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ABSTRACT

This paper uses novel, firm-level measures derived from communications metadata before and after a CEO transition in 102 firms to study if CEO turnover impacts employees' communication flows. We find that CEO turnover leads to an initial decrease in intra-firm communication, followed by a significant increase approximately five months after the CEO change. The increase is driven primarily by vertical (i.e. manager to employee) communication. Greater increases in communication after CEO change are associated with greater increases in firm market returns.

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1. Introduction

There is considerable differentiation in what CEOs do, and ultimately, the extent to which they are able to affect organizational performance (Bertrand & Schoar 2003, Bandiera et al. 2020). However, the specific mechanisms through which CEO decision making and behavior affect organizations are still largely unknown. In this paper, we study a specific channel through which CEOs may be able to affect firm performance: that is, by shaping internal communication flows.

A large theoretical literature has emphasized the importance of communication in firms. For instance, intra-firm communication is essential to developing and executing firms' strategies, enabling firms to share knowledge, create organizational memory, and make decisions (Simon 1947, Arrow 1974). More efficient and effective communication can reduce transaction costs in decisions to internalize aspects of operations (Williamson 1979), overcome the cognitive limitations of employees (Simon 1947), increase the ability for firms to analyze and understand information (Arrow 1974), make "sense" out of changes in firm strategy (Weick 1995), and is one of the main reasons why firms form (Coase 1937). In multi-divisional firms, employees use communication to coordinate decision-making across departments and align those decisions to local conditions to achieve the firm's goals (Alonso et al. 2008, Marshak & Radner 1972).

The literature has also long recognized that communication patterns across firms are not random, but can be shaped by leaders. For example, if intra-firm communication is crucial to the firm strategy, we should expect corporate leaders to attempt to shape it. This fact is recognized by management scholars (e.g. Kotter 1995, Schein 1994) and economists (e.g., Rotemberg and Saloner 2000, Van den Steen 2005). In spite of this rich theoretical literature, however, the direct connection between leaders and communication patterns has not yet been studied empirically due to data limitations. Comparable observational data on firm-level communication for large samples of firms are hard to find, and longitudinal data following the evolution of communication patterns over time within firms has not, to our knowledge, been available to researchers (Impink, Prat & Sadun 2020).

This paper provides the first empirical study of how CEOs affect internal communication patterns across a large sample of firms leveraging unique meeting and email metadata, from 102 firms undergoing a leadership change. CEO turnover is a common organizational "shock" impacting a firm's strategy and performance. We examine whether and how CEO turnover impacts employee's formal, internal communication patterns (as measured by intra-firm emails and meetings) with an event study research design that examines communication flows from six months before the transition to 14 months after the transition.

We find that CEO change leads to an initial decrease in intra-firm communication, followed by a significant increase in intra-firm communication approximately four months after the transition. Second, the medium-term increase in communication is primarily *vertical*—i.e. involving communication between managers to employees and vice-versa—rather than *horizontal*—i.e. involving managers with managers and employees with employees. Finally, though we cannot observe the CEO type directly, and we have very limited performance data, we observe that firms that experience a greater increase in medium-term communication also have higher cumulative abnormal stock returns for six months after the transition.

We then interpret these findings through the lens of a theoretical model of intra-firm communication based on Alonso et al. (2008), which formalizes the idea that directly following a CEO change confusion around the firm's changing goals and management's expectations increases ambiguity around the firm's objectives, reducing the formal communication needed to coordinate decision-making. However, as the new CEO sets expectations, redefines priorities, and then shares this new strategy with the firm, uncertainty is reduced. As uncertainty diminishes, employees within the firm communicate more to coordinate decisions. CEOs who are better leaders can restore coordination more quickly (Kotter 1995, Schein 1994) and to a higher point than previously attained.

This study innovates on the prior literature on four fronts. First, our findings contribute to the literature dedicated to understanding the impact that CEOs have on the "softer," less quantifiable aspects of firms that are typically hard to observe (Gibbons & Henderson 2012, Bloom, Sadun, et al. 2012, 2016,

Impink, Prat and Sadun, 2020) and their contribution to performance variation across firms (Syverson 2011). Second, we are the first study to use longitudinal firm-level communications metadata to analyze the impact of an organizational change across many firms. Our research design allows us to examine the dynamics of intra-firm communication patterns before and after a CEO transition. To our knowledge, only one other paper, Srivastava et al. (2015), shows the impact of an organizational event on communication patterns, yet only focuses on a single firm.

Third, we are among the first studies to use communications metadata at scale across many firms (Polzer et al. 2016, Polzer & DeFilippis 2020, DeFilippis, Impink, Singell, Polzer & Sadun 2020, Jacobs & Watt 2021). Communications metadata have been used in prior research to analyze employee coordination (Kleinbaum et al. 2008, Kleinbaum & Stuart 2013), the implementation of corporate strategies (Kleinbaum & Stuart 2014), and employee-level productivity (Aral et al. 2012). These studies have pioneered the idea that email and meeting metadata contain valuable insight into information flows within firms and that changes to information flows have important decision-making implications. However, they usually only observe a single organization rather than a large cross-section of firms.

Lastly, this paper relates to a rich literature in organizational economics that focuses on the importance of intra-firm communication (Hart and Holmstrom 2002, Dessein & Santos 2006, Cremer et al. 2007, Alonso et al. 2008, Rantakari 2008, Calvó-Armengol et al. 2015, Dessein et al. 2016, Van den Steen 2017) as a proxy for information flows and knowledge-sharing needed to support effective coordination. This literature has identified the existence of tradeoffs between the benefits of increased coordination and employees acting independently. Our contribution is to leverage an established model of intra-firm communication and decision making (Alonso et al. 2008, Rantakari, 2008) to guide the empirical analysis of communication flows after a significant organizational event.

The paper proceeds as follows. Section 2 describes the communications metadata and the measures we developed to test the model's predictions. Section 3 details the event study and performance research designs. Section 4 describes the main results and additional findings correlating communication changes

with firm performance. Section 5 describes the related theory that we use to understand our findings and discusses an example of a stylized model used to understand information flows between parties in a multi-divisional firm. Section 6 concludes.

2. Data

In this section, we describe the data employed in the empirical analysis. We start by describing how we constructed the sample of firms experiencing a CEO transition event (2.A). We then describe the communication variables proxying for internal communication flows (2.B) and French-Fama cumulative returns as stock market performance measures (2.C). Lastly, we discuss some limitations of using communications metadata (2.D).

2.A. Identifying CEO Turnover Events

We obtained metadata on meeting and communication flows thanks to a partnership with a large email provider. The provider allowed us to analyze firm-level aggregates based on meeting and email metadata, under the condition that the firms used in the sample could not be identified (by other external researchers or us). To identify a suitable sample for the analysis, the provider gave us a sense of the time period and geographies for which email and meeting metadata had been captured and retained (approximately three years of data). We identified all firms experiencing a CEO transition within a three-month window within this time period using the information on CEO names from Execucomp, Boardex, and Orbis. This sample consisted of 338 firms, for which we collected additional firm-level data from multiple databases, including information on the number of employees, industry, CHQ location from Dun & Bradstreet, and revenue data from Orbis. We manually coded why the CEO transition occurred (e.g., fired for performance issues, retirement, death, an internal transition to another role, merger, hired by another firm, or left to start an entrepreneurial venture) from press releases. This dataset was sent to the email provider to be anonymously

matched to firms in its database. We describe additional details on the initial sample and matching process with our email provider in the Appendix in Note A.1.

This matching process led to a sample of 102 firms with communication data before and after a CEO turnover event. The sample includes firms located in 21 different countries, though 40% of the firms are located in the United States. The CEOs left for various reasons, including being fired for performance reasons (20%), retirement (17%), and transfer to another firm (8%). Many CEOs (30%) remained at the firm in a different position. The majority of the firms in the sample are in the services[1] (30%), manufacturing (19%), or trade (9%) industries. Over half the firms (51%) replaced their CEO with an internal manager already at the firm. The average firm has 6,545 (SD 4,217) users, with the largest firm having almost 15,000 users. In any given period, the sample includes roughly 100,000 users. In total, this communications metadata contains approximately 500M emails and 80M meetings. We provide more details on the firms in our sample in Table A.6..

2.B. Describing Communication Measures

Once the usable sample was identified, we asked the email provider to build month-level, firm-specific aggregated communication measures using email and meeting metadata measured before and after the CEO transition. Our primary analysis is based on variables measuring meetings and email data at the firm-month level. We were also able to obtain information on emails and meetings for different subsets of each firm, such as employees by hierarchical level (top managers, i.e. managers of managers; other managers; and individual contributors) based on each firm's organogram.[2] In addition to total meeting and email communications, we also received measures of meeting and email communications within and across functional departments (though only for 89 firms) and measures of meeting communications across similar

[1] Includes financial and insurance services.
[2] Firms' organograms are derived from the firms' listing of formal reporting relationships, which are self-recorded by the firm when the email provider onboards a firm's employees to the platform. Through this pairing, we can distinguish between employees that are individual contributors, managers, and managers of managers.

managerial hierarchy levels (i.e. horizontal communication) and upward with management (i.e. vertical communication) (91 firms). In the main analysis, we use firm-level aggregates for 102 firms.

Meetings. We received data on average number of meetings per employee, average duration of meetings, average number of attendees per meeting for 17 months. Table A.7 shows basic summary statistics for the meeting data. Employees attended, on average, 39 (Median 29, Standard Deviation 32) internal meetings per month. These meetings lasted about 116 minutes (Med. 79, SD 327) and included 42 attendees (Med 23, SD 62).[3] In total, employees were scheduled to attend around 80 hours a month in meetings. We provide additional information on how these data are aggregated in the Appendix in Note A.2.

We also show the aggregated meeting data along the firm hierarchy, across similar hierarchal levels (i.e., *horizontal* communication between employees or between managers) and across different hierarchical levels between ICs and managers (i.e., *vertical* communication between managers and workers) to proxy for the different communication modes discussed in the model. Meetings vary along the hierarchy: senior managers have more meetings and send more emails than lower-ranked managers and individual contributors (59 meetings/month (Med. 52, SD 37) for senior managers, 42 meetings/month (Med. 36, SD 28) for other managers, and 20 meetings/month (Med. 16, SD 15) for ICs. Even though managers attend more meetings, these meetings are on average shorter (Senior managers: 90 minutes/meeting, Med. 77 SD 76; manager: 101 minutes/meeting, Med. 77 SD 145) or than those attended by ICs (151 minutes/meeting, Med. 85 SD 513). We use t-tests to confirm that the differences between the means of these subgroups are different from zero. For these groups, the only measure in which the means are not significantly different is the number of attendees present at a meeting. We report these summary statistics and results in Table A.7 and A.8 under Meetings.

For vertical and horizontal communication flows, there are an average of 14,155 (SD 38,127) horizontal meetings and 8,722 (SD 29,357) vertical meetings per month at the firm-level (96 firms). This

[3] To avoid the inclusion of all-hands meetings and training events, the data provider excluded meetings that lasted longer than eight hours, all-day meetings and multi-day meetings. The data also exclude meetings that were declined by an employee in their calendar metadata.

roughly equates to 2 (SD 2) vertical and 5 (SD 4) horizontal meetings per user per firm per month.[4] We report these details in Appendix A in Table A.9 and summarize the data available and provided in Table A.5.

Emails. For email measures, we received aggregated average number of internal emails, number of recipients, and the percent of same department only emails for 22 months. We further broke down these aggregates into the average number of different department emails and the mix of different-same department emails within each firm. On average, employees sent around 247 (Med. 223, SD 199) internal emails per month. Senior managers send 333 emails/month (Med. 310, SD 164), other managers: 266 emails/month (Med. 243, SD 130), ICs: 163 emails/month (Med. 132, SD 236). We report these summary statistics in Table A.7 and Table A.8 under Emails.

2.C. Performance Measures

We measure performance before and after the CEO transition using monthly stock market measures for the subset of public firms included in our sample (41). Specifically, we build Cumulative Abnormal Returns (CAR) measures 6 months before and 6 months after the CEO change.[5] Table A.10 shows basic summary statistics of these measures before and after CEO turnover for two alternative CAR measures (Market-Adjusted CAR, and French-Fama CAR). We provide additional details on the creation of these performance measures in Appendix A in Note A.3.

[4] This measure does not map back to our other data set because these are distinct meetings. For example, even if 100 employees attended an all-hands meeting, then it would still only count as one meeting.

[5] The market adjusted CAR is calculated as (return – risk-free market rate). The cumulative Fama-French abnormal stock return is calculated using monthly French-Fama data downloaded from the following website: http://mba.tuck.dartmouth.edu /pages/faculty/ken.french/. We build the pre-turnover CAR measure by summing AR for every month prior to the CEO change (so the CAR for month -6 is the AR between month -7 and -6, for month -5 it is the cumulative sum of the CAR measured at -6, and the AR between month -6 and -5, and so forth. The CAR for the post CEO change time period starts summing AR between month 0 (i.e. the month of the CEO change) and month 1 after the CEO change and so forth. We exclude the CAR at month 0 from our analysis since it reflects the effects of both prior and current CEOs.

2.D. Limitation of Communications Metadata

There are numerous limitations in the metadata aggregates used in the analysis. First, these measures do not capture all interactions, including informal communications on mobile phones or other consumer-focused software platforms. Our data only capture formal communications on the email provider's platform and do not capture any forms of informal communications (e.g., instant messenger, personal email, consumer messaging applications, SMS, and many more). Furthermore, employees that deal with highly-sensitive information may opt for an ad hoc phone call or in-person meeting to avoid sharing the information in a legally discoverable manner. To the extent that a CEO change affects these margins of adjustment in communication, we will be unable to capture them in our analysis.

Next, it is unclear if meetings represent what employees actually do or simply what they write in their digital calendars. For instance, employees could use their calendars inconsistently or may not attend meetings that they accept in their calendars. We do not know if employees attend the meeting; we only know that they have not "declined" the meeting. The types of communications, both meetings and email, could vary drastically across people according to their responding habits. Similarly, for emails, we do not know if an individual exerted more or less effort writing an email or quickly sending a message. Our data are limited in that we do not have access to the content or subject lines of emails and meeting requests, which could provide us with more insight into the interaction and the exertion of effort. For example, a one-on-one meeting with your manager is very different from a team-building event or monthly all-hands. An email used to update management is very different from an email used to coordinate firm strategy. Also, meetings could be set up to work on a single task or many different tasks.

Lastly, we do not have any network measures. Instead, we use firm-level aggregates with some network connotations (i.e. same versus different departments, horizontal versus vertical communication, management hierarchy, etc.). Given the nature of these data, the network approach where every person is a "node" would not adequately anonymize in our sample, and a panel containing more than 0.5 billion

communications for the 100K monthly user in our sample would have been difficult and exceedingly costly to analyze.[6]

3. Research Design

3. A. Communication

We exploit the CEO transition's timing by using an event study specification to analyze the change in email and meeting measures over different months before and after the CEO transition. All data are aggregated at the firm level and bi-monthly level.[7] The CEO transition occurs in month 0, and combined with the first month after the transition, is denoted "Period 0" in the tables and figures. The base period for these regressions is the bi-monthly period before the CEO transition (i.e. month -1 and -2, denoted as "Period-1" in the tables and figures). We include firm-level fixed effects in all specifications, such that the coefficients represent changes in communication patterns within the same firm over time.

$$ln\,(y_{i,t}) = \beta_0 + \sum_{t=-3}^{-2} \beta_t^L\, D_t + \sum_{t=0}^{6} \beta_t^L\, D_t + \gamma_i + \varepsilon_{i,t} \quad (1)$$

Where $y_{i,t}$ denotes a communication variable for firm i in bi-month period t (relative to the CEO transition period), and γ_i are firm fixed effects. We cluster standard errors at the firm level. In this specification, Periods 0 and 1 (i.e. months 0-3 after the CEO transition) map into the short-term transition period, Periods 2-3 (i.e. months 4-7 after the CEO transition) map into medium-term transition period, and Periods 4-6 (i.e. months 8-12 after the CEO transition) correspond to the new steady state.

Given that CEO changes are likely to be endogenous,[8] variation in communication patterns happening around the time of a CEO transition may be driven by other unobservable and time-varying firm-level factors (since we control for time-invariant factors with firm-level fixed effects). By observing

[6] The information underlying the meeting and email variables contains about 15 petabytes of data.
[7] We aggregate the communication data at the bi-monthly data to smooth out measurement error, but the results are qualitatively and quantitatively similar when we use monthly data. See Appendix in Table B.1 (Monthly Data) for more details.
[8] In our sample only one CEO transition was driven by truly exogenous events, i.e. CEO illness or death.

communications for several months prior to the CEO transition, however, we can at least examine whether the changes in communication are driven by trends in the data pre-dating the CEO turnover.

3.B. Performance

To examine whether different communication patterns map into different performance outcomes, we estimate a difference in differences model of the form:

$$R_{i,t} = \beta_0 + \sum_{t=1}^{3} \beta_t^L D_t + \sum_{t=1}^{3} \beta_t^L D_t \hat{y}_i + \hat{y}_i + \gamma_i + \varepsilon_{i,t} \quad (2)$$

Where $R_{i,t}$ denotes CAR computed for every bi-month following the CEO turnover, starting from Period 0 (corresponding to the CAR month 1, since the CAR in month 0 is excluded from the analysis). As in earlier specifications, γ_i denotes firm level fixed effects, and standard errors are clustered at the firm level. The variable $\hat{y}_i$ is a measure of communication intensity in the medium term after the CEO turnover event. We focus on medium-term changes in light of Prediction 3, which sees this intermediate time period as the period in which CEOs' heterogeneous ability to achieve alignment within the firm is manifested.

4. Results

Main Results. We show the event study results in Exhibit 1 and graph the bimonthly coefficients in the top two figures in Exhibit 4. Email and meeting measures do not display evidence of a pre-trend in months before the base period, Period -1, two months before the CEO transition month. Meeting counts and emails experience a sharp drop immediately after the CEO transition (Period 0, i.e. months 0 and 1 after the transition), and recover slightly but continue to remain depressed in Period 1, i.e. 2 and 3 months after the transition (meetings: P0: -33% SD 0.11, P1: -29% SD 0.09; and emails: P0: -16% SD 0.07, P1: -13% SD 0.06). Meetings and emails increase significantly from the base period (Period -1) to Period 2 (i.e. 4 and 5 months after the month of the CEO change) and stabilize through Periods 3 to 6, i.e. between 6 and 12 months after the CEO change month (meeting stabilize ~+20% from base and emails stabilize at ~+10%). Generally, meetings are more responsive after the CEO change event; Meetings initially decline twice as

fast and recover more quickly (recovering in Period 2) compared with emails (recovering in Period 3). The duration of meetings and the number of attendees also increases in the medium term,

Beyond average effects, we note that the medium-term increase in meetings and emails is more heterogeneous across firms than the short-term decrease in communication. To illustrate this point, Figure 5.A in Exhibit 5 shows the histograms of two firm level variables: first a measure of the average monthly change in emails between month 0 and month 2 after the CEO transition, and second, a measure of the average monthly change in emails between month 2 and month 6 after the transition. The mass of distribution of medium-term changes is shifted to the right relative to short-term changes depicting a higher medium-term mean change on average, and the variance of the medium-term changes is larger. We discuss a possible interpretation of these differences later in this section.

Vertical and Horizontal Communication Interactions. The email provider calculated vertical and horizontal communication metadata for meetings in 88 firms from six months before until eight months after the CEO transition.[9] We show these results in Exhibit 2 and graph these coefficients in the middle and bottom figures in Exhibit 4. Similar to the main results, both vertical and horizontal meeting interactions increase starting in Period 2, four months after the CEO change. We analyze the change in the ratio of vertical to horizontal meetings over time (i.e. horizontal meeting count divided by vertical meeting counts) to determine if the mix of intra-firm meeting interaction types changed. The ratio significantly increases in the medium term (P2 +12% SD 0.02, P3 +18% SD 0.02), i.e. communication flows were more likely to happen across different hierarchical layers rather than within the same layer.

Robustness Checks. We performed several robustness checks on the results discussed so far, which we report in Appendix B in Table B.4. First, our data capture all formal communications through an employee's work-provided email address. However, some employees may use their work email and calendars for personal interactions with their colleagues. As such, this additional metadata would be included in the

[9] Due to large gaps in the email meta-data from GDPR compliance, the email provider built these measures from meeting meta-data only. Additionally, we are provided with user counts in the second dataset that we used to build the firm x month per user communications measures form the firm.

aggregated data we received. Under the assumption that these types of informal interactions are more likely to be included among employees working in the same department, we built measures of aggregate emails and meetings based exclusively on data capturing communication flows between employees of different functional departments.[10] Reassuringly, the results are virtually identical when we use this subsample of interactions (column 3).[11]

A first robustness check relates to the unbalanced nature of the sample used in the analysis. This is because some firms only have meeting metadata after the CEO transition (data availability depends on when firms opted into the email provider's services). All firms have balanced email data; however, only 55 firms have balanced meeting data, including the transition month. When we re-run the main event study for the balanced sample of firms with data before and after the transition, we obtain similar coefficients, though less precisely estimated (column 5).

Second, we investigated whether the changes in communication flows were driven by the timing of the actual CEO transition or by its mere announcement. We were able to examine the reaction to the announcement of the CEO transition separately from that of the actual transition for 30 firms, for which the announcement occurred earlier than a month before the actual CEO transition. We find that the coefficients on the dummies denoting months after the actual transition are negative and significant (columns 7 and 9) even in this small subsample of firms, while the point estimates on the dummies relative to the announcements — while negative — are not precisely estimated (columns 8 and 10).[12]

[10] Kleinbaum et al. (2013), Zhang et al. (2020), for example, show that communication across departments included a higher proportion of communication with weak network ties. This data was only available for 89 firms of the 102 firms in the sample.

[11] Kleinbaum (2012) shows that "organizational misfits"—people who followed career trajectories that are atypical in their organization—are more likely to communicate to workers outside their unit for sense-making. Unfortunately, our data do not allow us to distinguish between employees with different career trajectories prior to the CEO change.

[12] Our communications data is at the calendar month level, so we are unable to adjust the model so that Period 0, which includes the transition month, starts on the actual transition day. In an unreported analysis, we examine the effects of the CEO transition if the CEO changes in the last 15 days of the transition month (55 firms) and find that the results of the event study are similar.

Third, we investigated whether the results were driven by compositional changes in the sample. For example, the short-term drop in communications could have been generated by the exit of managers or workers just after the arrival of a new CEO, rather than behavioral changes within incumbents. To do so, we examine the changes in meetings and emails for employees and managers that the provider identified as "Stayers", i.e. whose account was active at the firm before and after the CEO turnover. In Appendix B in Table B.2 (Stayers), we show these results for Stayers, which remain similar to the main. To support our findings further, we summarize the changes in turnover rates by month in Appendix B in Table B.3 (Turnover).

Finally, in unreported analyses, we analyzed whether the estimated changes in communication varied across small and large firms, for different types of reasons driving to a CEO transition (CEO death, firing, promotion, move to a different firm or retirement), and for different types of incoming CEOs (internal, i.e. hired from within the firm, or external CEO). We do not find strong evidence for heterogeneous effects, though we note that our sample may be too small to estimate these differences properly.

Communication and Performance. Finally, we investigate the relationship between communication and cumulative abnormal stock returns, computed starting from the first month in which the CEO takes office, and differently for firms that experienced a greater change in communication intensity in the medium term after the CEO transition—for brevity, we refer to these firms as high communication firms.[13] In practice, we identify these high communication firms by calculating the difference in communication intensity between Period 1, i.e. the end of the short-term transition period (months 2 and 3), and Period 3, the end of the medium-term transition period (months 6 and 7), and generating a dummy variable taking value 1 if the firm experienced an above-median change in communication within this time period.

[13] We exclude month 0—i.e. the month in which the CEO takes office—since abnormal returns in this time period may be affected by the announcement of a CEO change rather than the CEO him/herself.

We present the estimation of Equation 2 in Exhibit 3. Column 1 shows that, on average, high communication firms have different CARs immediately after the CEO change, and these differences persist for six months after the transition. In column 2, we explore the possibility that the CARs may have been on a different trend before the CEO change. To do so, we build a CAR measure that starts summing over unexpected results from 6 months before the CEO change until the month in which the new CEO takes over. The regression shows that the differences in CARs between the two groups are insignificant before the CEO change, and we show these results visually in Figure 5.B in Exhibit 5. Next, we look at the robustness of the relationship to the inclusion of firm fixed effects in column 3. We then repeat the same analysis using a different CAR measure build using French-Fama factors[14] in columns 4-6, finding similar results.

All in all, these results suggest that high communication firms start to diverge in terms of performance early on, especially in the first three months of the new CEO tenure. Yet, these differences do not accrue over time (i.e. persistent CAR differences are entirely driven by what happens in Period 1, and are sustained afterward). These results can be interpreted in two ways. Differences in the increase in communication in the medium turm after a CEO turnover event may proxy for latent differences in CEO types that become apparent to analysts and investors in the early months of a CEO tenure, and are then factored in stock prices after this initial period. The alternative interpretation is that an unobserved, firm-specific shock effect unrelated to the CEO type affects CARs immediately after a CEO change and that this shock effect also induces a change in communication intensity in the medium term after the CEO takes charge.

[14] We include four factors in our French-Fama model: SMB, HML, Risk-free market returns and momentum. We share the histogram on these returns in Appendix in Figure A.4.

5. A Simple Model of Intra-firm Communication

In summary, our results show that a CEO change maps into significant changes in within-firm communications. The first reaction to the CEO turnover event is a fall in internal communications, which is followed by a medium-term increase (especially in meetings, and more specifically in meetings that involve managers and individual contributors). We also find that differences in the medium-term increases in communication map into different performance in the year following the CEO change.

What theories best explain the patterns we observe? One possible framework is the model of intra-firm communication developed in organizational economics (Alonso et al. 2008, Rantakari 2008) to formalize influential perspectives such as Hayek (1945), Sloan (1964), and Chandler (1977). In Appendix C, we show that a highly stylized model of intra-firm communication based on Alonso et al. (2008), adapted to the context of a CEO change, can account for the evolution of communication patterns around a CEO transition described in the previous section.

In this framework, different units or agents within a firm pursue different objectives. The degree of *alignment* around a common vision reduces the distance between different objectives and determines how much information agents communicate with each other in equilibrium. When a new CEO arrives, there is uncertainty about their vision for the firm, thus leading to a reduction in alignment. We should expect less information to be communicated in equilibrium due to increased ambiguity (Weick 1995, Weick et al. 2005), which corresponds to what we observe in the data.

However, the new CEO is not a passive agent; instead, they will develop and pursue their new vision. This involves both understating the needs and constraints of the firm and communicating new objectives. For instance, CEOs may take into account that divisional managers have private information (i.e., asymmetric awareness) about local conditions and the fit of these more coordinated decisions with the external environment. Others highlight similar issues that arise with increased coordination, such as employees engaging in non-productive or "wasteful" activities to influence decision-making (Milgrom & Roberts 1990, Milgrom 1988, Powell 2015) which could impact communications patterns. We should

therefore expect a period of two-way vertical communication between the top of the organization and all its workers. As the new vision is established, communication intensity returns to, and possibly tops, its pre-transition level. This would explain the medium-term increase in meetings and email and why it is driven by vertical communication.

Finally, not all new CEOs are equal when it comes to alignment (Kotter 1995). Some are better than others at establishing and communicating a convincing vision for the firm. Those will generate higher alignment, a larger and faster increase in communication, and ultimately higher firm performance. Our evidence provides some reduced-form for that effect too.

While the empirical findings are consistent with the story above, it goes without saying that we claim no causation and that our empirics can help explain other similar models of firm communication (e.g., Van den Steen 2017).

6. Conclusion

We use email and meeting metadata on 102 firms to study how internal communication patterns evolve after a meaningful organizational change—a CEO transition. Then we use a theoretical model of intra-firm communication to interpret those results. To our knowledge, this is the first time that longitudinal measures of intra-firm communication could be analyzed and linked to meaningful organizational events across multiple firms and longitudinally.

Using an event study research design centered on these CEO transitions, we find that CEO changes are associated with large communication changes within firms. During the first three months after the CEO transition, email and meetings intensity drop significantly. Around four months after the CEO transition, there is a large increase in email and meeting communications, which more than compensates for the initial drop. The increase in communication is mostly driven by vertical (i.e. manager to employees) relative to horizontal (i.e. peer to peer) communication flows. These results are robust to a number of robustness

checks. We also find that firms that experienced a greater increase in communication in the medium term after the CEO change also generate higher cumulative abnormal returns in their stocks immediately after the CEO transition, and that these differences persist for six months after the event.

We see this paper as a first step in using email and meetings metadata to study the impact of significant organizational events, such as CEO change, on internal communications patterns. Much more could be done with data that are even richer than ours. For example, these data could be used to understand the structure of internal communication networks with greater precision rather than using broader aggregated measures. Furthermore, text from these communications could be analyzed to identify discussion topics and clean the data further. Despite these limitations, we see promise in using email and meetings metadata—typically passively collected by firms—to study unobserved aspects of the inner workings of organizations, and more specifically, the effect that CEOs can have on internal communication flows. We hope that our study can provide a possible blueprint to advance the exploration of these data, while at the same preserving the confidentiality of employees and firms.

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Exhibits

Exhibit 1 - Firm-level Event Study Regressions of Meeting and Email Measures

	(1)	(2)	(3)	(4)	(5)
	MEETINGS			**EMAILS**	
Dependent Variable is log of:	Meetings (count)	Avg. Duration (minutes)	Avg. Participants (people)	Emails (count)	Avg. Recipients (people)
Period -3	0.049	0.220	0.187	0.034	-0.057
	(0.071)	(0.077)	(0.099)	(0.033)	(0.026)
Period -2	-0.035	0.026	0.033	-0.108	-0.047
	(0.071)	(0.041)	(0.118)	(0.051)	(0.020)
Period -1 (Base Period)					
Period 0	-0.329	0.128	0.122	-0.164	-0.017
	(0.105)	(0.068)	(0.085)	(0.070)	(0.031)
Period 1	-0.286	0.117	0.057	-0.126	-0.016
	(0.090)	(0.076)	(0.091)	(0.055)	(0.031)
Period 2	0.236	0.051	0.307	0.069	0.003
	(0.074)	(0.056)	(0.090)	(0.052)	(0.030)
Period 3	0.227	0.175	0.513	0.111	0.025
	(0.075)	(0.077)	(0.097)	(0.047)	(0.032)
Period 4	0.137	0.289	0.536	0.095	0.033
	(0.075)	(0.086)	(0.104)	(0.049)	(0.034)
Period 5	0.268	0.269	0.379	0.108	0.029
	(0.076)	(0.078)	(0.110)	(0.052)	(0.038)
Period 6	-0.088	0.137	-0.081	0.014	0.035
	(0.091)	(0.067)	(0.121)	(0.083)	(0.041)
Observations	725	725	725	725	725
Firms	102	102	102	102	102

Notes: All columns are estimated by OLS. Standard errors are clustered at the firm level, in parentheses under the coefficient. Firm-level fixed effects are included in all models. The transition occurs during the first month of bi-monthly Period 0. Period -1, the bi-monthly period before the CEO transition, is the base period for the regressions.

Exhibit 2 - Firm-level Event Study Regressions of Meeting Interactions

	(1)	(2)	(3)	(4)	(5)	(6)
				MEETINGS		
	Total		**Horizontal**		**Vertical**	**Ratio**
Dependent Variable is log of:	Meetings (count)	Man-Man (count/user)	IC-IC (count/user)	All Horizontal	Vertical (count/user)	(Vertical/ Horizontal)
Period -3	0.062	0.071	0.065	0.084	-0.002	-0.030
	(0.079)	(0.057)	(0.065)	(0.070)	(0.058)	(0.015)
Period -2	-0.056	0.062	0.054	0.070	-0.028	-0.031
	(0.077)	(0.050)	(0.044)	(0.053)	(0.055)	(0.018)
Period -1 (Base Period)						
Period 0	-0.183	-0.053	-0.035	-0.054	-0.092	-0.016
	(0.094)	(0.036)	(0.044)	(0.046)	(0.054)	(0.021)
Period 1	-0.056	-0.008	0.038	0.021	-0.005	-0.005
	(0.096)	(0.046)	(0.045)	(0.052)	(0.055)	(0.023)
Period 2	0.418	0.025	0.070	0.065	0.273	0.115
	(0.087)	(0.047)	(0.045)	(0.053)	(0.049)	(0.020)
Period 3	0.576	-0.035	0.040	0.018	0.383	0.181
	(0.104)	(0.056)	(0.052)	(0.062)	(0.053)	(0.023)
Observations	352	352	352	352	352	352
Firms	88	88	88	88	88	88

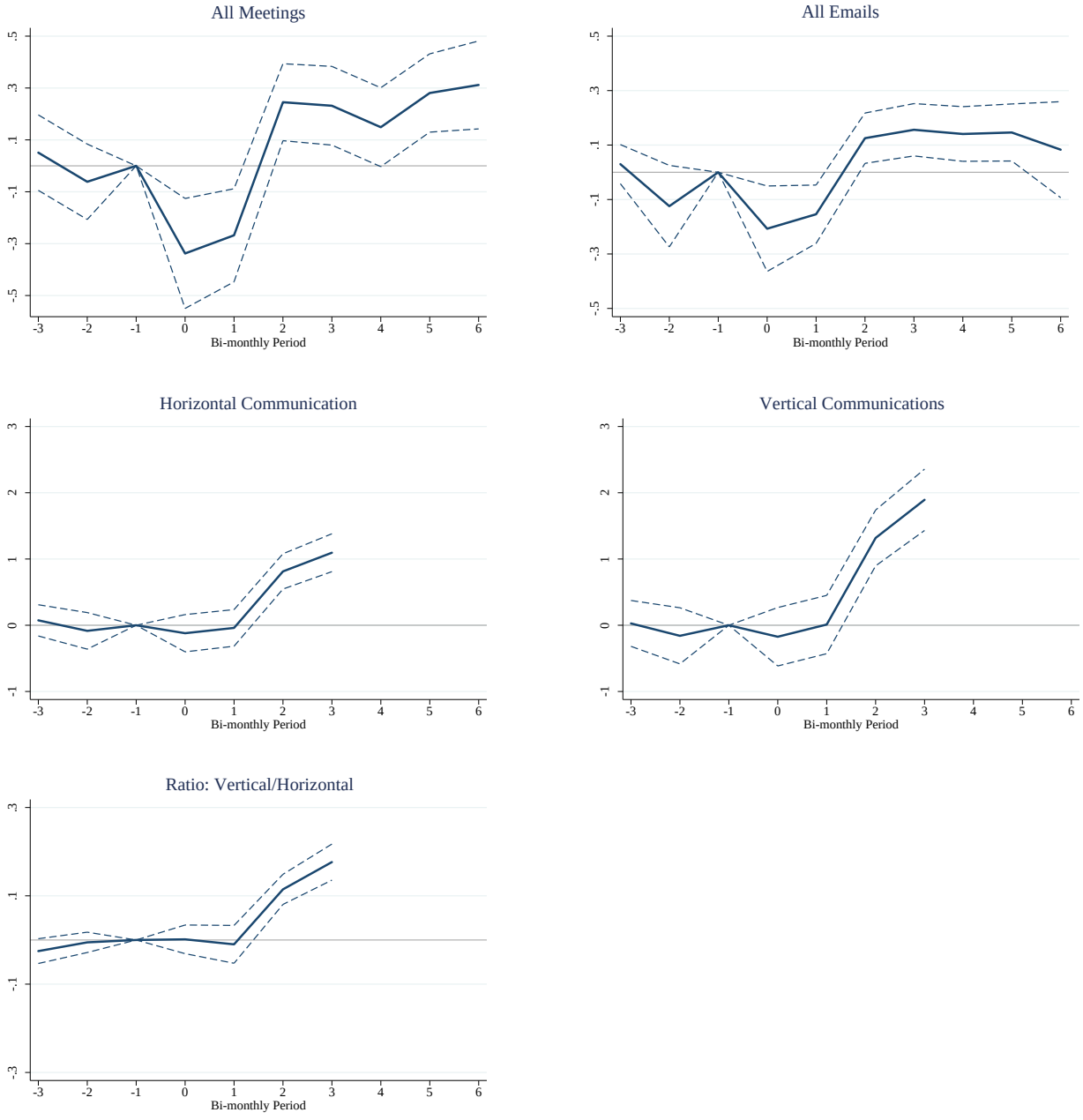
Notes: All columns are estimated by OLS. Standard errors are clustered at the firm level, in parentheses under the coefficient. Firm-level fixed effects are included in all models. The transition occurs during the first month of bi-monthly Period 0. Period -1, before the CEO transition, is the base period for the regressions. Regression (1) is the same measures as reported in Exhibit 1(1) but for the samples of matched observations/firms available in the meeting interactions data (352 firm-periods, 88 firms). Horizontal (1) is the mean of IC/IC and Man/Man meeting interactions. Vertical (2) is the IC/Manager meeting interactions. The ratio of vertical to horizontal meeting interactions (3) is vertical count divided by horizontal count at the firm-period level. The data underlying this table were limited to seven periods (Period -3 to Period 3).

Exhibit 3 - Cumulative Abnormal Returns in High vs. Low Communication Firms

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable is log of:	**Cumulative Abnormal Return**					
	Market-Adjusted			**French-Fama 3F**		
Time Period:	Post	All	All	Post	All	All
Period -3		0.014	0.014		0.010	0.010
		(0.031)	(0.031)		(0.031)	(0.031)
Period -2		-0.071	-0.071		-0.059	-0.059
		(0.047)	(0.047)		(0.047)	(0.047)
Period -1		-0.149	-0.149		-0.126	-0.126
		(0.076)	(0.076)		(0.076)	(0.076)
Period 0 (Base Period)						
Period 1	-0.095	-0.095	-0.095	-0.077	-0.077	-0.077
	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
Period 2	-0.130	-0.130	-0.130	-0.090	-0.090	-0.090
	(0.056)	(0.056)	(0.056)	(0.057)	(0.057)	(0.057)
Period 3	-0.139	-0.139	-0.139	-0.086	-0.086	-0.086
	(0.059)	(0.059)	(0.059)	(0.059)	(0.059)	(0.059)
Low/High Communication (quintile)	0.033	0.033		0.028	0.028	
	(0.034)	(0.034)		(0.034)	(0.034)	
Period -3 x High Communication		-0.065	-0.065		-0.067	-0.067
		(0.049)	(0.049)		(0.049)	(0.049)
Period -2 x High Communication		0.001	0.001		-0.000	-0.000
		(0.070)	(0.069)		(0.070)	(0.070)
Period -1 x High Communication		0.058	0.058		0.063	0.063
		(0.104)	(0.104)		(0.104)	(0.104)
Period 0 (Base) x High Communication						
Period 1 x High Communication	0.113	0.113	0.113	0.112	0.112	0.112
	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)
Period 2 x High Communication	0.132	0.132	0.134	0.136	0.136	0.139
	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)
Period 3 x High Communication	0.145	0.145	0.147	0.152	0.152	0.154
	(0.066)	(0.066)	(0.066)	(0.066)	(0.066)	(0.066)
Firm-Level Fixed Effects	No	No	Yes	No	No	Yes
Observations	290	542	542	290	542	542
Firms	42	42	42	42	42	42

Notes: All columns are estimated by OLS. Standard errors are clustered at the firm level, in parentheses under the coefficient. Firm-level fixed effects are included in models 3 and 6. The transition occurs during the first month of bi-monthly Period 0, which is used as the base period for these regressions. Firms are divided into Low and High Communications, each including 26 firms, based on whether the firm was above or below the median change in communication between month 2 and month 6 after the CEO change.

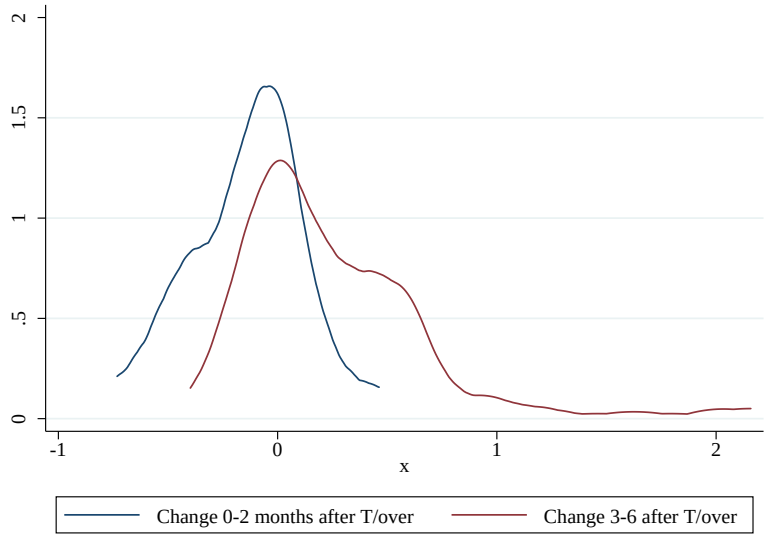
Exhibit 4 – Event Study Figures



Notes: We plot the OLS regression coefficients from the main event regression specification on the top two graphs, reporting in Exhibit 1, across time for total meeting count (left) and email count (right) in the full sample of 102 firms. We plot the OLS regression coefficients from the meeting interaction specification across time for horizontal communication (middle left), vertical communication (middle right) on these graphs. Additionally, we look at the coefficients for the regression on the mix of vertical to horizontal meeting count (bottom left). These results are reported in Exhibit 2, and the sample consists of 88 firms. The CEO change occurs in Period 0. We use the period before the transition, Period -1, as the event study's base period. These results include firm-level fixed effects and standard errors clustered at the firm level.

Exhibit 5 – Performance

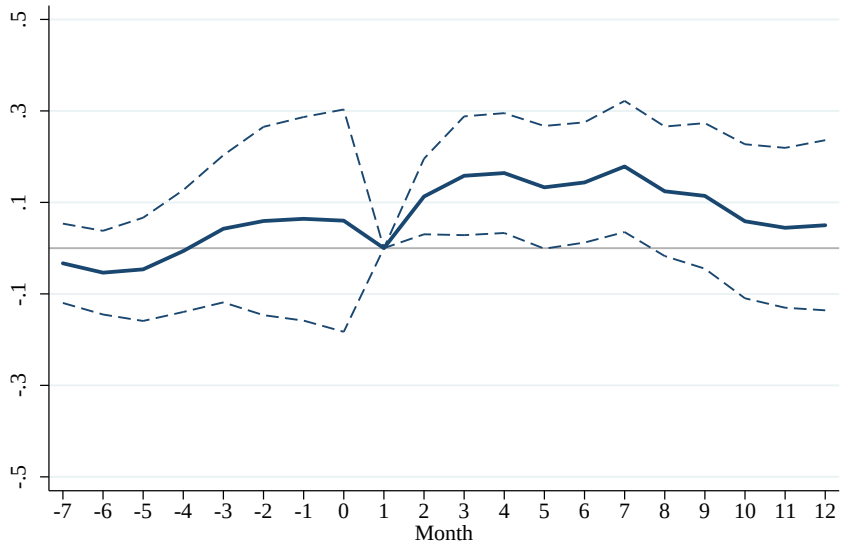
Figure 5.A – Histogram of Communication Changes by Short and Medium Terms



Notes: This figure shows the variance of the changes in communications between month 0 and 2, and months 2 and 6 after the CEO change. Months 0-2 are considered short term, and Months 2-6 are considered medium term.

Figure 5.B – Difference between CARs of High and Low Communications Firms

(Based on medium term change in emails)



Notes: Standard errors are clustered at the firm level. Firms are divided into Low and High Communications, each including 26 firms, based on whether the change in communications between month 2 and month 6 after the CEO change was above or below the sample median.

Appendices

Appendix A – Data

Note A.1 – Sample Construction

The sample construction involved several steps. First, the email provider gave us a sense of the time window over which it had comprehensive email and meeting metadata (due to certain policy and data collection system changes, the email provider had various gaps it is historical communications metadata records, and deleted certain data on a rolling basis in certain areas to comply with regulations). We then searched for all firms that experienced a CEO change in that period in three data sources: Execucomp, BoardEx, and Orbis. This search led to a sample of 338 firms that experienced a CEO transition consisting of 155 publicly traded and 183 private firms. Third, we collected auxiliary data on all these firms using public information. These firms have on average 9,000 employees and are located in 29 countries. The majority of the firms, however, are located in the United States (130 firms, 38%), United Kingdom (45 firms, 14%), and Canada (41 firms, 13%). We then provided this list of firms and associated firm-level data to the email provider to match our data with their communications data.

This matching process led to a sample of 102 firms from the broader 338 firms with communication data before and after a CEO turnover event. The matched sample includes firms located in 22 different countries, though 39% of the firms are located in the United States. In the matched sample, 42 firms are publicly traded. The average firm has 6,545 (SD 4,217) users, with the largest firm having almost 15,000 users. We do not have the average number of employees as measures such as employee count and revenue levels were matched as employee count and revenue quintiles (1-5) to preserve the firm's anonymity. We were also not provided information on organizations of smaller than five individuals or government entities.

Note A.2 – Data Aggregation

The email provider sent us data at the following level of granularity across time:

- ID
- Management hierarchy (IC, M, M+)
- Tenure (Exitor, Stayer, Entrant)
- HQ (CHQ or sub)

We refer to the ID x Hierarchy x Tenure x HQ x monthnum as the cell-level. There is a user count measure for both emails and meetings at the cell level.

For the main analysis, we sum meeting and email users at the month x id x hierarchy level (the lowest level of granularity as we do not use Tenure or HQ data cuts. We then create a weighting variable for user and meetings: users at the cell level divided by users at the month x id x heirarchy level. We then collapse using the weighting variable.

Note A.3 – Performance Measures

We build two measures of performance:

- The market-adjusted CAR is calculated as (return – risk-free market rate).
- The cumulative Fama-French abnormal stock return is calculated using monthly French-Fama data downloaded from the following website: http://mba.tuck.dartmouth.edu /pages/faculty/ken.french/.

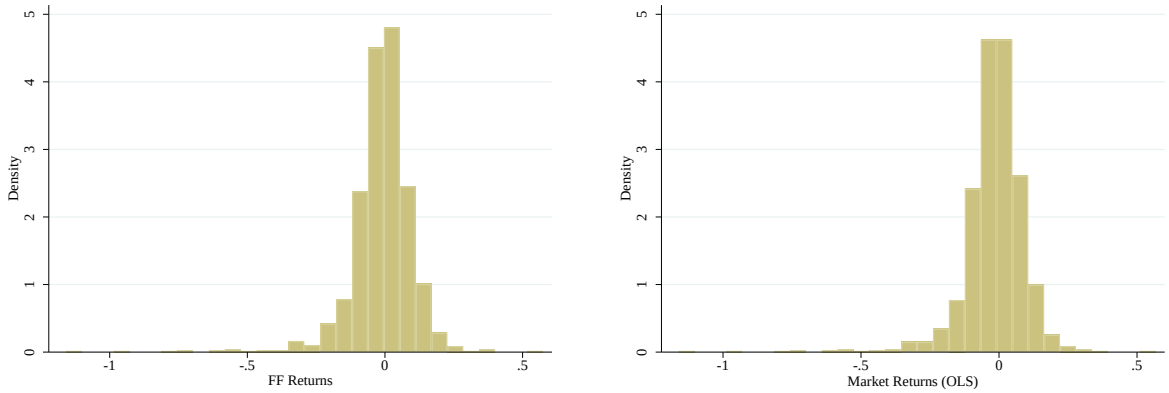
For the Fama-French stock return measure, we use the four-factor model to estimate the residuals. These four factors are:

- High minus Low
- Small minus Big
- Risk-free Market Returns
- Momentum

Since we run this model on a relatively small number of firms, we include 49 industries of firms in training the model (also from French's website) and then use the model to estimate abnormal returns for the public firms in our sample.

To capture the change of performance in the mid-term, we build the pre-turnover CAR measure by summing AR for every month before the CEO change (so the CAR for month -6 is the AR between month -7 and -6, for month -5 it is the cumulative sum of the CAR measured at -6, and the AR between month -6 and -5, and so forth. The CAR for the post CEO change time period starts summing AR between month 0 (i.e. the month of the CEO change) and month 1 after the CEO change and so forth. Lastly, we exclude the CAR at month 0 from our analysis since it reflects the effects of both prior and current CEOs.

Figure A.4 – CAR Histograms



Notes: These are the histograms of the cumulative average French Fama 3F one-year returns (Market(rf), SML, HML) and the OLS Market one-year return (Market(rf) for the sample of firms included in the performance regressions.

Table A.5 – Meeting Interaction Data Availability

	External	IC	Manager	No Hierarchy
External		Some External	Some External	
IC	Some External	Horizontal	Vertical	
Manager	Some External	Vertical	Horizontal	
No Hierarchy				

Data N/A

Notes: Data summarized based on data shared by the email provider. We do not have information on the following types of interactions by employees at the firm, as we only requested proxies for horizontal and vertical, intra-firm meeting interactions between employees with recorded hierarchy information. Email information was not provided.

Tables A.6-A.10 – Data Summaries

Table A.6 - Firm Summary

CEO Change Reason	Firms	%	Country	Firms	%	Industry	Firms	%
Within-firm Transfer	31	30%	United States	40	39%	Services/Fin. (SIC 60-89)	30	29%
Fired/Underperformed	20	20%	European Union	27	26%	Manufacturing (SIC 20-39)	19	19%
Other	21	21%	United Kingdom	16	16%	Trade (SIC 50-59)	9	9%
Retirement	17	17%	Canada	7	7%	Other Industry	44	43%
Poached/New Venture	8	8%	Rest of World	12	12%			
M&A	5	5%						
Death	1	1%						
Total Firms	102	100%		102	100%		102	100%

Notes: We collected reason, industry, and country from all firms in the broader sample from Execucomp, Boardex, and Orbis. This data was then provided to the email provided to be paired to the communications data.

Table A.7 - Communications Data Summary

	Total				
	Mean	Med.	SD	Min	Max
Meetings					
Count (avg/month)	39	29	32	1	377
Duration (minutes/meeting)	116	79	327	5	24344
Attendees (avg invited/meeting)	42	23	62	2	1470
Emails					
Count (avg/month)	247	223	199	1	46927
Recipients (avg employees/email)	3	3	4	1	491

Notes: Means are user weighted by average monthly email and meeting users provided by the email provider at the firm-month level for the 102 firms in the main effect analysis. Meeting count, duration, and attendees are based on calendar invites that include at least one other individual.

Table A.8 – Communications by Management Hierarchy Summary

	Individual Contributors			Other Managers			Senior Managers			T-Test (p-value)	
	Mean	Med.	SD	Mean	Med.	SD	Mean	Med.	SD	IC/ Ot. Man	Ot. Man/ Sr. Man
Meetings											
Count (avg/month)	20	16	15	42	36	28	59	52	37	0.00	0.00
Duration (minutes/meeting)	151	85	513	101	77	145	90	77	76	0.00	0.00
Attendees (avg invited/meeting)	36	23	50	45	24	67	46	25	68	0.06	0.96
Emails											
Count (avg/month)	163	132	236	266	243	130	333	310	164	0.00	0.00
Recipients (avg employees/email)	4	3	6	3	3	2	3	3	1	0.00	0.00

Notes: Management hierarchy is based on the firm's self-reported employee reporting structure: ICs have no direct reports, Other Managers only manage ICs, and Senior Managers manage at least one manager. Groups not included in the firm's formal reporting hierarchy, tagged as "no hierarchy" by the Email Provider, are dropped. Sample is the 102 firms of the main effect analysis. Two-sided t-test with equal variances: the null hypothesis is that the means are equal. IC/Ot. Man: 615 matched observations by id, period. Ot. Man/Sr. Man 564 matched observations by id, period.

Table A.9 - Meeting Interactions Summary (per user)

	Total		Man-Man		IC-IC		Horizontal		Vertical	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Meetings										
Count (avg/month)	9	6	2	2	3	3	5	4	2	2
Duration (minutes/meeting)			57	14	59	14			58	15

Notes: Meeting counts and duration provided at the firm level for 88 firms (353 observations) over seven bi-monthly periods (collapsed from 17 months of data). For these observations, we have matched firm-period observations in the main analysis. These are distinct meetings and do not include any information on the number of attendees. The means calculated above are based on the average number of meeting users per firm. Vertical meetings include an IC and a Manager (and no external or “no hierarchy” employees). Horizontal meetings are the sum of two groups: manager only meetings and IC only meetings. The Email Provider did not share separate details on manager type (i.e. other managers, senior managers) in this dataset; they are combined. Duration of meetings provided only for IC/Man, Man/Man, and IC/IC interactions.

Table A.10 - Stock Returns Measure Summary

	Cumulative Abnormal Returns			
	Pre-transition		Post-transition	
	Mean	SD	Mean	SD
Cumulative Return (Risk Free)	-0.11	0.25	-0.11	0.45
Market-Adjusted CAR	-0.10	0.26	-0.11	0.27
Market (OLS) CAR	-0.11	0.26	-0.11	0.27
French-Fama CAR	-0.09	0.25	-0.07	0.27

Notes: Stock market return data are sourced from CSRP for the 42 firms in our sample with available data. Information on the market, risk-free (10 yr T-bill), HML, and SML rates are from Ken French's website at dartmouth.edu. All data is daily. Market-adjusted return is the stock return minus the market return. The Market OLS model used the predicted residuals of an OLS model, including the market rate, with no constant, to predict the abnormal returns. The French-Fama model used the predicted residuals of an OLS model, including the market rate, HML, and SML, with no constant, to predict the abnormal returns. Returns are calculated at the month level and summed pre (month -6 to month 0, the transition month) and post (month 1 to month 6) CEO change.

Appendix B – Additional Results

Note B.1 – Monthly Data

Table B.1 shows the results of using a monthly instead of bi-monthly aggregation in the specification. Instead of the transition occurring in the bi-monthly Period 0 (in the main results), it occurs in month zero. The base period is the single month before the transition (Month -1), instead of the bi-monthly period, Period -1 (in the main results). The analysis provides support that our results are not dependent on aspects of aggregation in our specification.

Note B.2 – Stayers

To provide further support that our results were not driven by the entrance and exit of employees from the firms around the time of the transition, we run the analysis for Stayer, defined as employees that were at the firm before and after the transition. The email provider based this category on the date when the user's mailbox was created. Table B.2 shows a similar specification to the main result replicated for the subset of Stayers in each firm.

Note B.3 – Turnover

We find that turnover remains stable in our sample. First, we show a summary of the change in the turnover rate by month. We find no significant differences in analyzing these heterogeneous effects. The turnover rate is calculated as: [(change in Exitors) + (change in Entrants)] / (average Stayers). Table B.3 shows the change in the turnover from three months before the transition until 9 months after the tranistion.

Table B.1 - Firm-level Event Study Regressions of Meeting and Email Measures (Monthly)

	(1)	(2)	(3)	(4)	(5)
	MEETINGS			**EMAILS**	
Dependent Variable is log of:	Meetings (count)	Avg. Duration (minutes)	Avg. Participants (people)	Emails (count)	Avg. Recipients (people)
Month -3	-0.080	0.009	-0.032	-0.093	-0.052
	(0.100)	(0.059)	(0.162)	(0.065)	(0.028)
Month -2	0.020	-0.023	-0.191	-0.060	-0.021
	(0.094)	(0.052)	(0.121)	(0.051)	(0.028)
Month -1 (Base Period)					
Month 0	-0.221	0.089	0.131	-0.163	-0.034
	(0.107)	(0.073)	(0.094)	(0.062)	(0.029)
Month 1	-0.282	0.089	-0.014	-0.202	-0.031
	(0.114)	(0.074)	(0.107)	(0.077)	(0.030)
Month 2	-0.366	0.016	-0.034	-0.254	-0.022
	(0.105)	(0.067)	(0.101)	(0.057)	(0.031)
Month 3	-0.173	0.128	-0.019	-0.124	-0.020
	(0.099)	(0.089)	(0.106)	(0.054)	(0.032)
Month 4	0.173	0.037	0.177	0.034	-0.009
	(0.088)	(0.064)	(0.110)	(0.046)	(0.031)
Month 5	0.288	0.037	0.240	0.094	0.007
	(0.089)	(0.066)	(0.096)	(0.039)	(0.030)
Month 6	0.300	0.056	0.444	0.108	0.017
	(0.086)	(0.066)	(0.103)	(0.038)	(0.032)
Month 7	0.145	0.194	0.344	0.107	0.024
	(0.094)	(0.094)	(0.113)	(0.041)	(0.032)
Month 8	0.110	0.175	0.410	0.085	0.032
	(0.089)	(0.088)	(0.126)	(0.043)	(0.033)
Month 9	0.148	0.351	0.384	0.099	0.025
	(0.086)	(0.093)	(0.112)	(0.041)	(0.035)
Month 10	0.083	0.208	0.113	0.096	0.026
	(0.109)	(0.080)	(0.145)	(0.044)	(0.036)
Month 11	0.308	0.255	0.196	0.110	0.025
	(0.091)	(0.088)	(0.133)	(0.048)	(0.038)
Month 12	-0.032	0.143	-0.340	0.073	0.019
	(0.113)	(0.074)	(0.152)	(0.077)	(0.042)
Observations	1230	1230	1230	1230	1230
Firms	102	102	102	102	102

Notes: $p<0.1$, $p<0.05$, $p<0.01$. All columns are estimated by OLS. Standard errors are clustered at the firm level, in parentheses under the coefficient. Firm-level fixed effects are included in all models. The transition occurs during Month 0. Month -1, the month before the CEO transition, is the base period for the regressions.

Table B.2 - Firm-level Event Study Regressions of Meeting and Email Measures (Stayers Only)

	(1)	(2)	(3)	(4)	(5)
	MEETINGS			**EMAILS**	
Dependent Variable is log of:	Meetings (count)	Avg. Duration (minutes)	Avg. Participants (people)	Emails (count)	Avg. Recipients (people)
Period -3	0.046	0.236	0.203	0.048	-0.041
	(0.069)	(0.074)	(0.103)	(0.037)	(0.024)
Period -2	-0.073	0.039	0.038	-0.100	-0.033
	(0.075)	(0.040)	(0.118)	(0.052)	(0.017)
Period -1 (Base Period)					
Period 0	-0.296	0.145	0.132	-0.064	-0.002
	(0.106)	(0.062)	(0.087)	(0.057)	(0.026)
Period 1	-0.310	0.119	0.054	-0.051	0.016
	(0.093)	(0.077)	(0.085)	(0.049)	(0.027)
Period 2	0.232	0.030	0.342	0.115	0.021
	(0.073)	(0.049)	(0.088)	(0.049)	(0.028)
Period 3	0.208	0.161	0.510	0.131	0.040
	(0.072)	(0.073)	(0.096)	(0.049)	(0.030)
Period 4	0.137	0.212	0.539	0.107	0.050
	(0.069)	(0.069)	(0.104)	(0.051)	(0.033)
Period 5	0.243	0.197	0.385	0.113	0.049
	(0.071)	(0.057)	(0.108)	(0.052)	(0.037)
Period 6	-0.052	0.119	-0.089	0.032	0.046
	(0.086)	(0.059)	(0.115)	(0.085)	(0.044)
Observations	696	696	696	696	696
Firms	96	96	96	96	96

Notes: $p<0.1$, $p<0.05$, $p<0.01$. This analysis is the same as the main results, however, run only on the subset of Stayers (at the firm before and after the transitions) in each firm. All columns are estimated by OLS. Standard errors are clustered at the firm level, in parentheses under the coefficient. Firm-level fixed effects are included in all models. The transition occurs during the first month of bi-monthly Period 0. Period -1, the bi-monthly period before the CEO transition, is the base period for the regressions.

Table B.3 - Turnover Rate

Month	Mean	Std. Dev.
-3	-2.3%	0.093
-2	0.2%	0.007
-1	0.3%	0.012
0	5.6%	0.150
1	-2.3%	0.112
2	2.1%	0.108
3	3.0%	0.179
4	-1.6%	0.127
5	-2.0%	0.256
6	-0.7%	0.103
7	0.3%	0.098
8	-1.2%	0.099
9	1.4%	0.121

Note: The mean turnover rate is calculated as: [(change in Exitors) + (change in Entrants)] / (average Stayers).

Table B.4 - Robustness Tests: Firm-level Event Study Regressions

Sample:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Total		Department Data		Balanced Data		Pre-Announcement			
Dependent Variable is log of:	Meetings (count)	Emails (count)	Meetings (count)	Emails (count)	Meetings (count)	Emails (count)	Meetings (count)		Emails (count)	
Timeline: Annoucement = P0 or Transition = P0	Trans	Trans	Trans	Trans	Trans	Trans	Trans	Ann	Trans	Ann
Period -3	0.049	0.034	-0.005	-0.016	0.048	0.034	0.037		0.019	
	(0.071)	(0.033)	(0.071)	(0.036)	(0.072)	(0.034)	(0.094)		(0.051)	
Period -2	-0.035	-0.108**	-0.063	-0.122**	-0.035	-0.109**	-0.015	0.090	0.010	0.028
	(0.071)	(0.051)	(0.086)	(0.055)	(0.072)	(0.051)	(0.044)	(0.127)	(0.054)	(0.052)
Period -1 (Base Period)										
Period 0	-0.329***	-0.164**	-0.169*	-0.080	-0.324***	-0.161**	-0.372**	-0.216	-0.141***	-0.114
	(0.105)	(0.070)	(0.091)	(0.051)	(0.106)	(0.070)	(0.145)	(0.161)	(0.051)	(0.086)
Period 1	-0.286***	-0.126**	-0.112	-0.123**	0.096	-0.077	-0.610***	-0.101	-0.245***	-0.246
	(0.090)	(0.055)	(0.095)	(0.052)	(0.072)	(0.059)	(0.133)	(0.100)	(0.079)	(0.163)
Period 2	0.236***	0.069	0.365***	0.071	0.293***	0.080*	0.059	-0.284*	-0.038	-0.168
	(0.074)	(0.052)	(0.077)	(0.051)	(0.073)	(0.047)	(0.063)	(0.144)	(0.034)	(0.100)
Period 3	0.227***	0.111**	0.291***	0.092*	0.112	0.107**	0.087	0.061	0.001	-0.040
	(0.075)	(0.047)	(0.084)	(0.051)	(0.075)	(0.048)	(0.079)	(0.073)	(0.041)	(0.092)
Period 4	0.137*	0.095*	0.081	0.063	0.117	0.095*	0.047	0.132	0.017	-0.014
	(0.075)	(0.049)	(0.095)	(0.049)	(0.075)	(0.051)	(0.064)	(0.087)	(0.044)	(0.089)
Period 5	0.268***	0.108**	-0.108	0.055	0.207**	0.144***	0.122	0.160**	0.024	-0.003
	(0.076)	(0.052)	(0.126)	(0.051)	(0.078)	(0.052)	(0.079)	(0.076)	(0.046)	(0.088)
Period 6	-0.088	0.014			-0.214**	-0.042	-0.107	0.259***	0.005	0.017
	(0.091)	(0.083)			(0.106)	(0.111)	(0.098)	(0.086)	(0.047)	(0.092)
Observations	725	725	469	469	463	463	213	173	213	173
Firms	102	102	89	89	55	55	30	30	30	30

Notes: * p<0.1, ** p<0.05, *** p<0.01. Standard errors are clustered at the firm level. Firm-level fixed effects are included in all models. Models (1) and (2) are the main effect, mapping to Exhibit 1, models (1) and (4), respectively. Models (3) and (4) test the robustness of the main effect on the sample of 88 firms that have additional data on communication within and across functional departments within the firm. Models (5) and (6) test the robustness of the main effect on the sample of 55 firms that have balanced data, before and after the CEO transition event. Models (7) and (9) test the robustness of the main effect on the sample of 30 firms that have the announcement of the CEO change more than 1 month before the transition occurs, on the transition timeline (where the CEO transition event =Period 0 and the base = Period -1, one period before the CEO transition event), similar to the other regressions reported. Models (8) and (10) use the announcement timeline for this same sample of 30 firms (where the announcement of the pending CEO change= Period 0 and the base = Period -1, one period before the announcement.)

Appendix C – Simple Model of Intra-firm Communication

Subsection C.1. introduces a simplified version of this model and revisits two of its main results. Subsection C.2. adapts the model to include the possibility of CEO transitions. Subsection C.3. derives four predictions on communication dynamics around CEO transition by making three assumptions on the short-term and medium-term effects of a change in leadership.

C.1. A Simple Model of Intra-Firm Communication

Definitions. A highly stylized firm is modeled as a game with three players: the Center and two Agents. Each Agent i has a local payoff:

$$\pi_i = K_i - (d_i - \theta_i)^2 - \delta(d_i - d_{-i})^2$$

where K_i is a constant, d_i is Agent i's decision, and θ_i is the local state observed by i. The θ_i's are normally distributed with mean zero and variance one, and mutually independent. Besides the constant, the payoff depends on two components:

(1) Adaptation cost, $(d_i - \theta_i)^2$: how well the Agent's decision fits the local state of the world that she faces.

(2) Coordination cost, $(d_i - d_{-i})^2$: how well the Agent's decision fits with the decision taken by the other Agent.

The parameter δ measures the relative importance of coordination versus adaptation. It plays a central role in our analysis, and we refer to this variable as the *need for coordination*. If the need for coordination is high, the Agent's payoff depends more heavily on how her decision fits the other Agent's decision. Each Agent cares both about her functional unit's payoff and the other Agent's payoff. She maximizes:

$$\pi_i + \alpha\pi_{-i},$$

where α represents the *degree of alignment* of the Agent with the rest of the organization. When $\alpha = 0$, alignment is minimal, and the Agent only cares about her unit's payoff. When $\alpha = 1$, alignment is maximal, and the Agent cares about the whole organization's payoff $\pi_i + \pi_{-i}$.

Communication Modes. In Alonso et al. (2008), there are two possible modes of organization and communication. *Horizontal communication* occurs when the two Agents communicate with each other and then make decisions independently. Namely, first, each Agent observes the value of her local state. Second, Agent 1 sends a non-verifiable signal to Agent 2, and Agent 2 sends a non-verifiable signal to Agent 1. Third, each Agent makes a local decision. *Vertical communication* occurs when the two Agents communicate with the Center, who then makes decisions for both Agents (or tells them what decision to take).[15] Namely, after each state observes her local states, she sends a non-verifiable signal to the Center, who then selects both d_1 and d_2.

In both communication modes, each Agent faces a tension between communicating the true value of her signal, who will help the other player—be it the Agent or the Center—make a correct decision, and exaggerating her own signal in order to induce the decision-maker to make a decision that is closer to the Agent's preference. For instance, if θ_i is positive, Agent i knows that her signal is likely to be higher than the other Agent's signal. If signals were taken at face value, Agent i would have an incentive to communicate a signal higher than θ_i to induce the other Agent or the Center to select a higher action. This effect is related to the one present in the celebrated cheap talk game studied by Crawford and Sobel (1982).

As in Crawford and Sobel (1982), in equilibrium, Agents communicate a partitional signal. Although each Agent observes a continuous signal, she can only credibly communicate a coarser discrete signal with a finite number of realizations. Each realization informs the receiver that the true signal lies in a given interval. The residual variance after communication is a function of how coarse the partitional signal

[15] There are also two hybrid configurations: (i) The Agents communicate horizontally and the Center makes (uninformed) decisions; (ii) The Agents communicate with the Center and then make decisions themselves (without getting a signal from the other Agent). However, they are obviously suboptimal.

is. Therefore, in equilibrium, the partitional signal's fineness can be interpreted as a measure of the amount of information transmitted.[16]

While the incentive to exaggerate the Agent's own state is present both in horizontal and vertical communication, the two modes of communication differ in the relative importance decision-makers assign to local (i.e. functional unit) and global (i.e. firm-level) payoffs. As the Center always maximizes $\pi_1 + \pi_2$, we should expect her to assign more importance to achieve coordination gains.

Equilibrium. We next present two results borrowed from Alonso et al. (2008) that will form the basis of our predictions. The first links alignment and communication:

> ***Proposition 1****: For both modes of communication, an increase in the degree of alignment* α *increases the amount of information transmitted.*[17]

The intuition for this result is that more aligned Agents face a lower incentive to misrepresent their information because they internalize a higher share of the cost of misleading the other Agent or the Center. When the degree for alignment α is higher, the partitional message becomes finer and more information is transmitted. This proposition captures the basic idea that alignment breeds trust, and we communicate more and better when we trust each other.

This proposition applies to both modes of communication. In the vertical mode, communication occurs between the Center and the Agents, and information transmission is higher if alignment is higher. In the horizontal model, communication is directly between Agents and, again, it depends on alignment.

The second result links the need for coordination with the relative value of the two communication modes:

[16] A partitional equilibrium with n intervals would require transmitting approximately $log\ n$ bits of information.
[17] Proof: See Proposition 3(iii) in ADM (noting that our α is related to their λ according to α=λ/(1-λ)).

Proposition 2*: Holding α constant, an increase in the need for coordination δ makes vertical communication (weakly) more efficient than horizontal communication.*[18]

This second result derives from a tradeoff identified by Hayek (1945) between centralized and decentralized decision-making. Centralization, which builds on vertical communication, is more effective at solving coordination problems. Decentralization, which instead exploits horizontal communication, is better at using local knowledge, and thus at solving adaptation problems. If a firm experiences an increase in the relative importance of coordination over adaptation, it should optimally respond by increasing the relative importance of vertical over horizontal communication.

C.2. CEO Transition

Equipped with our intra-firm communication theory, we explore the effects of CEO transition on the intensity and mode (i.e. horizontal versus vertical) of intra-firm communication. We distinguish between four stages of the transition: the steady-state (when the prior CEO still runs the firm), the short-term transition (the first weeks of the transition), medium-term transition (the first months of the transition, excluding the very first weeks), and the new steady-state.

We make three assumptions on the evolution of our two key parameters: α and δ. First, the initial weeks of the transition are characterized by a certain degree of confusion in the organization and a lack of clarity over the implicit and explicit incentive structure. In the short term, alignment suffers, and each Agent becomes more protective of her turf. Following a large organizational change, increased ambiguity creates numerous, conflicting interpretations of the same situation (Weick 1995, Weick et al. 2005). This ambiguity persists until the new CEO effectively communicates a singular path forward, dispelling any possible misunderstandings regarding the firm's mission or strategy and reducing uncertainty. Thus, we make the following assumption.

[18] Proof: See Proposition 5 of ADM as depicted in their Figure 6. For any given value of the alignment parameter (our α, their λ – see previous footnote), decentralization is always optimal for a low value of the need for coordination δ. As δ increases, two cases are possible. If λ is low, decentralization remains optimal (weak increase). If λ is high, centralization instead becomes strictly better with a high enough increase in the need for coordination.

Assumption A*: In the short term, the degree of alignment falls from the pre-transition level* α_0 *to* α_{ST}*, where* $\alpha_{ST} < \alpha_0$.

In the medium term, the new CEO takes control of the firm, selects new leaders, and sets the firm's strategic vision. A new leader may change the firm's shared frame (Gibbons et al. 2020). Planned organizational changes require increased coordination, yet inertial pressures constrain the firm's ability to adapt (Gargiulo & Benassi 2000, Maurer & Ebers 2006). Prior structural rigidities (Leonard-Barton 1992) are challenging to overcome, and the repositioning costs of changing firm strategy further reduce flexibility (Menon & Yao 2017). The communication of the strategic visions ripples through the firm when information sharing is lower, requiring employees to update themselves and their teams on the updated strategies. Subsets of the firm begin to coordinate their decisions based on the shared strategy, reducing uncertainty and increasing the need to coordinate. So, we assume:

Assumption B*: In the medium term, the need for coordination increases from the pre-transition level* δ_0 *to* δ_{MT}*, where* $\delta_{MT} < \delta_0$.

Finally, in the medium term, the CEO affects alignment. The CEO has an unobservable type that determines her ability to create the right organizational culture and implement effective incentive mechanisms. The CEO's type is $\theta \in \{bad, good\}$. The quality of management is important in multi-divisional, decentralized firms (Sah & Stiglitz 1991), and aspects of CEO behavior and fit with the firm are related to increased firm performance (Bandiera et al. 2015, 2020). Good managers reduce employee turnover (Hoffman & Tadelis, 2021). Good managers can communicate their plans more effectively, reducing greater ambiguity (Kotter 1995, Schein 1994). This reduction in ambiguity facilitates communication. We make one last assumption:

Assumption C*: In the medium term, a good CEO increases alignment relatively more than a bad CEO:* $\alpha_{good} > \alpha_{bad}$.

C.3. Predictions

These three assumptions lead three predictions that are aligned with our results.

Prediction 1*: In the short-term transition, the amount of information transmitted falls.*

The first prediction is an immediate consequence of Proposition 1 and Assumption A. The reduction in the degree of alignment leads to less intense equilibrium communication. [19]

Prediction 2*: In the medium-term transition, the ratio between the amount of vertical communication to the amount of horizontal communication increases.*

The second prediction derives from the assumption that the need for coordination increased after a CEO transition together with Proposition 2. The increased need for coordination makes vertical communication relatively more efficient. In other words, to develop a "new" organization, the CEO requires more centralization: we thus, expect that there will be more "vertical" communication (i.e. manager to employee and vice versa) to coordinate decision-making around the new strategy.

Prediction 3*: A greater increase in communication in the medium term determines a higher steady-state performance.*

The third prediction is slightly more elaborate than the previous two, and focuses on the connection among CEO types, increased communication, and firm performance. By Assumption C combined with Proposition 1, a good CEO increases the degree of alignment and, hence, medium-term communication more than a bad CEO. However, the increase in the degree of alignment also translates into a higher level of firm performance ($\pi_1 + \pi_2$ in the model). We do not know the CEO type, but we observe changes in communication intensity and firm performance. The model predicts that the former will be correlated with the latter.

[19] One could expand our model by making communication costly. This would reinforce Prediction 1 as workers may exert less effort during the transition because they are subject to less monitoring.