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What Hinders Digital Communication? Evidence from Foreign Firms in Japan[†]

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Abstract

Digital technology such as virtual meetings is key to communication and collaboration for multinational firms, but it is unclear what hinders their digital communication. This paper estimates barriers to digital communication by using a firm-level survey on foreign firms in Japan that faced an exogenous shock to adopt digital technology for communication extensively during the COVID-19 pandemic. Efficient communication depends on existing barriers to internal communication in firm organization and external communication with clients and customers. The results show that foreign firms perceive a greater issue of digital communication in both internal and external communication channels. Contrary to common assertions, digital communication is perceived as a greater issue in remote-work feasible sectors. Thus, digital technology does not eliminate existing barriers to face-to-face communication.

Keywords: Digital technology, communication, foreign firms, working from home
JEL classification: D23, M14, M15, D83

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1. Introduction

Digital technologies such as email, instant messaging, and online meetings have become key communication channels for firms and workers to collaborate and communicate at a distance. Triggered by the COVID-19 pandemic, virtual discussions in digital platform substituted in-person interactions as a daily platform for collaboration among workers in proximity.[1] Stringent travel restrictions reduced international flights for business travel, and digital communication became the dominant channel for collaboration across borders. The pandemic significantly increased face-to-face communication costs for international business activities, which can discourage offshore production by multinational firms (Campante and Yanagizawa-Drott, 2018; Tanaka, 2019). The pandemic has highlighted the significant role of digital communication in multinational firms. However, there is little systematic evidence on barriers to digital communication in multinational activities, thereby making it ever more important to examine what hinders digital communication.

In this paper, I examine barriers to digital communication for multinational firms by using a firm-level survey in Japan that collects information on foreign firms' perception of digital communication issues during the COVID-19 pandemic. Since the first case of COVID-19 infection was observed in early 2020, the Japanese government took a wide range of measures to prevent the spread of infection, including an extensive request for companies to substitute remote work for office work. As the mobility of people in

[1] While Bloom et al. (2015) present experimental evidence for productivity gains from working from home in the case of call center jobs in China, recent studies show negative effects of digital communication. For instance, it discourages collaboration networks and sharing complex ideas (Yang et al., 2021). Digital communication for collaboration increases working hours and reduces productivity (Gibbs et al., 2021). Kitagawa et al. (2021) show productivity declines for workers who worked at home by using survey data on four manufacturing firms in Japan. Morikawa (2021) finds lower productivity of WFH relative to working at the usual workplace.

workplaces declined subsequently, a large number of workers substituted working from home (WFH) for office work and relied on digital communication channels for collaboration with coworkers.[2] Consequently, foreign-owned firms in Japan faced an exogenous shock to adopt digital technology for communication extensively among workers, clients, and their foreign headquarters.

In a quasi-experimental setting, a survey was conducted on August 1, 2020, to collect information on foreign-owned firms in Japan. The questionnaire asks them about business issues to conduct a business in Japan if the impact of the COVID-19 continues. They were asked to choose top 3 answers from 10 items, including client/customer retention, getting new clients/customers, and communication via digital technology. Calculating the industry-level share of firms that answered digital communication as an issue, I find that digital communication issues are more important for foreign firms in industries such as finance, insurance, and professional, scientific, and technical services. Meanwhile, they are less important for foreign firms in industries such as information, arts, entertainment, recreation, accommodation, and food services.

To examine a question of what determines firm-level perception of digital communication, I discuss a conceptual framework on digital communication barriers in multinational activities. My assumption is that information and communication technologies (ICT) are suitable for processing codified and explicit information, whereas face-to-face interactions are efficient for communicating complex knowledge and intangible ideas (Storper and Venables, 2004; Gaspar and Glaeser, 1998). If virtual discussions in digital platform do not completely remove existing communication barriers,

[2] Recent studies conducted firm surveys to document the prevalence of remote work during the COVID-19 pandemic and to examine the consequences of remote work experiences in an economy (Bartik et al., 2020; Barrero et al., 2021; Tomiura et al., 2021; Okubo, 2021).

firm-level perception of digital communication should depend on communication barriers not only within firm organization, but to clients and customers in local and foreign markets. In terms of observable variables, within-firm communication depends on culture and language, employment size, time-zone differences between local subsidiaries and their foreign headquarters. Communication with markets depends on sales and marketing function in local markets and international transactions in foreign markets. Additionally, sectoral differences in remote work constraints and in-person interactions with customers can affect the perception of digital communication. To empirically examine these conceptual linkages, I estimate a logit model for the probability that foreign firms perceived digital communication as an important issue during the COVID-19 pandemic.

The main results are summarized as follows. First, the perception of digital communication issues is significantly stronger for foreign firms indicating English skills as business communication difficulties in hiring Japanese workers, whereas it is significantly weaker for those with a larger share of foreign workers in employment. It is also significantly stronger for foreign firms with larger employment size and time differences from their foreign headquarters. Second, the perception of digital communication issues is significantly stronger for foreign firms with a stronger motivation for sales expansion and marketing in local markets, whereas it does not correlate significantly with exporting and importing. Digital communication affects domestic marketing activities, but has little impact on exporters and importers. Additionally, foreign firms in remote-work feasible sectors perceive a stronger issue in digital communication, while the intensity of face-to-face contact with customers has little influence on their perception. This result contrasts sharply with the common assertion that digital communication is effective for remote-work feasible sectors, but

difficult for in-person service sectors. Overall, the results suggest that digital communication still depends on existing communication barriers and thus does not replace completely face-to-face interactions among firms and workers.

This paper contributes to the limited literature on communication and multinational firms. Campante and Yanagizawa-Drott (2018) show that the availability of direct air links across countries significantly increases the number of foreign ownership at the global level through face-to-face interactions for business relationships. Tanaka (2019) shows that positive flight effects are significantly higher for Japanese multinational firms in sectors with more intensive face-to-face communication, which directly demonstrates a channel of face-to-face interactions between flights and multinational activities. By estimating the causal impact of international flights on multinational activities, these studies emphasize a role of face-to-face interactions for business relationships in multinational activities. This paper sheds new light on the role of digital technology communication in multinational activities, and systematically estimates the relative importance of barriers to digital communication for foreign subsidiaries by multinationals.

Based on a case-study approach, Lipiäinen et al. (2014) examine a Finnish multinational industrial corporation to examine the benefits and limitations of digital communication tools such as intranet, email, instant messaging, and blogs.[3] The findings suggest that digital communication is advantageous for easy and speedy sharing of information among employees worldwide, but can cause miscommunication and misunderstanding for different attitudes, habits, and perceptions across employees. Because of this feature of digital tools, they highlight the importance of face-to-face

[3] Aliefiani and Shihab (2018) examine a multinational telecommunications company in Indonesia and present interview results on the use of an integrated internal communication platform.

meetings in daily internal communication. The case-study approach provides insightful implications for digital communication, but is limited in terms of generality. In this respect, this paper study provides quantitative evidence of firm-level constraints on digital communication by using firm-level data in Japan.

The rest of this paper is organized as follows. Section 2 provides a background of the COVID-19 pandemic in Japan during the first half of 2020, which should shape firm-level perception of digital communication in my survey data. Section 3 describes data sources and provides a pattern of digital communication issues across sectors. Section 4 shows a conceptual framework for the role of digital communication in multinational firms and specifies an empirical model to estimate the relative importance of communication barriers. Section 5 presents the estimation results with robustness checks. Finally, section 6 concludes.

2. Background

This section provides a brief background of the COVID-19 pandemic in Japan during the first half of 2020. I focus on this period because my survey data are based on firm-level perception of digital communication in Japan as of August 1, 2020. In this respect, government responses to the COVID-19 during this period are most relevant for the perception of sample firms.

The first case of COVID-19 infection appeared in early 2020 and spread across Japan gradually. To prevent the spread of infection, the Japanese government implemented a wide range of measures. On April 8, the government issued the declaration of a state of emergency until May 6 for 7 prefectures, including Tokyo, Kanagawa, Chiba, Saitama, Osaka, Hyogo, and Fukuoka. The declaration was extended nationwide on April 16. The

state of emergency was lifted for 39 prefectures on May 14, 3 prefectures (Osaka, Kyoto, and Hyogo) on May 21, and 5 prefectures (Hokkaido, Saitama, Chiba, Tokyo, and Kanagawa) on May 25. Following the spread of infection all over the country, the government requested companies to substitute WFH for office work. While the government request was not enforced with any penalties, the mobility of people in workplaces declined substantially in April and May 2020.[4] This suggests that a large number of workers shifted from office work to WFH and communicated with coworkers mainly through digital communication channels during the period.

To prevent the spread of infection from other countries, the government also strengthened border measures. Visa restrictions were implemented on April 3 for a large number of countries and regions. The validity of issued visas before April 2020 was suspended, and visa exemption was suspended.[5] The government restricted arrival airports for passenger flights and requested airlines to curb the number of arrival passengers for quarantine purposes. As a result, travel restrictions reduced the number of inbound travelers substantially during the period. According to the Japan National Tourism Organization, the number of inbound foreign travelers declined from 31.8 million in 2019 to 4.1 million in 2020.

A vast number of workers in Japan experienced a rapid shift from office work to WFH during the period. According to the survey by the Persol Research and Consulting Company, an estimated 27.9% of full-time workers engaged in WFH on April 10, with an estimate of 7.6 million workers in Japan.[6] The estimate of WFH shares was larger for

[4] See Google COVID-19 Community Mobility Reports.
[5] See the website of the Ministry of Foreign Affairs of Japan on visa restrictions: https://www.mofa.go.jp/ca/fna/page4e_001056.html
[6] The sample includes 25,769 full-time workers in the online survey on April 10-12: https://rc.persol-group.co.jp/thinktank/research/activity/data/telework.html

prefectures such as Tokyo (49.1%), Kanagawa (42.7%), and Chiba (38.0%). In terms of occupational categories, WFH was more prevalent for occupations such as website designers, consultants, marketing workers, and IT service workers. These patterns are consistent with the prior findings that WFH is more prevalent for non-routine and measurable performance tasks (Kawaguchi and Motegi, 2021). Additionally, the likelihood of WFH was higher for firms with larger employment size. This finding is sensible because the Japanese government directly requested the Japanese business association to cooperate for public health policy, and thus large listed companies had to implement WFH extensively for their social responsibilities.

Taken together, the COVID-19 pandemic caused a sudden strong shock for firms and workers in Japan to adopt WFH extensively during the first half of 2020. While the intensity of virtual communication in digital platform should be heterogeneous for individual firms and workers, it provides a quasi-experimental setting in which firms and workers all over the country faced an exogenous shock to adopt digital technology as a key communication channel. Since foreign-owned firms are no exception for the government request, similar exogenous shocks should have induced them to rely strongly on digital communication among workers, clients, and their foreign headquarters during the period. In this respect, this period is ideal for investigating what multinational firms perceive an issue in the firm-wide adoption of digital communication during the pandemic.

3. Data Description

My dataset is based on the Survey of Trends in Business Activities of Foreign Affiliates (STBAFA) for 2019 and 2020 by the Japanese Ministry of Economy, Trade, and Industry (METI). The survey coverage of foreign-owned firms in March 2020

includes (i) a company in which more than one-third of shares or holdings are owned by foreign investors and (ii) a company in which more than one third of shares or holdings are owned directly or indirectly by a domestic company, which is ultimately owned by foreign investors with more than one third of shares or holdings. Moreover, a principal foreign investor must possess more than 10% of shares or holdings in the companies defined above. Thus, this paper focuses on the business enterprises in Japan that are substantially managed by foreign investors. A survey questionnaire was sent to foreign firms on August 1, 2020, to collect information on their business activities as of March 2020 or in fiscal year 2019. Survey questionnaires were collected via mail or online. While the number of survey firms in the sampling frame is 5,748 firms, the number of firms responding to the survey is 2,978 firms, with a response rate of 51.8%. Among the firms with valid responses, the number of firms in operation is 2,808 firms. After removing firms with missing values in variables used for estimation, the sample consist of 2,188 firms.

The survey asks foreign firms to provide information on the nationality of principal foreign investors, an entry mode of foreign firms into the Japanese market, and their economic activities including employment, export, and import. Specifically, I use a following question in the questionnaire: what business issues do you face to conduct a business in Japan if the impact of the COVID-19 continues? They are asked to give top 3 answers from the following issues: (1) client/customer retention; (2) getting new clients/customers; (3) difficulty in financing; (4) communication via digital technology; (5) finding an alternative route in supply chains; (6) securing human resources; (7) visa acquisition and renewal; (8) lack of information and support on markets in English; (9) living environments for foreigners such as schools and hospitals; and (10) others. For my

analysis, the key answer is the item (4) on digital communication as an issue during the pandemic.[7]

To gauge the relative importance of digital communication perception across industries, Table 1 presents the number of sample firms and the share of firms answering digital communication issues. The latter measures the industry-level perception of digital communication, with a larger value indicating the stronger perception of digital communication as an important issue in the corresponding industry. Focusing on industries with a large number of sample firms, I find that the average value of digital communication perception tends to be higher for industries such as finance, insurance, and professional, scientific, and technical services. Foreign firms in these industries perceive digital communication issues more strongly. Meanwhile, the average value tends to be lower for industries such as information, arts, entertainment, recreation, accommodation, and food services. Foreign firms in these industries perceive digital communication issues less strongly. Additionally, industries such as manufacturing, wholesale, and retail tend to be in between.

---Table 1 here---

4. Estimating Barriers to Digital Communication

This section presents an empirical framework for the role of digital communication in multinational firms. I provide a conceptual discussion for communication barriers in multinational activities, and present an empirical specification to estimate barriers to

[7] The survey report shows that the top response rates are 64.4% for client/customer retention and 61.9% for getting new client/customer, followed by 33.3% for digital communication. Meanwhile, the survey did not ask reasons for firms' perception of digital communication, an actual adoption of digital platform for communication, and an intensity/frequency of virtual discussions.

digital communication.

4.1. Conceptual Framework

Recent advances in ICT have reduced barriers to processing codified and explicit information on business activities through various channels such as internet access, instant messaging, and online meetings. As these technological improvements contributed to a substantial decline in communication costs at a distance, falling communication costs play an important role in global value chains, which require coordination of complex production tasks across borders (Baldwin and Evenett, 2015). However, these communication channels may not be suitable for processing uncodified and relationship-specific information in business activities because face-to-face discussions are crucial inputs for negotiating contract, building trustful business relationships, and training and monitoring workers (Storper and Venables, 2004). While digital technology is suitable for sharing codified and fixed information, it may be less efficient than face-to-face discussions in communicating and understanding complex knowledge and intangible ideas among workers and across firms. As Gaspar and Glaeser (1998) suggest that telecommunications can complement face-to-face interactions, digital technology may not completely substitute in-person contact in a wide range of business communication.

Communication issues in ICT suggest that firm-wide adoption of digital communication cannot completely reduce communication costs among coworkers during the COVID-19 pandemic. Because virtual discussions in digital platform do not remove existing barriers to face-to-face communication among coworkers, firm-level perception of digital communication issues should be influenced by existing communication barriers within firm organization. Specifically, managers in multinational firms need to

communicate with foreign workers who have different cultures and languages. Communication with foreign workers is more efficient via face-to-face interactions than digital communication because in-person interactions convey rich information from voice tones, facial expression, body language, and synchronization with people in conversation (Harvard Business Review, 2009). Thus, digital communication issues should be subject to language issues among local workers and foreign expatriates in a local subsidiary.

Communication channels can be more complex in larger worker groups. As managers and workers need to process more complex projects and tasks in larger teams, firm size affects the perception of digital communication issues. Additionally, foreign firms are distinctive from domestic firms in that they face cross-border barriers to communication with their foreign headquarters. Multinational firms operate a foreign subsidiary in an unfamiliar business environment and coordinate closely with local managers. During the pandemic, international business travel was largely curbed, and multinational firms had to rely on digital platform for communication across borders. As these virtual discussions are carried out across different time zones, foreign firms are likely to experience communication barriers with their foreign headquarters at a greater distance.

While these internal communications within multinational firms affect digital communication, external communication barriers outside firms can also affect firm-level perception of digital communication. Specifically, market access is one of key motivations for multinational firms to establish a local subsidiary, and local managers play an important role in retaining existing clients as well as winning new clients in a local market. These tasks require efficient communication with clients who are not knowledgeable about new products and services. In-person meetings are more efficient than digital communication in communicating complex information, and thus help clients

to understand products and services provided by multinational firms. For this reason, marketing motivations can affect firm-level perception of digital communication with clients in a local market. Additionally, a local subsidiary by multinationals may need to communicate with clients and suppliers in a foreign market via exporting and importing goods. Because digital communication is not a perfect substitute for communication with foreign clients and customers, exporting and importing activities can affect firm-level perception of digital communication.

Taken together, my discussion highlights that digital communication technology cannot completely substitute face-to-face communication for firms and workers to share and understand complex knowledge and intangible ideas. Since digital technology cannot reduce existing barriers to face-to-face communication, firm-level perception of digital communication should depend on existing barriers to internal communication in firm organization and external communication with clients in local and foreign markets. However, there remains an empirical question which conceptual linkages play a key role in determining firm-level perception of digital communication. This provides a motivation for estimating the relative importance of barriers to digital communication.

4.2. Empirical Specification

To examine barriers to digital communication, I estimate a logit model for firm *i* in sector *j*:

$$\Pr(D_i = 1) = f\left(\boldsymbol{X'}_i\boldsymbol{\gamma} + \delta_1 HW_{j(i)} + \delta_2 FF_{j(i)} + \varepsilon_i\right) \quad (1)$$

where $\Pr(D_i = 1)$ indicates the probability of firm *i* in sector *j* to perceive that digital communication is an important issue during the COVID-19 pandemic.[8] $\boldsymbol{X}_i$ is a vector of

[8] There are 18 sectors in my data, as shown in Table 1.

independent variables on firm-level characteristics that can affect firm-level perception of digital communication issues during the pandemic. These characteristics are largely related to internal communication channels in multinational firms, external communication channels in local and foreign markets, and other firm-specific factors. $HW_{j(i)}$ is an index to measure the feasibility of WFH for firm *i* in sector *j*, with a higher value indicating a greater feasibility of WFH (Dingel and Neiman, 2020). $FF_{j(i)}$ is an index to measure the importance of face-to-face interactions with consumers for firm *i* in sector *j*, with a higher value indicating a lower intensity of face-to-face interactions (Avdiu and Nayyar, 2020). Finally, ε_i is an error term.

Following firm-level variables on internal communication barriers are included in $\boldsymbol{X}_i$.[9] First, foreign firms in Japan employ Japanese workers and may perceive greater communication barriers with Japanese workers who are not fluent in English. This language barrier is captured by a dummy variable, *English*, that takes on unity for firm *i* indicating English skills as business communication difficulties in hiring Japanese workers in 2019, and zero otherwise. Second, foreign firms in Japan employ foreign workers and may perceive larger communication barriers with the foreign workers who are not fluent in Japanese. This barrier is explained by a dummy variable, *Japanese*, that takes on unity for firm *i* indicating Japanese skills as business communication difficulties in hiring foreign workers for 2019, and zero otherwise. Third, foreign workers can communicate efficiently with each other for similar languages and cultures, and foreign firms may perceive lower communication barriers when foreigners are dominant in a work team. This influence is captured by the variable, *Foreign workers*, that measures a

[9] Because firm-level variables are constructed from the STBAFA for 2019, foreign firms' perception of digital communication in 2020 should not affect the variables in 2019. Thus, simultaneity bias should be mitigated.

share of foreign employees in total employment for 2019. Fourth, more complex communication networks in large firms can increase communication costs for foreign firms. The effect of team size is captured by the variable, *Log employment*, defined as the log of total employment in 2019. Finally, a difference in time zones discourages real time communication between foreign firms in Japan and their headquarters abroad. This influence is represented by the variable, *Time difference*, as defined by time differences between Japan and parent countries of foreign firms.

The following variables are included to account for communication relationships with markets. First, market-seeking motives of foreign direct investment suggest that local marketing is a crucial management issue. Since virtual discussions in digital platform can reduce efficient communication with clients, digital communication issues pose a threat to foreign firms seeking local clients and customers. This market-access issue is captured by a dummy variable, *Marketing*, that takes on unity for firm *i* indicating a future plan to expand the business function of sales and marketing in 2019, and zero otherwise. Second, foreign firms communicate with clients and customers abroad for exporting to them. Since digital communication may discourage efficient communication in exporting tasks, exporting firms may be more likely than non-exporting firms to perceive stronger digital communication issues. This effect is represented by a dummy variable, *Export*, that takes on unity for firm *i* with a positive value of exports in 2019, and zero otherwise. For a similar reason, foreign firms may perceive greater communication barriers with suppliers abroad in importing goods. This effect is represented by a dummy variable, *Import*, that takes on unity for firm *i* with a positive value of imports in 2019, and zero otherwise.

The following variables are included to account for other firm-specific determinants

of communication barriers. First, foreign firms were established in different modes including greenfield, joint ventures, mergers and acquisitions (M&A), and others. These entry modes may represent a corporate structure of communication processes and affect firm-level perception of digital communication issues. Defining greenfield mode as a benchmark, I include dummy variables for other modes, *Joint venture*, *M&A*, and *Other*. Second, foreign firms may face greater communication issues upon entry for start-up projects while the length of operation in a local market can mitigate such communication barriers. This influence is captured by the variable, *Age*, defined as years from the establishment for firm *i*. Finally, communication process in local management can be simple for majority-owned subsidiaries through a dominant power of corporate management. I account for this effect by the variable, *Share*, which is the percentage of shares owned by foreign investors.

As described in section 3, firm-level perception of digital communication issues has a large variation across industries. As digital communication among coworkers can be less costly in some sectors, sector-specific factors should affect the perception of digital communication. To address this issue, I include the variables, $HW_{j(i)}$ and $FF_{j(i)}$, in specification (1). In terms of using digital platform for communication among coworkers, some jobs can be done at home more easily in certain sectors, and firms in these sectors may perceive digital platform as suitable for communication among coworkers. This sectoral difference the feasibility of remote work is captured by the variable, $HW_{j(i)}$, with a higher value of the variable indicating weaker constraints for remote work. Since weaker remote-work constraints mitigate firm-level perception of digital communication issues, I predict a negative sign for the coefficient δ_1.

Another key reason for sectoral variations is that some jobs need to be performed in

proximity to clients and customers. Service sectors such as retail sales, accommodation, and healthcare services cannot easily replace in-person interactions with digital communication partly because production of these services must coincide with consumption. Firms in these sectors may not perceive digital communication as appropriate for producing these services. This effect is accounted for by the variable, $FF_{j(i)}$, with a higher value indicating a lower intensity of face-to-face contact with customers. Since weaker in-person interactions with customers mitigate a concern about efficient digital communication, I predict a negative sign for the coefficient, δ_2.

I briefly discuss econometric issues in specification (1). First, there is a concern that firm-level variables may suffer from an endogeneity bias because foreign firms should address digital communication issues during the pandemic by re-organizing their structure and corporate strategy. In this case, the estimated impact of firm-level variables may be subject to a simultaneous bias arising from firm-level responses to pandemic issues such as remote work and digital communication. To reduce this bias, I use data on firm-level variables in 2019, a pre-pandemic period. Assuming that foreign firms could not forecast the COVID-19 pandemic and took few measures previously to improve digital communication in 2019, these variables should be plausibly exogenous to firm-level perception of digital communication issues during the pandemic. Second, the indexes of home-based work and face-to-face interactions with customers are defined at the industry level and constructed from occupational information network data in the U.S. In this respect, there is no strong concern about reverse causality in that the perception of foreign firms in Japan affects these industry-level indexes based on U.S. data. Additionally, a logit model is a benchmark specification while alternative methods may produce different estimation results. For a robustness check, ordinary least squares and

probit methods are also used.

5. Estimation Results

5.1. Benchmark Results

Table 2 presents the summary statistics of variables in the main sample.[10] While the survey data contain 2,808 firms with valid responses, the sample used in estimation includes 2,188 firms. The dependent variable, *Digital*, has a mean of 0.33, suggesting that one third of foreign firms answered digital technology communication as a key issue during the pandemic.

---Tables 2 and 3---

In Table 3, column (1) shows the estimated coefficients and robust standard errors in the logit model.[11] The coefficient of *English* is significant and positive, suggesting that digital communication is a more important issue for foreign firms that indicate English skills as a business communication difficulty in hiring Japanese workers. Meanwhile, the coefficient of *Japanese* is not significant, implying that foreign workers' Japanese skills do not affect digital communication perception. The results are sensible because English is a main communication language among coworkers for foreign firms in Japan. The coefficient of *Foreign worker* is significant and negative, suggesting that a larger share of foreign workers in employment can mitigate a concern about digital communication. Thus, foreign firms tend to perceive that language and culture are significant barriers to efficient communication in digital technology.[12] Additionally, the coefficients of *Log*

[10] The correlation coefficients of the variables are available upon request.
[11] The result of firm-level variables is similar quantitatively and qualitatively in the logit model with industry fixed effects, which is available upon request.
[12] Based on a field experiment, Lyons (2017) emphasizes that communication is more difficult and requires more time in nationally diverse teams, which reduces performance in production.

employment and *Time difference* are significant and positive. This suggests that efficient communication in digital platform is discouraged for complex coordination in large teams and for different time zones between subsidiaries and their foreign headquarters. Overall, the evidence shows that the perception of digital communication issues depends crucially on internal communication barriers in multinational firms.

The coefficient of *Marketing* is significant and positive, implying that digital communication issues are more important for foreign firms with stronger motivations for sales expansion and marketing in a local market. Meanwhile, the coefficients of *Export* and *Import* are not significant, suggesting that exporting and importing activities do not affect foreign firms' perception of digital communication. The results may indicate that international transactions such as orders and logistics involve a flow of explicit and tangible information across borders, and digital technology is an efficient channel for communication in exporting and importing activities. In this respect, government requests for remote work may not impose additional costs on exporting and importing firms to use digital platform for daily communication. Taken together, digital communication is an important issue for domestic marketing activities but has little impact on exporters and importers.

In terms of entry modes, the coefficients of *Joint venture* and *Other* are significant and positive, whereas the coefficient of *M&A* is not significant. As greenfield investment is a benchmark, joint-venture firms perceive stronger digital communication issues than newly established foreign firms do, which may reflect a conflict of managerial communication among key shareholders in joint-venture firms. Additionally, the coefficients of *Age* and *Share* are not significant. This implies that efficient communication in digital platform is not affected by the length of operation and the share

of foreign investors.

The coefficient of $HW_{j(i)}$ is significant and positive. This result is surprising because it is commonly argued that digital communication barriers are weaker for firms in sectors with lower remote-work constraints. By contrast to the common assertion, the evidence shows that foreign firms in remote-work feasible sectors perceive greater communication issues in digital platform. My interpretation is that remote-work feasible sectors such as finance, insurance, and IT services need to process a large amount of complex information and intangible ideas among coworkers for service provision and development, and an excessive reliance on digital platform for communication can discourage efficient and innovative communication among coworkers. In this respect, in-person discussions are more efficient for processing complex and intangible information. Thus, foreign firms in remote-work feasible sectors may perceive a greater concern for digital communication during the pandemic.

The coefficient of $FF_{j(i)}$ is not significant, suggesting that the intensity of face-to-face contact with customers has little influence on the perception about digital communication. A plausible interpretation is that some foreign firms did not adopt any digital platforms in daily communication to provide face-to-face services for customers and thus do not perceive digital communication as a key issue even if the pandemic continues for a long period. As a result, the *FF* index has little influence on the perception of digital communication. However, the risk of COVID-19 was uncertain and remarkable at the outset, and government requests strongly induced any foreign firms across all industries to adopt remote work during the first half of 2020. It is likely that foreign firms adopted any digital technology for daily communication to provide face-to-face services during the period. In section 5.3, I further discuss this issue.

To gauge the relative importance of digital communication barriers, I consider the odds of observing a positive outcome, i.e., perceiving digital communication issues, versus a negative one. Specifically, column (2) in Table 3 shows percentage changes in the odds of the positive outcome for a standard-deviation increase in variables. For instance, a standard deviation increase in *English* increases the odds of perceiving digital issues by 13.6%, holding all other variables constant. While a standard deviation increase in *Foreign worker* decreases the odds by 13.7%, standard deviation increases in *Log employment* and *Time difference* increase the odds by 11.9%, respectively. Additionally, a standard deviation increase in *Marketing* increases the odds by 8.6%. These results suggest that internal communication appears to play a quantitatively larger role than external communication in determining the perception of digital communication. Additionally, a standard deviation increase in $HW_{j(i)}$ increases the odds by 12.6%, whereas an increase in $FF_{j(i)}$ decreases the odds by 1.5%. Thus, remote-work feasibility has a larger influence on digital communication issues.

5.2. Robustness Checks

I proceed to check the robustness of the main results in several ways. First, I examine whether the results are sensitive to estimation methods. In Table 4, column (1) shows the results of a linear probability model for firm-level perception of digital communication. The coefficients of main variables remain similar in terms of sign and significance, suggesting that the OLS method shows similar results as the logit model. Column (2) shows the results of a probit model and the coefficients of most variables remain unchanged in terms of sign and significance. Only the mode variable, *Other*, becomes insignificant in the probit results, implying that digital communication issues have little

difference between greenfield investment and other entry modes. Second, unobserved regional effects can influence the main results because government requests for remote work may have heterogeneous effects on actual adoption of remote work across regions. Column (3) shows the logit result of specification (2) with province fixed effects. The coefficients of the main variables remain similar both quantitatively and qualitatively, suggesting that the main results are robust to the unobserved regional effects.

---Table 4---

Third, the original survey data have 2,808 sample firms with valid responses, but my sample uses only 2,188 firms in the benchmark estimation for missing values in explanatory variables. This sample issue raises a question of whether excluded survey firms differ systematically from the sample firms used in estimation. If missing sample firms are non-random, the main results may be subject to systematic sample bias. To check this issue, I estimate a simple linear regression model for several firm-level characteristics with the in-sample explanatory variable. Table 5 shows the results for sales in column (1), employment in column (2), foreign employees in column (3), export values in column (4), import values in column (5), and R&D expenditures in column (6). The coefficients of the in-sample variable are not significant for any firm-level characteristics across specifications. This suggests no evidence of any systematic differences between the excluded survey and sample firms used in estimation.

---Table 5---

Finally, I discuss other potential issues in estimation. First, foreign managers may be more important than foreign workers in determining firm-level perception of digital communication because local managers communicate directly with local workers. As my model does not explicitly account for foreign managers, there may be an omitted-variable

bias. However, my survey data show that a majority of foreign firms do not report the number of foreign managers or indicate a very low number of foreign managers, suggesting that the influence of foreign managers is likely to be small. Second, communication barriers with customers in a domestic market may be more complex for foreign firms with a larger number of regional offices for sales and marketing. Since the *Marketing* variable captures only firm-level intention for marketing function, it does not sufficiently account for the geographic scope of domestic marketing. Since my survey data do not have information on domestic marketing activities, it is difficult to examine this issue. However, the number of regional offices at the firm-level would correlate positively with the employment size, and thus this issue is partly mitigated by *Log employment*.

5.3. Discussion

My discussions up to this point have assumed that the pandemic shock induced foreign firms to adopt digital platform for communication, which shaped their perception of digital communication issues. However, there may be alternative processes by which foreign firms shape their perception about digital communication, which may confuse my analysis of digital communication. Specifically, foreign firms' perception of digital communication may partly capture the feasibility of WFH for IT infrastructure across industries. In this case, stronger perception of digital communication issues may represent insufficient IT infrastructures, rather than the perception of inefficient communication in digital platform.

To address this issue, I examine whether IT infrastructures during the pre-pandemic period can explain the variation in digital communication perception across firms.

Specifically, I estimate a logit model for firm *i* in sector *j*:

$$\Pr(D_i = 1) = f\left(\beta_1 \ln Information_i + f_{j(i)} + e_i\right) \quad (2)$$

where $\Pr(D_i = 1)$ shows the probability of firm i in sector j to perceive that digital communication is an important issue during the pandemic. $\ln Information_i$ is the log of information and telecommunication costs for firm *i* in 2019, which is a proxy for IT infrastructures across firms. $f_{s(i)}$ is an industry-level fixed effect to control for unobserved industry influences on the adoption of digital technology for communication. For estimation, I construct a dataset by linking the sample of foreign firms with firm-level information in 2019, which is taken from the Basic Survey of Business Structure and Activities for 2020 by the METI. The survey coverage includes the firms with 50 employees or more, capital of 30 million yen or more, and business activities in manufacturing and other sectors under the administrative jurisdiction of the METI.

Table 6 reports the results of specification (1). In column (1) for the specification without industry fixed effects, the coefficient of information costs is not significant. In column (2) with the industry fixed effects, the coefficient of information costs remain insignificant. The results show that the pre-pandemic level of information and telecommunications costs does not significantly explain the variation in a firm-level perception of digital communication issues during the pandemic. The results suggest that digital communication perception is not likely to simply capture firm-level differences in remote-work feasibility for IT infrastructures. Thus, information and telecommunications costs should not be a major determinant of digital communication perception.

---Table 6 here---

Another concern is that foreign firms in some sectors did not adopt digital platform to provide in-person services during the pandemic and thus perceive a weaker issue about

digital communication. According to Avdiu and Nayyar (2020), the intensity of face-to-face contact with customers is larger in sectors such as retail trade. The low use of digital platform to communicate with customer services in such sectors could shape their perception of digital communication in a different manner. For a lack of information on the actual adoption of digital communication, it is difficult to investigate directly underlying reasons for the perception. To this end, I examine whether the main result is robust to excluding in-person service sectors from estimation. Specifically, I re-estimate a logit model for the sample excluding (1) retail trade, (2) arts, entertainment, recreation, and (3) accommodation and food services. The results are reported in Table 7. Across alternative samples, the main results remain similar qualitatively and quantitatively. Thus, alternative interpretations of digital communication perception should not change my conclusion.

---Table 7 here---

6. Conclusion

Digital technology plays an essential role in collaboration and communication at a distance among firms and workers. While the COVID-19 pandemic caused a rapid shift from face-to-face communication to virtual discussions in digital platform, it also induced multinational firms to substitute digital communication for in-person contact in offshore production due to stringent travel restrictions. To shed light on the role of digital communication in multinational firms, this paper examines barriers to digital communication by using a firm-level survey in Japan, which collects information on foreign firms' perception of digital communication issues during the COVID-19 pandemic.

My conceptual framework assumes that digital technology cannot completely

substitute face-to-face contact to communicate complex information and intangible ideas among firms and workers. Firm-level perception of digital communication should be subject to existing barriers to internal communication in firm organization and external communication with clients and customers. My investigation shows that foreign firms tend to perceive a greater issue of digital communication in both internal and external communication channels. Specifically, effective communication in digital technology is inhibited by language differences, employee nationalities, employment size, time differences from foreign headquarters, and marketing contact with clients and customers. Foreign firms also perceive a greater digital communication issue in remote-work feasible sectors, but do not indicate a concern about digital communication in in-person service sectors. This finding contrasts sharply with the typical assertion that digital communication is efficient for remote-work feasible occupations, but difficult for in-person services. Overall, the evidence suggests that digital technology does not eliminate existing barriers to face-to-face communication for collaboration.

I conclude by discussing unexplored questions for future research. First, an unexplored issue is underlying conditions in which digital technology can be used efficiently for collaboration and communication. To this end, there needs a survey on digital technology to collect information on the adoption of specific digital technology across business functions such as planning, marketing, and production. Second, it is not clear why foreign firms perceive greater digital communication issues in some sectors. For instance, foreign firms in finance and insurance sectors must respond to volatile financial markets and enhance security in financial assets. As workers in these tasks process complex information and require trustful relationships, face-to-face communication can be more effective than virtual discussions in digital platform. Further

investigation of key reasons is promising. Additionally, an interesting question remains as to how digital technology for communication affects the structure of multinational organization and the geography of multinational production.

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Table 1. The summary of digital perception by industry

	No. of firms	Mean
Health Care, Social Assistance	2	1.000
Mining, Quarrying, Oil/Gas Extraction	4	0.750
Agriculture, Forestry, Fishing, Hunting	6	0.500
Finance and Insurance	106	0.452
Professional, Scientific, Technical Services	93	0.440
Utilities	7	0.428
Management of Companies	46	0.391
Construction	11	0.363
Transport, Warehousing	67	0.358
Other Services	165	0.341
Wholesale Trade	909	0.339
Manufacturing	366	0.308
Retail Trade	110	0.281
Information	206	0.237
Real Estate, Rental, Leasing	35	0.228
Arts, Entertainment, Recreation	29	0.172
Educational Services	7	0.142
Accommodation, Food Services	19	0.105
All	2,188	0.329

Notes: Digital index shows a share of firms indicating that digital technology for communication is one of three key business obstacles during the COVID-19 pandemic.
Source: The 2020 Survey of Trends in Business Activities of Foreign Affiliates by the Japanese Ministry of Economy, Trade, and Industry.

Table 2. Summary statistics

	No. of obs.	Mean	Std. Dev.	Min	Max
Digital	2,188	0.33	0.47	0	1
English	2,188	0.48	0.49	0	1
Japanese	2,188	0.59	0.49	0	1
Foreign worker	2,188	0.12	0.22	0	1
Log employment	2,188	3.19	1.74	0	10.2
Time difference	2,188	5.71	3.36	0	11.5
Marketing	2,188	0.37	0.48	0	1
Export	2,188	0.28	0.45	0	1
Import	2,188	0.49	0.50	0	1
Joint venture	2,188	0.16	0.37	0	1
M&A	2,188	0.14	0.35	0	1
Other	2,188	0.06	0.23	0	1
Age	2,188	20.8	13.3	2	101
Share	2,188	0.90	0.18	0.33	1
HW	2,188	0.44	0.19	0.034	0.76
FF	2,188	0.60	0.24	0	1

Table 3. Logit estimation result

Dependent: digital perception dummy

	(1)		(2)
	Coef.	Robust Std. Err.	Percentage change in odds (Std. Dev.)
English	0.25*	(0.10)	13.6
Japanese	0.13	(0.10)	6.7
Foreign worker	-0.66**	(0.26)	-13.7
Log employment	0.06*	(0.029)	11.9
Time difference	0.03*	(0.016)	11.9
Marketing	0.17+	(0.10)	8.6
Export	-0.04	(0.12)	-2.0
Import	0.12	(0.10)	6.5
Joint venture	0.26+	(0.14)	10.5
M&A	-0.08	(0.15)	-8.1
Other	0.34+	(0.20)	41.2
Age	0.0001	(0.003)	0.0
Share	0.02	(0.28)	0.4
HW	0.60*	(0.25)	12.6
FF	-0.06	(0.20)	-1.5
No. of observation		2,188	
Pseudo R-squared		0.024	

Notes: Constant is not reported; **, *, and + denote significance at the 1%, 5%, and 10% level, respectively.

Table 4. Robustness checks

Dependent: digital perception dummy

	(1)		(2)		(3)	
Estimation	OLS		Probit		Logit	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
English	0.05*	(0.02)	0.15*	(0.06)	0.23*	(0.10)
Japanese	0.02	(0.02)	0.07	(0.06)	0.12	(0.10)
Foreign worker	-0.12**	(0.04)	-0.39**	(0.15)	-0.75**	(0.26)
Log employment	0.01*	(0.006)	0.03*	(0.01)	0.06*	(0.02)
Time difference	0.007*	(0.003)	0.02*	(0.009)	0.27+	(0.01)
Marketing	0.03+	(0.02)	0.10+	(0.06)	0.19+	(0.10)
Export	-0.009	(0.02)	-0.02	(0.07)	-0.02	(0.12)
Import	0.02	(0.02)	0.07	(0.06)	0.13	(0.10)
Joint venture	0.06*	(0.03)	0.16+	(0.08)	0.32*	(0.14)
M&A	-0.01	(0.03)	-0.05	(0.08)	-0.04	(0.15)
Other	0.07+	(0.04)	0.21	(0.12)	0.40*	(0.20)
Age	0.00004	(0.0008)	0.00008	(0.002)	-0.0007	(0.003)
Share	0.005	(0.06)	0.02	(0.17)	0.01	(0.28)
HW	0.12*	(0.05)	0.36*	(0.15)	0.49+	(0.26)
FF	-0.01	(0.04)	-0.03	(0.12)	0.02	(0.96)
Province fixed effects					Y	
No. of observation	2,188		2,188		2,169	
R-squared	0.029					
Pseudo R-squared			0.023		0.030	

Notes: Constant is not reported; **, *, and + denote significance at the 1%, 5%, and 10% level, respectively.

Table 5. Results of in-sample differences

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent	Sales	Employment	Foreign employees	Export values	Import values	R&D
In-sample	1,682.7	-47.6	0.11	-2906.4	1094.6	116.9
	(4293.7)	(76.8)	(3.04)	(4560.4)	(1078.7)	(855.2)
No. of observation	2,235	2,519	2,519	868	1,299	399
R-squared	0.000	0.0002	0.000	0.0005	0.0004	0.000
No. of firms						
In-sample	1,897	2,188	2,188	754	1,137	331
Out-sample	338	331	331	114	162	68

Notes: In-sample indicates that sample firms are used in main estimation; parentheses report robust standard errors; constant is not reported; **, *, and + denote significance at the 1%, 5%, and 10% level, respectively.

Table 6. Results of information costs

Dependent: digital perception dummy

	(1)	(2)
Log information costs	0.091	0.088
	(0.060)	(0.065)
Industry-level fixed effects		Y
No. of observation	410	402
Pseudo R-squared	0.004	0.034

Notes: Parentheses show robust standard errors; constant is not reported; **, *, and + denote significance at the 1%, 5%, and 10% level, respectively.

Table 7. Logit estimation results of excluding sectors

Dependent: digital perception dummy

	(1)		(2)		(3)	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
English	0.27**	(0.10)	0.26**	(0.10)	0.26**	(0.10)
Japanese	0.08	(0.10)	0.13	(0.13)	0.12	(0.10)
Foreign worker	-0.65*	(0.26)	-0.68**	(0.26)	-0.62*	(0.26)
Log employment	0.05+	(0.03)	0.06*	(0.02)	0.06*	(0.02)
Time difference	0.03*	(0.01)	0.02*	(0.01)	0.03*	(0.01)
Marketing	0.19+	(0.10)	0.16	(0.09)	0.16+	(0.09)
Export	-0.04	(0.12)	-0.05	(0.11)	-0.04	(0.12)
Import	0.12	(0.10)	0.10	(0.10)	0.10	(0.10)
Joint venture	0.28+	(0.14)	0.27+	(0.14)	0.26+	(0.14)
M&A	-0.06	(0.15)	-0.06	(0.14)	-0.07	(0.14)
Other	0.37+	(0.20)	0.31	(0.19)	0.38	(0.19)
Age	0.0009	(0.003)	0.0005	(0.003)	0.00008	(0.003)
Share	0.01	(0.28)	0.02	(0.28)	0.003	(0.28)
HW	0.50+	(0.27)	0.57*	(0.25)	0.52*	(0.25)
FF	-0.16	(0.25)	-0.11	(0.20)	-0.12	(0.20)
No. of observation	2,078		2,159		2,169	
Pseudo R-squared	0.023		0.022		0.023	
Excluded sector	Retail trade		Arts, entertainment, recreation		Accommodation, food services	

Notes: Constant is not reported; **, *, and + denote significance at the 1%, 5%, and 10% level, respectively.