

Information in online labour markets

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Abstract: Online labour markets are virtual platforms that solve information problems to enable gains from trade in remote labour services. They make employers and workers aware of each other, and allow them to communicate, contract, and produce remotely. Recent research suggests, however, that organizing production to include remote work remains challenging because employers and workers in these markets continue to lack information that is less easily communicated. Employers appear unable to accurately anticipate the full costs and benefits to them of using the market prior to entry, and continue to have difficulty evaluating worker applications even when experienced in these markets. Information is particularly incomplete when wage arbitrage opportunity is greatest.

Keywords: services trade, trade in tasks, ICT, labour markets, information frictions

JEL classification: D02, F16, J24, M51

I. Introduction

Labour market structure and efficiency are determined by production and hiring technologies, and it is unsurprising that digitalization has transformed both activities. In this journal in 2002, Richard Freeman discussed how new information and communication technology (ICT), and particularly the internet, was redefining job search and recruitment by allowing information to be transmitted at low cost (Freeman, 2002). In the 15 years since his article, many aspects of labour markets have been shaped by the use of ICT, and it has also brought new labour markets into existence.

In particular, new types of working arrangements have emerged, including remote work mediated by ICT. Once remote work is possible, the wage differences across countries suggest that it is not just possible but also efficient to move remote work to an offshore location. It seems logical that when output can be delivered electronically and there are limited tangible local fixed costs in production, the opportunity for efficiency gains within online labour markets is greatest when work can be performed to an equivalent standard in low local wage environments.

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Research has shown that a significant percentage of jobs are ‘offshorable’, that is, colocation is not a necessary condition of production and so these jobs can feasibly be performed abroad (Jensen and Kletzer, 2006; Blinder and Kruger, 2013). In their 2013 study, Blinder and Kruger found that roughly 25 per cent of US jobs are offshorable. The potential for wage arbitrage between developed and developing economies combined with the extent of offshorability of jobs in developed economies suggests the existence of large opportunities in online labour markets.

Global trade in online labour services has come to be dominated by several large platforms that epitomize the ways of working allowed by new ICT. This article focuses on the labour market platforms in which (i) the matching process takes place online and (ii) the work is done via ICT and output delivered electronically. Freelancing marketplaces of this type include Upwork, Amazon Mechanical Turk, and peopleperhour.com. These platforms generally operate as follows: ‘employers’ post a job and evaluate wage bids from freelancers. Bids are generally made in terms of price per hour. Each freelancer has an online profile that can contain a summary of work experience, samples of work, as well as client feedback. The platforms often provide tools that assist in production. Payments are carried out through the platforms via services such as Visa or Paypal. The Appendix presents a table that sorts the major platforms into two main groups according to different platform characteristics, drawing from Corporaal (2017).

In assessing the development of online labour markets in the last 15 years, we view platforms as channels of digital information exchange. First, digital information is the typical *output* in these markets. Most of the jobs advertised on these platforms concern services such as web development, mobile app development, writing, virtual assistance, marketing, accountancy, etc. Second, digital information is required to enable *hiring* and *production* in these markets. Production-enabling technology determines whether employers choose to organize tasks through a platform when individually performed remote work is technically feasible. Their choices reflect how costly it is to integrate and coordinate remotely performed tasks with the rest of the production process.

It is now well known that individual platforms have experienced huge growth rates over the last few decades, both in transaction volumes and values. According to data from the Oxford Internet Institute, the number of projects and tasks posted online on the six largest English-language platforms grew by 26 per cent in the year to the end of June 2017. However, this fast growth is relative to a low base and these markets have so far had only a limited impact on reshaping the world of work in an aggregate sense. For example, the value of ICT services exports as a share of total service exports from India, a leading provider in several of the platforms studied here, has remained relatively flat over the last 15 years. Data also show that exports of ICT services from the US continue to make up a stable share of all services exports, in contrast to the size of opportunity in cross-country wage arbitrage in these activities. At the micro level, several research papers document the large number of available workers who remain unemployed in the online markets, as well as job postings that remain unfilled.

The hypothesis that we propose to explain this puzzle is that organizing remote production remains costly for employers despite large potential savings in variable labour costs. We argue that organizing for work to be done remotely is costly because relevant information is missing. While online labour platforms help solve some of the information problems prevalent in traditional offline labour markets, for example, by allowing employers and workers to find each other, many information problems remain,

and some are exacerbated by the lack of face-to-face contact at any stage of hiring or production.

First, it is hard to know *ex ante* how easy or hard it is to coordinate remotely performed activities with each other or with others that continue to be performed locally. Hiring in an online labour market typically involves a new way of organizing the inputs to production—a challenge that does not necessarily arise when hiring in traditional labour markets. Stanton and Thomas (2018) show that new employers in the largest online global labour market must learn about what is feasible in the market and how to use the marketplace, and this knowledge can only be acquired through experience. Second, to produce efficiently, an employer must be able to hire the right worker. Much recent work has shown that the concerns about adverse selection of worker quality that plague offline labour markets remain significant in online labour markets, and are often amplified in these settings (Mill, 2011; Pallais, 2014; Agrawal *et al.*, 2015).

These two missing information problems are not independent: the more critical it is to coordinate the task with other aspects of production, the more important it is to find the right person for the job. As such, any production function that is more than just the sum of a set of discrete tasks requires some degree of coordination between workers and/or outputs, even when hires are a good match for the job. As a consequence, platforms have been most successful when they have avoided these issues by focusing on a narrow set of tasks on their site—those that do not require significant coordination (e.g. in Amazon's Mechanical Turk). However, activities that require no coordination are only a small subset of the tasks where remote production is technically feasible.

Other sites attempt to reduce or circumvent the information problems associated with organizing production to include remote activity using innovative technology within the platform. Often, we see a general push to minimize the extent of incomplete contracting over labour inputs by permitting contractual terms more closely related to work outputs. Some platforms include fixed-price contracts, and most involve short-term contracts tied to specific work deliverables.

The papers reviewed in the rest of this piece are empirical studies demonstrating that there continues to be missing information about markets and about individual workers in these labour market platforms. Most of the papers draw from theories of the implications of incomplete information in traditional offline labour markets, and we are not aware of any new theories specifically related to online labour services trade. The implications of the empirical work done to date is that missing information hampers the level of activity in these markets on both the intensive and extensive margins—just as in offline markets. Technology that facilitates exchange of the information that is needed for efficient organization remains central to realizing the potential gains from trade in these new markets.

Global online labour markets have significant potential consequences for how local labour markets are organized, and for local labour outcomes: the number of jobs, hours worked, wages earned. Understanding the forces that shape these platforms' growth rates and the nature of work that they offer is therefore critical for effective policy-making over the short and long run. One implication of this body of research is that ICT service sector jobs in developed economies remain, to a certain extent, protected from offshoring because of the challenges of organizing production (hiring and working) when a subset of tasks is done remotely.

The next section presents a classification of the potential scope of online labour markets and section III presents summary statistics about their current reach. Section IV reviews papers that establish that missing information in these markets hampers their growth. Section V presents some findings about technological responses to incomplete information. Section VI raises some discussion points that emerge from the research done to date and then concludes.

II. Trading tasks online

This section first describes the nature of the work that can be contracted via online labour markets and then the type of contractual relationship that is typically established between online employers and freelancers.

The defining nature of the work transacted in these labour markets is that colocation or face-to-face interaction is not necessary for production to take place. Labour services that meet these criteria are a subset of those labour tasks categorized by [Blinder and Krueger \(2013\)](#) as offshorable. Their definition is: the ability to perform work duties in a foreign country but supply the good or service to the home market. Their estimate of 25 per cent of American jobs in this category includes the labour tasks that are inputs into goods manufacture and services. The share of tasks for which their two criteria apply is likely to increase over time in line with ‘the upward march of technology’ (their footnote 5). The subset of these tasks where the labour services are tradable online could be producing inputs to the final manufacture of goods or the provision of services—for instance, a graphic designer working on the design of a particular good that will then be manufactured.

[Table 1](#) compares the 2017 median annual salary in five countries (the US, the UK, Poland, Bangladesh, and India) for software developers and graphic designers. The large wage differentials for activities that are largely offshorable suggest the existence of important arbitrage opportunities.

In online labour markets, as in offline labour markets, the service being traded is usually the labour input and not the output of the labour. This means that the role of organizing the purchased labour input to production remains in the hands of the employer. The Blinder and Krueger task classification does not permit the 25 per cent of potentially offshorable jobs to be decomposed into tasks that are traded versus tasks that are inputs to downstream intermediate products that are subsequently traded. This distinction is clearly related to the extent to which production can be fragmented into vertically distinct stages.¹ This paper argues that this matters for the growth of online labour markets because it determines the extent to which the buyer/employer must organize labour directly, and thereby the nature of the information that has to be processed for production to happen.

¹ There is a new and growing literature in international economics that models global value chains as a production process that can be fragmented and distributed across national borders. The upstream stages provide inputs to the stages further downstream, introducing important organizational spillovers across stages. To the best of our knowledge, the papers to date take the nature of production technology (and the extent to which it can be fragmented) as exogenous.

Table 1: Median annual salary (US\$): software developer, graphic designer

Median annual salary	Job title: software developer, 25 years old, Bachelor degree, with 3 years' experience	Job title: graphic designer, 25 years old, Bachelor degree, with 3 years' experience
San Francisco, United States	\$112,000	\$60,000
London, United Kingdom	\$50,000	\$34,000
Warsaw, Poland	\$24,000	\$12,000
Dhaka, Bangladesh	\$8,000	\$5,000
Bangalore, India	\$8,000	\$3,000

Source: Payscale.com (accessed 3 January 2018).

The tasks that are traded in online labour markets span the influential routinizability index developed in [Autor *et al.* \(2003\)](#) (also [Autor and Dorn, 2013](#); [Autor *et al.*, 2013](#)), which measures the degree to which specific jobs can be automated because they consist mainly of routine, codifiable job tasks. For instance, the index is high in the production, assembly, machine operations, and clerical occupation groups. This task-level measure is positively correlated with Blinder and Krueger's offshorability index. But, the work output that can be delivered via an online platform includes the work done by high-skill software engineers and that done by middle-skill office clerks, that are low and high routinizability, respectively.

Contracting in online labour markets typically resembles a spot market, and it is the case that most of the work transacted in the online markets studied here is relatively short term. But some online tasks last for longer, and many offshored goods markets act as spot markets with no time horizon at all. The short-term nature of labour contracts in offshorable activity is a relevant dimension for the costs of doing business in these markets because any transaction-level fixed costs (such as the cost of communicating the details of what the job requires) make up a larger share of the total cost of shorter jobs.

A different issue relates to firm boundaries: tasks traded in online labour services markets are activities that could be done in-house or at arm's length. Assuming that an activity is at least potentially offshorable—that is, it can be done remotely—what determines whether buyers/employers find it optimal to contract on the labour input directly in a remote labour market, rather than employ someone to do the task in-house or to contract on the labour input only indirectly as embodied in an intermediate input to downstream production? The answer to this question depends in large part on the completeness of the labour contracts that are feasible within these platforms.

The nature of the contractual relationship between workers and employees in online labour markets often shares characteristics of both traditional employment relationships and sales contracts ([Chen and Horton, 2016](#)). While some online labour markets (e.g. Upwork) resemble traditional employment relationships, with workers being paid by the hour for long-term projects involving different tasks and close monitoring by the employer, other online labour markets, such as Amazon Mechanical Turk (MTurk), are more task-focused, with contracts more akin to those of sales relationships (for instance, answering a short survey, transcribing a podcast, or identifying and removing duplicates in yellow pages directory listings) (see the Appendix). There are two main

dimensions that determine the nature of the contractual relationship: the length of the commitment (short term vs long term) and the mode of compensation (hourly rates or piece-work). These dimensions determine, in turn, the type of information that is needed from both parties for the market to function well.

III. Organizing production in online labour markets

The extent of arm's-length trade in services, domestically and across borders, is relatively under-studied because of data sparsity compared to trade in physical goods. This is particularly true when the output does not cross any kind of physical national border. As part of a new project, the Oxford Internet Institute has constructed the Online Labour Index (OLI; see [Kässi and Lehdonvirta, 2016](#)). It estimates values and volumes from the five largest global market places. They estimate this covers around 60 per cent of global markets.

Upwork is by far the largest market, with over 200m estimated monthly unique visitors. This platform is a result of the merger of oDesk and eLance in 2005. The next four largest platforms included in the OLI are Freelancer, MTurk, Peopleperhour, and Guru. Over 50 per cent of the work performed in these markets is software development. But historical data from Upwork show that this type of work is decreasing and there is more data entry and clerical work in more recent years.

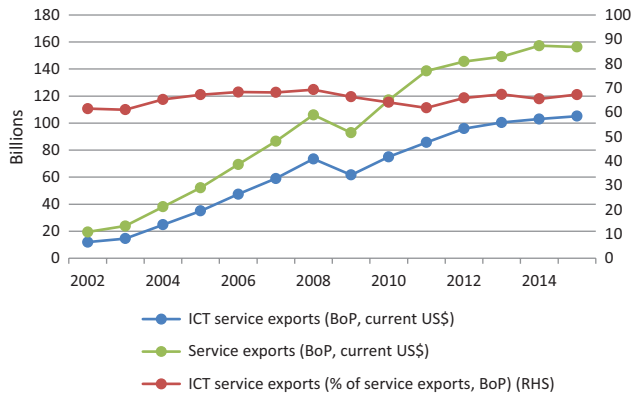
Around 50 per cent of the employers are in the US, followed by the large English-speaking markets—UK (7 per cent), India (5 per cent), Australia (6 per cent), and Canada (5 per cent) (*source*: OLI). Most of the workers are located in English-speaking developing countries, with 25 per cent of the workers in India, 18 per cent in Bangladesh, and 10 per cent in Pakistan. This is followed by the US (9 per cent) and the UK (7 per cent). The type of work done varies by country. For instance, the top occupations in South Asia, China, and Russia are software and technology development, while the top occupations in the US and in Latin American countries, such as Brazil, Peru, and Colombia, are writing and translation.

OLI estimates that the markets grew by 26 per cent in the last year in terms of the number of posted jobs. But this number reflects a relatively low starting point. [Kuek et al. \(2015\)](#) estimated that over 48m workers had online profiles, but only around 10 per cent were active. This prompts the question of whether these numbers are large enough to have an impact on aggregate labour market measures.

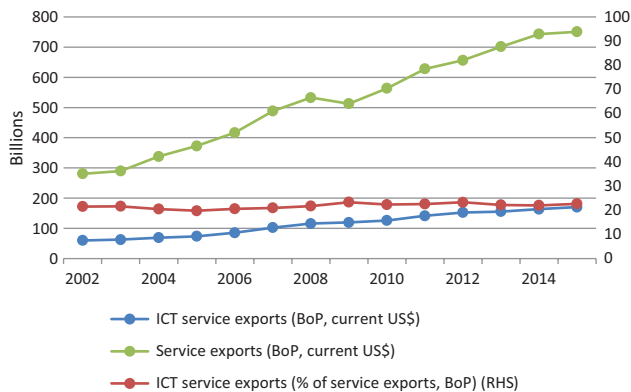
To answer, it is instructive to examine ICT services exports from India ([Figure 1](#)), one of the largest exporters of this type of services to the US. Total service exports from India have grown fast, at an average annual growth rate of 17 per cent over the last 15 years, but ICT service exports continue to represent a relatively stable share of this total at around 65 per cent.

[Figure 2](#) shows that ICT service exports from the US as a percentage of total service exports have grown at 8 per cent per year over the same 15-year period, at about the same rate as services exports overall. If we are willing to assume that export levels reflect domestic activity, these figures provide no evidence of increasing global specialization of ICT activity in low-wage economies.

This is important because the impact of offshoring on local labour demand has been a keenly debated issue. Has there been a fall in domestic demand for labour in tasks

Figure 1: ICT services exports from India

Source: World Development Indicators, World Bank.

Figure 2: ICT Services exports from the US

Source: World Development Indicators, World Bank.

that can be easily offshored? [Goos *et al.* \(2014\)](#) show that it is the routinization index of [Autor *et al.* \(2003\)](#) that is much more strongly associated with the polarization of labour demand in EU countries because the technological change is biased toward replacing labour in routine tasks that tend to be concentrated around the middle of the skill distribution. The authors show that task offshoring also contributes to the decrease of the demand for middling occupations, but to a lesser extent.² This is consistent with our observation that the services work offshored via labour market platforms spans high- and medium-skill tasks.

What can we make of this more macro-level data? We know that the large wage differentials across countries provide variable cost-related incentives to hire in these markets. We might, then, expect faster growth of service offshoring on the extensive margin

² Unconditional on the routinizability index (RTI), the offshorability index is significant and negatively associated with labour demand at the occupation level.

relative to offshoring of goods because tangible entry costs are low. Further, since it is technically feasible to experiment in these markets with smaller jobs, we might expect the piecework-type jobs that are common in these markets to be a fast-growing component of ICT services. However, evidence of this cannot yet be clearly detected at the aggregate level.

One fact that may be informative about the apparent slow growth of services offshoring is the observation in [Stanton and Thomas \(2015\)](#) that the majority of employers who posted job openings in oDesk did not end up hiring on the site. The body of recent research in these markets provides evidence consistent with the hypothesis that it is costly for employers to organize production to include a component of offshore labour. More specifically, gathering or transmitting the information required to enable efficient production in this form appears to be prohibitively costly for many.

IV. Research findings related to incomplete information

Research suggests that potential employers in online labour markets have incomplete information about two aspects of organizing production: how to organize production to include these remote workers (Theme 1); and how to select the right remote workers (Theme 2).

(i) Theme 1: How to organize production to include remote workers

When contracting work online, employers face the challenge of organizing production across multiple locations. In addition, they also need to learn how to operate in the online market. [Stanton and Thomas \(2018\)](#) observe that applicants treat new and experienced employers in a large online labour platform differently, and use this variation to infer that new employers have incomplete information about the market place. There is evidence from employer behaviour that knowledge about market value can be learned through market experience, and that acquiring this information is costly.

Data on the hourly bids submitted in job applications on the platform reveal that workers anticipate incurring higher marginal costs when applying to jobs posted by inexperienced employers. [Stanton and Thomas \(2018\)](#) describe these costs as the hassle costs of high interview-to-hire ratios, the need to guide employers through the transactions processes, and the increased risks of non-payment for unverified employers. However, the data show that employers learn fast through experience and, after hiring four workers, employers conduct 40 per cent fewer interviews and hire more often, and impose lower costs on workers.

New employers also receive higher wage bids because their probability of hiring is less sensitive to workers' bids. The intuition for this mechanism is that an employer hires the applicant with the highest expected value to them given the information available. An inexperienced employer has little to go on in assessing worker quality other than the noisy signals sent by this applicant pool. Each worker anticipates that in the event

that he is the highest ranked in the pool, the inexperienced employer finds the second-highest ranked applicant to be a less close substitute for the most preferred when the employer has an imprecise prior about the distribution of worker quality in the market. This fact gives every applicant local market power that leads to higher equilibrium mark-ups. On average, this accounts for a 4 per cent premium in the wage bids received by inexperienced employers. After having made a number of hires, employers are significantly more wage-bid elastic. They receive correspondingly lower mark-ups in bids for their later job posts.

This research reveals that it is costly for employers to acquire information when entering these markets and new employers also end up sharing more rents with employees because their incomplete information leads to higher mark-ups in wage bids. It also shows that there is a large variance in the value of using online markets, perhaps because some employers find using the market too costly, despite low variable wage costs and having incurred some of the sunk costs of entry.

A recent paper by [Lyons \(2017\)](#) asks what type of work is best suited to these platforms. She examines job market outcomes for employers engaged in teamwork in online labour markets. If production requires communication or teamwork between team members employed on the site, being from different countries reduces team performance relative to same-country teams. The experiment in the paper employs teams of two, one Javascript and one PHP programmer. Under various treatments, team members are from the same or different countries and are employed for work that requires or does not require team communication. Teamwork is shown to increase output only for same-country teams. There is no evidence that workers anticipate these penalties because they do not reveal a relative preference to work with workers from the same country by submitting lower wage bids for these jobs. These findings imply that difficulties associated with transmitting information during production limit the scope of work that can be effectively organized in online labour markets given the current technology of the markets.

(ii) Theme 2: How to find the right worker

In order to generate gains from trade in an online labour market, just as when hiring offline, an employer must be able to identify at least one applicant whom she expects will create more value than the employer's outside option of hiring elsewhere or doing the work herself. The employer and employee must communicate and agree the work to be done; the employer perhaps provides input and guidance on an ongoing basis. She then receives the completed work and makes a payment via the platform. For the employee, he must be able to make his availability and capabilities known to the potential employer, understand the work that needs to be done, choose to undertake the project, engage in production and work delivery, and then receive payment.

[Freeman \(2002\)](#) observes that the internet makes it easier than ever before to inform large numbers of potential job applicants about vacancies, and it is less costly to apply for jobs online. He also comments that a less costly application process is likely to lead to more applications for each job and more searching time for employers. The data on low hiring rates in these platforms have motivated research into the question of the information employers have available to them when choosing among applicants.

Several papers have reached a similar conclusion: despite the large quantity of data available in employee applications, employers face incomplete information about the quality of job applicants.

Autor's prescient article 'Wiring the Labor Market' (Autor, 2001) hypothesized that online job applications lack the 'high-bandwidth' data that employers often use to assess the fit of applicants to the job opening.³ To identify that there is, indeed, missing information of this form in online labour markets, research has taken the approach of contrasting labour market outcomes for groups of workers with varying amounts of worker-specific missing information. It shows that those for whom less information is available have worse market outcomes. In most of these studies, the starting point is that feedback from past employers on the site is more 'high-bandwidth' than other observable characteristics such as detailed resumé data.⁴

Pallais (2014) sets up an experiment in oDesk that demonstrates the value of a reputation for workers in an unskilled job category by varying the quality of the reputation—the public feedback received after employment. She invited inexperienced data entry workers from the Philippines to apply for a short job and hired a share of those who applied. Of those that she hired, she gave feedback scores to some and feedback scores and more detailed descriptive feedback to others. Those workers not hired did not receive any feedback. She then tracked the subsequent career progression of all of these applicants within the market. Those in either treated group fared much better, with earnings of more than 300 per cent of the earnings of the control group workers who were not hired. Those that received more detailed feedback did particularly well.

Stanton and Thomas (2015) document the difficulties faced by new workers without experience, and therefore without feedback or a reputation, across all job categories in oDesk. Of the more than 125,000 workers who applied for their first job in oDesk in the 15-month period up to the end of 2009, only around 10 per cent of workers found at least one job. However, of those that were hired once, 54 per cent went on to be hired at least once more. The vast majority of workers hired on oDesk receive excellent feedback scores from their employers, and a worker's feedback score is highly positively correlated with being re-hired. Initial hourly wage rates rise over time, with the largest jump between the first and second jobs.

The striking difference that feedback scores make to the success of workers' applications suggests that employers find the experience of other employers to be very useful information in assessing worker quality. In fact, research establishes that this information is orthogonal to the large amount of objective data contained in job applications. Even for applicants who are new to the market, there are tests they can take to establish their competence on any number of technical skills. Employers also have the option of conducting online applicant interviews, often via Skype. The fact that other employers' experiences are so valuable supports Autor's view that high-bandwidth data is hard to convey other than in face-to-face interaction.

³ In contrast, low-bandwidth data are objectively verifiable information such as education, experience, etc., while high-bandwidth data include information on attributes such as motivation and 'fit' that are typically hard to verify except through direct interactions (Autor, 2001).

⁴ Codagnone *et al.* (2016) discuss how reputation measures, such as customer ratings on previous jobs, are more strongly correlated with earnings than skills or experience.

Pallais (2014) and Stanton and Thomas (2015) provide strong evidence that missing information about new worker quality leads to inefficiently low hiring of new workers—in line with the theoretical model developed by Tervio (2009). In his model, as in the oDesk market, new worker quality is revealed on the job and the subsequent benefits of having a public reputation accrue to the worker. In settings where jobs are short term in nature and workers cannot bid negative wages, there is no mechanism by which employers can capture the full upside from revealing worker quality. In online labour markets, hiring an inexperienced worker is an investment that generates the value of the worker's output on that job and also the value of the worker's reputation. Their first employer cannot capture any of this second benefit, and therefore hires an inefficiently low number of new workers. This is similar to the reason why firms may be reluctant to invest in the general skills training that is also valuable to other potential future employers of their current workforce (Becker, 1962).

Other empirical work shows that new workers in developing markets are particularly disadvantaged by the lack of an online reputation. The inference made is that this is because the low-bandwidth information that is available about these workers is less salient to employers in developed economies. For example, Agrawal *et al.* (2016) show that the feedback scores for workers with market experience are particularly strongly positively associated with subsequent career outcomes on the site for workers from less developed economies. The data about educational achievement and offline work experience are less informative to their potential employers. Objective application information salience is often positively correlated with applicants' hourly wage bids because employers typically come from high-wage countries. This means that the ability to determine fit is lower precisely when the wage-arbitrage opportunity is greatest.

Mill (2011) demonstrates that employers' ability to extract information from applications is shaped by their own experience in a market, which, in the setting studied in his paper, is Freelancer.com. Workers from developing countries find it particularly hard to find work without a reputation, but employers with positive experience hiring from a country become more favourably disposed to all workers from that country. Mill concludes that this is statistical discrimination. An implication of this finding is that it is relatively hard to get a job in an online platform if a worker happens to be from a country where there are small numbers of active workers in the market.

Ghani *et al.* (2014) reveal another channel through which familiarity reduces uncertainty about job applicants. They show that, on oDesk, members of the Indian diaspora, as identified by last name, are more likely to hire workers in India than are other employers. In relative terms, they find a 16 per cent increase in hiring probability. While they also point out that the Indian diaspora is not big enough for this effect to explain why India is among the largest suppliers to the oDesk market, they are able to show that the increased hiring probabilities are not because Indian applicants submit lower wage bids to the diaspora. This finding suggests that the employers benefit from diaspora ties through channels other than wages, and, consistent with the description of missing information in Theme 1, this is perhaps in the ease of doing business together.

In showing how information does matter for groups of workers, these papers establish that workers without these credentials fare relatively poorly. Employers' tendency to use heuristics in hiring decisions, also a form of statistical discrimination, is revealed by Chan and Wang (2017). They show that among workers from developing economies in oDesk, there is a favourable bias towards women applicants. This effect

falls as employers gain experience, but exists for both inexperienced male and female employers. They also show that employers prefer women applicants in what they call feminine-typed occupations, but there is no gender bias in either direction in so-called masculine-typed occupations.

It is worth emphasizing that workers without proven track records, and workers with backgrounds that are foreign to potential employers, likely face similar problems in all labour markets, both online and offline. But, there are structural reasons why the same degree of incomplete information has larger consequences for worker outcomes in online labour markets. First, the short term or ‘gig’ nature of the work acts as an impediment: employers do not have the incentives to uncover missing information because contracts are short term. Firms do not want to bear the cost of information discovery because structural issues mean this will become public. Longer contracts would make this feasible, and increase the amount of information, but at the cost of flexibility within the market.

V. Technological responses to incomplete information

The problems of missing information in online labour markets can be solved in two ways. First, employers restrict the nature of the work done to work where the two problems of coordination and selection are minimized. Second, platform technologies can be improved to make it as easy to use as possible for employers.

It is likely that the job tasks least affected by this missing information about individual worker quality and the nature of the overall labour market will be the first to be transacted online. This is the case of jobs advertised on MTurk, which typically require little coordination and focus on very specific tasks. Jobs in this market tend to be very specific and allow workers to opt in, charging employers only for successfully delivered work. Tasks sometimes take only a few seconds and pay pennies. MTurk essentially puts employers in touch with a remote workforce to undertake ‘human intelligence tasks’ in contexts where the scale of response is paramount. As [Chen and Horton \(2016\)](#) point out, in this market there is no scope for the employer to exercise authority or to monitor employees. Indeed, employers do not communicate with workers, as workers are free to take on any task they want at the terms proposed by the buyer. In this configuration, employers are effectively purchasing the output produced by labour inputs, just as they purchase other intermediate inputs to production.

MTurk represents an extreme version of task-focused online markets, with limited exchange of information during production or employer screening of the potential workers. However, the extent to which online labour markets can convey information will determine their growth in less autonomous and anonymous production tasks. The existence and design of mechanisms to address these information problems shed light on the completeness of information ([Spulber, 1999](#)). The matching and production technologies jointly determine both what type of work can be performed in these markets and how the platforms mitigate missing information.

How does the current technology in online markets for more general labour services help employers evaluate worker quality sufficiently well to select an employee? The papers referred to in the previous section suggest that online reputation (and, mainly,

the feedback score) tells employers something that is missing from low-bandwidth data, but can the platforms make better use of this information?

Using data from over one million jobs, [Kokkodis and Ipeirotis \(2015\)](#) show that more sophisticated use of past feedback scores can predict hired employee performance on subsequent jobs. Their idea is that employees work on a variety of tasks with differing employer needs. If the employer is able to view feedback scores that are more heavily weighted to reflect past performance on similar jobs, she can more accurately assess workers' suitability for her own job. These authors construct worker-level reputation measures that predict performance on the next job up to 25 per cent better than equally weighted feedback. These findings come from Upwork data and are shown to also exist in the MTurk marketplace.

Other work examines the use of worker referrals in these markets. For example, [Horton \(2017\)](#) presents experimental evidence that algorithmic recommender systems can infer employer preferences, determine the feasible choice set of applicants, and then solve the would-be employer's constrained optimization problem. It is possible that algorithmic recommendations can reflect more information than any individual party could feasibly evaluate because they have lower processing costs. The quality of the recommendations also potentially improves with the size of the market as the site has a larger number of workers to choose among and has less costly search technology than any individual employer. Horton finds that being offered recruiting assistance raises the probability that an employer hired someone for her job opening. The effect was concentrated in technical jobs, for which there was an increase in the hiring rate of 20 per cent, implying also that the recommendations did not crowd out organic applications. The inference is that employer search costs are high in these types of jobs; perhaps because they are buying a particular skill that they do not have themselves, and find it hard to evaluate applicant quality. This finding exists despite the fact that employers have larger incentives to search harder in these higher value adding job categories, where finding the right employee is particularly valuable.

What about information that is not available to the platform from within the market? [Pallais and Sands \(2016\)](#) conduct an experiment asking workers to make recommendations from among their peers using their own private information. They show that referred workers perform better on the jobs they are hired for. Their paper also reveals that this mechanism provides missing information about worker type rather than hidden worker actions. That is, it solves an adverse selection problem rather than a moral hazard problem. This is established by the result that workers who were referred performed better on jobs where their referrer had no connection—was not working there and may have made the recommendation to another employer. The information in the referrals was otherwise unobservable.

It is not clear that online labour markets are able to capture or report the information contained in peer referrals any better than in offline labour markets. But, autonomous third-party organizations, known as agencies, have arisen within oDesk as an institutional response to solve missing reputation for new workers. [Stanton and Thomas \(2015\)](#) observe that a large fraction of oDesk workers with reputations were also affiliated with organizations known as agencies, which unlike offline employment agencies, serve only as a shared branding for member workers rather than also performing an employee–employer matching function. In the cross section of all applicants, being affiliated with an agency did not increase the probability that a given applicant was hired

for a job. However, observable agency affiliation was a strong determinant of whether a new worker would be hired for a first job. Moreover, for new workers affiliated with an agency, other observable measures of quality, such as education and the skills tests taken on the platform, were less relevant to employers when selecting among potential hires. The data suggest that because agency affiliates share a common reputation based on all members' work histories on the site, agency affiliation acts to transmit information from offline worlds in the online market. In equilibrium, all agency affiliates are high quality. Agency founders are able to set up long-term contracts with agency affiliates to capture a share of their career earnings in the market. They, therefore, have an incentive to reveal new worker quality, solving the problem set out in [Tervio \(2009\)](#).

Nonetheless, the same fact that allows agency founders to ensure only high-quality workers become agency affiliated also suggests there are constraints on the extent that agencies can fully resolve the inefficiencies of missing information about new workers. This fact is that agency founders appear to know agency members offline and have alternative means of verifying their quality. In fact, many attended school or university together. Agencies in this setting do not have to undertake the quality screening of new workers that employers find so costly because agencies often have pre-existing knowledge of worker quality through offline ties. Since a new agency head can have gone to school with only a limited number of high-quality potential online workers, the size of any one agency is limited. The number of new agencies is also limited by the fact that the pool of potential new agency heads includes only those high-quality but unaffiliated workers who are fortunate enough to be hired.

VI. Discussion and conclusion

Online labour markets are made possible by advances in technology. Specific technical change has allowed different parts of the employment relationship to be done remotely: searching, matching, contracting, production, and output delivery.

If incomplete information constrains the set of activities that is currently feasible online to those activities that can be packaged like output contracts, then do online labour markets commoditize labour services? There is an increasing amount of evidence that the answer to this question is no. Work quality, among hired workers, is relatively homogeneous, but nonetheless employers do not hire the lowest cost workers, even in low-skill activity. [Stanton and Thomas \(2018\)](#) show that the job applicants that are hired are in the lowest 10 per cent of hourly wage bids less than 20 per cent of the time. [Chen and Horton \(2016\)](#) show that even in markets that look like spot markets, where workers are paid by the task, choose what tasks to work on, and have little or no interaction with their buyer/employer, the relationship that employer and worker create is of a quasi-employment nature.

There has been much recent debate about the legal status of employment relationships in labour market platforms. In most cases, workers on the site are viewed as self-employed contractors and are not subject to local labour market regulations.⁵ [Horton \(2011\)](#) conducted a short survey on MTurk and found that workers have very

⁵ See elsewhere in this issue for research about employment protection in online markets.

positive views of online employers compared to offline employers. While this bodes well for the supply side, criticisms regarding payment evasion and the inability to negotiate prices with employers have prompted the development of a third-party platform, Turkopticon, allowing workers to give feedback on their employees, for the benefit of other workers.

Research has shown that the technology related to hiring and production shapes the scope of work that can be done in these markets. Frictions resulting from incomplete information about market participants, market infrastructure, and the output itself, determine the share of potential gains that is realized and how the gains from trade are distributed among market participants. Information technology, by reducing these frictions, shapes the nature of the contractual relationships that are feasible between parties on the platform.

The irony established in the research is that at the current time, information is particularly incomplete where the potential gains to trade are the largest, for instance between online employers in the US and workers/freelancers in India. We have not seen the ‘death of distance’ (Cairncross, 1997) in these labour markets, even when it is technically feasible, because the ease of information exchange decays with economic, institutional, and geographic distance. The research done to date on online labour markets has shown that finding ways to improve the ease of information exchange about how to organize production—about applicants during hiring, and about production after hiring—is the key to realizing growth in these markets.

Appendix: A comparison of main online platforms

Platforms	Nature of tasks	Task coordination	Compensation	Tasks/project duration
Amazon Mechanical Turk; Crowdfunder	Microtasks/human intelligence tasks	Automated—through algorithmic management by platform	Piece rate (but not paid if not done correctly)	Task/project completion takes minutes or seconds
Upwork (formerly ODesk); peopleperhour.com; guru.com	Larger projects and tasks, job type: web, software, and IT; writing, accounting, etc.	Manual—through human management by client	Hourly rate; fixed rate also possible.	Task/project completion takes hours, days, or months

Source: Adapted from Corporaal (2017).

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