Online Labor Markets

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Abstract. In recent years, a number of online labor markets have emerged that allow workers from around the world to sell their labor to an equally global pool of buyers. The creators of these markets play the role of labor market intermediary by providing institutional support and remedying informational asymmetries. In this paper, I explore market creators' choices of price structure, price level and investment in platforms. I also discuss competition among markets and the business strategies employed by market creators. The paper concludes with a discussion of the productivity and welfare effects of online labor.

1 Introduction

In the late 1990s, a number researchers began studying the effects that the Internet was having—or might yet have—on the labor market. One question examined was whether we might see the emergence of entirely online labor markets, where geographically dispersed workers and employers could make contracts for work sent "down a wire." Such markets would be an unprecedented development, as labor markets have always been geographically segmented.

Researchers were of mixed opinions: Malone predicted the emergence of such an "E-lance" market [9], while Autor was skeptical, arguing that informational asymmetries would make such markets unlikely [3]. Instead, Autor predicted the emergence of third-party intermediaries that could use their own reputation to convey "high bandwidth" information about workers—such as ability, skills, reliability and work ethic—to buyers who would be unwilling to hire workers based solely on demographic characteristics and self-reports.

In the approximately 10 years since, we have witnessed the emergence of a number of truly global online labor markets, as Malone predicted. By 2009, over 2 million worker accounts had been created across different markets, with over $700 million in gross wages paid to workers [7]. However, consistent with Autor's position, these markets have emerged not "in the wild," but within the context of highly structured platforms created by for-profit intermediaries.

The ultimate success and trajectory of these markets remains to be seen. If they become more important, they will raise policy questions, particularly about labor laws and taxation. They might spur the already large shift towards part-time employment [10] and have implications for inequality and development.

The purpose of this paper is to describe the key economic features of online labor markets. In addition to a positive examination, this paper highlights features of the markets likely to be relevant for welfare and productivity. Special

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attention is given to the ability of these markets to give workers in developing countries access to buyers in rich countries.

2 Overview

Online labor markets (OLMs) fall into two broad categories: "spot" and "contest." No labor market is truly "spot" in the sense of a commodity market, but certain OLMs feature buyer/seller agreements to trade at agreed prices for certain durations of time. Examples of spot markets include oDesk, Elance, iFreelance and Guru. Workers create online profiles and buyers post jobs and wait for workers to apply and/or actively solicit applicants.

In contest markets, buyers propose contests for informational goods such as logos (e.g., 99Designs and CrowdSPRING), solutions to engineering problems (e.g., InnoCentive) and legal research (e.g., Article One Partners). Workers create their own versions of the good and the buyer selects a winner from a pool of competitors. In some markets, the buyer must agree to select (and pay) a winner before they can post a contest; in other high-stakes markets where a solution may be unlikely, the buyer is under no obligation to select a winner.

2.1 Definition

Not all people working online do so through markets: some work is unpaid (e.g., open-source software and Wikipedia) and other work products are transferred within a firm, such as through conventional off-shoring. Even within clearly identifiable markets, there is great diversity. I propose a definition of OLMs that captures the essential common features of all markets and yet distinguishes the markets from other examples of online work: a market where (1) labor is exchanged for money, (2) the product of that labor is delivered "over a wire" and (3) the allocation of labor and money is determined by a collection of buyers and sellers operating within a price system.

2.2 Nature of Labor Markets and Role for Intermediation

Labor markets are fundamentally different from other kinds of markets in at least two ways. First, there is no single "commodity" of labor with an immediately observable quality and single prevailing price—both jobs and workers are idiosyncratic. This makes it difficult for firms and workers to find a good match, and even when matches are formed, it is difficult for either party to know precisely what they are getting when they enter into contracts. Buyer/seller information asymmetries, when combined with opportunities for strategic behavior, can impede markets; if sufficiently severe, they can prevent markets from existing [2][13]. Second, labor is a service that is delivered over time, often accompanied by relationship-specific investments in human capital (e.g., learning a particular skill for a particular job), which creates a number of the incentive issues that make it hard for parties to fully cooperate [14].

In traditional labor markets, third-party intermediaries such as temp agencies, unions and testing services profit from supplying information [4]. The creators

of online labor markets do the same thing, though their scope is wider and more comprehensive. They also provide infrastructure like payment and record-keeping systems, communications infrastructures and search technology—functions typically provided by a government or by parties themselves.

2.3 What the Market Creators Provide

In order to increase the information on the demand side, OLMs often offer worker skills tests, manage reputation systems and provide worker data from prior within-OLM employment, such as hours worked and wages. Making buyer feedback public not only prevents adverse selection, but also serves to reduce moral hazard, as workers make decisions about effort "in the shadow" of the evaluations that they will likely receive. To increase supply-side information, OLM creators verify buyers' abilities to pay and reports on their past behavior in the market. For example, oDesk guarantees that workers will be paid for hourly work, putting the impetus on the buyer to interrupt an unprofitable relationship.

The influence of the market creator is so pervasive that their role in the market is closer to that of a government: they determine the space of permissible actions within market, such as what contractual forms are allowed and who is allocated decision rights.[1] Presumably they design their "institutions" to maximize expected profits. For example, they design rules to reduce the probability of disputes (subject to the constraint imposed by reducing flexibility). If disputes do arise, the market creators are likely to be able to settle them quickly using clear rules or unambiguous assignments of decision rights, such as making buyers the arbiters of contract compliance.[2]

3 Price and Price Structure

Market creators have at least three ways to earn revenue: they can charge membership fees, levy ad valorem charges on payments and charge buyers and sellers for using the market (e.g., for listing a job, taking a skills test or applying for a job).[3] These different structures are not mutually exclusive and many market creators use a hybrid structure.

A market creator has to attract both buyers and sellers to a market and facilitate valuable interactions. There is a growing literature on "two-sided" markets [12] that tries to understand price structure in the presence of membership externalities. This research focuses on scenarios where the identity of the party that

[1] Their software even serves a weights-and-measures function traditionally performed by governments by keeping universal time for logging worker hours.

[2] Although there are obvious drawbacks to such an assignment of rights, it radically reduces the space for disputes. This is in fact the precise rule used by Amazon Mechanical Turk.

[3] Typical usage fees appear to be modest and may serve as a kind of Pigouvian "tax," since some of the activities seem to be over-supplied in the markets. The costs of applying for jobs are so low that there is a good deal of application "spam."

pays the fees (or receives subsidies) matters. In online labor markets, buyers and sellers independently arrive at prices after negotiation, strongly suggesting that the Coase theorem applies, which permits a conventional one-sided analysis.[4]

Suppose that potential buyer/seller pairs would get value v from completing a project and would pay a cost c, not including any fees, if the work were intermediated. The outside option is 0. The market creator's marginal intermediation costs are assumed to be zero. If an ad valorem charge γ is leveled, the project goes forward if $v-(1+\gamma)c>0$, whereas if a lump sump fee τ is leveled, $v-c-\tau>0$. With the lump sum fee, the buyer/seller pair makes use of the market so long as the fee is less than the surplus: $\tau<v-c$. With the ad valorem charge, the pair makes use of the market so long as $\gamma<1-\frac{c}{v}$. In the lump sum case, absolute surplus matters, whereas in the ad valorem case, project efficiency matters.

Depending on the distributions of c and v, either price structure might be optimal or some hybrid might be best, but the ad valorem charge appears to have several practical advantages. First, it short-circuits the chicken-and-egg dynamics of any platform with a two-sided nature [5]. No OLM sprang forth fully formed with contingents of buyers and sellers. To be useful, the markets needed members; to attract members, they needed to be useful. An ad valorem charge avoids this problem. Second, setting an optimal lump sum charge requires knowledge of project surplus, and surplus could change dramatically as different kinds of work become more or less popular, or as firms shift more work onto the market. A firm can change membership fees, but this introduces menu costs. Finally, groups of buyers can bundle their projects under a single account and amortize their membership costs over many transactions, but this strategy offers no benefits when using usage fees. While membership fees can be important and are used in some markets, the rest of this analysis focuses on the ad valorem price structure.

3.1 Setting the Optimal ad Valorem Price Level

Perhaps because of the advantages enumerated above, ad valorem charges seem to be nearly universally applied, even in the contest markets. Assume that the buyers are purchasing efficiency units of labor from homogeneous workers and that there is a single market clearing price. The market clearing price is p and the quantity of units bought and sold is Q. Figure 1 depicts the problem in terms of intersecting supply and demand curves determining the market clearing price and quantity for a given γ. The market creator's revenue is indicated by the box with height $p\gamma$ (the side runs from p to $p(1+\gamma)$) and width Q_0. As γ grows larger, the quantity is lowered, but the height of the rectangle increases. The nested revenue box shows that as supply and demand become more elastic (S' and D'), the same size γ, even if it leads to the same market clearing price, would lead to a decrease in the quantity (and hence revenue), which is now at Q_0'.

[4] For example, if buyers have to pay a membership fee, there will be fewer buyers. This lowers the demand and therefore the price of labor, transferring some of the cost of the membership fee to sellers.

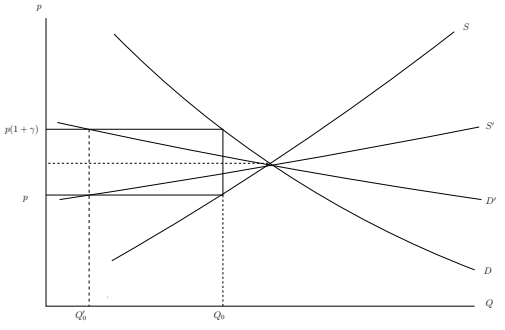

Fig. 1. Market creator profits and market clearing price

The market creator's profit maximization problem is:

$$\max_{\gamma} p(\gamma)Q(\gamma)\gamma \tag{1}$$

where γ is the ad valorem charge and $p(\gamma)$ and $Q(\gamma)$ are the resultant prices and quantities in the market. The profit-maximizing first-order condition is $(p'Q + Q'p) + pQ = 0$, which implies that profits are a maximum when $\epsilon_{\gamma}^{p} + \epsilon_{\gamma}^{Q} = -1$. The market creator increases the ad valorem charge until a small change in γ, say $x\%$ is offset by a combined $x\%$ decrease in some percentage combination of market price and quantity. Of course, the quantities ϵ_{γ}^{Q} and ϵ_{γ}^{p} are not known and are not parameters that usually receive attention in economics. However, if we make some assumptions about the functional form of the supply and demand curves, we can solve for γ^* as a function of the relevant elasticities. Assume that both the supply and demand curves have constant elasticity of substitution, $s(p) = Q_s p^{\alpha}$ and $d(p) = Q_d p^{\beta}$. In the absence of a market creator, assuming the market could function, the efficient price for labor would be $p_e = e^{\frac{\log Q_d - \log Q_s}{\alpha - \beta}}$. Under intermediation, for the market to clear, $Q_s p_I^{\alpha} = Q_d(p_I(1+\gamma))^{\beta}$. We can solve for the intermediation market clearing price, p_I, and write it in terms of the efficient market price: $p_I = p_e(\gamma+1)^{\frac{\beta}{\alpha-\beta}}$. Because $\gamma > 0$, $\beta < 0$ (downward sloping demand curve) and $\alpha > 0$ (upward sloping supply curve), in order for the market to still clear with the ad valorem charge, the price received by sellers must be lower than in the efficient market case.[5] The market creator's profits are:

$$\pi = \left[\underbrace{(Q_s p_e^{\alpha})p_e}_{\text{efficient wage bill}}\right] \times \left[\gamma\,(\gamma+1)^{\frac{\beta(\alpha+1)}{\alpha-\beta}}\right] \tag{2}$$

[5] Note, however that this "distortion" from the efficient market price is not necessarily an inefficiency, as it is the actions of the market creator that make the market possible.

Solving for the optimal charge, we have:

$$\gamma^* = \frac{\beta - \alpha}{\alpha(\beta + 1)} \tag{3}$$

If we assume that the supply and demand elasticities have the same magnitude, i.e., $\alpha = |\beta|$, then in order to give the highest observed ad valorem charge of 25% employed by BitWine[6], $\alpha = |\beta| = 9$; in order to give the more standard $\approx 10\%$ used by oDesk, Amazon Mechanical Turk and others, $\alpha = |\beta| = 21$. These are remarkably high elasticities. It is not clear whether constant elasticity of substitution is a reasonable assumption, but if it is, and assuming that the market creators know their business and are not radically undercharging, it seems likely that implied elasticities are large for the simple reason that workers and buyers have ready and close substitutes for their intermediated transactions: they can make use of other online labor markets or traditional labor markets, or they can take their chances and disintermediate.

4 Competition and Specialization

It is well beyond the scope of this paper to try to model the market of intermediation markets, never mind make predictions about the likely market structure, product types, prices, etc. However, it is possible to discuss some of the key economic factors and sketch out areas for future research. The factors likely to affect ultimate market structure include whether there are economies or diseconomies of scale in providing intermediation services, barriers to entry and the potential for product differentiation.

5 Market Creator Strategy

Even after picking a price structure and level, the market creator can still increase revenues by increasing the size of the wage bill. This can be done by increasing the extent of the market, such as by recruiting more buyers and sellers, increasing worker productivity or preventing buyers and sellers from working outside the market.

5.1 Recruitment that Affects Supply and Demand

Let the market creator's initial revenues be $r_0 = p_0 Q_0$. The market creator is considering changing supply and demand in the market via recruitment of more buyers and sellers, such as through advertising. After the change, the new revenue will be $r_1 = p_1 Q_1$. Define Δx as a percentage change in x. We can write $r_1 = p_0 Q_0 (1 + \Delta p)(1 + \Delta Q)$. It is worth making the change from r_0 to r_1 if

$$\Delta Q + \Delta p + \Delta p \Delta Q > 0 \tag{4}$$

[6] BitWine is a network of freelance advisers who charge clients per-minute rates for consultations. Advisers are self-styled experts in fields such as nutrition, travel, coaching, technology and psychic prediction.

We can see that increasing within-market demand unambiguously raises profits because as ΔQ increases, so does Δp, as positive demand shocks raise both price and quantity. For supply increases, price and quantity will move in opposite directions. For small changes in supply or demand, two elasticity formulas must hold: $\Delta Q = \Delta S + \epsilon^S \Delta p$ and $\Delta Q = \Delta D + \epsilon^D \Delta p$. Because we are considering only a supply increase, $\Delta Q = \epsilon^D \Delta p$, which allows us to re-write the profit-maximizing condition as $\epsilon^D \Delta p + \Delta p + \Delta p \Delta Q > 0$. Dividing through by Δp (which is negative) and reversing the sign, we have: $\epsilon^D + \Delta Q < -1$, and since $(\epsilon^D - \epsilon^S)\Delta p = \Delta S$, the market creator finds it revenue-maximizing to increase supply so long as:

$$\epsilon_D \left(1 + \frac{\Delta S}{\epsilon^D - \epsilon^S}\right) < -1 \tag{5}$$

If supply and demand are highly elastic, $|\epsilon^D - \epsilon^S|$ is large, meaning that small positive changes in supply are likely to increase revenue.

6 Productivity and Welfare Implications

Online work offers the cost-saving benefits of telecommuting, such as reduced congestion and increased flexibility, as well as some advantages unique to the way such markets appear to be structured. First, global labor markets permit greater specialization in human capital. Second, the rapid mixture of workers across and between firms might speed up innovation spillovers, creating a kind of pseudo geographic co-location, which has been shown to increase productivity in other contexts [8]. Third, OLMs allow firms to buy small amounts of labor as needed, lowering the barriers to entrepreneurship.

OLMs also permit a kind of virtual migration that offers many of the benefits of physical migration. Assuming that increased virtual labor mobility will generate effects similar to those of increased real labor mobility, the potential gains to welfare are enormous [6]. Further, these markets create incentives for people otherwise disconnected from the global labor market to invest in their human capital [11].

Given the central role that a country's institutions play in its economic development [1], it is remarkable how little these markets demand from the institutions of the worker's home country. Prospective workers need only to be able to get online and have some way of receiving remittances. Workers do not need functioning courts, developed finance sectors, work visas, information about commodity prices, local reputations or race, class or social backgrounds required for employment in local labor markets.

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