The Firm as a Nexus of Relational Contracts

Duoxi Li Michael B. Wong*

Cornerstone Research *HKU*

March 2024

Abstract

We develop a repeated-game model of an exchange economy in which buyers may enter relational contracts either directly with producers or with centralized intermediaries. We show that intermediation can be efficient even when matching is frictionless. A buyer's optimal choice between bilateral contracting and intermediation depends on the expected duration of business needs, the gains from specialization, the tightness of the matching market, and the strength of word-of-mouth reputational effects. We derive realistic predictions regarding the labor boundaries of firms and macroeconomic trends in outsourcing and specialization. We discuss applications to supply chains, franchises, online platforms, managers, and public organizations.

*Emails: duoxili@bu.edu, mbwong@hku.hk.

We thank Dan Barron, Lisa Bernstein, Anthony Casey, Matthias Fahn, Luis Garicano, Bob Gibbons, Leshui He, Jin Li, Dilip Mookherjee, Andy Newman, Juan Ortner, Joel Watson, Birger Wernerfelt, Giorgio Zanarone, and seminar participants at HKU, MIT, Hong Kong Economic Association, and the 9th Workshop on Relational Contracts for helpful comments and suggestions.

1 Introduction

Competitive equilibrium theory assumes that exchange takes place in large and anonymous markets where contract performance is guaranteed. According to a large body of research, however, relational contracts — long-lasting collaborations built on trust and sustained by the value of future relationships — are ubiquitous in trade and essential for performance (Macaulay 1963; Geertz 1962, 1978; Macneil 1978; Bernstein 1992; Dyer and Singh 1998; Baker, Gibbons and Murphy 2002; Gibbons and Henderson 2012). Moreover, exchange is widely observed to be embedded in complex relational networks, in which centralized intermediaries function as key nodes that coordinate transactions, monitor performance, and guarantee quality (Coase 1937; Granovetter 1985; Powell 1990; Spulber 1996; Ménard 2012; Bernstein 2016).

This paper develops a repeated-game model of an exchange economy in which buyers may enter relational contracts either directly with producers or through centralized intermediaries. We show that intermediation may dominate bilateral contracting even when buyers and producers can frictionlessly meet. Our model clarifies some key intuitions in the theory of the firm. It formalizes the idea that the presence of a centralized intermediary can strengthen incentives for performance (Alchian and Demsetz 1972). It also generates realistic predictions regarding the existence, boundaries, and internal organization of firms.

In devising this theory, we have in mind that in many real-world markets, intermediaries fulfill the demands of buyers by coordinating the activities of producers. For instance, professional service firms assign workers to provide cleaning, security, legal, or accounting services for their clients. Retailers and online platforms operate stores filled with inventory from different producers to satisfy the wants of consumers. Manufacturers assemble parts from specialized component suppliers and sell the combined products downstream. Table 1 lists further examples. As we shall show, the model sheds new light on a wide range of economic phenomena, including the organizational structure of supply chains, the labor boundaries of firms, the role of managers, and macroeconomic trends in outsourcing and specialization.

Our analysis incorporates the possibility of intermediation into a model of relational contracts in frictionless matching markets (Shapiro and Stiglitz 1984; MacLeod and Malcomson 1989,

Table 1: Examples of intermediaries that both aggregate demand and enforce relational contracts

Intermediaries	Buyers	Producers
Professional service firms (e.g., law, accounting, HR, cleaning, security, consulting)	Clients	Workers
Retailers, wholesalers, and e-commerce platforms (e.g., Walmart, Amazon, Alibaba, eBay, Etsy)	Customers	Sellers
Midstream manufacturers (e.g., Johnson Controls)	Downstream manufacturers	Upstream manufacturers
Franchisors (e.g., Marriott, Starbucks, McDonald's, UPS)	Consumers	Franchisees
Ride-sharing platforms (e.g., Uber, Lyft, Grab, Didi)	Riders	Drivers
Online rental markets (e.g., Airbnb, Turo)	Renters	Owners
Online labor markets (e.g., Upwork)	Businesses	Freelancers
Hospitals and clinics	Patients	Doctors
Schools and universities	Students	Teachers
Governments	Taxpayers	Providers

1998; Board and Meyer-ter Vehn 2015). In our model, written legal contracts are insufficient to compel producers to perform, so buyers must motivate producers using future surplus in long-term contractual relationships. Unlike existing models, however, buyer demand may fluctuate. Buyers whose business needs are short-lived have little future surplus to promise and would find it difficult to sustain bilateral relational contracts. We show that under these conditions, there is a use for intermediaries that enter relationships with a large number of buyers and producers. These intermediaries aggregate business needs from many buyers and assign producers to provide services to different buyers as needed. As such, they can more easily sustain relational contracts with producers and emerge as a nexus between buyers and producers.

In our model, the benefit of intermediation — less costly relational contracts with producers due to the aggregation of demand and supply — arises only if the buyer's demand is short-lived. Under a bilateral contract, the producer must either become idle or unmatched when a buyer's demand vanishes. However, under an intermediated contract, the intermediary instead reallocates the producer to serve another buyer. Therefore, intermediated contracts require lower efficiency payments to the producer than bilateral contracts if and only if the buyer's demand fluctuates.

The cost of intermediation is that the buyer must pay a marked-up service fee to incentivize the intermediary to perform its managerial duties. In other words, intermediation results in a form of double marginalization. For this reason, buyers with sufficiently persistent demand prefer to directly contract. Bilateral contracts are also preferred if the producer market is slack and the opportunity cost of keeping a producer idle is therefore low.

There is a unique steady-state equilibrium. In equilibrium, if producer idleness is sufficiently costly, centralized intermediaries emerge to service the subset of buyers whose business needs are short-lived. The remaining buyers contract with producers in a sea of decentralized pairings. This result is important because it clarifies some key intuitions in the theory of the firm. It shows that centralized intermediaries can be useful even when buyers and producers can frictionlessly meet and costlessly enter contracts. Moreover, centralized intermediation may be efficient in the absence of specific investments, bargaining frictions, and bounded rationality. Centralized intermediaries emerge in our model simply because they aggregate short-lived demand and can thereby more strongly punish producers who shirk.

In an extended application, we show that the model generates realistic predictions regarding the labor boundaries of firms and the equilibrium behavior of wages, job transitions, and skill choices. We focus on the provision of professional services like cleaning, security, accounting, legal, and HR services. We define employment as a bilateral relational contract between an employer and a worker, while outsourcing is an intermediated contract in which an intermediary employs workers and assigns them to different clients on demand. Workers choose upon entry whether to become specialists in one of two activities needed by entrepreneurs or generalists with middling skills in both services.

We show that intermediation enables specialization. First, outsourcing is more likely when demand is variable and there is a need for specialization. Second, outsourced workers have on average greater skill specialization, lower and more compressed wages, and reduced separation to unemployment than direct employees. Third, as communication technologies improve, outsourcing and specialization increase, and unemployment falls. These patterns are broadly consistent with firm-level evidence (Abraham and Taylor 1996; Houseman 2001; Berlingieri 2013; Espinosa 2020), worker-level evidence (Dube and Kaplan 2010; Goldschmidt and Schmieder 2017; Guo, Li and Wong 2024), as well as recent macroeconomic trends (Katz and Krueger 1999; Weil 2014; Handwerker 2023).

In further applications, we show that the model generates realistic predictions regarding the patterns of intermediation and disintermediation in supply chains, the organizational boundaries of franchises, the economics of online platforms, the organization of schools and hospitals, as well as the roles and responsibilities of managers. Reputation concerns and multilateral relational contracts may also be realistically incorporated into our framework as important determinants of the choice between intermediation and direct contracting.

To our knowledge, we are the first to formally argue that centralized intermediaries who coordinate exchange and production can emerge from the optimal arrangement of relational contracts. The literature on repeated-game models of relational contracts is substantial and growing (for overviews, see MacLeod 2007; Malcomson 2013; Gil and Zanarone 2017; Macchiavello and Morjaria 2023). Our model is related to recent works in this literature that explore the tension between allocative efficiency and incentive provision in fluctuating business environments (Tunca and Zenios 2006; Board 2011; Andrews and Barron 2016). We incorporate this tension into an otherwise standard model of relational contracts in frictionless matching markets (Shapiro and Stiglitz 1984; MacLeod and Malcomson 1989, 1998; Board and Meyer-ter Vehn 2015). We then introduce intermediaries that can enter a large number of relational contracts on both sides of the market, and show that intermediation can ease this tension.[1]

Our model relates to the large literature on the theory of the firm, which was inaugurated by Coase (1937) and explores why individuals form partnerships, companies, and other centralized entities rather than trading bilaterally through contracts on a market.[2] In a related contribution,

[1]There are two other models in the relational contracting literature that feature hierarchies with intermediary layers. Fong and Li (2017) show that relational contracts can be deepened by the presence of a non-strategic supervisor carrying out subjective performance reviews. Troya-Martinez and Wren-Lewis (2023) explore a model where a manager may receive kick-backs and show that such managers can improve relational contracts in environments with commitment difficulty. The possibilities of demand aggregation and double marginalization, however, are not the focus of these models.

[2]See Gibbons (2005) and Lafontaine and Slade (2007) for overviews.

Baker, Gibbons and Murphy (2002) use repeated-game models to examine how asset allocation affects the strength of relational contracts. Unlike them, however, we do not follow the property rights approach proposed by Grossman and Hart (1986) in viewing firm boundaries as purely determined by asset ownership.[3] Though insightful and useful, the property rights paradigm does not explain the existence of firms that own very few assets, like professional service firms. Moreover, as many scholars have argued, the capabilities of firms are largely embodied in the inalienable human capital such as the knowledge, licenses, and social connections of its employees rather than in its owned physical inputs.[4] Our theory instead emphasizes the usefulness of intermediaries that function as nexuses of relational contracts.[5] Our predictions about the labor boundaries of firms and the organizational structure of supply chains are broadly consistent with empirical evidence.

An important strength of our framework is that we avoid arguments based on reduced-form transaction costs and bounded rationality. According to the theory of contracts as reference points proposed by Hart and Moore (2007, 2008), flexible long-term employment contracts allow parties to adapt to uncertainty but cause inefficient shading. According to Levin and Tadelis (2010), service contracts are costly to write but provide stronger incentives than employment contracts. In related contributions, Wernerfelt (2015, 2016) proposes models wherein the choice between using long-term employment contracts and a competitive market depends on switching costs, demand fluctuations, and gains from specialization. We show that centralized intermediation can dominate decentralized bilateral contracting even in the absence of reduced-form contract-writing

[3]There are many variants of the property rights approach (Hart and Moore 1990; Aghion and Tirole 1994; Baker, Gibbons and Murphy 2002; Matouschek 2004; Gibbons 2005; Schmitz 2006; Van den Steen 2010; Powell 2015). This framework has been used to analyze the boundaries of multinational firms in open economies (Antràs 2003, 2014; Antràs and Helpman 2004; Acemoglu, Antràs and Helpman 2007) and firm organization in industry equilibrium (Grossman and Helpman 2002; Gibbons, Holden and Powell 2012; Legros and Newman 2013).

[4]Rajan and Zingales (1998) wrote that "a firm is more than a simple collection of assets. There is a sense in which employees 'belong' to an organization even in a world without permanent indenture. This sense of belonging arises from the expectation 'good citizens' of an organization have that they will receive a share of future organizational rents." See also Hart and Moore (2008) for a related discussion.

[5]The original nexus-of-contracts theory, first developed by Alchian and Demsetz (1972), argued that the firm is no more than a collection of contracts organized around a central party and opposed the view that the firm possesses unusual powers of authority and control (e.g., Coase 1937; Simon 1951; Williamson 1971, 1975, 1985; Grossman and Hart 1986; Hart and Moore 1990; Gibbons 2005). In an elaboration, Jensen and Meckling (1976, pp. 310–311) argued that "contractual relations are the essence of the firm, not only with employees but with suppliers, customers, creditors, and so on." See also Cheung (1983), Demsetz (1988), and He (2016).

costs, switching costs, or irrational shading. As such, we clarify the conditions under which centralized intermediaries may emerge.

Finally, our work is related to the literature on double marginalization in vertical chains. In the classic literature in industrial organization, double marginalization occurs when both upstream and downstream parties possess market power and use restrictive linear contracts (Tirole 1988). This form of double marginalization can be eliminated by vertical integration of pricing decision rights, resale-price maintenance, or non-linear pricing. In our model, double marginalization instead arises from the non-verifiability of contract performance and the non-transferability of production and intermediation capabilities. This is similar to models of middleman margins (Biglaiser and Friedman 1994; Bardhan, Mookherjee and Tsumagari 2013). Conventional remedies do not eliminate this form of double marginalization.

The rest of the paper proceeds as follows. Section 2 introduces the model. Section 3 compares bilateral and intermediated contracts. Section 4 characterizes the steady-state equilibrium. Section 5 applies the model to study labor boundaries and specialization. Section 6 discusses further applications. Section 7 concludes.

2 Model

Basics. Time is discrete and infinite, $t \in \{0, 1, ...\}$. There are a continuum of infinitely-lived buyers indexed by $i \in \mathcal{I}$ who demand services, a continuum of producers indexed by j who provide services, and a finite number K of infinitely-lived intermediaries indexed by k who neither directly demand nor provide services. They have a common discount factor $\delta \in (0, 1)$.

Producer entry and demand realization. In the beginning of each period, an excess of identical producers choose whether to enter the economy at cost $C > 0$. Cost C represents the producers' training or opportunity cost. The service demand of each buyer i, denoted $d_{it} \in \{0, 1\}$, is then realized and publicly observed.[6] Demand d_{it} is redrawn at the beginning of each period

[6] To focus on the relational incentives, we abstract from any adverse selection problem in the model. Therefore, when contracting with buyers, producers know whom they are dealing with and have the correct expectation of how the relationships will go.

t following a Markov process. The demand-switching probabilities are each buyer's publicly known type $\alpha_i = (\alpha_{1i}, \alpha_{0i})$. With probability α_{1i}, buyer i's demand switches from 1 to 0. With probability α_{0i}, buyer i's demand switches back from 0 to 1. The distribution of buyers types is a distribution F on $[0, 1] \times [0, 1]$.

Matching. Buyers and intermediaries can offer bilateral contracts to producers in a producer market, while buyers can also offer intermediated contracts to intermediaries in an intermediary market. Each contract is a contingency plan specifying compensation, effort levels, and the probability of continuation when demand switches. Following Board and Meyer-ter Vehn (2015), matching is frictionless, meaning that all offers are accepted subject to participation constraints. In the producer market, matching is random and anonymous in that all unmatched producers have the same probability of being matched with a given buyer or intermediary regardless of their histories; matched producers do not receive contract offers.[7] In the intermediary market, matching is not anonymous, so matching probabilities may depend on the observable history of an intermediary. Since intermediaries cannot produce by themselves, they meet service contract requirements by entering bilateral contracts with producers. We assume that an intermediary can match with a continuum of buyers and producers. However, in any period, buyers can match with at most one producer or intermediary, while producers can match with at most one buyer or intermediary.[8] Matching in intermediary market precedes matching in the producer market, so intermediaries can always fulfill the service demands of their matched buyers if there is an excess of producers.

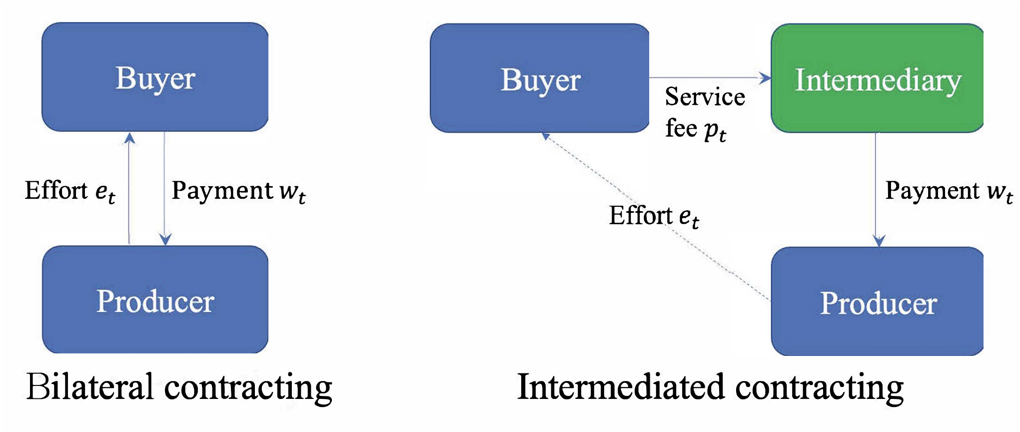
Bilateral contracts. If a buyer matches with a producer, the remainder of the period proceeds as follows. First, the buyer makes a payment $w_t \geq 0$ to the producer.[9] The producer then chooses

[7]The assumption of random and anonymous matching simplifies analysis but is not important. Similar results can be obtained under the assumption that buyers and intermediaries first offer contracts to unmatched producers with whom they had previously matched. Relatedly, Board and Meyer-ter Vehn (2015) analyzes relational contracts in a frictionless matching market where matched producers may receive on-the-job offers. They show this leads to heterogeneous productivity across otherwise identical firms. We rule out this possibility for simplicity.

[8]This assumption rules out the possibility that producers and buyers become intermediaries themselves.

[9]Following Board and Meyer-ter Vehn (2015), we do not allow for ex-post bonus payments. This is without loss since, when buyers and intermediaries can immediately rematch with new producers, they have no incentive to honor any bonus payments.

Figure 1: Illustration of bilateral and intermediated contracts



an effort level, denoted by $e_t \in \{0, 1\}$. The cost of effort is given by $c(e_t)$, where $c(0) = 0$ and $c(1) = c > 0$. The effort generates an output for the buyer only if demand is positive, so $y_{it} = yd_{it}e_t$. Effort and output are observable by the buyer but are not verifiable by a court. We assume that $y > \frac{c}{\delta} + (1 - \delta)C$, so that for buyers with unchanging and positive demand, there is always enough surplus to incentivize producer effort.

Intermediated contracts. If a buyer matches with an intermediary, she pays a service fee $p_t \geq 0$ to the intermediary. The intermediary chooses to assign one or none of its producers to the buyer. The intermediary pays w_t to the producer. The producer then exerts costly effort e_t and produces output y_{it} for the buyer.[10] Effort and output are observable by both the buyer and the intermediary, but are not verifiable by a court.

Separation and death. Either party in a match can choose to terminate their contract and separate from each other both after demand realization and after production. If separation occurs after demand realization, both parties can participate in the producer or intermediary market matching in the current period. However, if separation occurs after production, they need to wait till the next period to rematch. At the end of each period, producers die with probability $\rho \in (0, \delta)$.

[10]Similarly, we do not allow for ex-post service fees. This is without loss for the same reason; since buyers can immediately rematch with new intermediaries, they have no incentive to honor any ex-post service fees.

Payoffs. In a bilateral contract, the buyer's payoff is $y_{it} - w_t$ in each period t. In an intermediated contract, the buyer's payoff is $y_{it} - p_t$. The intermediary's payoff per service demand is $p_t - w_t$. The producer's payoff is $w_t - c(e_t)$.

Remark. This model has two key features that are not present in standard models of relational contracting in frictionless matching markets, such as Shapiro and Stiglitz (1984). First, we allow buyers to have fluctuating demand. Second, we introduce intermediaries who can enter relational contracts with a multitude of agents on both sides of the market. These intermediaries do not have intrinsic demand or productive ability. What they can do, however, is to match with a large set of buyers and producers and monitor the performance of all of their matched producers. As we shall show, when demand is volatile and the cost of idleness is high, intermediaries can sustain cheaper relational contracts on both sides of the market by reassigning their producers across buyers. Buyers may therefore prefer intermediation rather than bilateral contracting.

3 Bilateral and Intermediated Relational Contracts

In this section we characterize optimal bilateral and intermediated relational contracts. We then analyze the buyer's choice between bilateral and intermediated contracts. This analysis explains why and when intermediation may be preferred over bilateral contracting.

3.1 Bilateral Relational Contracts

To analyze bilateral relational contracts, we take the perspective of a single buyer i. Since producers are homogeneous, we omit the j subscript. We assume that the producer's pre-matching continuation value is exogenously given as $\overline{U} > 0$. We endogenize $\overline{U}$ in Section 4.

We say that strategies under a relational contract are *contract-specific* if they do not depend on the player's identity, calendar time, or any history outside the current contract. A contract is *stationary* if strategies are time-invariant functions of the buyer's demand realizations. A contract is offerer-optimal if it yields the highest possible surplus for the party offering the contract. We restrict our attention to buyer-optimal, contract-specific, stationary contracts in which producer's effort level is one if and only if $d_{it} = 1$.[11] These contracts must also satisfy the following two conditions. First, on the equilibrium path, parties within a match always choose to continue their relationship immediately after production. Second, off the equilibrium path, deviations are punished in the harshest possible way. These assumptions are standard in the literature (MacLeod and Malcomson, 1998; Baker, Gibbons and Murphy, 2002; Board and Meyer-ter Vehn, 2015).

Let $C_i^B = (w_{1i}, w_{0i}, \beta_i)$ denote a contract-specific, stationary relational contract offered by buyer i directly to a producer. In this contract, w_{1i} is the payment when $d_{it} = 1$, w_{0i} is the payment when $d_{it} = 0$, and $\beta_i \in [0, 1]$ is the probability that buyer i stays with the producer when the buyer's demand switches from one to zero. The time subscript is dropped since we focus on stationary contracts.

Under a bilateral contract, the buyer motivates the producer to exert effort using credible promises of future surplus from their contractual relationship. If the buyer deviates from the specified payment, the producer exerts no effort and separates from the buyer after production with probability one. If the producer deviates from the specified effort, the buyer separates from the producer after production with probability one. Since the buyer has fluctuating demand, the retention probability β_i determines the expected duration of the relationship and therefore affects the level of payments needed to incentive the producer.

If $\beta_i > 0$, the post-matching continuation payoffs for the producer when $d_{it} = 1$ and $d_{it} = 0$ are, respectively, given by

$$U_{1i} = w_{1i} - c + \delta\Big[(1 - \alpha_{1i})U_{1i} + \alpha_{1i}(\beta_i U_{0i} + (1 - \beta_i)\overline{U})\Big], \tag{1}$$

and

$$U_{0i} = w_{0i} + \delta\Big[\alpha_{0i}U_{1i} + (1 - \alpha_{0i})(\beta_i U_{0i} + (1 - \beta_i)\overline{U})\Big]. \tag{2}$$

Here the possibility of death ρ is incorporated into the producer's discount factor δ, so that all

[11]Focusing on stationary relational contracts is without loss when imposing pairwise stability (or "bilateral efficiency" in Board and Meyer-ter Vehn (2015)) on the equilibrium concept. A pairwise stable relational contract is a Pareto-optimal contract for parties in a match when they take their outside options as given. See Li (2022) for a more detailed discussion on how non-stationary relational contracts may be optimal in equilibrium when the pairwise stability restriction is relaxed.

players have a common discount factor, so ρ does not enter the above two equations.

The relevant incentive constraints for the producer are as follows:

$$U_{1i} \geq w_{1i} + \delta \overline{U}, \tag{P-IC-e}$$

$$U_{1i} \geq \overline{U}, \tag{P-IC1}$$

$$U_{0i} \geq \overline{U}. \tag{P-IC0}$$

Constraint (P-IC-e) requires the producer to choose effort over shirking when the service is needed. Constraints (P-IC1) and (P-IC0) require that the producer remain with the current buyer when the demand is 1 or 0, respectively. If $\beta_i = 0$, equation (2) and constraint (P-IC0) do not apply, as the buyer immediately separates from the producer when demand is zero.

For the buyer, the post-matching continuation payoffs when $d_{it} = 1$ and $d_{it} = 0$ are

$$\Pi_{1i} = y - w_{1i} + \delta \Big[(1 - \alpha_{1i}) \Pi_{1i} + \alpha_{1i} (\beta_i \Pi_{0i} + (1 - \beta_i) \overline{\Pi}_{0i}) \Big],$$

and

$$\Pi_{0i} = -w_{0i} + \delta \Big[\alpha_{0i} \Pi_{1i} + (1 - \alpha_{0i}) (\beta_i \Pi_{0i} + (1 - \beta_i) \overline{\Pi}_{0i}) \Big].$$

where $\overline{\Pi}_{1i}$ and $\overline{\Pi}_{0i}$ is the value of the buyer's pre-matching continuation values when $d_{it} = 1$ or $d_{it} = 0$, respectively. Since there is an excess of producers in the frictionless matching market, the buyer can always successfully find a match, so $\overline{\Pi}_{1i} = \Pi_{1i}$.

The relevant incentive constraint for the buyer is

$$\Pi_{1i} \geq \delta (\alpha_{1i} \overline{\Pi}_{0i} + (1 - \alpha_{1i}) \overline{\Pi}_{1i}), \tag{B-IC-w}$$

$$\Pi_{1i} \geq \overline{\Pi}_{1i}, \tag{B-IC1}$$

$$\Pi_{0i} \geq \overline{\Pi}_{0i}, \tag{B-IC0}$$

Constraint (B-IC-w) ensures that the buyer honors the payment to the producer. Constraints (B-IC1) and (B-IC0) reflect the buyer's desire to retain the producer when there is a demand or not, respectively. As before, if $\beta_i = 0$, the term Π_{0i} and constraint (B-IC0) do not apply, as the buyer would immediately separate from the producer.

The optimal bilateral contract is obtained by choosing w_{1i}, w_{0i}, and β_i to maximize Π_{1i}, subject to (B-IC-w), (B-IC1),(P-IC-e), (P-IC1), as well as (B-IC0) and (P-IC0) if $\beta_i > 0$.

Lemma 1. *Suppose an optimal bilateral relational contract exists. Under this contract, if*

$$\frac{(1-\delta)\overline{U}}{c} > \frac{\alpha_{0i}}{1-\alpha_{1i}}, \tag{3}$$

then the buyer pays

$$w_{BS}(\alpha_i) = \left(\frac{1}{\delta}\frac{1}{1-\alpha_{1i}}\right)c + (1-\delta)\overline{U}. \tag{4}$$

when demand is one and separates from the producer when demand becomes zero. Otherwise, the buyer pays

$$w_{BI}(\alpha_i) = \left(\frac{1}{\delta}\frac{1+\frac{\delta}{1-\delta}\alpha_{0i}}{(1-\alpha_{1i})+\frac{\delta}{1-\delta}\alpha_{0i}}\right)c + \left(\frac{1+\frac{\delta}{1-\delta}\alpha_{0i}}{(1-\alpha_{1i})+\frac{\delta}{1-\delta}\alpha_{0i}} - \delta\right)\overline{U} \tag{5}$$

when demand is one, remains matched with the idle producer when demands switches to zero, and pays zero until demand switches back to one.

As shown in Lemma 1, the optimal bilateral contract features a buyer who either always separates from a producer or always retains him when their demand switches to zero. According to Equation (3), bilateral contracts with separation dominates bilateral contracts with idleness when (a) the producer's continuation value when unmatched $\overline{U}$ is high, (b) the buyer has a smaller α_{0i}, so a longer period of idleness is expected, and (c) the buyer has a large α_{1i}, so a shorter period without idleness is expected.

The payment to producers in a bilateral contract, $w_B(\alpha_{1i}) \equiv \min\{w_{BS}(\alpha_{1i}), w_{BI}(\alpha_{1i})\}$, is increasing in α_{1i}. This is because when business needs are shorter-lived, the producer faces a higher chance of either separating or becoming idle, so the future surplus in the relationship is smaller. A higher efficiency payment is therefore needed to incentivize producer effort.

3.2 Intermediated Relational Contracts

Under intermediated contracts, buyers delegate to intermediaries the responsibility of motivating and monitoring producers. The intermediary fulfills the buyers's demand by entering relational contracts with a large number of producers and assigning producers to buyers according to demand realization.

We first analyze the contract that intermediaries offer to producers. To meet buyer demand, we assume that each intermediary offers intermediary-optimal, contract-specific, and stationary contracts to producers. As shown in Section 3.1, the terms in an optimal bilateral contract with producer hinge on the buyer's demand-switching probabilities. Unlike buyers, however, intermediaries face constant demand for services and therefore have constant demand for effort from its matched producers. The reason is that each intermediary randomly matches with a continuum of buyers drawn from the same distribution, so by the law of large numbers, the intermediaries face total demand from buyers that is constant over time. Anticipating this stable demand for services, the measure of producers that each intermediary contracts with is equal to the expected measure of demand realizations, and each matched producer is asked to exert effort in every period. Therefore, by the logic of Lemma 1, the compensating payment for the producer is $w_{1i} = w_M$ in every period, where

$$w_M = \frac{c}{\delta} + (1 - \delta)\overline{U}. \tag{6}$$

We next consider how producers are assigned to buyers in each period under the intermediated contract. Note that buyers are indifferent between any assignment of producers where the assigned producer exerts effort, since producers are identical in our model. Producers are also indifferent between any assignment of buyers where the intermediaries offer the same level of payments. Since intermediaries require producers to exert effort and provide the same compensating payment in every period, buyers and producers have the same payoffs in any assignment where producers are matched with buyers with positive demand in every period. Therefore, any such assignment is optimal.

We can now characterize the optimal intermediated contract. Let $C_i^M = (p_{1i}, p_{0i}, \beta_i)$ denote a buyer-optimal, contract-specific, and stationary intermediated relational contract offered by a buyer to an intermediary. Here p_{1i} and p_{0i} are the service fees when the buyer needs and does not need the service, respectively. If the buyer deviates from the specified service fee, the intermediary does not assign a producer to the buyer and separates from the buyer. If instead the producer assigned by the intermediary deviates from the specified effort, the buyer separates from the intermediary after production. Since matching is not anonymous in the intermediary market, the buyer never chooses to match with the defaulted intermediary again in the future.[12]

Under C_i^M, the post-matching continuation payoffs for the intermediary in a buyer-intermediary match, when the service is and is not needed, respectively, are

$$V_{1i} = p_{1i} - w_M + \delta\Big[(1-\alpha_{1i})V_{1i} + \alpha_{1i}(\beta_i V_{0i} + (1-\beta_i)\overline{V})\Big], \tag{7}$$

$$V_{0i} = p_{0i} + \delta\Big[\alpha_{0i}V_{1i} + (1-\alpha_{0i})(\beta_i V_{0i} + (1-\beta_i)\overline{V})\Big], \tag{8}$$

where $\overline{V}$ is the value of an intermediary's continuation value after separating from a buyer. The relevant incentive constraints for the intermediary, similar with those for a producer, are

$$V_{1i} \geq p_{1i} + \delta\overline{V}, \tag{M-IC-w}$$

$$V_{1i} \geq \overline{V}, \tag{M-IC1}$$

$$V_{0i} \geq \overline{V}, \tag{M-IC0}$$

Note that $\overline{V} = 0$ on the equilibrium path. If an intermediary separates from a buyer, it cannot match with a new buyer, because all other potential buyers are matched with some intermediary and will not become unmatched on the equilibrium path.

For the buyer, the continuation payoffs and incentive constraints are the same as in the bilateral contract, except that the payments w_{0i} and w_{1i} to the producer are replaced with service fee

[12]We assume that in the intermediary market, buyers randomly match with an intermediary who has not breached the relational contracts with them. Specifically, let $\mathbf{K}_{i,t}$ be the set of intermediaries who have interacted with buyer i and breached the relational contract with i before period t. Should a buyer become unmatched and match with an intermediary in the intermediary market in period t, she randomly matches with one of the intermediaries from the set $\mathbf{K} \setminus \mathbf{K}_{i,t}$.

payments p_{0i} and p_{1i} to the intermediary. For concision, we omit these conditions, which simply repeat (B-IC-w), (B-IC-1), and (B-IC0). The optimal intermediated contract maximizes Π_{1i} subject to these incentive compatibility constraints.

Lemma 2. *Suppose an optimal intermediated contract exists. Under this contract, the buyer always retains the intermediary, pays zero service fees to the intermediary when there is no demand, and when there is demand, she pays the intermediary a service fee equal to*

$$p(\alpha_i) = \left(\frac{1}{\delta} \frac{1 + \frac{\delta}{1-\delta}\alpha_{0i}}{(1 - \alpha_{1i}) + \frac{\delta}{1-\delta}\alpha_{0i}} \right) w_M. \tag{9}$$

Note that $p(\alpha_i)$ can be rewritten as the product of $\lambda(\alpha_i) = \frac{1}{\delta}\frac{1+\frac{\delta}{1-\delta}\alpha_{0i}}{(1-\alpha_{1i})+\frac{\delta}{1-\delta}\alpha_{0i}}$ and the payment to the producer w_M. Here $\lambda(\alpha_i)$ can be thought of as an intermediary markup. Furthermore, as shown in Equation (6), w_M is elevated above the cost of effort to the producer. In other words, both the intermediary and producer are paid rents so that both are incentivized to honor their contractual obligations. Therefore, the cost of intermediated contract is a form of double marginalization.

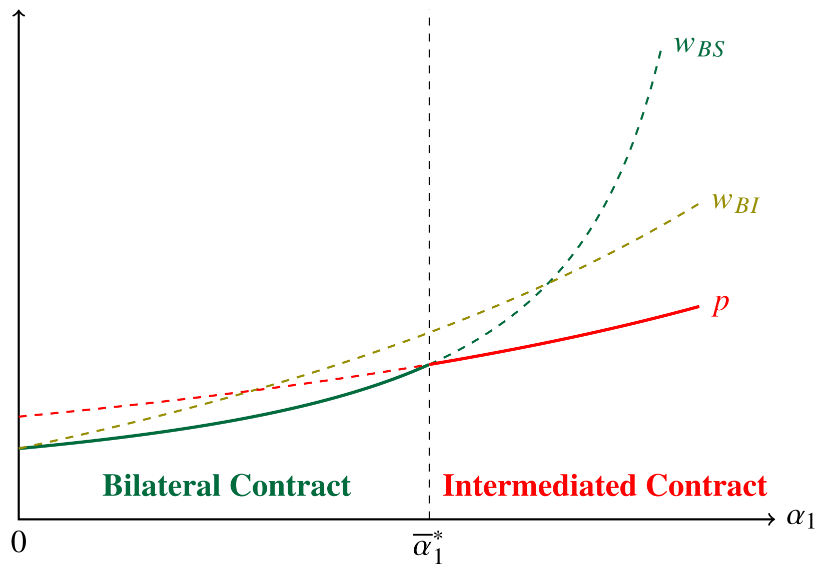
The benefit of intermediated contract is that the payment to the producer is lower than the payment under bilateral contracts, since the intermediary can smooth demand across its buyers. To see this, note that $w_B(\alpha_i) \geq w_M$ for all α_i, where equality holds if and only if $\alpha_{1i} = 0$.

3.3 Optimal Contractual Choice

Having characterized bilateral and intermediated contracts, we now characterize when buyers choose intermediation. We focus on buyers who have the same α_{0i}, which is greater when a buyer's demand quickly returns to one from zero. We ask how the optimal contractual choice depends on α_{1i}, which is greater when the spells where a buyer have demand are short-lived, and $\overline{U}$, which is greater when producer entry is costly, so the producer market is tight and it is easy for producers to rematch.

To compare the two arrangements, it suffices to compare the payment $w_B(\alpha_{1i})$ under bilateral contracting and the service fee $p(\alpha_{1i})$ under intermediation. This is because the buyer pays

Figure 2: Service cost under bilateral and intermediated contracts



Note: α_1 is the probability that the buyer's demand switches from 1 to 0.

nothing when their demand is zero and can always match with a producer when her demand is one.

Figure 2 provides a graphical illustration of this comparison. For a buyer with stable demand, i.e., for whom $\alpha_{1i} = 0$, intermediated contracting is strictly more expensive than bilateral contracting because of double marginalization. To obtain high-quality services, the buyer needs to pay additional rent to the intermediary. However, there is no benefit to intermediation, since demand is stable, so the producer is paid the same efficiency payment under bilateral contracting.

The advantage of intermediation over bilateral contracting becomes larger when business needs are short-lived. As α_{1i} becomes larger, producers must be paid elevated payments in order for them to exert effort. Since intermediaries can reassign producers across buyers based on demands so producers neither separate nor become idle, the cost of incentivizing producers is lowered. To see this mathematically, note that $w_{BS}(\alpha_i)$ approaches infinity as α_{1i} approaches one. Furthermore, $p(\alpha_i)$ increases in α_{1i} less steeply than $w_{BI}(\alpha_i)$ if c is relatively small and $\overline{U}$ is relatively large. Therefore, when rematching is easy, the intermediary operates a more cost-efficient internal producer market by having long-standing relational contracts on both sides of the market.

Figure 3: Optimal contractual choice given model parameters

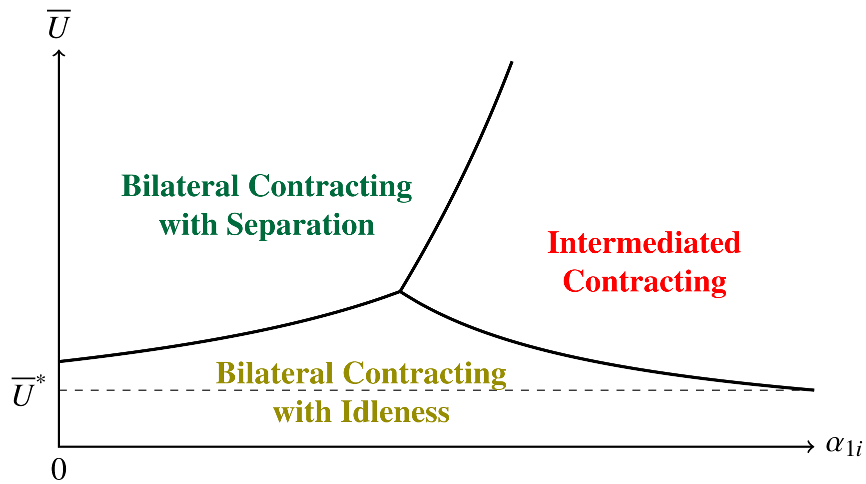


Figure 3 graphically shows the optimal contracts as a function of α_{1i} and $\overline{U}$. In this figure, provided $\overline{U} > \overline{U}^*$, then there exists a cutoff value such that intermediated contracts dominates if and only if α_{1i} is sufficiently large. If $\overline{U} < \overline{U}^*$, then the producer's pre-matching continuation value is low, so it is optimal to retain them and keep them idle until demand returns.

The following proposition formalizes this result.

Proposition 1. *Take any set of buyers i with the same α_{0i} for whom an optimal contract exists. There exists $\overline{U}^*$ such that:*

1. *If $\overline{U} < \overline{U}^*$, a bilateral contract is optimal for all i in this set;*
2. *If $\overline{U} > \overline{U}^*$, there exists $\alpha_1^* \in (0, 1)$ such that an intermediated contract is optimal if and only if $\alpha_{1i} \geq \alpha_1^*$.*

Proposition 1 shows that intermediated contracts dominate when business needs are sufficiently short-lived and the continuation value of an unmatched producer is sufficiently high. This is a new answer to Coase (1937), who first asked: Why and under what conditions should we expect centralized intermediaries to emerge? Proposition 1 suggests that buyers with short-lived demand choose intermediation, while the remaining buyers bilaterally contract with producers. If all buyers have long-lasting demand, then all buyers bilaterally contract.

Importantly, this result is shown in an environment where buyers and producers can frictionlessly meet and enter contracts. It therefore highlights that centralized intermediaries can emerge even in the absence of many types of transaction costs, including search, bargaining, and contract-writing costs. Centralized intermediaries may emerge simply to aggregate demand and thereby more strongly punish producers who shirk.

4 Steady-State Equilibrium

In this section, we show that there exists a unique steady-state equilibrium.

We say that the economy is in a steady state when (1) the number of producers in the economy and the distribution of contracts in the matching market are unchanging across periods and (2) each buyer's demand evolves according to its long-run distribution. By the properties of Markov processes, the steady-state probability that a buyer i has positive demand in any period is equal to $\pi_i = \alpha_{0i}/(\alpha_{0i} + \alpha_{1i})$.

At the start of each period, some buyers and intermediaries are unmatched and directly offer bilateral contracts to unmatched producers. Let $\mathcal{I}_{BS}$ denote the set of buyers who enter bilateral contracts that end when their demand switches to zero. For a buyer $i \in \mathcal{I}_{BS}$, the steady-state probability that they are unmatched is

$$v_i = \pi_i (1 - \alpha_{1i}) \rho + (1 - \pi_i) \alpha_{0i}. \tag{10}$$

The first term comes from buyers who continue to have positive demand but become unmatched because their matched producers die. The second term comes from buyers whose demands switches from zero to one.

Let $\mathcal{I}_{BI}$ be the set of buyers who directly contract with producers in contracts that continue when demand switches. Here, for simplicity, we assume that if a producer dies when demand is zero, the buyer does not match with a new producer until demand switches back to one. Then for a buyer $i \in \mathcal{I}_{BI}$, the steady-state probability that they are unmatched is

$$v_i = \pi_i \rho + (1 - \pi_i)(1 - \omega_i)\alpha_{0i}, \tag{11}$$

where ω_i is the steady-state probability that a buyer without demand has not separated from the previous producer due to producer death.[13] The first term arises from producer deaths for buyers whose demand is initially positive. The second term comes from buyers who are no longer matched with producers due to deaths and whose demand switches from zero to one.

Let $\mathcal{I}_M$ be the set of buyers who contract with intermediaries. Under intermediated contracts, producers do no separate with the intermediary unless they die. For a buyer $i \in \mathcal{I}_M$, the steady-state probability that a new contracts is offered by an intermediary to fulfill i's demand is

$$v_i = \pi_i \rho. \tag{12}$$

The total measure of new contracts offered in the producer market is given by

$$v = \int_{\mathcal{I}_{BS} \cup \mathcal{I}_{BI} \cup \mathcal{I}_M} v_i dF. \tag{13}$$

The total measure of unmatched producers before matching, u, is given by

$$u = \rho n + (1 - \rho)(n - n_B - n_M) + \int_{\mathcal{I}_{BS}} (1 - \rho)\pi_i \alpha_{1i} dF. \tag{14}$$

where n, n_B, and n_M are the steady-state measures of all producers, directly contracted producers, and intermediated producers in the economy. The first term denotes unmatched producers who newly enter after producer deaths. The second term denotes unmatched producers that were previously unmatched and did not die. The final term denotes unmatched producers who are newly separated after their previous buyer's demand switched to zero and did not die.

[13] It can be shown that $\omega = \alpha_0(1 - \rho)/\rho((2 - \rho)(1 - \alpha_0) + (1 - \alpha_1))$ by the properties of Markov chains.

Note that n_B, the steady-state measure of producers in direct contracts, is given by

$$n_B = \int_{\mathcal{I}_{BS}} \pi_i dF + \int_{\mathcal{I}_{BI}} [\pi_i + (1 - \pi_i)\omega_i] dF. \tag{15}$$

Similarly, n_M, the steady-state measure of producers in intermediated contracts, is given by

$$n_M = \int_{\mathcal{I}_M} \pi_i dF. \tag{16}$$

The value of entering either bilateral or intermediated contracts is higher than the value of being unmatched, so there is an excess of producers who enter the producer market. This implies that $n \geq n_B + n_M$. Since matching is frictionless, all contracts offered in the producer market are immediately filled. The measure of unmatched producers after matching is $n - n_B - n_M$.

We assume that matching is random and that contract offers are never made to matched producers. The Bellman equation for an unmatched producer is then given by

$$\overline{U} = \int_{\mathcal{I}_{BS}} \frac{v_i}{u} U_{BS}(\alpha_i) dF + \int_{\mathcal{I}_{BI}} \frac{v_i}{u} U_{BI}(\alpha_i) dF + \frac{\rho n_M}{u} U_M + \left(1 - \frac{v}{u}\right) \delta \overline{U}. \tag{17}$$

As shown above, the value of being unmatched consists of four components. The first two terms reflect the value of matching with a buyer. The third term reflects the value of matching with an intermediary. The fourth term reflects the value of remaining unmatched.

To close the model, we solve for the steady-state number of producers that enter the economy. By assumption, producers enter the economy at the beginning of each period by paying an entry cost C. Entry drives down the likelihood that producers are matched, so they enter only until the continuation value of being unmatched in the labor market equals their entry cost. This yields the following condition:

$$\overline{U} = C. \tag{18}$$

We can now define an equilibrium in our economy.

Definition 1. *A steady-state equilibrium is a distribution of contracts offered by each buyer and intermediary such that:*

1. *All contracts are offerer-optimal, contract-specific, and stationary;*

2. *Each player's pre-matching continuation value is determined by steady-state transition probabilities and frictionless and random matching via Equation* (17)*;*

3. *The measure of producers in the economy is derived from the producer entry condition, given by Equation* (18)*.*

Proposition 2. *There exists a unique steady-state equilibrium.*

Proof. By Equation (18), $\overline{U}$ equals the entry cost C. Given $\overline{U}$, we can compare the values of $w_{BS}(\alpha_i)$, $w_{BI}(\alpha_i)$, $p(\alpha_i)$, and y for each i using Equations (4), (5), and (9) to determine $\mathcal{I}_{BS}$, $\mathcal{I}_{BI}$, and $\mathcal{I}_M$. Having derived these, we can obtain unique values for v_i, v, n_B, and n_M from Equations (10), (11), (12), (13), (15), and (16). We plug these into Equation (17) to solve for a unique value for u. Plugging u into Equation (14) then yields a unique value for n. □

5 Application: Labor Boundaries and Specialization

The model above can be used to analyze the labor boundaries of the firm and the patterns of specialization in the economy. For example, many entrepreneurs require professional services like cleaning, security, accounting, legal, IT, and HR services. These services could either be performed by an in-house employee or contracted out to an external firm.[14] In this section, we extend the model and use it to predict the determinants of professional service outsourcing. We also investigate its consequences for worker wages, employment security, and skill specialization.

5.1 Defining Employment and Outsourcing

We consider a labor market with a measure of entrepreneurs i who in each period have unit demand for one of two tasks $d_{it} \in \{A, B\}$. Each entrepreneur's demand switches from one

[14]Professional service firms account for 12 percent of U.S. employment and are among the largest employers in the world (Berlingieri 2013). More broadly defined, services account for the vast majority of cross-establishment trade (Bostanci and Kambhampati 2022).

task to another task with some symmetric probability α_i at the start of each period.[15] There is also an excess measure of workers who choose whether to become either specialists in one of two activities needed by entrepreneurs or a generalist with middling skill in both services. Let $\phi_j \in \{A, B, G\}$ denote the chosen type of the worker, where A and B refer to specialists and G refers to the generalist. The output depends on the fit between the entrepreneur's demand and the worker's type, as well as the worker's chosen effort, and is given by

$$y_{it} = \left[y \cdot \mathbf{1}\{\phi_j = G\} + (y + \Delta_i) \cdot \mathbf{1}\{\phi_j = d_{it}\} \right] e_t,$$

where $\Delta_i > 0$ denotes the entrepreneur-specific *gains from specialization*.[16]

As before, neither wage w_t nor effort e_t are contractible and must be incentivized through relational contracts. We define *employment* as a bilateral relational contract between an employer and a worker, while *outsourcing* is defined as an intermediated contract in which an intermediary employs workers and assigns them to different clients. We assume that output y is sufficiently large so that entrepreneurs are always able to receive positive profit by employing a generalist. We also assume that each worker's entry cost C is sufficiently large so that specialist workers never remain employed but become idle when the demand of their employer changes. These assumptions allow us to focus on each entrepreneur's choice between employing a generalist, employing a specialist who is never idle, and outsourcing. There are K intermediaries for each task. Each intermediary employs workers specializing in the task and are randomly matched with entreprenuers who offer outsourcing contracts.

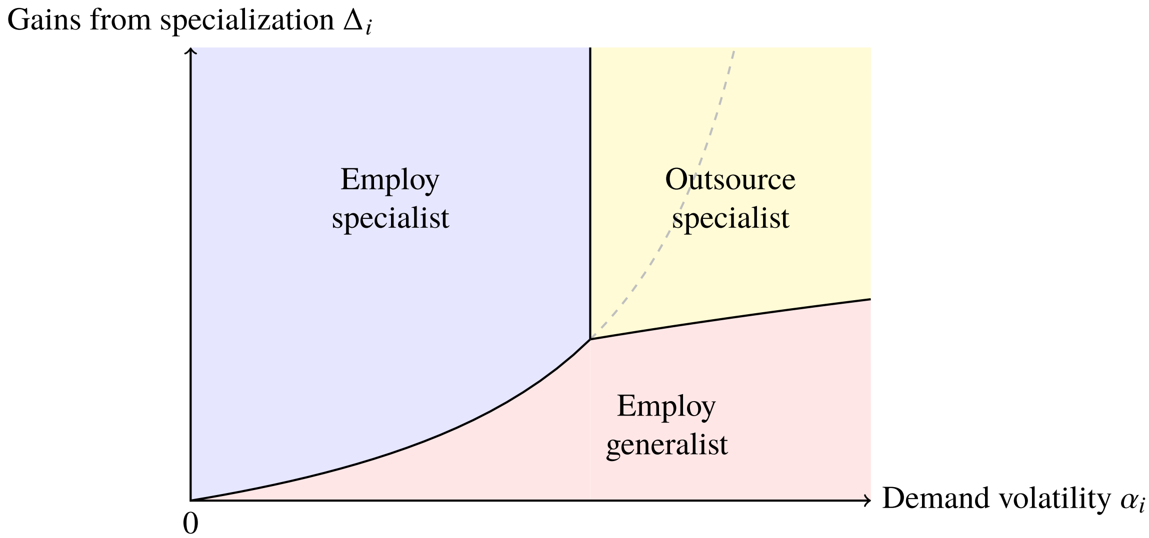
5.2 The Choice between Employment and Outsourcing

It is easy to show that in the absence of intermediaries, entrepreneurs with greater α_i and hence more volatile demand employ generalists, while those with smaller α_i and hence less volatile demand employ specialists. The dashed curve in Figure 4 shows the boundary between employing

[15] This is essentially simplifying the model in Section 2 by assuming $\alpha_{1i} = \alpha_{0i} = \alpha_i$.

[16] We assume that (α_i, Δ_i) are drawn from a distribution that includes values of α_i and Δ_i sufficiently large that in equilibrium, a non-zero measure of entrepreneurs choose to outsource. This would be true if the distribution of α_i has positive support on $[0, 1]$.

Figure 4: Optimal contractual choice in the presence of gains from specialization



a specialist and a generalist in the absence of outsourcing.

The presence of intermediaries encourages workers to specialize. For entrepreneurs with large α_i and large Δ_i, outsourcing dominates either employment arrangement. Therefore, when outsourcing becomes possible, their demand for directly employed generalists is replaced with demand for outsourced specialists. This causes the overall demand for specialists to rise. In response, more workers choose to become specialists.

Due to double marginalization, however, it is optimal to directly employ workers if demand is volatile and gains from specialization are small. It is also never optimal to enter an outsourcing contract wherein the intermediary employs a generalist worker and sends the worker to different clients. Therefore, some entrepreneur outsource specialists, while others employ either specialists or generalists.

Proposition 3. *There are more specialist workers in an economy with intermediaries than one without. An entrepreneur i outsources if and only if their demand volatility α_i and gains from specialization Δ_i are both sufficiently large.*

Proposition 3 is broadly consistent with empirical evidence. For example, Abraham and Taylor (1996) find that establishments with cyclical demand are more likely to outsource accounting services. Similarly, Houseman (2001) finds that the need to accommodate fluctuations in workload is a commonly cited reasons for using flexible staffing arrangements.

5.3 Effects of Outsourcing on Workers

Having characterized the determinants of outsourcing, we now discuss how outsourcing affects the wages and employment security of workers in our model. There are four findings.

First, direct employees in our model have higher *average wages* than outsourced workers. Formally, we can show that $E[w_E(\alpha_i)] \geq E[w_O]$, where w_E is the per-period wage payment by an entrepreneur with demand volatility α_i to its employees, and w_O is the wage payment from an intermediary to outsourced workers. This follows from the fact that $w_E(\alpha_i) \geq w_O$ for all α_i.[17]

Second, directly employees have more *dispersed wages* than those of outsourced workers. Formally, we can show that $\text{Var}[w_E(\alpha_i)] \geq \text{Var}[w_O]$, since $w_E(\alpha_i)$ takes on different values depending on α_i and α_i is heterogeneous across entrepreneurs, while w_O is constant.

Third, directly employees have higher separation rates. We define a worker's *separation rate* as their probability of becoming unmatched in any period. This probability is higher for directly employees, since they may separate from entrepreneurs when their demand changes, while outsourced workers are always reallocated among the intermediary's clients.

Fourth, direct employees are more likely to be idle during their employment spells. We define *idleness* as the expected fraction of periods while matched that the worker does not exert effort. In our model, outsourced workers are never idle, while directly employed workers may have positive idleness.

Corollary 1. *Compared to outsourced workers, directly employed workers have higher average wages, more dispersed wages, higher separation rates, and greater idleness than outsourced workers.*

Corollary 1 is broadly consistent with recent empirical findings regarding the effects of labor service outsourcing on workers. For example, Guo, Li and Wong (2024) document that outsourced workers in Brazil have lower hazard into unemployment than comparable direct employees. They attribute this difference to the fact that intermediaries help to reallocate workers

[17] As shown in the Appendix, $w_E(\alpha_i) = \frac{1}{\delta}\frac{1}{1-\alpha_i}c + (1-\delta)\overline{U}$ and $w_O = \frac{c}{\delta} + (1-\delta)\overline{U}$.

across clients and thereby prevent transitions to unemployment. In addition, a large number of studies have documented that outsourcing is associated with lower and more compressed wages for workers (Dube and Kaplan 2010; Goldschmidt and Schmieder 2017; Drenik et al. 2020). Although these studies attribute the elevated wages of direct-hire workers to firm-level rent-sharing, it is possible that the direct-hire wage premium partly arises from the fact that a higher efficiency wage is necessary for non-core activities of a firm, as suggested by our model.

5.4 Technical Change and Labor Market Structure

During the past half century, firms increasingly outsource their non-core activities, workers and firms have become increasingly specialized, wages have compressed within occupations, and unemployment has fallen (Katz and Krueger 1999; Weil 2014; Goldschmidt and Schmieder 2017; Handwerker 2023). Our model explains that these trends can result from the arrival of communication technologies like the Internet and social media, which increased the role of branding and reputation in facilitating trade.

In our model, intermediation becomes cheaper if the performance of the intermediary is partially observable to outside parties. For example, if low service quality is communicated with some probability to buyers who are not involved in production but can withhold future business from the intermediary, then the intermediary's continuation value from reneging on the relational contract worsens, so a lower service fee is needed to incentivize the intermediary to perform.

To see this, suppose that low effort by a worker is communicated with some probability to other entrepreneurs who can withhold future business from the intermediary. Specifically, we assume that with probability $\gamma \in [0, 1]$, the effort choice by a worker employed by the intermediary is observed by another entrepreneur, who is drawn among all entrepreneurs with uniform probability. The parameter γ measures the *ease of word-of-mouth communication* as enabled by communication technologies such as the Internet and social media platforms.[18]

As γ increases, the intermediary faces a harsher punishment if it reneges on its contracts.

[18] Here the intermediary will not wish to renege on more than one of its clients if she does not wish to do so for a single client, since an entrepreneur may learn of bad service provided to multiple clients from word-of-mouth communication but can only punish maximally once.

To see this, note that an intermediary's mean continuation value from being matched with an entrepreneur is $\tilde{V} = \frac{1}{|\mathcal{I}|}\int_{\mathcal{I}_O} \pi_i V_{1i} + (1-\pi_i)V_{0i} dF > 0$. When $\gamma > 0$, the intermediary's binding IC constraint is now given by:

$$V_1 \geq p_1 + \delta(-\gamma\tilde{V}), \tag{M-IC-w'}$$

In other words, the threat of multilateral punishment means that a reduced mark-up is needed to incentivize the intermediary to perform. The unit cost of outsourced labor therefore falls as γ increases.

As the cost of outsourcing decreases, a larger measure of entrepreneurs outsource, while the measure of entrepreneurs who employ specialists and generalists both fall. Since total demand for specialized workers increases, in steady-state equilibrium more workers enter as specialists. Correspondingly, there are fewer direct employers that pay elevated wages, so fewer workers enter, and unemployment falls.

Corollary 2. *As the ease of word-of-mouth communication increases, the measure of outsourced workers increases, the measure of specialist workers increases, and the measure of unmatched workers falls.*

These predictions help explain recent empirical findings. For example, Bergeaud et al. (2021) provide causal evidence that the rise of broadband internet increased outsourcing and increased the homogeneity of occupations within firms. Katz and Krueger (1999) show suggestive evidence that the rise of the temporary help sector helped to lower the unemployment rate.

6 Further Applications

Supply chains. Food processors aggregate the supply of livestock and crops from farmers and sell the processed ingredients to downstream wholesalers and retailers. Midstream manufacturers assemble commodities from various input suppliers and sell the assembled components to downstream manufacturers. Wholesalers buy goods in bulk quantity at a discounted rate and resell them to retailers and institutional users after sorting and repacking them into small lots.

Retailers purchase goods in large quantities from manufacturers or wholesalers and then resell them in smaller quantities to consumers.

Each link in the supply chain can be viewed as a nexus of relational contracts. Each node — whether they are the food processor, midstream manufacturer, retailer, or wholesaler — maintains relationships with buyers on one side and producers on the other. They aggregate the fluctuating demand and supply. They also enforce relational contracts to ensure performance.

To make this concrete, consider a set of pig farmers. Each specializes in a specific location for raising livestock. The farmers sell the pigs to a centralized pork processor, who slaughters them, cuts the meat, processes it for preservation, and then sells these parts to downstream buyers. In our model, centralized pork processing is efficient only for buyers with fluctuating demand in a large market. For buyers with sufficiently stable demand for pork, it is efficient to disintermediate and buy directly from a farmer whom they know.

As another example, consider a set of households that have different desires for consumer products each day. They want potato chips today, watermelons tomorrow, and so on. Retail stores stock many different items and thereby maintain lasting relationships with repeat customers. As such, they face stable aggregated demand and can maintain cheaper relational contracts with specialized suppliers. Therefore, it is efficient for consumer households with fluctuating demand to shop at retail stores. However, for customers with stable demand — such as restaurants with fixed menus — it is more efficient to directly purchase from suppliers.

That buyers with frequent demand are more likely to disintermediate has been frequently remarked upon in related literature. Williamson (1985) attributes this tendency to administrative and bargaining costs in repeated transactions. Wernerfelt (2015, 2016) attributes it to switching costs.[19] Our model instead suggests that the cost of intermediation is a price premium charged by the intermediary to ensure its performance as an aggregator, monitor, and standard enforcer.

Stigler (1951) conjectures that firms spin-off production stages because of increasing economies of scale as the market grows. Our model provides a way to understand this claim. In our model, it becomes possible to aggregate demand and supply only if there is a sufficiently large number of sellers and buyers such that the law of large numbers holds. Therefore, intermediaries

[19] See also Demsetz (1988).

emerge only when the market is sufficiently big.

Franchises. Many retail chains are operated as franchises, in which a franchisor creates a branded good or service that is distributed by locally owned and operated franchisees. Examples include fast food restaurant chains like McDonald's, Starbucks, and Dunkin Donuts, hotel chains like Marriott, home health care chains such as BrightStar, and business service chains like UPS. A related form of franchising involves an upstream manufacturer and a downstream retailer who sells the good, such as gasoline or automobiles. The website of the International Franchise Association (2024), a leading trade group, explains that:

> At its core, franchising is about the franchisor's brand value, how the franchisor supports its franchisees, how the franchisee meets its obligations to deliver the products and services to the system's brand standards and most importantly – franchising is about the relationship that the franchisor has with its franchisees.

In other words, the franchisor can be viewed as a nexus of relational contracts. By maintaining relationship with both franchisees and customers, the franchisor ensures that there are proper incentives for the provision of quality services even for customers with fluctuating demand.

Consider, for example, a set of customers who demand a service in every period but in different locations over time. These locations may be in different neighborhoods of the same city or in different cities altogether. Furthermore, suppose that it is cost-efficient for service providers to specialize in providing services in a specific location, given the fixed costs involved in setting up a physical site. For customers who travel between locations who easily fall prey to tourist traps, franchised stores provide a guarantee of service quality. For customers with unchanging demand, however, it is efficient to avoid the premium prices demanded by branded franchises and instead directly purchase from local service providers. A prediction of our model is therefore that airports filled with itinerant travelers would be filled with franchised stores, while small towns with immobile populations are more likely to have independent operations. This testable prediction appears consistent with casual observation.[20]

[20] Klein (1995) provides a related repeated-game model of franchise contracts. See also Blair and Lafontaine (2005), who provide a comprehensive empirical analysis of franchises and franchise contracts.

Online platforms. The advents of the Internet in the 1990s and the mobile web in 2010s have led to a proliferation of online platforms. Examples include Uber and Didi for riding-hailing, Airbnb for accommodation, Youtube and Netflix for entertainment, Amazon and eBay for shopping, among many others. The use of online platforms now pervades daily life. The economic analysis of online platforms largely focuses on platform pricing in the presence of usage and membership externalities (Rochet and Tirole 2003, 2006) and the impact of platforms on consumer search (Brynjolfsson and Smith 2000; Ellison and Ellison 2009). Less attention has been devoted to understanding how these platforms incentivize platform participants to perform.[21]

Although online platforms have some distinctive features, they are also nexuses of relational contracts. The choice to use platforms instead of directly contracting is a choice to intermediate instead of contracting bilaterally. The use of platforms therefore makes sense only for users with intermittent demand. For example, an occasional traveler would call for an Uber ride, but a company with persistent demand for rides may prefer to disintermediate and hire a full-time driver instead. Online platforms also operate reputation systems based on user input and recommendation algorithms informed by user behavior on the platform (Resnick and Varian 1996; Dellarocas 2003). These systems incentivize participant performance by penalizing platform participants with demotion or even exclusion from the platform. This function is similar to the allocative and monitoring tasks performed by human managers in more traditional businesses.

Schools. Our theory helps explain why education occurs in schools and sheds light on the management of schools and universities. Consider that students must learn different skills over time. To aid this, schools perform two vital functions. First, schools flexibly allocate teacher time across students, so that teachers can specialize in teaching specific courses to multiple sections. Second, schools enforce relational contracts to ensure that students behave and teachers perform. They do so in part by dismissing underperforming teachers and by expelling students who engage in significant or repeated misconduct. By aggregating the demand and supply in the market for

[21] A notable exception is Hagiu and Wright (2015), who model the organizational difference between vertical integration and multi-sided platform as a difference in the allocation of decision rights, following Gibbons (2005).

knowledge transfer, schools are centralized intermediaries that improve upon decentralized and bilateral student-teacher pairings.

Hospitals. Our theory can also be used to understand hospitals. Consider that many patients fall sick randomly and intermittently. They may have different medical needs each time. It is efficient to assign patients to different doctors and nurses, who specialize in specific medical procedures and knowledge. This can give rise to trusted hospital organizations that aggregate the demand for medical services, assign the appropriate medical practitioners to provide services, and ensure that patients are provided with quality care. Since there is less scope for demand aggregation, our model predicts that independent clinical practices are more prevalent in small towns. Independent practices will tend to be generalist and will be more susceptible to idleness.

Governments. It should be noted that governments are also centralized intermediaries. Consider that taxpayers demand the provision of services such as trash pickup, fire-fighting, public security, conflict resolution, enforcement of property rights, maintenance of infrastructure and natural resources, and market regulation. Governments aggregate the intermittent and changing needs of taxpayers for these services, monitor and direct workers or contractors who fulfill these needs, ensure their performance, and face backlash from taxpayers if they fail. In other words, governments function as centralized providers of trust in economic exchange, much like firms. Of course, governments differ from private-sector firms in many respects. The differences include their focus on non-excludable public services that are difficult for private firms to successfully provide, their possession of coercive powers not available to non-governmental entities, and the replacement of market-based competition with alternative modes of incentive provision, such as elections (see, e.g., Fearon 2011). It is beyond the scope of this article to provide a proper application of our theory to the various forms of governments, which includes organizational forms as diverse as medieval itinerant courts, merchant guilds, modern democratic regulatory states, and Marxist-Leninist party states. Such an exercise, however, is likely to generate many insights into their organizational structures.

7 Discussion

This paper develops a model of an exchange economy wherein centralized intermediaries may emerge as nexuses of relational contracts. Our model explains why some collaborative partners contract through a centralized intermediary that organizes exchange and production, while others contract in a decentralized and bilateral manner. The benefit of intermediation is stronger relational contracts arising from aggregation and matching of demand and supply. Its cost is a markup needed to incentivize the intermediary. Our main proposition shows that there exists a unique steady-state equilibrium wherein both contracting forms may coexist: buyers with sufficiently volatile demand choose intermediation, while buyers with long-lasting demand choose bilateral contracts.

We apply the model to study the labor boundaries of firms and the patterns of skill specialization in the economy. We define employment as a bilateral contract between an entrepreneur and a worker, while we define outsourcing as a trilateral contract involving an intermediary. We derive three realistic predictions. First, entrepreneurs outsource if and only if demand is volatile and gains from specialization are large. Second, outsourced workers have lower and more compressed wages, are less likely to transition into unemployment, and are more specialized. Third, as communication technology becomes more prevalent, outsourcing and specialization increase and unemployment falls. We also use model to understand the organization of supply chains, franchises, online platforms, hospitals, and schools.

This section discusses three additional ideas. First, we discuss the role of reputational capital and multilateral relational contracts in the choice between intermediation and direct contracting. Second, we discuss the role of managers and management in facilitating exchange and production. Finally, we conclude with remarks about the methodological approach, the limitations of the present model, and future directions.

7.1 Reputation Capital and Multilateral Relational Contracts

Our model follows Shapiro and Stiglitz (1984) in assuming that producers are motivated to perform through the threat of contract termination, which would require them to wait to rematch in an anonymous matching market. Another source of motivation, as modeled by Klein and Leffler (1981), is that sellers may lose reputational capital when they renege on promises to deliver high-quality services, causing a broader set of buyers to withhold future business.

In reality, reputation concerns play an important role in shaping the contractual choice between intermediation and direct bilateral contracting. As shown in Section 5.4, intermediation becomes more attractive when the intermediary maintains a reputation among buyers. Since other buyers now learn of bad service quality and can collectively punish the intermediary, the service fee needed to incentivize the intermediary is reduced. However, intermediation becomes less attractive if producers themselves can build and maintain reputational capital. In such a world, they would not rematch on an *anonymous* market, as modeled above. Instead, if a producer shirks their contractual responsibilities, buyers can cause producers to face difficulty rematching thereafter. In this case, the producer faces a stronger incentive to perform and does so even if the particular buyer they currently provide services for is expected to have no demand next period. Therefore, the presence of the intermediary becomes less useful.

Other forms of multilateral punishments can also alter a buyer's choice between intermediation and bilateral contracting. Levin (2002) analyzes multilateral relational contracts that provide stronger incentives than bilateral contracts because agents can threaten to collectively punish a principal through coordinated action. In our model, the threat of losing multiple producer relationships has no bite because intermediaries can immediately rematch with new producers. However, if rematching is difficult, then the presence of a multilateral relational contract between an intermediary and its producers will increase the intermediary's incentive to perform, thereby lowering its service fee. Intermediation may therefore become more attractive if producers matched with the intermediary can easily communicate with one another about the intermediary's actions, such as through regular conferences among suppliers.

7.2 Managers and Managerial Practices

Since at least Walker (1887), economists have recognized the importance of managers and managerial practices in determining the wealth of nations. A growing literature in economics documents their importance as drivers of productivity (Bertrand and Schoar 2003; Bloom and Van Reenen 2007; Bloom et al. 2013; Bloom, Sadun and Van Reenen 2016; Metcalfe, Sollaci and Syverson 2023). Recent empirical work shows that managers and managerial practices matter both in motivating workers to perform (Lazear 2000; Bandiera, Barankay and Rasul 2005) and in allocating talent appropriately to needed tasks (Bandiera, Barankay and Rasul 2007; Minni 2023; Caplin et al. 2023).

Our model provides a game-theoretic lens to understand the work that managers perform and clarifies why managerial practices matter for economic performance. In our model, the intermediary is at once a monitor of producer performance, a resource allocator, and a mediator maintaining relational contracts with buyers on one side and producers on the other. This is similar to what a manager does in real life. As the model makes clear, the tasks of a manager are very different from those of production workers. They do not directly manufacture goods or provide services desired by customers but instead are facilitators of exchange and production. Nevertheless, the presence of effective managers can substantially alter economic performance by simultaneously improving the allocation of resources and reducing the cost of contract enforcement.

7.3 Theory of the Firm: Past and Future

Early literature in the theory of the firm identifies and catalogs transaction costs that shape organizational boundaries and structure (e.g., Coase 1937; Alchian and Demsetz 1972; Klein, Crawford and Alchian 1978; Williamson 1971, 1975, 1985). The pioneering work of Grossman and Hart (1986) prompted economists to develop parsimonious game-theoretic models to clarify why firm-like organization emerges as an equilibrium response to the underlying informational and technological environment. Many models of the firm build on the approach pioneered by Grossman and Hart (1986), which analyzes the optimal allocation of ownership and control rights (see Gibbons 2005). We explore a complementary approach by studying the optimal arrangement of relational contracts among a large population of economic agents. Our approach builds on a burgeoning literature that emphasizes the importance of relational contracts within and between organizations (MacLeod and Malcomson 1989, 1998; Baker, Gibbons and Murphy 2002; Levin 2003; MacLeod 2007; Gibbons and Henderson 2012; Malcomson 2013; Gil and Zanarone 2017; Macchiavello and Morjaria 2023). We show that this approach can generate realistic predictions regarding organizational boundaries and behavior that are not present in prior models.

In devising our model, many simplifying assumptions were made. These assumptions enable us to highlight the incentive role that intermediaries play but they also limit realism. First, we assume that the parties have common knowledge regarding demand realizations and buyer and producer types. As such, we abstract from potential misallocation arising from centralized resource distribution in the presence of private local information (cf. Hayek 1945; Aghion and Tirole 1997). We also ignore the potential role that intermediaries may play in overcoming asymmetric information and search frictions (Biglaiser 1993; Autor 2009). Second, we assume the complete absence of market power. In reality, the allocative, monitoring, and reputational capabilities of an intermediary can be sources of enduring competitive advantage, leading to market dominance and monopoly power (Penrose 1959; Rumelt 1984; Wernerfelt 1984, 1997; Prahalad and Hamel 1990; Barney 1991; Conner and Prahalad 1996). Third, we have completely ignored asset ownership and specific investments, which existing papers highlight as important components of firm-like organization (Grossman and Hart 1986; Gibbons 2005). Understanding the interaction between asset ownership and the structure of contractual relationships, as first highlighted by Baker, Gibbons and Murphy (2002), is a task of first-order importance.

A good deal of further research is needed to better understand the structure of networks that are connected by relational contracts. Our work focuses only on networks with centralized intermediaries that coordinate transactions and incentivize effort. In reality, a wide variety of network and hierarchical structures are linked by relational contracts (Powell 1990; Ménard 2004, 2012). The relational contracts embedded in these network shape incentives not only for effort but also for a large assortment of activities including communication and decision-making (Alonso and Matouschek 2007; Barron and Powell 2019), experimentation (Chassang 2010), investment (Halac 2015; Englmaier and Fahn 2019), and knowledge transfer (Garicano and Rayo 2017). Further analyses of these relational networks can greatly enhance our understanding of organizations and marketplaces.

References

Abraham, Katharine G. and Susan K. Taylor. 1996. "Firms' use of outside contractors: Theory and evidence." *Journal of Labor Economics* 14(3):394–424.

Acemoglu, Daron, Pol Antràs and Elhanan Helpman. 2007. "Contracts and technology adoption." *American Economic Review* 97(3):916–943.

Aghion, Philippe and Jean Tirole. 1994. "The management of innovation." *The Quarterly Journal of Economics* 109(4):1185–1209.

Aghion, Philippe and Jean Tirole. 1997. "Formal and Real Authority in Organizations." *Journal of Political Economy* 105(1):1–29.

Alchian, Armen A. and Harold Demsetz. 1972. "Production, information costs, and economic organization." *The American Economic Review* 62(5):777–795.

Alonso, Ricardo and Niko Matouschek. 2007. "Relational delegation." *The RAND Journal of Economics* 38(4):1070–1089.

Andrews, Isaiah and Daniel Barron. 2016. "The allocation of future business: Dynamic relational contracts with multiple agents." *American Economic Review* 106(9):2742–59.

Antràs, Pol. 2003. "Firms, contracts, and trade structure." *The Quarterly Journal of Economics* 118(4):1375–1418.

Antràs, Pol. 2014. "Grossman–Hart (1986) goes global: Incomplete contracts, property rights, and the international organization of production." *The Journal of Law, Economics, and Organization* 30(suppl_1):i118–i175.

Antràs, Pol and Elhanan Helpman. 2004. "Global sourcing." *Journal of Political Economy* 112(3):552–580.

Autor, David H. 2009. *Studies of Labor Market Intermediation*. The University of Chicago Press.

Baker, George, Robert Gibbons and Kevin J Murphy. 2002. "Relational contracts and the theory of the firm." *Quarterly Journal of Economics* 117(1):39–84.

Bandiera, Oriana, Iwan Barankay and Imran Rasul. 2005. "Social preferences and the response to incentives: Evidence from personnel data." *The Quarterly Journal of Economics* 120(3):917–962.

Bandiera, Oriana, Iwan Barankay and Imran Rasul. 2007. "Incentives for managers and inequality among workers: Evidence from a firm-level experiment." *The Quarterly Journal of Economics* 122(2):729–773.

Bardhan, Pranab, Dilip Mookherjee and Masatoshi Tsumagari. 2013. "Middlemen margins and globalization." *American Economic Journal: Microeconomics* 5(4):81–119.

Barney, Jay. 1991. "Firm resources and sustained competitive advantage." *Journal of Management* 17(1):99–120.

Barron, Daniel and Michael Powell. 2019. "Policies in relational contracts." *American Economic Journal: Microeconomics* 11(2):228–249.

Bergeaud, Antonin, Clement Malgouyres, Clement Mazet-Sonilhac and Sara Signorelli. 2021. Technological change and domestic outsourcing. CEP Discussion Papers dp1784 Centre for Economic Performance, LSE.

Berlingieri, Giuseppe. 2013. "Outsourcing and the rise in services." *Working Paper* .

Bernstein, Lisa. 1992. "Opting out of the legal system: Extralegal contractual relations in the diamond industry." *The Journal of Legal Studies* 21(1):115–157.

Bernstein, Lisa. 2016. "Beyond Relational Contracts: Social Capital and Network Governance in Procurement Contracts." *Journal of Legal Analysis* 7(2):561–621.

Bertrand, Marianne and Antoinette Schoar. 2003. "Managing with style: The effect of managers on firm policies." *The Quarterly Journal of Economics* 118(4):1169–1208.

Biglaiser, Gary. 1993. "Middlemen as experts." *The RAND Journal of Economics* pp. 212–223.

Biglaiser, Gary and James W. Friedman. 1994. "Middlemen as guarantors of quality." *International Journal of Industrial Organization* 12(4):509–531.

Blair, Roger D. and Francine Lafontaine. 2005. *The Economics of Franchising*. Cambridge University Press.

Bloom, Nicholas, Benn Eifert, Aprajit Mahajan, David McKenzie and John Roberts. 2013. "Does management matter? Evidence from India." *The Quarterly Journal of Economics* 128(1):1–51.

Bloom, Nicholas and John Van Reenen. 2007. "Measuring and explaining management practices across firms and countries." *The Quarterly Journal of Economics* 122(4):1351–1408.

Bloom, Nicholas, Raffaella Sadun and John Van Reenen. 2016. Management as a Technology? Working Paper 22327 National Bureau of Economic Research.

Board, Simon. 2011. "Relational Contracts and the Value of Loyalty." *American Economic Review* 101(7):3349–67.

Board, Simon and Moritz Meyer-ter Vehn. 2015. "Relational contracts in competitive labour markets." *Review of Economic Studies* 82(2):490–534.

Bostanci, Gorkem and Ashwin Kambhampati. 2022. "A theory of firm boundaries with long-run incentives and at-will employment." *Working Paper* .

Brynjolfsson, Erik and Michael D. Smith. 2000. "Frictionless commerce? A comparison of internet and conventional retailers." *Management Science* 46(4):563–585.

Caplin, Andrew, David J. Deming, Søren Leth-Petersen and Ben Weidmann. 2023. "Allocative skill." *National Bureau of Economic Research working paper* .

Chassang, Sylvain. 2010. "Building routines: Learning, cooperation, and the dynamics of incomplete relational contracts." *American Economic Review* 100(1):448–65.

Cheung, Steven N.S. 1983. "The contractual nature of the firm." *The Journal of Law & Economics* 26(1):1–21.

Coase, Ronald H. 1937. "The nature of the firm." *Economica* 4(16):386–405.

Conner, Kathleen R and C. K Prahalad. 1996. "A resource-based theory of the firm: Knowledge versus opportunism." *Organization Science* 7(5):477–501.

Dellarocas, Chrysanthos. 2003. "The digitization of word of mouth: Promise and challenges of online feedback mechanisms." *Management Science* 49(10):1407–1424.

Demsetz, Harold. 1988. "The theory of the firm revisited." *Journal of Law, Economics, & Organization* 4(1):141–161.

Drenik, Andres, Simon Jäger, Miguel Pascuel Plotkin and Benjamin Schoefer. 2020. "Paying outsourced labor: Direct evidence from linked temp agency-worker-client data." *Working Paper* .

Dube, Arindrajit and Ethan Kaplan. 2010. "Does outsourcing reduce wages in the low-wage service occupations? Evidence from janitors and guards." *ILR Review* 63(2):287–306.

Dyer, Jeffrey H. and Harbir Singh. 1998. "The relational view: Cooperative strategy and sources of interorganizational competitive advantage." *The Academy of Management Review* 23(4):660–679.

Ellison, Glenn and Sara Fisher Ellison. 2009. "Search, obfuscation, and price elasticities on the internet." *Econometrica* 77(2):427–452.

Englmaier, Florian and Matthias Fahn. 2019. "Size matters: How over-investments relax liquidity constraints in relational contracts." *The Economic Journal* 129(624):3092–3106.

Espinosa, Miguel. 2020. "Labor Boundaries and Skills: The Case of Lobbyists." *Management Science* .

Fearon, James D. 2011. "Self-enforcing democracy." *The Quarterly Journal of Economics* 126(4):1661–1708.

Fong, Yuk-fai and Jin Li. 2017. "Relational contracts, limited liability, and employment dynamic." *Journal of Economic Theory* 169:270–293.

Garicano, Luis and Luis Rayo. 2017. "Relational knowledge transfers." *The American Economic Review* 107(9):2695–2730.

Geertz, Clifford. 1962. "The rotating credit association: A "middle rung" in development." *Economic Development and Cultural Change* 10(3):241–263.

Geertz, Clifford. 1978. "The bazaar economy: Information and search in peasant marketing." *American Economic Review* 68(2):28–32.

Gibbons, Robert. 2005. "Four formal (izable) theories of the firm?" *Journal of Economic Behavior & Organization* 58(2):200–245.

Gibbons, Robert and Rebecca Henderson. 2012. "Relational contracts and organizational capabilities." *Organization Science* 23(5):1350–1364.

Gibbons, Robert, Richard Holden and Michael Powell. 2012. "Organization and information: firms' governance choices in rational-expectations equilibrium." *The Quarterly Journal of Economics* 127(4):1813–1841.

Gil, Ricard and Giorgio Zanarone. 2017. "Formal and Informal Contracting: Theory and Evidence." *Annual Review of Law and Social Science* 13(1):141–159.

Goldschmidt, Deborah and Johannes F. Schmieder. 2017. "The rise of domestic outsourcing and the evolution of the German wage structure." *The Quarterly Journal of Economics* 132(3):1165–1217.

Granovetter, Mark. 1985. "Economic action and social structure: The problem of embeddedness." *American Journal of Sociology* 91(3):481–510.

Grossman, Gene M. and Elhanan Helpman. 2002. "Integration versus outsourcing in industry equilibrium." *The Quarterly Journal of Economics* 117(1):85–120.

Grossman, Sanford J. and Oliver D. Hart. 1986. "The costs and benefits of ownership: A theory of vertical and lateral integration." *Journal of Political Economy* 94(4):691–719.

Guo, Naijia, Duoxi Li and Michael B. Wong. 2024. "Domestic Outsourcing and Employment Security." *Working Paper* .

Hagiu, Andrei and Julian Wright. 2015. "Multi-sided platforms." *International Journal of Industrial Organization* 43:162–174.

Halac, Marina. 2015. "Investing in a relationship." *The RAND Journal of Economics* 46(1):165–185.

Handwerker, Elizabeth Weber. 2023. "Outsourcing, Occupationally Homogeneous Employers, and Wage Inequality in the United States." *Journal of Labor Economics* .

Hart, Oliver and John Moore. 1990. "Property rights and the nature of the firm." *Journal of Political Economy* 98(6):1119–1158.

Hart, Oliver and John Moore. 2007. "Incomplete contracts and ownership: Some new thoughts." *American Economic Review* 97(2):182–186.

Hart, Oliver and John Moore. 2008. "Contracts as reference points." *The Quarterly Journal of Economics* 123(1):1–48.

Hayek, F. A. 1945. "The use of knowledge in society." *The American Economic Review* 35(4):519–530.

He, Leshui. 2016. "Beyond asset ownership: Employment and assetless firms in the property rights theory of the firm." *Journal of Economic Behavior & Organization* 130:261–273.

Houseman, Susan N. 2001. "Why employers use flexible staffing arrangements: Evidence from an establishment survey." *ILR Review* 55(1):149–170.

International Franchise Association. 2024. “What is a franchise?”.
URL: *https://www.franchise.org/faqs/basics/what-is-a-franchise*

Jensen, Michael C. and William H. Meckling. 1976. “Theory of the firm: Managerial behavior, agency costs and ownership structure.” *Journal of Financial Economics* 3(4):305–360.

Katz, Lawrence F. and Alan B. Krueger. 1999. “The High-Pressure U.S. Labor Market of the 1990s.” *Brookings Papers on Economic Activity* 30(1):1–88.

Klein, Benjamin. 1995. “The economics of franchise contracts.” *Journal of Corporate Finance* 2(1-2):9–37.

Klein, Benjamin and Keith B. Leffler. 1981. “The role of market forces in assuring contractual performance.” *Journal of Political Economy* 89(4):615–641.

Klein, Benjamin, Robert G. Crawford and Armen A. Alchian. 1978. “Vertical Integration, Appropriable Rents, and the Competitive Contracting Process.” *The Journal of Law & Economics* 21(2):297–326.

Lafontaine, Francine and Margaret Slade. 2007. “Vertical integration and firm boundaries: The evidence.” *Journal of Economic Literature* 45(3):629–685.

Lazear, Edward P. 2000. “Performance pay and productivity.” *The American Economic Review* 90(5):1346–1361.

Legros, Patrick and Andrew F. Newman. 2013. “A price theory of vertical and lateral integration.” *Quarterly Journal of Economics* 128(2):725–770.

Levin, Jonathan. 2002. “Multilateral contracting and the employment relationship.” *The Quarterly Journal of Economics* 117(3):1075–1103.

Levin, Jonathan. 2003. “Relational incentive contracts.” *American Economic Review* 93(3):835–857.

Levin, Jonathan and Steven Tadelis. 2010. “Contracting for government services: Theory and evidence from US cities.” *The journal of industrial economics* 58(3):507–541.

Li, Duoxi. 2022. “Relationship Building under Market Pressure.” *Available at SSRN 4380443* .

Macaulay, Stewart. 1963. “Non-contractual relations in business: A preliminary study.” *American Sociological Review* 28(1):55–67.

Macchiavello, Rocco and Ameet Morjaria. 2023. Relational Contracts: Recent Empirical Advancements and Open Questions. NBER Working Paper 30978.

MacLeod, W. Bentley. 2007. “Reputations, relationships, and contract enforcement.” *Journal of Economic Literature* 45(3):595–628.

MacLeod, W. Bentley and James M. Malcomson. 1989. “Implicit contracts, incentive compatibility, and involuntary unemployment.” *Econometrica* 57(2):447–480.

MacLeod, W. Bentley and James M. Malcomson. 1998. “Motivation and markets.” *American Economic Review* pp. 388–411.

Macneil, I.R. 1978. "Contracts: Adjustment of long-term economic relations under classical and neoclassical, and relational contract law." *Northwestern University Law Review* 72:854–905.

Malcomson, James M. 2013. Relational incentive contracts. In *The Handbook of Organizational Economics*. Princeton University Press pp. 1014–1065.

Matouschek, Niko. 2004. "Ex post inefficiencies in a property rights theory of the firm." *Journal of Law, Economics, and Organization* 20(1):125–147.

Metcalfe, Robert, Alexandre Sollaci and Chad Syverson. 2023. "Managers and productivity in retail." *Working Paper* .

Minni, Virginia. 2023. "Making the invisible hand visible: Managers and the allocation of workers to jobs." *Working Paper* .

Ménard, Claude. 2004. "The economics of hybrid organizations." *Journal of Institutional and Theoretical Economics* 160(3):345–376.

Ménard, Claude. 2012. Hybrid Modes of Organization: Alliances, Joint Ventures, Networks, and Other Strange Animals. In *The Handbook of Organizational Economics*. Princeton University Press pp. 1066–1106.

Penrose, Edith Tilton. 1959. *The theory of the growth of the firm*. Oxford: Basil Blackwell.

Powell, Michael. 2015. "An influence-cost model of organizational practices and firm boundaries." *The Journal of Law, Economics & Organization* 31(suppl 1):i104–i142.

Powell, Walter W. 1990. Neither market nor hierarchy:Network forms of organization. In *Research in Organizational Behavior*, ed. Barry M. Staw and Larry L. Cummings. Vol. 12 JAI Press Inc. pp. 295–336.

Prahalad, C.K and Gary Hamel. 1990. "The core competence of the corporation." *Harvard Business Review* 68(3):79–91.

Rajan, Raghuram G. and Luigi Zingales. 1998. "Power in a theory of the firm." *The Quarterly Journal of Economics* 113(2):387–432.

Resnick, Paul and Hal R. Varian. 1996. "Recommender systems." *Communications of the ACM* 40(3):56–58.

Rochet, Jean-Charles and Jean Tirole. 2003. "Platform competition in two-sided markets." *Journal of the European Economic Association* 1(4):990–1029.

Rochet, Jean-Charles and Jean Tirole. 2006. "Two-sided markets: A progress report." *The RAND Journal of Economics* 37(3):645–667.

Rumelt, Richard P. 1984. "Towards a strategic theory of the firm." *Competitive Strategic Management* 26(3):556–570.

Schmitz, Patrick W. 2006. "Information gathering, transaction costs, and the property rights approach." *American Economic Review* 96(1):422–434.

Shapiro, Carl and Joseph E. Stiglitz. 1984. "Equilibrium unemployment as a worker discipline device." *American Economic Review* 74(3):433–444.

Simon, Herbert A. 1951. "A formal theory of the employment relationship." *Econometrica* 19(3):293–305.

Spulber, Daniel F. 1996. "Market Microstructure and Intermediation." *Journal of Economic Perspectives* 10(3):135–152.

Stigler, George J. 1951. "The division of labor is limited by the extent of the market." *Journal of Political Economy* 59(3):185–193.

Tirole, Jean. 1988. *The theory of industrial organization*. The MIT Press.

Troya-Martinez, Marta and Liam Wren-Lewis. 2023. "Managing relational contracts." *Journal of the European Economic Association* 21(3):941–986.

Tunca, Tunay I. and Stefanos A. Zenios. 2006. "Supply auctions and relational contracts for procurement." *Manufacturing & Service Operations Management* 8(1):43–67.

Van den Steen, Eric. 2010. "Interpersonal authority in a theory of the firm." *American Economic Review* 100(1):466–90.

Walker, Francis A. 1887. "The source of business profits." *The Quarterly Journal of Economics* 1(3):265–288.

Weil, David. 2014. *The fissured workplace*. Harvard University Press.

Wernerfelt, Birger. 1984. "A resource-based view of the firm." *Strategic Management Journal* 5(2):171–180.

Wernerfelt, Birger. 1997. "On the nature and scope of the firm: An adjustment-cost theory." *The Journal of Business* 70(4):489–514.

Wernerfelt, Birger. 2015. "The comparative advantages of firms, markets and contracts: a unified theory." *Economica* 82(326):350–367.

Wernerfelt, Birger. 2016. *Adaptation, specialization, and the theory of the firm: Foundations of the resource-based view*. Cambridge University Press.

Williamson, Oliver E. 1971. "The vertical integration of production: Market failure considerations." *The American Economic Review* 61(2):112–123.

Williamson, Oliver E. 1975. *Markets and hierarchies, Analysis and antitrust implications : a study in the economics of internal organization*. New York: Free Press.

Williamson, Oliver E. 1985. *The economic institutions of capitalism: Firms, markets,relational contracting*. New York: Free Press.

A Appendix

We omit the subscript i in the proofs. We first establish the following two lemmas.

Lemma A.1. *Suppose an optimal bilateral relational contract exists. Under this contract, if $\beta > 0$, then $w_0 = 0$, both (B-IC1) and (B-IC0) bind, and (P-IC1) is slack.*

Proof. Prove by contradiction. Suppose that $w_0 > 0$. Since there is an excess of producers in the frictionless matching market, $\overline{\Pi}_1 = \Pi_1$. So

$$\begin{aligned}\Pi_0 &= -w_0 + \delta\Big[\alpha_0\Pi_1 + (1-\alpha_0)(\beta\Pi_0 + (1-\beta)\overline{\Pi}_0)\Big] \\ &= -w_0 + \delta\Big[\alpha_0\overline{\Pi}_1 + (1-\alpha_0)(\beta\Pi_0 + (1-\beta)\overline{\Pi}_0)\Big].\end{aligned}$$

Also note that $\overline{\Pi}_0 = \delta\Big[\alpha_0\overline{\Pi}_1 + (1-\alpha_0)\overline{\Pi}_0\Big]$. Therefore,

$$\Pi_0 - \overline{\Pi}_0 = -w_0 + \delta(1-\alpha_0)\beta(\Pi_0 - \overline{\Pi}_0) < \delta(1-\alpha_0)\beta(\Pi_0 - \overline{\Pi}_0),$$

where the inequality comes from $w_0 > 0$. Since $\delta \in (0,1)$ and $\beta \in (0,1]$, we discuss whether $\alpha_0 = 1$. If $\alpha_0 < 1$, the equation above cannot be satisfied, which contradicts that $w_0 > 0$. On the other hand, if $\alpha_0 = 1$, $\overline{\Pi}_0 = \delta\overline{\Pi}_1$ and then $\Pi_0 = -w_0 + \delta\overline{\Pi}_1 < \overline{\Pi}_0$, which contradicts to (B-IC0) and also indicates that $w_0 = 0$. Therefore, $w_0 = 0$ and $\Pi_0 = \overline{\Pi}_0$. Thus both (B-IC1) and (B-IC0) bind.

We now show that (P-IC1) is slack. Suppose it binds, namely $U_1 = \overline{U}$. Then given $w_0 = 0$ and $\delta < 1$, plug in $U_1 = \overline{U}$ and get

$$\begin{aligned}U_0 &= \delta\Big[\alpha_0\overline{U} + (1-\alpha_0)(\beta U_0 + (1-\beta)\overline{U})\Big] \\ &< (1-\alpha_0)\beta U_0 + (1-(1-\alpha_0)\beta)\overline{U}.\end{aligned}$$

The inequality above indicates that $U_0 < \overline{U}$, which contradicts to (P-IC0). So (P-IC1) is slack. $\square$

Lemma A.2. *For any buyer who directly contracts with producers, maximizing Π_1 is equivalent to minimizing w_1.*

Proof. Based on Lemma A.1, the buyer's continuation payoffs can be written as

$$\Pi_1 = \frac{1-\delta(1-\alpha_0)}{1-\delta\alpha_0\alpha_1-\delta(2-\alpha_0-\alpha_1)+\delta^2(1-\alpha_0)(1-\alpha_1)}(y-w_1),$$

$$\Pi_0 = \frac{\delta\alpha_0}{1-\delta(1-\alpha_0)}\Pi_1.$$

Since $\frac{\partial \Pi_1}{\partial w_1} < 0$, a buyer's problem is equivalent to minimize w_1 subject to producer's incentive constraints. □

Proof of Lemma 1

For simplicity, we write w_1 as w in the rest of the proof. We complete the proof by analyzing and comparing the terms in the optimal bilateral relational contracts when choosing $\beta = 0$ or $\beta > 0$.

Choice 1: $\beta = 0$. If the optimal choice of β is 0, $U_1 = w - c + \delta\Big[(1-\alpha_1)U_1 + \alpha_1\overline{U}\Big]$. The buyer optimally chooses w subject to a binding (P-IC-e), which gives

$$w_{BS} = \frac{1}{\delta(1-\alpha_1)}c + (1-\delta)\overline{U}.$$

Choice 2: $\beta \in (0, 1]$. If the optimal choice of β is greater than 0, a buyer's optimization problem becomes $\min_{w,\beta} w$ subject to (P-IC-e), (P-IC0), (1), (2), $0 < \beta \leq 1$, and $w \geq 0$.

The Lagrangian is given by

$$\begin{aligned} L = w &+ \lambda_1(U_1 - (w - c + \delta((1-\alpha_1)\cdot U_1 + \alpha_1(\beta U_0 + (1-\beta)\overline{U})))) \\ &+ \lambda_2(U_0 - \delta(\alpha_0 \cdot U_1 + (1-\alpha_0)\cdot(\beta U_0 + (1-\beta)\overline{U}))) \\ &+ \mu_1(w + \delta\overline{U} - U_1) + \mu_2(\overline{U} - U_0) + \mu_3(\beta - 1) + \mu_4(-w). \end{aligned}$$

The Kuhn-Tucker conditions are given by

$$\frac{\partial L}{\partial w} = 1 + \mu_1(1 - \frac{\partial U_1}{\partial w}) - \mu_2\frac{\partial U_0}{\partial w} - \mu_4 \leq 0,$$

$$\frac{\partial L}{\partial w}w = 0,$$

$$\frac{\partial L}{\partial \beta} = -\mu_1\frac{\partial U_1}{\partial \beta} - \mu_2\frac{\partial U_0}{\partial \beta} - \mu_3 = 0,$$

$$\lambda_1, \lambda_2 > 0,$$

$$\mu_1, \mu_2, \mu_3, \mu_4 \geq 0,$$

$$\mu_1(w + \delta\overline{U} - U_1) = 0,$$

$$\mu_2(\overline{U} - U_0) = 0,$$

$$\mu_3(1 - \beta) = 0,$$

$$\mu_4 w = 0.$$

Meanwhile, by taking derivatives on both sides of equations (1) and (2) with respect to w, get

$$\frac{\partial U_1}{\partial w} = 1 + \delta\Big[(1 - \alpha_1)\frac{\partial U_1}{\partial w} + \alpha_1\beta\frac{\partial U_0}{\partial w}\Big], \tag{A1}$$

$$\frac{\partial U_0}{\partial w} = \delta\Big[\alpha_0\frac{\partial U_1}{\partial w} + (1 - \alpha_0)\beta\frac{\partial U_0}{\partial w}\Big]. \tag{A2}$$

By taking derivatives on both sides of equations (1) and (2) with respect to β, get

$$\frac{\partial U_1}{\partial \beta} = \delta\Big[(1 - \alpha_1)\frac{\partial U_1}{\partial \beta} + \alpha_1(U_0 - \overline{U} + \beta\frac{\partial U_0}{\partial \beta})\Big], \tag{A3}$$

$$\frac{\partial U_0}{\partial \beta} = \delta\Big[\alpha_0\frac{\partial U_1}{\partial \beta} + (1 - \alpha_0)(U_0 - \overline{U} + \beta\frac{\partial U_0}{\partial \beta})\Big]. \tag{A4}$$

We proceed by the following steps.

Step 1: Show that $\mu_4 = 0$ and $w > 0$. Suppose that $w = 0$. Then

$$\begin{aligned} U_1 &= -c + \delta\Big[(1 - \alpha_1)U_1 + \alpha_1(\beta U_0 + (1 - \beta)\overline{U})\Big] \\ &< (1 - \alpha_1)U_1 + \alpha_1(\beta U_0 + (1 - \beta)\overline{U}), \end{aligned}$$

where the inequality comes from that $c > 0$ and $\delta < 1$. The inequality above implies that

$$U_1 < \beta U_0 + (1-\beta)\overline{U} < U_0,$$

where the second inequality comes from (P-IC0). Meanwhile,

$$\begin{aligned} U_0 &= \delta\Big[\alpha_0 U_1 + (1-\alpha_0)(\beta U_0 + (1-\beta)\overline{U})\Big] \\ &< \alpha_0 U_1 + (1-\alpha_0)(\beta U_0 + (1-\beta)\overline{U}) \\ &< U_0, \end{aligned}$$

where the first inequality comes from $\delta < 1$ and the second inequality comes from (P-IC0) and $U_1 < U_0$. Since $U_0 < U_0$ can never be true, we know that $w > 0$ and thus $\mu_4 = 0$.

The implication for $w > 0$ is that

$$\frac{\partial L}{\partial w} = 1 + \mu_1(1 - \frac{\partial U_1}{\partial w}) - \mu_2 \frac{\partial U_0}{\partial w} = 0,$$

Step 2: Discuss the values of μ_1 and μ_2. **Case 1)** $\mu_1 = \mu_2 = 0$. In this case, $\frac{\partial L}{\partial w} = 0$ is violated, indicating that this case is not possible. In other words, at least one of two incentive compatibility constraints bind.

Case 2) $\mu_1 = 0$ and $\mu_2 > 0$. In this case, $U_1 > w + \delta\overline{U}$ and $U_0 = \overline{U}$. Solve U_1 and w based on equation (1) and get

$$U_1 = \frac{1-\delta(1-\alpha_0)}{\delta\alpha_0}\overline{U},$$

$$w = c + \frac{(1-\delta)^2 - \delta(1-\delta)(\alpha_0+\alpha_1)}{\delta\alpha_0}\overline{U}.$$

So $\frac{\partial U_1}{\partial \beta} = \frac{\partial U_0}{\partial \beta} = 0$. Meanwhile, $\frac{\partial L}{\partial w} = 0$ and $\mu_1 = 0$ imply that $1 = \mu_2 \frac{\partial U_0}{\partial w}$. $\frac{\partial L}{\partial \beta} = 0$ implies $\mu_3 = 0$, namely $\beta < 1$.

There are two conditions that need to be satisfied for this case to be feasible and optimal. First, for feasibility, the solved w and U_1 need to satisfy $U_1 > w + \delta\overline{U}$. After plugging in U_1 and

w as functions of $\overline{U}$, this requires that

$$\frac{(1-\delta)\overline{U}}{c} > \frac{\alpha_0}{1-\alpha_1}.$$

Second, since we are considering the case where choosing $\beta > 0$ is weakly better than choosing $\beta = 0$, the solved w needs to be lower than w_{BS}, which gives

$$\frac{(1-\delta)\overline{U}}{c} \leq \frac{\alpha_0}{1-\alpha_1}.$$

These two conditions contract each other, indicating that this case is not possible.

Case 3) $\mu_1 > 0$ and $\mu_2 > 0$. In this case, both incentive compatibility constraints bind, which give $U_1 = w + \delta\overline{U}$ and $U_0 = \overline{U}$. Under binding (P-IC-e) and (P-IC0), equations (1) and (2) can be satisfied only if

$$\frac{(1-\delta)\overline{U}}{c} = \frac{\alpha_0}{1-\alpha_1}.$$

In that case, the solved w also coincides with w_{BS}, and a buyer is thus indifferent among choosing any value of $\beta \in [0, 1]$.

Case 4) $\mu_1 > 0$ and $\mu_2 = 0$. In this case, $U_1 = w + \delta\overline{U}$, $U_0 > \overline{U}$, $\frac{\partial L}{\partial w} = 1 + \mu_1(1 - \frac{\partial U_1}{\partial w}) = 0$, and $\frac{\partial L}{\partial \beta} = -(\mu_1 \frac{\partial U_1}{\partial \beta} + \mu_3) = 0$.

We discuss whether $\beta = 1$ or not. If $\beta \neq 1$, $\mu_3 = 0$, then $\frac{\partial U_1}{\partial \beta} = 0$. Given that, equation (A3) suggests that $\frac{\partial U_0}{\partial \beta} < 0$, while equation (A4) suggests that $\frac{\partial U_0}{\partial \beta} > 0$. Therefore, a contradiction exists, indicating that $\beta = 1$.

Given $\beta = 1$ and $\mu_3 > 0$, solve

$$w_{BI} = \left(\frac{1}{\delta}\frac{1 + \frac{\delta}{1-\delta}\alpha_0}{(1-\alpha_1) + \frac{\delta}{1-\delta}\alpha_0}\right)c + \left(\frac{1 + \frac{\delta}{1-\delta}\alpha_0}{(1-\alpha_1) + \frac{\delta}{1-\delta}\alpha_0} - \delta\right)\overline{U}.$$

In sum, if a buyer decides to choose $\beta > 0$, she will optimally choose $\beta = 1$ with paying w_{BI} when her demand is 1. The comparison between choice 1 and choice 2 hinge on comparing w_{BS}

and w_{BI}. It turns out that $w_{BS} < w_{BI}$ if and only if

$$\frac{(1-\delta)\overline{U}}{c} > \frac{\alpha_0}{1-\alpha_1}.$$

Therefore, whenever the condition above holds, the buyer chooses $\beta = 0$ (separating from the producer when demand becomes 0) and pays w_{BS} when her demand is 1. Otherwise, she chooses $\beta = 1$ (retaining the producer when demand becomes 0) and pays w_{BI} when her demand is 1.

Proof of Lemma 2

Observe that the continuation payoffs and incentive compatibility constraints for an intermediary in an intermediated contract are similar with those for a producer in a bilateral contract. The only differences are that the "cost of production" for an intermediary is w_M and its continuation value after separating from a buyer, given by $\overline{V}$, is 0. Since

$$\frac{(1-\delta)\overline{V}}{w_M} \leq \frac{\alpha_0}{1-\alpha_1}$$

for any α_0 and α_1. Therefore, the value of p is determined by replacing c with w_M and $\overline{U}$ with 0 in w_{BI}.

Proof of Proposition 1

We prove the proposition in four steps.

Step 1: Compare bilateral contracting with separation with bilateral contracting with idleness. The following lemma comes directly from Lemma 1.

Lemma A.3. *If $\overline{U} > \overline{U}^{ei} \equiv \frac{c}{1-\delta}\alpha_0$, there exists a unique cutoff $\overline{\alpha}_1^{ei} \in (0, 1)$ such that $w_{BS} < w_{BI}$ if and only if $\alpha_1 < \overline{\alpha}_1^{ei}$.*

Step 2: Compare bilateral contracting with separation with intermediated contracting.

Lemma A.4. *There exists a unique cutoff $\overline{\alpha}_1^{eo} \in (0, 1]$ such that $w_{BS} < p$ if and only if $\alpha_1 < \overline{\alpha}_1^{eo}$.*

Proof. Observe that $w_{BS} < p$ if and only if

$$\frac{1}{\delta}\frac{1}{1-\alpha_1}c + (1-\delta)\overline{U} < (\frac{1}{\delta}\frac{1+\frac{\delta}{1-\delta}\alpha_0}{(1-\alpha_1)+\frac{\delta}{1-\delta}\alpha_0})\frac{c}{\delta} + (\frac{1}{\delta}\frac{1+\frac{\delta}{1-\delta}\alpha_0}{(1-\alpha_1)+\frac{\delta}{1-\delta}\alpha_0})(1-\delta)\overline{U},$$

or

$$\frac{1}{1-\alpha_1}\frac{c}{\delta} + (1-\delta)\overline{U} - \frac{1}{\delta - \frac{\delta}{1+\frac{\delta}{1-\delta}\alpha_0}\alpha_1}(\frac{c}{\delta} + (1-\delta)\overline{U}) < 0.$$

Let the LHS to be $f(\alpha_1) = \frac{1}{1-\alpha_1}\frac{c}{\delta} + (1-\delta)\overline{U} - \frac{1}{\delta - \frac{\delta}{1+\frac{\delta}{1-\delta}\alpha_0}\alpha_1}(\frac{c}{\delta} + (1-\delta)\overline{U})$. Observe that, when $\alpha_0 = 0$, $f(\alpha_1)\big|_{\alpha_0=0} = (1-1/\delta)\frac{c}{\delta}\frac{1}{1-\alpha_1} + (1 - \frac{1}{\delta(1-\alpha_1)})(1-\delta)\overline{U} < 0$. In this case, $w_{BS} < p$ for sure, so $\overline{\alpha}^{eo} = 1$.

When $\alpha_0 > 0$, observe that $f(0) = (1-\frac{1}{\delta})\kappa < 0$, and $f(1)$ goes to infinity. We now show that the continuous function $f(\alpha_1)$ intersects with 0 only once. Compute

$$\frac{\partial f(\alpha_1)}{\partial \alpha_1} = \frac{\zeta(\zeta\frac{c}{\delta} - \kappa)\alpha_1^2 - 2(c-\kappa)\zeta\alpha_1 + (\delta c - \zeta\kappa)}{(1-\alpha_1)^2(\delta - \zeta\alpha_1)^2}.$$

where $\zeta = \frac{\delta}{1+\frac{\delta}{1-\delta}\alpha_0}$ and $\kappa = \frac{c}{\delta} + (1-\delta)\overline{U}$.

Observe that the numerator is a quadratic equation, where the coefficient of α_1^2 is negative, the coefficient of α_1 is positive, and the constant $\delta c - \zeta(\frac{c}{\delta} + (1-\delta)\overline{U})$ can be positive or negative. Therefore, $f(\alpha_1)$ is either strictly increasing, or is first decreasing then increasing. In either case, $f(\alpha_1)$ intersects with 0, with the intersect being $\overline{\alpha}^{eo} \in (0,1)$.

In sum, there exists a unique cutoff $\overline{\alpha}^{eo} \in (0,1]$ such that $w_{BS} < p$ if and only if $\alpha_1 < \overline{\alpha}^{eo}$. $\square$

Step 3: Compare bilateral contracting with idleness with intermediated contracting.

Lemma A.5. *If $\overline{U} > \overline{U}^{io} \equiv \frac{(1-\delta(1-\alpha_0))c}{\delta(\delta(2-(1-\delta)\alpha_0)-1)}$, there exists a unique cutoff $\overline{\alpha}_1^{io} \in (0,1)$ such that $w_{BI} < p$ if and only if $\alpha_1 < \overline{\alpha}_1^{io}$. Otherwise, $w_{BI} < p$ for sure.*

Proof. Observe that $w_{BI} < p$ if and only if

$$(\frac{1}{\delta}\frac{1+\frac{\delta}{1-\delta}\alpha_0}{(1-\alpha_1)+\frac{\delta}{1-\delta}\alpha_0})c + (\frac{1+\frac{\delta}{1-\delta}\alpha_0}{(1-\alpha_1)+\frac{\delta}{1-\delta}\alpha_0} - \delta)\overline{U} < (\frac{1}{\delta}\frac{1+\frac{\delta}{1-\delta}\alpha_0}{(1-\alpha_1)+\frac{\delta}{1-\delta}\alpha_0})(\frac{c}{\delta} + (1-\delta)\overline{U}),$$

or

$$\frac{1+\frac{\delta}{1-\delta}\alpha_0}{1+\frac{\delta}{1-\delta}\alpha_0-\alpha_1}(\frac{2\delta-1}{\delta}\overline{U}-\frac{1-\delta}{\delta}\frac{c}{\delta})<\delta\overline{U}.$$

Let the LHS to be $g(\alpha_1)=\frac{1+\frac{\delta}{1-\delta}\alpha_0}{1+\frac{\delta}{1-\delta}\alpha_0-\alpha_1}(\frac{2\delta-1}{\delta}\overline{U}-\frac{1-\delta}{\delta}\frac{c}{\delta})$. Observe that $g(0)=\frac{2\delta-1}{\delta}\overline{U}-\frac{1-\delta}{\delta}\frac{c}{\delta}$ and $g(1)=\frac{1+\frac{\delta}{1-\delta}\alpha_0}{\frac{\delta}{1-\delta}\alpha_0}(\frac{2\delta-1}{\delta}\overline{U}-\frac{1-\delta}{\delta}\frac{c}{\delta})$. Also observe that $g(0)-\delta\overline{U}=\frac{-(1-\delta)^2}{\delta}\overline{U}-\frac{1-\delta}{\delta}\frac{c}{\delta}<0$.

If $\overline{U}<\overline{U}^{io}$, $g(1)<\delta\overline{U}$ and thus the inequality holds for sure. Otherwise, since $g(\alpha_1)$ is strictly increasing in α_1, there exists a unique cutoff $\overline{\alpha}^{io}$ by the intermediate value theorem. □

Step 4: Let $\overline{U}^*=\overline{U}^{io}$ and $\alpha^*=\min\{\overline{\alpha}^{io},\overline{\alpha}^{eo}\}$.

If $\overline{U}<\overline{U}^{io}$, $w_{BI}<p$ by Lemma A.5. Otherwise, if $\overline{U}\geq\overline{U}^{io}$ there are two cases. If $w_{BS}<w_{BI}$, intermediated contract is optimal when $p<w_{BS}$, namely when $\alpha_1>\overline{\alpha}_1^{eo}$. If $w_{BS}>w_{BI}$ intermediated contract is optimal when $p<w_{BI}$, namely when $\alpha_1>\overline{\alpha}_1^{io}$.

Proof of Proposition 3

Based on Lemma 1 and 2, the payments by entrepreneur i under direct employment or outsourcing are

$$w_E(\alpha_i)=\frac{1}{\delta}\frac{1}{1-\alpha_i}c+(1-\delta)\overline{U},$$

$$w_G=w_O=\frac{c}{\delta}+(1-\delta)\overline{U},$$

$$p(\alpha_i)=\frac{1}{\delta}\frac{1+\frac{\delta}{1-\delta}\alpha_i}{1+\frac{\delta}{1-\delta}\alpha_i-\alpha_i}\left[\frac{c}{\delta}+(1-\delta)\overline{U}\right],$$

where $w_E(\alpha_i)$ is the wage for a specialist, w_G is the wage for a generalist, w_O is the wage from an intermediary to an outsourced worker, and $p(\alpha_i)$ is the service fee for outsourcing.

The entrepreneur's post-matching continuation payoffs when she has demand when choosing to employ specialists, to employ a generalist, or to outsource are thus

$$\Pi_E(\alpha_i)=\frac{y+\Delta_i}{1-\delta}-\left[\overline{U}+\frac{c}{(1-\alpha_i)\delta(1-\delta)}\right],$$

$$\Pi_G=\frac{y}{1-\delta}-\left[\overline{U}+\frac{c}{\delta(1-\delta)}\right].$$

$$\Pi_O(\alpha_i) = \frac{y+\Delta_i}{1-\delta} - \Big[\frac{1}{\delta}\frac{1+\frac{\delta}{1-\delta}\alpha_i}{1+\frac{\delta}{1-\delta}\alpha_i - \alpha_i}(\overline{U} + \frac{c}{\delta(1-\delta)})\Big],$$

respectively.

By comparing $\Pi_E(\alpha_i)$ and Π_G, we know that an entrepreneur prefers to employ specialists than employ a generalist if and only if $\Pi_E(\alpha_i) \geq \Pi_G$, namely,

$$\Delta_i \geq \frac{\alpha_i}{1-\alpha_i}\frac{c}{\delta}.$$

Similarly, the entrepreneur prefers to employ specialists than outsource if and only if

$$\Big[\frac{1}{\delta}\frac{1+\frac{\delta}{1-\delta}\alpha_i}{1+\frac{\delta}{1-\delta}\alpha_i - \alpha_i} - 1\Big]\Big[\overline{U} + \frac{c}{\delta(1-\delta)}\Big] \geq \frac{\alpha_i}{1-\alpha_i}\frac{c}{\delta(1-\delta)}.$$

It is established in Lemma A.3 that there exists a unique cutoff on α_i, α^{eo}, based on which the entrepreneur to strictly prefer one or the other. Specifically, the entrepreneur prefers to outsource if and only if α_i is sufficiently large.

Finally, the entrepreneur prefers to outsource than employ a generalist if and only if

$$\Delta_i \geq \overline{\Delta}(\alpha_i) \equiv \Big[\frac{1}{\delta}\frac{1+\frac{\delta}{1-\delta}\alpha_i}{1+\frac{\delta}{1-\delta}\alpha_i - \alpha_i} - 1\Big]\Big[\overline{U} + \frac{c}{\delta(1-\delta)}\Big].$$

In sum, the entrepreneur choose to outsource if and only if α_i and Δ_i are both large enough. Meanwhile, given that some entrepreneurs have sufficiently low Δ_i (i.e., $\Delta_i < \overline{\Delta}(\alpha^{eo})$), those entrepreneurs choose direct employment and some generalists may be employed. When some Δ_i exceeds $\overline{\Delta}(\alpha^{eo})$, those entrepreneurs begin to outsource to specialists, and fewer generalists in the economy will be employed. Suppose all Δ_i is sufficiently high (i.e., $\Delta_i > \overline{\Delta}(1)$ for all i), no generalists will be employed and workers are all specialized.