of firm age, calculated using the earliest of the year of establishment, registration, or the firm's bylaws. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	CEO Hospitalization		CEO Death	
	(1)	(2)	(3)	(4)
At least 10 days hospitalized, *t*	−0.01166***	−0.00912***		
	(0.00359)	(0.00352)		
CEO death, *t*			−0.02861***	−0.01869**
			(0.00854)	(0.00845)
Firm controls	No	Yes	No	Yes
Year FE	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	133,219	133,063	133,219	133,063

with no hospitalization stay is absent seven days per year, an employee who is hospitalized from one to three (four to six) days is absent for 23 (39) days. For male senior managers aged between 50 and 65, the respective values are 3, 13, and 27 days. Overall, Figure 3 shows that even short hospitalization stays can lead to prolonged absences from work.

Another way to get a sense of the magnitude of our main effect is to compare it with the decline in performance around CEO deaths. CEO deaths have been extensively studied in the literature. Because they are more dramatic than hospitalizations, they are likely to provide an upper bound to the magnitude of the CEO hospitalization effect that we document. In Table VI, we compare results of a 10-day hospitalization event to a CEO death event. In models with no controls, a 10-day hospitalization event leads to a decline in OROA of 1.2% (column (1)), while a CEO death event leads to a decline in OROA of 2.9% (column (3)). With controls, hospitalizations lead to a 0.9% decrease in OROA (column (2)) and CEO deaths lead to a 1.7% decline (column (4)). In sum, a 10-day hospitalization leads to about half of the decline in firm performance as a CEO death.

An important aspect in interpreting our results is whether our test captures a "pure" CEO effect, or whether we are capturing the combined effect of a CEO absence and the organizational response to this absence. The magnitude of the CEO effect that we document may be a lower bound on the "pure" CEO effect if the firm responds to a CEO absence by reorganizing its senior management team. To explore this possibility, we estimate the effect of a 10-day hospitalization on the number of incoming and outgoing non-CEO managers. The results

are reported in columns (1) and (2) of Table VII, Panel A. We find that a 10-day hospitalization does not significantly affect the number of incoming and outgoing non-CEO managers. The coefficients are close to zero and not statistically significant at any conventional level. Thus, to the extent that we can observe organizational structure, the only change around the hospitalization event seems to be the absence of the CEO.

For comparison, we next repeat the above regressions for CEO deaths. The results are reported in columns (3) and (4). The coefficients are positive and larger in magnitude. In addition, in the regression with the number of incoming non-CEO executives as dependent variable, the coefficient on CEO deaths is significant at the 10% level. This evidence suggests that after the death of a CEO, the incoming CEO brings her own management team. As a result, the CEO effect around CEO deaths comprises both the pure CEO effect and the effect of the restructured management team. When a CEO is hospitalized, however, no observable management team reorganization takes place.

Finally, in Table VII, Panel B, we explore the effect of organizational preparedness on the magnitude of the CEO effect by focusing on unexpected shocks. We identify unexpected shocks by focusing on the first hospitalization of a CEO and by using the diagnosis code to identify illnesses that are unexpected. Column (1) presents our benchmark regression for comparison (the regression presented in Table IV, column (3)). To capture the effect of a CEO's first hospitalization event during the sample period, we eliminate those hospitalization events for CEOs who had experienced a previous hospital stay since 1996. Column (2) shows that the effect of CEO hospitalization duration on performance is slightly larger in absolute value than the benchmark regression, but it is not statistically different from the benchmark result.

We obtain a similar result when we use unexpected medical conditions. Using all employees in the survey of absences, we compute for each medical condition the average number of days absent the year prior to the hospitalization. We classify conditions with a lower number of average absences in the prior year as unexpected. In the regression in column (3), we only keep unexpected hospitalizations. The coefficient estimate on the number of days is similar to that obtained in column (2). The small and insignificant differences between expected and unexpected shocks suggest that it might be difficult to temporarily cover the CEO's responsibilities during her absence, consistent with the lack of organizational response that we find above.

Overall, we find that even short hospital stays can lead to prolonged absences from work. However, as we show in Table III, only hospitalizations lasting at least five days lead to a decline in the performance. According to Figure 3, these hospitalizations correspond to absences from the firm of at least 27 working days. We also compare hospitalizations of at least 10 days with CEO deaths. We find the magnitude of the effect for hospitalizations to be about half that for deaths. Interestingly, we show that these hospitalizations are not accompanied by organizational changes, whereas CEO deaths are. Finally, we find slightly larger effects for unexpected shocks.

Table VII

Organizational Response and Preparedness

Panel A shows organizational responses to CEO hospitalization and CEO death events. In columns (1) and (3), the dependent variable is the number of incoming non-CEO senior managers. In columns (2) and (4), the dependent variable is the number of outgoing non-CEO senior managers. *At least 10 days hospitalized*, *t*, is an indicator taking the value of 1 if a CEO has been hospitalized at least 10 days in year *t* and 0 otherwise. *CEO death*, *t*, is an indicator variable that takes the value 1 if the CEO died in year *t* and 0 otherwise. Panel B examines the effect of CEO hospitalization events on operating return on assets (OROA) as a function of organizational preparedness. Column (1) includes the full sample, column (2) omits all observations that are not the first hospitalization for a given CEO in our data, and column (3) focuses on hospitalization events that are unexpected. Using all employees in the survey of absences, we compute for each medical condition the average number of absent days the year prior to the hospitalization. We classify conditions with below-average number of absences as unexpected. *N days of hospital stay*, *t*, is the number of days of hospital stay for a CEO in a given year. In both panels, unreported firm-level controls include *Ln(Assets in real DKK)*, the natural logarithm of the lagged value of total assets (in DKK millions), *CEO age dummies* for every five-year bin of CEO age, and *Firm age dummies* for every five-year bin of firm age, calculated using the earliest of the year of establishment, registration, or the firm's bylaws. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Organizational Response

	Dependent Variable: Number of non-CEO Senior Managers			
	Incoming (1)	Outgoing (2)	Incoming (3)	Outgoing (4)
At least 10 days hospitalized, *t*	−0.01828	−0.05674		
	(0.06311)	(0.06992)		
CEO death, *t*			0.25712*	0.34104
			(0.13964)	(0.21082)
Firm Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	110,076	110,251	110,076	110,251

Panel B: Organizational Preparedness

	Dependent Variable: OROA		
	Hospitalizations Included		
	All (1)	First Shock (2)	Unexpected (3)
N. days at hospital, *t*	−0.00050***	−0.00065***	−0.00070***
	(0.00011)	(0.00024)	(0.00023)
Firm controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Observations	133,063	128,145	126,328

E. Alternative Outcome Variables

In Table VIII, we investigate the effect of CEO hospitalization shocks on a number of alternative outcome variables. For each variable, we rely on firm-CEO fixed-effect specifications and report clustered (firm) standard errors to relax the assumption that multiple observations from the same firm are uncorrelated.

We first analyze the effect of CEO hospitalization on financial distress. The ES data set contains the dates at which firms enter different stages of the bankruptcy process. Since we are interested in a broad measure of financial distress, we define the onset of financial distress to be the earliest date when the firm enters any of these processes. Based on this definition, column (1) shows that longer hospital stays lead to a higher probability of distress in the next two years. The coefficient is significant at the 5% level. In column (2), we restrict the sample to firms below the median in terms OROA in the year prior to the hospitalization. In this specification, the size of the coefficient is about twice as large and is significant at the 5% level.

We next turn to sales, asset size, and investment. The results presented in Table VIII, column (3), show that CEO hospitalizations do not have a statistically significant effect on firm sales. Column (4) shows the effect of CEO hospitalization on the level of assets. The coefficient implies that a 10-day hospitalization leads to a reduction in assets of 0.6%, significant at the 1% level. Finally, the number of days that a CEO is hospitalized has a negative effect on firm investment (column (5)): a 10-day hospital stay leads to a decline in investment rates of 0.4% or about 12% from its mean. This effect is statistically significant at the 5% level.

To shed more light on the role of the CEO, we analyze important decisions around CEO hospitalization events. Table VIII, columns (6) to (8), present evidence indicating that hospitalization events affect corporate restructuring decisions, which typically involve significant input from the CEO. In column (6), we find that the probability of a spin-off decreases. This effect is statistically significant at the 5% level. Furthermore, in column (7), we show that the probability of a large asset increase (larger than 5% of total assets) decreases, with the effect statistically significant at the 10% level. However, in column (8), we do not find any effect of hospitalization on large asset decreases.

III. Are CEOs Unique?

The evidence presented in Tables III to VIII shows a striking connection between the personal health of a firm's chief executive and the firm's performance. In this section, we test whether CEOs are unique, or whether the effects reported for CEOs also apply to other senior executives. To examine this question empirically, we test whether the hospitalization events of senior managers have significant consequences for profitability.

To identify senior executives, we use employment records that contain broad job classifications and we sort employees into three groups according to the

Table VIII

The Effect of CEO Hospitalization Events: Alternative Outcome Variables

This table examines the effect of CEO hospitalization events on various outcome measures. The dependent variables are: *Distress* (columns (1) and (2)), an indicator variable taking the value of 1 if the firm starts any bankruptcy or reorganization procedure in years t to $t+2$; *Ln Sale* (column (3)), the natural logarithm of sales in DKK millions; *Ln Assets* (column (4)), the natural logarithm of total book value of assets in DKK millions; *Investment Rate* (column (5)), the rate of growth of total assets; *Ln Spin-offs* (column (6)), the natural logarithm of the number of spin-offs in years t to $t+2$; *Large Asset Increase* (column (7)), an indicator variable taking the value of 1 if assets increased by more than 5%; and *Large Asset Decrease* (column (8)), an indicator variable taking the value of 1 if assets decrease more than 5%. *N days at hospital, t*, is the number of days the CEO was hospitalized in a given year. All specifications include year indicator variables as controls (results not shown). Unreported firm-level controls include *Ln(Assets in real DKK)*, the natural logarithm of the lagged value of total assets (in DKK millions), *CEO age dummies* for every five-year bin of CEO age, and *Firm age dummies* for every five-year bin of firm age, calculated using the earliest of the year of establishment, registration, or the firm's bylaws. Each column reports results for a separate fixed effect (firm-CEO) specification. Clustered (firm) standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Distress	Distress	Ln Sale	Ln Assets	Investment Rate	Ln Spin Offs	Large Asset Increase	Large Asset Decrease
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
N. days at hospital, t	0.00044**	0.00087**	−0.00032	−0.00058***	−0.00042**	−0.00022**	−0.00084*	0.00029
	(0.00022)	(0.00036)	(0.00034)	(0.00020)	(0.00021)	(0.00009)	(0.00044)	(0.00041)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-CEO FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospitalization events included	All	Firms below median ind. OROA	All	All	All	All	All	All
Observations	104,251	100,823	132,979	133,063	130,859	133,063	133,063	133,063

Table IX

Are CEOs Unique? Other Managers' Hospitalization Events and Firm Performance

This table examines the impact of non-CEO senior manager's hospitalization events on: (a) *Operating return on assets* (OROA) (columns (1) to (3)), the ratio of operating income to total assets, and (b) *Net income to assets* (column (4)), the ratio of net income to total assets. For each firm-year observation, we (1) use employment data and randomly select a non-CEO senior manager, and (2) obtain matching hospitalization data from Statistics Denmark. *N days of hospital stay, t*, is the number of days the chosen senior manager was hospitalized in a given year. *N days of hospital stay*, $t-1$, is the number of days the chosen senior manager was hospitalized in the prior year. *N days of hospital stay btw 1 and 4*, *N days of hospital stay btw 5 and 9*, and *N days of hospital stay at or above 10* are indicator variables equal to 1 if the chosen senior manager experienced a hospital stay in the range indicated or 0 otherwise. Clustered (firm) standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	OROA	OROA	OROA	Net Income/Assets
	(1)	(2)	(3)	(4)
N. days at hospital, t	−0.00023**	−0.00024**		−0.00020**
	(0.00010)	(0.00010)		(0.00010)
N. days at hospital, $t-1$		0.00006		
		(0.00011)		
N. days of hospital stay btw 1 and 4			−0.00098	
			(0.00162)	
N. days of hospital stay btw 5 and 9			−0.00427	
			(0.00316)	
N. days of hospital stay at or above 10			−0.00702*	
			(0.00367)	
Firm controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	132,429	132,429	132,429	132,429

seniority of their positions. The first group includes the most senior employees ("top managers" or "high-level managers"), the second group includes midlevel employees ("intermediate" positions), and the third group includes the rest (employees classified as performing "basic" or "other" jobs). Using these data, for each firm-year, we randomly select an employee from the most senior category. With the identity of the senior employee in hand, we obtain matching hospitalization records using the same procedure that we follow for the sample of CEOs.

Table IX reports the effect of senior employees' hospitalization events on firm performance. In columns (1) to (3), we examine the effect of the number of days in the hospital on operating profitability, the benchmark performance measure used in the preceding section. Interestingly, the effect of a hospital stay by non-CEO executives, reported in column (1), is negative and statistically significant at the 5% level. However, the size of this effect is around half the size of the CEO effect. We do not find any effect of lagged hospitalization events (column (2)). Column (3) shows that this effect is driven by long hospitalization stays.

In column (4), we use net income over assets as the profitability measure. We again find a negative effect that economically is about half the size of the CEO effect.

Taken together, the evidence in Table IX shows that while shocks to managers' health do have a negative effect on firm operations, CEOs are particularly important for firm performance, as their absence is more than twice as costly as the absence of other managers. This evidence highlights the importance of a comprehensive CEO succession and contingency plan.

IV. Heterogeneity in the Impact of CEO Hospitalization Events on Firm Performance

Having established the importance of CEOs for firm performance, we examine conditions under which CEOs affect performance most. Toward this end, we divide event firms into subsamples based on their CEO's characteristics, as well as firm and industry traits.

In the interest of conserving space, in Table X, we only report the estimated coefficient on the key variable of interest, namely, the number of hospitalization days. Thus, each coefficient in this table corresponds to a separate specification. As before, we rely on firm-CEO fixed effects to stress deviations in performance between a firm with a hospitalized CEO and the same firm with the same CEO in periods without a hospitalization. All specifications include firm controls and year fixed effects.

A. CEO Characteristics

Columns (1) to (3) of Table X, Panel A, examine the effect of the number of days a CEO is hospitalized on subsamples grouped by the tenure of the CEO at the time of the hospitalization event. Column (1) reports the effect of CEO hospitalization events on firms with relatively new CEOs. We show that CEO hospitalizations have an insignificant effect on outcomes for these firms. In contrast, columns (2) and (3) show that for firms with CEOs who have been at the helm for more than two years prior to their hospitalization, performance consistently declines when their CEOs are hospitalized. These decreases in performance are significant at conventional levels.

To further explore the effect of CEO tenure, in columns (4) and (5), we split firms based on whether their CEO has served past normal retirement age. In the subsample of firms with CEOs older than 65 years of age, we do not find a significant effect of CEO hospitalization on firm profitability. However, this subsample is small since few CEOs stay past their retirement age. In contrast, in the subsample of firms with younger CEOs, we obtain a coefficient similar in magnitude to the one in our main specification that is significant at the 1% level.

We also explore whether the result that CEO hospitalizations affect performance can be explained by CEO deaths (i.e., hospitalization may simply be a noisy proxy for death), in which case our findings would not strictly be new. To

Table X

CEO Hospitalization Events on Firm Performance: CEO Characteristics

This table examines the impact of CEO hospitalization events on firm outcomes when event firms are classified into subsamples based on a CEO's individual (Panel A), firm (Panel B), and industry (Panel C) characteristics. The dependent variables are *Operating return on assets* (OROA), the ratio of operating income to total assets; *Ln revenue,* the natural logarithm of sales in DKK millions; and *Ln assets,* the natural logarithm of total book value of assets in DKK millions. In Panel A, individual characteristics include: *CEO tenure*, the number of years since the individual first appears as CEO of the firm; *CEO age*, the age of the CEO at the time of the initial hospitalization event; *CEO status,* whether the CEO was alive as of the end of 2012; and *CEO education*, whether the CEO obtained a college education based on data from Statistics Denmark. In Panel B, firm-level characteristics include: *Size*, the total number of employees; *Board presence*, whether the firm has a formal board; and *Family firm status,* an indicator that takes the value of 1 when at least three members of the same family are board members and/or CEO. In Panel C, firms are classified into the high (low) industry growth group when the aggregate rate of growth in aggregate industry (four-digit NACE classification) assets is above (below) the sample median over the period 1996 to 2012. Firms are classified into the above-median (below-median) human capital industry group if the fraction of employees in the industry with a college degree is above (below) the median over the period 1996 to 2012. Each estimated coefficient corresponds to a separate regression that results from a fixed effect (firm-CEO) specification. All specifications include as controls *Ln(Assets in real DKK)*, the natural logarithm of the lagged value of total assets (in DKK millions), *CEO age dummies* for every five-year bin of CEO age, *Firm age dummies* for every five-year bin of firm age, calculated using the earliest of the year of establishment, registration, or the firm's bylaws, and year fixed effects. Clustered (firm) standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: By CEO Characteristics

	CEO Tenure			CEO age		CEO Status as of 2012		CEO Education	
	Short (1)	Medium (2)	Long (3)	Age ≤ 65 (4)	Age > 65 (5)	CEO Passed Away (6)	CEO Is Alive (7)	No College (8)	College (9)
OROA	0.00007	−0.00040***	−0.00055**	−0.00060***	−0.00025	−0.00043**	−0.00054***	−0.00032***	−0.00083***
	(0.00024)	(0.00015)	(0.00024)	(0.00012)	(0.00024)	(0.00018)	(0.00013)	(0.00012)	(0.00021)
Observations	33,592	61,295	38,176	123,515	9,548	5,701	127,362	87,454	43,897

(*Continued*)

Table X—*Continued*

Panel B: By Firm Characteristics						
	Size (number of employees)		Board Presence		Family Firm Status	
	Smallest Quartile (1)	Largest Quartile (2)	No Board (3)	Board (4)	Nonfamily Firm (5)	Family Firm (6)
OROA	−0.00032**	−0.00081***	−0.00111***	−0.00036***	−0.00033***	−0.00099***
	(0.00013)	(0.00029)	(0.00031)	(0.00011)	(0.00012)	(0.00023)
Observations	33,284	33,255	37,501	95,562	95,422	26,698

Panel C: By Industry Characteristics				
	Industry Growth (Increase in ind. Assets)		Industry Human Capital (% ind employee w/college)	
	Above Median (1)	Below Median (2)	Above Median (3)	Below Median (4)
OROA	−0.00047***	−0.00053***	−0.00052***	−0.00045***
	(0.00014)	(0.00016)	(0.00016)	(0.00014)
Observations	68,299	64,764	65,766	67,297
Ln revenue	−0.00042	−0.00030	−0.00090*	0.00053
	(0.00041)	(0.00056)	(0.00047)	(0.00045)
Observations	68,254	64,725	65,721	67,258
Ln assets	−0.00073***	−0.00033	−0.00080***	−0.00031
	(0.00025)	(0.00029)	(0.00026)	(0.00029)
Observations	68,299	64,764	65,766	67,297

do so, we split firms into two groups depending on whether the CEO is alive as of the end of our sample. The results, reported in columns (6) and (7), indicate that the effect of CEO hospitalization on firm outcomes obtains in both subsamples. These results reinforce the idea that the hospitalization-performance results presented in this paper reveal a hitherto unexplored link between CEOs and firm performance.

Columns (8) and (9) present results obtained by splitting sample firms based on CEO education. We find that firms with college-educated CEOs suffer a larger decline in performance when their CEO is hospitalized. Assuming that education proxies for managerial talent, such evidence is consistent with the idea that highly talented CEOs are particularly valuable.

Taken together, the results of the analysis of CEO characteristics show that strong managerial effects obtain in settings in which the CEO is relatively young, college educated, and with an intermediate or long tenure. In addition, the results rule out the possibility that our main effect is a consequence of CEO deaths, which have been explored in the literature at least since Johnson et al. (1985).

These results allow us to distinguish between two theories on the role of a CEO. In the first, it is important to have a CEO, but anyone in the CEO position would have the same effect. In the second, CEOs differ in their ability to manage firms. Our results in this section support the second explanation.

B. Firm Characteristics

In Table X, Panel B, we explore the effect of CEO hospitalization on profitability by firm size. To do so, we split firms into quartiles by their average number of employees across years. Columns (1) and (2) report the effect of the length of hospitalization on the performance for firms in the smallest and largest quartiles, respectively. We find a significant negative effect for both the smallest and the largest quartile of firms. However, the effect on the largest quartile of firms is more than twice as large as the effect on the smallest quartile, indicating that the CEO effect we document is not driven by small firms.

In columns (3) to (6), we report evidence on the role of governance characteristics. We find that firms with no board of directors (column (3)) suffer a more severe decline in performance around CEO health shocks. However, we also obtain a negative and highly statistically significant coefficient for the subsample of firms with boards (column (4)), suggesting that our result is not only driven by firms with no boards.

In columns (5) and (6), we compare family firms to nonfamily firms. We define a family firm as one in which at least three members of the same family are either board members or CEO. Using this definition, we find that the decline in performance is present for both family and nonfamily firms. The effect of hospitalizations, however, is three times larger for family firms.

Taken together, the results in columns (3) to (6) highlight the role of organizational structure in mediating the CEO effect. Specifically, it appears that

organizations in which power is more concentrated (firms with no boards and family firms) suffer more around CEO health shocks.

C. Industry Characteristics

In Table X, Panel C, we test whether the industry environment in which a firm operates has a bearing on the results by investigating the cost of having a hospitalized CEO in a rapidly expanding or in a high human-capital-intensive industry.

In columns (1) and (2), we split firms into two groups based on the aggregate asset growth of their industry (four-digit NACE code) during the sample period. For the fast-growing industries, we find a negative and significant effect on OROA and asset size, but we do not observe any effect on revenue. In contrast, firms in moderate growth industries exhibit less robust effects: while these firms' profitability is significantly depressed by CEO hospital stays, neither revenue nor assets are affected. The latter results may indicate that CEO actions in low-growth industries are potentially more influential in reducing costs than in expanding operations. Thus, having a sick CEO hurts profits but leaves the scale of operations unaffected.

In columns (3) and (4), we split firms based on the percentage of college-educated employees in their industry. While we obtain a significant decline in OROA in both groups, revenue and assets decline significantly only in firms that operate in a high human-capital-intensive industry.

In sum, Table X demonstrates that our results are present across the spectrum of CEO, firm, and organizational characteristics, but the size of the hospitalization effect is larger for younger, better educated, and longer tenured CEOs. The hospitalization effect is also larger for larger firms, for firms in which CEO power is more concentrated, and for firms in an environment that is more difficult to manage (rapidly growing and human-capital-intensive).

The above results provide suggestive evidence on the settings in which CEO succession and contingency plans may have the most meaningful effect on the performance. For example, the evidence suggests that succession plans are extremely valuable in firms with a younger CEO and in a high-growth industry. Furthermore, the results point to specific variables that may be targeted in designing contingency plans. For example, shielding cost-cutting initiatives relative to other policies may be crucial for firms operating in low-growth and low human-capital-intensive environments.

V. CEO Turnover

The basic premise of this paper is that hospitalizations affect the productive capacity of CEOs. The evidence above is consistent with this premise, as it demonstrates that firms whose CEO experienced a hospital stay underperform relative to both their peers and their own performance in years without a hospital shock. To further test this idea, we investigate whether CEO hospitalizations affect turnover decisions. If, as predicted, the effectiveness of CEOs is

reduced by hospitalizations, we would expect that those executives who experience a hospital stay are more likely to exit the labor force than other executives. Note that while we observe CEO turnovers, we are unable to identify whether these turnover events are forced or voluntary. A potential interpretation of our turnover results is that CEOs leave their positions voluntarily because, after a hospitalization, the cost of staying in such a stressful position increases.

In Table XI, we examine the impact of the number of days of hospitalization on CEO turnover outcomes in the subsequent year using probit (columns (1) to (3)) and linear probability models with fixed-effects specifications (columns (4) to (6)), as well as an IV specification (column (7)). The results show that CEO hospitalizations have an economically large and statistically significant effect on CEO turnover. For instance, the model in column (6) indicates that the probability of CEO turnover increases by 0.8%, 2.8%, and 6.9% for hospitalizations of between one to four days, five to nine days, and 10 or more days, respectively. These magnitudes are large given that the baseline CEO turnover probability in the sample is 3%. Fixed-effects estimates, reported in columns (4) to (6), show that probit estimates are not driven by time-invariant firm characteristics. Finally, column (7) uses the fraction of long hospitalizations by medical condition to instrument for the number of days. The results continue to be economically and statistically significant.

The above evidence indicates that even moderate-length hospitalizations trigger economically large and statistically significant increases in the probability of CEO turnover. This is the first systematic evidence that a continuous variable reflecting the productive ability of CEOs, such as the number of days hospitalized, affects CEO turnover decisions.

Given the results reported in Table XI, we explore whether the performance results of this paper hold for those firms without CEO turnover events. Doing so is important as an established line of research documents the relevance of CEO turnover events for performance (Weisbach (1988), Parrino (1997), Huson, Parrino, and Starks (2001), Jenter and Kanaan (2015), among others). In contrast, relatively little is known about whether variation in firms' exposure to their CEO within firm-CEO pairs matters in the absence of CEO turnover. This latter setting is particularly interesting as turnover events coincide with periods of high business uncertainty, complicating inference about the direct effect of CEOs on performance.

To evaluate this question empirically, in Table XII, we reexamine the benchmark model in Table IV and the IV specification of Table V, focusing solely on nonturnover firms. In these tests, we omit firms that experienced both a hospitalization and a turnover event. The results show a negative effect of hospitalization on profits. Furthermore, the estimated coefficients are virtually identical to those reported in previous analyses. In other words, changes in exposure to the CEO resulting from hospital stays significantly affect firm performance even in the absence of CEO turnover events.

Overall, these results highlight two important contributions to the extant literature. First, holding the firm-CEO match constant, CEO exposure has an economically and statistically important effect on firm performance. Second,

Table XI

CEO Hospitalization and CEO Turnover Decisions

This table examines the impact of CEO hospitalization events on CEO turnover. The dependent variable is *CEO Turnover*, an indicator variable equal to 1 whenever the CEO is replaced. *N days of hospital stay*, *t*, is the number of days a CEO is hospitalized in a given year. *N days of hospital stay btw 1 and 4*, *N days of hospital stay btw 5 and 9*, and *N days of hospital stay at or above 10* are indicator variables equal to 1 if a given CEO experienced a hospital stay in the range indicated and 0 otherwise. Firm-level controls include *Ln(Assets in real DKK)*, the natural logarithm of the lagged value of total assets (in DKK millions), *CEO age dummies* for every five-year bin of CEO age, and *Firm age dummies* for every five-year bin of firm age, calculated using the earliest of the year of establishment, registration, or the firm's bylaws. Columns (1) to (3) report estimates using a maximum-likelihood probit model. Columns (4) to (6) report fixed effects (firm) estimates using a linear probability model. Column (7) reports estimates of a linear probability model in which the number of hospital days is instrumented using the fraction of patients who spend at least 10 days at the hospital for a given medical condition (99 diagnosis) between 1995 and 2012 over the entire Danish population. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: CEO Turnover						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
N. days of hospital stay, *t*	0.01861***	0.01866***		0.00301***	0.00264***		0.00460***
	(0.00379)	(0.00397)		(0.00061)	(0.00055)		(0.00056)
N. days of hospital stay btw 1 and 4			0.20718***			0.00779**	
			(0.03318)			(0.00303)	
N. days of hospital stay btw 5 and 9			0.49494***			0.02800***	
			(0.05589)			(0.00756)	
N. days of hospital stay at or above 10			0.78802***			0.06885***	
			(0.05133)			(0.00967)	
Year controls	No	Yes	Yes	No	Yes	Yes	Yes
Specification	Probit	Probit	Probit	LPM, FE	LPM, FE	LPM, FE	LPM, FE, IV
Observations	117,272	117,272	117,272	117,272	117,272	117,272	117,013

Table XII
CEO Hospitalization Events and Firm Performance: Evidence from Nonturnover Firms

This table examines the impact of CEO hospitalization events on firm performance for the subsample that excludes observations in which the CEO is replaced after being hospitalized. The dependent variable is *operating return on assets* (OROA), the ratio of operating income to total assets. *N days of hospital stay*, *t*, is the number of days a CEO was hospitalized in a given year. Unreported controls include *Ln(Assets in real DKK)*, the natural logarithm of the lagged value of total assets (in DKK millions), *CEO age dummies* for every five-year bin of CEO age, *Firm age dummies* for every five-year bin of firm age, calculated using the earliest of the year of establishment, registration, or the firm's bylaws, and (iv) year fixed effects. Each column reports results of a separate fixed effect regression using, respectively: (a) firm fixed effects (column (1)) and (b) firm-CEO fixed effects (columns (2) to (3)). Clustered (firm) standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: OROA		
	(1)	(2)	(3)
N. days at hospital, *t*	−0.00075***	−0.00057***	−0.00114***
	(0.00015)	(0.00013)	(0.00027)
Firm controls	No	Yes	Yes
Year FE	No	Yes	Yes
Firm/Firm-CEO FE	Firm	Firm-CEO	Firm-CEO
2SLS - IV	No	No	Yes
Observations	126,263	126,107	125,998

CEO hospitalizations, even relatively short hospital stays, can lead to drastic increases in the probability of observing a CEO turnover event.

VI. Conclusions

CEOs play a central role in theoretical and empirical work in financial economics. At the core of the optimal contracting, literature lies the notion that CEOs' actions have a meaningful effect on firm performance, holding constant firm and CEO characteristics. Yet, establishing these effects has proved empirically challenging.

Using a novel data set containing individual hospitalization records from Denmark, in this paper, we exploit variation in firms' exposure to their CEO, resulting from the number of days she is hospitalized, to estimate the effect of CEOs on firm performance. We posit that hospitalizations negatively affect managers' ability to perform their role as CEOs, and thus we use hospitalizations as a proxy for lower CEO effectiveness, at the margin. To our knowledge, this is the first empirical study to test for the effect of CEOs using firm-CEO fixed effects. As a result, we are able to provide an empirical estimate of the value of CEOs that closely resembles the theoretical benchmark of interest.

Our results demonstrate that CEOs play a central role in organizations. Specifically, we find that hospitalizations lead to a significant decline in a broad set of firm performance measures. We also find that CEOs are unique:

identical shocks to other senior managers have a smaller effect on firm outcomes. Furthermore, the costs of having a hospitalized CEO are particularly strong in settings in which the value of managerial discretion is high, as expected. Our results emphasize the importance of comprehensive CEO succession and contingency plans.

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