Inferring Supplier Quality in the Gig Economy: The Effectiveness of Signals in Freelance Job Markets

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Abstract

Inferring quality of labor suppliers is a challenge in the gig economy. Many online freelance job markets address this challenge by incorporating signals. We test effectiveness of two kinds of information signals as indicators of supplier quality: skill signal (which reflects suppliers' skill and potential), and achievement signal (which reflects suppliers' past achievement). We theorize that two job characteristics in cross-national labor demand settings strengthen effectiveness of these signals: job duration, and cultural distance. Econometric analysis on a dataset from a leading online freelance job marketplace containing information on jobs posted by buyers and completed by suppliers located across several countries supports our hypotheses. We find that both skill and achievement signals are more effective at inferring supplier quality in jobs involving longer duration, and in jobs involving greater cultural distance between buyers and suppliers.

1. Introduction

Online freelance job markets (e.g., Upwork, freelancer.com) have transformed the nature of labor markets by connecting buyers and independent labor suppliers located across the globe. Recent events, such as the COVID-19 pandemic, have accelerated the proliferation of such markets, making it incumbent upon buyers and sellers to seek strategies to be successful in these labor markets [1]. These markets "match buyers of electronically deliverable services with freelancers—self-employed individuals or teams who offer their services on a per-job basis (p. 860)" [2], are an important component of the gig economy, which engages about 57 million Americans [3].

Despite their potential, online freelance job markets create significant strategic challenges for buyers in inferring the quality of labor suppliers, an important metric when sourcing services, for at least two reasons. First, because online freelance job markets offer a multitude of suppliers across the globe, there is high selection risk because suppliers are globally distributed and independent heterogeneous agents. Second, online freelance job markets are generally characterized by a lack of formal procedures or service level agreements [4]. Because the digital nature of the platform limits in-person contact and hinders buyers' ability to verify suppliers' processes and quality of work in progress, there is a high opportunism risk [5]. Due to selection risk and opportunism risk, buyers find it challenging to assess a good match, and even when matches are formed, it is difficult for buyers to know precisely the quality of the labor supplier that they are hiring [6].

These risks are particularly salient given that online freelance job markets are global in nature and hence present cross-national labor demand settings. The significant cultural differences between suppliers and buyers can pose hindrances and cause divergent interpretations of requirements [7, 8], resulting in major challenges to the effective completion of jobs [9]. Further, because of the geographically dispersed nature of providers and suppliers, time differences across locations, and the digital nature of the job marketplace, there is a lack of transparency and greater difficult for buyers to monitor the progress of the jobs effectively. As a result, there are increased selection risks and opportunism risks, which imply that buyers may need to rely on signals embedded within the market [10]. When information about suppliers' quality is limited and difficult to observe, signals are an effective and cost-efficient way to alleviate uncertainty regarding labor supplier quality. Many freelance job markets provide signals that depict suppliers' achievement and skills on their public profiles.

Although signals can be used by clients to evaluate the quality of suppliers, there remains a lack of clarity regarding their usefulness as indicators of supplier quality in online freelance job markets, and the gig economy in general. For instance, according to a survey conducted by the European Union, although 51% of gig workers had indicated some level of signals (e.g., their

HⅈCSS

skills) in an online freelance job market, only 36% believed that the signals were actually helpful to them to be more successful in the marketplace [11]. In addition, many clients also found that the signals were not reliable indicators of overall quality of gig workers. Further, different online freelance markets exhibit mixed evidence on the usefulness of signals on the platforms. For example, in 2019, Upwork removed most of the signals related to skills from its platform, only retaining a test for basic skills to be taken only by newcomers. In contrast, other platforms place more emphasis on skill signals by promoting their importance on the platform [11]. In other words, it remains unclear whether and under what conditions the signals are true reflections of labor supplier quality [2]. Specifically, signals of supplier quality are not verifiable because due to the distributed, remote, and global nature of online freelance job markets, there are limited opportunities for buyers to familiarize themselves with suppliers and their processes [4]. The lack of a consensus regarding effectiveness of signals suggests that there may be other contextual job conditions which either strengthen or impede their effectiveness.

Against this backdrop, this study examines whether signals in online freelance job markets are effective indicators of supplier quality and whether the effectiveness of signals depends on job characteristics. We focus on two kinds of signals that are important to buyers and suppliers: signals that indicate potential of suppliers, and signals that indicate achievement of suppliers [12-14]. First, a common way that online freelance job markets incorporate signals of potential is by embedding signals in the platform that depict the skills of suppliers. Thus, we define *skill signal* as the verified information signal that emphasizes a supplier's technical skills and process related knowledge. It is represented by benchmarking assessments of certifications and examinations. Second, a common way that online freelance job markets incorporate signals of achievement is by embedding signals in the platform that depict the achievement of suppliers such as their past performance [13]. Thus, we define *achievement signal* as the information signal that emphasizes the supplier's fulfillment of past jobs within resource constraints of time and budget.

Our key theoretical argument is that due to the nature of online freelance job markets and the cross-national labor demand settings they operate within, there are two salient conditions that influence the effectiveness of skill signals and achievement signals as indicators of supplier quality: *cultural distance* and *job duration*. First, online freelance job markets are highly decentralized because the digital nature of the platform facilitates transactions between globally dispersed suppliers and buyers. Hence, selection risk is higher in

jobs in which there is higher cultural distance (which pertains to differences in cultural norms) between supplier and buyer. Second, online freelance job markets "represent the long tail of business service— they allow buyers and suppliers to engage in small-scale projects that would not have been economical to outsource without the electronic medium (p.346)" [15]. Jobs with longer duration usually have larger scale and scope and require interconnected tasks typical of longer engagements, whereas online freelance job market suppliers have limited capacity to handle jobs of large scale and scope [16]. Hence, opportunism risk is higher in jobs with higher duration. We focus on cultural distance and job duration as conditions that influence the effectiveness of signals of potential and achievement.

Formally, we pose the following research question: *how do job duration and cultural distance between buyer and supplier influence the effectiveness of skill signal and achievement signal as indicators of supplier quality in online freelance job markets?* We theorize that the effectiveness of skill signal and achievement signal as indicators of supplier quality is stronger for longer jobs and jobs characterized by greater cultural distance between supplier and buyer. We empirically test our hypotheses using a unique dataset collected from a leading online freelance job market of jobs conducted across several distinct buyer-supplier country tuples. Our analysis suggests that skill signal and achievement signal are more effective indicators of supplier quality in jobs of longer duration and jobs involving greater cultural distance. Interestingly, when not accounting for these conditions, achievement signal is an effective indicator of supplier quality, whereas skill signal does not indicate supplier quality.

2. Theoretical Background and Hypotheses

2.1. Signals in Online Freelance Job Markets

Scholars have investigated advantages and challenges of online freelance job markets from perspectives of both buyers and suppliers. First, buyers source labor in online freelance job markets not only to reduce costs but also for strategic reasons, such as flexibility [4]. Second, buyers face new challenges due to difficulty in handling suppliers and managing multiple tasks [17]. Hence, buyers develop capabilities to manage online freelance job market suppliers and tasks. Third, scholars have examined characteristics of jobs and auctions that influence suppliers' bidding behavior (e.g., [18]).

In absence of adequate formal communication and coordination mechanisms, signals explain the behavior

of parties [12, 19] and can be used by suppliers to convey information to buyers [20]. Recent research has examined issues related to signals as reputation mechanisms in online freelance job markets. For instance, capacity signaling by suppliers influences worker response to recruiter invitations [21]. Buyers in online freelance job markets place significant weight on seller reputations [2] and suppliers with low reputation ratings are less likely to be chosen by buyers Given the salience of signals, it is crucial for platform owners to institutionalize information or signals to help buyers and suppliers to make decisions [10].

Various types of signals and situations in which they are used are important for interpretations, although their relative importance and effectiveness may differ [22, 23]. In the context of online freelance job markets, the effects of past performance signal on worker quality depend on the context of previous evaluations [13]. Similarly, the extent to which the volume of reputational rating influences the probability of winning the bid depends on whether the contract is an output-based or input-based contract [15]. Scant research has examined how the effectiveness of signals as indicators of supplier quality depends on specific job conditions.

2.2. Selection Risk and Opportunism Risk

Selection risk results from a buyer selecting an inappropriate or low-quality supplier for a job [2, 4]. Selection risks can be mitigated through appropriate care in the pre-contract phase in supplier selection, bidding, and quality assessments [24]. However, mechanisms such as elaborate contractual arrangements and relevant planning are not in place in many online freelance job markets.

Opportunism risk results when suppliers are inclined to deliberately underperform or withhold resources or to utilize information gained through their relationship with the customer for their own benefit. Opportunism risk is traditionally addressed by emphasizing learning, extensive contract development, and management control mechanisms [25] that facilitate monitoring of suppliers. Other ways in which buyers mitigate opportunism risk include providing training or learning opportunities to suppliers, selecting pre-trained suppliers, selecting suppliers based on business familiarity, or designing detailed and measurable contractual terms. However, buyers in online freelance job markets rarely provide training or learning opportunities for suppliers [16] and are typically not equipped with process standards, formal employee management practices or processes to monitor suppliers [4]. Hence, selection and opportunism risks are critical in online freelance job markets and may deter optimal outcomes [2].

Selection risk and opportunism risk are even more salient in jobs of longer duration and greater cultural distance between supplier and buyer. First, longer jobs require interconnected tasks or coordination of multiple skillsets typical of longer engagements, whereas suppliers in online freelance job markets have limited capacity to handle jobs of large scale and scope [16]. Moreover, buyers often assign jobs lacking clear details of scope and work expectations [4]. Thus, job duration accentuates the opportunism risk because longer duration allows suppliers more time to slack off and devote fewer resources to jobs. Overall, job duration is a relevant aspect in online freelance job markets where buyers cannot see the time and resources that suppliers devote to each task.

Second, cultural distance, defined as the degree to which cultural norms differ between the countries of the supplier and buyer [26], arises in the online freelance job market context due to physical separation of supplier and buyer across countries and cultures. Cultural distance can lead to misunderstandings, act as a barrier to interaction between people, and result in preconceived notions about people from different cultures [27, 28]. Cultural distance results in coordination and control costs, communication difficulties between supplier and buyer, and subsequent mismatch of expectations during job execution, often resulting in failures [29]. Further, cultural distance hinders the efficiency and effectiveness of coordination and communication [30]. Due to these reasons, higher cultural distance increases the selection risk for buyers.

2.3. Hypotheses Development

Our research model and hypotheses are based on the premise that before hiring a supplier in an online freelance job market, a buyer observes information signals. We test whether and under what job conditions information signals are good predictors of supplier quality in the focal job, as evaluated by the buyer subsequent to completion of the focal job.

2.3.1. Skill Signal and Achievement Signal as Indicators of Supplier Quality

Signals help disclose private information to buyers and allow high ability suppliers to differentiate themselves from low ability ones [21, 31]. When capabilities of suppliers are not directly visible, signals help buyers to overcome problems associated with selection risks [32]. Information signals in online freelance job markets are key mechanisms for differentiation because signals should be indicators of suppliers' expertise and quality [13, 15].

First, skill signal suggests that the supplier performs jobs with competency reflected through certifications and exams. Skill signals in online freelance job markets are manifested through a supplier's completion of technical and managerial exams, or assessment tests. These examinations and certifications verify that the supplier has higher technical and managerial skills. Suppliers with such verified knowledge credentials can potentially offer superior quality solutions to satisfy buyers' needs [33]. Thus, buyers experience a lower materialization of selection risk and therefore tend to rate such suppliers higher at the end of the focal job.

Second, the achievement signal suggests the goal-focused nature of the supplier to complete jobs on time and within budget in the past [13]. High achievement signal enhances buyers' trust in the efficiency and productivity of the supplier, because suppliers' achievement signal illustrates their dependability and suggests a lower risk of opportunism. Thus, suppliers with high achievement signals are more likely to complete jobs on time and within budget and are thereby more likely to get better buyer evaluations.

In sum, we expect that skill signal and achievement signal are effective indicators of supplier quality because by reducing selection and opportunism risks, they increase the likelihood of a supplier delivering a high-quality job.

2.3.2. Signals as Indicators of Supplier Quality for Longer Jobs and Culturally Distant Participants

Skill signal reflects the abilities of suppliers to handle technology-, task-, or work-related aspects more competently [34]. Long duration jobs in online freelance job markets are a challenge for suppliers due to lack of scale, standardized processes, and advanced coordination and communication mechanisms [16]. Suppliers with high skill signal are more likely to showcase their abilities in the job [20]. In longer duration jobs, suppliers need to possess more specific knowledge and techniques to manage the job and buyer interactions [33]. Hence, longer duration jobs benefit more from verified credentials of suppliers because buyers would have the perception that the verified knowledge and expertise are being applied to overcome difficulties and reduce errors during the longer job duration [35]. Further, in longer duration jobs, opportunism risk is higher because longer duration implies a greater chance that the supplier has more time to slack off or devote fewer resources to the job. Therefore, in longer duration jobs, skill signals have greater significance since buyers can rely on the supplier's verified credentials. Hence, we posit:

Hypothesis H1a: In online freelance job markets, skill signal is a more effective indicator of the quality of suppliers in jobs with a longer duration than in jobs with shorter duration.

In jobs involving higher cultural distance, buyers need to manage suppliers with differing beliefs and norms. Individuals' misconceptions about other individuals at a greater cultural distance create biases and divergent interpretations that complicate understanding of the business problem [9]. Skill signals act as standard benchmarks of verified knowledge notwithstanding language, cultural barriers, and biases that may lead to selection risks. Skill signals indicate that the supplier has technical and managerial competency, as reflected through certifications or tests. Suppliers with higher skill signals are likely to have higher expertise levels and face fewer hurdles while interacting with buyers at a greater cultural distance. Suppliers with greater cultural distance require greater details about specifications and other aspects of the job. Hence, jobs involving greater cultural distances between buyers and suppliers are more likely to benefit from suppliers with stronger skill signal because such suppliers may be more likely to overcome biases by relying on their technical and managerial skills. Further, buyers will benefit from an objective representation of suppliers' skills and knowledge, because skill signal will reduce any biases that buyers may have due to cultural differences with the supplier. Hence, buyers can rely on skill signals as indicators of supplier quality particularly under the condition of greater cultural distance, where selection risk is higher.

Hypothesis H1b: In online freelance job markets, skill signal is a more effective indicator of the quality of suppliers in jobs involving higher cultural distance than in jobs involving lower cultural distance.

Achievement signal indicates the extent to which the supplier has completed past jobs successfully on time and within budget. Effectiveness of achievement signal is higher in longer duration jobs, due to two reasons. First, in jobs with longer duration, there is a greater need for meeting clear deadlines and understanding buyers' requirements for each deadline. However, there is also greater opportunism risk because suppliers may be more likely to slack off. Suppliers with higher achievement signal will likely have more frequent communication with buyers as a critical step towards meeting job timelines and budgets. Such communication between suppliers and buyers create complementary knowledge and understanding, which in turn is more crucial in long duration jobs where there is greater opportunism risk. In

such jobs, achievement signals are more likely to predict quality because of tendency of suppliers with such signals to meet job timelines and budgets. Thus, suppliers with higher achievement signal are likely to obtain higher evaluation of quality by buyers, especially in longer duration jobs. Moreover, achievement-focused suppliers tend to cultivate their relationship with buyers resulting in shared goals and sense of trust, which are essential for successful sourcing. Consequently, achievement-focused suppliers are likely to maintain good communication with buyers. This is particularly important in longer duration jobs where opportunism risk is higher.

Second, a supplier with higher achievement signal is likely to guide the buyer through a long duration job due to the supplier's ability to efficiently manage its resources. This guidance reduces uncertainty and anxiety during course of the longer job, enhancing the buyer's confidence in supplier's ability to eventually meet goals. This process reassures the buyer that the supplier is devoting adequate resources to the job. Salience and effectiveness of achievement signal as an indicator of supplier quality is thus higher in a longer duration job, where opportunism risk is higher. Hence:

Hypothesis H2a: In online freelance job markets, achievement signal is a more effective indicator of the quality of suppliers in jobs with a longer duration than in jobs with shorter duration.

We argue that achievement signal is a more effective indicator of supplier quality in jobs characterized by higher cultural distance due to two reasons. First, in jobs with higher cultural distance, there is a higher selection risk due to the difference in cultures. This, in turn, results in greater likelihood of disagreements on priorities [15, 29] and difficulties in negotiations regarding job specifications, thereby exacerbating the challenge to maintain focus on objectives. Therefore, activities that deviate from original specifications may arise, which result in time and budget overruns, causing low buyer evaluations of supplier quality. In presence of such potential distractions and difficulties, a high achievement signal by the supplier is more effective as it preempts the surge of deviating activities by focusing job priorities on completion within cost and time constraints.

Second, due to higher cultural distance, buyers and suppliers are likely to have different communication styles, demands, and expectations [27], thereby resulting in higher selection risk. An achievement-focused supplier is likely to adapt the jobs' goals and direction, or even transform its services to provide value-added outcomes to customers effectively. As the achievement-oriented supplier focuses on providing services that satisfy customers' needs and demands, buyers and suppliers will start sharing objectives. An achievement-oriented supplier is hence likely more valuable in jobs of higher cultural distance where there are more likely to be discrepancies in communication styles, demands, and expectations. Hence, we posit:

Hypothesis H2b: In inter-organizational platforms, achievement signal is a more effective indicator of the quality of suppliers in jobs involving higher cultural distance than in jobs involving lower cultural distance.

3. Methods

3.1. Data

We collected data from a leading global online freelance job market. We used a time structure design relevant to the job progress to capture data and code our variables. Platform information signal variables were collected prior to execution of the focal job, whereas the dependent variable was collected after job completion. This temporal ordering significantly mitigates concerns of reverse causality. The jobs included categories such as web services, software, or mobile app development jobs. We collected information at the completion of each job. For suppliers, we again collected all information regarding all jobs completed by the supplier during this period. By following such a recursive process, we were able to gather all relevant information on jobs. Figure 1 depicts the job progression over time in our context. This strengthens inference of temporal ordering because signals precede assessment of supplier quality.
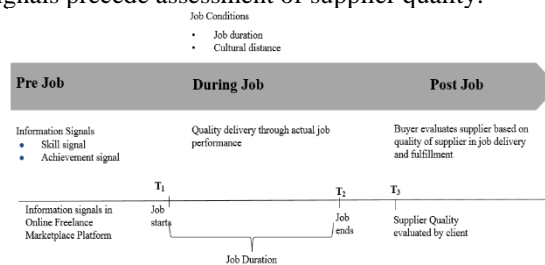
Figure 1. Time Progression of Jobs

Although our initial dataset covers 6452 service jobs, after removing duplicates, incomplete jobs and jobs for which information was not completely available, the final dataset covers 5432 service jobs. The jobs were assigned by 3221 buyers across 64 countries, and completed by 642 suppliers from 49 countries, encompassing 638 distinct buyer-supplier country tuples.

3.2. Variables

We created our variables from objective data available in the online freelance job market. We measure *Skill Signal* as a sum of the number of examinations completed by the supplier prior to the focal job. These exams included technical exams (e.g., programming exams) and process-related exams (e.g., employer orientation), and represent the extent to which skill signals are captured in the platform. We measure *Achievement Signal* by the product of the proportion of on-time, on-budget, and completed jobs by the supplier. For robustness, we also used the average of the proportion of on-time, on-budget, and completed jobs, and obtained similar results.

A buyer announces a job with a description and tentative budget on the website, and then seeks, selects and awards the job to a supplier. The job start date and completion date are captured on the platform; we used the difference of these dates to compute *Job Duration*. We capture the country names of buyer and supplier for the focal job and use a standard measure to calculate *Cultural Distance*. *Cultural Distance* is operationalized to incorporate differences in national culture across dimensions of individualism, uncertainty avoidance, power distance, masculinity, and long-term orientation [26, 36] by adopting a widely used measure of *Cultural Distance* [26, 37]. This measure is calculated using Hofstede's dimensions of culture. The index is based on deviation of the supplier's country from the buyer's country along five Hofstede [36] cultural dimensions. These differences are adjusted for differences in variance of each dimension and then averaged. Thus:

$$Cultural\ Distance_{jk} = \sum_{i=1}^{5} \left(\frac{(I_{ij} - I_{ik})^2}{V_i} \right) / 5$$

where *Cultural Distance$_{jk}$* is the cultural distance of country of supplier j from the country of buyer k; I_{ij} is an index for i^{th} cultural dimension of jth country; and V_i is the variance of the ith dimension.

Buyer's evaluation score of supplier quality in the focal job is the measure of *Supplier Quality*, consistent with prior research [13]. After completion of the job, the buyer evaluates supplier quality across five dimensions, resulting in a quality score on a continuous rating scale ranging from 0 to 5. Buyer evaluations after job completion are widely used as a quality measure in online labor markets literature [13] and in other contexts [38]. This is an effective measure of quality of suppliers in online freelance job markets since buyer satisfaction is derived from services provided by suppliers. Quality of sourcing providers, encompassing strategic, economic, technological and social factors of job success is reflected in buyer evaluations. Service quality is reflected via service experience rendered by the supplier.

We include a rich set of control variables. To account for supplier's experience with the platform, we control for supplier's average prior ratings across all jobs (*Supplier Prior Rating*), prior supplier experience as number of past projects completed by the supplier (*Supplier Experience*), and the number of prior reviews received by the supplier (*Supplier Reviews*). Since quality evaluations may be influenced by clarity of the job specification, we control for job specification clarity (*Job Spec. Clarity*) which is rated by the supplier on a scale of 0 to 5. We control for the extent to which the buyer may have under-bid or over-bid for the job relative to the average bid of other bidders for the same job (*Job Bid Deviation*). Further, we control for extent to which the job may have overrun or underrun its budget by measuring percentage difference between final job price and initial budgeted price (*Job Price Diff.*). We also use a dummy control for mobile apps related jobs (*Mobile Job*). Finally, we include dummy variables for buyer and supplier continents to control for geographical influences (*Buyer Location* and *Supplier Location*). We omit descriptive statistics and correlations due to space limitations (available from authors on request).

4. Results

4.1. Estimation Results

The dependent variable *Supplier Quality* is left-censored at 0, and right-censored at 5. To account for double-censoring of the dependent variable, we use double-censored Tobit maximum likelihood estimator, which explicitly accounts for nonlinearity introduced by a double-censored dependent variable [39]. We specify the double-censored Tobit model equation as $y_i = \beta x_i + \varepsilon_i$, where β is vector of coefficient parameters, x_i is a vector of independent variables, and εi is error term. The double-censored Tobit model supposes a latent unobservable variable y_i^*. The observable variable y_i is:

$$y_i = \begin{cases} L & \text{if } y_i^* \leq L \\ y_i^* & \text{if } L < y_i^* < U \\ U & \text{if } y_i^* \geq U \end{cases}$$

Where L and U are respectively the lower and upper bounds on y_i^*.

Table 1 presents the results. Although we do not postulate hypotheses for unconditional effects, *Achievement signal* has a positive and significant coefficient (column 1, $\beta = 1.22$, $p < 0.01$), suggesting that achievement signal is an effective indicator of supplier quality. However, *Skill signal* (column 1, $\beta = NS$) has a non-significant coefficient, suggesting that

skill signal is not an effective indicator of supplier quality when one does not account for conditions of job duration and cultural distance.

Table 1. Estimation Results

|	1	2
Skill signal	0.004 (0.03)	-0.04 (0.06)
Achievement signal	1.22*** (0.18)	0.63* (0.33)
Skill signal × Job Duration		0.003** (0.001)
Achievement signal × Job Duration		0.04*** (0.01)
Skill signal × Cultural Distance		0.08*** (0.02)
Achievement signal × Cultural Distance		0.50*** (0.11)
Job Duration	-0.008*** (0.003)	-0.04*** (0.01)
Cultural Distance	-0.10*** (0.03)	-0.58*** (0.08)
Intercept and Controls	Included	Included
Log pseudo-likelihood	-2929.01	-2828.14
F-statistic	6.76***	7.25***
F-test		14.47***

Notes: (1) Obs.: 5432. (2) ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$. (3) Parentheses show robust standard errors clustered by supplier. (4) Dependent variable is log (1+ *Supplier Quality*).

The interaction term (*Skill signal × Job Duration*) is positive and significant (column 2, $\beta = 0.003$, $p < 0.05$), consistent with H1a. This suggests that skill signal is a stronger indicator of supplier quality in longer duration jobs. The interaction term (*Skill signal × Cultural Distance*) is positive and significant (column 2, $\beta = 0.08$, $p < 0.01$), consistent with H1b. This suggests that skill signal is a stronger indicator of supplier quality in jobs with higher cultural distance.

We find support for H2a, as the interaction term (*Achievement signal × Job Duration*) is positive and significant (column 2, $\beta = 0.04$, $p < 0.01$). This suggests that achievement signal is a stronger indicator of quality of suppliers in longer duration jobs. The interaction (*Achievement signal × Cultural Distance*) is positive and significant (column 2, $\beta = 0.50$, $p < 0.01$), supporting H2b. This suggests that achievement signal is a stronger indicator of supplier quality in jobs involving higher cultural distance. The main effect of *Cultural Distance* is negative and significant, implying that cultural distance hinders coordination effectiveness. Control variables are generally in expected directions. For example, supplier experience, supplier's prior reviews, and job specification clarity have positive and significant coefficients.

Figure 2 illustrates the results graphically. At low levels of *Job Duration* or *Cultural Distance*, skill signal is not an effective indicator of quality (Figures 2a and 2b). However, at high levels of *Job Duration* or *Cultural*

Distance, effectiveness of skill signal as a signal of quality is high. At low *Job Duration* or *Cultural Distance*, achievement signal is a reasonable indicator of quality; however, at high *Job Duration* or *Cultural Distance*, effectiveness of achievement signal as signal of quality is substantially higher (See Figures 2c and 2d). The graphs and marginal effects suggest that the interactions are substantive in magnitude.
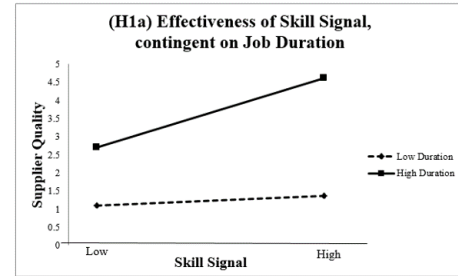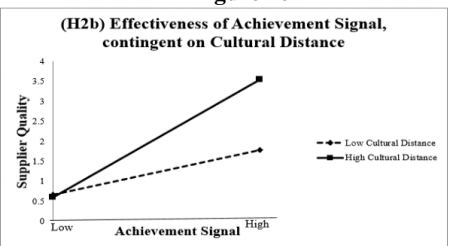

Figure 2a
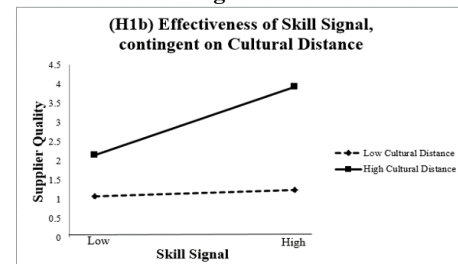
Figure 2b
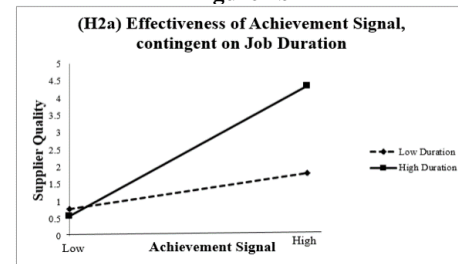
Figure 2c

Figure 2d
Figure 2. Interaction Effects

Interestingly, the coefficient of *Achievement signal × Job Duration* is higher than the coefficient of *Skill signal × Job Duration* ($p < 0.05$), suggesting for longer duration jobs, *Achievement Signal* is more effective than *Skill signal* as an indicator of supplier quality. Likewise, the coefficient of *Achievement Signal × Cultural*

Distance is higher than the coefficient of *Skill Signal ×
Cultural Distance* ($p < 0.01$), suggesting that for jobs
involving higher cultural distance, *Achievement Signal*
is more effective than *Skill Signal* as an indicator of
supplier quality. These results suggest that in jobs with
higher duration or higher cultural distance, *Achievement
Signal* is more effective than *Skill Signal* as an indicator
of supplier quality.

4.2. Accounting for Endogeneity of the Signals

A potential concern in our study may be that the
signals are endogenous. Such endogeneity can occur if
there are unobserved (to the researcher) factors that
affect the level of supplier signals as well as supplier
quality. We took two approaches to address this
concern. First, we accounted for potential endogeneity
by using Garen's methodology which is a residual
analysis technique to correct for selection bias [40]. We
estimated the first stage regressing *Signals* on factors
likely to impact the extent to which suppliers signal (eq.
i). We then calculated residuals $\tilde{\eta}$ from the first stage,
and included $\tilde{\eta}$ and interaction term $\tilde{\eta} \times Signals$ as
endogeneity correction terms in the quality equation (eq.
ii). $\tilde{\eta}$ corrects for selection bias, and $\tilde{\eta} \times Signals$ accounts
for unobserved heterogeneity over the range of the
selection variable [40]. The equations are:
Stage 1: $Signals = \text{f}(\beta_a + \beta_r W + \eta)$ .. (i)
Stage 2: $SupplierQuality = \text{f}(independent\ variables,
interaction\ terms,\ \tilde{\eta},\ \tilde{\eta} \times Signals,\ controls,\ \varepsilon)$ .. (ii)

Where W is the vector of variables in the first stage;
η and ε are error terms, and $\tilde{\eta}$ is the estimate of residuals
from the first stage. Supplier and job characteristics are
used as regressors in the first stage.

The first stage model is significant and the second
stage addresses endogeneity by including endogeneity
correction terms calculated from the first stage. Our
results (omitted for brevity) are unchanged, suggesting
that the findings are robust to endogeneity.

Second, we accounted for endogeneity using an
extension of Garen's model for scenarios with multiple
potentially endogenous variables. With this approach,
results are retained and omitted for brevity.

4.3. Additional Robustness Checks

We conducted several additional tests to assess
robustness of our results. First, we used an alternate
measure of cultural distance, based on Euclidean
distance. Findings remained qualitatively unchanged.
We repeated the analysis using only the first four of
Hofstede's cultural dimensions (instead of five) and
found similar results. Likewise, we repeated the analysis
using the original Kogut and Singh [26] index without
adjusting for variance of each dimension and found

unchanged results. For robustness, we repeated the
analysis by computing *Achievement Signal* by using the
average of proportion of on-time, on-budget, and
completion rate (rather than the product). Results were
unchanged. Second, we assessed sensitivity of our
results to clustering by suppliers and buyers and results
are qualitatively unchanged. Further, results with and
without clustering of standard errors remain similar. We
repeat the analysis using endogeneity-corrected
Ordinary Least Squares models instead of Tobit models
and got unchanged results. Third, variance inflation
factors indicated that multicollinearity is not
problematic. Finally, as an additional control variable,
we included the number of past transactions between the
same buyer and supplier. We found similar results.

5. Discussion

5.1. Findings

Our study has several key findings. First, we find
that achievement signal is an effective indicator of
quality, implying that suppliers with high achievement
signals (signals indicating completion of past jobs on-
time and within-budget) performed focal jobs well to get
high evaluations of quality. In contrast, without
accounting for job characteristics, skill signal is not an
effective indicator of supplier quality.

Second, our results suggest that the effectiveness of
achievement signal as an indicator of supplier quality is
amplified in jobs that are of longer duration and higher
cultural distance. Third, we find that skill signal is an
effective indicator of supplier quality in jobs of longer
duration and jobs with higher cultural distance. This
result is salient because it points to the key importance
of skill signals in these conditions (long job duration and
high cultural distance), although skill signals are not an
effective indicator of quality without accounting for
these conditions. In addition, we compared the
difference in the coefficients of the interaction terms and
found that in jobs with longer duration or higher cultural
distance, achievement signal is more effective than skill
signal as an indicator of supplier quality. Hence, for jobs
of long duration or high cultural distance, buyers would
be better off by relying on the achievement rather the
skill signal of suppliers to infer quality. Overall, our
findings point to achievement and skill signals as
effective solutions to the challenge of inferring labor
supplier quality in online freelance job markets.

5.2. Theoretical Contributions

Our study offers two key theoretical contributions.
First, we contribute to literature on online freelance job

markets by highlighting conditions under which signals of skill and achievement are effective in conveying quality of suppliers. Prior research lacks a consensus on signal effectiveness in online freelance job markets [2, 15] and studied signals from agency affiliation, evaluations, past performance signal [13] and capacity signaling [21] perspectives. Prior research also calls for studying the influence of various kinds of signals and how conditions related to country of origin or job characteristics influence effectiveness of signals [15].

We contribute to this conversation by offering a novel perspective of specific job conditions in which skill signals and achievement signals are more useful indicators of supplier quality — a key challenge in cross-national labor demand settings in freelance job markets. Job characteristics in such markets have a salient influence on effectiveness of signals as indicators of supplier quality. In jobs of high duration or cultural distance, buyers benefit from observing suppliers' skill signals and achievement signals, which allow buyers to make more accurate inferences about supplier quality. Long duration jobs are characterized by high opportunism risk due to high likelihood that suppliers may slack off on delivering quality.

Likewise, due to the global nature of online freelance job markets, jobs of high cultural distance are subject to higher selection risk due to the greater likelihood that cultural differences lead to biases and misconceptions. Hence, in jobs of high duration and cultural distance, which respectively pose high opportunism risk and selection risk, it behooves buyers to pay attention to achievement signal and skill signal as indicators of supplier quality. For suppliers, it is crucial to be aware of the importance of skill and achievement signals in terms of how their quality will be judged by buyers. Suppliers can take appropriate steps to strengthen their signaling, since effectiveness of signals is substantial, particularly in job conditions of longer duration and higher cultural distance. The implications of these findings are profound for prior and future work with supplier quality as a phenomenon of interest. Prior work [e.g., 2, 15] can be revisited as it is plausible that the results may have been influenced by a combination of job characteristics and supplier signals. Future work must incorporate these combinations of signals and job characteristics both conceptually and empirically. In sum, we complement and contribute to the stream of research on freelance job markets in gig economy by uncovering specific contextual influences of signals in such settings.

Second, our study provides a novel perspective related to the seminal work of Spence [41] in context of online freelance job markets. Spence [41] suggested that job candidates (signalers) obtain an education to signal their quality and reduce information asymmetry.

However, in online freelance job markets, education credentials (skill signal) may fall short in signaling actual quality of signalers (suppliers). The effectiveness of skill and achievement signals as indicators of supplier quality is not straightforward as we counter-intuitively found that skill signal is not effective in explaining supplier quality without accounting for job conditions, whereas achievement signal is an effective indicator. Thus, skill signals may not always predict actual supplier quality. Psychology literature suggests that people often prefer potential over achievement when evaluating others in offline contexts [14]. However, to the extent that skill signal reflects supplier potential whereas achievement signal reflects supplier prior achievement, our findings suggest that in digital platforms, achievement matters more than potential.

5.3. Managerial Implications and Conclusion

Our study has key managerial implications. First, it points to how signals of achievement and skill in online freelance job markets mitigate a strategic challenge that buyers encounter when leveraging these online freelance markets, especially in jobs of high duration or cultural distance. Our results help online freelance job market buyers interpret signals and infer supplier quality considering job conditions. Second, the study underscores job duration and cultural distance as key boundary conditions for effectiveness of signals in online freelance job markets. Third, our study has implications for signal provisioning in online freelance job markets as a relevant platform design problem. Platform designers may need to focus on devising appropriate achievement signals that highlight on-time and within-budget completion of jobs.

To conclude, given the salience of online freelance job markets in global labor markets, our findings are valuable to infer supplier quality based on information signals under conditions of job duration and cultural distance in cross-national labor demand settings.

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