Communication within Firms: Evidence from CEO Turnovers

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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 increase in communication after CEO change are associated with greater increases in firm market returns.

Keywords: CEO change, communication, alignment.

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1. Introduction

Intra-firm communication enables firms to share knowledge, create organizational memory, and make decisions that are essential to developing and executing firms' strategies (Simon 1947, Arrow 1974). Internal communication flows have been extensively studied in the organizational economics literature, primarily from a theoretical perspective. 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 ultimate drivers of internal communication patterns and their variation across firms and over time, however, are still largely unknown due to data limitations. Comparable observational data on firm-level communication for large samples of firms are hard to find (Impink, Prat & Sadun 2020), and longitudinal data following the evolution of communication patterns over time within firms has not, to our knowledge, been available to researchers. As a consequence, though prior research in organizational economics has provided many theoretical models of intra-firm communication flows from both a static and dynamic perspective, these predictions have not yet been tested empirically.

This paper provides one of the first empirical examinations of internal communication patterns across a large sample of firms. We leverage unique meeting and email metadata from 102 firms to study the effects of specific organizational shocks—CEO turnover, a pivotal event impacting a firm's strategy and performance (Bertrand & Schoar 2003)—on internal communication patterns. Guided by a canonical model of intra-firm communication (Alonso et al. 2008, Rantakari 2008), 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.

The model formalizes the idea that directly following a CEO change, confusion around the firm's changing goals and management's expectations (Srivastava 2015) 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.

The empirical findings are largely supportive of the model's predictions. Namely, 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, vertical communication (i.e. managers to employees and vice-versa) increases more than horizontal communication (managers with managers and employees with employees) starting about four months after the CEO transition. 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.

This study innovates on the prior literature on four fronts. First, 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). Communications metadata have been used in prior research to analyze employee coordination (Kleinbaum et al. 2008, Kleinbaum & Stuart 2013) and the implementation of corporate strategies (Kleinbaum & Stuart 2014). 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.

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, 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) and their contribution to performance variation across firms (Syverson 2011).

Lastly, this paper related 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) as a proxy for information flows and knowledge sharing needed to support effective coordination. Additionally, the literature has identified the existence of tradeoffs between the benefits of increased coordination and employees acting independently. Managers often have strategically important, private information (i.e. asymmetric awareness) about a decision's fit with the external environment. Centralization of decision-making across departments may help coordination, but also make it harder for managers to adapt their decisions to local conditions (Alonso et al. 2008). Others highlight 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). Our contribution is to leverage an established model of intra-firm communication and decision making (Alonso et al. 2008) to guide the empirical analysis of communication flows after a significant organizational event.

The paper proceeds as follows. Section 2 describes the related theory and discusses a stylized model of information flows between parties in a multi-divisional firm. This model provides us with testable predictions in the context of a CEO change. Section 3 describes the communications metadata and the

measures we developed to test the model's predictions. Section 4 details the event study and performance research designs. Section 5 describes the main results and additional findings correlating communication changes with firm performance. Section 6 concludes.

2. Theory

This short section builds a highly stylized model of intra-firm communication and uses it to make predictions on the evolution of communication patterns around a CEO transition. Subsection 2.A introduces a simplified version of the canonical organizational economics model of intra-firm communication (Alonso et al. 2008, Rantakari 2008) and revisits two of its main results. Subsection 2.B adapts the canonical model to include the possibility of CEO transitions. Subsection 2.C derives four predictions on communication dynamics around CEO transition by making three assumptions on the short- and medium-term effects of a change in leadership.

2.A. A Simple Model of Intra-Firm Communication

We develop a simplified version of a widely used model of intra-firm communication (Alonso et al. 2008, Rantakari 2008), and we report some existing results that will be useful later for the empirical analysis.

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).[1] 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

[1] 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.

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 is. Therefore, in equilibrium, the partitional signal's fineness can be interpreted as a measure of the amount of information transmitted.[2]

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.*[3]

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

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

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:

> ***Proposition 2****: Holding α constant, an increase in the need for coordination δ makes vertical communication (weakly) more efficient than horizontal communication.*[4]

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.

2.B. 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.

[4] 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.

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.

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, forthcoming). 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:* $\alpha_{good} > \alpha_{bad}$.

2.C. Predictions

These three assumptions lead to a set of testable predictions.

> ***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. [5]

> ***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.*

[5] 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.

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.

3. 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 (3.A). We then describe the communication variables proxying for internal communication flows (3.B) and French-Fama cumulative returns as stock market performance measures (3.C). Lastly, we discuss some limitations of using communications metadata (3.D).

3.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. Additional details on the initial sample and matching process with our email provider are described in the Appendix in Note A5.

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[6] (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. More details on the firms in our sample are provided in Table 1a.

3.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.[7] In addition to total meeting and email

[6] Includes financial and insurance services.

[7] 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.

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 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 1b shows basic summary statistics for the meeting data. Employees attended, on average, 40 (Median 31, Standard Deviation 32) internal meetings per month. These meetings lasted about 118 minutes (Med. 80, SD 326) and included 44 attendees (Med 25, SD 63).[8] In total, employees were scheduled to attend around 80 hours a month in meetings.

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 (which maps into the idea of measuring vertical communication between managers and workers) to proxy for the different communication modes discussed in the model. We report these summary statistics and results in Table 1c. Meetings vary along the hierarchy: senior managers have more meetings and send more emails than lower-ranked managers and individual contributors (61 meetings/month (Med. 54, SD 37) for senior managers, 46 meetings/month (Med. 37, SD 28) for other managers, and 20 meetings/month (Med. 17, SD 15) for ICs. 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. 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 roughly equates to two vertical

[8] 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.

and five horizontal meetings per user per firm per month.[9] We report these details in Table 1d and summarize the data available and provided in the Appendix in Table A2.

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 249 (Med. 224, SD 200) internal emails per month. Senior managers send 335 emails/month (Med. 129, SD 164), other managers: 267 emails/month (245 Med., SD 129), ICs: 164 emails/month (Med. 132, SD 240). Even though more senior managers attend more meetings, these meetings are on average shorter (92 minutes/meeting, Med. 78 SD 69) than those attended by other managers (103 minutes/meeting, Med. 78 SD 133) or ICs (153 minutes/meeting, Med. 87 SD 516). We report these summary statistics in Table 1b, under Emails.

Communication Index. We create a measure of communication intensity based on both email and meeting data. To build this measure, we add the total meeting intensity, calculated as the average number of meetings multiplied by the average length of the meetings, and the total email intensity, calculated at the average number of emails multiplied by the average number of recipients. Meetings take up roughly half of the average employees' working hours (assuming a 160-hour average work month).[10]

3.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

[9] 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.

[10] Another way to compute email intensity is to assign an average length of time to write and send an email. For example, if your work consisted of only meetings and email time, which is certainly an overstatement, each email would take on average 3 minutes to write and send. When we use this approach, the results are almost identical as the average number of emails recipients is also 3.

(CAR) measures 6 months before and 6 months after the CEO change.[11] Table 1e shows basic summary statistics of these measures before and after CEO turnover for two alternative CAR measures (Market-Adjusted CAR, and French-Fama CAR).

3.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-

[11] The market adjust 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.

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.[12]

4. Research Design

4. 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.[13] 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,

[12] The information underlying the meeting and email variables contains about 15 petabytes of data.
[13] 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 Table A4 for more details.

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,[14] 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 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.

4.B. Performance

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

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

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.

[14] In our sample only one CEO transition was driven by truly exogenous events, i.e. CEO illness or death.

5. Results

Main Results. We show the event study results in Table 2 and graph the bimonthly coefficients in Figure 1. 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. Supporting Prediction 1, 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 -33.0%, SD 0.1, P1 -25.8%, SD 0.09; emails: P0 -16.0%, SD 0.03, P1 -11.9% SD 0.06). Meetings and emails increase significantly from the base period from 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 and12 months after the CEO change month (meeting stabilize ~+30% from base and emails stabilize at ~+10%). The duration of meetings and the number of attendees also vary over time, but the changes are small and insignificant. The communication intensity index measure follows a similar pattern after the transition event (-22.6% SD 0.1, P1: -12.9%). However, the increased duration of meetings and number of recipients on emails starting in Period 2 leads to a greater rebound in communication intensity (+~40%) and a higher steady-state level in the medium term than were recorded before the CEO transition.

Beyond average effects, it is interesting to see 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 3 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 not only shifted to the right relative to short term changes, but also more heterogeneous. This is in line with the model, which interprets the medium term changes in communication

as a proxy for the latent CEO ability to generate alignment within the firm. We discuss how this heterogeneity in medium term communication correlates with performance later in this section.

Vertical and Horizontal Communication Interactions. The email provider calculated vertical (i.e. meetings with the Center) and horizontal communication (i.e. meetings amongst peer Agents) metadata for meetings in 88 firms from six months before until eight months after the CEO transition.[15] We show these results in Table 3 and graph these coefficients in Figure 2. 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. Supporting Prediction 2, this ratio significantly increases in the medium run (P2 +3.8% SD 0.12, P3 +6.5% SD 0.14), 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 Table 4. First, the model focuses primarily on formal aspects of communication—i.e. information that is exchanged for the purposes of decision-making rather than informal interactions (e.g. personal meetings), which may be included in the aggregate 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.[16] Reassuringly, the results are virtually identical when we use this subsample of interactions (column 3).[17]

[15] Due to large gaps in the email meta-data from GDPR compliance, the email provider built these measures from meeting meta-data only.

[16] 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.

[17] Kleimbaum (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.

A second 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).

Finally, 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 coefficient 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).[18]

In unreported analysis, we analyzed whether the coefficients on the period dummies 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 heterogeneity, 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-run

[18] 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.

after the CEO transition—for brevity, we refer to these firms as high communication firms.[19] 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.

We present the estimation of Equation 2 in Table 5. 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 prior to the CEO change. To do so, we build a CAR measure that starts summing over unexpected results from 6 months prior to 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 prior to the CEO change, and we show these results visually in Figure 4. Finally, we look at the robustness of the relationship to the inclusion of firm fixed effects in column 3, and in columns 4-6 we repeat the same analysis using a different CAR measure build using French-Fama factors, and find similar results.

All in all, these results suggest that high communication firms start to diverge in terms of performance early on, and specifically in the first three months of the new CEO tenure, but these differences do not accrue over time (i.e. the persistent CAR differences are entirely driven by what happens in Period 1, and are sustained afterward). These results can be interpreted in two ways. First, in line with Prediction 3, differences in the increase in communication in the medium-term period 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 affects unrelated to the CEO type affects CARs immediately after

[19] 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.

a CEO change, and that this shock also induces a change in communication intensity in the medium-term after the CEO takes charge.

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. 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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Table 1a - Firm Summary

CEO Change Reason	Firms	%	Country	Firms	%	Industry	Firms	%
Within-firm Transfer	31	30%	United States	41	40%	Services/Fin. (SIC 60-89)	31	30%
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: CEO change reason, industry, and country were collected for 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 1b - Summary of Communications Data

	Total				
	Mean	Med.	SD	Min	Max
Meetings					
Count (avg/month)	40	31	32	1	377
Duration (minutes/meeting)	118	80	326	5	24344
Attendees (avg invited/meeting)	44	25	63	2	1470
Emails					
Count (avg/month)	249	224	200	1	46927
Recipients (avg employees/email)	3	3	4	1	491
Communication Index	4772	3551	9303	14	677443

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. Communication Intensity Index is log (meeting count * meeting duration + email count * email recipients).

Table 1c - Summary of Management Hierarchy

	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	17	15	46	37	28	61	54	37	0.00	0.00
Duration (minutes/meeting)	153	87	516	103	78	133	92	78	69	0.00	0.00
Attendees (avg invited/meeting)	39	23	51	47	26	68	49	27	68	0.06	0.96
Emails											
Count (avg/month)	164	132	240	267	245	129	335	129	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 1d - Summary of Meeting Interactions (per user)

	Total		Vertical		Horizontal		Some External	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Meetings								
Count (avg/month)	7	5	2	2	5	4	0.3	0.3
Duration (minutes/meeting)			59	17	58	11		

Data N/A

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 1e - Summary of Stock Returns

	Cumulative Abnormal Returns			
	Pre-transition		Post-transition	
	Mean	SD	Mean	SD
Cumulative Return (Risk Free)	-0.11	0.25	-0.11	0.40
Market-Adjusted CAR	-0.10	0.25	-0.11	0.26
Market (OLS) CAR	-0.11	0.25	-0.11	0.26
French-Fama CAR	-0.09	0.25	-0.09	0.26

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.

Table 2 - Firm-level Event Study Regressions of Meeting and Email Measures

	(1)	(2)	(3)	(4)	(5)	(6)
	MEETINGS			**EMAILS**		**INDEX**
Dependent Variable is log of:	Meetings (count)	Avg. Duration (minutes)	Avg. Participants (people)	Emails (count)	Avg. Recipients (people)	Comm. Intensity
Period -3	0.049	0.220***	0.187*	0.034	-0.057**	0.197**
	(0.071)	(0.077)	(0.099)	(0.033)	(0.026)	(0.092)
Period -2	-0.035	0.026	0.033	-0.108**	-0.047**	-0.060
	(0.071)	(0.041)	(0.118)	(0.051)	(0.020)	(0.069)
Period -1 (Base Period)						
Period 0	-0.329***	0.128*	0.122	-0.164**	-0.017	-0.216**
	(0.105)	(0.068)	(0.085)	(0.070)	(0.031)	(0.104)
Period 1	-0.286***	0.117	0.057	-0.126**	-0.016	-0.154*
	(0.090)	(0.076)	(0.091)	(0.055)	(0.031)	(0.090)
Period 2	0.236***	0.051	0.307***	0.069	0.003	0.231***
	(0.074)	(0.056)	(0.090)	(0.052)	(0.030)	(0.071)
Period 3	0.227***	0.175**	0.513***	0.111**	0.025	0.334***
	(0.075)	(0.077)	(0.097)	(0.047)	(0.032)	(0.079)
Period 4	0.137*	0.289***	0.536***	0.095*	0.033	0.363***
	(0.075)	(0.086)	(0.104)	(0.049)	(0.034)	(0.091)
Period 5	0.268***	0.269***	0.379***	0.108**	0.029	0.446***
	(0.076)	(0.078)	(0.110)	(0.052)	(0.038)	(0.088)
Period 6	-0.088	0.137**	-0.081	0.014	0.035	0.030
	(0.091)	(0.067)	(0.121)	(0.083)	(0.041)	(0.094)
Observations	725	725	725	725	725	725
Firms	102	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 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. Communication Intensity Index is log (meeting count * meeting duration + email count * email recipients).

Table 3 - Firm-level Event Study Regressions of Meeting Interactions

	(1)	(2)	(3)	(4)
		MEETINGS		
Dependent Variable is log of:	Meetings (count)	Horizontal (count/user)	Vertical (count/user)	Ratio (Vertical/ Horizontal)
Period -3	0.062	0.126	0.080	-0.046
	(0.079)	(0.086)	(0.128)	(0.076)
Period -2	-0.056	0.108	0.034	-0.075
	(0.077)	(0.069)	(0.126)	(0.094)
Period -1 (Base Period)				
Period 0	-0.183*	-0.043	-0.097	-0.054
	(0.094)	(0.067)	(0.143)	(0.105)
Period 1	-0.056	0.071	0.078	0.007
	(0.096)	(0.073)	(0.151)	(0.112)
Period 2	0.418***	0.126*	0.662***	0.536***
	(0.087)	(0.075)	(0.152)	(0.112)
Period 3	0.576***	0.071	0.898***	0.827***
	(0.104)	(0.081)	(0.165)	(0.134)
Observations	353	353	353	353
Firms	88	88	88	88

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 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 Table 2 (1) but for the samples of matched observations/firms available in the meeting interactions data (353 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).

Table 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	0.052	0.034	0.049	0.022	0.051	0.030	0.054		0.028	
	(0.072)	(0.033)	(0.080)	(0.034)	(0.074)	(0.037)	(0.104)		(0.061)	
Period -2	-0.032	-0.108**	-0.083	-0.120**	-0.061	-0.124	-0.011	0.105	0.020	0.031
	(0.071)	(0.051)	(0.079)	(0.058)	(0.074)	(0.076)	(0.037)	(0.133)	(0.064)	(0.053)
Period -1 (Base Period)										
Period 0	-0.330***	-0.160**	-0.217**	-0.039	-0.336***	-0.207**	-0.373**	-0.256	-0.168***	-0.120
	(0.105)	(0.069)	(0.103)	(0.052)	(0.108)	(0.080)	(0.141)	(0.175)	(0.054)	(0.088)
Period 1	-0.258***	-0.119**	-0.173*	-0.080	0.088	-0.059	-0.575***	-0.135	-0.299***	-0.252
	(0.088)	(0.055)	(0.092)	(0.053)	(0.075)	(0.054)	(0.129)	(0.100)	(0.078)	(0.166)
Period 2	0.269***	0.076	0.302***	0.140***	0.251***	0.104**	0.093	-0.333**	-0.013	-0.170
	(0.073)	(0.052)	(0.080)	(0.047)	(0.075)	(0.044)	(0.061)	(0.142)	(0.032)	(0.101)
Period 3	0.259***	0.117**	0.281***	0.171***	0.090	0.140***	0.130	0.019	0.034	-0.048
	(0.074)	(0.048)	(0.084)	(0.050)	(0.077)	(0.048)	(0.077)	(0.073)	(0.040)	(0.094)
Period 4	0.171**	0.101**	0.186**	0.141***	0.093	0.122**	0.096	0.101	0.045	-0.021
	(0.076)	(0.050)	(0.084)	(0.051)	(0.075)	(0.052)	(0.062)	(0.087)	(0.043)	(0.090)
Period 5	0.304***	0.115**	0.328***	0.119**	0.176**	0.164***	0.146*	0.121	0.038	-0.009
	(0.076)	(0.053)	(0.099)	(0.054)	(0.077)	(0.053)	(0.074)	(0.078)	(0.043)	(0.090)
Period 6	0.315***	0.060			0.225**	0.002	0.194***	0.304***	0.031	0.038
	(0.086)	(0.094)			(0.100)	(0.140)	(0.065)	(0.084)	(0.044)	(0.097)
Observations	709	709	469	469	448	448	209	172	209	172
Firms	102	102	89	89	55	55	30	30	30	30

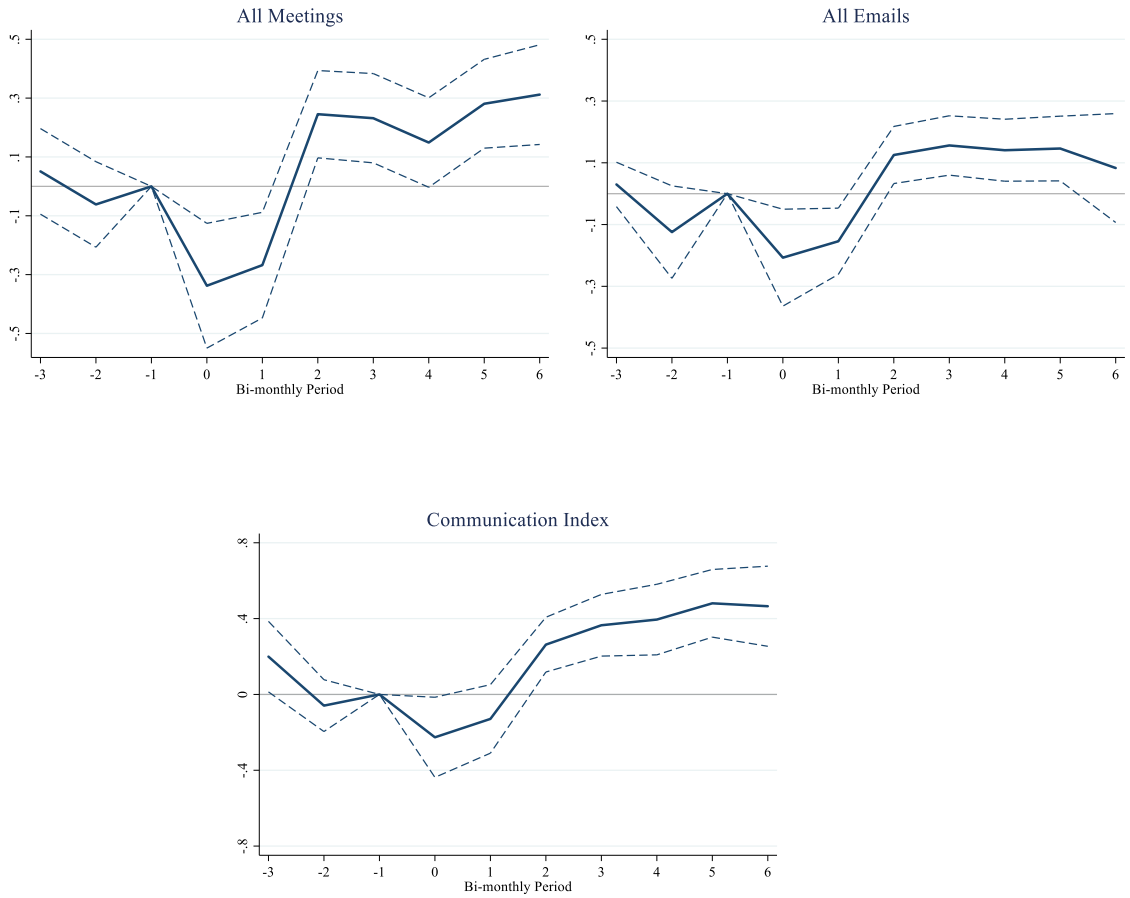
Notes: * p<0.1, ** p<0.05, *** p<0.01. Standard errors are clustered at the firm level. Firm-level fixed effects are included in all models. Regressions (1) and (2) are the main effect, mapping to Table 2 Regressions (1) and (4), respectively. Regressions (3) and (4) test the robustness of the main effect on the sample of 88 firms that have additional data on communication within and across functional departments within the firm. Regressions (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. Regressions (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. Regressions (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.)

Table 5 - 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:	Pre	All	All	Pre	All	All
Period -3		0.053	0.053		0.075**	0.075**
		(0.034)	(0.034)		(0.034)	(0.034)
Period -2		-0.045	-0.045		0.006	0.006
		(0.039)	(0.039)		(0.039)	(0.039)
Period -1		-0.122*	-0.122*		-0.068	-0.068
		(0.072)	(0.072)		(0.073)	(0.073)
Period 0 (Base Period)						
Period 1	-0.101**	-0.101**	-0.101**	-0.075*	-0.075*	-0.075*
	(0.040)	(0.040)	(0.040)	(0.041)	(0.041)	(0.040)
Period 2	-0.139***	-0.139***	-0.139***	-0.086*	-0.086*	-0.086*
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
Period 3	-0.160***	-0.160***	-0.160***	-0.094*	-0.094*	-0.094*
	(0.050)	(0.050)	(0.050)	(0.051)	(0.051)	(0.051)
Low/High Communication (quintile)	0.048	0.048		0.037	0.037	
	(0.052)	(0.052)		(0.052)	(0.052)	
Period -3 x High Communication		-0.065	-0.065		-0.061	-0.061
		(0.054)	(0.054)		(0.053)	(0.053)
Period -2 x High Communication		0.003	0.003		0.002	0.002
		(0.063)	(0.063)		(0.062)	(0.062)
Period -1 x High Communication		0.047	0.047		0.072	0.072
		(0.099)	(0.099)		(0.100)	(0.099)
Period 0 (Base) x High Communication						
Period 1 x High Communication	0.128***	0.128***	0.128***	0.102**	0.102**	0.102**
	(0.045)	(0.045)	(0.045)	(0.046)	(0.046)	(0.046)
Period 2 x High Communication	0.128**	0.128**	0.131**	0.110*	0.110*	0.113**
	(0.055)	(0.055)	(0.055)	(0.056)	(0.056)	(0.056)
Period 3 x High Communication	0.123**	0.123**	0.126**	0.116*	0.116**	0.119**
	(0.057)	(0.057)	(0.057)	(0.058)	(0.057)	(0.057)
Firm-Level Fixed Effects	No	No	Yes	No	No	Yes
Observations	249	501	501	249	501	501
Firms	42	42	42	42	42	42

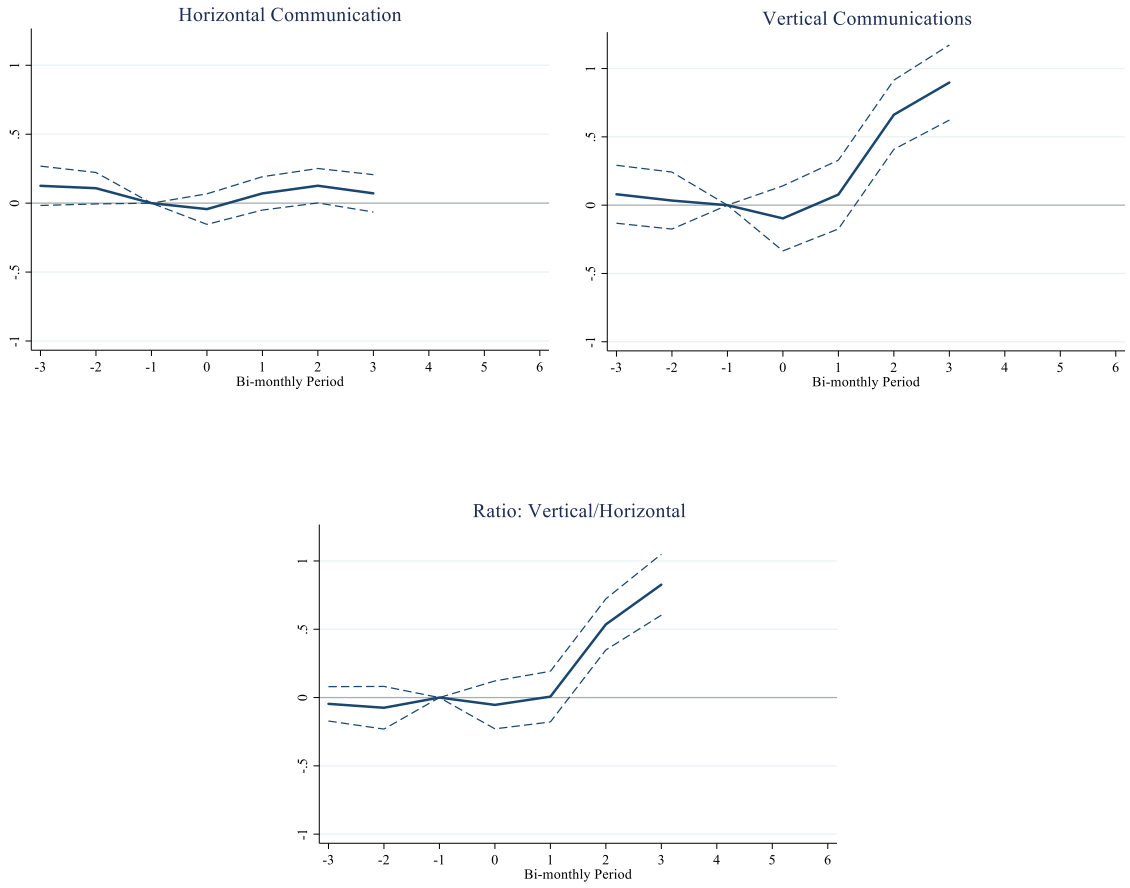
Notes: * p<0.1, ** p<0.05, ***, p<0.01. All columns are estimated by OLS. Standard errors are clustered at the firm level, in parentheses under the coefficient. Firm-level fixed effects are included in columns 3 and 6. The transition occurs during the first month of bi-monthly Period 0, which is used 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.

Figure 1: Event Study (Main Results)



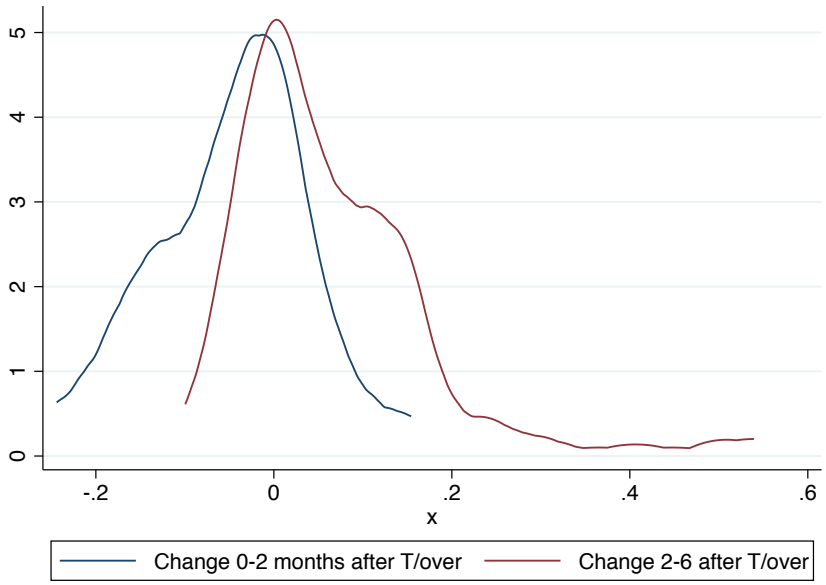
Notes: We plot the OLS regression coefficients from the main event regression specification on these two graphs, reporting in Table 2, across time for total meeting count (left) and email count (right) in the full sample of 102 firms. The CEO change occurs in Period 0. We use the period before the transition, Period -1, as the event study's base period. These results include firm-level fixed effects and standard errors clustered at the firm level.

Figure 2: Event Study (Meeting Interactions, Horizontal and Vertical Communication)



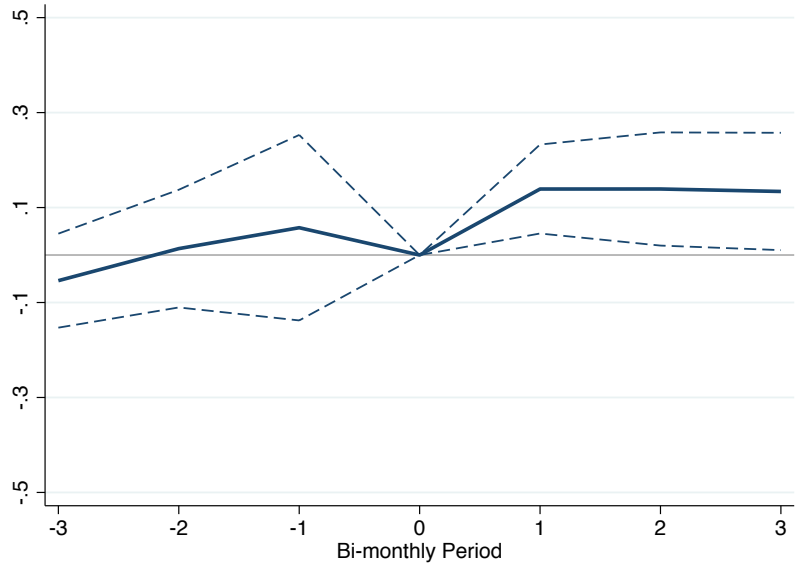
Notes: We plot the OLS regression coefficients from the meeting interaction specification across time for horizontal communication (top left), vertical communication (top right) on these graphs. Additionally, we look at the coefficients for the regression on the mix of vertical to horizontal meeting count (bottom left). These results are reported in Table 3, 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.

Figure 3: Histogram of Communication Changes by Short and Medium-Term



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 the short-run and Months 2-6 are medium-run.

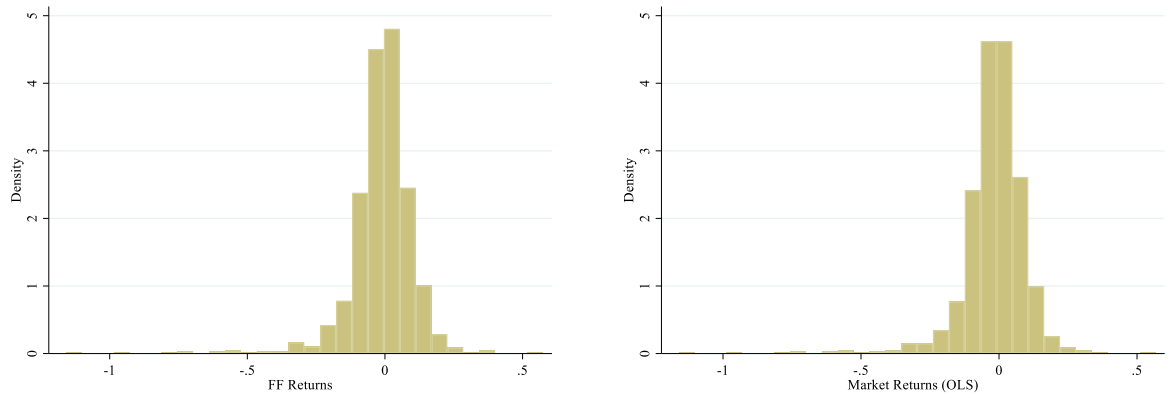
Figure 4: Difference between CARs of High and Low Communications Firms (Based on Medium Term Change in emails)



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.

Appendix

Figure A1: 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 A2: 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.

A3: Note on Sample Selection

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.

Table A4 - Firm-level Event Study Regressions of Meeting and Email Measures (Monthly)

	(1)	(2)	(3)	(4)	(5)	(6)
	MEETINGS			**EMAILS**		**INDEX**
Dependent Variable is log of:	Meetings (count)	Avg. Duration (minutes)	Avg. Participants (people)	Emails (count)	Avg. Recipients (people)	Comm. Intensity
Month -3	-0.080	0.009	-0.032	-0.093	-0.052*	-0.123
	(0.100)	(0.059)	(0.162)	(0.065)	(0.028)	(0.090)
Month -2	0.020	-0.023	-0.191	-0.060	-0.021	-0.065
	(0.094)	(0.052)	(0.121)	(0.051)	(0.028)	(0.080)
Month -1 (Base Period)	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Month 0	-0.221**	0.089	0.131	-0.163***	-0.034	-0.183*
	(0.107)	(0.073)	(0.094)	(0.062)	(0.029)	(0.096)
Month 1	-0.282**	0.089	-0.014	-0.202***	-0.031	-0.247**
	(0.114)	(0.074)	(0.107)	(0.077)	(0.030)	(0.107)
Month 2	-0.366***	0.016	-0.034	-0.254***	-0.022	-0.348***
	(0.105)	(0.067)	(0.101)	(0.057)	(0.031)	(0.100)
Month 3	-0.173*	0.128	-0.019	-0.124**	-0.020	-0.088
	(0.099)	(0.089)	(0.106)	(0.054)	(0.032)	(0.093)
Month 4	0.173*	0.037	0.177	0.034	-0.009	0.146**
	(0.088)	(0.064)	(0.110)	(0.046)	(0.031)	(0.069)
Month 5	0.288***	0.037	0.240**	0.094**	0.007	0.239***
	(0.089)	(0.066)	(0.096)	(0.039)	(0.030)	(0.070)
Month 6	0.300***	0.056	0.444***	0.108***	0.017	0.266***
	(0.086)	(0.066)	(0.103)	(0.038)	(0.032)	(0.068)
Month 7	0.145	0.194**	0.344***	0.107**	0.024	0.264***
	(0.094)	(0.094)	(0.113)	(0.041)	(0.032)	(0.087)
Month 8	0.110	0.175**	0.410***	0.085*	0.032	0.214**
	(0.089)	(0.088)	(0.126)	(0.043)	(0.033)	(0.084)
Month 9	0.148*	0.351***	0.384***	0.099**	0.025	0.403***
	(0.086)	(0.093)	(0.112)	(0.041)	(0.035)	(0.089)
Month 10	0.083	0.208**	0.113	0.096**	0.026	0.234**
	(0.109)	(0.080)	(0.145)	(0.044)	(0.036)	(0.094)
Month 11	0.308***	0.255***	0.196	0.110**	0.025	0.459***
	(0.091)	(0.088)	(0.133)	(0.048)	(0.038)	(0.094)
Month 12	-0.032	0.143*	-0.340**	0.073	0.019	0.096
	(0.113)	(0.074)	(0.152)	(0.077)	(0.042)	(0.106)
Observations	1230	1230	1230	1230	1230	1230
Firms	102	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. Communication Intensity Index is log (meeting count * meeting duration + email count * email recipients).