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The Appeal of Third-Party Certifications: Information Unraveling in Natural Experiments¹

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Abstract

Despite the abundance of studies on consequences of certification, there is little empirical research on what motivates sellers to attempt certifications in the first place. One of the most intriguing theoretical predictions is the “information unraveling” proposition, which predicts a “domino- effect” in sellers’ certification-seeking behavior when a certification opportunity arises. To test this proposition, and to further identify factors that motivate sellers to seek certifications, we exploit two unique natural experiments and detailed transaction data on VWorker.com, a global online labor market. The first natural experiment was the introduction of certifications into the market, with a fee; and the second occurred when certification exams were made free. We derive and test hypotheses on factors that motivate sellers to seek certifications, including word-of-mouth, repeat customers, cost of certification, and informational cascading. We also find that, contrary to theoretical predictions, certification status *negatively* impacts some sellers’ ability to obtain contracts. These findings have important managerial as well as academic implications.

Key words: *third-party certification; quality disclosure; information asymmetry; signaling; information unraveling; cascading; online labor markets; online outsourcing.*

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1. Introduction

Information asymmetry between buyers and sellers has long been a fundamental issue in market transactions (Akerlof 1970), where sellers often find it difficult to convincingly communicate their quality to potential buyers. This is especially true for online electronic markets (Bolton et al. 2004; Forman et al. 2008). One important mechanism to mitigate this issue is third-party certifications, where an independent, objective third party evaluates the quality of sellers (or their products), and conveys that information to buyers. Economists have established a long stream of literature on certifications (Dranove and Jin (2010) provide a detailed survey). In this literature however, an overwhelming focus has been on the *consequences* of certifications, such as how certifications affect buyer behavior (Gao et al. 2010; Goldhaber et al. 2007). Yet we have only limited understanding of the *antecedents* to certifications, i.e., how sellers react to opportunities of certifications². Empirical investigations in this area are few and far between (Gopal et al. 2009). We seek to fill some of these gaps by studying a proprietary dataset from VWorker.com, one of the largest online labor markets, and testing hypotheses derived from theoretical literature.

A major challenge in empirical studies of certification antecedents is data availability. Ideally, researchers should identify a random sample of sellers before certification opportunities arise, track them over time, and (paradoxically) wait for an exogenous introduction of certification opportunities. The introduction of certification opportunities should be exogenous if we are to avoid biases due to self-selection³. Such conditions are difficult to be satisfied simultaneously. Our dataset provides two such rare opportunities: in the history of VWorker.com

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² Gopal & Gao (2009) study certification-seeking behavior in traditional outsourcing and find that cost-effective and export-oriented firms are more likely to acquire certifications.

³ For instance, certain types of sellers may enter a market after certification opportunities arise, and unobservable qualities of those sellers can correlate with the timing of attempts, resulting in biased estimates. We focus on sellers who registered prior to these announcements, thereby mitigating such concerns.

so far, there have been two “natural experiments” for certifications. The first one occurred on June 1st, 2002, when the market introduced third-party certifications for sellers⁴, with a fee; that is, sellers had to pay a fee to take the exams, and the fees were non-refundable whether they passed or not. The second one occurred on October 1st, 2009, when the website unexpectedly announced that exam fees were henceforth waived. In addition, we obtain access to historical transaction data of the site, allowing us to “track” sellers over time.

Exploiting these two unique natural experiments and the comprehensive field data, we address the following research questions. First, how do online sellers respond to opportunities of third-party certifications? Do they behave the way that theories such as “information unraveling” predict? Second, what factors influence sellers’ willingness to attempt third-party certifications? And third, how do third-party certifications influence buyer behavior?

Our study contributes to this literature in several ways. First, most existing empirical studies of certifications focus on binary certifications (either certified or not certified). Recent research suggests that binary certifications may not be efficient (Dranove et al. 2010; Farhi et al. 2008), yet transparent certifications are still very rare in reality. VWorker.com adopts exactly a transparent certification scheme, and we are one of the first to empirically study such transparent certifications. Second, for traditional labor and outsourcing contracts, it is often difficult to observe the actual pool of competitors for a project, but this information is directly available in our data. Third, we exploit two unique natural experiments on this market. Our dataset spans three periods: (1) no certification was available; (2) certification was available for a fee; and (3) certification was available, and free of charge. Transitions across these three periods provide two unique opportunities to study how sellers react to (a) availability of for-fee certifications, and (b)

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⁴ In this paper we refer to those on the supply side of the market as sellers or workers, and both terms are used interchangeably. Buyers or customers refer to the demand side of the market.

zero financial cost of certifications. This has been very rare in the empirical literature. Finally, a unique feature of the site is that only successful attempts are visible to buyers, but we have access to actual scores that sellers obtain even if they did not pass the exams. This allows us to test the effect of certification on buyer choice using a quasi-experimental regression-discontinuity design, which is also unique among studies of certification consequences.

As an overview of our results, we find no empirical support for the “informational unraveling” hypothesis, but several theoretically-grounded factors show systematic effects on sellers’ certification-seeking behavior. The sequence of scores that sellers obtain on exams is much less orderly than the theory predicted; we therefore identify several factors from theory about what motivates sellers to attempt certification exams, and test them in a competing risks framework. We document an interesting “herding” effect in third-party certifications: sellers were much more likely to attempt certifications when they lost to competing sellers who were certified. We also find that sellers who have ratings are more likely to seek certification than those who do not. Sellers with better ratings, and those with more repeat customers, are more likely to seek certification as well. This suggests that sellers consider third-party certifications a *complement* to, rather than a *substitute* for, other reputational information such as repeated transactions and word-of-mouth. Certification motivations are affected by financial costs of certification as well. Finally, under the transparent certification mechanism used by the site, there is a *negative* impact of certification on sellers’ probability of winning contracts: those who attempted certification but barely failed still enjoy the “benefit of doubt” from buyers, even when certifications are free. This stands in sharp contrast to theoretical predictions. Overall, our findings have important implications for the theory and practice on third-party certifications in electronic commerce, especially in the burgeoning area of online labor markets.

2. Context and Natural Experiments

(1) Context

Our data come from vworker.com, one of the largest online labor markets headquartered in the US. Buyers and sellers on the site hail from around the world. Software development projects are popular, but other jobs such as website design, translations, graphical designs and “virtual assistants” are also available. Buyers and sellers are manually verified for their real identities before they can start conducting transactions. For privacy reasons, they are only identified by user IDs instead of real names on the website.

A typical transaction process begins when a verified buyer creates a reverse auction, similar to a procurement auction (Crocker et al. 1993; Jap 2003). On the auction web page, the buyer specifies the requirements for the work, including the deliverables, specifications and deadlines. Sellers then place bids. These are independent, sealed bids: only the buyer knows the bid amount, and sellers cannot see each other’s bids. From the buyer side, they can see the buyer’s bid as well their profile information, including their prior ratings and certifications (if any). The buyer is free to choose any seller, and low bids do not necessarily win. Once the winning seller is chosen, the buyer transfers the amount of the winning bid into an escrow account hosted by the site; the contract is thus created. At that time, the winning seller’s ID (with a link to his or her profile page) and the bid amount are made public so as to prevent fraud or collusion. The winning seller will then begin working, and continues to communicate with the buyer through the website⁵. Buyers examine the output from the seller when it is ready. If the buyer accepts the output as satisfactory, the escrowed funds will be released to the seller after the website deducts a service fee, and the project is considered complete. At that time, buyer and

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⁵ Although it is technically possible for buyers and sellers to communicate offsite, offsite communications are not considered by arbitrators should disputes arise; only on-site communications will be binding on both parties.

seller can provide ratings on each other. If the project does not complete successfully, either party may initiate an arbitration process by submitting a request to the site. A staff member of the site will act as an arbitrator. All communications on the site will be used to determine fault.

At the seller selection stage, one piece of information that the seller can show to potential buyers is a third-party certification, obtained through certification exams. Certification exams are provided by ExpertRating.com but fully integrated to VWorker.com; sellers do not need to leave vworker.com to attempt certifications. ExpertRating.com is an independent, third party certification agency. It creates and maintains extensive databases of exams on various subjects, and has a large customer base besides VWorker.com. According to its website, its customers include IKEA, Ericsson, Associate Press and UPS. It is widely considered a neutral third-party that measures seller or worker abilities through objective tests. If (and only if) a seller passes the exam, the worker becomes “ExpertRating Certified,” and there will be a “certified” icon displayed on their public profile. This icon will also show up next to all their bids (see Figure 1). Buyers can click on the icon to see the subject and actual score that the seller had obtained. The seller cannot turn off this icon, or hide the actual scores of their attempts. It is also not their discretion whether to show exam results on each specific bid; disclosure automatically applies to all future bids. The seller is allowed to make multiple attempts on an exam (with at least 48 hours between attempts), and the most recent successful attempt will be shown on their profile. One important feature of the website is that failed attempts are not displayed publicly; to users of the site, a seller who attempted but failed will appear exactly the same way as a seller who never attempted. The appeal of our dataset is that we have information on all certification *attempts* of all sellers since the creation of the site, including failed attempts not visible to site users. We will exploit this feature when studying the effect of certification on buyer choices.

[Insert Figure 1 about here.]

Our dataset includes detailed transactional information on the site, including information about buyers and sellers, all bids placed in each auction, and all certification exams attempted by sellers. We combine this detailed information with the natural experiments that arise, and quasi-experimental designs, to answer our research questions.

(2) Natural Experiments

In addition to the comprehensive data, we leverage two unique natural experiments related to certification exams on vworker.com. The first one (henceforth “NE1”) occurred when opportunities of certifications were first introduced to the site on June 1st, 2002, but for a fee. Sellers interested in being certifications needed to pay \$50 to take an exam, and the fees were non-refundable whether they passed or failed. This is comparable to other certifications documented in the literature, such as ISO certifications, bar exams, and CPA exams, in the sense that examinees need to pay fees to take those exams no matter what the outcome is. The second natural experiment (henceforth “NE2”) occurred on October 1st, 2009, when the website quite unexpectedly announced that the fees for exams were waived, whereas all other features of the exam remained the same. To understand sellers’ certification-seeking behavior, we take a random sample of sellers, track them over time (especially over NE1 and NE2), and construct a longitudinal survival dataset. We describe these samples in the *data* section.

3. Hypotheses

Our study is informed and motivated by the extensive literature in several disciplines. We classify our hypotheses into three categories: (1) Macro-level hypothesis on the unraveling

process; (2) factors that may affect sellers' motivation to attempt certifications; and (3) effects of being certified.

The two natural experiments provide an ideal situation to test the “information unraveling” hypothesis. “Information unraveling” refers to the following theoretical scenario: In a marketplace with asymmetric information, sellers cannot convincingly communicate their product quality to buyers (Akerlof 1970) because quality is inherently unobservable and unverifiable. To mitigate this concern, certifications allow firms to convey quality information more convincingly through a neutral third-party (Daughety et al. 2008). Under the assumption that sellers know their true quality type, if certification is made available in a market with sellers of varying quality, the highest-quality seller will have the strongest incentive to obtain it so as to differentiate from competitors. Once the highest-quality seller is certified, the seller with the second-highest quality will have a similar incentive to seek certification so that they can differentiate from the remaining population of sellers. As this chain-reaction process unfolds, all sellers will be certified (their abilities measured and disclosed by the certifications) , and bad sellers exit the market because buyers interpret the lack of certification as a negative signal (Dranove et al. 2010). Information is now “unraveled” because seller quality is no longer hidden. This has long been an intriguing proposition in the theoretical literature, but has received little systematic empirical tests. Part of the reason is that in reality it is difficult to identify the “time zero” at which certifications are introduced.

The two natural experiments that we describe earlier provide two ideal situations to test this theory. For both NE1 and NE2, if “information unraveling” theory is correct, we can expect that sellers who attempt exams earliest should have higher scores than those taking the exam later. If we examine the time series of exam scores ordered by the time of attempts, it should

have negative auto-correlation. In particular, when certification exams are made free, the unraveling process should not only occur, but at a faster rate than the first one. This is consistent with the argument made by Grossman (1981) and Milgrom (2008): when certifications are free, consumers should infer that sellers who do not disclose are of lower qualities. All sellers should now have a much higher incentive to seek certification. In this “rush to certification,” then, best sellers should be even more likely to attempt early so as to differentiate from competitors, and the unraveling process should occur even faster. We therefore hypothesize that:

H1 (information unraveling): The time series of the exam scores should have negative auto-correlation after either of the natural experiments occurred.

Regardless of whether H1 is supported, it only depicts a macro pattern of the process. To understand how various seller characteristics are related to their certification-seeking behavior, we now turn to the second hypothesis. Certification is not the only remedy for information asymmetry. Two important alternatives are sellers’ reputation, and repeat transactions with customers (Banerjee et al. 2000; Dellarocas 2003; Forman et al. 2008). These mechanisms are well studied in the literature. However, few studies have addressed how these signals affect sellers’ motivations to seek third-party certifications, i.e., do sellers consider these signals to be a complement or substitute of certifications?

We hypothesize that sellers with higher ratings are more likely to seek certifications than those with lower ratings. Despite the “complete information” assumption in theoretical economics, sellers may not fully be aware of their quality until they have interacted with buyers and received buyer feedback, either in terms of repeat transactions or good ratings⁶. When they do receive such positive feedback, sellers should be more confident in seeking certifications.

This is especially plausible in our context because certification results are transparent. For those

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⁶ We note that an important assumption for the “information unraveling” hypothesis is that sellers know their “type,” or quality.

who still do not have any word-of-mouth, a low exam score may eliminate any chance of winning contracts, as exam score becomes the sole quality signal visible to buyers. For those who already have ratings but the ratings are low, showing a mediocre exam score will not help either. This is less of an issue when certification is binary, but it becomes risky in our context because it is transparent. Hence, we should expect that sellers who have ratings information are *more* likely to do so than those who do not have any, and those with better reputational or relational information are *more* likely to seek certifications than those who do not.

One may argue that sellers with good reputation may have an incentive to avoid certifications; however, such effects will be quite limited. Contract work in online labor markets can be considered “credence goods” (Darby et al. 1973; Wolinsky 1993) in the sense that buyers are typically unable to fully evaluate quality even after its completion. A seller may be able to gain buyers’ trust by providing minimally workable programs, being nice to the buyer, and giving what the buyer *wants*. This will allow the seller to establish repeat business as well as good word-of-mouth, yet in fact, a different seller may have provided better solutions that address the actual *needs* of the buyer. In other words, reputation and repeat business may be useful, but they are ultimately subjective. Certifications are the opposite. Exam results provide an objective and vertically ranked metric of sellers’ abilities (e.g. a score of x points out of 100). Therefore, unless sellers achieve very high scores, repeat customers may start to doubt their own judgment. In this scenario, established sellers will be reluctant to attempt certifications. However, this effect will be limited to those repeat customers. Getting certified, on the other hand, may open doors to many new customers. Given the decentralized nature of this market, it is unlikely that this effect will outweigh its opposite effect that we discussed earlier. We therefore hypothesize that overall, established sellers should be more likely to seek certification.

H2a (Reputation): Sellers who have ratings should be more likely to seek certification than those who do not have any. Among those that do have ratings, sellers with higher ratings should be more likely to seek certification than those with lower ratings.

H2b (Relational factors): Sellers with more repeat customers will be more likely to attempt certification than those with fewer repeat customers.

Whether it is free or not, third-party certification is an informational product or service, and sellers may have uncertainties over its usefulness. Just like the diffusion of products and services throughout a population, sellers may also exhibit “informational cascading” (Bikhchandani et al. 1992; Welch 1992) or “herding” (Bernhardt et al. 2006; Hong et al. 2005) in their certification-seeking behavior. On VWorker.com, before the buyer chooses a seller, all bids are sealed and sellers do not know who their competitors are. However after the buyer chooses a seller, the winner’s ID – with a link to his or her profile showing their certification status – is made public. When losing sellers observe that the winner is certified, they will be more motivated to seek third-party certification as well. In other words, observing the behavior of others, especially those with desirable outcomes, will induce the imitation of such behaviors. We therefore hypothesize that:

H3 (Cascading Effects): Sellers are more likely to seek certification when they lose to certified sellers.

Financial costs of certifications should also play a role in sellers’ intention to disclose, although there may be two opposite effects. From a signaling perspective, it is well established in the economics literature that signals are more useful when they are more costly (Grossman 1981; Spence 1973; Spence 2002), as higher costs create better separating equilibrium between good and bad sellers. Removing the financial cost of certifications may – all else equal – reduce sellers’ expected *benefits* of obtaining them. Consistent with this argument, several prior studies suggest that sellers may not disclose even if the cost is minimal (Cheong et al. 2004).

Meanwhile, the *costs* are lower as well, so the net result is not immediately obvious. However there may be additional costs to *not* being certified: prior theoretical literature suggests that when costs are lower or zero, the lack of certifications is likely to be interpreted as low quality (Dranove et al. 2010; Grossman 1981; Milgrom 2008). This should provide addition incentive to seek certification. We therefore hypothesize that overall, sellers should be more likely to attempt certifications when financial costs are waived.

H4: Sellers should be more likely to attempt certifications when the costs are waived.

Finally, although the focus of this paper is antecedents to sellers' certification-seeking behavior, our understanding will not be complete without studying some direct consequences of being certified. One of the basic reasons for certification is that all else equal, buyers should be more likely to award projects to a certified seller. In particular, we discussed earlier that when the cost of disclosure is zero, consumers will infer that firms who are not certified must be of lower qualities (Dranove et al. 2010; Grossman 1981; Milgrom 2008); hence, there should be a negative effect of *not* being certified. Not surprisingly, existing literature has documented much empirical evidence on the positive effect of certifications (Corbett et al. 2005; Gopal et al. 2009). We therefore hypothesize a positive effect. However, since certifications in our context are transparent (Farhi et al. 2008) rather than the typical binary scheme, results may differ from common wisdom and prior studies.

H5: Certification status should lead to a higher likelihood of winning contracts.

4. Data

We now describe the data used in our analyses. We begin with an overview of certification exam activities on the site, which provides the basis to test the first hypothesis on informational unraveling (H1). We then describe the construction of survival datasets that allow us to test the

hypotheses on factors that motivate sellers to seek certifications (H2a-H4). We describe empirical modeling strategies in the subsequent section, including models used to test H5.

(1) Overview of Data

Our main interest is the first time that each seller takes certification exams. Figure 2 plots the number of sellers' first attempts at certifications on the entire site since the site was created.

There is a striking jump in the number of certification attempts per day after the certification fees are waived. Between NE1 and NE2, 1505 sellers took certification exams, and within one year after NE2, 7466 sellers did. As of September 2010, among all the first-attempts at certifications, 59.19% (5309) sellers passed and were certified, and the rest did not. Among those who passed, their average score is 74 with a standard deviation of 10. Among those who failed, the average is 42, with a standard deviation of 12. We use the time series of scores that sellers obtained on exams to test Hypothesis 1.

[Insert Figure 2 about here.]

(2) Variable constructions and random samples

To test Hypotheses 2a-4, we look at each seller over time, and calculate an extensive list of variables on a monthly basis. The outcome variable is each seller's "time to first attempt," because this reveals his or her motivations to disclose. We therefore construct the dataset as a survival dataset. In addition to certification attempts, censoring may also occur when the seller leaves the market, so we consider it as a competing risk. Specifically, for each seller in each month, we calculate the seller's rating at the beginning of the month (whether they have ratings and if so, the volume and valence of ratings); number of buyers that they repeatedly contracted with; number of times that they lost to a certified seller in the prior month; whether they made attempts at the certification exams in that month; whether they exit the market in that month; and

so on. To ensure comparability as well as computational tractability, we compile two random samples of 500 sellers each, one for each natural experiment, which we describe below.

(a) Sample 1 (for the first natural experiment: Certification made available)

We identify all sellers who registered on the site prior to NE1 (Natural Experiment 1) and had remained active on the site as of NE1. From these, we randomly draw 2000 sellers. We then track their activities at monthly intervals all the way until September 2010, one year after NE2.

(b) Sample 2 (for the second natural experiment: Certification made free)

The second natural experiment is slightly different in the sense that sellers could, in theory, attempt certifications prior to the exams are made free. To account for this, we look at all sellers on VWorker.com as of September 2008. Out of these sellers, we also take a random sample of 2000 sellers, and track their behavior over time till September 2010. This allows for the possibility that they attempt certifications prior to NE2. In addition to the monthly information that we described above, we also include a dummy variable *FreeCert* indicating whether the month is before or after NE2 (1 if exams are free; 0 otherwise). Table 1 provides a summary of the major variables in our analyses.

[Insert Table 1 about here.]

5. Models

Since we have access to all certification exam attempts (including those not disclosed to the public), we test the first hypothesis using straightforward time-series methods. If the basic rationale behind “information unraveling” is correct, we should be able to observe that the first attempt results in the highest scores, second lower, third even lower, so on so forth. In other

words, there should be a negative autocorrelation in the time series of exam scores, starting from NE1. This can be tested using the simple regression model below⁷:

$$Score_t = \alpha_0 + \alpha_1 Score_{t-1} + \epsilon_t \quad (1)$$

To test the set of hypotheses on factors encouraging or discouraging seller certifications (H2-H4), we use competing risks models (Cleves et al. 2010; Fine et al. 1999) to model how soon after NE1 and NE2 that sellers first attempt certification exams, and how various covariates are associated with the timing of certification attempts. While the sellers can attempt multiple times, the first certification attempt is the most significant as it shows their willingness to disclose. The two natural experiments provided natural points for the onset of “risk,”⁸ or the beginning of analysis time. For H2a, we measure the seller’s rating information in two ways and therefore estimate two parallel models: one using a binary indicator for whether the seller has any ratings as of that month, and the other using both the volume and valence of the seller’s ratings as of that month (i.e. number of ratings, and the weighted average of ratings that buyers can see on the seller’s profile). In the second specification, sellers with no ratings information will not be included in the estimation. For H2b, we measure the sellers’ relational status using the number of repeat buyers that the seller had in the previous quarter, i.e., those who conducted at least two transactions with the seller. For H3 (cascading), we calculate the number of times in the previous month that the seller placed bids in an auction, did not win, and the winner was certified at the time of auction. To accommodate the fact that sellers may exit the market before

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⁷ This assumes that sellers’ scores on the exams do measure their underlying capabilities. In one of our robustness tests, we replicate this analysis using alternative measures of quality, such as sellers’ later reputation and repeat transactions. While results are consistent, these alternative measures are noisier due to their subjectivity and selectivity (i.e. only those who have sufficient number of transactions will have information on those metrics).

⁸ Note that “risk” here refers to the conditional probability of the seller attempting certification exams in each period, given that he or she has not attempted until the period before. For NE2, we consider October 2, 2009 as the onset of “risk,” albeit a slightly different risk in the sense that certifications are free after that.

they attempt exams⁹, we adopt a competing risks framework. Fine and Grey (1999) suggest that we can model the subhazard in a semi-parametric fashion similar to Cox proportional hazards model:

$$\bar{h}(t|X) = \bar{h}_0(t)\exp(X\beta) \quad (2)$$

where X is the vector of covariates, including reputational information (as described above, in two different specifications), relational information (number of repeat customers), the number of times that the seller lost to certified competitors, as well as a number of other variables that may affect sellers' tendency to seek certification but we do not pose *ex ante* hypotheses for. These include (1) number of days since the seller registered on the site, (2) number of active sellers on the market as of that month; and (3) seller's bid success rate in the previous month. Just as in Cox proportional hazards models, the baseline subhazard function ($\bar{h}_0(t)$) is not estimated directly. We implement this in Stata using the `-xtcrreg-` routine.

To identify the effect of certification on buyer choices, we cannot use cross-sectional analysis because the certification status is not exogenously assigned to sellers, and the estimate will be biased due to endogeneity. Instead, we take a quasi-experimental regression-discontinuity approach¹⁰ (Shadish et al. 2002; Thistlethwaite et al. 1960). Specifically, we have access to all certification *attempts*, including failed ones; but buyers can only see the result of successful attempts. Hence, sellers who *almost passed* (scored lower than the threshold, but only by a small margin) and those who *almost failed* (scored higher than the threshold, but only by a small margin) have highly similar unobservable qualities, but they simply differ in the status of being certified or not. Within a small bandwidth of the passing grade (60), the status of being certified is nearly random, and regression-discontinuity yields unbiased estimates (Shadish et al. 2002).

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⁹ Even if we do not consider the competing risk of exiting the market, results are still consistent when we use a Cox proportional hazards model.

¹⁰ Alternatively, the readers may consider this the reverse of the effect of *not* getting certified.

This rationale is highly comparable to previous empirical studies in the regression discontinuity tradition. For instance, when studying the effect of awarding scholarship on educational outcomes, Thistlethwaite and Campbell (1960) exploit the cutoff in exam scores that determines whether a scholarship is awarded or not. For us, the sharp difference in whether a certification status is observed or not provides a unique opportunity to identify the effect of certification on buyer choices. We gather all bids that these sellers placed after these “borderline” attempts and before they make any other certification attempts. We use scores of 5 points above or below 60, i.e. 55 to 64, inclusive¹¹. We identify the amount of these bids, the outcome of those bids, their ratings information as of that time, number of competitors they face in those auctions, and the length of the text that accompanies their bids. We then estimate the probability of the bid being accepted by the buyer as a logit model (accounting for robust standard errors), with the above variables as covariates in addition to the main variable of interest, i.e. whether the seller is certified or not. The logistic model that we estimate is:

$$\ln \frac{p_i}{1 - p_i} = \beta_0 + \beta_1 \text{Certified}_i + \beta_2 X_i + \epsilon_i \quad (3)$$

where p_i is the probability that Bid_i is the winning bid in the auction that it was placed in, Certified_i is a dummy variable that equals 1 if the seller had passed his first certification exam prior to the bid but the score was between 60 and 65, inclusive; and 0 if the seller had taken a certification exam but did not pass (therefore not certified), and his score was between 55 and 59, inclusive. X_i is a vector of control variables, including the sellers’ reputational information and so on as described. We estimate this logistic model using maximum likelihood with robust standard errors.

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¹¹ We also tried bandwidths of 4 and 6; results are consistent as well.

6. Results and Discussions

H1 predicts that if the Information Unraveling hypothesis is accurate, we should observe that α_1 should be negative and statistically significant. Since sellers sign up at different times, we take advantage of NE1 and NE2 and estimate Equation 1 on six series of exam scores. The first three focuses on exam scores achieved by sellers who signed up before NE1; those who signed up 1-6 months before NE1; and those who signed up 7-12 months before NE1, respectively. We then repeat this for NE2, and all results are reported in Table 2. Even in this univariate specification, α_1 , the coefficient on $Score_{t-1}$, is never statistically significant. In fact, when we test the above series of scores, as well as the entire series of all scores on the site using Portmanteau test for white noise, none of them is statistically differentiable from white noise. In other words, the sequence of exam scores is much more random than H1 predicted. In fact, our results suggest that the process by which different sellers seek certifications is much more complicated in this market than predicted by theory. We therefore turn to the competing risks models, which more systematically relate seller characteristics to their certification-seeking behavior. Results are reported in Table 2.

[Insert Table 2 about here.]

Our competing risks models estimate the probability that the seller seeks certification given that he or she has not sought until the previous period, accounting for the fact that the seller may exit the market before certification attempts. Table 2 reports coefficients; however, to better interpret the economic significance of results, we use exponentiated form of these coefficients instead, which is equal to the sub-hazard ratios (SHRs). These ratios are compared against 1. If the ratio for a covariate X is greater than one, it means that all else equal, when X is higher, the seller is more likely to seek certification sooner. If the ratio is smaller than one, it

means that all else equal, when X is higher, the seller is likely to seek certification later. Results are reported in Table 3.

[Insert Table 3 about here.]

H2a and H2b explore how sellers' existing reputational and relational information affect their decision to seek third-party certifications. Results from the two subsamples for the two natural experiments are quite consistent. The SHR of the dummy variable *hasRating* is greater than one (specifically, 9.3 in NE1, and 8.3 in NE2), meaning that those who have ratings are about 8-9 times more likely to seek certification than those who do not have any ratings yet. This provides first support of H2a, suggesting that sellers tend to view certifications as complements, rather than substitutes, to ratings information. Across different specifications, the SHR on this variable is larger for NE1 than NE2, suggesting that when certification is free, sellers consider its "complementary" values to be somewhat lower, as it is now more accessible to competitors.

We next consider the volume and valence of ratings, noting that valence of ratings are only available when the seller has at least one rating (thereby reducing the number of usable observations). Results in columns 2 and 4 ("Model 2") show that sellers' rating valence is significantly associated with their probability of seeking certification, whereas the volume of ratings is not. This means that once sellers have ratings, the valence of ratings affects their tendency of seeking certifications more than the volume. The SHR on rating valence is 1.54 for NE1 and 1.23 for NE2, suggesting that sellers with higher ratings are more likely to attempt, also consistent with H2a. Similarly, the complementary value of certification in the eyes of established sellers seems to be lower for NE2 once certifications are made free. We conclude that H2a is supported for the valence of ratings but not the volume of ratings. We obtain similar results for H2b; sellers with more repeat customers are more likely to seek certification.

The next hypothesis that we test is H3, the cascading hypothesis. A consistent finding across both natural experiments is that losing to certified sellers is an important motivation for sellers to seek certification, which lends support to H3. This result is consistent when we use the absolute number of times that the seller lost to certified sellers in the previous month, or a dummy variable indicating that such events occurred. The subhazard ratio in the first natural experiment is higher than the second (1.112 vs. 1.038), suggesting that when there is a financial cost to seek certification, the effect of informational cascading is even stronger. As we discussed earlier, certification itself is a “product” with uncertain value to sellers, and sellers will be even more likely to imitate others’ behaviors when there is an upfront cost, as the downside to taking the risk is higher.

We next examine the results on the financial cost of certification (H4). We included a dummy variable indicating whether certification is free in that month, for the NE1 subsample, since this set of sellers experienced both NE1 and NE2. The SHR on this dummy variable is positive and statistically significant, suggesting that removing the cost of certification significantly motivates sellers to attempt them. This is consistent with the visualization in Figure 2 where we observe the sharp increase in certification attempts after NE2.

Last but not least, we test H5, the effect of certification status on buyer choice using the regression discontinuity approach. The multivariate specification is described in Equation 3 and the results are provided in the first two columns of Table 4. The outcome is binary: 1 if winning and 0 otherwise. In addition to a dummy variable for being certified (i.e. barely passing), we control for a number of other variables that could have affected buyer choice as well, such as rating. Since rating valence is only available when the seller has more than one rating, we estimate one specification in which reputation is indicated by whether or not the seller has any

ratings; and the other in which reputation is measured by both the volume and valence of ratings (similar to our approach in the competing risks models). We estimate this model using a logistic specification with robust standard errors.¹² Results regarding the effect of certification are highly consistent in both specifications; the coefficients on “*Certified*” are negative and statistically significant, indicating that being certified is actually associated with a lower probability of winning contracts. The odds ratios provide insights into their economic significance. Across all sellers (in columns 1 and 3, “Model 1”), being “barely certified” reduces the probability of winning contracts by about 19% ($1 - \exp(-0.213)$). Among sellers who have ratings (in columns 2 and 4, “Model 2”), being “barely” certified reduces the probability of winning by about 17% ($1 - \exp(-0.183)$). Results remain highly consistent when we retain only bids placed after NE2, when certifications are made free¹³.

[Insert Table 4 about here.]

The findings on the effect of certification are intriguing especially when we consider predictions from the theoretical literature. It has been suggested that when certifications are free, buyers will infer that uncertified sellers – whether they failed certification, or they never even attempted – are of inferior qualities (Dranove et al. 2010; Grossman 1981; Milgrom 2008). Note that buyers cannot differentiate whether the seller had attempted but failed, or had never attempted at all. Quite surprisingly in our context, we find that buyers still give uncertified sellers significant “benefit of doubt” even after the second natural experiment, when certifications are available to sellers for free.

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¹² The last two columns are robustness test results; i.e. for the continuous variables such as number of bidders, we tried log-transforming them before including them in the model. Results are highly consistent. We also obtain consistent results when we use probit models instead.

¹³ There are not enough observations of such bids placed between NE1 and NE2, since much fewer certification attempts occurred before NE2.

7. Robustness and additional tests

(1) Robustness

We previously tested the information unraveling hypothesis using the time series data on sellers' scores on certification exams. An underlying assumption here is that these scores can serve as an indicator for the sellers' abilities. This is indeed the goal of these tests and the basic rationale behind certifications. To ensure robustness, we re-test H1 using two alternative measures of seller quality: (1) seller's *future* ratings from buyers; and (2) the number of seller's *future* repeat customers. These have both been used in the literature as measurements of seller quality (Banerjee et al. 2000; Crocker et al. 1993). We therefore conduct the following tests.

To use a seller's "future" reputation as an indicator of his or her quality, we first identify sellers who registered on the site before NE1. We calculate the valence (weighted average) of their ratings prior to NE2¹⁴, or as of the time that they exited the market if they did. We then test whether those who had better ratings prior to NE2 were more likely to attempt certifications earlier. Similar to the scores on exams, the time series of the sellers' ultimate ratings is also not statistically differentiable from white noise. We further fitted a first-order auto-regressive model; the coefficient is not statistically significant either. For NE2, we identify sellers who were active on the site prior to NE2, and similarly obtained their ratings info as of the end of our sampling period (September 2010), or when they exited the market if they did. We repeat the same analysis, and the same results emerge. In other words, the information-unraveling hypothesis is rejected for both NE1 and NE2 even when we measure qualities using sellers' *future* reputation profiles.

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¹⁴ It should be noted that not all sellers have ratings (or repeat transactions as we discuss next), as they have to find jobs before they can be rated. Ratings and repeat transactions can also be influenced by buyer-side factors; therefore, they are more restrictive measures of seller quality than exams.

Another measurement of seller quality is the number of repeat customers that the seller is later able to retain (Banerjee et al. 2000; Crocker et al. 1993). We repeat the same data construction as above, but instead of reputation profiles, we now calculate the number of repeat buyers (defined as those who have 2 or more transactions) that the seller has worked with as of NE2, and one year after NE2. Results are highly consistent: There is still little evidence to support the information unraveling argument.

To ensure the robustness of the findings in the competing risks model, we test an alternative specification where all continuous variables enter as dummy variables. For instance, instead of “number of times losing to certified sellers,” we replace it with a binary indicator for such losses taking place. Results are highly consistent.

(2) Other consequences of certification

Certifications have important implications for the market. In the body of the paper, we focus on the effect of certification on buyer choice, as this is the first-order effect that sellers should care about. For market makers however, the overall efficiency of the market is no less important. We therefore conduct exploratory study of how “free” certifications affect project outcomes and market outcomes. Specifically, we gather data on all disputes that occurred in the market. The outcome that we are interested in is a dummy variable for whether the seller is found to be at fault (1 if yes and 0 otherwise). We model this as a function of sellers’ ratings information before the project, as well as his or her certification status. We incorporated the ratings variables in the model first as a binary indicator (has rating or not); then as both the volume and valence of ratings; and then as a log-transformed number of ratings together with the valence of ratings. Results are highly consistent across these three specifications. For projects that enter arbitrations, it appears that sellers who are certified are less likely to be found at fault

(about 14% less likely), suggesting that these sellers may indeed be of higher quality.

Interestingly, we also find that these sellers are also more likely to initiate arbitrations in the first place (about 20% more likely). It appears that their certification status helps these sellers gauge their abilities and become more confident. In fact, they are confident enough to initiate arbitrations when disputes arise – and are able to win them. A detailed analysis will exceed the scope of this paper, but it does appear that certification has interesting implications for buyer-seller relationship dynamics as well.

8. Implications and Future Research

Two of the most important mechanisms designed to mitigate information asymmetry in electronic markets are online reputations (word-of-mouth) and third-party certifications.

Whereas online word-of-mouth has attracted significant interest from IS researchers, there has been much less attention on third-party certifications. With the growth of electronic markets, third-party certifications may come to play an increasingly more prominent role, especially as concerns grow recently over potential abuses of the word-of-mouth mechanism¹⁵. Existing research in certifications has mostly focused on its consequences rather than antecedents. Due to challenges in data collection, few studies have examined what drive online sellers to seek certifications. In addition, although the theoretical literature suggests that transparent certification schemes are more effective and preferable to binary certifications, there has been very little empirical work on the transparent type.

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¹⁵ For instance, customer reviews can be easily – and increasingly more sophisticatedly – manipulated or even purchased, and there are no easy ways to filter out bogus reviews given their highly decentralized nature. A recent New York Times article (Streitfeld 2012) documented websites that allow book publishers to *buy* good product reviews. While third-party certifiers may also be manipulated, product reviews are much more decentralized and less accountable, making them much more difficult to regulate than third-party certifiers. Certifications can therefore become an important complementary mechanism for e-commerce.

We seek to fill this gap in the literature by employing a comprehensive longitudinal, micro-level data set from VWorker.com, one of the largest online labor markets with participants from around the world. In particular, we exploit two natural experiments that provide unique opportunities to study factors that motivate sellers to seek certification: one, when certifications were made available to sellers but for a fee; and the other, when certifications were made free. We construct two random samples of sellers in the market, one for each natural experiment, and “track” them over time to create longitudinal datasets. Drawing on the rich theoretical literature in economics and IS, we relate their certification seeking behavior to factors such as their reputational profile in a competing risks framework. Furthermore, taking advantage of a unique feature of the website that failed attempts are not shown to buyers, we estimate the effect of being certified using a quasi-experimental regression-discontinuity approach.

Our analysis yields some interesting findings about factors that drive online sellers to seek third-party certifications, and consequences of being certified. We find that sellers who already have ratings and repeat customers are more likely to seek certifications, indicating that they tend to view certifications as complementary to, rather than substitute of, these alternative quality signals. In addition, the valence of ratings overwhelms the volume of ratings in motivating sellers to seek certification. Moreover, to our knowledge, we are the first to identify a “herding” phenomenon in third-party certification: sellers who lose to certified competitors are much more likely to seek certifications. We also find that when certifications are made free, sellers are much more likely to seek certifications as well. This is particularly interesting when we consider our finding that in fact, medium-quality sellers would have been better off (in winning contracts) if they were *not* certified.

Many of our findings have important implications for future theoretical and empirical work. For instance, our finding that buyers continue to give uncertified sellers the “benefit of the doubt,” even when certification exams are free, stands in stark contrast to theoretical predictions in the literature. Second, the apparently “irrational” behavior of medium quality sellers also casts doubt on the seemingly innocuous assumption in theoretical economics that sellers are fully aware of their qualities. In fact, as we discussed in “overview of data,” a significant number of sellers appear to be overconfident with their capabilities – or they may have been driven to do so because of the herding effect that we identified earlier (which is still a behavioral bias). This may also help explain why we do not observe the dynamic pattern of certification-seeking behavior as the “information unraveling” proposition predicts.

From a practical point of view, our findings suggest several means that market makers can better encourage seller disclosure – for instance, online markets will be more likely to convince established sellers (especially in terms of the valence of ratings) than new sellers to seek certifications. Alternatively, they may encourage such behavior by even more prominently highlight the fact that winner of an auction is certified so as to induce a herding effect. Reducing the financial costs of exams helps as well.

Third-party certification can serve an increasingly prominent role in electronic markets, especially in online labor markets, and our study can be extended in several directions. For instance, we focus on sellers’ first attempts because they reveal the sellers’ intention. It will be interesting to examine sellers re-taking behaviors and see if there is any learning that may take place, which will help address the long-standing debate in economics regarding the signaling versus human-capital effect of certifications (Bedard 2001): do certification exams increase the ability of sellers, or do they merely reflect their inherent quality? Furthermore, with a different

dataset, one may study whether our findings still hold when certifications are not as transparent as they are on VWorker.com, but binary (e.g. either pass or fail). Last but not least, in addition to our study on certification's effect on buyer choice, more detailed research should be done to identify the effect of certification on market structure, social welfare, and the flow of labor (entry and exit) on the market.

Tables and Figures

Figure 1: Screen-shot of certification icon displayed on a bid

Figure 2: Number of sellers making first attempt, over time

Table 1: Definitions of Major Variables

Variables	Definition
<i>hasRating</i>	A dummy variable that equals one if the seller has had at least one rating. 0 otherwise (e.g. new sellers)
<i>AvgRating</i>	Valence of seller's rating at the beginning of that month
<i>NbrRatings</i>	Number of ratings that the seller had received as of the beginning of that month
<i>NbrRepBuyers</i>	Number of buyers with whom the seller had at least 2 contracts in the previous quarter
<i>NbrLostToCert</i>	Number of times that the seller lost to a certified competitor in the previous month
<i>freeCert</i>	A dummy variable that equals one if the certification is free in that month; 0 otherwise
<i>NbrActiveSellers</i>	Number of active sellers on the market as of that month (registered and not yet exited the market). A seller is considered to have exited the market if there is no activities reported anywhere on the site.
<i>NbrDaysReg</i>	Number of days since the seller signed up on the site as of the current month
<i>Certified</i>	Dummy for whether the seller is certified at the time of bid. In the regression-discontinuity design, <i>certified</i> sellers are those who barely passed but almost failed (<i>certified</i> = 1). <i>Certified</i> = 0 correspond to bids placed but sellers who attempted certification exam, did not pass, but the score is very close to the passing grade of 60.
<i>BidAmount</i>	The dollar amount of the bid the seller placed
<i>NumberBidders</i>	Number of competing sellers that participated in the same auction
<i>bidCommentLen</i>	Length of the comment that the seller enclosed with the bid

Note: Variables above *Certified* are mostly used in the competing risks model. Variables below are mostly used in the model that estimates the effect of being certified on winning contracts. Some variables overlap (e.g. *hasRating*).

Table 2: Testing Information Unraveling

	Scores after NE1, for sellers signing up before NE1	Scores after NE1, for sellers signing up 1-6 months before NE1	Scores after NE1, for sellers signing up 6-12 months before NE1	Scores after NE2, for sellers signing up before NE2	Scores after NE2, for sellers signing up 1-6 months before NE2	Scores after NE2, for sellers signing up 6-12 months before NE2
$Score_{t-1}$	0.004	0.050	-0.085	0.006	-0.008	-0.025
	(0.061)	(0.094)	(0.078)	(0.014)	(0.031)	(0.033)
Intercept	64.826***	59.626***	72.856***	59.039***	57.723***	59.532***
	(3.821)	(5.741)	(4.982)	(0.838)	(1.918)	(2.023)
N	157	82	67	4917	1007	756

This table reports results of the model in equation (1) on different time series of scores. Contrary to the prediction of H1, the coefficient on $Score_{t-1}$ is not statistically significant in any scenario. Robust standard errors are reported in parentheses. (* p<0.1, ** p<0.05, *** p<0.01)

Table 3: Results of Competing Risks Models

	NE1		NE2	
	Model 1	Model 2	Model 1	Model 2
<i>hasRating</i>	2.235***		2.115***	
	(0.410)		(0.232)	
<i>AvgRating</i>		0.432***		0.210***
		(0.097)		(0.043)
<i>NbrRatings</i>		-0.010		-0.002
		(0.007)		(0.005)
<i>NbrRepBuyers</i>	0.320***	0.368***	0.150***	0.135**
	(0.065)	(0.107)	(0.053)	(0.065)
<i>NbrLostToCert</i>	0.106***	0.108***	0.038***	0.037***
	(0.013)	(0.014)	(0.005)	(0.006)
<i>freeCert</i>	17.086***	14.949***		
	(0.289)	(0.413)		
<i>NbrActiveSellers</i>	0.001***	0.001**	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
<i>NbrDaysReg</i>	-0.001***	-0.002***	-0.004***	-0.004***
	(0.000)	(0.000)	(0.001)	(0.001)
Other controls	(included)			
N	118215	36169	13375	8319
N (subjects)	2000	493	2000	1033
N (failures)	41	31	146	118
Log Likelihood	-240.616	-140.024	-973.906	-703.059
Chi-squared	7399.479	2184.620	300.928	193.139

This table reports results from the competing risks model estimated on the two random samples of sellers. Model 1 and Model 2 are different in how reputational information is incorporated. In Model 1 we use a binary indicator (0 if no ratings have been received), and in Model 2 we include both the volume (number of ratings) and valence (average of ratings). Coefficients are reported in the tables; subhazard ratio (SHR) of each variable referred to in the discussions is equal to the exponent of the coefficient. Some control variables are omitted for brevity. Robust standard errors are in parentheses beneath the coefficients. (* p<0.1, ** p<0.05, *** p<0.01)

Table 4: Effect of not being certified on probability of winning contracts

	Original scale		Log scale (robustness)	
	Model 1	Model 2	Model 1	Model 2
<i>Certified</i>	-0.213***	-0.183**	-0.235***	-0.232**
	(0.073)	(0.084)	(0.084)	(0.098)
<i>hasRating</i>	0.851***		0.772***	
	(0.083)		(0.090)	
<i>AvgRating</i>		0.263***		0.305***
		(0.043)		(0.058)
<i>NbrRatings</i>		0.003***		
		(0.001)		
<i>log(NbrRatings+1)</i>				0.338***
				(0.033)
<i>BidAmount</i>	-0.000***	-0.000**		
	(0.000)	(0.000)		
<i>log(BidAmount+1)</i>			-0.199***	-0.245***
			(0.031)	(0.038)
<i>NumberBidders</i>	-0.148***	-0.145***		
	(0.010)	(0.011)		
<i>log(NumberBidders+1)</i>			-1.945***	-1.914***
			(0.055)	(0.061)
<i>bidCommentLen</i>	-0.001***	-0.001***		
	(0.000)	(0.000)		
<i>log(bidCommentLen+1)</i>			-0.077***	-0.122***
			(0.020)	(0.025)
Intercept	-0.337***	-2.043***	3.189***	0.877
	(0.117)	(0.434)	(0.177)	(0.599)
N	10057	6813	10057	6813

This table reports the results of how being “certified” affects chances of winning a contract. For robustness we report results based on original scale as well as those based on log-transformed values of continuous variables. The main variable “*Certified*” is 1 when the seller passed the exam but almost failed; 0 if the seller failed the exam, but almost passed. Among these sellers, the status of being “certified” is approximately random. We control for other factors that may affect winning a contract, including ratings, number of competitors in the auction, and the length of text that accompanied the bid. Each observation is a bid. Model 1 uses binary indicator for ratings (*hasRating*), and Model 2 uses both the volume and valence of ratings. They are estimated using logistic models with robust standard errors (shown in parentheses under the coefficients). (* p<0.1, ** p<0.05, *** p<0.01)

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