Technology and Disintermediation in Online Marketplaces[*]

Abstract

This study seeks to understand how technology affects disintermediation—sellers and buyers circumventing a platform to transact directly—in online two-sided marketplaces. Using the blocking of Skype by the Great Firewall of China as an exogenous shock, the study examines the impact of such a change on disintermediation and platform performance in a major US online freelance marketplace. It finds that restricting alternative communication technologies, which are not monitored by the platform, leads to a decrease in disintermediation on the focal platform; in other words, the Skype block reduces disintermediation between US clients and mainland China freelancers. The magnitude of this effect is larger for communication-intensive jobs and jobs posted by personal clients instead of business clients. The study provides implications for platforms to invest in their own communication technologies to fight against disintermediation.

Keywords: Disintermediation; Online Marketplace; Intermediary; Communication Technology

1. Introduction

Online intermediaries match and facilitate transactions between sellers and buyers (e.g., Parker & Van Alstyne, 2005; Rochet & Tirole, 2006; Hagiu & Wright, 2015; among many others). However, disintermediation—sellers and buyers circumventing a platform to transact directly—prevents the platform from capturing value in this process (e.g., Edelman & Hu, 2016; Gu & Zhu, 2021). As a result, online businesses, such as Homejoy, have failed to sustain their revenue in the long run.[1] For platform owners, understanding the factors that lead to disintermediation has become increasingly urgent in sustaining the platform's value creation and value capture.

While intermediation has received much attention in scholarly literature (e.g., Burt, 1992; Fernandez & Gould, 1993; Hargadon & Sutton, 1997; Sasson, 2008; Rider, 2009; Quintane & Carnabuci, 2015), disintermediation is not well understood. Extant literature on intermediaries summarizes an intermediary's positional advantages as to initiate exchange between actors and control the flow of information (e.g., Burt, 1992; Burt, 2007; Fernandez-Mateo, 2007; Rider, 2009). However, intermediaries' positional advantages are more fragile compared to other structural positions (Stovel, et al., 2011; Rider & Samila, 2019), because their return relies on privileged access to connections and the information asymmetry in the local structure (Burt, 2007; Bidwell & Fernandez-Mateo, 2010; Ryall & Sorenson, 2007; Quintane & Carnabuci, 2015). Once the intermediary no longer creates value creation by bridging uninformed actors, actors will substitute the intermediary and transact directly with each other, i.e., disintermediate (Edelman & Hu, 2016; Krakovsky, 2016). Yet, the mechanisms of how intermediaries can sustain their value creation to prevent this risk of being cut out from the partnership remain unclear (Rider & Samila, 2019; Gu & Zhu, 2020).

The rapid development of information technology stimulated the surge of disintermediation because the Internet and digital payment technologies made it easier, faster, and cheaper for people to transact online. For instance, authors can now directly sell to readers on Amazon instead of via traditional book publishers. Also, hotels and airlines incentivize customers to book directly on their official websites, threatening the business model of online travel agencies (OTAs). Scholarly literature on technology development has long recognized its role in facilitating information sharing and learning (Hinds & Kiesler, 1995; Kane & Alavi, 2007), enabling connectivity and coordination (Argyres, 1999; Tucker, 2008), lowering communication and transaction costs (Harris & Katz, 1991), enhancing virtual tasks and new channel adoption (Overby, 2008; Overby & Ransbotham, 2019), and improving productivity and innovation (Schilling, 2015). These technological advances allow users to find and transact with each other more easily online, thus weakening

---

[1] About 90% of transactions involve disintermediation after platforms match customers with service providers, according to a survey on one of the world's largest freelancing marketplaces (Zhu et al. 2018).

the role of intermediaries while increasing the risk of disintermediation. However, there is yet to be theoretical or empirical evidence illustrating the impact of technology development on disintermediation tendencies.

This research attempts to fill the abovementioned gap in the literature and examine the impact of a particular type of technology, online communication technology, on user disintermediation tendencies in two-sided marketplaces. We propose that restricting communication technology outside an intermediary can effectively reduce users' tendencies to disintermediate from the intermediary. Users adopt third-party online communication technologies, such as instant messaging software like Skype or WhatsApp, to connect with other users, hence these technologies can substitute for an intermediary's own communication features during user transactions. As a result, users can connect with one another without the intermediary, providing a channel for users to disintermediate. In addition, third-party communication tools lower users' transaction costs outside the intermediary, giving them incentives to cut out the intermediary to avoid paying charges to the intermediary. Therefore, we propose theoretical hypotheses and investigate whether and how changes in such outside communication technology affect disintermediation on the focal intermediary.

The research design uses an exogenous shock to communication technology, the sudden Skype block in mainland China, as a natural experiment to observe its impact on disintermediation in the setting of a major United States (US) online outsourcing platform. This platform has its own messaging system but its users also turn to third-party communication tools to assist with their transactions, the mostly popular of which is Skype, one of the world's leading online messaging software with more than 300 million monthly active users in 2019.[2] The blockade of Skype in 2017 affected this outsourcing platform to a large extent, because Skype is the most-used software among the platform's users when they try to contact each other directly.[3] In addition, the platform has a major crowd of users located in mainland China. Because other major third-party communication software, such as Gmail, WhatsApp, and Facebook Messenger, have all been blocked in mainland China over the past years,[4] the recent Skype block cuts off the main communication software left that allowed mainland Chinese Internet users to disintermediate with users outside the country, significantly affecting transaction outcomes and the platform's performance.

The study employs matching and difference-in-differences methods to estimate the effect of the exogenous shock. First, we construct a control group for the platform's mainland China freelancers who were affected by the Skype block in October 2017. Considering China's "One Country, Two Systems"

---

[2] Source: https://www.statista.com/statistics/258749/most-popular-global-mobile-messenger-apps/, accessed January 2021.

[3] According to a survey conducted by the platform.

[4] Source: https://en.wikipedia.org/wiki/Websites_blocked_in_mainland_China, accessed January 2021.

policy in Hong Kong and Macau, the "1992 Consensus" with Taiwan, and various historical connections with Singapore and Malaysia, freelancers located in these five regions share similar cultural backgrounds and user characteristics to mainland China freelancers, making them a highly comparable control group after matching. Next, based on all the job transactions of the two groups from January 2017 to June 2018, a difference-in-differences analysis estimates the average treatment effect of the Skype block on the affected freelancers' job hours, job total charges, and disintermediation tendencies.

While the measure for users' disintermediation tendencies is key to the analysis, disintermediated transactions are hard to observe in practice, which also makes the topic understudied in the literature. We employ a text analysis approach to analyze users' historical chat messages on the platform using a machine learning algorithm. Specifically, the algorithm detects sensitive keywords in the messages that indicate users' intentions to disintermediate, assigns weights to these keywords, and quantifies the users' disintermediation tendencies users express during each job as a numeric score. This text analysis algorithm has been tested and improved over time in the platform's business practice, thus providing a direct proxy for disintermediation.

The empirical findings support our hypotheses. Reduced availability of alternative communication technologies outside the focal platform leads to a decrease of disintermediation on the platform. In the 6 months after Skype was blocked, the platform's total charge per job for mainland China freelancers increases by an estimate of 27.5%, and the total number of hours per job increases by 33.3%. Meanwhile, the freelancers' intention to disintermediate significantly decreases. The magnitude of these main effects is larger for communication-intensive jobs and for jobs posted by personal clients instead of business clients. To understand the mechanism behind the changes in disintermediation tendencies, we find that the affected freelancers are more likely to continue working on the platform after the block compared to the matched freelancers, especially those who used to work on a higher percentage of hourly jobs. As a result, there are a greater number of jobs and a greater percentage of hourly jobs completed by the affected freelancers compared to the matched group after the block. Apart from this, there is no evidence of selection on job characteristics, freelancer qualities, or client qualities, indicating that the reduced disintermediation is mainly due to a compositional shift among freelancers continuing working after the Skype block.

To conclude, freelancers in mainland China are less likely to take transactions off the platform after Skype is blocked. In other words, restricting communication technology outside an intermediary reduces the risk of user disintermediation that the intermediary is facing, strengthening its positional advantages and value capture.

2. Relationship between Technology and Disintermediation

2.1. What is Disintermediation?

An intermediary is an entity that provides matching and facilitates transactions between sellers and buyers (e.g., Parker & Van Alstyne, 2005; Rochet & Tirole, 2006; Hagiu & Wright, 2015). In the strategic management literature, it is close to the concept of a *broker*, who creates value by connecting two actors to initiate exchange (e.g., Burt, 1992; Fernandez & Gould, 1993; Hargadon & Sutton, 1997; Ahuja, 2000; Quintane & Carnabuci, 2015). The phenomenon of intermediation also corresponds to the *brokerage* phenomenon (e.g., Burt, 2007; Rider, 2009; Bidwell & Fernandez-Mateo, 2010).

Brokers are theoretically important; brokers control the access and flow of information through their structural positions (Burt, 2007), initiate value exchanges between actors (Burt, 1992), bridge connections in networks (Sasson, 2008), and facilitate matching and certification of actors (Rider, 2009). With such positional advantages, brokers can obtain multiple benefits such as excessive returns or better transacting opportunities (Bidwell & Fernandez-Mateo, 2010), have more influence in their partnerships (Fernandez & Gould, 1993), and gain competitive advantages (Ryall & Sorenson, 2007; Long Lingo & O'Mahony, 2010). Brokerage positions improve innovation (Hargadon & Sutton, 1997; Vasudeva, et al., 2012) and cultivate leadership in community (Fleming & Waguespack, 2007).

Disintermediation, on the contrary, is the phenomenon of users circumventing the intermediary, or the broker, to transact. Brokers charge for the information or resources they accumulate in the network (Fernandez-Mateo, 2007), strategize to maximize their returns in mediating the exchanges of information (Quintane & Carnabuci, 2015), exploit information asymmetry to extract excess gains (Stovel, et al., 2011), and capture economic value through their long-term relationship (Bidwell & Fernandez-Mateo, 2010). As a result, users have the incentive to circumvent the broker to save such costs paid to the broker (Edelman & Hu, 2016; Gu & Zhu, 2021). In other words, once matched, the users can "cut out the middleman" to transact directly with each other (Krakovsky, 2016), depriving the broker of its positional advantages and resulting in loss of returns or even failure of the brokerage business model. Therefore, understanding the determinants of disintermediation is crucial to brokers and organizations in general.

Despite the profound consequences of disintermediation to intermediaries, it is not well understood, as the mechanisms of how intermediaries can sustain their value creation to prevent being cut out from the partnership remain unclear (Rider & Samila, 2019; Gu & Zhu, 2021). In addition, because intermediaries cannot observe disintermediated transactions, it is hard in practice to quantify and measure the tendency of disintermediation (Gu & Zhu, 2021). As the problem has surged in recent years due to the ubiquitous use of digital platforms, a small number of existing work approaches the problem by asking how disintermediation disrupts the market for ideas (Peukert & Reimers, 2019), how disintermediation affects

product quality over time in the music industry (Waldfogel, 2012), or how user trust influences disintermediation in online marketplaces (Gu & Zhu, 2021). There is still theoretical gap and practical need for more understanding toward the influencing factors of disintermediation and its prevention.

Hence, in this research, we aim to further our understanding about disintermediation, from the perspective of technological development as an influencing factor, to provide theoretical and empirical contributions to the strategic management literature.

2.2. Why Does Disintermediation Happen?

We first turn to the brokerage literature to understand why disintermediation happens. A broker creates value by holding privileged access to and control of information (e.g., Burt, 1992). However, such value-creation process would be hindered if the broker is not able to successfully match and facilitate exchanges between two sides (Sasson, 2008), fails to protect its privileged access to information or keep others from controlling the flow of such information (Quintane & Carnabuci, 2015), encounter role conflict in the partnership (Stovel, et al., 2011), or have difficulty realizing returns from its brokerage action (Bidwell & Fernandez-Mateo, 2010; Stovel, et al., 2011). Therefore, the positional advantages for brokers are more fragile compared to other structural positions (Stovel, et al., 2011; Rider & Samila, 2019; Gu & Zhu, 2021).

The above theories suggest that brokers are more likely to be disintermediated when users have alternative channels that they prefer to obtain access to information or initiate exchange outside the intermediary. Such outside channels weaken the brokers' information advantage to control information flow and provide matching or certification (Rider, 2009; Quintane & Carnabuci, 2015; Rider & Samila, 2019), and the actors have incentives to initiate exchange directly with each other to reduce information asymmetry and also save cost (Bidwell & Fernandez-Mateo, 2010; Stovel, et al., 2011; Gu & Zhu, 2021). Thus, the brokerage relationship will be broken, and the broker can no longer charge excessive returns from their positional advantages (Burt, 2007; Stovel, et al., 2011). This leads to disintermediation.

Transaction cost economics (TCE) theories explains when transactions are more likely to happen outside an intermediary. Intermediaries need to secure their governance structure with their partners by locking-in transactions (Arthur, 1989; Farrell & Klemperer, 2007), where strategic alliance incentivizes long-term relationship rather than short-term opportunism (Parkhe, 1993; Young-Ybarra & Wiersema, 1999). For this purpose, intermediaries use economic constraints, such as investment of specific assets, to lower the transaction cost and make credible economic commitments for the partnership (Williamson, 1989, 2010).

On the contrary, if the transaction cost outside the intermediary becomes lower, the two sides have an incentive to break such lock-in condition and seek alternative channels to transact without the intermediary

(Rysman, 2009; Edelman & Hu, 2016). For example, in the book publishing and the music industry (Waldfogel & Reimers, 2015; Peukert & Reimers, 2019), digitization lowers the search cost and frictions in marketplaces, incentivizing the two sides to cut out the intermediary.

In sum, when there are alternative channels to transact *outside* the intermediary with lower cost compared to that *within* the intermediary, users choose to transact *outside*, thus disintermediation happens.

2.3. The Impact of Technology on Disintermediation

Can platforms reduce disintermediation? Based on our theory development, disintermediation is more likely to happen when the cost of transacting outside the intermediary is lower. Technology, especially communication technology, which greatly cuts off the users' costs when communicating outside the intermediary, may facilitate disintermediation. But how?

With the rapid development of technology in recent decades, especially the ubiquity of Internet use, Internet Communication Technology (ICT) has been widely adopted in online communication and has been gaining significant importance in our life. Many mainstream ICT software has emerged for Internet users to manage instant communication online, such as Skype, Google Talk, WhatsApp and so on. There has been immense interest on the development of ICT in the scholarly literature (e.g., Hinds & Kiesler, 1995; Hsieh, et al., 2010). The benefits of ICT development on various business performance measures (e.g., Hinds & Kiesler, 1995; Xu, et al., 2014) or its impact on organizational forms (e.g., Bloom, et al., 2014). There is also literature comparing ICT's effects in various country and cultural settings (e.g., Tan, et al., 2014; Venkatesh, et al., 2016). However, no study has yet explored disintermediation as a side effect of the rapid technological development.

Communication technology could encourage disintermediation, as improved communication technology lowers users' costs to contact *outside* the intermediary, encouraging them to directly transact with each other. When channels to contact each other outside the platform becomes more reliable, such as when there is high user trust, the users are more likely to disintermediate and transact by themselves (Gu and Zhu, 2021). Digitization in more traditional markets, such as the music industry or book publishing (Waldfogel & Reimers, 2015; Peukert & Reimers, 2019), also facilitates disintermediation. In this case, the development of technology weakens the value creation of the middleman.

The recent development of communication technology contributes to the rising threat of disintermediation. As improved communication technology in the environment lowers users' communication costs, their costs to transact directly with each other outside the intermediary becomes significantly lower. Hence, as a potential way to prevent disintermediation, the blocking of communication technology in the environment would add to the transaction costs outside the intermediary, discouraging

users from taking the transactions outside and instead increase their willingness to complete transactions with the intermediary. We hypothesize the following:

Hypothesis 1 (main hypothesis): Reducing communication technology outside an intermediary can lead to a *decrease* in users' disintermediation tendencies on the intermediary.

This main effect may be heterogenous in various aspects. Firstly, users' tendencies to disintermediate may be heterogeneous due to differences in transaction characteristics. One example would be that some transactions rely more on communications between the two sides compared to other transactions. Such transactions are more "ICT-reliant": they could be less structured or less modular in the task form and procedures (Baldwin & Clark, 2000), have less standardized use demand or lack a clear measure of requirement when conducted online (Orlikowski, et al., 1995; Overby, 2008), or their quality control is ambiguous and needs more communication as mediation to ensure satisfactory completion of the task (Leonardi, et al., 2011). Under these circumstances, cutting off communication technology in the environment would have a greater impact on communication-intensive jobs compared to others, making disintermediation less desired. This leads to the next hypothesis:

Hypothesis 2 (moderating effect of communication intensiveness): Reducing communication technology outside an intermediary can lead to a *greater* decrease in users' disintermediation tendencies on the intermediary when the job is communication intensive.

Secondly, from the perspective of customers, disintermediation tendencies may also be heterogeneous in the sense that some customers are more cost-sensitive than others. Because customers can avoid paying the commission fee required by the platform when they take the transaction outside, and individual customers who are more in need of saving cost would be more cost-sensitive, thus they have a stronger incentive to disintermediate (Edelman & Hu, 2016). On the contrary, enterprise customers may be less sensitive to costs compared to individual customers, and they would care more about the additional services they receive when transacting within the platform. Hence, the next hypothesis is:

Hypothesis 3 (moderating effect of personal vs. enterprise buyer): Reducing communication technology outside an intermediary can lead to a *greater* decrease in users' disintermediation tendencies on the intermediary when the job is from a personal instead of an enterprise buyer.

3. Research Context

The empirical setting of this study is a major online outsourcing marketplace in the US. It is an apt setting for the study as the platform is vulnerable to disintermediation and is also sensitive to technological

change. On this platform, freelancers located in mainland China were affected by the blocking of Skype in mainland China in October 2017. The block had no prior government announcements or news media coverage. After the block, mainland China Skype users could no longer download or update the software, refill credit, group video chat, or make landline calls via Skype.

3.1. Online Outsourcing Platform that is Vulnerable to Disintermediation

To test our hypotheses, an ideal setting would be a commission-fee-based intermediary that matches users and facilitates their transaction procedures such as communication and payment. As users communicate, they look for alternative communication technologies to disintermediate and avoid the commission fee. Based on this, the empirical setting of this study is a major online outsourcing platform in the US.

Because observing disintermediation is key to this study, this outsourcing platform has several advantages as the research setting. First, since the platform charges freelancers a service fee of between 5% and 20% of the amount they bill a client, it provides an incentive for both sides to disintermediate to avoid the fee at various stages of the transaction. A client posts a *job opening* and receives freelancer applications. When the client hires a freelancer, an active *job assignment* is in process until the job is complete and both sides agree to close the assignment. Jobs can be either *hourly* or *fixed price*. The amount charged for a fixed price job is negotiated and set when the job assignment begins. For hourly jobs, only an hourly rate is pre-negotiated at the time of hiring, and the total amount charged equals the number of working hours times the hourly rate. In such a setting, disintermediation can happen in two ways: before a transaction starts or after a transaction starts but before it is completed. This study focuses on the latter case, which the job outcomes reflect.

Second, although the platform has its own online messaging system, since the jobs on the platform are communication-intensive, using third-party software may help convey specific work needs. The platform supports a wide range of job categories, such as writing; sales & marketing; accounting & consulting; web, mobile & software development; design & creative; and administrative support. In many of these categories, jobs are not standardized, such as designing a logo. To communicate about job requirements and progress, the client can converse with the freelancer by creating a one-on-one or group *room*, which stores all messages between the room participants. While this room offers some functions, including video and audio chatting, screenshot sharing, and file attachments, it does not provide other functions, such as computer-to-phone calls, SMS messages, or group meetings. Therefore, for non-standardized jobs, users may need other software, such as Skype, for urgent requirements or to remotely monitor work quality.

Moreover, a large proportion of the jobs are long-term and repeat transactions, which allow clients and freelancers to try each other out and then disintermediate for the rest of the job. For long-term jobs, the client and the freelancer can agree upon *milestones*, at which the client pays a corresponding part of the bill each time the freelancer completes a portion of the job until the job assignment is fully complete. Such long-term jobs usually last from a week to more than six months, with regular milestones and billing cycles, which makes it easier to disintermediate in the middle of the transaction.

Finally, freelancers on the platform are located worldwide, and, hence, rely heavily on online communication software for contact. Over 1/3 of all jobs on the platform are completed by freelancers outside the US, from regions, such as Europe and Asia. Also, a high portion of domestic clients tend to hire international freelancers. The global setting of this platform makes online chatting the major and almost only channel to communicate and monitor job quality.

In sum, the platform faces a high risk of disintermediation and is also sensitive to technological changes, as its transactions are repetitive, global, and communication intensive. This makes it an apt setting for the study. For the above reasons, several studies have used such platforms as the empirical context to study online labor contracting (e.g., Stanton & Thomas, 2016; Kokkodis, 2020) or disintermediation (Gu & Zhu, 2021).

3.2. The Great Firewall of China and the Blockade of Skype

To identify the effects from changes in communication technology, this study takes advantage of the Skype block in mainland China in 2017 as a sudden change to communication technologies in the environment. The blockade was implemented by the mainland China government's Internet censorship system, known as The Great Firewall (GFW), which is the world's largest online censorship system. First started in 1998, and with an affected population of 800 million Internet users today,[5] the goal of the GFW project is to legislate domestic Internet usage and regulate the Chinese Internet economy through online traffic monitoring, limited access to foreign websites, the selected blockade of foreign Internet tools and software, and so on.[6]

The GFW restricted access to various major communication software in mainland China, including Google's Gmail and Gtalk, Facebook Messenger, Twitter, WhatsApp, and major online media sources, such as The New York Times and YouTube. The most recent target of the GFW is Skype. Skype is an

---

[5] Source: https://www.bloomberg.com/quicktake/great-firewall-of-china, accessed January 2021.

[6] Source: https://en.wikipedia.org/wiki/Great_Firewall, accessed January 2021.

online instant messaging software offering free video and audio chatting functions all over the world.[7] Before its blockade in China in 2017, Skype was widely used to connect mainland China users to US and European online marketplaces, especially after the GFW blocked other instant messaging software. Between October 19 and October 22, 2017, the Chinese government took Skype down from all major online app stores in mainland China due to "political concerns."[8] There were no prior government announcements or media coverage. The block immediately affected various Internet users in global business and online trading industries. While users could still turn to Internet proxy tools, such as a virtual private network (VPN), to circumvent the GFW, on February 1st, 2018, the Chinese government officially banned the usage of all VPNs nationwide, making it impossible to use Skype via VPN.

The block has had several long-lasting effects on mainland China Skype users. First, no new downloads or installations of Skype were possible for mainland China users. For existing installed versions, money refill was no longer allowed; therefore, paid services, such as landline calls and group video chatting, were unusable once the user ran out of points in his or her Skype account. Moreover, future version updates were no longer available, so current users would be forced to stop using the software, as Skype does not allow logins using older versions once it issues a major software update.

4. Research Design, Data, and Measures

The research design uses the Skype block in mainland China in 2017 as an exogenous shock to communication technology and employs matching and difference-in-differences approaches to estimate the impact of technology on disintermediation. The matching process is based on mainland China's government policies with Hong Kong, Macau, and Taiwan and its historical connections with Singapore and Malaysia. The matched group of freelancers show parallel pre-trends to the affected freelancers in terms of their disintermediation tendencies and job outcomes before the shock. The main analysis uses transaction-level data for the matched pairs, including disintermediation scores and job outcomes for all job assignments completed by the affected and matched freelancers from January 2017 to June 2018.

4.1. Constructing a Matched Control Group

To obtain an estimation of the counterfactual scenario, we first take advantage of mainland China's government policies with Hong Kong, Macau, and Taiwan to construct a control group comparable to the affected freelancers in mainland China. Under the People's Republic of China's "One Country, Two

---

[7] Source: https://www.skype.com/en/, accessed January 2019.

[8] Source: https://www.nytimes.com/2017/11/21/business/skype-app-china.html, accessed January 2019.

Systems" policy in Hong Kong and Macau,[9] people living in those regions commute frequently to mainland China, including for work, education, healthcare, or family reasons. Similarly, given the "1992 Consensus" with Taiwan, mainland China has strong cultural and economic connections with Taiwan. Therefore, freelancers located in these regions tend to be highly comparable to mainland China freelancers.

In addition, freelancers from two other Asian countries, Singapore and Malaysia, are also highly comparable to mainland China freelancers, as the two countries have the top two largest overseas Chinese populations in the world due to historical reasons.[10] They also have a majority of Chinese-speaking population across the countries. Because the Skype block only applies to mainland China but not Hong Kong, Macau, Taiwan, or other countries like Singapore and Malaysia, the block did not affect freelancers in these regions, making them an ideal control group for this study's purpose.

Propensity score matching (PSM) ensures that the two groups are comparable across various covariates. The level of matching is each freelancer in the affected or control regions. Each mainland China freelancer is paired with another freelancer in the control regions with no replacement based on their likelihood of being treated. The covariates include the freelancers' profile complete percentages, availability, their job success rates, English language skills, and the number of skill tests that they passed on the platform. Section 4.4 describes the results of the balance check before and after matching.

4.2. Data and Sample

To observe transaction outcomes and user disintermediation tendencies, we collect proprietary transaction-level data from the major US outsourcing platform before and after the Skype block. The main analysis sample contains all job assignments completed by mainland China freelancers and their matched freelancers on this outsourcing platform from January 2017 to June 2018, with job outcomes and user profile data to allow for observing disintermediation tendencies per transaction.

Specifically, 883 treated freelancers and 2,237 control freelancers completed at least one job assignment in 2017 before the Skype block; the matching constructs a balanced sample of 1,724 freelancers, who are equally split between the two groups into 862 pairs. They completed 15,281 job assignments from January 2017 to June 2018, among which 7,538 job assignments are completed outside the shock period

---

[9] Source: https://en.wikipedia.org/wiki/One_country,_two_systems, accessed September 2018.

[10] The Chinese populations in Singapore and Malaysia are 75% and 23% of the total populations, respectively. See https://en.wikipedia.org/wiki/Overseas_Chinese for a list of overseas Chinese population percentages in all countries, accessed September 2018.

between October 2017 and January 2018.[11] The clients for these jobs are limited to those located in the US to control for geographical difference on the demand side. These 7,538 job assignments from 862 pairs of freelancers form the main analysis sample.

4.3. Measures

One of the key difficulties in this study is measuring the tendency of disintermediation. A direct measure of disintermediation, called *Disintermediation_Score*, uses text analysis based on the platform's keyword detection algorithm of chat messages sent between the clients and the freelancers (Gu and Zhu 2021).[12] To be specific, the platform constructs a list of sensitive words together with their weights based on an algorithm trained from a large set of past transaction data. For each message associated with a job assignment, the algorithm sums up the numeric values of sensitive words and uses the maximum value among all messages as the disintermediation score for the assignment. Compared to approaches that add up sensitive words in all messages or that take an average of all messages, this approach is independent of the frequency of communication; also, as users typically express their desire to disintermediate in only a few sentences, not all messages are useful for detecting disintermediation; hence, this approach focuses on the messages that are most likely related to disintermediation. The scores are learned and refined over time, and detected instances are confirmed based on manual checking during interviews or payments; thus, this measure is practically reliable. In total, 2,016 out of the 7,538 job assignments have a *Disintermediation_Score* that is a positive integer; the others have a *Disintermediation_Score* of 0.

Beyond the direct measure, two indirect measures on the job outcomes also help identify disintermediation, the number of job hours and the job's total job charge, both of which aim to measure jobs that are partially disintermediated. These two measures and *Disintermediation_Score* together quantify the tendency of user disintermediation. Specifically, as an indirect approach, disintermediated jobs tend to have shorter working hours, as the client only tries out part of the job with the freelancer on the platform and takes the rest outside the platform. The reduction in time is captured by *Hours*, the number of working hours recorded by the freelancer time tracking software for each assignment. *Hours* is only available for

---

[11] After Skype was blocked in October 2017, some mainland China users could still circumvent the GFW to download or update Skype using VPN or proxies. On February 1st, 2018, VPN was also banned by law. Therefore, in the main analysis, the four months from October 2017 to January 2018 are considered as the period when the shock is "being implemented," and the months since February 2018 are considered as the period "after the shock." we also did a robustness check by including October 2017-January 2018 in the "after the shock" period in the main analysis; all findings are qualitatively unchanged.

[12] The platform used a text analysis tool on aggregated data to detect conduct in violation of the Terms of Service. The actual content of chat messages was not reviewed, and all user information was kept confidential.

hourly jobs and is missing for fixed-price jobs. Similarly, for disintermediated jobs, *Total_Charge*, the total amount paid on the platform when a job assignment is closed, tends to be small, indicating that the rest is being paid outside the platform to avoid commission fees. *Total_Charge* has a non-negative value for all job assignments.

For each assignment, the dummy variable *Treated* equals 1 if a freelancer in mainland China completes the assignment and equals 0 otherwise. Also, to mark the time periods before or after the Skype block, a dummy variable *Post* is assigned as 0, if the job assignment finished between January 1st and September 30th, 2017, and as 1, if the job assignment finished after February 1st, 2018. The time period between October 1st, 2017 and January 31st, 2018 is considered to be when the block happened; therefore, *Post* has no value in that interval, since the samples does not include any job assignments during that interval.

In addition, we construct two moderating variables to examine the heterogeneous tendencies of disintermediation based on the communication-intensiveness of the job and the client type. First, jobs that require more communication to convey the client's specific needs rely more on video or audio chatting during the working process to monitor job quality. Therefore, such jobs are likely to be more affected by the Skype block than jobs requiring less communication. The level of communication required can be quantified by the average number of milestones per job in each job category; in other words, by whether the client constantly monitors the job quality throughout the transaction or just waits for final delivery once the job starts. The number of milestones ranges from 1 to more than 200 among the 12 job categories. This allows the jobs to be split into three groups based on their categories—*Communication_High*, *Communication_Med*, and the baseline group. *Communication_High* equals 1 for job categories with an average number of milestones in the top 25% of the milestone distribution: Web, Mobile and Software Development, Administrative Support, and Customer Service. The baseline group includes the job categories with the least number of milestones per job in the bottom 25% of the milestone distribution: Writing, Translation, Data Science and Analytics, and Accounting and Consulting. For the rest of the categories, whose number of milestones is between the top and the bottom 25% of the distribution, *Communication_Med* equals 1.

Also, jobs from business clients generally rely less on Skype for disintermediation relative to personal clients, since company employers are more likely to have their own communication tools or websites for the freelancers to contact directly. Hence, blocking Skype may affect personal clients' jobs more than those from business clients. This heterogeneity is captured by a dummy variable called *Client_Personal*, which equals 1 if the client self-report as a personal client on the user profile and equals 0 if the client self-reported as a business client.

4.4. Balance Check and Summary Statistics

A. Parallel Pre-Trends Assumption: To establish the validity of the causal inference in the matching and the difference-in-differences specification, it is important to investigate the parallel pre-trend assumptions of the dependent variables between the treated and matched group freelancers. Figures 1 to 3 compare the trends of the three dependent variables' changes over time for the two groups before and after the Skype block. In Figure 1, for instance, each point represents the monthly total charge per job of each freelancer in a given month, averaging among all freelancers in the treated or matched groups. If a freelancer does not complete any assignment that month, the person's total charge for that month is 0.

As is evident from Figures 1 to 3, the pre-trends for all three variables are similar between the two groups, which verifies that the matched groups satisfy the parallel pre-trends assumption. Meanwhile, the two groups diverge on each variable after the Skype block, visualizing the potential impact of the shock on job outcomes and level of disintermediation.

FIGURE 1

Difference between the Treated and Control Freelancer's Disintermediation Score over Time
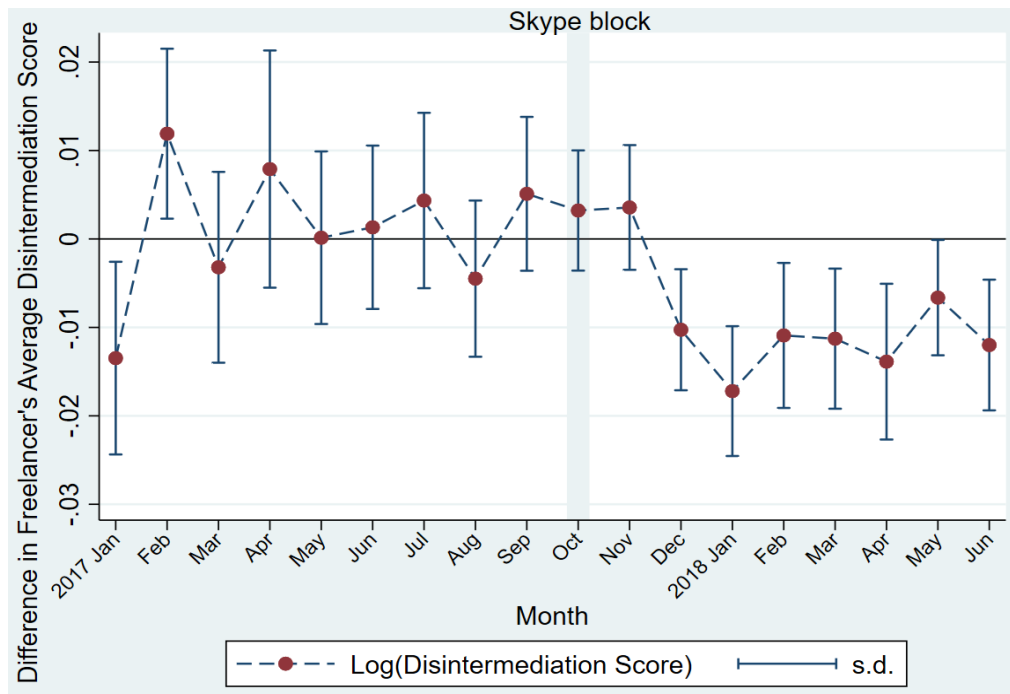

14

FIGURE 2

Difference between the Treated and Control Freelancer's Average Job Total Charge over Time
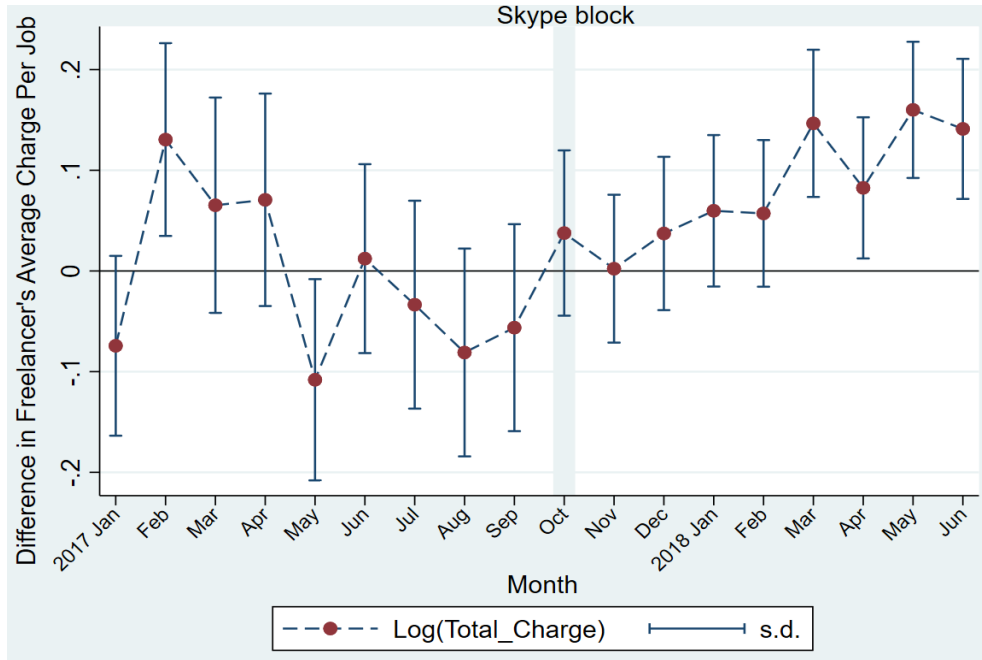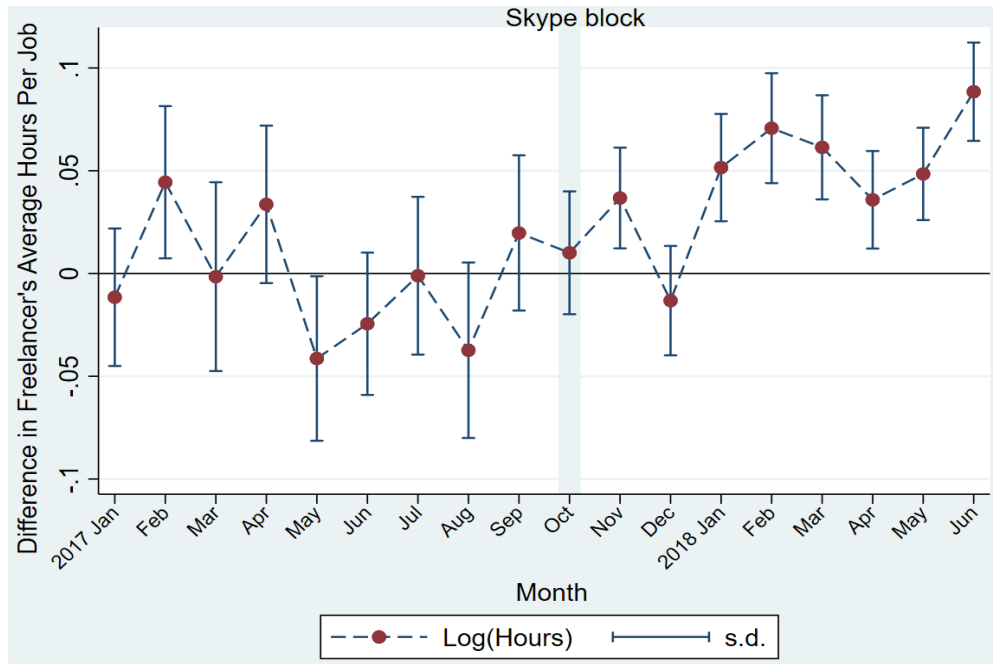

FIGURE 3

Difference between the Treated and Control Freelancer's Average Job Hours over Time

B. Balance Table: It is also necessary to make sure that the two groups of freelancers are balanced on various characteristics and dimensions before the shock. Table 1 presents paired t-tests results at the freelancer level to compare various aspects of the treated and the matched group freelancers before the Skype block, such as the freelancers' number of days on the platform, the average job opening amount in the past year, and the freelancers' language skills. We can see that the blocked and matched group freelancers are balanced on all dimensions.

C. Summary Statistics: The main analysis of this study is conducted at the job assignment level. Table 2 shows the summary statistics of all variables. The number of observations in the main analysis sample is 7,538, of which 2,117 are hourly jobs. There are 2,016 jobs with non-zero disintermediation scores. Since *Hours*, *Total_Charge,* and *Disintermediation_Score* are highly skewed, the main analysis uses the natural logarithms of each of the three measures as the dependent variables. Furthermore, 49.9% of the job assignments in the main sample are from the treated group freelancers, while 50.1% are from the matched group freelancers.

Table 3 compares the three dependent variables for the treated and matched group assignments before and after the Skype block. Before the block, assignments from the two groups are similar in total charges, numbers of hours, and disintermediation scores. After the block, however, the treated group assignments demonstrate significantly more hours, higher total charges, and higher disintermediation scores than the matched group assignments, all suggesting a smaller likelihood of disintermediation.

5. Empirical Results

Based on a difference-in-differences estimation framework, the main analysis shows that restricting alternative communication technologies outside the platform leads to a decrease in disintermediation on the focal platform. Also, the total charge per job and the number of hours per job increase, suggesting that freelancers in mainland China are less likely to take transactions off the platform after the Skype block compared to unaffected freelancers. The magnitude of the main effect is larger for communication-intensive jobs and for jobs posted by personal clients instead of business clients.

5.1. Evidence of Reduced Disintermediation

The following difference-in-differences regression framework estimates how the shock changes the three dependent variables: *Disintermediation_Score*, *Total_Charge*, and *Hours*:

$$Y = \ \beta_0 + \beta_1 Treated + \ \beta_2 Post + \beta_3 Treated \times Post + \varepsilon. \tag{1}$$

The unit of analysis is each job assignment. The two groups' job average difference before the shock equals β_1, whereas their average difference after the shock equals $\beta_1 + \beta_3$. Therefore, the estimated coefficient for the interaction term, β_3, captures the shock's impact on the two groups' differences, which is the coefficient of interest here.

Table 4 reports the regression results. Models (1), (3), and (5) use the logarithm of the disintermediation score, the job total charge, and the number of job hours as the dependent variables, respectively. We can see from Models (1), (3), and (5) that, on average, the blocking of Skype seems to have a negative impact on the level of disintermediation on the platform. The estimates of β_3 show that, after Skype is blocked, assignments between mainland China freelancers and US clients become 18.7% less in detected disintermediation scores, 33.6% higher total charges, and 26.5% longer hours relative to assignments with matched freelancers in Hong Kong, Taiwan, Macau, Singapore, and Malaysia. All three sets of results suggest that the Skype block reduces users' tendencies to disintermediate in the affected regions, supporting Hypothesis 1.

Models (2), (4), and (6) repeat the analysis, controlling for month fixed effects. Adding month fixed effects controls for potential seasonal impacts on the absolute level, allowing the analysis to focus on the changes in the assignment outcomes before and after the block. The main findings continue to hold.

5.2. Which jobs had reduced disintermediation?

Various factors moderate the impact of technology on disintermediation; in particular, the effect has a greater magnitude when the job is communication-intensive and when the job is posted by a personal client instead of a business client.

A. Communication-intensive Jobs: Since certain job categories rely more on video or audio chatting to monitor job quality and align the client and the freelancer's expectations, such jobs may require more facilitation during the working process. Hence, the Skype block may have a greater impact when users try to disintermediate on communication-intensive jobs.

Such heterogeneity is tested using a triple difference model that adds a moderator to Equation (1). In Table 5, Model (1) reports the regression results. The negative coefficients of the two three-way interaction terms suggest that jobs that require more facilitation and monitoring during the working process are more significantly affected by the Skype block, with a greater level of decrease in disintermediation tendencies for the most communication-intensive job categories. These results indicate that blocking Skype hinders the treated users' communication outside the platform and enhances the platform's value creation in facilitating the transactions, supporting Hypothesis 2.

B. Client Type: The tendency of disintermediation may also vary depending on whether the job is for a business client or a personal client. One potential reason is that enterprise employers are more likely to have their own communication tools or websites for freelancers to contact directly; thus, relative to personal clients, business clients may rely less on Skype for disintermediation and are less affected by the Skype block.

Model (2) in Table 5 provides the estimates of the heterogeneity based on whether the job is posted by a personal versus a business client. As expected, the negative coefficient for the three-way interaction term indicates that the Skype block reduces the disintermediation of personal client jobs significantly more than that of business client jobs. Therefore, jobs from personal clients are affected more by the Skype block than business clients, supporting Hypothesis 3.

6. Mechanism Discussion: What does technology affect disintermediation?

From where do the above changes come? To understand the mechanism behind the changes in disintermediation tendencies, we find that the affected freelancers are more likely to continue working on the platform after the block compared to the matched freelancers, especially those who used to work on a higher percentage of hourly jobs. As a result, there are a greater number of jobs and a greater percentage of hourly jobs completed by the affected freelancers compared to the matched group after the block. Apart from this, we do not find evidence of selection on job characteristics, freelancer qualities, or client qualities otherwise, indicating that the reduced disintermediation is mainly due to a compositional shift among freelancers continuing working after the Skype block.

6.1. Potential Changes in Freelancer Qualities

First, one might argue that selection on freelancer qualities for those who remain active after the block could be the reason for job outcome differences between the two groups. To test for this possible explanation, we summarize the number of freelancers who stayed on the platform in each group. The statistics show that a greater number of freelancers in the treatment group are more likely to continue working on the platform after the shock compared to the control group. Specifically, 224 freelancers from the treatment group continue to complete jobs on the platform out of the 862 pairs, whereas the number of remaining freelancers is only 171 in the control group. In addition, freelancers who continue working in the treatment group have completed a greater percentage of hourly jobs in the past, compared to that of the control group freelancers.

Are there differences among the remaining freelancers besides the percentage of hourly jobs they completed in the past? The matching procedure in Section 4 ensures that the freelancers are comparable in

1) their work habits, reflected in the average charge per job, average hours per job, and disintermediation scores and 2) their characteristics, such as job success ratings, availability, and skills. However, since the Skype block introduces additional friction in communication, the clients may tend to hire freelancers who are more capable, more available, or of higher quality to reduce uncertainty in delivering the work, as well as reduce communication costs.

Hence, we test for the potential selection of freelancers after the shock based on their characteristics and past working habits. The t-test results in Panel A of Table 6 show that, after the shock, the freelancers who continue to work in the two groups still have comparable profiles in terms of availability hours, language skills, and total number of tests passed, and there is no significant difference in the remaining freelancers' past job success ratings, ruling out the potential explanation that the freelancers were selected based on their characteristics.

In addition, when comparing the freelancers' past working habits in Panel B of Table 6, we can see that the remaining freelancers are again comparable: their past jobs have similar average charges per job, average number of hours per job, and disintermediation scores. But the average past percentage of hourly jobs completed is significantly higher among the remaining treatment group freelancers than that among the control group freelancers. This significant difference in hourly job percentage is consistent with the earlier observation that the freelancers who used to work on more hourly jobs are more likely to stay on the platform after Skype is blocked.

In sum, we find that the blocked freelancers are *more* likely to continue completing jobs on the platform after the shock compared to unaffected freelancers, especially those who used to work on a greater percentage of hourly jobs. Apart from this, the freelancers are not significantly different in their 1) job success, availability, and skills or 2) past working habits. Therefore, there is a compositional change but no selection on qualities among the remaining freelancers.

To correct for potential changes in freelancer composition between the two groups, we repeat the main analysis conditional on the freelancers staying on the platform after the shock, the results of which is reported in Table 7. We can see that, after controlling for the freelancer composition change, all main findings continue to hold.
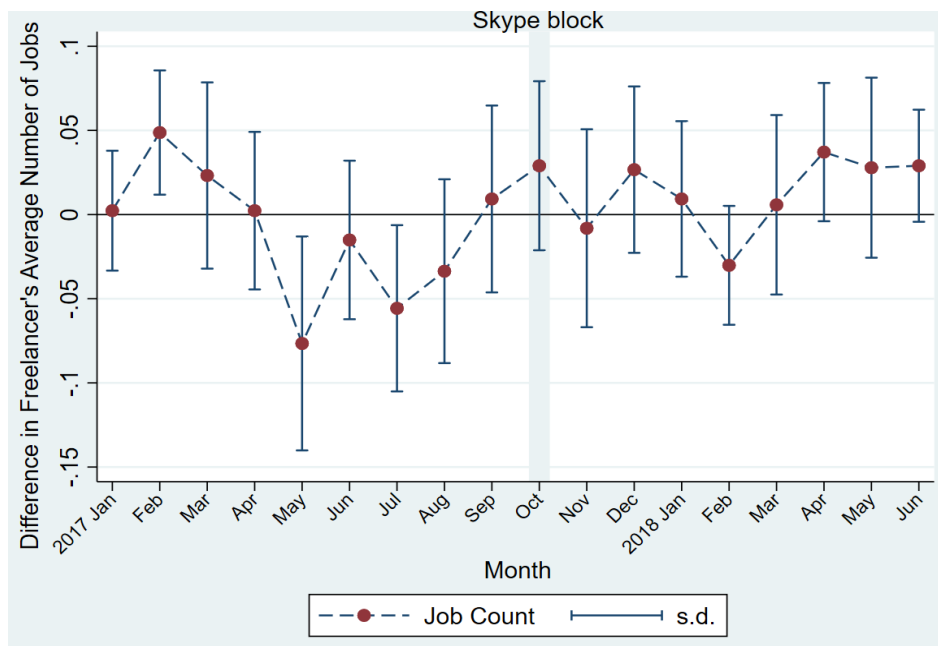
6.2. Potential Changes in Job Qualities

Given the compositional change of freelancers after the shock, a natural follow-up question is how their jobs become different. we find that, in terms of the total number of jobs, there are slightly more jobs completed by the treatment group than by the control group after Skype is blocked; furthermore, the

percentage of hourly jobs becomes significantly higher for the treatment group. Apart from these, the jobs do not show difference in other qualities such as the job category and job expected duration.

Figure 4 compares the average number of jobs per month that the treated and control freelancers complete before and after the Skype block. While the two groups do not demonstrate any different pre-trends in their numbers of jobs, after the shock, the number of treatment group jobs slowly becomes greater than that of the control group over time. As a result, the total number of jobs of the treatment group (848) is larger than that of the control group (788) after the shock. We observed that the treated freelancers are more likely to stay and continue working on the platform after the shock, which is consistent with the statistics here that they complete more jobs after the shock than the control group freelancers.

FIGURE 4

Difference between the Treated and Matched Freelancer's Monthly Number of Jobs over Time

Next, we compare the changes in job type (i.e., whether the jobs are hourly or fixed-priced jobs). Two-sample t-tests show that, while before the shock, there is no significant difference in the percentages of hourly jobs between the treatment group and the control group freelancers, after the shock the percentage is significantly higher ($p < 0.0001$) for the treatment group jobs (0.36) than for the control group jobs (0.17). This difference is again consistent with the compositional change among freelancers; since treated freelancers, who are also those used to work on a greater percentage of hourly jobs, are more likely to continue working on the platform after the shock, the proportion of hourly jobs in the treatment group would as a result become higher overall assuming that these treated freelancers continue to prefer hourly jobs.

I also compare the job's other characteristics such as the job category and job expected duration. We find no significant differences between the treatment and control group jobs' distribution of job categories (p = 0.312 from a Kolmogorov-Smirnov test) or the expected duration reported as the number of work days expected in the job description (p = 0.587 from a T-test). These suggest that the clients' job needs on the platform are likely to be exogenous overall and are not influenced by the block of Skype in mainland China.

6.3. Potential Changes in Client Qualities

Finally, in terms of the demand side, it is useful to test for any potential changes among the clients who hired the freelancers in each group, since the clients who hired the blocked freelancers might have less intention to disintermediate in the first place. The comparison results suggest that the clients are highly comparable between the two groups, indicating that the Skype block did not result in a difference of demand that the affected and unaffected freelancers face on the platform, at least in the short run.

Table 8 reports the t-tests results comparing various characteristics of the clients who hire each group's freelancers before and after the shock. Specifically, we compare the clients' profile information on their days since first using the platform, the clients' ratings, and whether the client is large size or not. The pre-shock comparison, as expected, shows that there is no difference in the characteristics of the clients who hired the matched pairs of freelancers. After the shock, all the t-test differences are still insignificant between the post-shock clients. The results suggest that the clients who hire mainland China freelancers after the Skype block still have similar characteristics to those who hire freelancers in the unaffected regions. This rules out the possibility of selection bias among clients.

A potential reason that we do not observe significant changes on the demand side after the Skype block might be that the tasks the clients need are not likely to drastically change in a short period of time. In addition, since the clients may tend to be experienced in hiring, their job requirements are not likely to change due to technological reasons.

7. Robustness Checks: Are the Findings a Result of Lower Efficiency?

Lastly, to corroborate the main findings, we test for the alternative explanation that the results are driven by lowered efficiency from mainland China freelancers when they work without Skype. The longer working hours and increased total charges could result from a decrease in the affected freelancers' working efficiency instead of disintermediation.

With lower efficiency, freelancers may work longer hours. However, if the affected freelancers demonstrate lower efficiency, we should not observe an increase in the total charge for fixed-price jobs, as

the charge is pre-negotiated. In addition, the results on the disintermediation score also provide more direct evidence of reduced disintermediation regardless of efficiency.

Table 9 repeats the main analysis by job type. When examining fixed-price jobs only, still a significant increase in the treatment group job's total charge after the shock, meaning that the increase in the charge is the result of less disintermediation instead of lower efficiency.

To sum up, the mechanism behind the reduced disintermediation is mainly due to a "compositional shift" among the freelancers who remain working on the platform after the shock: the freelancers who are affected by the Skype block, especially those who used to work on a higher percentage of hourly jobs, are more likely to continue working on the platform compared to those who are unaffected. As a result, after the block we see a greater number of jobs aa well as a greater percentage of hourly jobs completed by the affected freelancers compared to the matched group. There is no evidence of changes in job qualities or client qualities otherwise. One possible explanation to this compositional shift could be that such increases in the percentage and number of hourly jobs in the treated group is due to the greater cost of disintermediation after Skype is blocked, which forces the freelancers to bring those jobs that would have been disintermediated back to the platform.

8. Conclusion and Discussion

While intermediaries focus on understanding internal factors to combat disintermediation, external factors, such as the advancement of technology, may also pose an increasing threat of disintermediation to intermediaries. When Skype is suddenly blocked in mainland China, a major US freelance marketplace has a significant decrease in mainland China freelancers' tendency to disintermediate compared to freelancers in Taiwan, Hong Kong, Macau, Singapore, and Malaysia. The affected freelancers are more likely to continue working on the platform after the block compared to the unaffected freelancers, especially those who used to work on a higher percentage of hourly jobs, potentially due to the increased cost of disintermediation. Therefore, a higher number of jobs and a greater percentage of hourly jobs are completed by the affected freelancers compared to others after the block.

The above findings mainly contribute to the growing body of literature on disintermediation, as there is not yet any work focused on communication technology as a factor that leads to disintermediation. Disintermediation disrupts the market for ideas (Peukert & Reimers, 2019) and affects product quality over time in the music industry (Waldfogel, 2012). Other prior work investigates how user trust, elaborated in a randomized control trial, influences disintermediation in online platforms (Gu and Zhu 2021), which is distinct from this paper's focus.

Few studies have explored disintermediation as a side effect of the rapid technological development in recent years. Most of the research in this community investigates the benefit of ICT development on various business performance measures (e.g., Hinds & Kiesler, 1995; Xu, et al., 2014) or its impact on organizational forms (e.g., Bloom, et al., 2014). comparing ICT's effects in various country and cultural settings (Tan, et al., 2014; Venkatesh, et al., 2016). The threat of disintermediation, on which this study focuses, adds another lens to discussing the impacts of communication technology.

Finally, this study furthers our understanding for the large stream of research on value creation and value capture, as theoretical and empirical evidence is scant on how disintermediation hinders value creation from technology. Prior discussion in the field involves value creation in the context of technology innovation ecosystems (Iansiti & Levien, 2004; Kapoor & Lee, 2013), competitive strategies in platform-based markets (Cennamo & Santalo, 2013; Shankar & Bayus, 2003), and value capturing for high-technology new entrants and incumbents in network markets (Zhu & Iansiti, 2012; Fuentelsaz, et al., 2014) and among technologically interdependent complementors (Adner & Kapoor, 2010; Boudreau & Jeppesen, 2015; Pierce, 2009). There is yet to be any theoretical or empirical research on how disintermediation acts as a mechanism that affects how technology creates value. Future research can explore the long-term participation and welfare implications of technological change on disintermediation.

REFERENCES

Adner, R. & Kapoor, R., 2010. Value Creation in Innovation Ecosystems: How the Structure of Technological Interdependence Affects Firm Performance in New Technology Generations. *Strategic Management Journal,* Volume 31, p. 306–333.

Ahuja, G., 2000. Collaboration Networks, Structural Holes and Innovation: A Longitudinal Study. *Administrative Science Quarterly,* 45(3), p. 425–455.

Argyres, N. S., 1999. The Impact of Information Technology on Coordination: Evidence from the B-2 "Stealth" Bomber. *Organization Science,* 10(2).

Arthur, W., 1989. Competing Technologies, Increasing Returns, and Lock-in by Historical Events. *Economic Journal,* 99(394), p. 116–131.

Baldwin, C. Y. & Clark, K. B., 2000. *Design Rules: The Power of Modularity. Vol. 1..* Cambridge, MA: MIT Press.

Bidwell, M. & Fernandez-Mateo, I., 2010. Relationship Duration and Returns to Brokerage in the Staffing Sector. *Organization Science,* 21(6), p. 1141–1158.

Bloom, N., Garicano, L., Sadun, R. & Van Reenen, J., 2014. The Distinct Effects of Information Technology and Communication Technology on Firm Organization. *Management Science,* 60(12), p. 2859–2885.

Boudreau, K. & Jeppesen, L., 2015. Unpaid Crowd Complementors: The Platform Network Effect Mirage. *Strategic Management Journal,* Volume 36, p. 1761–1777.

Burt, R. S., 1992. *Structural Holes: The Social Structure of Competition.* Cambridge, MA: Harvard University Press.

Burt, R. S., 2007. Secondhand Brokerage: Evidence on the Importance of Local Structure for Managers, Bankers, and Analysts. *Academy of Management Journal,* 50(1), p. 119–148.

Cennamo, C. & Santalo, S., 2013. Platform Competition: Strategic Trade-Offs in Platform Markets. *Strategic Management Journal,* Volume 34, p. 1331–1350.

Edelman, B. & Hu, P., 2016. Disintermediation in Two-Sided Marketplaces. *Harvard Business School Technical Note 917–004.*

Farrell, J. & Klemperer, P., 2007. Coordination and Lock-In: Competition with Switching Costs and Network Effects. *Handbook of Industrial Organization,* Volume 3, p. 1967 –2072.

Fernandez-Mateo, I., 2007. Who Pays the Price of Brokerage? Transferring Constraint Through Price-Setting in the Staffing Sector. *American Sociological Review,* Volume 72, p. 291–317.

Fernandez, R. M. & Gould, R. V., 1993. A Dilemma of State Power: Brokerage and Influence in the National Health Policy Domain. *American Journal of Sociology,* 99(6), p. 1455–1491.

Fleming, L. & Waguespack, D. M., 2007. Brokerage, Boundary Spanning, and Leadership in Open Innovation Communities. *Organization Science,* 18(2), p. 165–180.

Fuentelsaz, L., Garrido, E. & Maicas, J. P., 2014. Incumbents, Technological Change and Institutions: How The Value of Complementary Resources Varies across Markets. *Strategic Management Journal,* Volume 36, p. 1778–1801.

Gu, G. & Zhu, F., 2021. Trust and Disintermediation: Evidence from an Online Freelance Marketplace. *Management Science,* 67(2), p. 794–807.

Hagiu, A. & Wright, J., 2015. Marketplace or Reseller?. *Management Science,* 61(1), p. 184–203.

Hargadon, A. & Sutton, R. I., 1997. Technology Brokering and Innovation in a Product Development Firm. *Administrative Science Quarterly,* 42(4), p. 716–749.

Harris, S. E. & Katz, J. L., 1991. Organizational Performance and Information Technology Investment Intensity in the Insurance Industry. *Organization Science,* 2(3).

Hinds, P. & Kiesler, S., 1995. Communication across Boundaries: Work, Structure, and Use of Communication Technologies in a Large Organization. *Organization Science,* 6(4), p. 373–393.

Hsieh, J. J. P.-A., Rai, A. & Keil, M., 2010. Addressing Digital Inequality for the Socioeconomically Disadvantaged Through Government Initiatives: Forms of Capital That Affect ICT Utilization. *Information Systems Research,* 22(2).

Iansiti, M. & Levien, R., 2004. *The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability.* Boston, MA: Harvard Business School Press.

Kane, G. C. & Alavi, M., 2007. Information Technology and Organizational Learning: An Investigation of Exploration and Exploitation Processes. *Organization Science,* 18(5).

Kapoor, R. & Lee, J. M., 2013. Coordinating and Competing in Ecosystems: How Organizational Forms Shape New Technology Investments. *Strategic Management Journal,* Volume 34, p. 274–296.

Kokkodis, M., 2020. Designing Dynamic Reputation Systems for Online Labor Markets. *Information Systems Research,* Volume forthcoming.

Krakovsky, M., 2016. *The Middleman Economy: How Brokers, Agents, Dealers, and Everyday Matchmakers Create Value and Profit.* s.l.:Springer.

Leonardi, P. M., Neeley, T. B. & Gerber, E. M., 2011. How Managers Use Multiple Media: Discrepant Events, Power, and Timing in Redundant Communication. *Organization Science,* 23(1).

Long Lingo, E. & O'Mahony, S., 2010. Nexus Work: Brokerage on Creative Projects. *Administrative Science Quarterly,* 55(1), p. 47–81.

Orlikowski, W. J., Yates, J., Okamura, K. & Fujimoto, M., 1995. Shaping Electronic Communication: The Metastructuring of Technology in the Context of Use. *Organization Science,* 6(4).

Overby, E., 2008. Process Virtualization Theory and the Impact of Information Technology. *Organization Science,* 19(2).

Parker, G. & Van Alstyne, M., 2005. Two-Sided Network Effects: A Theory of Information Product Design. *Management Science,* 51(10), p. 1494–1504.

Parkhe, A., 1993. Strategic Alliance Structuring: A Game Theoretic and Transaction Cost Examination of Interfirm Cooperation. *Academy of Management Journal,* 36(4), p. 794-829.

Peukert, C. & Reimers, I., 2019. Digital Disintermediation and Efficiency in the Market for Ideas. *Available at SSRN: https://ssrn.com/abstract=3110105.*

Pierce, L., 2009. Big Losses in Ecosystem Niches: How Core Firm Decisions Drive Complementary Product Shakeouts. *Strategic Management Journal,* 30(3), p. 323–347.

Quintane, E. & Carnabuci, G., 2015. How Do Brokers Broker? Tertius Gaudens, Tertius Iungens, and the Temporality of Structural Holes. *Organization Science,* 27(6), p. 1343–1360.

Rider, C. I., 2009. Constraint on the Control Benefits of Brokerage: A Study of Placement Agents in U.S. Venture Capital Fundraising. *Administrative Science Quarterly,* 54(4), p. 575–601.

Rider, C. I. & Samila, S., 2019. Envisioning Value: Certification, Matchmaking, and Returns to Brokerage. *Working paper, Georgetown University, Washington, DC.*

Rochet, J.-C. & Tirole, J., 2006. Two-Sided Markets: A Progress Report. *The RAND Journal of Economics,* 37(3), p. 645–667.

Ryall, M. D. & Sorenson, O., 2007. Brokers and Competitive Advantage. *Management Science,* 53(4), p. 566–583.

Rysman, M., 2009. The Economics of Two-Sided Markets. *Journal of Economic Perspectives,* Volume 23, p. 125–143.

Sasson, A., 2008. Exploring Mediators: Effects of the Composition of Organizational Affiliation on Organization Survival and Mediator Performance. *Organization Science,* 19(6), p. 891–906.

Schilling, M. A., 2015. Technology Shocks, Technological Collaboration, and Innovation Outcomes. *Organization Science,* 26(3).

Shankar, V. & Bayus, B., 2003. Network Effects and Competition: An Empirical Analysis of The Home Video Game Industry. *Strategic Management Journal,* Volume 24, p. 375–384.

Stanton, C. T. & Thomas, C., 2016. Landing the First Job: The Value of Intermediaries in Online Hiring. *Review of Economic Studies,* 83(2), p. 810–854.

Stovel, K., Golub, B. & Milgrom, E., 2011. Stabilizing Brokerage. *Proceedings of the National Academy of Sciences,* 108(Supplement 4), p. 21326-21332.

Tan, C., Sutanto, J., Phang, C. & Gasimov, A., 2014. Using Personal Communication Technologies for Commercial Communications: A Cross-Country Investigation of Email and SMS. *Information Systems Research,* 25(2), p. 307–327.

Tucker, C., 2008. Identifying Formal and Informal Influence in Technology Adoption with Network Externalities. *Management Science,* 54(12).

Vasudeva, G., Zaheer, A. & Hernandez, E., 2012. The Embeddedness of Networks: Institutions, Structural Holes, and Innovativeness in the Fuel Cell Industry. *Organization Science,* 24(3).

Venkatesh, V., Bala, H. & Sambamurthy, V., 2016. Implementation of an Information and Communication Technology in a Developing Country: A Multimethod Longitudinal Study in a Bank in India. *Information Systems Research,* 27(3), p. 558–579.

Waldfogel, J., 2012. And the Bands Played on: Digital Disintermediation and the Quality of New Recorded Music. *Available at SSRN: https://ssrn.com/abstract=2117372*.

Waldfogel, J. & Reimers, I., 2015. Storming the Gatekeepers: Digital Disintermediation in the Market for Books. *Information Economics and Policy,* 31(1), p. 47–58.

Williamson, O., 1989. Transaction Cost Economics. *Handbook of Industrial Organization,* 1(3), p. 135-182.

Williamson, O., 2010. Transaction Cost Economics: The Natural Progression. *American Economic Review,* 100(3), pp. 673-690.

Xu, X., Thong, J. & Venkatesh, V., 2014. Effects of ICT Service Innovation and Complementary Strategies on Brand Equity and Customer Loyalty in a Consumer Technology Market. *Information Systems Research,* 25(4), p. 710–729.

Young-Ybarra, C. & Wiersema, M., 1999. Strategic Flexibility in Information Technology Alliances: The Influence of Transaction Cost Economics and Social Exchange Theory. *Organization Science,* 10(4), p. 439-459.

Zhu, F. & Iansiti, M., 2012. Entry into Platform-Based Markets. *Strategic Management Journal,* Volume 33, p. 88–106.

TABLE 1

Descriptive Statistics of the Treated and Matched Freelancers' Characteristics and Job Outcomes,
Before the Shock

Variables	Treated		Matched		Paired t-test
	Mean	Standard error	Mean	Standard error	t-stats
Profile Available Hours	39.66	0.09	39.50	0.12	-1.11
Profile Complete Percentage	86.99	0.78	88.74	0.78	1.59
Freelancer Success Score	0.84	0.01	0.83	0.01	-0.94
Number of Tests Passed	2.92	0.11	3.16	0.12	1.54
English Level	4.71	0.04	4.70	0.05	-0.09
Avg. Job Hours	16.54	0.67	15.84	0.69	-0.73
Avg. Job Total Charge	447.71	41.18	451.75	38.17	0.07
Avg. Disintermediation Score	0.53	0.05	0.47	0.05	-0.77

Notes. The unit of analysis is each freelancer in the treated and control group. Variables are calculated based on the freelancers' job assignments in 2017 before the Skype block in October. The number of observations for each group is 862, except for *Avg. Job Hours*, which is only available for freelancers who have completed at least one hourly jobs and has 407 observations in the treated group and 398 observations in the matched group. None of the above paired t-test results is significant.

TABLE 2

Summary Statistics of Variables Used in Main Analysis

Variables	Observations	Mean	Std. dev.	Min	Max
Treated	7,538	0.499	0.500	0	1
Post	7,538	0.217	0.412	0	1
Log(Disintermediation_Score)	7,538	0.234	0.459	0	3.466
Log(Total_Charge)	7,538	4.504	1.648	0.207	11.035
Log(Hours)	2,117	2.537	0.753	-0.329	5.930
Communication_Med	7,538	0.247	0.431	0	1
Communication_High	7,538	0.346	0.476	0	1
Client_Personal	7,538	0.534	0.499	0	1

Notes. The unit of analysis is each job assignment. Number of observations in this main analysis sample is 7,538, except for *Log(Hours)*, which is the logarithm of the number of hours the freelancer worked on the assignment, and has values only for 2,117 hourly jobs. *Log(Disintermediation_Score)* is the logarithm of the disintermediation score computed from all messages associated with the assignment plus 1. *Log(Total_Charge)* is the logarithm of the total amount of money charged at the end of the assignment plus 1.

TABLE 3

Comparing Treated and Matched Group Job Assignment Outcomes, Before vs. After the Block

Variables	Treatment		Control		Paired t-test
	Mean	Standard error	Mean	Standard error	t-stats
Assignments Before Block:					
Log(Total_Charge)	4.526	0.030	4.504	0.032	-0.503
Log(Hours)	2.550	0.023	2.513	0.029	-0.997
Log(Disintermediation_Score)	0.228	0.009	0.209	0.008	-1.626
Assignments After Block:					
Log(Total_Charge)	4.633	0.054	4.283	0.058	-4.445***
Log(Hours)	2.651	0.046	2.350	0.048	-3.981***
Log(Disintermediation_Score)	0.211	0.015	0.378	0.019	6.837***

Notes. The unit of analysis is each job assignment for the treatment/control group freelancers in the main sample. As in the main analysis, "before the shock" is from Jan to Sep 2017, and "after the shock" is from Feb to Jun 2018. Before the shock, none of the paired t-test results are significant; after the shock, all the paired t-test results are significant. ** significant at 5%; *** significant at 1%.

TABLE 4

Difference-in-Differences Regressions on the Effect of Skype Block on Disintermediation

Model	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Log(Disintermediation_Score)	Log(Disintermediation_Score)	Log(Total_Charge)	Log(Total_Charge)	Log(Hours)	Log(Hours)
Treated	0.019	0.019	0.022	0.019	0.037	0.031
	[0.012]	[0.011]	[0.043]	[0.053]	[0.037]	[0.071]
Post	0.170***	0.158***	-0.222***	-0.215*	-0.164***	-0.158
	[0.021]	[0.017]	[0.066]	[0.115]	[0.056]	[0.112]
Treated x Post	-0.186***	-0.187***	0.329***	0.336***	0.265***	0.265**
	[0.027]	[0.020]	[0.090]	[0.080]	[0.076]	[0.114]
Observations	7,538	7,538	7,538	7,538	2,117	2,117
R-squared	0.012	0.012	0.003	0.003	0.008	0.008
Month FE	No	Yes	No	Yes	No	Yes

Notes. Observations are all the job assignments in the main sample. Column (5) and (6) contains only hourly jobs. *Treated* equals 1 if the freelancer is in mainland China. *Post* equals 1 for assignments completed after the block. *Log(Disintermediation_Score)* is the logarithm of the disintermediation score computed from all messages associated with the assignment plus 1. *Log(Total_Charge)* is the logarithm of the total amount of money charged at the end of the assignment plus 1. *Log(Hours)* is the logarithm of the number of hours the freelancer worked on the assignment. Robust standard errors in brackets. *significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 5. Heterogeneity in Disintermediation Tendencies

Model	(1)	(2)
Dependent Variable	Log(Disintermediation_Score)	
Treated	0.0003	0.015
	[0.017]	[0.017]
Post	0.054*	0.132***
	[0.029]	[0.029]
Treated x Post	-0.054	-0.120***
	[0.040]	[0.040]
Communication_Med	0.006	
	[0.020]	
Communication_High	0.007	
	[0.018]	
Treated x Communication_Med	0.044	
	[0.031]	
Treated x Communication_High	0.022	
	[0.026]	
Post x Communication_Med	0.161***	
	[0.048]	
Post x Communication_High	0.233***	
	[0.051]	
Treated x Post x Communication_Med	-0.175***	
	[0.064]	
Treated x Post x Communication_High	-0.278***	
	[0.066]	
Client_Personal		-0.006
		[0.016]
Treated x Client_Personal		0.007
		[0.023]
Post x Client_Personal		0.076*
		[0.042]
Treated x Post x Client_Personal		-0.124**
		[0.055]
Observations	7,538	7,538
R-squared	0.018	0.013

Notes. Observations are all the job assignments in the main analysis sample. *Communication_High* and *Communication_Med* denotes job categories for which the number of milestones is in the top 25%, or the 25% to 75%, of the milestone distribution, respectively. *Client_Personal* equals 1 if the client account type is personal instead of business. Robust standard errors in brackets. *significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 6

Comparing the Treated and Matched Freelancers for Those Who Remained After the Block

Panel A – Comparing the Freelancers' Characteristics

Outcome variable	Treated		Matched		Paired t-test
	Mean	Standard error	Mean	Standard error	t-stats
Profile Available Hours	39.53	0.17	39.24	0.33	-0.84
Profile Complete Percentage	94.38	1.01	91.64	1.45	-1.59
Freelancer Success Score	0.90	0.01	0.89	0.01	-0.41
Number of Tests Passed	3.14	0.18	3.10	0.28	-0.14
English Level	4.73	0.07	4.75	0.06	0.17

Panel B – Comparing the Freelancers' Past Working Habits

Outcome variable	Treated		Matched		Paired t-test
	Mean	Standard error	Mean	Standard error	t-stats
Past Avg. Job Hours	15.85	1.25	14.19	0.89	-0.96
Past Avg. Job Total Charge	384.43	71.03	376.69	65.47	-0.08
Past Avg. Disintermediation Score	0.57	0.09	0.45	0.08	-0.92
Past Percentage of Hourly Jobs	0.31	0.02	0.21	0.02	-2.88***

Notes. The unit of analysis is each freelancer in the treated and control group who completed at least one job after Oct 2017. Past job outcome variables are calculated using assignments before the Skype block in Oct 2017, and freelancer characteristics are obtained in Oct 2017 as well. The number of freelancers is 224 in the treated group and 171 in the matched group, except for: *Past Avg. Job Hours*, which is only available for freelancers who have completed hourly jobs and has 128 observations in the treated group and 81 observations in the matched group; *Freelancer Success Score*, which is only available for freelancers with 3 or more jobs and has 300 observations in the treated group and 240 observations in the matched group. None of the above paired t-test results is significant except for *Past Percentage of Hourly Jobs*.

TABLE 7

Difference-in-Differences Regressions on the Effect of Skype Block on Disintermediation, Conditional on Staying

Model	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Log(Disintermediation _Score)	Log(Disintermediation _Score)	Log(Total_Charge)	Log(Total_Charge)	Log(Hours)	Log(Hours)
Treated	0.040**	0.043*	0.030	0.027	0.002	-0.003
	[0.017]	[0.021]	[0.058]	[0.061]	[0.056]	[0.074]
Post	0.176***	0.156***	-0.045	-0.050	-0.155**	-0.199*
	[0.022]	[0.021]	[0.072]	[0.111]	[0.066]	[0.099]
Treated x Post	-0.207***	-0.212***	0.321***	0.326***	0.299***	0.310**
	[0.030]	[0.031]	[0.098]	[0.075]	[0.087]	[0.112]
Observations	4,414	4,414	4,414	4,414	1,079	1,079
R-squared	0.018	0.019	0.006	0.006	0.017	0.017
Month FE	No	Yes	No	Yes	No	Yes

Notes. Observations are the job assignments for freelancers who continued working on platform after the shock. Column (5) and (6) contains only hourly jobs. All variables are defined the same as in Table 4. Robust standard errors in brackets. *significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 8

Comparing the Clients Who Hired Treated and Control Freelancers, Before and After the Block

| Variables | Treated | | Control | | Paired t-test |
	Mean	Standard error	Mean	Standard error	t-stats
Clients Before the Block					
Client Days On Platform	1131.74	22.77	1134.60	19.77	0.10
Client Rating High	0.24	0.01	0.23	0.01	-0.54
Client Large Size	0.19	0.01	0.20	0.01	0.30
Clients After the Block					
Client Days On Platform	933.39	40.47	945.01	43.40	0.20
Client Rating High	0.28	0.02	0.30	0.02	0.51
Client Large Size	0.16	0.02	0.17	0.02	0.52

Notes. The unit of analysis is each client who hired treated or control group freelancers in the main sample. The number of observations is 1,538 for the treatment group and 1,907 for the control group before the block, and 500 for the treatment group and 458 for the control group after the block. *Client Days On Platform* is the client's days since first using the platform *Client Rating High* is whether the client's rating is above 90% in the distribution, and *Client Large Size* denotes whether the client self-reports the company's relationships greater than 90% of all clients. None of the above paired t-test results is significant.

TABLE 9

Robustness Check of Treatment Effect on Disintermediation Tendencies, by Job Types

	(1)	(2)	(3)	(4)
Sample	Fixed-Price Jobs		Hourly Jobs	
Dependent Variable	Log(Disintermediation_Score)	Log(Total_Charge)	Log(Disintermediation_Score)	Log(Total_Charge)
Treated	0.010	0.161**	0.040	-0.400***
	[0.009]	[0.069]	[0.027]	[0.080]
Post	0.160***	-0.045	0.153**	-0.231
	[0.025]	[0.117]	[0.048]	[0.141]
Treated_x_Post	-0.181***	0.209*	-0.207***	0.144*
	[0.026]	[0.104]	[0.043]	[0.067]
Observations	5,421	5,421	2,117	2,117
R-squared	0.014	0.006	0.008	0.014
Month FE	Yes	Yes	Yes	Yes

Notes. The sample is the same as the main analysis sample, split by the job type. All variables are defined the same as in Table 4. Robust standard errors in brackets. *significant at 10%; ** significant at 5%; *** significant at 1%.