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On Factors that Moderate the Effect of Buyer-Supplier Experience on E-Procurement Platforms

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E-procurement platforms facilitate transactions between suppliers and buyers from all over the world. Over time, suppliers and buyers may develop familiarity from prior experience with earlier transactions. The literature has established that prior experience leads to better project performance. In this study, we examine the effectiveness of prior experience between buyers and suppliers in e-procurement platforms with a focus on the moderating roles of temporal distance and language difference between the buyer and the supplier as well as routine tasks in the project (termed "task routinization"). Using a unique observational data set from a large e-procurement platform, we first find that buyers' prior experience with a supplier positively affects project outcomes, and temporal distance and language difference both negatively affect project outcomes. More interestingly, we find that the effectiveness of prior experience is constrained by both temporal distance and language difference, such that if a greater temporal distance separates the buyer and supplier or if the two speak different languages, prior experience is less likely to be helpful. In addition, while task routinization does not directly affect a project's success, it has a positive interaction effect with prior experience, suggesting that buyers' prior experience with a supplier is more effective in enhancing project outcomes when a project comprises routine tasks. Our findings on prior experience, temporal distance, language difference, and task routinization contribute to a better understanding of the e-procurement platform for global outsourcing and procurement. Limitations are discussed and topics are identified for future research.

Key words: e-procurement; outsourcing; prior experience; temporal distance; task routinization
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1. Introduction

Technological advances and economic incentives have been driving the rapid development in global outsourcing and procurement of services (Carmel and Tjia 2005, Hahn et al. 2009, Huang et al. 2019, Niu et al. 2019). As traditional enterprise outsourcing matures, e-procurement platforms have emerged in recent years as an important platform-mediated marketplace for global service outsourcing by providing effective channels to match buyers and sellers for setting prices and carrying out projects (Chen and Horton 2016, Hong and Pavlou 2017, Stoll and Zöttl 2017). In today's economic environment wherein, businesses are moving online and remote due to the Covid-19 pandemic, e-procurement has become even more important. An e-procurement platform is defined as a market where service is exchanged for money, the service is delivered online through a telecommunication network, and the allocation of service and money is decided by a set of buyers and suppliers operating within a price system mediated by the platform (Horton 2010). E-procurement platforms bring together potential buyers and suppliers to form a two-sided network platform that helps match these two distinct user groups (Eisenmann et al. 2006, Parker and Van Alstyne 2017, Parker et al. 2016).

In recent years, the practice of sourcing services from global suppliers has become increasingly common, as evidenced by the growth of such popular e-procurement platforms as *Upwork*, *Freelancer*, and *Guru*. E-procurement platforms have become the go-to places for service procurement as of late (Rothkopf and Whinston 2007, Stoll and Zöttl 2017) and have significantly expanded the scope of traditional procurement auctions (Aloysius et al. 2016, Brosig-Koch and Heinrich 2014, Haruvy and Katok 2013). Notably, on *Freelancer* and *Upwork*, millions of suppliers are completing projects worth billions of dollars for buyers located all over the world. This upward trajectory of e-procurement platform adoption and usage has seen tremendous growth as the Covid-19 pandemic pushes business to the remote working arrangements.[1]

Despite the growing number of projects contracted through e-procurement platforms, their success is not guaranteed. In service outsourcing projects, buyers

encounter a number of unique challenges, ranging from difficulty in managing projects to struggles coordinating with suppliers (Espinosa et al. 2007). In fact, many projects have failed, and several reasons have been offered to explain these failures.[2] Specifically for e-procurement platforms, the project failure rate is quite high, as over one-third of the contracted projects end up being not completed. Project failures pose a challenge for e-procurement platforms, as geographical separation and unfamiliarity between the buyer and supplier add more layers of difficulty and ambiguity. On an e-procurement platform, buyers and suppliers desire completed projects with high satisfaction because they have spent significant time and effort on both the pre-contract search and post-contract implementation. Failure to complete a project in a satisfactory manner leads to both tangible and intangible losses for all parties involved. Thus, understanding the determinants of project success is important to buyers and suppliers alike (Cummings et al. 2009).

For global service delivery via e-procurement platforms, coordination and communication pose a particular challenge (Hong and Pavlou 2017). Coordination and communication issues arise mainly from the unfamiliarity and distance between buyer and supplier. In globally outsourced service projects, the buyer may not have the opportunity to meet, vet, become acquainted with the supplier (Lacity and Rottman 2008), or to build trust (Fugger et al. 2019). This is the case particularly on the e-procurement platforms where most of the service projects are small to medium size ones and buyers have little financial resources available to facilitate in-person, face-to-face meetings. The lack of a buyer's familiarity with suppliers relates to information asymmetry (Lin et al. 2016) and communication barrier (Hong and Pavlou 2017). The buyer has limited information and limited knowledge about the skill and expertise of bidding suppliers. While many e-procurement platforms provide a rating system, the ratings tend to be skewed toward the positive with little variation and differentiation power. Further, the buyer may struggle to communicate with the supplier due to a lack of a synchronized schedule and the same mother tongue. It takes time and effort from both parties to learn and accommodate each other's work patterns and availability.

Given that most of the projects on e-procurement platforms are knowledge services with incomplete contracts (Hong and Pavlou 2017), the buyer and supplier relationship is crucial for the success of the projects (Fugger et al. 2019). To address the two hurdles of information asymmetry and communication barriers, buyers have an incentive to choose familiar suppliers with whom they have previous experience with from prior projects. For example, Herbsleb and Grinter (1999) find that teaming up with members who have worked together in the past helps global software development. Familiarity from prior experience helps reduce the need for constant communication for project check-ups and ad hoc inquiries for issue resolution (Espinosa et al. 2007, Herbsleb and Mockus 2003). Gefen and Carmel (2008) find that in the online programming marketplace, buyers prefer a provider with whom they have had a previous relationship. Therefore, it is likely that prior experience plays a key role in the service procurement performance, but it is unclear what contingency factors may affect the effectiveness of prior experience on the e-procurement platform. Bearing this in mind, the specific research questions we seek to answer are as follows:

- Can prior experience between the buyer and the supplier lead to better performance for current projects?
- How do temporal distance, language difference, and task routinization moderate the effectiveness of prior experience?

On the one hand, prior experience may translate into familiarity between the buyer and supplier and thus help with a current project's performance. On the other hand, prior experience may be more or less effective, depending on the situation of team-level and project-level heterogeneities. If prior experience does have a direct effect on project outcomes, it may be constrained by the temporal distance (defined as the time zone difference between the buyer's and the supplier's residing cities) and language difference, both of which can impose hurdles for the two parties to establish routines and familiarity. Furthermore, some projects that consist of highly routine tasks require less communication and coordination between the buyer and the supplier (AlMarzouq et al. 2015). Routinized tasks in a project are expected to provide a greater benefit when combined with prior experience, as the buyer and supplier are familiar with each other's requirements and capabilities and have more confidence in each other to carry out these routine tasks with little communication. Therefore, we expect a project's task routinization to reinforce the effectiveness of prior experience.

To answer the two research questions posed above, we analyze archival data obtained from a major e-procurement platform that allows buyers to contract out projects to suppliers from around the world. Based on a set of econometric analyses, we first find a positive effect of prior experience and negative effects of both temporal distance and language difference on project outcomes, which echo previous research on distributed project teams. More interestingly, we find empirical evidence for the salient moderating effects:

temporal distance and language difference constrain the effectiveness of prior experience while task routinization enhances it. Further, we perform instrumental variable analyses to show that the validity of our results from the main analyses is not jeopardized by endogeneity concerns.

Our study provides two key contributions to the related literature in operations management and information systems on project contracting and outsourcing through e-procurement platforms (Hong and Pavlou 2017, Stoll and Zöttl 2017). First, while previous research has primarily focused on the direct effects of prior experience, temporal distance, language difference, and task routinization on subjective performance metrics, we hypothesize and empirically test the *moderating* roles of temporal distance, language difference, and task routinization for prior experience in influencing *both* objective and subjective project outcomes. In doing so, we relax a common assumption made in the literature that familiarity is solely reflected in prior experience (Assudani 2011, Espinosa et al. 2007). Our results indicate that temporal distance and language difference influence the formation of familiarity between buyers and suppliers, and projects made up of routine tasks benefit more from prior experience. Second, the extant literature on procurement is predominantly analytical (Allon et al. 2012, Huang et al. 2019, Niu et al. 2019), with only a few empirical papers that focus on the main effects of the factors on one dimension of project outcomes (Espinosa et al. 2007). We empirically examine a large-scale data set covering both aspects of objective and subjective project outcomes (i.e., project completion and buyer satisfaction) to provide a comprehensive perspective on the effects of prior experience, temporal distance, language difference, and task routinization.

2. Research Framework and Hypotheses

2.1. Prior Experience on E-procurement Platforms

An e-procurement platform is based on a sales contract where the supplier agrees to complete a specific task for a specified price (Horton 2010). An e-procurement platform not only fulfills the traditional function of a labor market in information sharing but also provides infrastructure and features like payment, record keeping, communication, and search functionality. To build and enhance trust about suppliers for buyers, an e-procurement platform typically manages supplier evaluations via a reputation system and shares supplier data from prior employment. Similarly, to help develop and boost trust about buyers for suppliers, an e-procurement platform verifies buyer credibility and keeps track of their prior transactions, behavior, and reputation in the system. Making reputation information publicly available on the e-procurement platform improves market efficiency by preventing adverse selection and moral hazards due to information asymmetry. Accordingly, the role of reputation in mitigating these agency-related problems has been the central theme of research on e-procurement platform (e.g., Hong and Pavlou 2017, Kokkodis and Ipeirotis 2015, Lin et al. 2016, Pallais 2014, Stoll and Zöttl 2017, Yoganarasimhan 2013).

E-procurement platforms facilitate global sourcing of services through an arrangement where a client (buyer) contracts out service tasks to a supplier (seller) located in a different country (Kotlarsky et al. 2014). The global sourcing of service tasks has been viewed as an appealing practice by buyers that aim to control costs (Shao and David 2007), and e-procurement platforms have emerged as a viable approach to sourcing these service tasks on a global scale (Allon et al. 2012). Both practitioners and researchers have noted the high transaction volume and significant economic benefits of e-procurement platforms like *Upwork* and *Freelancer* (Hong et al. 2016).

In the context of operations management, e-procurement platforms have been examined from a number of perspectives. While OM researchers have looked at various aspects of e-procurement platforms, such as surge pricing (Cachon et al. 2017), auction design (Xu and Huang 2017), buyer surplus (Stoll and Zöttl 2017), and individual biases (Lee et al. 2018), the papers that are most related to our study include those that focus on prior experience, which has also been found to have a positive effect on performance. For example, Easton and Rosenzweig (2012, 2015) study the role of individuals' experience working together on six sigma project teams and find team familiarity creates social capital that increases the likelihood of project success while a well-developed and structured problem-solving process may reduce the importance of team familiarity. Lumineau and Henderson (2012) examine legal disputes between buyers and sellers, and they find that contractual coordination governance reinforces the positive effect of cooperative relational experience on cooperative negotiation strategy. When the buyer and the supplier on an e-procurement platform have experience interacting with each other from previous projects, they can establish accurate expectations, communicate effectively, become aware of each other's work schedule, and collaborate better. The two parties can develop dyadic familiarity, which improves the chance of completing subsequent projects by decreasing both the ex-ante risk of adverse selection and the ex-post need for information exchange and coordination. Aided by prior experience, the buyer and the

supplier on an e-procurement platform can better understand each other's actions, routinize communication and coordination tasks, and convey and interpret information effectively to avoid ambiguity. Consequently, for our first research question, we expect prior experience to have a positive effect on project outcomes. More importantly, our second research question is focused on the moderating effects of key factors (i.e., temporal distance, language difference, and task routinization) on the relationship between prior experience and the project outcomes. In the following subsections, we conceptualize the moderating effect of each of these factors for procurement performance.

2.2. Temporal Distance

Geographical distance is found to have a negative effect on performance in operations management literature. For example, Gray et al. (2011) compare offshore plants vs. onshore plants and find geographical distance between headquarters and plants is associated with higher quality risk. Bardhan et al. (2013) find a similar negative effect of team dispersion on project performance and discover that IT can mitigate this effect. Service delivery on e-procurement platforms is a knowledge-intensive undertaking and often a complex project that requires planning and coordination (Shao et al. 2014). For global service projects, the geographical distance between buyers and suppliers creates a hindrance for coordination that affects project performance through time zone differences (Carmel and Agarwal 2001, Cummings et al. 2009, Gopal et al. 2011, O'Leary and Cummings 2007).

Geographical and temporal distance may affect the outcome of projects by curtailing face-to-face contact that helps solve problems (Olson and Olson 2000). Geographical and temporal distance also limits the shared context for cooperating persons who have difficulty understanding job responsibility and other work arrangements (Cramton 2001). Both spatial and temporal boundaries are found to increase coordination delays and affect project outcomes for distributed project teams (Cummings et al. 2009). These distances may also alter an individual's mental construal process (Trope and Liberman 2010), making people think abstractly rather than concretely in formulating problem identification and understanding information requirements. Abstract thinking may lead to solution misspecification.

On e-procurement platforms, temporal distance leads to both a decrease in overlapped work hours and an increase in the mental gap between buyers and suppliers. When they work in different time zones due to geographical distance, the amount of overlapped work time is limited. To overcome the time zone difference, the supplier and the buyer need to adjust their work schedules during the day, which imposes higher coordination overhead on both parties. As a result, a delay is likely to occur, since it takes longer for communication across time zones to receive a response or resolve an issue. The buyer and the supplier are thus not in sync (O'Leary and Cummings 2007, Saunders et al. 2004).

Part of our second research question is related to how temporal distance, as a moderating factor, affects the relationship between prior experience and project outcomes on an e-procurement platform. A central argument we make is that familiarity does not automatically build up with prior experience. Familiarity based on prior experience may be subject to the constraint of distance. Because the buyer and the supplier in outsourced offshore service projects are not physically proximate to each other, communication frequency and effectiveness can decrease due to the nonoverlapping work schedule and the mental gap caused by the physical distance (Espinosa and Carmel 2003, Hinds et al. 2000, Hinds and Mortensen 2005). This decrease in communication frequency and effectiveness makes it less likely that buyer and supplier will develop familiarity through their prior experience. In other words, for two offshore service projects with the same level of prior experience, the seller located farther away from the buyer faces greater coordination overhead (Carmel 1999) and hence is less likely to complete the project on schedule and with satisfaction than the other seller who is located closer to the buyer.

The operations management literature also shows that distance can hinder the development of familiarity. Looking at software project teams, Staats (2012) find that team familiarity gained by working together in the same location has a greater positive effect on team performance than team familiarity gained while members collaborate in different locations. It is noted that familiarity is facilitated via interactions enabled by synchronous communication that offers verbal/preverbal cues, supports turn-taking, provides instant feedback, and conveys the subtle meanings of the conversation (Massey et al. 2003, McGrath 1991). Further, external knowledge sharing through direct feedback is particularly effective in enhancing work performance when the group is structurally diverse (Cummings 2004), as in the context of e-procurement platform. Greater temporal distance means less overlapping work hours between the supplier and the buyer, which leads to both less usage of synchronous communication methods— such as teleconferencing with direct feedback—and more dependence on asynchronous communication methods—such as email. Therefore, temporal distance between the buyer and the supplier is hypothesized to have a negative

moderating effect in attenuating the effectiveness of prior experience.

H1. The effect of prior experience on the outcomes of offshore service projects (i.e., project completion and buyer satisfaction) on an e-procurement platform is attenuated by temporal distance.

2.3. Language Difference

Distance can be tangible like geographical and temporal distance or intangible like language and cultural differences. While both types of distance may be correlated, they are not exactly the same constructs. It is possible that the buyer and the provider on an e-procurement platform are physically distant but speak the same language (e.g., U.K. and New Zealand). Such intangible distance can exert a different effect on the relationship between prior experience and project outcomes. In the operations management literature, Gray and Massimino (2014) find language difference between headquarters and plants is negatively associated with process compliance, while cultural incongruence between headquarters and plants relates to inferior compliance performance. Looking at the buyer-supplier relationship, Cannon et al. (2010) find that the effects of trust and performance on long-term orientation are moderated by culture while Ribbink and Grimm (2014) note that cultural difference reduces joint profits and negatively moderates the impact of trust and bargaining strategy on joint profits. Bockstedt et al. (2015) study an online innovation contest platform and find that contestants who share greater cultural similarities with the contest holder are more likely to succeed in a contest.

Another part of our second research question focuses on how language differences influence the impact of prior experience on project outcomes on an e-procurement platform. It is noted that language, ethnicity, and belief are the three key components that make up cultural difference (Moieni et al. 2017). However, on the e-procurement platform that we study, ethnicity and belief cannot be reliably measured, therefore, we decide to solely focus on language difference. When the buyer and the seller speak different languages, it creates hurdles for the effective communication necessary for successful project outcomes. In addition, the familiarity engendered by their experience of working together on prior projects would be more difficult to establish. When different languages are spoken, it is more challenging for a buyer to assess in advance the qualification, expertise, and skills of potential suppliers, as well as to monitor the progress and resolve issues with the chosen seller during the project development phase. As a result, language difference between the buyer and the supplier would affect the effectiveness of prior experience in achieving desirable project outcomes on an e-procurement platform. Based on these arguments, we expect language difference to have a negative moderating effect on the relationship between prior experience and project outcomes.

H2. The effect of prior experience on the outcomes of offshore service projects (i.e., project completion and buyer satisfaction) on an e-procurement platform is attenuated by language difference.

2.4. Task Routinization

The nature of tasks in a service project is another factor that can influence the outcome of projects outsourced on an e-procurement platform. Task routineness refers to the simplicity and predictability of task development (March and Simon 1993). Routine tasks are simple in nature and require less domain knowledge and effort to complete (Grant 1996, Turner and Makhija 2006). Non-routine tasks, on the other hand, involve greater unpredictability and require more knowledge and effort from the suppliers to complete. As a result, outsourced projects that consist mainly of routine tasks have a higher likelihood of completion than those that involve non-routine tasks. On an e-procurement platform, service projects made up of routine tasks require less domain knowledge, time, and effort for the supplier to accomplish. Therefore, we expect that service projects that comprise routine tasks have better project outcomes. The last part of our second research question prompts us to investigate task routinization's moderating effect with prior experience on the outcome of service projects contracted on an e-procurement platform.

Operations management researchers have studied task routinization (using similar measures such as task complexity) in a variety of contexts. Fransoo and Wiers (2006) analyze a material requirements planning (MRP) database and find that routine tasks require little attention but problem-solving tasks require planners to conceptualize and design complex solutions. Rosenzweig (2009) studies manufacturers in a B2B marketplace and finds that product complexity has a negative direct effect on operational and business performance. Regarding business process outsourcing (BPO) integration, Narayanan et al. (2011) find that task complexity has a significant effect on internal process integration for a BPO service provider. For software development project teams, Staats (2012) find frequent task change has a negative effect on team performance. Bellos and Cavadias (2019) find that routine services produce outcomes that conform more to standardized specifications than non-routine services.

For the service projects outsourced on an e-procurement platform, routine tasks are predictable in nature, so they tend to require less communication and

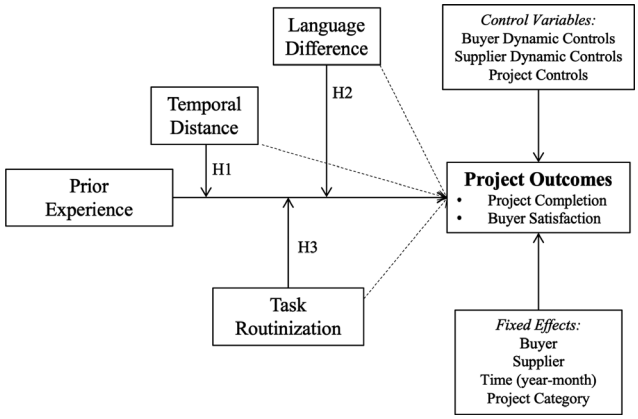
coordination between the buyer and the supplier. For routine tasks, buyers and suppliers who have prior experience can rely on usual code check-in and regular progress updates that take less time and effort. For difficult, highly complex, non-routine tasks that require more time and effort to complete, even a buyer-supplier pair with prior experience will still need to communicate and coordinate with each other to make sure all the technical specifications are well understood. Thus, for a buyer-supplier pair that has prior experience working together, routine tasks are more suitable to outsource, and the benefits of less communication and coordination overhead are more pronounced. On the other hand, for a buyer and supplier with no prior experience, routine tasks would likely require the same amount of communication and coordination as non-routine task. The reason is that the buyer and the supplier must still make sure all the information requirements of the routine tasks are clearly identified, understood, and agreed to, even though they are less complex than non-routine tasks.

In addition, previous research has established that in a centralized control environment, tasks that are routine and have low supplier uncertainty tend to perform better (AlMatzouq et al. 2015). Lawrence and Lorsch (1967) argue that a centralized control structure is better suited for processing routine tasks, as it involves less coordination cost. In this light, an e-procurement platform provides a well-structured centralized infrastructure to connect potential buyers and qualified suppliers (Horton 2010). It is conceivable that projects outsourced on the platform that consist of routine tasks and have prior buyer-supplier experience have a higher chance of satisfactory completion. The above logic forms the basis of our third hypothesis:

H3. The effect of prior experience on the outcomes of offshore service projects (i.e., project completion and buyer satisfaction) on e-procurement platforms is reinforced by task routinization.

In sum, Figure 1 presents our research framework of prior experience on e-procurement platforms with the three hypotheses on the moderating effects of temporal distance, language difference, and task routinization.

Figure 1 Research Framework



3. Empirical Methodology

3.1. Data and Variables

The data used for the analyses in this study are obtained from the database of our corporate partner. Our corporate partner is a leading e-procurement platform for services in the world, which uses a buyer-determined, reverse auction mechanism (Hong et al. 2016). As the digital economy grows, e-procurement platforms enable a prominent business model that mediates the traditional offline procurement processes in the online setting. The buyers request services by posting projects in the form of calls for bids on the platform's website portal and interested suppliers submit bids to obtain service contracts. Our data were collected in March 2010. We obtained a random sample from the database for the period between August 2009 and February 2010.

In the data set, we were able to observe the key independent variable (i.e., whether the buyer and supplier have any prior experience working together on a service project) and two important project outcomes, including the objective outcome of whether a project was completed and a subjective outcome of how satisfied the buyer was with the supplier on this project. Further, we observed the supplier's and buyer's locations, the project's characteristics, supplier experience, and other variables related to the suppliers and the buyers. Notably, these variables were directly obtained from the database and thus were the least prone to measurement error. The top 10 countries with the most suppliers are India, the United States, Pakistan, Bangladesh, the Philippines, Romania, Great Britain, China, Ukraine, and Vietnam. The top 10 countries with the most buyers are the United States, Great Britain, India, Canada, Bangladesh, Australia, Pakistan, Germany, the Netherlands, and Singapore. The projects on the platform span categories such as Websites, IT & Software, Writing & Content, Design, Media & Architecture, Data Entry & Admin, Engineering & Science, Sales & Marketing, Business, Accounting, Human Resources & Legal, Product Sourcing & Manufacturing, and Mobile Phones & Computing.

We describe how our variables are measured in Table 1. Descriptive statistics of these variables are presented in Table 2.

3.2. Estimation Model

The goal of our analysis is to estimate the extent to which prior experience affects project outcomes and how the three key independent variables (i.e., Time Zone Difference, Language Difference, and Task Routinization) moderate the effectiveness of prior experience.

The variation of the dependent variables in the data comes from both the buyer level and the supplier level. Specifically, in the data set, we observe multiple contracts for the same buyer with different suppliers and find variation in whether these projects were successfully completed or not. Therefore, a buyer-level fixed effect could essentially control for any buyer-level unobserved heterogeneity that is time invariant. Further, we also observe numerous cases of a supplier working with more than one buyer; therefore, we can control for the supplier-level fixed effects. Additionally, we incorporate time dummies and project category dummies to capture the time and category effects on project completion. We consider a number of essential control variables, including supplier-level

Table 1 Variable Definitions and Descriptions

Variable	Description
Project Outcome	Project Outcome is measured by four variables that capture various aspects of project completion. First, we use a binary indicator that reflects whether a project has been completed after the buyer and the supplier contracted to start the project (Completed). Second, we use a continuous interval measure (1-10) that shows the buyer's satisfaction with the supplier (Satisfaction). This measure captures the buyers' subjective evaluations of the project beyond completion.
Prior Experience	Prior Experience is a dummy variable indicating whether the buyer and the supplier have had transactions on this platform prior to the focal transaction.
Time Zone Difference	Time Zone Difference (0-12) is calculated by the absolute time zone difference between the buyer's and the supplier's residing cities.
Latitude Distance	Latitude distance measures the absolute difference in the latitudes of the cities where the buyer and the supplier reside in. This variable is logarithm transformed.
Longitude Distance	Longitude distance measures the absolute difference in the longitudes of the cities where the buyer and the supplier reside in. This variable is logarithm transformed.
Language Difference	Language difference is a binary variable indicating if there is a shared official language between the buyer's and the supplier's residing countries.
Task Routinization	Task Routinization is a continuous variable based on the study of Autor and Dorn (2013), which reflects how easily a project can be routinized. In a nutshell, highly routinized projects are those that involve repetitive tasks or consistent tasks that can be performed at fixed or regular time intervals. Autor and Dorn provided the data for the "routine tasks" measure for various jobs with different occupation codes.[3] Specifically, we hired two research assistants to complete a task to map the sub-categories of the projects (e.g., mobile development, content SEO, etc.) onto the routinization measures provided by their study of a comprehensive set of job occupations. We provide a training session to go over 15 sub-categories together, and the research assistants independently coded the rest of the sub-categories. This resulted in numerical values for the "task routinization" measure at the project sub-category level with high consistency (91%). The measures are averaged and then mean centered. For example, in our data set, the "Data Entry & Admin" category has a high average routinization score (1.823), whereas "Writing & Content" has a low average routinization score (−1.755).
Buyer Experience	Buyer Experience measures the total number of projects completed by the buyer, prior to the focal transaction.
Supplier Experience	Supplier Experience measures the total number of projects completed by the supplier, prior to the focal transaction.
Supplier Rating	Supplier Rating is the average rating of a supplier on the platform on a 10-point Likert scale.
Project Budget	Project Budget is the buyer-specified budget of the project in US dollars.
Auction Duration	Auction Duration is the number of days the auction for the project was active.
Number of Bids	Number of Bids is the number of bids received by the auction for the project.
Days to Finish	Days to Finish is the number of days the supplier proposed to finish the project by.
Project Description	Project Description is the number of words in the project description posted by the buyer.
Supplier-Project Match	Supplier-Project Match measures the fit of a supplier with a project using a text mining approach. Specifically, we calculated the cosine similarity between pairs of documents for each seller-project pair (seller profile description and the project description) after computing the term frequency-inverse document frequency (TF-IDF) score.
Projects in Thirty Days	Number of projects a buyer has posted in the past 30 days. Note that we also used seven and fourteen days to check for sensitivity of results, and we found that the main effects and interaction effects are consistent across these alternative measures.
Probability of Prior Experience (Instrumental Variable)	The multiplication of the extent to which a supplier is likely to bid for the same buyers and the extent to which a buyer is likely to hire the same suppliers.
Time Dummies	Time Dummies are operationalized as binary variables that indicate year-month.
Project Category Dummies	Project Category Dummies are operationalized as binary variables that indicate each project category.

Table 2 Descriptive Statistics

	Mean	Std. Dev.	Min	Max	median
Dependent Variables					
Completed	0.578	0.494	0.000	1.000	1.000
Satisfaction	5.556	4.459	1.000	10.000	8.000
Independent Variables					
Prior Experience	0.206	0.404	0.000	1.000	0.000
Time Zone Difference	4.125	3.383	0.000	12.000	4.000
log(Latitude Distance)	2.520	1.241	0.000	4.595	2.821
log(Longitude Distance)	3.439	1.542	0.000	5.527	4.097
Language Difference	0.647	0.478	0.000	1.000	1.000
Task Routinization	0.000	1.311	−3.085	2.652	0.394
Control Variables					
log(Buyer Experience)	2.307	1.569	0.000	7.142	2.197
log(Supplier Experience)	2.805	1.997	0.000	7.413	2.890
Supplier Rating	4.949	3.350	0.000	10.000	5.833
Project Budget (in US$)	359.125	324.857	100.000	5000.000	250.000
Auction Duration (in days)	9.202	14.126	1.000	60.000	5.000
log(Number of Bids)	2.015	1.256	0.000	5.881	2.197
Days to Finish	6.570	17.958	0.000	999.000	2.000
Project Description	103.555	130.367	0.000	5296.000	69.000
Supplier-Project Match	0.071	0.082	0.000	0.709	0.047
log(Projects in Thirty Days)	1.189	1.080	0.000	4.860	1.099
Propensity to Rebid	1.243	0.439	1.000	13.333	1.157
Propensity to Rehire	1.830	2.507	1.000	37.000	1.200
Probability of Prior Experience	2.607	6.168	1.000	163.333	1.443

and buyer-level time-variant information, such as their experience, and project-level information, such as project budget, auction duration, etc. Our estimation model is specified as follows:

$$\begin{aligned}\text{Project Outcome}_{ijpt} = \boldsymbol{X_{ij}\beta} + \boldsymbol{C}_i + \boldsymbol{D}_{it} + \boldsymbol{V}_j \\ + \boldsymbol{U}_u + \boldsymbol{W}_{jt} + \boldsymbol{P}_p\xi + \boldsymbol{\alpha}_t + \in_{ijpt}\end{aligned} \quad (1)$$

In this model, i is used to index buyers, j is used to index suppliers, p is used to index projects, and t is used to index time. We set $\boldsymbol{X_{ij}}$ as a vector of buyer-supplier specific variables, including our key variables of interest and other control variables. We use $\boldsymbol{C_i}$ as a vector to capture unobserved buyer effects. We denote by $\boldsymbol{V_j}$ the supplier-level fixed effect that would capture factors such as observed or unobserved time-invariant supplier quality. We use $\boldsymbol{U_u}$ to control time-invariant project category effect. Similarly, $\boldsymbol{P_p}$ captures project-related covariates such as project budget, and $\boldsymbol{\alpha_t}$ represents time dummies. Lastly, we also capture time-variant buyer and supplier factors using $\boldsymbol{D_{it}}$ and $\boldsymbol{W_{jt}}$, respectively. Note that the variances of those time-varying variables within buyer or supplier over a short period time could be very small, and thus the effects need to be interpreted with caution. For variables that contain zeroes (e.g., Number of Bids, Buyer Experience, etc.), we added the lowest non-zero value (+1) to every data point before the log transformation (McCune and Grace 2002).

Table 3 Estimation Results for the Main Effects

	(1) Completed	(2) Satisfaction
Prior Experience	0.044***(0.010)	0.442***(0.096)
Time Zone Difference	−0.006***(0.002)	−0.058***(0.021)
Language Difference	−0.035**(0.014)	−0.386***(0.139)
Task Routinization	−0.000(0.007)	0.047(0.066)
log(Buyer Experience)	−0.001(0.007)	−0.040(0.067)
log(Supplier Experience)	0.005(0.011)	0.064(0.099)
Supplier Rating	−0.019***(0.002)	−0.205***(0.024)
Project Budget	−0.000***(0.000)	−0.003***(0.000)
Auction Duration	−0.001***(0.000)	−0.013***(0.004)
log(Number of Bids)	−0.014***(0.004)	−0.165***(0.034)
Days to Finish	−0.001*(0.000)	−0.009**(0.004)
Project Description	0.000(0.000)	−0.000(0.000)
Supplier-Project Match	0.083(0.058)	0.782(0.547)
log(Projects in Thirty Days)	−0.011*(0.006)	−0.108*(0.059)
Constant	0.948***(0.038)	9.572***(0.361)
Buyer fixed effects	Yes	Yes
Supplier fixed effects	Yes	Yes
Year-month fixed effects	Yes	Yes
Project category fixed effects	Yes	Yes
Observations	22,729	19,798
Within R-squared	0.607	0.644
Number of Buyers	4035	3601
Number of Suppliers	3292	2961

Notes: Cluster-robust standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

3.3. Estimation of Main Effects

The estimations were conducted with the REGHDFE procedure in Stata 16 (Correia 2017). An Instrumental Variable version is included with the same package. REGHDFE is a popular package that accommodates efficient computation of multiple high-dimensional fixed effects, and thus is most suitable for this analysis. The standard errors are clustered on both the buyers and the suppliers. We first report our estimation results for the main effects of prior experience, temporal distance, language difference, and task routinization in Table 3. This analysis offers several insights. First, as shown in columns (1) and (2), prior experience has a positive effect on project completion and buyer satisfaction, whereas temporal distance has a

negative effect on the two outcome variables. Further, we also observe that language difference also negatively affects both project completion and buyer satisfaction. We did not observe a significant direct effect for task routinization, likely because we already controlled for the project category fixed effect, which is highly correlated with the task routinization measure. The variations for the task routinization variable are at the project sub-category level, and they are rather small within each project category. Even though we do not observe a direct main effect of task routinization on project outcomes, our research design should allow us to detect any heterogeneity in its effect (e.g., moderating effect). We report on this later.

In essence, we find evidence that prior experience, temporal distance, and language difference affect project outcomes on the e-procurement platform, consistent with the findings reported in prior studies, such as Espinosa et al. (2007) and Cummings et al. (2009). In addition, we observe several interesting results for our control variables. Consistent with prior research (Snir and Hitt 2003), larger projects represented by project budget, number of bids, and days to finish are more likely to have unfavorable outcomes. Lastly, as a sanity check, we find that when the buyer has posted more projects in the past 30 days, the project completion rates and buyer satisfaction are lower.

3.4. Moderation Effects

In this section, we report the estimation results on how time zone difference, language difference, and task routinization respectively moderate the effect of buyer-supplier prior experience on the two dependent variables. Based on the results reported in Table 4, we find that the effects of prior experience on project completion and buyer satisfaction are moderated by time zone difference, language difference, and task routinization. Specifically, the positive effect of prior experience is weaker when there is a time zone difference and a language difference, and the effect is higher when the project comprises more routine tasks. Hypotheses H1-H3 are supported by our empirical findings. We further visualize the predicted margins of the prior experience on dependent variables with regard to each moderator with 95% confidence intervals. Specifically, Figures 1, 2, and 3 illustrate each moderation effect in detail. Note that for Figures 2–4, (a) refers to the outcome of project completion and (b) refers to buyer satisfaction.

Using a spotlight analysis approach, Figure 2 visualizes the predicted probability of (a) project completion and (b) buyer satisfaction when the buyer and the supplier have any prior experience and when the time zone differences are varied. We can draw several insights from Figure 2. First, on average, prior experience has a positive effect on both project completion and buyer satisfaction. Second, the time zone difference has a negative direct effect on the two project outcomes, both when the buyer and the supplier have prior experience and when they do not. Third, the effect of prior experience (the difference between the triangle marker and the circle marker) is much higher when there is less of a time zone difference.

Figure 3 visualizes the predicted probability of (a) project completion and (b) buyer satisfaction when the buyer and the supplier have prior experience, and when the buyer and the supplier are from countries that speak different official languages. We can draw several insights from Figure 3. Besides the consistent finding that prior experience has a positive effect on both project completion and buyer satisfaction, the language difference has a negative direct effect on the two project outcomes. Further, the effect of prior experience (the difference between the triangle marker and the circle marker) is much higher when the language is the same.

Lastly, we inspect the interaction effects and their implications for how task routinization moderates the effect of prior experience on e-procurement project

Table 4 Estimation Results for the Interaction Effects

	(1)	(2)
	Completed	**Satisfaction**
Prior Experience	0.100***(0.018)	0.970***(0.177)
Time Zone Difference	−0.004**(0.002)	−0.045**(0.021)
Language Difference	−0.025*(0.014)	−0.292**(0.143)
Task Routinization	−0.005(0.008)	0.004(0.070)
Prior Experience × Time Zone Diff	−0.009***(0.003)	−0.089***(0.025)
Prior Experience × Language Diff	−0.038**(0.017)	−0.326*(0.167)
Prior Experience × Task Routinization	0.018**(0.008)	0.148**(0.073)
log(Buyer Experience)	−0.001(0.007)	−0.038(0.067)
log(Supplier Experience)	0.004(0.011)	0.060(0.099)
Supplier Rating	−0.019***(0.002)	−0.205***(0.024)
Project Budget	−0.000***(0.000)	−0.003***(0.000)
Auction Duration	−0.001***(0.000)	−0.013***(0.004)
log(Number of Bids)	−0.014***(0.004)	−0.172***(0.034)
Days to Finish	−0.001*(0.000)	−0.009**(0.004)
Project Description	−0.000(0.000)	−0.001(0.000)
Supplier-Project Match	0.078(0.058)	0.750(0.550)
log(Projects in Thirty Days)	−0.012*(0.006)	−0.115*(0.059)
Constant	0.941***(0.038)	9.498***(0.365)
Buyer fixed effects	Yes	Yes
Supplier fixed effects	Yes	Yes
Year-month fixed effects	Yes	Yes
Project category fixed effects	Yes	Yes
Observations	22,729	19,798
Within R-squared	0.608	0.645
Number of Buyers	4035	3601
Number of Suppliers	3292	2961

Notes: Cluster-robust standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Figure 2 Interaction Effects Visualization – Temporal Distance [Color figure can be viewed at wileyonlinelibrary.com]

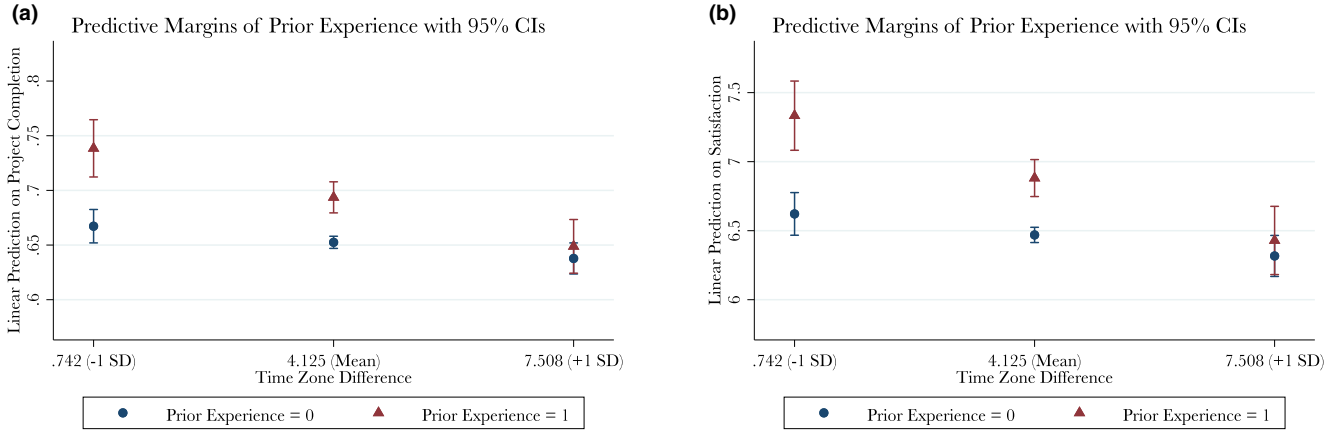


Figure 3 Interaction Effects Visualization – Language Difference [Color figure can be viewed at wileyonlinelibrary.com]

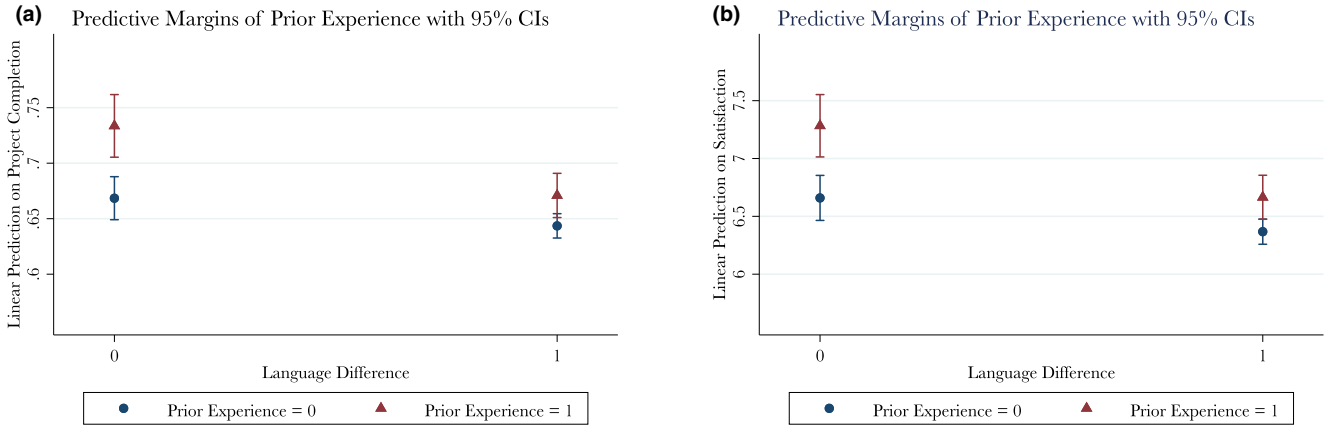
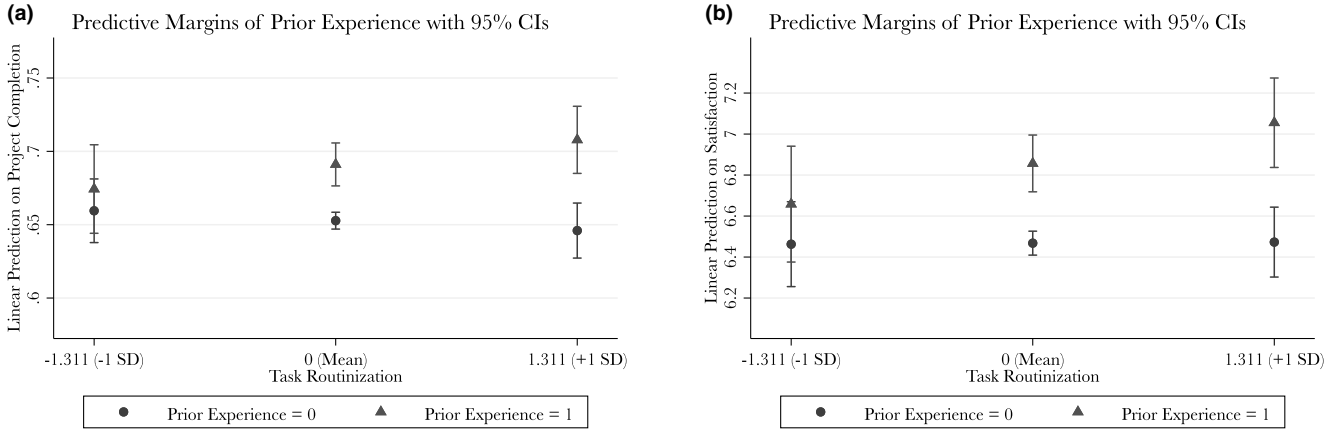


Figure 4 Interaction Effects Visualization – Task Routinization [Color figure can be viewed at wileyonlinelibrary.com]



outcomes. In Figure 4, we observe that first, while the effect of prior experience is significantly positive, there is no significant direct effect of task routinization on project outcomes. Further, the effect of prior experience becomes stronger when the project has higher task routinization.

3.5. Breaking Down Time Zone Differences

One concern with using time zone difference as the measure for temporal distance is that it is partially confounded with spatial distance. To assess this possibility, we break down the spatial distance into two orthogonal dimensions: the vertical dimension (latitude distance) and the horizontal dimension (longitude distance). Specifically, out of the two dimensions of spatial distance, only the horizontal dimension (longitude distance) is related to time zone difference.

To illustrate the different effects of longitude distance and latitude distance, consider a buyer based in New York and two potential suppliers, one located in Madrid, Spain and the other located in Lima, Peru, as shown in Figure 5. Both vendors have a similar geographical distance (3600 miles) from the client in New York. However, the vendor in Madrid is 70° east in longitude (or six hours ahead) from the client, and the vendor in Lima is 52° south in latitude from the client but still operating in the same time zone. While both vendors have roughly the same spatial distance from the client, the fact that the vendor in Lima is operating in the same time zone means the client can contact the vendor, or vice versa, when a question or ambiguity arises during the course of project development, and therefore build a close relational routine. The same, however, cannot be said about the vendor in Madrid, as the time zone difference of six hours may either force them to rely on asynchronous communication channels like email or require them to pre-arrange a meeting time in advance for synchronous communication. Either way, the communication is less effective and incurs higher coordination overhead. As a result, they are less likely to build a relational routine.

With the same regression model, we estimate the respective moderation effects of latitude distance and longitude distance instead of time zone difference. As indicated in Table 5, we observe that neither latitude distance nor longitude distance has a direct effect. More importantly, while there is a significant moderation effect of longitude distance on the effectiveness of prior experience, we do not observe such moderation with latitude distance. We similarly plot the predicted margins in Figure 6.

Based on Figure 6, we can clearly observe that while prior experience continues to have a positive direct effect (based on all the values from the graphs' Y axis), latitude distance (Figure 6a and Figure 6c) does not have a direct or interaction effect on it whereas longitude distance (or the horizontal distance that leads to time differences) moderates its effect (Figure 6b and Figure 6d).

3.6. Robustness Check on Potential Endogeneity

Although we have established the correlational evidence for our hypotheses, one may argue that project outcome is not causally driven by prior experience, but instead it is prior experience that is driven by prior project performance, which predicts the outcomes of the current project. We surmise that controlling for both the buyer fixed effects and the supplier

Figure 5 Longitude vs. Latitude Illustration [Color figure can be viewed at wileyonlinelibrary.com]

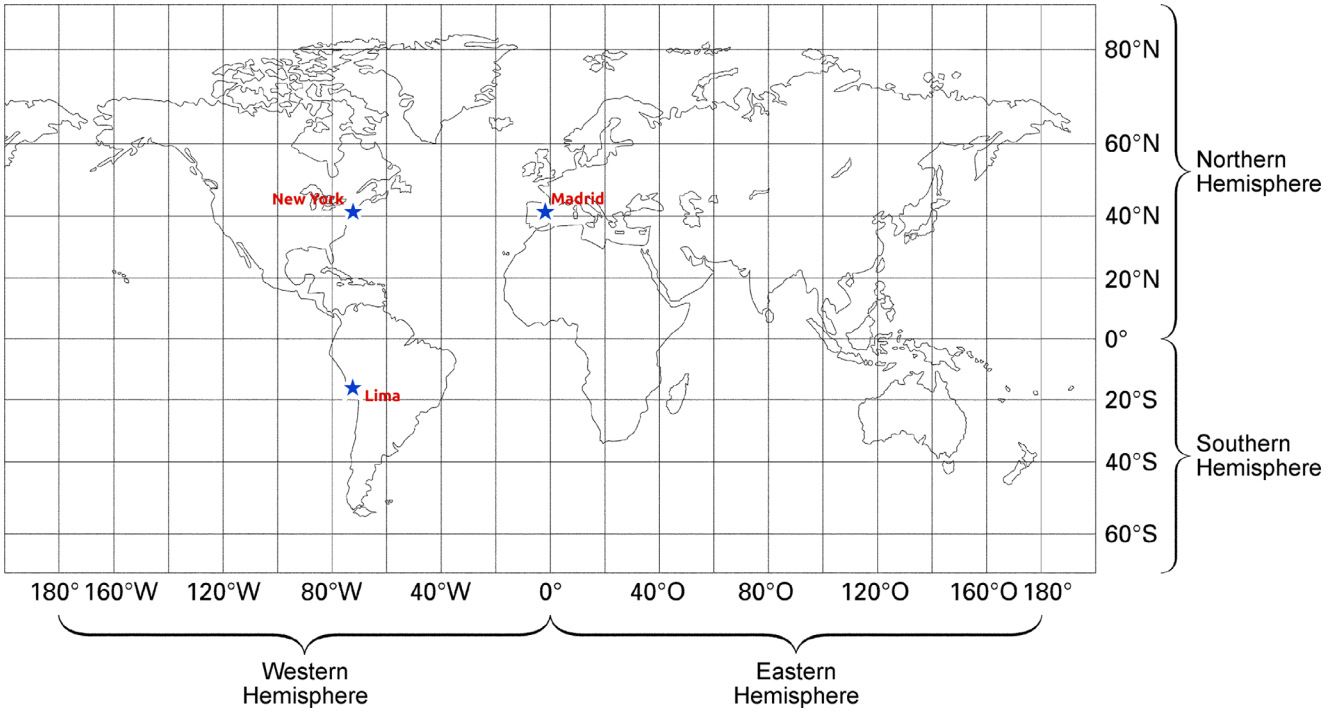


Table 5 Estimation Results for the Interaction Effects (with Zone Difference Break Down)

	(1)	(2)
	Completed	**Satisfaction**
Prior Experience	0.123***(0.023)	1.194***(0.215)
log(Latitude Distance)	0.003(0.008)	−0.014(0.078)
log(Longitude Distance)	−0.008(0.007)	−0.064(0.065)
Language Difference	−0.018**(0.009)	−0.212**(0.105)
Task Routinization	−0.005(0.008)	0.007(0.070)
Prior Experience × Latitude Difference	−0.001(0.010)	−0.019(0.107)
Prior Experience × Longitude Difference	−0.020**(0.009)	−0.196**(0.089)
Prior Experience × Language Difference	−0.020*(0.011)	−0.130*(0.072)
Prior Experience × Task Routinization	0.016**(0.008)	0.132*(0.073)
log(Buyer Experience)	−0.001(0.007)	−0.036(0.067)
log(Supplier Experience)	0.004(0.011)	0.060(0.099)
Supplier Rating	−0.020***(0.002)	−0.206***(0.024)
Project Budget	−0.000***(0.000)	−0.003***(0.000)
Auction Duration	−0.001***(0.000)	−0.013***(0.004)
log(Number of Bids)	−0.014***(0.004)	−0.172***(0.034)
Days to Finish	−0.001*(0.000)	−0.009**
Project Description	−0.000(0.000)	−0.001(0.000)
Supplier-Project Match	0.076(0.058)	0.736(0.550)
log(Projects in Thirty Days)	−0.012*(0.006)	−0.117**(0.059)
Constant	0.941***(0.040)	9.522***(0.383)
Buyer fixed effects	Yes	Yes
Supplier fixed effects	Yes	Yes
Year-month fixed effects	Yes	Yes
Project category fixed effects	Yes	Yes
Observations	22,729	19,798
Within R-squared	0.608	0.645
Number of Buyers	4035	3601
Number of Suppliers	3292	2961

Notes: Cluster-robust standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

fixed effects can alleviate the selection problem to a certain extent, given the observational nature of the data. There is still potential endogeneity due to unobserved time-variant factors. Thus, we use an instrumental variable (IV) approach to assess the severity of the issue (Angrist and Pischke 2008) by constructing the IV of the "predicted probability of prior experience." We explain the conceptual intuition and the empirical construction of the IV as follows.

We obtained data from our corporate partner to construct this instrumental variable. Specifically, we obtained all the bids that the suppliers have placed in their entire platform lifetime (which leads to a total of 4,175,118 bids). We then computed two variables: the total number of bids each supplier has submitted and the total number of unique buyers each supplier has submitted a bid to. Next, we calculated the bidding propensity for the same buyers by dividing the total number of bids submitted by each supplier by the total number of unique buyers each supplier has submitted a bid to (herein referred to as "propensity to rebid"). Similarly, for each buyer in our sample, we calculate the buyer's propensity to rehire the same bidders by dividing the total number of contracts each buyer has offered by the total number of unique suppliers each buyer has contracted with. We expect that the propensity to rebid and the propensity to rehire jointly determine the exogenous variation in the likelihood that prior experience would happen. Because our analysis controls for both buyer and supplier fixed effects, to maintain variability in the IV, we create our IV as the multiplication of these two propensity variables, as in Eq. (2), which predicts the probability of prior experience for a buyer-supplier pair. A simple correlation analysis shows the predicted probability of prior experience has a strong correlation ($\rho = 32.2\%$) with the variable of prior experience.

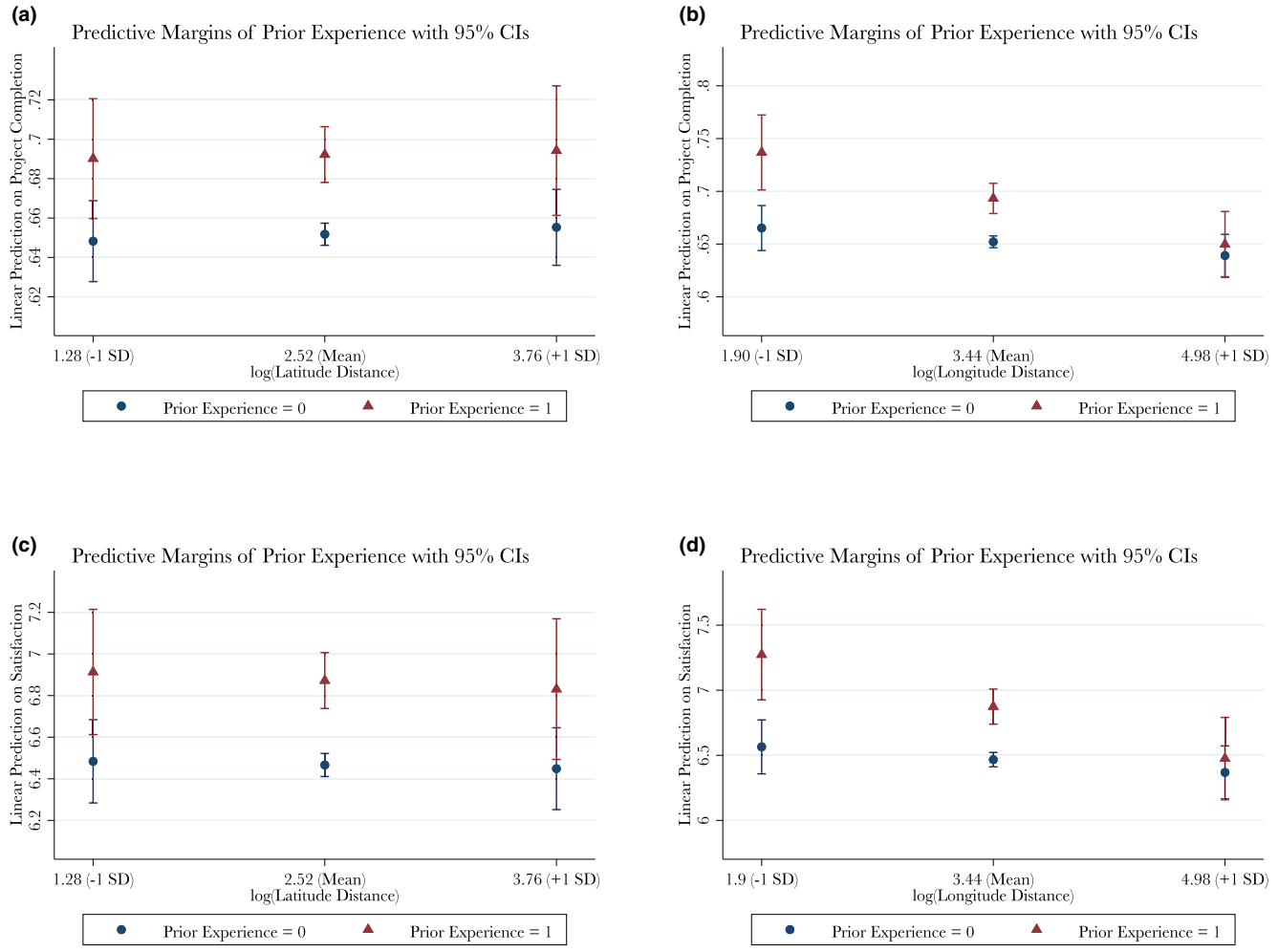
$$\begin{aligned}&\text{Predicted probability of prior experience}_{ij}\\&= \text{Propensity to rebid}_j \times \text{Propensity to rehire}_i\end{aligned} \tag{2}$$

The argument for the relevancy and exogeneity of this instrument variable is twofold. The predicted probability of prior experience is the multiplication of two components: a suppliers' innate propensity to rebid for the same buyer and a buyer's innate propensity to rehire the same supplier. If a supplier is more prone to bidding for the same buyers, it is also more likely that he or she would get contracts from the same buyers, since bidding is the prerequisite for obtaining contracts. However, conditional on supplier quality (captured by the supplier fixed effects, rating, and experience), this propensity should not be related to the performance of the specific, current project. Similarly, if a buyer is more prone to hiring the same suppliers, it is more likely that a supplier who has worked for the buyer will win the contract; however, this propensity should not be related to the performance of the specific, current project. Further, our two-way fixed effects models controlled for both the buyer characteristics and the supplier characteristics, lending further support to the exogeneity assumption of this variable.

For the interaction models, as per Greene (2003), we use predicted probability of prior experience and three additional instruments: the multiplication of the predicted probability of prior experience and time zone difference, language difference, and task routinization, respectively. For our parameter estimation, we use the panel data instrumental variable procedure for the high-dimensional fixed effects procedure IVREGHDFE.

As reported in Table 6, we find that when using the IV approach, our results remain largely consistent. Looking at the diagnostic statistics for instrument strength, we find that the instrumental variable passes

Figure 6 Interaction Effects Visualization – Latitude vs. Longitude Distance [Color figure can be viewed at wileyonlinelibrary.com]



the weak instrument test based on the Cragg-Donald Wald F-statistics (15% maximal IV size = 8.96). Moreover, the instrument under-identification test (Kleibergen-Paap rk LM statistics) is consistently significant at $p < 0.001$ level. Note that since we have one instrument at the buyer-supplier level, our IV model is just-identified, and we are unable to assess the over-identification restrictions. Given the unavailability of a randomized experiment or random, exogenous policy shocks, our identification relies highly on the validity of the IV, and the results should be largely interpreted as associational.

4. Discussion

4.1. Contribution to the Literature

This research makes several key contributions to the extant operations management and information systems literature on e-procurement platforms (Gefen and Carmel 2008, Hong et al. 2016, Horton 2010, Lin et al. 2016), offshore outsourcing Carmel and Tjia 2005, Lacity and Rottman 2008), and, more broadly, distributed virtual teams (Cummings et al. 2009, Espinosa and Carmel 2003, Espinosa et al. 2007). Notably, the prior research on e-procurement operations is predominantly analytical (e.g., Allon et al. 2012, Huang et al. 2019, Niu et al. 2019), with only a few empirical papers that focus on the main effects of prior experience or other dyadic buyer-supplier level variables (e.g., Espinosa et al. 2007, Gefen and Carmel 2008). We empirically examine a large-scale data set covering both objective and subjective aspects of project outcomes (i.e., project completion and buyer satisfaction) to provide a comprehensive perspective on the joint effects of prior experience with temporal distance, language difference, and task routinization.

The first contribution is the empirical findings that relate to prior research but are shown in the novel context of e-procurement platforms. The first key finding from our empirical results is that temporal distance matters for outsourced offshore service projects, thus echoing findings from the current literature (Cummings et al. 2009, Hong and Pavlou 2017). We surmise that the communication overhead incurred

Table 6 IV Estimations

	(1) IV	(2) IV	(3) IV	(4) IV
	Completed	**Satisfaction**	**Completed**	**Satisfaction**
Prior Experience	0.153***	1.974***	0.068***	0.955***
	(0.045)	(0.437)	(0.028)	(0.362)
Time Zone Difference	−0.006***	−0.059***	−0.003**	−0.039**
	(0.002)	(0.021)	(0.001)	(0.019)
Language Difference	−0.029*	−0.300*	−0.046*	−0.578**
	(0.016)	(0.154)	(0.024)	(0.251)
Task Routinization	−0.001	0.035	−0.026*	−0.102
	(0.007)	(0.068)	(0.014)	(0.097)
Prior Experience × Time Zone Difference			−0.017*	−0.140**
			(0.009)	(0.081)
Prior Experience × Language Difference			−0.102*	−1.420*
			(0.057)	(0.763)
Prior Experience × Task Routinization			0.095**	0.509**
			(0.048)	(0.254)
log(Buyer Experience)	−0.005	−0.094	−0.003	−0.077
	(0.009)	(0.083)	(0.010)	(0.086)
log(Supplier Experience)	−0.002	−0.032	0.002	0.009
	(0.014)	(0.135)	(0.014)	(0.135)
Supplier Rating	−0.023***	−0.260***	−0.021***	−0.243***
	(0.006)	(0.055)	(0.006)	(0.055)
Project Budget	−0.000***	−0.003***	−0.000***	−0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Auction Duration	−0.001***	−0.012***	−0.001***	−0.011***
	(0.000)	(0.004)	(0.000)	(0.004)
log(Number of Bids)	−0.004	−0.028	−0.012	−0.083
	(0.014)	(0.125)	(0.014)	(0.125)
Days to Finish	−0.001**	−0.010**	−0.001**	−0.010**
	(0.000)	(0.004)	(0.000)	(0.004)
Project Description	0.000	0.001	0.000	0.000
	(0.000)	(0.001)	(0.000)	(0.001)
Supplier-Project Match	0.081	0.703	0.057	0.577
	(0.057)	(0.541)	(0.059)	(0.548)
log(Projects in Thirty Days)	−0.018	−0.201**	−0.016	−0.183*
	(0.011)	(0.102)	(0.010)	(0.098)
Buyer fixed effects	Yes	Yes	Yes	Yes
Supplier fixed effects	Yes	Yes	Yes	Yes
Year-month fixed effects	Yes	Yes	Yes	Yes
Project category fixed effects	Yes	Yes	Yes	Yes
Observations	22,729	19,798	22,729	19,798
Number of Buyers	4035	3601	4035	3601
Number of Suppliers	3292	2961	3292	2961
Cragg-Donald Wald F statistic	48.66	54.78	13.06	15.50
Kleibergen-Paap rk LM statistic	14.09***	16.12***	16.38***	18.62***

Notes: Cluster-robust standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

by the time zone difference (i.e., temporal distance) would lead to coordination delays and lower the likelihood of project completion. Moreover, such communication difficulties cannot be overcome by asynchronous communication technologies such as email, wikis, or bulletin boards. Since temporal distance (i.e., time zone difference) is decided by the shape and rotation of the Earth, it is an exogenous, independent factor that influences project outcomes. Considering that we further broke down the spatial distance variable into two orthogonal dimensions (latitude distance and longitude distance), our results provide additional confidence that it is the temporal aspect, not spatial aspect, that influences project completion. The second key finding from our analysis involves a buyer's prior experience with suppliers. We first examine the direct effect of prior experience on project outcomes. All else being equal, having prior experience with a certain offshore supplier assists in the completion of and buyer satisfaction with a project contracted on an e-procurement platform. This finding echoes the importance of familiarity (Espinosa et al. 2007) and trust (Fugger et al. 2019) between a buyer and a supplier, especially in a

distributed setting. Familiarity and trust built through prior experience help the buyer and the supplier develop a better understanding of each other's actions, routines, and expected outcomes, and it facilitates the process of coordination. Prior experience also provides a shared context for subsequent project endeavors where the required communication between the two becomes more routinized, more effective, and less demanding.

Second, we examine the moderating roles of temporal distance, language difference, and task routinization in influencing the effectiveness of prior experience, which yielded new findings to the literature. We find that temporal distance exerts a negative moderating effect on the association between prior experience and the outcomes of service projects outsourced on e-procurement platforms. Although prior experience generally has a positive main effect on the outcomes of outsourced projects, such an effect is significantly smaller when the buyer and the supplier are separated by greater time zones. This finding complements the existing literature (e.g., Espinosa et al. 2007). This attenuation (negative moderation) effect of temporal distance suggests that the efficacy of a buyer's prior experience in developing familiarity and routines with the supplier for globally outsourced projects is constrained by time zone difference. In other words, our results suggest that with greater temporal distance, there is less to gain from prior experience, whereas with shorter temporal distance, it is easier for prior experience to assist the buyer and the supplier in improving project outcomes. We surmise that time zone difference and the ensuing lack of overlapping work schedules create obstacles for establishing familiarity and hinder buyer's and supplier's capacity to accumulate relational capital that can help with the outcomes of outsourced service projects (Rai et al., 2012). Similarly, this study extends prior work on the effects of language differences in operations with multi-cultural teams (Bockstedt et al. 2015, Cannon et al. 2010, Gray and Massimino 2014, Ribbink and Grimm 2014). Specifically, we do not just report the negative main effect of language difference on project completion and buyer satisfaction, but we also find that language difference constrains the effectiveness of prior experience, likely because it creates hurdles for establishing effective communication and relational routines.

Third, adding to the extant literature in operations management, our finding of the positive interaction effect of task routinization suggests that its effects are more nuanced than what has been reported in prior literature. For example, in a study on manufacturers that sell direct goods in a B2B marketplace, Rosenzweig (2009) does not find that product complexity moderates the relationship between e-collaboration and performance. Similarly, in examining software service project teams, Huckman and Staats (2011) do not find the interaction of team familiarity with task change to have a significant effect on project performance. Relatedly, Avgerinos and Gokpinar (2017) study cardiac surgeries in a hospital and find that teams with a higher familiarity gained from complex tasks have higher team productivity, and the positive effect of team familiarity on productivity is enhanced when performing more complicated tasks. In our context of e-procurement platforms that connect semi-anonymous transaction partners, it is much harder to establish relational routines than the in the contexts of prior studies, such as software development and cardiac surgeries. Because buyers have access to a large pool of suppliers, there is little incentive for buyers to actively create a relational routine with suppliers. Therefore, the contextual factors such as temporal distance, language difference, and task routinization become particularly important in facilitating the creation of familiarity and routines. Similarly, Espinosa et al. (2007) and Assudani (2011) study global project team members who work for the same company, and they assume that team familiarity exists when there is prior experience. This is a valid assumption in their context, because familiarity is embodied when a team becomes more engaged in a workplace. For outsourced service projects, however, the buyer and the supplier are two separate entities who do not necessarily share a common objective. In fact, a typical agency problem with information asymmetry exists between the two on the e-procurement platform. Therefore, prior experience does not necessarily translate into buyer-supplier familiarity or relational routines in our context. Instead, it needs to be facilitated and built. In other words, while the literature has generally assumed that familiarity automatically builds up with prior experience, we find such an assumption does not necessarily hold true for transactional partners who are geographically dispersed and who are assembled for varied purposes in different contexts.

4.2. Contribution to the Practice

In terms of managerial implications, procurement managers and buyers are advised to take temporal distance and language difference into account when selecting an offshore supplier for their projects. Specifically, they need to pay special attention to the temporal distance of potential suppliers. It is much easier to manage projects contracted to suppliers who are in the same time zone or who have work schedules that significantly overlap with their own. The reason is that synchronous communication technologies can help address many of the coordination problems. On the other hand, projects that are outsourced to offshore suppliers with significant time zone difference (i.e., with little or no

overlapping of work schedules) need more supervision, better coordination, and frequent communication to ensure steady progress and eventual success.

Since coordination and face-to-face communication are more difficult to establish in an offshore setting, contracting service projects to unfamiliar suppliers (even reputed ones) in a foreign country imposes inherent risk. Buyers are well advised to outsource projects to suppliers with whom they have prior experience from past projects. Working with a familiar offshore provider helps avoid many potential pitfalls associated with a globally outsourced service project and in turn increases the chance of completing the project on time with satisfaction. One caveat is that prior experience has its limit, as its benefit decreases with temporal distance (i.e., time zone difference), language difference, and projects that comprise nonroutine tasks. Thus, procurement managers and buyers cannot solely rely on prior experience as the main determinant for contracting out their projects to suppliers located far away with little or no overlapping of work schedules. In this case, effective supervision and constant communication are still indispensable to the success of outsourced service projects. On the other hand, when considering potential suppliers with no prior interaction, referrals through trusted third parties might provide some assurance to address the unfamiliarity issue.

To service providers operating on an e-procurement platform, our findings suggest that they should target clients with whom they have prior experience, who are located closer, who speak the same language, and whose posted projects mainly comprise routine tasks. The rationale is that these conditions not only may lead to successful project outcomes but can also engender potential favorable complementarity. Working on projects of routine tasks with familiar buyers who have overlapped work schedule and can better understand each other through the same language increases the likelihood of project completion and buyer satisfaction. For e-procurement platform owners, our results imply that they should focus on enhancing the matching function of their platforms to improve market efficiency so that buyers and sellers can easily identify the other parties who have a better fit of the attributes examined in our study, i.e., prior project interaction, time zone proximity, shared language, and routine task requirements. It is cognitively challenging for buyers and sellers to process lots of information before deciding on a transaction (Sundararajan 2016). In this regard, platforms can help by continuously and accurately collecting essential data on both users and projects, including background, transaction, reputation, task requirements, work history, etc. The e-procurement practice can be greatly enhanced through such endeavors by platform owners.

4.3. Limitations

Like any research, our study has its limitations. Many of these limitations are due to a lack of data and hence represent potential topics for future research if more data become available. First, the service projects outsourced on the e-procurement platform that we examined tend to be small or medium size ones, our findings need to be further validated for large-scale projects (e.g., enterprise software outsourcing). Second, we do not have insights into the involvement level of prior experience. Thus, it would be interesting if prior buyer-supplier involvement data become available, which would allow for a more granular analysis. Lastly, although we have discussed the possible endogeneity issue for prior experience, it may not be fully addressed due to the observational nature of our data. Therefore, the results in this study are largely associational. Future research may conduct field experiments or exogenous policy shocks to further establish the causal effect and the heterogeneous impacts of prior experience on project outcomes.

5. Concluding Remark

Compared with in-house development, service projects outsourced and procured from third parties who reside in a different location are more challenging and more difficult to manage. Temporal distance, language difference, and lack of routine project tasks create both tangible (physical) and intangible (mental) obstacles that decrease the likelihood that these outsourced projects will be completed with satisfaction. In this study, we look at an e-procurement platform of global suppliers to explore the effects of prior experience, temporal distance, langue difference, and task routinization on two important outcomes of outsourced projects: project completion and buyer satisfaction. We first find that prior experience, temporal distance, and language difference matter for the satisfactory completion of service projects outsourced on the e-procurement platform. Furthermore, while a buyer's prior experience with the supplier helps with project completion and buyer satisfaction, those benefits decrease for suppliers who are located far from the buyer in distant time zones, or who come from a country that speaks a different language. In addition, the effectiveness of prior experience is enhanced for service projects with more routine tasks. Taken together, these findings contribute to a better theoretical and practical understanding of the effects of prior experience, temporal distance, language difference, and task routinization on project outcomes and their interplay in creating relational routines in the context of e-procurement platforms.

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Notes

[1]https://www.cnbc.com/2020/07/07/freelance-work-grows-amid-covid-19-math-stats-game-hiring-in-demand.html.
[2]A plethora of articles have described why projects fail, including the following two examples: http://www.ibmsystemsmag.com/power/Systems-Management/Workload-Management/project_pitfalls; http://www.cio.com/article/2380469/careers-staffing/why-are-so-many-it-projects-failing-.html.
[3]https://www.ddorn.net/data.htm.

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