Enabling versus controlling

Andrei Hagiu* and Julian Wright†

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Abstract

In an increasing number of industries, firms choose how much control to give professionals over the provision of their services to clients. We study the tradeoffs that arise in choosing between a traditional mode (where the firm takes control of service provision) and a platform mode (where professionals retain control over service provision). The choice of mode is determined by the need to balance two-sided moral hazard problems arising from investments that only professionals can make and investments that only the firm can make, while at the same time minimizing distortions in decisions that either party could make (e.g. promotion and marketing of professionals’ services, price setting, choice of service offering, etc).

JEL classification: D4, L1, L5

Keywords: platforms, theory of the firm, vertical integration, control rights, moral hazard

1 Introduction

In many service industries (e.g. consulting, education, home services, legal, outsourcing and staffing, taxi), traditional firms employ service providers (professionals) and control most (if not all) of the relevant decision rights pertaining to the interactions with customers—work schedule and scope, service fees, and how services are marketed and performed. The last decade has brought a rapidly increasing number of firms in these industries that take advantage of information technologies to enable independent professionals to connect directly with customers, such that professionals control some or all of the relevant decisions (e.g. Coursera, Elance-oDesk, Gerson Lehrman Group, Lyft and Uber, Task Rabbit, etc.). Motivated by these examples, this paper studies a firm’s choice between two modes of organization—a traditional mode versus a platform mode—where the key difference between the

*Harvard Business School, Boston, MA 02163, E-mail: ahagiu@hbs.edu
†Department of Economics, National University of Singapore, Singapore 117570, E-mail: jwright@nus.edu.sg
two modes is that professionals hold more control rights in the platform mode than in the traditional mode.\textsuperscript{1}

The model we develop captures that both professionals and the firm typically add value to the services offered to clients. Specifically, each makes a costly and non-transferable investment (or effort) decision which raises the revenue that can be obtained from clients. This creates a two-sided moral hazard problem for the firm. However, two-sided moral hazard is not sufficient to generate an interesting tradeoff between the two modes given that we allow the firm to compensate professionals based on the revenues obtained from clients. To create an interesting tradeoff we add a third decision variable that can either be controlled by the firm or the professional, i.e. a transferable decision variable. The allocation of control rights over this third transferable decision variable is what determines the mode of organization in our model. If control rights are given to professionals then the firm operates in the platform mode. If control rights are instead kept by the firm then it operates in the traditional mode. We show that, in the presence of two-sided moral hazard, a meaningful trade-off exists between the platform mode and the traditional mode only if the transferable decision variable is non-contractible, and is either costly (e.g. promotional activities, investments in equipment, etc.) or exhibits spillovers across multiple professionals (e.g. prices, horizontal marketing decisions).

In this setting, we first show that the optimal contract involves a linear (two-part) contract, with a fixed payment and a fixed portion of revenue being paid between the two parties. Since revenues need to be split between the two parties, in general both professionals’ and the firm’s non-transferable efforts will fall short of the first-best level, as will the transferable decision variable if it is costly. In the baseline model without spillovers across professionals, or interaction effects between the three decision variables, we show that the party whose moral hazard problem is more important should receive a greater share of the revenue. This implies the same party should also be given control over the transferable decision variable to lessen the distortion from the transferable decision variable being set too low. Thus, we predict the traditional mode is chosen when the firm’s moral hazard problem is more important and the platform mode is chosen when the professionals’ moral hazard problem is more important.

This tradeoff is modified when there are spillovers across professionals’ transferable decisions. Consider first the case when the transferable decision is a revenue-increasing, costly investment (e.g. marketing or equipment). If a larger investment by one professional also increases the revenue obtained by other professionals providing services through the same firm (i.e. positive spillovers), then the spillover always shifts the trade-off between the two modes in favor of the traditional mode, as expected. This is simply because in the traditional mode, the firm coordinates investment decisions to internalize the spillover, whereas in the platform mode, individual professionals leave it uninternalized and therefore invest too little. Things are more interesting with negative spillovers. In platform mode, individual professionals now invest too much by not internalizing the spillovers. But these higher investments can help offset the primary distortion due to revenue sharing, namely that the party with

\textsuperscript{1}This focus is also consistent with legal definitions that emphasize control rights as the most important factor determining whether professionals providing services through a given firm should be considered independent contractors (platform mode) or employees (traditional mode).
control rights invests too little because it keeps less than 100% of the revenue generated. As a result, we find that the platform mode can be a useful way for the firm to get professionals to choose higher levels of the transferable decision variable without giving them an excessively high share of revenues. Thus, if negative spillovers are strong enough then it is possible that professionals get a lower share of revenues in the platform mode than the traditional mode. This leads to a reversal of the normal logic, according to which control rights over the transferable decision variable should be given to the party whose moral hazard problem is more important.

In the case when the transferable decision variable is the price for the professionals’ services, the trade-off between the two modes is determined by different considerations. Since setting a higher price does not involve any real cost, revenue-sharing does not distort price-setting in either mode, so revenue-sharing can be used to balance the two-sided moral hazard problem equally well in both modes. However, a higher price raises the return to each party from costly investments, thereby mitigating each party’s moral hazard problem. Thus, when services are substitutes, independent professionals set prices too low in platform mode, which exacerbates moral hazard. As a result, the traditional mode dominates. On the other hand, if professionals’ services are complements, then independent professionals set prices too high in the platform mode, thus mitigating each of the moral hazard problems. As a result, we find that the platform mode can be preferred.

The next section discusses related literature. Section 3 provides some examples of markets in which the traditional mode vs. platform mode choice that we model is relevant. Section 4 introduces our theory and obtains results for the simpler case with a single professional, while Section 5 extends the theory to the case with multiple professionals and spillovers. Section 7 concludes.

2 Related literature

A key and novel contribution of our paper is to extend in a natural way the theory of the firm based on control rights and incentive systems (see Grossman and Hart, 1986, Hart and Moore, 1990) to platforms. Our focus on platforms makes our work quite different from earlier works studying the classic “make” versus “buy” decision. The “make” part is similar: a firm operating in the traditional mode controls most decisions but still needs to design contracts in order to address moral hazard by employees. However, the “enabling” (platform) scenario is quite different from “buying” (i.e. contracting via the market). The difference is that the “platform” mode gives professionals control rights over the transaction with end-customers. In a “buy” relationship between firm and suppliers, the firm still has complete control over the final payoffs that arise from selling the final good or service to customers (this difference is discussed in detail in our previous paper, Hagiu and Wright 2015b).

We focus on ex-post moral hazard, hence the need to provide incentives in the form of revenue sharing. We show that linear contracts remain optimal in our setting despite the fact that both the principal and the agent take non-contractible actions after the contract is signed (two-sided moral hazard) and one of the parties takes a third payoff-relevant action (the transferable decision variable) that also depends on the contract signed. In this respect, we extend the earlier literature showing the
optimality of linear contracts (see Holmstrom and Milgrom, 1987 and especially Romano, 1994).

This paper relates to two of our earlier works that study how firms choose to position themselves closer to or further from a multi-sided platform business model. The focus on incentive systems and moral hazard in the current paper contrasts with Hagiu and Wright (2015a), which applied the “adaptation theory of the firm” to marketplaces. The adaptation theory emphasized the advantage of a marketplace over a reseller in allowing third-party suppliers to adapt decisions to their local information. We abstract from information advantages in the present theory. Closer to the current paper is Hagiu and Wright (2015b). A key difference in that paper is that it only allows for one-sided moral hazard. In the current paper, regardless of which party controls the choice of the transferable variable, the other party still makes non-contractible decisions that affect the outcome. This feature of our model captures what we think is a key characteristic of platforms: even though a platform enables professionals to interact with customers on terms they control, the platform still makes important decisions that affect the revenues derived by professionals. Thus, in contrast to our earlier work, here we introduce two-sided moral hazard, which is fundamental to the tradeoffs we study. Another difference is that the current model is much more general, and applies to a wider range of firms rather than just multi-sided platforms facing cross-group network effects.

In the literature on multi-sided platforms, a few other authors have noted the possibility that platforms can sometimes choose whether or not to vertically integrate into one of their sides, although they have not modelled this choice: Gawer and Cusumano (2002), Evans et al. (2006), Gawer and Henderson (2007) and Rysman (2009). The trade-offs these works discuss revolve around platform quality and product variety and therefore are quite different from the ones we identify here.

3 Examples

The most natural examples of markets in which the choice we study is relevant involve firms that can either employ professionals and control how they deliver services to clients, or operate as platforms enabling independent professionals to provide services directly to clients. While this choice has become particularly prominent due to the proliferation of Internet-based services (e.g. Coursera, Elance-oDesk, Handy and Homejoy, Hourly Nerd, Lyft and Uber, Task Rabbit, etc.), it has been long relevant in a number of “offline” industries.

The hair salon industry is a good example as it has long featured both modes of organization. Some salons employ their hair stylists and pay them fixed hourly wages plus commissions that are a percentage of sales. Such salons control schedule and product lines, provide all the necessary equipment, do all the marketing to customers and provide stylists with some training and guidance. In contrast, other salons simply rent out chairs (booths) to independent hair stylists. The stylists keep all earnings minus booth rental fees paid to the salon: these fees are usually some combination of flat weekly fees and a variable percentage of sales. In such salons, each stylist decides her/his own schedule and product line, provides her/his own equipment and advertises to customers.

2See Gibbons, 2005 for a classification of different theories of the firm.
Another offline example that may be more familiar to readers is economic consulting firms, such as Analysis Group, Charles River Associates, Cornerstone Research, National Economics Research Associates (NERA). Almost all of these firms use a hybrid between the two modes of organization, relying both on in-house consultants that are employed, and outside economists that act as independent professionals. The latter set their own work schedule and fees (the firms typically add a percentage fee on top and charge the total to clients). There is significant variation across firms in the share of in-house vs. independent consultants. For instance, NERA relies mainly on in-house consultants, whereas Cornerstone Research relies mainly on independent consultants.

Table 1: Examples

<table>
<thead>
<tr>
<th></th>
<th>Transferable decisions</th>
<th>Non-transferable investment decisions made by professionals</th>
<th>Non-transferable investment decisions made by the firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair salons</td>
<td>investments in equipment and uniforms; advertising of individual professionals’ services to customers (online and offline)</td>
<td>effort regarding service quality and/or customer experience (friendliness, before and after service, etc.)</td>
<td>investments in maintenance of the salon (cleanliness, signage), common washing and coloring facilities and advertising of the salon to customers; training and guidance provided to professionals</td>
</tr>
<tr>
<td>Uber &amp; Lyft vs. traditional taxi companies</td>
<td>quality, maintenance and cleanliness of car subject to minimal requirements; work schedule</td>
<td>customer service (e.g. friendliness, politeness); investment in local information</td>
<td>advertising the service (company) to customers; investments in the quality of the corresponding app and back-end infrastructure (e.g. payment processing, dispatch system)</td>
</tr>
<tr>
<td>Elance-oDesk vs. traditional staffing and outsourcing agencies (e.g. Adecco, Infosys)</td>
<td>advertising of individual professionals services; work schedule and scope</td>
<td>investments in development of skills and expertise; effort put into understanding and responding to customer needs; effort supplied in the provision of the service</td>
<td>investments in the (online) infrastructure that allows communication and monitoring by the client; investment in payment functionality; advertising the firm to corporate clients</td>
</tr>
<tr>
<td>Hospitals &amp; their clinics</td>
<td>equipment; support staff; work schedule and scope; advertising of individual clinics services</td>
<td>investments in development of skills and expertise; customer service; effort supplied in the provision of the service</td>
<td>development and maintenance of common infrastructure (e.g. physical space, common staff, any shared equipment); advertising the hospital (e.g. website)</td>
</tr>
<tr>
<td>Coursera vs. University of Phoenix</td>
<td>curriculum design (topics, length, assessment); advertising of individual instructors and courses</td>
<td>quality of content and its delivery; effort put into understanding and responding to students needs</td>
<td>investments in online infrastructure for content delivery, interactions, feedback and evaluations (both ways); advertising the brand</td>
</tr>
<tr>
<td>eBay Motors vs. Beepi</td>
<td>advertising and presentation of individual cars; after-sale customer service and guarantees</td>
<td>quality and/or maintenance of the product</td>
<td>investments in the website and related infrastructure (e.g. payment system, fulfillment, delivery, customer service, etc.); advertising of the website to users</td>
</tr>
</tbody>
</table>

Our model can also potentially fit intermediaries for products rather than just services, provided either (i) the price charged by intermediaries to buyers is contracted upon between suppliers and the intermediary (e.g. resale price maintenance clauses) or (ii) the contracts between suppliers and intermediaries specify variable fees as percentage of revenues generated (or of the price to buyers).
instead of nominal wholesale prices.\textsuperscript{3} Some product intermediaries act as platforms (marketplaces), others as traditional resellers that take control over most decisions relevant to the sale to buyers (see Hagiu and Wright, 2013 and 2015a). As an example, consider two online intermediaries facilitating the sale of used cars. eBay Motors is a pure marketplace where sellers retain all relevant control rights regarding their listing (price, photos, information, warranties and other ancillary services offered, etc). eBay charges car sellers a fixed listing fee as well as a fee that depends on the sale price of the car. By contrast, Beepi facilitates the sale of used cars from individuals to other individuals, but takes control over many relevant aspects of the sale. Beepi sends an inspector to each seller to appraise the car and suggest a price, guarantees sale within 30 days at that price (if not, Beepi buys the car itself), takes professional and standardized pictures with Beepi plates on, arranges delivery to the buyer and offers buyers a range of ancillary services (10-day money back guarantee, complete warranty for several months). Beepi adds 3-9\% on top of the price suggested to the seller and charges the total to the buyer.

Table 1 shows how these and other examples where firms may choose between the two modes fit our theory. In particular, it illustrates how the revenue generated by each professional (or supplier) can depend on each of the three different types of non-contractible decision variables featured in our model: (i) a costly investment always chosen by the firm; (ii) a costly investment always chosen by the professional; and (iii) a transferable decision that is chosen by the firm in traditional mode and by the professional in platform mode. We have not included the price (or fee) charged to customers in Table 1, which is potentially another transferable decision variable in each of the examples listed. However, the price is also sometimes contractible or pinned down by market constraints, in which case it can be treated as a fixed constant in our analysis. Finally, while we have included examples in Table 1 in which firms act as intermediaries for the sale of products, for conciseness we will focus on the case of professional services in the rest of the paper.

4 General model with one professional

We start by considering a model with a single professional. Section 5 will allow for multiple professionals and consider spillovers between them.

4.1 Assumptions

There is a firm (the principal) and a professional (the agent). The revenue generated by the firm and the professional is $R(a, e, E)$, which depends on three types of actions, all of which are non-contractible. Actions $E$ and $e$ are non-transferable: the firm always chooses $E \in \mathbb{R}_+$ at cost $c^E (E)$ and the professional always chooses $e \in \mathbb{R}_+$ at cost $c^e (e)$. This means there is two-sided moral hazard. To fix ideas, one can think of $E$ as capturing the firm’s ongoing investments in infrastructure, and of $e$ as the effort made by the professional in the provision of the service. Action $a$ is transferable, i.e.

\textsuperscript{3}The reason for these conditions is that in our model we assume only total revenue is contractible, not the underlying demand. Either one of these two conditions ensures that contracting on revenue is equivalent to contracting on demand.
it can be chosen either by the firm or by the professional, depending on the mode in which the firm chooses to operate. The party that chooses \( a \in \mathbb{R}_+ \) incurs cost \( c^a(a) \). Our analysis encompasses two possibilities:

- Costly actions which always increase revenues, i.e. \( c^a(a) > 0 \) for \( a > 0 \) and \( R \) increasing in \( a \). Examples include marketing or promotional activities, customer service efforts, investments in equipment, etc.

- Costless actions \( (c^a = 0) \), such that \( R \) is single-peaked in \( a \). Price is the most natural example, but such actions also include “horizontal choices” (see Hagiu and Wright 2015a), e.g. the allocation of a fixed promotional capacity between emphasizing brand vs. emphasizing product features.

We assume throughout the paper that the only variable that can be contracted on is the realized revenue \( R(a, e, E) \). In other words, any contract offered by the firm to the professional can only depend on \( R(a, e, E) \), but not on any of the underlying variables \((a, e, E)\).

We make the following technical assumptions\(^4\):

(a1) All functions are twice continuously differentiable in all arguments.

(a2) The cost functions \( c^e \) and \( c^E \) are increasing and strictly convex in their arguments. If \( c^a \neq 0 \) then \( c^a \) is also increasing and strictly convex. Furthermore,

\[
\begin{align*}
c^a(0) &= c^a_a(0) = c^e(0) = c^e_e(0) = c^E(0) = c^E_E(0) = 0.
\end{align*}
\]

(a3) The revenue function \( R \) is non-negative for all \((a, e, E)\), strictly increasing and weakly concave in \((e, E)\). If \( a \) is costless (i.e. if \( c^a = 0 \)), then \( R \) is concave and single-peaked in \( a \) for all \((e, E)\). If \( a \) is costly (i.e. if \( c^a \neq 0 \)), then \( R \) is strictly increasing and weakly concave in \( a \).

(a4) \( \lim_{e \to \infty} (R_e(a, e, E) - c^e_e(e)) < 0 \) for all \((a, E)\) and \( \lim_{E \to \infty} (R_E(a, e, E) - c^E_E(E)) < 0 \) for all \((a, e)\). If \( c^a = 0 \) then for all \((e, E)\) there exists \( \hat{a}(e, E) \) such that \( R(a, e, E) = 0 \) for all \( a \geq \hat{a}(e, E) \). If \( c^a \neq 0 \) then \( \lim_{a \to \infty} (R_a(a, e, E) - c^a_a(a)) < 0 \) for all \((e, E)\).

(a5) For all \( t \in [0, 1] \), each of the following two systems of three equations in \((a, e, E)\) admits a solution:

\[
\begin{align*}
&\{ tR_a(a, e, E) = c^a_a(a) \\
&\{ (1 - t) R_e(a, e, E) = c^e_e(e) \\
&\{ tR_E(a, e, E) = c^E_E(E)
\end{align*}
\]

and

\[
\begin{align*}
&\{ (1 - t) R_a(a, e, E) = c^a_a(a) \\
&\{ (1 - t) R_e(a, e, E) = c^e_e(e) \\
&\{ tR_E(a, e, E) = c^E_E(E).
\end{align*}
\]

\(^4\)Subscripts indicate derivatives throughout the paper. Thus, \( c^a_a \) indicates the derivative of \( c^a \) with respect to \( a \), and \( R_a \) indicates the partial derivative of \( R \) with respect to \( a \).
These assumptions are standard and are made to ensure that the optimization problems considered below are well-behaved. Assumption (a4) ensures there is always a finite solution to the optimization problems we consider. The first set of equations in (a5) are the first-order conditions corresponding to the T-mode, while the second set of equations in (a5) are the first-order conditions corresponding to the P-mode.\footnote{A simple sufficient condition for (a5) to hold is that there exist \((\pi, \tau, E)\) such that \(R(a, e, E) - c^a(a) - c^e(e) - c^E(E) < 0\) whenever \(a > \pi, e > \tau\) or \(E > \bar{E}\). Indeed, this condition ensures that the relevant space in \((a, e, E)\) is compact, so we can apply the Kakutani fixed point theorem for existence of the solutions to the two systems of equations.} Note that if \(R(a, e, E)\) is additively separable in its three arguments then (a5) is implied by (a1)-(a4) and the solution to each of the two sets of equations is unique for all \(t \in [0, 1]\).

The firm has all the bargaining power and we denote the professional’s outside option by \(W_0\). The firm can choose to operate in one of two modes: T-mode and P-mode. In both modes, the firm offers the professional a contract consisting of a fixed fee \(F\) and a variable fee \(tR(a, e, E)\), where \(t \in [0, 1]\). This means the net payment from the professional to the firm is \(F + tR(a, e, E)\), and the professional is left with \((1 - t)R(a, e, E) - F\). In the next subsection, we show that the restriction to such linear contracts is without loss of generality. The difference between the two modes is that in T-mode (traditional), the firm controls the transferable action \(a\), whereas in P-mode (platform) \(a\) is chosen by the professional. This generally implies different levels of \(R(a, e, E)\) across the two modes, and different optimal contracts \((t, F)\). Thus, it is possible for \(F\) to be negative under T-mode (i.e. the professional receives a fixed wage) and positive under P-mode (i.e. the professional pays a fixed fee). Nevertheless, if \(W_0\) is high enough then the professional will receive a net payment in both modes. Note also that in our model it is immaterial whether the firm or the professional collects revenues \(R\) and pays the other party their share. If in T-mode the firm collects revenues and pays \((1 - t)R(a, e, E)\) to the professional then this can be interpreted as a bonus in an employment relationship. Given that the firm holds all the bargaining power, it will set \(F\) in both modes so that the professional is indifferent between participation and her outside option, which for convenience we normalize throughout to \(W_0 = 0\).

The game we study has the following timing. In stage 0, the firm chooses whether to operate in T-mode or P-mode. In stage 1, the firm sets \((t, F)\) and the professional decides whether to accept and pay the fixed fee \(F\). In stage 2, there are two possibilities depending on the firm’s choice in stage 0. In T-mode, the firm chooses \(E\) and \(a\), and the professional simultaneously chooses \(e\). In P-mode, the firm chooses \(E\) and the professional simultaneously chooses \(e\) and \(a\). Finally, in stage 3, revenues \(R(a, e, E)\) are realized; the firm receives \(tR(a, e, E)\) and the professional receives \((1 - t)R(a, e, E)\).

### 4.2 General results

We first establish that the restriction to linear contracts in both modes is without loss of generality (the proof is in the appendix).

**Proposition 1** In both modes, the firm can achieve the best possible outcome with a linear contract.
This proposition implies that the firm’s profits in $T$-mode can be written as\(^6\)

$$\Pi^T = \max_{t,a,e,E} \{ R(a,e,E) - c^a(a) - c^e(e) - c^E(E) \}$$  \hspace{1cm} (1)

subject to

$$\begin{aligned}
& tR_a(a,e,E) = c^a(a) \\
& (1-t)R_e(a,e,E) = c^e(e) \\
& tR_E(a,e,E) = c^E(E) .
\end{aligned}$$

Similarly, the firm’s $P$-mode profits are

$$\Pi^P = \max_{t,a,e,E} \{ R(a,e,E) - c^a(a) - c^e(e) - c^E(E) \}$$  \hspace{1cm} (3)

subject to

$$\begin{aligned}
& (1-t)R_a(a,e,E) = c^a(a) \\
& (1-t)R_e(a,e,E) = c^e(e) \\
& tR_E(a,e,E) = c^E(E) .
\end{aligned}$$

Assumption (a5) ensures the existence of a solution $(a,e,E)$ to (2) and to (4) for any $t \in [0,1]$. If there are multiple solutions for a given $t$ then the way we have written the optimization programs above implicitly assumes that the firm can choose a stage 2 Nash equilibrium that maximizes its profits.

Note that, in general, the respective profits yielded by both modes are lower than the first-best profit level

$$\max_{a,e,E} \{ R(a,e,E) - c^a(a) - c^e(e) - c^E(E) \} .$$

The reason is two-sided moral hazard: the payoff $R(a,e,E)$ needs to be divided between the firm and the professional in order to incentivize each of them to choose their respective actions. In other words, this inefficiency is the moral hazard in teams identified by Holmstrom (1982), where a team here consists of the professional and the firm. To reach the efficient solution, Holmstrom (1982) shows that one needs to break the budget constraint, i.e. credibly commit to “throw away” revenue in case a target specified ex-ante is not reached. This type of solution is unrealistic in the contexts we have in mind. Furthermore, our focus is not on offering general solutions to this class of problems, but rather to analyze the trade-offs between the two modes of organization, both of which are unable to reach the first-best.

Comparison of programs (1) and (3) makes it clear that the difference between the two modes comes from the choice of the non-transferable action $a$. The trade-off between the $T$-mode and the $P$-mode boils down to whether it is better to align the choice of $a$ with the firm’s choice of effort $E$ ($T$-mode) or with the professional’s choice of effort $e$ ($P$-mode).

\(^6\)At the optimum, the fixed fee $F$ of the linear contract is always set such that the participation constraint of the professional is binding, i.e. $(1-t)R(a,e,E) - F - c^e(e) = 0$. 

9
Proposition 2  Compare the firm’s profits under the two modes.

(a) If the transferable action $a$ is contractible or costless (i.e. $c^a = 0$), then the two modes are equivalent and lead to the same firm profits ($\Pi^{T*} = \Pi^{P*}$).

(b) Suppose the transferable action $a$ is non-contractible and costly. If the non-transferable action $e$ is contractible or if it has no impact on revenue ($R_e = 0$) then $\Pi^{T*} > \Pi^{P*}$. If the non-transferable action $E$ is contractible or if it has no impact on revenue ($R_E = 0$) then $\Pi^{P*} > \Pi^{T*}$.

Proof. For (a), if $a$ is contractible then the constraint in $a$ disappears in both modes, so the programs (1) and (3) become identical. If $c^a = 0$, then the constraint in $a$ is the same in both modes and is defined by $R_a(a, e, E) = 0$, so the two modes are equivalent once again.

For (b), if the professional’s effort has no impact on revenues ($R_e = 0$) then professionals will set $e = 0$ in both modes. In $T$-mode it is then optimal for the firm to retain the entire revenue ($t = 1$), so profits are

$$\Pi^{T*} = \max_{a,E} \left\{ R(a,0,E) - c^a(a) - c^E(E) \right\}. $$

This is clearly higher than profits under $P$-mode:

$$\Pi^{P*} = \max_{t,a,E} \left\{ R(a,0,E) - c^a(a) - c^E(E) \right\}$$

subject to

$$\begin{align*}
  a &= \arg \max_{a'} \left\{ (1 - t) R(a',0,E) - c^a(a') \right\} \\
  E &= \arg \max_{E'} \left\{ t R(a,0,E') - c^E(E') \right\}.
\end{align*}$$

If the professional’s effort $e$ is contractible then in $T$-mode the firm optimally sets $t = 1$ and profits are

$$\Pi^{T*} = \max_{a,e,E} \left\{ R(a,e,E) - c^a(a) - c^e(e) - c^E(E) \right\}, $$

i.e. the first-best level of profits, which strictly dominate the profits that can be achieved in $P$-mode.

By a symmetric argument, we obtain the result for the case when the firm’s effort has no impact on revenues ($R_E(a,e,E) = 0$) or $E$ is contractible.

Thus, for there to exist a meaningful tradeoff between the two modes with a single professional, (i) all three actions must be non-contractible and have a strictly positive impact on revenues $R$, and (ii) the non-transferable action $a$ must carry a strictly increasing cost $c^a(a)$. In particular, the addition of any number of contractible transferable actions will not have any meaningful impact on the trade-off. Furthermore, part (a) of the proposition implies that if the transferable action $a$ is price then, even if it cannot be contracted on, the two modes are equivalent. As we will see in section 5.4, this no longer holds when there are multiple professionals and the price for each individual service generates spillovers on the revenues generated by other professionals.

In the general case of interest, when all three actions are non-contractible, have a positive impact on revenues and carry strictly increasing costs, the two modes distort the choice of $a$, but they do so in different ways, leading to different profits. Heuristically, if the firm’s moral hazard ($E$) is more
important (in the sense that it has a larger impact on \( R \)) then the optimal \( t \) is higher in both modes, but then the \( T \)-mode induces relatively less distortion in \( a \) and is therefore more likely to be preferred. Conversely, if the professional’s moral hazard (\( e \)) is more important then the optimal \( t \) is lower in both modes, so that the \( P \)-mode induces relatively less distortion in \( a \) and is therefore more likely to be preferred.

4.3 Additively separable case

To achieve a better understanding of the trade-off between the \( T \)-mode and \( P \)-mode in the case of a single professional, in this section we assume the revenue function is fully additively separable, i.e.

\[
R(a, e, E) \equiv r^a(a) + r^e(e) + r^E(E),
\]

where \( r^a \), \( r^e \) and \( r^E \) are strictly increasing and weakly concave, and \( c^a \), \( c^e \) and \( c^E \) are strictly increasing and convex. The expression of \( R(a, e, E) \) could result from additively separable demand with an exogenously fixed price for the professional’s service.

Define \((a(t), e(t), E(t))\) as the respective solutions to the following equations:

\[
\begin{align*}
tr^a_a(a) &= c^a_a(a) \\
tr^e_e(e) &= c^e_e(e) \\
tr^E_E(E) &= c^E_E(E).
\end{align*}
\]

Assumptions (a1)-(a4) imply that \( a(t), e(t) \) and \( E(t) \) are well-defined, unique and increasing in \( t \).
Furthermore, \( a(0) = e(0) = E(0) = 0 \). With this notation, when the firm sets a linear contract with variable fee \( t \in [0, 1] \) in stage 1, the stage 2 equilibrium actions are \((a(t), e(1-t), E(t))\) in \( T \)-mode and \((a(1-t), e(1-t), E(t))\) in \( P \)-mode.

Denote

\[
\begin{align*}
\pi^a(t) &\equiv r^a(a(t)) - c^a(a(t)) \\
\pi^e(t) &\equiv r^e(e(t)) - c^e(e(t)) \\
\pi^E(t) &\equiv r^E(E(t)) - c^E(E(t)).
\end{align*}
\]

It is easily verified that under assumptions (a1)-(a4), the functions \( \pi^a(t) \), \( \pi^e(t) \) and \( \pi^E(t) \) are all increasing in \( t \).\(^7\) Resulting profits for the two modes are then

\[
\begin{align*}
\Pi^{T^*}_T &= \max_t \{ \pi^a(t) + \pi^e(1-t) + \pi^E(t) \} \tag{5} \\
\Pi^{P^*}_P &= \max_t \{ \pi^a(1-t) + \pi^e(1-t) + \pi^E(t) \} \tag{6}
\end{align*}
\]

These two expressions show that the difference between the two modes lies in the distortion created by each party not keeping all of the revenue attributable to the transferable action. In \( T \)-mode, a higher variable fee means the firm keeps a higher share of the revenue generated by the transferable action, and there is less distortion in the profits \( \pi^a(t) \) generated by the transferable action. In \( P \)-

\(^7\)For example, \( \pi^a_a(t) = (1-t) r^a_a(a(t)) a(t) > 0 \).
mode, a higher variable fee means the professional keeps a lower share of the revenue generated by the transferable action, so there is more distortion in the profits \( \pi^a (1 - t) \) generated by the transferable action.

Denote also

\[
t^T \equiv \arg \max_t \left\{ \pi^a (t) + \pi^e (1 - t) + \pi^E (t) \right\}
\]

\[
t^P \equiv \arg \max_t \left\{ \pi^a (1 - t) + \pi^e (1 - t) + \pi^E (t) \right\}
\]

the respective, optimal variable fees charged by the firm in the two modes.

**Proposition 3** The firm keeps a larger share of revenue in \( T \)-mode than in \( P \)-mode, i.e. \( t^T \geq t^P \).

**Furthermore,** if \( t^T < 1/2 \) then \( \Pi^T > \Pi^P \); if \( t^P > 1/2 \) then \( \Pi^P < \Pi^T \).

**Proof.** Since \( \pi^a \), \( \pi^e \) and \( \pi^E \) are increasing functions, we have

\[
\arg \max_t \left\{ \pi^e (1 - t) + \pi^E (t) \right\} \geq t^P.
\]

For the second part of the proposition, since \( \pi^a (t) \) is increasing, the following inequality holds for all \( t < 1/2 \):

\[
\pi^a (1 - t) + \pi^e (1 - t) + \pi^E (t) > \pi^a (t) + \pi^e (1 - t) + \pi^E (t).
\]

Thus, if \( t^T < 1/2 \) then

\[
\Pi^T < \pi^a (1 - t^T) + \pi^e (1 - t^T) + \pi^E (t^T) \leq \pi^a (1 - t^P) + \pi^e (1 - t^P) + \pi^E (t^P) = \Pi^P,
\]

and symmetrically for \( t^P > 1/2 \). ■

The first part of the proposition confirms the common intuition according to which independent contractors working through platforms should claim a larger share of the revenues they generate than employees working for firms. This is because in \( P \)-mode, sharing revenues with the firm leads to a higher distortion of the transferable variable and lower profit; by contrast, in \( T \)-mode, the more revenue the firm keeps, the lower the distortion of the transferable variable and the higher the profit. We will see in Section 5.3 that this is no longer always true with \( N > 1 \) professionals and spillovers.

The second part of the proposition can be interpreted as stating that a firm would never find it optimal to function in \( T \)-mode and pay bonuses above 50% or function in \( P \)-mode and charge variable fees above 50%. In other words, according to this prediction of our model, if the professional receives or keeps more than 50% of variable revenues, the firm is functioning in \( P \)-mode, and not in \( T \)-mode. This prediction is supported by our examples. Traditional hair salons that employ their hair stylists offer bonuses ranging from 35% to 60% of sales, whereas the variable fee charged by salons that rent chairs (when such a fee is used) ranges from 30% to 40% of independent stylists’ sales, thus leaving 60%-70% for the stylists. Task Rabbit retains a total of approximately 35% of the total amount paid by clients to taskers, who act as independent contractors.\(^8\) oDesk retains approximately 9% of the

\(^8\) Task Rabbit adds to the hourly rate set by its taskers a service fee set such that it is equal to 30% of the total paid by the client (e.g. $30 if the tasker rate is $70), plus a trust and safety fee equal to 5% of the total.
amount paid by employers to its independent contractors. Finally, Lyft and Uber retain 20% of the price per ride paid by users, which is consistent with the P-mode (although the two companies control price, their drivers are free to choose the cars they drive and their work schedule).

4.4 Additively separable example

Suppose the revenue generated by the service provided by the professional is

\[ R(a, e, E) = \theta a + \gamma e + \delta E, \]

where \( \theta, \gamma \) and \( \delta \) are all positive constants. The fixed costs are assumed to be

\[ c^a(a) = \frac{1}{2} a^2, \quad c^e(e) = \frac{1}{2} e^2 \quad \text{and} \quad c^E(E) = \frac{1}{2} E^2. \]

Thus, \( \gamma \) can be interpreted as the importance of professionals’ moral hazard, whereas \( \delta \) represents the importance of the firm’s moral hazard.

Relegating calculations to an online appendix available from the authors’ websites, we obtain

\[ t^T* = \frac{\theta^2 + \delta^2}{\theta^2 + \gamma^2 + \delta^2}, \quad t^P* = \frac{\delta^2}{\theta^2 + \gamma^2 + \delta^2} \]

and the following proposition.

**Proposition 4** The firm prefers the P-mode to the T-mode if and only if \( \gamma^2 > \delta^2 \).

In other words, the firm prefers the P-mode if professionals’ moral hazard is more important than the firm’s moral hazard. In particular, in this example the tradeoff does not depend on \( \theta \), the impact of the transferable action on revenues. The reason is that in both modes the share of revenues retained by the party that chooses the transferable action \((t^T* \text{ in } T\text{-mode and } (1-t^P*) \text{ in } P\text{-mode})\) is increasing in \( \theta \). Since \( t^T* \) and \((1-t^P*)\) increase at the same rate in this particular example (due to the symmetry of T-mode and P-mode profits in \( \delta^2 \) and \( \gamma^2 \)), the resulting trade-off does not depend on \( \theta \).

5 General model with multiple professionals and spillovers

In this section, we extend the model from Section 4 to \( N > 1 \) identical professionals and introduce the possibility that the non-transferable action \( a_i \) can also impact the revenue generated by each of the other professionals \( j \neq i \) (i.e. that there are spillovers).

\(^9\)oDesk adds a 10% fee on top of the rate charged by the contractor.
5.1 Assumptions

To keep the analysis as streamlined as possible, we assume that revenue is large enough relative to costs such that it is optimal for the firm to induce all \( N \) professionals to join in both modes. Then the revenue attributable to professional \( i \) who joins the firm (in \( P \)-mode or \( T \)-mode) when all \( N \) professionals join is \( R(a_i, s_i, e_i, E) \), where

\[
s_i = \sigma(a_{-i})
\]

and \( \sigma \) is a symmetric function of the transferable actions chosen by the professionals (or for the professionals) that join other than \( i \), with values in \( \mathbb{R}_+ \). In the specific examples used below, \( \sigma \) will be the average of these other actions, i.e.

\[
\sigma(a_{-i}) = \frac{\sum_{j \neq i} a_j}{N-1}
\]

For convenience, we denote by \( \overrightarrow{a}_n = (a, \ldots, a) \) the vector made of \( n \) coordinates all equal to \( a \), and by \( \sigma_n(a) \) the partial derivative of \( \sigma(a_{-i}) \) with respect to any \( j \neq i \), evaluated at \( \overrightarrow{a}_{N-1} \) (symmetry implies that all these partial derivatives are equal).

As before, \( e_i \) is the non-transferable action (effort) chosen by professional \( i \) and \( E \) is the non-transferable action (investment) chosen by the firm. Note that the firm chooses a single \( E \) that impacts the revenues attributable to all \( N \) professionals. Also note that \( R(a_i, s_i, e_i, E) \) does not depend on the choices of non-transferable actions \( e_j \) for other professionals \( j \neq i \). As we discuss below, introducing this possibility would not add any meaningful aspects to the trade-off between the two modes that we focus on.

The costs of the transferable and non-transferable actions are the same as before and the same across professionals: \( c^a(a_i) \), \( c^e(e_i) \) and \( c^E(E) \).

Finally, the firm is not allowed to price discriminate, i.e. is restricted to offer the same contract \( \Phi(R) \) to all professionals.

The technical assumptions (a1)-(a2) from section 4 remain as before. Assumptions (a3)-(a5) are adapted as follows:

(a3') The revenue function \( R(a, s, e, E) \) is non-negative for all \((a, s, e, E)\), strictly increasing and weakly concave in \((e, E)\). If \( c^a = 0 \) then \( R(a, s, e, E) \) is concave and single-peaked in \( a \) for all \((s, e, E)\) and \( \sum_{i=1}^N R(a_i, \sigma(a_{-i}), e_i, E) \) is concave and single-peaked in all \( a_i \) for all \((e_i, E)\) and \( i \in \{1, \ldots, N\} \). If \( c^a \neq 0 \) then \( R(a, s, e, E) \) is strictly increasing and weakly concave in \( a \) and \( \sum_{i=1}^N R(a_i, \sigma(a_{-i}), e_i, E) \) is strictly increasing and weakly concave in all \( a_i \), \( i \in \{1, \ldots, N\} \).

(a4') \( \lim_{e \to \infty} (R_e(a, s, e, E) - c^e_e(e)) < 0 \) for all \((a, s, E)\) and \( \lim_{E \to \infty} (R_E(a, s, e, E) - c^E_E(E)) < 0 \) for all \((a, s, e)\). If \( a \) is price then for all \((s, e, E)\) there exists \( \hat{a}(s, e) \) such that \( R(a, s, e, E) = 0 \).
for all \( a \geq \hat{a}(s,e,E) \). If \( a \) is not price then \( \lim_{a \to \infty} (R_a(a,s,e,E) - c_a^a(a)) < 0 \) for all \((s,e,E)\).

(a5') For all \( t \in [0,1] \), each of the following two systems of three equations in \((a,e,E)\) admits a solution:

\[
\begin{cases}
  t (R_a(a, \sigma(\overrightarrow{a}_{N-1}), e, E) + (N - 1) \sigma_a(a) R_s(a, \sigma(\overrightarrow{a}_{N-1}), e, E)) = c^a_a(a) \\
  (1 - t) R_e(a, \sigma(\overrightarrow{a}_{N-1}), e, E) = c^e_e(e) \\
  tN R_E(a, \sigma(\overrightarrow{a}_{N-1}), e, E) = c^E_E(E)
\end{cases}
\]

and

\[
\begin{cases}
  (1 - t) R_a(a, \sigma(\overrightarrow{a}_{N-1}), e, E) = c^a_a(a) \\
  (1 - t) R_e(a, \sigma(\overrightarrow{a}_{N-1}), e, E) = c^e_e(e) \\
  tN R_E(a, \sigma(\overrightarrow{a}_{N-1}), e, E) = c^E_E(E).
\end{cases}
\]

(a6') The optimization problem solved by the firm admits a well-defined solution which is symmetric in all \(N\) professionals in both modes.

The main addition to (a3) is to ensure that the spillover is not so large that it overcomes the “main” effect of \(a_i\). Assumption (a6') is an additional assumption, which is used to rule out asymmetries in the optimal solution due to spillovers. It is always satisfied in the absence of spillovers.

The timing is the same as in Section 4.

### 5.2 General results

We first establish the analogous result to Proposition 1 (the proof is in the appendix).

**Proposition 5** If assumptions (a1)-(a2) and (a3')-(a6') hold, then in both modes the firm can achieve the best possible symmetric outcome with a linear contract.

The proposition implies that the firm’s profits in T-mode can be written

\[
\Pi^T = \max_{t,a,e,E} \left\{ N (R(a, \sigma(\overrightarrow{a}_{N-1}), e, E) - c^a(a) - c^e(e) - c^E(E) \right\}
\]

subject to

\[
\begin{cases}
  t (R_a(a, \sigma(\overrightarrow{a}_{N-1}), e, E) + (N - 1) \sigma_a(a) R_s(a, \sigma(\overrightarrow{a}_{N-1}), e, E)) = c^a_a(a) \\
  (1 - t) R_e(a, \sigma(\overrightarrow{a}_{N-1}), e, E) = c^e_e(e) \\
  tN R_E(a, \sigma(\overrightarrow{a}_{N-1}), e, E) = c^E_E(E)
\end{cases}
\]

Similarly, the firm’s profits in P-mode can be written

\[
\Pi^P = \max_{t,a,e,E} \left\{ N (R(a, \sigma(\overrightarrow{a}_{N-1}), e, E) - c^a(a) - c^e(e) - c^E(E) \right\}
\]

subject to

\[
\begin{cases}
  (1 - t) R_a(a, \sigma(\overrightarrow{a}_{N-1}), e, E) = c^a_a(a) \\
  (1 - t) R_e(a, \sigma(\overrightarrow{a}_{N-1}), e, E) = c^e_e(e) \\
  tN R_E(a, \sigma(\overrightarrow{a}_{N-1}), e, E) = c^E_E(E).
\end{cases}
\]
Comparing the two programs above, there are now two differences between the two modes, both originating in the choice of the non-transferable actions $a_i$. The first difference is the same as in the case $N = 1$: the first-order condition in $a$ has a factor $t$ in $T$-mode and a factor $(1 - t)$ in $P$-mode. The second difference is new and stems from the presence of spillovers across the $N$ professionals: in $T$-mode the firm internalizes the spillover when setting $a_i$ for $i = 1, .., N$, whereas the spillovers are left uninternalized in $P$-mode when each $a_i$ is chosen by individual professional $i$.

We can now derive the corresponding proposition to Proposition 2.

**Proposition 6** Compare the firm’s profits under the two modes.

(a) If the transferable actions $a_i$ are contractible, then the two modes are equivalent and lead to the same firm profits ($\Pi^T* = \Pi^P*$). If the transferable actions are non-contractible and costless (i.e. $c^a = 0$), then the two modes lead to different profits except when there are no spillovers ($R_s = 0$). If in addition the revenue function is additively separable in $(a, s)$, $e$ and $E$ (i.e. if it can be written $R(a_i, s_i, e_i, E) = r^{as}(a_i, s_i) + r^e(e_i) + r^E(E)$) then $\Pi^T* > \Pi^P*$.

(b) Suppose the transferable actions are non-contractible. If the non-transferable actions $e_i$ are contractible or if they have no impact on revenue ($R_e = 0$), then $\Pi^T* > \Pi^P*$. If $c^a = 0$ and the non-transferable action $E$ is contractible or has no impact on revenue ($R_E = 0$), then $\Pi^T* > \Pi^P*$.

**Proof.** For part (a), if $a_i$ is contractible then the first constraint in (8) and the first constraint in (10) disappear, so the programs (7) and (9) become identical. If the actions $a_i$ carry no cost ($c^a = 0$) then these first constraints remain distinct in the two modes, unless $R_s = 0$. Suppose in addition that $R(a, s, e, E)$ is additively separable. Then in stage 2, the equilibrium choices of $(e, E)$ as functions of $t$ are identical in both modes. Denote them by $(e(t), E(t))$. The firm’s $T$-mode profits can then be written:

$$\max_{t,a} \left\{ Nr^{as}(a, \sigma(\overrightarrow{d}_{N-1})) + N (r^e(e(t)) - c^e(e(t))) + Nr^E(E(t)) - c^E(E(t)) \right\}$$

subject to $r^{as}_a(a, \sigma(\overrightarrow{d}_{N-1})) + (N - 1) \sigma'(a) r^{as}_s(a, \sigma(\overrightarrow{d}_{N-1})) = 0$

which is equal to

$$\max_{t,a} \left\{ Nr^{as}(a, \sigma(\overrightarrow{d}_{N-1})) + N (r^e(e(t)) - c^e(e(t))) + Nr^E(E(t)) - c^E(E(t)) \right\}.$$

This is strictly higher than $P$-mode profits

$$\max_{t,a} \left\{ Nr^{as}(a, \sigma(\overrightarrow{d}_{N-1})) + N (r^e(e(t)) - c^e(e(t))) + Nr^E(E(t)) - c^E(E(t)) \right\}$$

subject to $r^{as}_a(a, \sigma(\overrightarrow{d}_{N-1})) = 0$. 

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For part (b), if the professionals’ efforts are contractible or if \( R_e = 0 \) then the firm can achieve the first-best level of profits in \( T \)-mode by setting \( t = 1 \), obtaining

\[
\Pi^{T*} = \max_{a, e, E} \left\{ N (R (a, \sigma (\overrightarrow{d}_{N-1})), e, E) - c^a (a) - c^e (e) - c^E (E) \right\}.
\]

In \( P \)-mode, we know the resulting profits are strictly lower because the choice of \( a \) is not first-best optimal (it does not account for spillovers).

If \( c^a = 0 \) and \( E \) is contractible or \( R_E = 0 \) then the firm can once again achieve the first-best level of profits in \( T \)-mode, this time by setting \( t^T \) arbitrarily close to 0, obtaining

\[
\Pi^{T*} = \max_{a, e, E} \left\{ N (R (a, \sigma (\overrightarrow{d}_{N-1})), e, E) - c^a (a) - c^e (e) - c^E (E) \right\}.
\]

In \( P \)-mode it is also optimal to set \( t^P \) arbitrarily close to 0 but resulting profits are less than first-best because the choice of \( a \) is not first-best optimal (it does not account for spillovers). As a result, \( \Pi^{T*} > \Pi^{P*} \).

There are two key differences in Proposition 6 relative to Proposition 2. First, due to spillovers, the case with \( c^a = 0 \) no longer leads to equivalence. This reflects that in \( T \)-mode, spillovers are internalized, whereas in \( P \)-mode they are not. One may think that this always leads to the \( T \)-mode to dominate the \( P \)-mode, but this is only true when the revenue function is additively separable in all its arguments or when \( E \) is contractible or when \( E \) has no impact on revenue. If instead all three types of actions are non-contractible and impact revenues and there are interaction effects between \( a \) and the two types of non-transferable effort, then either mode may dominate. In particular, interaction effects between \( a_i \) and \( e_i \) or \( E \) may either exacerbate or dampen the disadvantage of the \( P \)-mode in terms of not internalizing spillovers.

The second difference is that in case (b), contractibility of \( E \) or \( R_E = 0 \) no longer necessarily implies that the \( P \)-mode dominates. The advantage of the \( P \)-mode in achieving the constrained first-best level of \( e_i \) must still be traded-off against the advantage of the \( T \)-mode in internalizing spillovers. At the extreme, if, in addition, the transferable action is costless then the \( T \)-mode can also achieve the constrained first-best level of \( e_i \), which implies that the \( T \)-mode does strictly better.

Note that all the results in Proposition 6 would continue to hold even if we allowed for spillovers of effort \( e_i \) across revenues attributable to other agents \( j \neq i \) (accompanied by the appropriate changes in assumptions (a3’)-(a6’)). Indeed, the respective first-order conditions corresponding to \( e \) in programs (7) and (9) would stay the same: the spillover from professionals’ efforts remains uninternalized in both \( T \)-mode and \( P \)-mode because in both modes professionals choose \( e_i \)’s individually. Thus, the trade-off between the two modes would not be materially impacted by spillovers generated by the non-contractible, non-transferable efforts \( e_i \). This is why we have abstracted away from such spillovers.

Based on Proposition 6, the two simplest scenarios in which the trade-off between the two modes is meaningful are:
1. Costly transferable actions \( a_i \) and additively separable revenue function \( R(a_i, s_i, e_i, E) \)

2. Costless transferable actions \( a_i \) (namely, prices) and non-additively separable revenue function \( R(a_i, s_i, e_i, E) \).

The two cases exhibit different mechanisms—we consider them in the next two subsections through two specific examples. These two cases also correspond to realistic scenarios. In many contexts prices are easily observable and contracted on, which means they do not have an impact on the \( T \)-mode versus \( P \)-mode distinction. Alternatively, in other cases parties cannot observe price or quantity separately, so can only contract on revenue. Then price becomes a relevant transferable and non-contractible variable.

5.3 Additively separable example with spillovers

This section extends the example studied in section 4.4 to the case of \( N > 1 \) professionals and spillovers. Specifically, the revenue generated by the service provided by professional \( i \) is

\[
R(a_i, s_i, e_i, E) = \theta a_i + x(s_i - a_i) + \gamma e_i + \delta E
\]

and \( s_i = \sigma(a_{-i}) \) is the average of the transferable actions chosen for services \( j \neq i \):

\[
\sigma(a_{-i}) = \frac{\sum_{j \neq i} a_j}{N - 1} = \bar{a}_{-i}.
\]

We can therefore write directly

\[
R(a_i, \bar{a}_{-i}, e_i, E) = \theta a_i + x(\bar{a}_{-i} - a_i) + \gamma e_i + \delta E.
\]

Thus, when spillovers are negative \((x < 0)\), revenue \( R \) is decreasing in \( \bar{a}_{-i} \), which means that in \( P \)-mode the transferable actions \( a_i \) are set too high. Conversely, when spillovers are positive \((x > 0)\), revenue \( R \) is increasing in \( \bar{a}_{-i} \), so that in \( P \)-mode the \( a_i \)'s are set too low. For example, if \( a_i \) represents advertising then negative (respectively, positive) spillovers occur when services are substitutes (respectively, complements).

We assume

\[
x < \theta \quad \text{and} \quad x(\theta - x) < N\delta^2,
\]

which ensures that (i) assumptions (a1’)-(a6’) are satisfied for this example, and (ii) the optimal variable fee is strictly between 0 and 1 in both modes. Note that all \( x < 0 \) are permissible under \((11)\).

We obtain (all calculations are in the online appendix)

\[
\begin{align*}
t^T^* &= \frac{\theta^2 + N\delta^2}{\theta^2 + \gamma^2 + N\delta^2} \\
t^P^* &= \frac{N\delta^2 - x(\theta - x)}{(\theta - x)^2 + \gamma^2 + N\delta^2}
\end{align*}
\]
and the following proposition.

**Proposition 7** The firm prefers the P-mode to the T-mode if and only if

\[-\theta^2 - N\delta^2 - \sqrt{\theta^2 (\theta^2 + \gamma^2 + N\delta^2)} + \gamma^4 \leq x \frac{\gamma^2}{\theta} \leq -\theta^2 - N\delta^2 + \sqrt{\theta^2 (\theta^2 + \gamma^2 + N\delta^2)} + \gamma^4 \]  

In other words, the P-mode is preferred if and only if the magnitude of spillovers is not too large. Note that the entire range of \(x\) defined by (13) is permissible by assumptions (11) for \(\theta\) sufficiently large.

Inspection of (13) reveals that the range of spillover values \(x\) for which the firm prefers the P-mode is skewed towards negative values. To understand why, recall that negative spillovers cause the \(a_i\)’s to be set too high in P-mode, which offsets the primary revenue distortion (\(a_i\)’s being set too low because the party choosing \(a_i\) does not receive the full marginal return when \(0 < t < 1\)). Thus, when spillovers are negative, choosing the P-mode (and thereby letting professionals choose \(a_i\)) provides a way for the firm to commit to achieving a level of \(a_i\) closer to the first-best. By contrast, positive spillovers cause the \(a_i\)’s to be set too low in P-mode, which exacerbates the primary revenue distortion. This makes the P-mode relatively less likely to dominate. There still exists a range of positive spillovers for which the P-mode is preferred but that range is smaller than the corresponding range of negative spillovers.

We now investigate the impact of \(\gamma^2\) and \(N\delta^2\) on the trade-off between P-mode and T-mode, i.e. on the profit differential \(\Pi^P - \Pi^T\). From (13), this impact seems difficult to ascertain. Fortunately, one can use first-order conditions and the envelope theorem, which lead to simple conditions (see the online appendix for calculations).

**Proposition 8** A larger \(\gamma\) shifts the tradeoff in favor of P-mode (i.e. \(\frac{\partial (\Pi^P - \Pi^T)}{\partial (\gamma^2)} > 0\)) if and only if \(t^P < t^T\). A larger \(\delta\) shifts the tradeoff in favor of T-mode (i.e. \(\frac{\partial (\Pi^P - \Pi^T)}{\partial (N\delta^2)} < 0\)) if and only if \(t^P < t^T\).

In other words, the effects of both types of moral hazard on the tradeoff conform to common intuition whenever the share of revenues retained by the firm is larger in T-mode. Recall from the analysis in section 4 that this is always the case in the absence of spillovers. However, with spillovers this may no longer be the case, so the effects of the two types of moral hazard can be counter-intuitive. In particular, from (12) we obtain that, with spillovers, \(t^P > t^T\) if and only if

\[ \frac{x}{\theta} + \frac{\theta}{\theta - x} < -\frac{\theta^2 + N\delta^2}{\gamma^2} \]  

i.e. if the spillover \(x\) is sufficiently negative (recall all \(x < 0\) are permissible under assumptions (11)).

When the inequality in (14) holds, professionals offset the primary revenue-sharing distortion with the distortion due to spillovers in P-mode. As a result, a higher \(t\) induces less distortion in P-mode, so the firm can charge a higher \(t\) in P-mode to the point that \(t^P > t^T\). When this occurs, professionals
retain a lower share of revenues in $P$-mode than in $T$-mode, so their choice of non-transferable effort $e_i$ is more distorted in $P$-mode. Consequently, when professionals’ effort (moral hazard) becomes more important in this parameter region, the $T$-mode becomes relatively more attractive. Similarly, when the firm’s effort (moral hazard) becomes more important in the same parameter region, the $P$-mode becomes relatively more attractive. This counter-intuitive scenario can never occur in the absence of spillovers in the additively separable case.

5.4 Non-additively separable example (prices)

We now turn to the other case of interest identified in Section 5.2: the transferable action is the price for each professional’s service, and therefore does not carry any costs. Furthermore, in this case the revenue function is not additively separable, although the underlying demand function is. Specifically, the revenue generated by the service provided by professional $i$ is now

$$R(p_i, \bar{p}_{-i}, e_i, E) = p_i \left(d + \theta p_i + x(p_{-i} - p_i) + \gamma e_i + \delta E\right),$$

(15)

where $d > 0$ is the demand intercept and $\bar{p}_{-i}$ is the average of the prices chosen for services $j \neq i$.

To ensure (a1’)-(a6’) are satisfied for this example, we assume

$$\theta < 0, \gamma > 0, \delta > 0$$

$$-2\theta + \min \{0, 2x\} > \max \{N\delta^2, \gamma^2\}$$

(16)

Note that (16) implies all $x > 0$ are permissible and $x > \theta$, so demand $d + \theta p_i + x(p_{-i} - p_i) + \gamma e_i + \delta E$ is decreasing in $p_i$.

From (15), positive spillovers ($x > 0$) correspond to the usual case with prices, i.e. substitute services. Also note that one could replace $p_i$ with $q_i$ (quantities), but then the usual case in which services are substitutes would be captured by negative spillovers ($x < 0$).

Define

$$k \equiv \frac{1}{N\delta^2} + \frac{1}{\gamma^2} \in \left[\frac{1}{|\theta|}, +\infty\right).$$

We then obtain (the lengthy but straightforward calculations are in the online appendix):

**Proposition 9** The firm prefers the $P$-mode if and only if

$$\frac{-4(1 + \theta k)}{k(1 + 2\theta k)} < x < 0.$$

(10)

First, note that the proposition identifies a meaningful trade-off since any $x$ satisfying the last inequality above also satisfies (16) provided $\theta$ is sufficiently negative, as do all positive $x$.

Second, the $T$-mode is always preferred if spillovers are positive (services are substitutes) or if spillovers are very negative (services are strong complements). The logic is different here relative to

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10Recall $\theta k < -1$ so $-\frac{4(1 + \theta k)}{k(1 + 2\theta k)} < 0$. 

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the case with costly transferable actions. Given that the transferable action here (price) does not carry any costs, there is no distortion of price in either mode due to revenue-sharing between the firm and each professional. As a result, the variable fee $t$ can be used in both modes to balance the two-sided moral hazard problem ($e_i$ versus $E$) equally well. Furthermore, due to the strategic complementarity between $p_i$ and $(e_i, E)$, the choice of $p_i$ can either offset or compound the two moral hazard problems.

The $T$-mode has an advantage in internalizing spillovers across services. This explains why there is a larger region over which the $T$-mode dominates. But the fact that professionals do not internalize spillovers in $P$-mode can work in favor of the $P$-mode when spillovers are negative ($x < 0$). Namely, when $x < 0$, the $P$-mode leads to excessively high choices of $p_i$, which can help offset the two-sided moral hazard problem. This is because higher $p_i$’s lead to higher $e_i$’s and $E$ due to strategic complementarity, which partially corrects the problem of inefficiently low $e_i$’s and $E$ that arises from revenue sharing and moral hazard. In contrast, when $x > 0$ (positive spillovers), the $P$-mode leads to $p_i$ being set too low, which compounds the two-sided moral hazard problem. As a result, the $T$-mode always dominates in that case.

Third, the parameters measuring the strength of the two moral hazard problems, $N\delta^2$ and $\gamma^2$, have the same effect on the tradeoff between the two modes (through $k$). This surprising result stands in contrast to the additively separable case where they work in opposing directions. The explanation is as follows. Again, since the transferable action (price) is not distorted by the variable fee $t$ in either mode, both modes do just as well in terms of balancing the two-sided moral hazard problem. As noted above, when spillovers are negative, raising prices reduces the moral hazard problems due to the strategic complementarity between prices and efforts, and this works equally well for both $e_i$ and $E$. Thus, the extent to which the $P$-mode is preferred over the $T$-mode when moral hazard problems become more important does not depend on the source of the moral hazard, but only on its magnitude.

Finally, it is easily verified that $-\frac{4(1+\theta k)}{k(1+2\theta k)}$ is decreasing for $k \in \left[\frac{1}{|\theta|}, \frac{1}{|\theta|} + \frac{\sqrt{2}}{2|\theta|}\right]$ and increasing for $k \geq \frac{1}{|\theta|} + \frac{\sqrt{2}}{2|\theta|}$. Thus, assuming negative spillovers, when $\gamma^2$ and $N\delta^2$ are small (i.e. $k$ large), the range of $x$ over which the $P$-mode is preferred increases as $\gamma^2$ and $N\delta^2$ increase (i.e. $k$ decreases); and vice versa when $\gamma^2$ and $N\delta^2$ are large ($k$ small). In other words, when the two-sided moral hazard problem is of small importance, the effectiveness of the $P$-mode in compensating for moral hazard with excessive prices increases as moral hazard becomes more important, so the trade-off shifts in favor of the $P$-mode. And vice versa when two-sided moral hazard is already very important.

6 Extensions

6.1 Timing

When $E$ represents a basic infrastructure investment that is fundamental to the firm’s operations, it may be more natural that this investment is made prior to the choice of business model ($T$-mode vs. $P$-mode), rather than afterwards. This reflects that it may be easier for a firm to change its business model than its basic infrastructure. In this case, the model becomes very similar to that in Hagiu and Wright (2015b), but without private information.
The net result of this change in timing is to shift the firm’s business model trade-off in favor of the P-mode. Indeed, if the firm is able to commit to its choice of E prior to the choice of business model, then the need to keep a larger share of variable revenues in order to motivate investments in E disappears. This observation implies that one of the factors that determines the choice of mode is the extent to which the firm’s investment and effort is determined upfront versus ongoing. Thus, when the firm’s ongoing investments in infrastructure (or other forms of common investment) are more important than its ex-ante investments, the trade-off shifts towards the T-mode. Taking these investments as given, our analysis continues to apply assuming that there remains some investment or effort decisions for the firm following its choice of business model.

6.2 The transferable action is not entirely relationship specific

The transferable action \( a \) can drive an additional wedge between the two modes when it is no longer entirely specific to the relationship between a professional and the firm. To see this simply, consider the model with one professional. Suppose that \( a \) influences some outside payoffs, \( Y(a) \) for the firm and \( y(a) \) for the professional. For example, effective marketing choices for the services provided by professionals may also increase demand for some complementary products that the firm may be selling (e.g. some hair salons also sell hair products) and also the ability of professionals to sell their services elsewhere (e.g. a hair stylist may work at a salon but may also occasionally provide her/his services in other venues).

This results in two changes in programs (1) and (3) that determine T-mode and P-mode profits respectively:

- in both modes the firm is now maximizing 
  \[
  R(a, e, E) + Y(a) - c^a(a) - c^e(e) - c^E(E)
  \]
- the respective first-order conditions in \( a \) are now
  \[
  tR_a(a, e, E) = c^a_a(a) - Y_a(a)
  \]
  \[
  (1 - t) R_a(a, e, E) = c^a_a(a) - y_a(a).
  \]

Consequently, it is clear that \( Y(a) \) and/or \( y(a) \) play effectively the same role as the cost function \( c^a(.,) \), except that they introduce the possibility that the cost of \( a \) may be different depending on whether it is chosen by the professional or by the firm. Predictably, it can be shown that a larger \( Y_a(a) \) shifts the trade-off in favor of the T-mode, whereas a larger \( y_a(a) \) shifts the trade-off in favor of the P-mode.

6.3 Hybrid mode across services

Hybrid modes, with some professionals offering their services in T-mode and others in P-mode, are found quite often in the markets we consider (hair and nail salons, oDesk, etc). We show below that a strictly hybrid mode can be optimal even without spillovers (i.e. we assume \( R_s = 0 \) and despite
the fact that all $N$ professionals are identical. This is due to the fact that $E$ is a common investment across all services offered, for instance corresponding to an investment in a common infrastructure, and to the concavity of the profit function with respect to $E$.

We focus on the additively separable case with no spillovers, which, at first glance, is the least likely scenario for a hybrid mode to be optimal (no interaction effects and no asymmetries between firm and professionals). Suppose the firm functions in $T$-mode with respect to professionals $i \in \{1, \ldots, n\}$ and in $P$-mode with respect to professionals $i \in \{n + 1, \ldots, N\}$, where $n \leq N$. Thus, the firm offers contract $(t^T, F^T)$ to the $n$ professionals that work in $T$-mode (employees) and contract $(t^P, F^P)$ to the $N - n$ professionals that work in $P$-mode (independent contractors). Using the notation in Section 4.3, the $n$ employees each choose a level of effort equal to $e \left(1 - t^T\right)$, whereas the $N - n$ independent contractors each choose a level of effort equal to $e \left(1 - t^P\right)$ and a level of the transferable activity equal to $a \left(1 - t^P\right)$. For the $n$ employees, the firm chooses a level of the transferable action equal to $a \left(t^T\right)$. Finally, the level $E \left(t^T, t^P\right)$ chosen by the firm solves

$$E \left(t^T, t^P\right) = \arg \max_E \left\{ nt^T r^E (E) + (N - n) t^P r^E (E) - c^E (E) \right\} = E \left(\bar{t}\right),$$

where

$$\bar{t} = \frac{n}{N} t^T + \frac{N - n}{N} t^P$$

is the "average" transaction fee collected by the firm.

The fixed fees for employees and independent contractors are set to render both indifferent between working for/through the firm and their outside option. Consequently, the total profit of the firm is

$$\Pi^H \left(t^T, t^P, n\right) = n \left(\pi^a \left(t^T\right) + \pi^e \left(1 - t^T\right)\right) + (N - n) \left(\pi^a \left(1 - t^P\right) + \pi^e \left(1 - t^P\right)\right) + N \pi^E \left(\bar{t}\right).$$

Note that $\Pi^H \left(t^T, t^P, n = N\right) = \Pi^T \left(t^T\right)$ and $\Pi^H \left(t^T, t^P, n = 0\right) = \Pi^P \left(t^P\right)$, where $\Pi^T \left(t^T\right)$ and $\Pi^P \left(t^P\right)$ are the expressions of "pure mode" profits (5) and (6) in Section 4.3.

It is easily seen from the expression of $\Pi^H \left(t^T, t^P, n\right)$ that a necessary condition for the optimal choice of $n$ to be interior (i.e. strictly between 0 and $N$) is concavity of $\pi^E$. The key reason is that the firm can only choose a single $E$, which affects all professionals. If the firm could choose different $E_i$’s for each individual professional $i$, then it is easily seen that the optimal solution would be $n = N$ or $n = 0$. Given the firm’s profit function with respect to $E$ is concave, the firm does better with an intermediate value of $E$ (i.e. that arising from a mix of modes) than it would get from having all professionals in one mode or the other.

To obtain closed-form solutions, consider the additively separable example from Section 4.4:

$$R \left(a_i, e_i, E\right) = \theta a_i + \gamma e_i + \delta E$$

with quadratic costs

$$c^a \left(a_i\right) = \frac{1}{2} a_i^2; \, c^e \left(e_i\right) = \frac{1}{2} e_i^2; \, c^E \left(E\right) = \frac{1}{2} E^2$$
In this example, $\pi^E (t)$ is strictly concave:

$$\pi^E (t) = \frac{\delta^2 t (2 - t)}{2}$$

The optimal number of employees is then (see the online appendix for the full derivation)

$$n^* = \begin{cases} N \left( 1 - \frac{\gamma^2 (\theta^2 + \gamma^2 - N\delta^2)}{2N\delta^2\theta^2} \right) & \text{if } N\delta^2 > \theta^2 + \gamma^2 \\
0 & \text{if } N\delta^2 < \frac{\theta^2\gamma^2}{2\theta^2 + \gamma^2}
\end{cases}$$

Note that $n^*$ is increasing in $N\delta^2$ (the importance of the firm’s moral hazard) and decreasing in $\gamma^2$ (the importance of professionals’ moral hazard), consistent with the intuition built in section 4.4.

6.4 Hybrid modes across actions

In our model above, we have always restricted attention to a single transferable action for concision. In many real-world examples, however, there are multiple relevant transferable actions (see Table 1 in Section 3). This provides another dimension along which firms can (and oftentimes do) operate in hybrid modes, with some transferable decisions controlled by professionals and others by the firms.

Our model can be extended to encompass this dimension as well. Consider the case with 1 professional but multiple transferable actions, $a^j$, with $j \in \{1, \ldots, M\}$. Assume the revenue function has the additively separable form

$$R \left( a^1, \ldots, a^M, e, E \right) = \sum_{j=1}^{M} r^{aj} (a^j) + r^e (e) + r^E (E).$$

The fixed cost associated with transferable action $a^j$ is $c^{aj} (a^j)$. The costs associated with non-transferable actions are $c^e (e)$ and $c^E (E)$ as before.

Similarly to the treatment of the additively separable case in section 4.3, define

$$a^j (t) \equiv \arg \max_a \left\{ tr^{aj} (a) - c^{aj} (a) \right\}$$

$$\pi^{aj} (t) \equiv r^{aj} (a^j (t)) - c^{aj} (a^j (t))$$

$\pi^e (t)$ and $\pi^E (t)$ are the same as in section 4.3.

With this notation, it is easily verified that the firm’s revenues when it charges variable fee $t$ and keeps control over decisions $j \in A \subset \{1, \ldots, M\}$ while giving the professional control over decisions $j \in \{1, \ldots, M\} \setminus A$ are

$$\Pi (A, t) = \pi^E (t) + \sum_{j \in A} \pi^{aj} (t) + \sum_{j \notin A} \pi^{aj} (1 - t) + \pi^e (1 - t).$$
The firm optimizes this revenue expression over both $A$ and $t$.

First, the following proposition establishes that at least two functions $\pi^{a_{j_1}}(t)$ and $\pi^{a_{j_2}}(t)$ ($j_1 \neq j_2 \in \{1, .., M\}$) must be non-colinear in order for a hybrid interior mode to be optimal.

**Proposition 10** If $\pi^{a_j}(t) = \alpha_j \pi^a(t) + \beta_j$ for some set constants $(\alpha_1, \beta_1, ..., \alpha_M, \beta_M)$ with $\alpha_i > 0$ for all $i$, then the optimal mode is either $A = \emptyset$ or $A = \{1, .., M\}$.

**Proof.** Denote by $t^*$ the optimal transaction fee corresponding to $A^*$ and suppose $A^* \neq \emptyset$ and $A^* \neq \{1, .., M\}$. Let then $j_1 \in A$ and $j_2 \in \{1, .., M\} \setminus A$. If $\pi^{a_{j_1}}(t^*) < \pi^{a_{j_2}}(1 - t^*)$ then the firm could strictly improve profits by giving up control over action $j_1$ to the professional and keeping $t^*$ unchanged (profits would increase by $\pi^{a_{j_1}}(1 - t^*) - \pi^{a_{j_1}}(t^*)$), which contradicts the optimality of $(A^*, t^*)$. If $\pi^{a_{j_1}}(t^*) > \pi^{a_{j_2}}(1 - t^*)$ then colinearity implies $\pi^{a_{j_2}}(t^*) > \pi^{a_{j_2}}(1 - t^*)$, so the firm could strictly improve profits by taking over control over action $j_2$ from the professional and keeping $t^*$ unchanged, which once again contradicts optimality of $(A^*, t^*)$. Thus, either $A = \emptyset$ or $A = \{1, .., M\}$.

Perhaps surprisingly, collinearity holds for many simple functional forms:

- $r^{a_j}(a) = \theta_j a^\alpha$ and $c^{a_j}(a) = a^{\alpha + \beta}$, with $\alpha > 1$ and $\beta > 0$, leads to $\pi^{a_j}(t) = \theta_j^{\frac{\alpha}{\alpha + \beta}} \left( \frac{t\theta_j}{\alpha + \beta} \right)^{\frac{\alpha}{\alpha + \beta}} \left( 1 - \frac{t\theta_j}{\alpha + \beta} \right)$
- $r^{a_j}(a) = \theta_j \ln a$ and $c^{a_j}(a) = a$ leads to $\pi^{a_j}(t) = \theta_j \ln \theta_j + \theta_j (\ln t - t)$
- $r^{a_j}(a) = \theta_j a$ and $c^{a_j}(a) = e^{ca}$ with $c > 0$ leads to $\pi^{a_j}(t) = \theta_j a \ln \left( \frac{\theta_j}{c} \right) + \frac{\theta_j}{c} (\ln t - t)$

In general, however, it is possible that the optimal mode is a strictly interior split of control rights over actions $\{1, .., M\}$. A simple example which does not lead to colinearity and therefore can generate a strictly interior split of control rights is

$$r^{a_j}(a) = \theta_j \left( a - \frac{a^2}{2} \right)$$ and $c^{a_j}(a) = \frac{a^2}{2}$.

This leads to

$$\pi^{a_j}(t) = \theta_j^2 \frac{t}{1 + \theta_j t} \left( 1 - \frac{\theta_j + 1}{2} \frac{t}{1 + \theta_j t} \right)$$

Note that $\pi^{a_j}(t)$ is increasing in $t$ and $\theta_j$ for all $\theta_j > 0$.

The analysis above shows how strictly interior splits of control rights over transferable actions can be optimal even when there are no asymmetries between the firm and the professional regarding the costs of undertaking these actions or their effectiveness (impact on revenues in our model). It is, however, important to recognize that in some real-world examples such asymmetries are an important factor in determining which control rights are held by the firm and which are held by professionals. For instance, Uber and Lyft have a clear advantage in setting prices for rides over their drivers (better

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11Recall from above that such asymmetries may also reflect the fact that non-transferable actions are not entirely relationship-specific.
information due to large amounts of data), whereas drivers are in a better position to choose their work schedules and the amount of maintenance their individual cars need. Things are different in the case of Airbnb. Individual apartment owners set prices because they arguably have better relevant information. On the other hand, Airbnb has figured out over time that it can be more effective at marketing individual properties on the site than the properties’ owners. As a result, Airbnb now pays professional photographers to take pictures of owners’ properties and decides which pictures to post on the site (this is still an optional service for owners but many opt in). In yet another example, hair salons may take control over the choice of “uniforms” because they can obtain lower costs due to scale effects (relative to individual hair stylists), but the marketing of hair stylists may be more efficiently done by each individual.

7 Conclusion

By substantially reducing the costs of remote monitoring and communication, the widespread adoption of Internet and mobile technologies have made it possible to build marketplaces and platforms for a rapidly increasing variety of services, ranging from house cleaning to programming, consulting and legal advice. As a result, the choice between platform mode and traditional mode, and the associated trade-offs that we have examined in this paper are becoming increasingly relevant in a growing number of sectors throughout the economy.

Specifically, we have considered the choice a firm faces between keeping control over transferable actions that affect the revenues extracted from customers (traditional mode) and giving that control to professionals or suppliers (platform mode). At the most fundamental level, we have shown that the trade-off comes from balancing two-sided moral hazard, while at the same time minimizing distortions in the choice of the transferable action due to revenue-sharing or spillovers. Our modelling approach and some of our key results are reminiscent of the theory of the firm based on property rights and incentive systems. In particular, in the baseline model without spillovers, a key prediction is that control rights over the transferable actions should be given to whichever party’s (the firm or the professionals) moral hazard problem is more important. However, we have shown that this prediction can be over-turned when spillovers are introduced, both with costly and costless transferable actions. In particular, when the transferable action is price (and therefore there are interaction effects with the non-transferable actions), the trade-off between the two modes no longer depends on the source of moral hazard, but only on its magnitude. These insights are novel and contribute to extending the theory of the firm based on property rights and incentive systems to new types of organizational choices - platform vs. traditional firms.

Our analysis is also relevant to current legal and regulatory debates about whether "sharing economy" service marketplaces should be forced to treat professionals that work through them as employees rather than independent contractors.\textsuperscript{12} In particular, all existing legal definitions emphasize control rights as the most important factor in determining this issue. The distinction is naturally along a

\textsuperscript{12}See for example Justin Fox “Uber and the Not-Quite-Independent Contractor” Bloomberg, June 30, 2015.
continuum. For instance, oDesk and Task Rabbit are almost pure platforms and therefore their professionals are clearly independent contractors: they set their own hourly rates, hours of work and choose which projects to work on. In contrast, other firms are positioned in the gray area in-between pure platforms (enabling independent contractors) and pure traditional firms (employing workers), because they control certain key decisions. For example, Uber and Lyft notoriously control the price of rides, although they allow drivers flexibility in choosing the cars they drive (subject to some minimal requirements) and their work hours. Handy, which connects users with house cleaners, provides a more extreme example. Handy not only controls price, but also imposes numerous and detailed requirements on how cleaners should present themselves and complete the jobs (e.g. mandatory Handy insignia on clothing, how to communicate with customers before and after service, etc.). Unsurprisingly, Uber, Lyft and Handy are all currently involved in lawsuits aimed to determine whether their control over various aspects of the professional-customer transaction implies that they should treat professionals as employees instead of independent contractors.13 This would carry significantly higher costs in the form of employee benefits. One can interpret this issue in terms of our framework as implying that taking control over transferable actions in $T$-mode carries additional fixed costs, which the firm does not have to incur in $P$-mode. This simply shifts the trade-off in favor of the $P$-mode, but all other considerations in our model continue to hold.

Needless to say, there are other considerations that are relevant to the policy debate regarding the proper boundary between employees and independent contractors, but are not captured in our model: the impact of the work being done and the control rights associated with it on professionals’ outside options, the intensity of competition faced by the relevant firms/platforms, etc. Incorporating some of these aspects into the analysis provides a promising avenue for future research based on our work in this paper. There are several other directions in which our work can be extended. One would be to allow the firm to charge customers a fixed access fee in both modes and study the impact of such a fee on the trade-off between the two modes. Such a fee is used by some firms selling some basic hardware or software to consumers, which is required in order to access the relevant services or products (e.g. video-game consoles). Another direction would be to study competition among firms that can each choose between the traditional mode and the platform mode, potentially leading to equilibria in which firms compete with different models. Finally, one could pursue the analysis of hybrid modes along the lines briefly described in Section 6 by incorporating cost or information asymmetries between the firm and the professionals and determining their effect on the optimal allocation of control rights.

References


Appendix

Proof of Proposition 1

The optimal contract $\Phi^* (R)$ chosen by the firm in $T$-mode solves

\[
\Pi^{T^*} = \max_{\Phi(\cdot), a, e, E} \left\{ R(a, e, E) - \Phi(R(a, e, E)) - c^a(a) - c^E(E) \right\}
\]

subject to

\[
\begin{cases}
  a = \text{arg max}_{a'} \left\{ R(a', e, E) - \Phi(R(a', e, E)) - c^a(a') \right\} \\
  e = \text{arg max}_{e'} \left\{ \Phi(R(a, e', E)) - c^e(e') \right\} \\
  E = \text{arg max}_{E'} \left\{ R(a, e, E') - \Phi(R(a, e, E')) - c^E(E') \right\} \\
  0 \leq \Phi(R(a, e, E)) - c^e(e).
\end{cases}
\]

We start by proving the following lemma.

**Lemma 1** $\Phi^* (R)$ must be continuous and differentiable at $R^* = R(a^*, e^*, E^*)$, where $R^*$ is the revenue that results from the optimization problem above.

**Proof.** Suppose $\Phi^*$ is discontinuous at $R^*$ and $\lim_{R \to R^+} \Phi^* (R) > \lim_{R \to R^-} \Phi^* (R)$. Then

\[ E^* = \text{arg max}_E \left\{ R(a^*, e^*, E) - \Phi^* (R(a^*, e^*, E)) - c^E (E) \right\} \]

implies $\Phi^* (R^*) = \lim_{R \to R^+} \Phi^* (R)$, because otherwise $\Phi^* (R^*) > \lim_{R \to R^+} \Phi^* (R)$, so the firm could profitably deviate to $E^* + \varepsilon$, with $\varepsilon$ sufficiently small. But then we must have $e^* = 0$, since otherwise $e^* > 0$ and the professional could profitably deviate to $e^* - \varepsilon$ with $\varepsilon$ sufficiently small. If $e^* = 0$ then it must be that $\Phi^* (R^*) = 0$ and therefore

\[ (a^*, E^*) = \text{arg max}_{a, E} \left\{ R(a, 0, E) - c^a(a) - c^E(E) \right\}. \tag{17} \]

In this case the firm could switch to the following linear contract:

\[ \Phi_\varepsilon(R) = \varepsilon R + c^e(e(\varepsilon)) - \varepsilon R(a(\varepsilon), e(\varepsilon), E(\varepsilon)), \]

where $\varepsilon > 0$ is sufficiently small and $(a(\varepsilon), e(\varepsilon), E(\varepsilon))$ is a solution to

\[
\begin{cases}
  a(\varepsilon) = \text{arg max}_a \left\{ R(a, e(\varepsilon), E(\varepsilon)) - \Phi_\varepsilon(R(a, e(\varepsilon), E(\varepsilon))) - c^a(a) \right\} \\
  e(\varepsilon) = \text{arg max}_e \left\{ \Phi_\varepsilon(R(a(\varepsilon), e(\varepsilon), E(\varepsilon))) - c^e(e) \right\} \\
  E(\varepsilon) = \text{arg max}_E \left\{ R(a(\varepsilon), e(\varepsilon), E) - \Phi_\varepsilon(R(a(\varepsilon), e(\varepsilon), E)) - c^E(E) \right\}.
\end{cases}
\]

Denote the firm profits that result from offering contract $\Phi_\varepsilon$ by

\[ \Pi^T(\varepsilon) \equiv R(a(\varepsilon), e(\varepsilon), E(\varepsilon)) - c^a(a(\varepsilon)) - c^e(e(\varepsilon)) - c^E(E(\varepsilon)). \]
Clearly, \((a(0), e(0), E(0)) = (a^*, 0, E^*)\) and \(\Pi^T(0) = \Pi^{T*}\). We can then use (17), the definition of \(c(e)\) and assumption (a2) to obtain

\[
\Pi^{T*}_\epsilon(0) = (R_a(a^*, 0, E^*) - c^a_a(a^*)) a_\epsilon(0) + (R_e(a^*, 0, E^*) - c^e_e(0)) e_\epsilon(0) \\
+ (R_E(a^*, 0, E^*) - c^E_E(E^*)) E_\epsilon(0) \\
= R_e(a^*, 0, E^*) \frac{R_e(a^*, 0, E^*)}{c^e_e(0)} > 0,
\]

where \(c^e_e = \frac{d^2 c^e}{d e^2}\).

Thus, if \(\lim_{R \to R^-} \Phi^*(R) > \lim_{R \to R^+} \Phi^*(R)\) then the firm can profitably deviate to \(\Phi_\epsilon(R)\) for \(\epsilon\) small enough, which contradicts the optimality of \(\Phi^*(R)\).

The other possibility is \(\lim_{R \to R^-} \Phi^*(R) > \lim_{R \to R^+} \Phi^*(R)\). Then \(e^* = \arg \max_e \{ \Phi^*(R(a^*, e, E^*)) - c^e(e) \}\) implies \(\Phi^*(R^*) = \lim_{R \to R^+} \Phi^*(R)\), because otherwise \(\Phi^*(R^*) < \lim_{R \to R^+} \Phi^*(R)\), so the professional could profitably deviate to \(e^* + \epsilon\), with \(\epsilon\) sufficiently small. But then we must have \(E^* = 0\), otherwise the firm could profitably deviate to \(E^* - \epsilon\) with \(\epsilon\) sufficiently small.

If \(a\) is not price then \(R_a(a, e, E) > 0\) for all \((a, e, E)\) so the same logic implies \(a^* = 0\). We must then have

\[
\Pi^{T*} = R(0, e^*, 0) - c^e(e^*) = \max_e \{ R(0, e, 0) - c^e(e) \}.
\]

This cannot be optimal. Indeed, the firm could switch to the linear contract

\[
\tilde{\Phi}_\epsilon(R) = (1 - \epsilon) R + c^e(\tilde{e}(\epsilon)) - (1 - \epsilon) R \left( \tilde{a}(\epsilon), \tilde{e}(\epsilon), \tilde{E}(\epsilon) \right),
\]

where \(\epsilon > 0\) is sufficiently small and \((\tilde{a}(\epsilon), \tilde{e}(\epsilon), \tilde{E}(\epsilon))\) is a solution to

\[
\begin{align*}
\tilde{a}(\epsilon) &= \arg \max_a \left\{ R\left( a, \tilde{e}(\epsilon), \tilde{E}(\epsilon) \right) - \tilde{\Phi}_\epsilon \left( R\left( a, \tilde{e}(\epsilon), \tilde{E}(\epsilon) \right) \right) - c^a(a) \right\} \\
\tilde{e}(\epsilon) &= \arg \max_e \left\{ \tilde{\Phi}_\epsilon \left( R\left( a, \tilde{e}(\epsilon), \tilde{E}(\epsilon) \right) \right) - c^e(e) \right\} \\
\tilde{E}(\epsilon) &= \arg \max_E \left\{ R\left( \tilde{a}(\epsilon), \tilde{e}(\epsilon), E \right) - \tilde{\Phi}_\epsilon \left( R\left( \tilde{a}(\epsilon), \tilde{e}(\epsilon), E \right) \right) - c^E(E) \right\}.
\end{align*}
\]

Denote the firm profits that result from offering contract \(\tilde{\Phi}_\epsilon\) by

\[
\tilde{\Pi}^T(\epsilon) = R\left( \tilde{a}(\epsilon), \tilde{e}(\epsilon), \tilde{E}(\epsilon) \right) - c^a(\tilde{a}(\epsilon)) - c^e(\tilde{e}(\epsilon)) - c^E(\tilde{E}(\epsilon)).
\]

Clearly, \((\tilde{a}(0), \tilde{e}(0), \tilde{E}(0)) = (0, e^*, 0)\) and \(\tilde{\Pi}^T(0) = \Pi^{T*}\). Using (18), the definitions of \(\tilde{a}(\epsilon)\) and \(\tilde{E}(\epsilon)\) and assumption (a2), we obtain

\[
\tilde{\Pi}^T_\epsilon(0) = R_a(0, e^*, 0) \tilde{a}(0) + (R_e(0, e^*, 0) - c^e_e(e^*)) \tilde{e}(0) \\
+ R_E(0, e^*, 0) \tilde{E}(0) \\
= R_a(0, e^*, 0) \frac{R_a(0, e^*, 0)}{c^a_a(0)} + R_E(0, e^*, 0) \frac{R_E(0, e^*, 0)}{c^E_E(0)} > 0,
\]

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where \( c_{a0}^a = \frac{\partial^2 c}{\partial s^2} \) and \( c_{EE}^E = \frac{\partial^2 E}{EE} \).

Thus, the firm can profitably deviate to \( \Phi_t (R) \) for \( \varepsilon \) small enough, which contradicts the optimality of \( \Phi^* (R) \).

If \( a \) is price then \( c^a = 0 \) so we must have

\[
\Pi^T = R(a^*, e^*, 0) - c^\varepsilon (e^*) \leq \max_{a, e} \left\{ R(a, e, 0) - c^\varepsilon (e) \right\}.
\]

Once again, it is straightforward to verify that the firm could profitably deviate to \( \Phi_t (R) \) for \( \varepsilon \) small enough.

We have thus proven that \( \lim_{R \to R^+} \Phi^* (R) = \lim_{R \to R^-} \Phi^* (R) \), so \( \Phi^* \) is continuous at \( R^* \).

Suppose now that \( \Phi^* \) is non-differentiable at \( R^* \) and \( \lim_{R \to R^+} \Phi_R^* (R) > \lim_{R \to R^-} \Phi_R^* (R) \). This implies \( e^* = 0 \), otherwise we must have

\[
0 \geq \lim_{e \to e^*} \left\{ \Phi_R (R(a^*, e, E^*)) \right\} R_e (a^*, e, E^*) - c^\varepsilon (e) > \lim_{e \to e^*} \left\{ \Phi_R (R(a^*, e, E^*)) \right\} R_e (a^*, e, E^*) - c^\varepsilon (e),
\]

so setting \( e \) slightly below \( e^* \) would violate \( e^* = \arg \max_e \left\{ \Phi (R(a^*, e, E^*)) - c^\varepsilon (e) \right\} \). If \( e^* = 0 \) then we must have \( \Phi^* (R^*) = 0 \) (recall \( c^\varepsilon (0) = 0 \)) and therefore

\[
(a^*, E^*) = \arg \max_{a, E} \left\{ R(a, 0, E) - c^a (a) - c^E (E) \right\}.
\]

But then we can apply the same reasoning as above to conclude that the firm could profitably deviate to the linear contract \( \Phi_t (R) \) for \( \varepsilon \) small enough.

Suppose instead \( \lim_{R \to R^+} \Phi_R^* (R) < \lim_{R \to R^-} \Phi_R^* (R) \). This implies \( E^* = 0 \), otherwise we must have

\[
0 \leq \lim_{E \to E^*} \left\{ R_E (a^*, e^*, E) \right\} (1 - \Phi_R (R(a^*, e^*, E))) - c^E (E) < \lim_{E \to E^*} \left\{ R_E (a^*, e^*, E) \right\} (1 - \Phi_R (R(a^*, e^*, E))) - c^E (E),
\]

so setting \( E \) slightly above \( E^* \) would violate \( E^* = \arg \max_E \left\{ R(a^*, e^*, E) - \Phi (R(a^*, e^*, E)) - c^E (E) \right\} \).

If action \( a \) is not price then \( c^a \neq 0 \) and \( R_a > 0 \), therefore the exact same reasoning applies to \( a^* \) and leads to \( a^* = 0 \). This would mean that

\[
\Pi^T = R(0, e^*, 0) - c^\varepsilon (e^*) \leq \max_{e} \left\{ R(0, e, 0) - c^\varepsilon (e) \right\}.
\]

We have already proven above that this cannot be optimal.

If action \( a \) is price then \( c^a = 0 \) and

\[
\Pi^T = R(a^*, e^*, 0) - c^\varepsilon (e^*) \leq \max_{a, e} \left\{ R(a, e, 0) - c^\varepsilon (e) \right\}.
\]

In this case, we have proven above that the firm could do strictly better with the linear contract \( \Phi_t (R) \)
for \( \varepsilon \) small enough.

We conclude that \( \Phi^* (.) \) must be continuous and differentiable at \( R^* \). ■

The lemma implies that \((a^*, e^*, E^*)\) solve

\[
\begin{align*}
R_a (a^*, e^*, E^*) (1 - \Phi^*_R (R^*)) &= c^a (a^*) \\
R_e (a^*, e^*, E^*) \Phi^*_R (R^*) &= c^e (e^*) \\
R_E (a^*, e^*, E^*) (1 - \Phi^*_R (R^*)) &= c^E (E^*).
\end{align*}
\]

Let then \( t^* = 1 - \Phi^*_R (R^*) \) and \( F^* = (1 - t^*) R^* - \Phi^* (R^*) \). Clearly, the linear contract \( \hat{\Phi} (R) = (1 - t^*) R - F^* \) can generate the same stage 2 equilibrium as the initial contract \( \Phi^* (R) \). Furthermore, both \( \Phi^* (R) \) and \( \hat{\Phi} (R) \) cause the professional’s participation constraint to bind and therefore result in the same profits for the firm.

A similar proof applies to the case when the firm chooses the \( P \)-mode.

**Proof of Proposition 5**

Consider first the \( T \)-mode. By \((a6')\) it is optimal for the firm to induce all \( N \) professionals to join, so the optimal contract \( \Phi^* (.) \) solves

\[
\Pi^T^* = \max_{\Phi(\cdot), E, (a_i, e_i)_{i=1}^{N}} \left\{ \sum_{i=1}^{N} [R (a_i, \sigma (a_{-i}) , e_i, E) - \Phi (R (a_i, \sigma (a_{-i}), e_i, E)) - c^a (a_i)] - c^E (E) \right\}
\]

subject to

\[
(a_1, \ldots, a_N) = \arg \max (a'_1, \ldots, a'_N) \left\{ \sum_{i=1}^{N} [R (a'_i, \sigma (a'_{-i}) , e_i, E) - \Phi (R (a'_i, \sigma (a'_{-i}), e_i, E)) - c^a (a'_i)] \right\},
\]

\[
e_i = \arg \max e'_i \left\{ \Phi (R (a_i, \sigma (a_{-i}) , e'_i, E')) - c^e (e'_i) \right\} \text{ for all } i \in \{1, \ldots, N\},
\]

\[
E = \arg \max_{E'} \left\{ \sum_{i=1}^{N} [R (a_i, \sigma (a_{-i}) , e_i, E') - \Phi (R (a_i, \sigma (a_{-i}), e_i, E'))] - c^E (E') \right\},
\]

\[
0 \leq \Phi (R (a_i, \sigma (a_{-i}) , e_i, E)) - c^e (e_i) \text{ for all } i \in \{1, \ldots, N\}
\]

By assumption \((a6')\), we know that the solution to this program is symmetric, so we can write

\[
\Pi^T^* = \max_{\Phi(\cdot), E, a, e} \left\{ N [R (a, \sigma (\bar{a}_{N-1}) , e, E) - \Phi (R (a, \sigma (\bar{a}_{N-1}) , e, E)) - c^a (a)] - c^E (E) \right\}
\]

subject to

\[
a = \arg \max_{a'} \left\{ R (a', \sigma (\bar{a}_{N-1}) , e, E) - \Phi (R (a', \sigma (\bar{a}_{N-1}) , e, E)) + (N - 1) (R (a, \sigma (a', \bar{a}_{N-2}) , e, E) - \Phi (R (a, \sigma (a', \bar{a}_{N-2}) , e, E)) - c^a (a') \right\},
\]

\[
e = \arg \max_{e'} \left\{ \Phi (R (a, \sigma (\bar{a}_{N-1}) , e', E')) - c^e (e') \right\},
\]

\[
E = \arg \max_{E'} \left\{ N [R (a, \sigma (\bar{a}_{N-1}) , e, E') - \Phi (R (a, \sigma (\bar{a}_{N-1}) , e, E'))] - c^E (E') \right\},
\]

\[
0 \leq \Phi (R (a, \sigma (\bar{a}_{N-1}) , e, E)) - c^e (e)
\]

Let then \((a^*, e^*, E^*)\) denote the symmetric outcome of this optimization problem. Also define \( R^* \equiv R (a^*, \sigma (\bar{a}_{N-1}^*), e^*, E^*) \).

**Lemma 2** \( \Phi^* (.) \) is continuous and differentiable at \( R^* \).
Proof. Due to symmetry, the proof is almost identical to the one of lemma 1, so we omit it. In particular, assumption (a5') ensures that the deviation contracts \( \Phi_\varepsilon \) and \( \tilde{\Phi}_\varepsilon \) yield the desired result, just like in lemma 1. 

The lemma and program (19) imply that \((a^*, e^*, E^*)\) solve

\[
\begin{align*}
(1 - \Phi_R^*(R^*)) \left( R_a \left( a^*, \sigma \left( \hat{a}^N_{N-1} \right), e^*, E^* \right) \right) + (N - 1) \left( \sigma_a (a^*) R_s \left( a^*, \sigma \left( \hat{a}^N_{N-1} \right), e^*, E^* \right) \right) &= c_a^a (a^*) \\
\Phi_R^* (R^*) R_e \left( a^*, \sigma \left( \hat{a}^N_{N-1} \right), e^*, E^* \right) &= c_e^e (e^*) \\
N (1 - \Phi_R^* (R^*)) R_E \left( a^*, \sigma \left( \hat{a}^N_{N-1} \right), e^*, E^* \right) &= c_E^E (E^*)
\end{align*}
\]

Let then \( t^* \equiv 1 - \Phi_R^* (R^*) \) and \( F^* \equiv (1 - t^*) R^* - \Phi^* (R^*) \). Clearly, the linear contract \( \tilde{\Phi} (R) = (1 - t^*) R - F^* \) can generate the same stage 2 symmetric Nash equilibrium \((a^*, e^*, E^*)\) as the initial contract \( \Phi^* (R) \). Furthermore, both \( \Phi^* (R) \) and \( \tilde{\Phi} (R) \) cause the professionals’ participation constraint to bind and therefore result in the same profits for the firm.

A similar proof applies to the case when the firm chooses the \( P \)-mode.