Strategic delegation in procurement

Eduard Alonso-Paulí[*†] and Lluís Bru [‡§]

Abstract

In a firm organized into business units, we show that profitability increases if procurement is delegated to the division in charge of production. We emphasize that our results are driven by the business unit having a different objective function than the headquarters (HQ). The profitability of procurement delegation is affected by how essential the production facilities are to the activities of the firm, and by strategic distortions in both transfer and input prices. We also examine vertical separation of activities as an alternative to procurement delegation.

Keywords: strategic delegation, transfer pricing, procurement

JEL classification: D24, D43, M11

1 Introduction

Recent research has documented that firms in the US, Germany, and Austria have shifted recently to a more decentralized organization, in which managers of divisions have been

[*]Corresponding author. Email: eduard.alonso@uib.es

[†]Universitat de les Illes Balears, Spain

[‡]Universitat de les Illes Balears, Spain

[§]We would like to thank to seminar participants at the internal seminar at UIB, and different conferences such as 1st CESC (Barcelona) XXXII Jornadas de Economia Industrial (Pamplona), 42nd Simposio de Análisi Económico (Barcelona) and 45th Annual Conference of the European Association for Research in Industrial Economics (EARIE in Athens). We also gratefully acknowledge financial support from grant ECO2017-86305-C4-1-R (AEI/FEDER, UE)

empowered to make more decisions (see Marin and Verdier (2014) and references therein). In multinationals this decentralization is frequently accompanied by a transfer pricing system for internal transactions that transform divisions into profit centers (Tang, 2002).[1]

However, the mix of centralized and delegated activities within an organization varies from one firm to another, and this is particularly the case for procurement. Procter and Gamble, for instance, centralizes both product development and accounting, while divisions are responsible for sales and procurement; whereas in General Electric, divisions are in charge of sales, but procurement is centralized (Dessein et al. 2010). In a KPMG survey from 2008 75% of respondents believed procurement to be a high strategic priority, and nearly half of firms in the survey used some level of decentralization for procurement. Most importantly for our purposes, respondents also emphasized that the internal organization of procurement can affect the prices charged by suppliers.

This paper analyzes the decision of a firm to delegate or centralize the procurement of essential inputs to profit centers already in charge of production. We show the circumstances under which delegation of procurement can increase a firm's clout when bargaining with suppliers. When there is an increase in bargaining power, it comes from the use of a delegated agent (namely, the manager of the profit center in charge of production) with a different objective function from the headquarters. Importantly, and in contrast to the previous literature on strategic transfer pricing, we take the view in this paper that the firm has a commitment on the organization of the firm but not to the value of the transfer price: As Göx (2000) and Sengul et al. (2012) noted, it can be argued that several structural aspects of the organization of a firm possess the character of a long-term commitment

[1] Tax purposes are usually essential for understanding how transfer pricing is set. Anyway, according to Ernst and Young (2003), approximately 40% of firms believe that achieving management/operational objectives has a stronger influence in their firm than tax purposes.

and are observable by participants in the market; the creation of profit centers and the accounting system and transfer price policy adopted by a firm in its implementation would therefore be credible and public. However, the particular value of a transfer price chosen by headquarters is something much easier to modify and therefore lacks any commitment force. We show below that there is no need for distortions in transfer prices to gain clout in negotiations: An efficiently set transfer price also leads to discounts in the price of inputs; what is crucial strategically are the observability and irreversibility of the delegation decision, that is, the credible delegation of decisions to profit centers.

In Section 2 below, we model the procurement problem of a firm in which the division in charge of production is organized as a profit center. Production involves two stages. First, the firm acquires a crucial input; then, once a procurement contract is agreed upon, headquarters sets an internal transfer price and production decisions are made. Into this procurement problem, we introduce a prior stage in which headquarters chooses who leads procurement negotiations: It can keep procurement centralized or delegate them to the profit center. We model a game situation in which participants cannot use prices (neither the transfer price nor the input price) in a strategic manner. In particular, when procurement is delegated to the profit center, we assume that the transfer price is not observable to the supplier and that the contract signed between the profit center and the supplier can be renegotiated.

In Section 3, we compare the outcomes of the game when headquarters retains the procurement decision with that obtained when there is delegation of procurement to the profit center. Proposition 1 states that the firm obtains a better deal from suppliers and higher profits when procurement is delegated. By delegating procurement, the firm can shift profits away from the bargaining stage, in turn increasing the bargaining clout of the

profit center against the supplier.

In Section 4, we discuss the relevance of our assumptions to achieve our main result and determine what can happen if we relax or change some of them. We first show that the value of the procurement delegation result holds whenever the profit center manager does not fully internalize the profits of the whole company. Second, we find that internal decentralization can dominate vertical separation of production as a way to increase bargaining clout against suppliers. We also discuss the situation in which headquarters can credibly announce a distorted transfer price, and we show that it is still optimal for headquarters to delegate procurement; however, and unlike in the existing literature, we show that the possibility of strategic transfer prices (in addition to the decentralization of procurement) does not necessarily lead to higher profits, compared to a scenario in which the only tool available to headquarters is the delegation of procurement.

We also discuss in Section 4 the changes in our model that can lead to the emergence of centralized procurement. First, when contracts are not renegotiable, delegating procurement to the manager in charge of the profit center has a negative drawback: The profit center and the supplier have incentives to set higher input prices since they lead headquarters to increase transfer prices. Eventually, this incentive increases the payoffs of the supplier and the profit center at the cost of reduced overall profits for the firm. Centralized procurement could also emerge when headquarters can threaten to outsource production since it adds a negotiation tool against suppliers not available to the profit center.

Our paper is related to two main strands of the literature. First, our paper can be seen as an illustration of the use of delegated agents in bargaining, first discussed by Schelling (1960). Delegation of decisions serves as a commitment device and could allow the principal to obtain some strategic advantage since the agent playing the game can

commit to a certain behavior. However, as noted by Katz (1991), delegation might not be useful if binding contracts are not observable by other participants in the market. Although observability of contracts is an important feature rendering commitments valid, Fershtman and Kalai (1997) found conditions under which delegation to an agent still has some impact. In particular, they showed that what is crucial is that it is known that the agent faces an incentive contract, even if the specifics of the contract are not known.[2] More recently, and from an experimental perspective, several authors have pointed out that delegation to an agent might help the firm to be tougher in negotiations (Fershtman and Gneezy, 2001 or Hamman et al., 2010).

Second, our paper relates to the literature on transfer pricing initiated in the seminal paper by Hirshleiffer (1956). Our paper is not the first analysis of the strategic impact of transfer prices. Since Alles and Datar (1998), many papers have focused on the strategic use of transfer pricing. There are two main differences between our analysis and the bulk of this research. First, this literature has not discussed the commitment and observability requirements regarding contracts and has generally assumed that firms can commit to a particular level of transfer price that is moreover fully observable by outsiders. Second, the focus of this literature has been on the use of a transfer price system to gain a competitive advantage against rivals, either in the final or in the intermediate market;[3] however, as far as we know, there has been almost no research analyzing the impact of transfer pricing on procurement activities. An exception and the closest paper to ours is Arya et al. (2007). Like us, they analyze the interaction between procurement activities and a transfer price

[2] More recently, Koçkesen and Ok (2004) and Gerratana and Koçkesen (2012 and 2015) extended these results, showing that renegotiation of contracts limits the effect of strategic delegation but does not completely eliminate it.

[3] See Göx and Schiller (2007) for a survey on the use of transfer prices, in particular as a strategic device and its limitations. See also Sengul et al. (2012) for a recent review of strategic delegation in general.

scheme, but they limit their analysis to linear input prices set by the supplier. Then, they show that headquarters reduces transfer prices to decrease the input demand of the profit center since doing so, in turn, forces the supplier to set lower input prices. Therefore, the main differences with our model are that we explicitly consider a negotiation of the input price, and we allow for more complex input contracts. Furthermore, we show that a commitment to distorted transfer prices is not necessary for delegated procurement to be profitable.

Finally, our analysis shares some relationship with the literature analyzing the strategic decisions that can modify the bargaining clout of a firm in front of workers and unions. As in our paper, Zhao (1998) analyzes the strategic role of transfer prices, whereas there have been other papers (Perotti and Spier (1993), Matsa (2010) and Quadrini and Sun (2017)) showing that firms use their capital structures strategically to improve their bargaining positions.

This paper is organized as follows. In the next section, we present the main characteristics of the model. In Section 3, we show the main results of our model: delegation of procurement improves a firm's bargaining clout and, as a consequence, is a profitable way of organizing procurement. We discuss in Section 4 the roles of the different assumptions in the results obtained in the previous section and different extensions that qualify these results. Section 5 concludes the study. All proofs are presented in an Appendix.

2 The model

Figure 1 graphically represents the industry interaction that we analyze in the paper. There is a firm that transforms an input on a one-to-one basis into an output at production cost

$C(q)$ and that can generate revenues $R(q)$. Revenues $R(q)$ satisfy $R(0) = 0, R' > 0$ and $R" \leq 0$. Production costs are given by $C(q)$, with $C(0) = 0, C' > 0$ and $C" > 0$. There exist two sources of the input; that feature constant marginal costs c_1 and c_2 respectively, and one source is more efficient than the other: $c_2 > c_1$. We assume $R'(0) - C'(0) - c_2 > 0$, which guarantees that, even with the less efficient source of the input, it is profitable to produce a strictly positive quantity. We name the efficient source of the input *the efficient supplier* or simply *the supplier*.[4]

Figure 1 about here

The firm has production organized as a profit center. More specifically, the headquarters (HQ from now on) of the firm sets a transfer price p and managers in charge of the profit center (*the manager* for short from now on) choose the level of production q that maximizes the profits of the division, defined as

$$pq - C(q) - T(q), \tag{1}$$

where $T(q)$ are the procurement costs of the input. Therefore, both production and procurement costs ($C(q)$ and $T(q)$ respectively) are imputed to the profit center, and its accounting revenues are pq.

Procurement can be delegated to this profit center or centralized into HQ. Either way, the inefficient input can be obtained at a marginal cost, so that the procurement costs become $T(q) = c_2 q$ if it is the source of input used. To obtain the input from the efficient

[4]We can interpret c_2 in several ways: the source of input c_2 could be the competitive price of a less efficient fringe of suppliers; or c_2 could capture the cost of producing the required input internally. Still another alternative interpretation is that the firm is in negotiations with a labor union to implement new production methods; introducing a new method of production would lower costs from c_2 to c_1.

supplier, the firm must negotiate a two-part tariff $T(q) = F + wq$ with the supplier. If procurement is delegated to the profit center, negotiation occurs between the profit center (which seeks to maximize its profits (1) in the bargaining process) and the supplier; if procurement is centralized, the negotiating parties are the HQ (which is concerned with the whole profits of the firm $R(q) - C(q) - T(q)$ when it negotiates) and the supplier.

The quantity q^* that maximizes the firm's profits satisfies the first-order condition $R'(q^*) - C'(q^*) - w = 0$.[5] Define

$$\Pi(w) = \max_q \{R(q) - C(q) - wq\} \tag{2}$$

as the level of gross profits that can be achieved (not taking into account the fixed fee paid to suppliers). Our assumptions about revenues and costs guarantee the existence of a unique solution $q(w)$ to this maximization problem, strictly decreasing in the input cost, $q'(w) = \frac{1}{R" - C"} < 0$; and that the profit is decreasing in the input cost, $\Pi'(w) = -q(w) < 0$.

It is clear that, under our technological assumptions, efficiency involves the use of the input that features the lower marginal cost c_1. Assume that the firm and the efficient supplier are indeed one entity; in this case, the level of production that maximizes joint profits is $q(c_1)$, which leads to total rents $\Pi(c_1)$. If, instead, the firm produces using the alternative, both the optimal quantity, $q(c_2)$, and the rents generated, $\Pi(c_2)$, are lower. The difference in profits between choosing the efficient supplier or the alternative, $\Pi(c_1) - \Pi(c_2)$, can be shared between the firm and the supplier. The aim of this paper is to study whether the allocation of authority over procurement affects the achievement of this increase in rents, as well as its effect on the distribution of these rents.

[5] FOC are necessary and sufficient for a unique global maximum since the problem is strictly concave: Note that the SOC is $R'' - C'' < 0$ according to our assumptions about R and C.

Timing. The timing conveys three basic events. In Stage 1, the HQ decides to whom to allocate authority over procurement: Centralized or delegated procurement. In Stage 2, a negotiation with the supplier starts, and finally, in Stage 3 production decisions are made.

Assuming that negotiations occur before the production stage provides the company with great flexibility; the firm sets a transfer price p contingent on the outcome of the negotiation stage, adjusting production decisions q in accordance with the real marginal cost (either c_2 or the marginal price w as agreed with the supplier). This flexibility is crucial to our analysis. If production decisions were made before the bargaining stage, and could not be modified afterward, the supplier would take advantage of this situation capturing larger rents in the negotiation stage;[6] foreseeing what would happen in the bargaining stage, the firm would presumably reduce its production in the first place, leading to inefficiencies and thus to lower total profits.

In Stage 2 we assume efficient negotiations; in particular, we model the negotiation as a cooperative Nash-bargaining problem between the firm (HQ or the profit center) and the efficient supplier, in which the expected profits, in case of both agreement and disagreement, come from the expected outcome in the production stage of the game.

Finally, note that the strategic interaction of the firm and the supplier greatly differs when procurement is delegated and when it is centralized. Under centralization, the role of the manager only concerns production activities, whereas when the procurement is delegated, the manager is involved in negotiations as well, indicating that, under delegation,

[6] If the firm commits to producing $q(c_1)$, the efficient quantity under the efficient supplier, the supplier can increase the fee compared to the case in which there is no commitment because, under commitment, and if negotiations fail, the firm is stuck with production $q(c_1)$ using the inefficient source of the input, which reduces the level of profits under the alternative source of input.

the timing considers that the manager communicates the outcome of the negotiation stage to the HQ, which in turn can create incentives to use prices strategically. As we see in detail in the following section, the aim of the timing assumed is precisely to avoid prices (neither the transfer price nor the procurement contract) having a strategic impact, so we can focus on the strategic role played by the organization itself.

3 Optimal organization of procurement

In this section, we obtain the main result of the paper. First, we discuss the outcome under centralization of procurement in Subsection 3.1, and under delegation of procurement in Subsection 3.2. In Subsection 3.3 the two different organizational structures are compared and the main result is obtained.

3.1 Centralized procurement

When, in Stage 1, procurement negotiations remain centralized at HQ, the timing under this organizational structure afterward is the following:

Stage 2: Negotiation stage: HQ and the efficient supplier negotiate a procurement contract $T(q) = F + wq$. In case of disagreement, the firm has procurement costs $c_2 q$.

Stage 3. Production stage:

3.1: HQ chooses a transfer price p.

3.2: The profit center chooses the level of production q.

With the timing that we assume, we see that in the third stage, the manager in charge of the profit center maximizes profits in (1). Both the transfer price p and the procurement contract $T(q)$ are givens for the profit center, who can only decide on the level of production

q. Procurement costs depend on the outcome of the negotiation between HQ and the efficient supplier in the previous stage; if there has been agreement between HQ and the efficient supplier, the profit center input costs are $T(q) = F + wq$; in case of disagreement, the input costs are $T(q) = c_2 q$. Given a unit price of the input w and a transfer price p, we define

$$q(p, w) = \arg\max_q \{pq - C(q) - wq\} \tag{3}$$

as the level of production that maximizes the profits of the division, and

$$\pi(p, w) = R\left(q(p, w)\right) - C(q(p, w)) - w{\cdot}q(p, w) \tag{4}$$

as the gross profits of the firm (not taking into account the fixed fee paid to suppliers).

As we know from Hirschleifer (1956), if HQ sets a transfer price

$$p(w) = R'(q(w)) \tag{5}$$

the factory fully internalizes the impact of production on the firm's profits and therefore chooses the optimal production (given marginal procurement costs w) $q(p(w), w) = q(w)$. Therefore, HQ can maximize the profits of the whole firm in (2) in a decentralized manner, setting the transfer price according to the marginal cost of procurement, which is $p(w)$ in case of agreement with the input supplier in the previous stage and $p(c_2)$ otherwise; the firm achieves profits of either $\pi(p(w), w) - F = \Pi(w) - F$ or $\pi(p(c_2), c_2) = \Pi(c_2)$, respectively. For the supplier, the profits are $F + (w - c_1)q(w)$ in case of agreement and zero otherwise.

We can now solve the Nash-bargaining problem of the second stage. The HQ and the efficient supplier negotiate a procurement contract $T(q)$ that is the solution to the

Nash-bargaining problem[7]

$$\max_{\{F,w\}} \left[\Pi(w) - F - \Pi(c_2)\right]^{\frac{1}{2}} \left[F + (w - c_1)q(w)\right]^{\frac{1}{2}}. \tag{6}$$

The solution of this problem involves a fee $F = \frac{1}{2}\left(\Pi(w) - \Pi(c_2) - (w - c_1)q(w)\right)$ that redistributes profits and a marginal price w that maximizes joint profits (total rents) $\Pi(w)+(w - c_1)q(w)$. The optimal marginal price is $w = c_1$, yielding an efficient outcome with total surplus $\Pi(c_1)$; then, the extra rents from the agreement $\Pi(c_1) - \Pi(c_2)$ are equally distributed through a fixed payment

$$F^C = \frac{1}{2}\left(\Pi(c_1) - \Pi(c_2)\right). \tag{7}$$

Therefore, the profits of the firm when procurement is centralized to the HQ become

$$\Pi^C = \Pi(c_1) - F^C = \frac{1}{2}\left(\Pi(c_1) + \Pi(c_2)\right), \tag{8}$$

whereas the supplier achieves profits F^C.

3.2 Delegated procurement

We discuss now the outcome of the interaction between the firm and the efficient supplier when in Stage 1 HQ delegates the negotiation of the procurement contract to the profit center. The timing under this organizational structure afterward is the following:

[7]Note that we treat profits in case of disagreement, $\Pi(c_2)$ for the HQ and 0 for the supplier, as disagreement points and not as an outside option (see Binmore et al. (1986)). We thank one of the referees for pointing out this issue.

Stage 2: Negotiation stage

2.1: The profit center and the supplier negotiate a procurement contract $\widehat{T}(q) = \widehat{F} + \widehat{w}q$. In case of disagreement, the firm has procurement costs $c_2 q$.

2.2: The profit center announces its outcome to the HQ; that is, it announces whether an agreement has been reached or not, and if there is indeed an agreement, it also announces the terms $\left\{\widehat{F}, \widehat{w}\right\}$ of the contract upon which they have agreed.

Stage 3. Production stage

3.1: If an agreement has been reached in Stage 2, HQ chooses a transfer price p, and *simultaneously,* the profit center and the supplier can renegotiate the terms $\{F, w\}$ of the procurement contract $T(q)$.

3.2: The profit center observes the transfer price p and chooses the level of production $q(p, w)$ that maximizes its profits.

Different from the centralized procurement case, this timing includes a communication stage (Stage 2.2) and a renegotiation phase (in Stage 3.1). This setup is built to prevent both the transfer price p and the procurement contract $T(q)$ from having any strategic effect on the outcome and so to analyze the possible strategic role of the delegation of procurement. First, in Stage 2.2, the profit center announces a contract $\widehat{T}(q)$, and this contract can be enforced by the parties (the profit center and the supplier), but its terms can be altered if both parties agree; that is, the contract can be renegotiated afterward (in Stage 3.1). Second, in Stage 3, HQ adjusts the transfer price p to the expected marginal cost of the input (either w or c_2), but it cannot affect the negotiation itself since the transfer price p is set after there is an agreement with the supplier. On the other hand, we allow the parties to the negotiation (the profit center and the supplier) to alter the initial procurement contract; therefore, if the contract set in Stage 2 prevents maximization of

their joint profits, it is corrected in Stage 3.1.

We now proceed to solve backwards the delegated procurement case starting in Stage 3. We assume an efficient negotiation between the profit center and the supplier, so that they set a contract $\{F, w\}$ that maximize their (expected) joint profits $JP(p^{\exp}, w) = p^{\exp}q(p^{\exp}, w) - C(q(p^{\exp}, w)) - c_1 q(p^{\exp}, w)$, where we denote as $p^{\exp}$ the transfer price that they expect the HQ to choose simultaneously, and $q(p^{\exp}, w)$ is the level of production that the profit center chooses afterward. It is clear that, for any expected transfer price $p^{\exp}$, their joint profits are maximized by setting the unit input price $w = c_1$, that allows the profit center to internalize the real procurement costs of the efficient supplier when choosing the level of production. As a consequence, HQ is set to maximize firm's profits $\pi(p, c_1) - F$ setting a transfer price $p(c_1)$, which leads to $\pi(p(c_1), c_1) = \Pi(c_1)$ and overall firm profits $\Pi(c_1) - F$. If we define

$$\Pi_f(w) = \max_q \{p(w)q - C(q) - wq\}, \tag{9}$$

then the profits of the division and the supplier are $\Pi_f(c_1) - F$ and F, respectively.

In case of disagreement, the profit center is left to use the input from the inefficient source at unit price c_2. In this case, the third stage of the game is similar to that when procurement is centralized in HQ: first HQ chooses a transfer price p and the profit center chooses the level of production $q(p, c_2)$ that solves (1) when $w = c_2$. Then, HQ sets the optimal transfer price according to (5), $p(c_2) = R'(q(c_2))$ to achieve the optimal level of profits at these procurement costs, and the profit center achieves profits $\Pi_f(c_2)$.

We can now solve the Nash-bargaining problem of the second stage. For simplicity, we limit our analysis to renegotiation-proof contracts; that is, we look for announcements in

Stage 2 that emerge unchanged in Stage 3.1. Both the manager and the efficient supplier negotiate a procurement contract $T(q)$, or to be more precise, they negotiate a fixed fee F in a contract in which the unit input price is $w = c_1$, which is the solution to the Nash-bargaining problem[8]

$$\max_{\{F\}} \left[\Pi_f(c_1) - F - \Pi_f(c_2)\right]^{\frac{1}{2}} \left[F\right]^{\frac{1}{2}}. \tag{10}$$

The solution of this problem involves a fee

$$F^D = \frac{1}{2}\left(\Pi_f(c_1) - \Pi_f(c_2)\right), \tag{11}$$

and the profits of the firm become

$$\Pi^D = \Pi(c_1) - F^D = \Pi(c_1) - \frac{1}{2}\left(\Pi_f(c_1) - \Pi_f(c_2)\right) \tag{12}$$

whereas the supplier achieves profits F^D.

3.3 The main result

We look now at HQ's optimal decision in Stage 1: Whether to delegate or to centralize procurement. First, direct observation of firm's profits under centralization, $\Pi^C = \Pi(c_1) - F^C$, and under delegation, $\Pi^D = \Pi(c_1) - F^D$, reveal that gross profits (i.e., not taking into account the fixed fee paid to the supplier) are the same under both organizational structures. Hence, any preference that HQ has for one structure or the other must come

[8] Where $(\Pi_f(c_2), 0)$ are treated as disagreements points of the factory manager and the supplier, respectively.

from a different distribution of the surplus between the firm and the supplier; in other words, HQ should choose the allocation of authority that minimizes the fixed payment to the supplier. The following Proposition does compare F^C and F^D and states the main result of the paper.

Proposition 1 *If R" < 0, fees are strictly less under delegated procurement than under centralized procurement. As a consequence, the firm's profits are greater under delegated procurement than under centralized procurement.*

According to Proposition 1, the firm's profits are greater when procurement negotiations are delegated to the manager. Crucially, this improvement in profits is obtained through a reduction of the fee paid to the supplier ($F^D < F^C$) and without changes in total surplus. Regardless of who bargains with the efficient supplier, the profit center makes the same production decisions; $q(c_1)$ is obtained in case of success and $q(c_2)$ in case of disagreement. The improvement is achieved because the amount of profits to be bargained differ depending on who is negotiating the terms of the agreement. Further, it is this effect that reduces the fee paid to the supplier, $F^D < F^C$: If we rewrite the firm's profit as

$$\Pi(w) = R(q(w)) - R'(q(w))q(w) + \underbrace{R'(q(w))q(w) - C(q(w)) - wq(w)}_{\Pi_f(w)}$$

where $R'(q(w))q(w)$ is the transfer payment to the profit center, we see that delegation of procurement is profitable whenever $R(q(w)) - R'(q(w))q(w) > 0$ is increasing with the efficiency of the firm. In other words, the relevant feature of delegating procurement to the profit center is that the manager has more clout than the HQ when negotiating the fee with the supplier, because an increase in production costs has less impact on profits of the division than on those of the company as a whole.

A linear demand quadratic cost case illustrates Proposition 1. With revenues $R(q) = \left(1 - \frac{bq}{2}\right) q$, quadratic costs $C(q) = m\frac{q^2}{2}$ and input costs $T(q) = F + wq$, optimal production, namely, that solving (2), is $q(w) = \frac{1-w}{b+m}$ and gross profits (i.e., not taking into account the fee) are $\Pi(w) = \frac{(1-w)^2}{2(b+m)}$. At the production stage, the profit center produces $q(p, w) = \frac{p-w}{m}$. Optimal production can be decentralized with a transfer price $p(w) = R'(q(w)) = \frac{m+bw}{b+m}$, and the profit center achieves gross profits (again, not taking into account the fee) $\Pi_f(w) = \frac{m}{2}\left(\frac{1-w}{b+m}\right)^2$.

In this linear example, the way in which profits are shifted between divisions is captured by parameter $\theta = \frac{m}{b+m} \in (0, 1)$; that is, the profits of the division are a share of the firm's profits $\Pi_f(w) = \theta\Pi(w)$. Interestingly, the input cost plays no role in the way in which these profits are split between divisions. What matters exclusively is the relative steepness of the firm's cost and revenue function.[9] Delegating procurement becomes less appealing when the rents that the manager and the HQ negotiate with the supplier are similar, that is, when revenues are less concave (b low) and/or costs are more convex (high m). To see these facts in greater detail, normalize input costs as $0 = c_1 \leq c_2 = c \leq 1$. Under centralized procurement, the fee in (7) becomes

$$F^C = \frac{\theta(2-c)c}{4m} \tag{13}$$

and net profits in (8) are

$$\Pi^C = \Pi(c_1) - F^C = \frac{\theta\left(2 - (2-c)\,c\right)}{4m} \tag{14}$$

[9] The way in which profits are shifted from one division to the other remains the same, that is, $\theta = \frac{m}{b+m}$ when the revenue and cost function are $R(q) = \left(v - \frac{bq^s}{1+s}\right) q$, and $C(q) = m\frac{q^{1+s}}{1+s}$ with $s > 0$.

Under delegated procurement, the fee in (11) becomes

$$F^D = \frac{\theta\left(\Pi(c_1) - \Pi(c_2)\right)}{2} = \frac{\theta^2(2-c)c}{4m}. \tag{15}$$

and net profits in (12) are

$$\Pi^D = \Pi(c_1) - F^D = \frac{\theta\left(2 - \theta\left(2-c\right)c\right)}{4m} \tag{16}$$

Direct comparison of equations (13) and (15) shows that the fee paid to the supplier is lower under delegated procurement, $F^C > F^D$, whenever $\theta < 1$ and similarly comparing equations (14) and (16) show that profits under delegated procurement are higher, $\Pi^C > \Pi^D$, whenever $\theta < 1$.

4 Discussion and extensions

4.1 Discussion

In our model, to let to the profit center both purchasing and production decisions provide firms with a strategic edge. Delegated procurement is beneficial for reasons closely similar to other settings of strategic delegation: By delegating to the manager, a delegated agent with its own objective function, the HQ convinces the supplier that the manager will be stricter when negotiating. To achieve this result, we have made some assumptions, either implicitly or explicitly. We discuss below whether our results change if we relax or modify some of these assumptions.

Incentive contract. The advantage of delegating procurement to the profit center

does not critically rely on the manager maximizing only its own division profit. As long as the manager puts more weight on the profit center profit rather than the whole company's profit, our main result still applies. To see this outcome, assume the manager incentives (IC) are now a combination of both corporate and divisional performance, that is,

$$\pi_{IC} = \mu\pi + (1-\mu)\pi_f,$$

with weights μ chosen by HQ in a previous stage to the delegation decision. If $\mu = 1$, the manager only attempts to maximize the firm's profits; when $0 \leq \mu < 1$,[10] the objective function of the manager is not perfectly aligned with the firm's interests. Note that, for any given μ, production decisions remain optimal and both the supplier and the manager maximize joint rents by setting $w = c_1$. Thus, the difference lies in the amount of rents to be shared between the firm and the supplier through the fixed payment F. In this case, it can be shown that, under this incentive contract, the fee is simply a convex combination between F^C and F^D, that is,

$$F^{IC} = \mu F^C + (1-\mu)\, F^D.$$

It is clear, then, that Proposition 1 extends to any μ that satisfies $0 \leq \mu < 1$.

Vertical Separation. One might consider other organizational arrangements, rather than delegated procurement, to gain clout over the supplier. For instance, the HQ could vertically split the company into two different entities: one retaining the sales division being able to obtain revenues $R(q)$; and the other entity owning the factory with costs

[10] Crawford et al. (2018) provide empirical support to $0 < \mu < 1$. They study whether the internalization of profits at the division level actually occurs in the multichannel television market. They obtain an estimate value $\mu = 0.79$, i.e. according to their empirical results there is no full internalization of profits.

$C(q)$. Under *Vertical Separation*, or simply VS, the HQ of the former company plays no further role in production, and the manager of the profit center becomes HQ of the new company, taking over both procurement and production decisions. When the HQ chooses to create two companies, assume that the HQ cares about total profits of the firm, that is, $\Pi(c_1) - T^{VS}(q)$ where $T^{VS}(q)$ is the payment to the supplier in the vertical separation case. In other words, assume perfect capital markets that allows the HQ to obtain from the sale of the factory a payment that covers exactly the profits of the separated entity.

We use the Shapley value as a solution concept for the negotiation with three players involved in sharing the rents: The sales company, the factory company and the supplier.[11] In this simple case, the rents of the grand coalition are $\Pi(c_1)$. The supplier is not needed to achieve $\Pi(c_2)$, but it becomes as essential as the factory and the sales division to generate the extra rents $\Pi(c_1) - \Pi(c_2)$. Therefore, the profits of the supplier will be $\frac{1}{3}(\Pi(c_1) - \Pi(c_2))$. The allocation of profits can be achieved by a two-part tariff with an input price equal to the marginal cost of production c_1 and a fee:

$$F^{VS} = \frac{1}{3}(\Pi(c_1) - \Pi(c_2)) \tag{17}$$

It is immediate from equations (7) and (17)) that payments under vertical separation

[11] Similar results could be obtained if, instead of the Shapley value, we use simultaneous negotiations processes. Formally, the approach we use to share rents is a cooperative game in which we have $N = 3$ players (the grand coalition) and a characteristic function $v : S \to R$ from the set of all possible coalitions of players to a set of payments that satisfies $v(\varnothing) = 0$. The Shapley value gives any player i his or her (average) contribution to a coalition, in which the contribution is averaged over all possible coalitions to which a player i might belong. More formally, a player's i's share of the rents is given by

$$\Pi_i^{VS} = \sum_{S \subseteq N \setminus \{i\}} \frac{|S|!\,|n - |S| - 1|!}{n!} \left(v(S \cup i) - v(S)\right),$$

where n is the total number of players and the sum extends over all subsets S belonging to N not containing player i.

are less than under centralized procurement: $F^{VS} < F^{C}$. The intuition for this result is that, under centralized procurement, the firm and the supplier equally share the rents generated, $\Pi(c_1) - \Pi(c_2)$ whereas in the separating case, the supplier must agree with two other companies rendering the supplier less determinant to achieve the extra rents. Then, when comparing delegated procurement and vertical separation, we observe that both organizational structures reduce the fixed payment, compared to the centralized procurement case. Therefore, the preference of one structure over the other depends crucially on the cost/revenue structure.

In the linear demand and quadratic cost case, we can explicitly compare both organizational arrangements. In particular, from equations (15) and (17), we see that which organizational arrangement is more profitable depends on the convexity of the revenue and cost functions: payments are lower under delegation, $F^{VS} > F^{D}$, if and only if $\theta \in \left(0, \frac{2}{3}\right)$ (and $F^{VS} < F^{D}$ if and only if $\theta \in \left(\frac{2}{3}, 1\right)$).

Transfer Price Commitment.

The existing literature on transfer pricing has extensively focused on the strategic role observable (and uneasy to adjust) transfer prices might play, whereas we have concentrated our analysis on the role of the organization structure and we have shown that there is no need to distort transfer price to obtain leverage in negotiations. We discuss now the addition of strategic transfer prices to our framework by analyzing two different cases. First, and as a benchmark, we discuss the case in which the firm can announce a menu of transfer prices (that is, there are two different transfer prices, one in force if there is an agreement with the efficient supplier, and a different one in case of disagreement). Afterwards, we analyze strategic transfer price when the firm can only commit to a single transfer price.

Thus, we can slightly modify the timing of our setup to account for the possibility that the HQ sets transfer prices strategically. If the firm centralizes procurement, the game is exactly the same as in Section 3.1. Under delegating procurement, we change the interaction as follows: In Stage 1 the HQ delegates procurements negotiations to the manager *and credibly announces a transfer price scheme at which divisions trade.* Subsequently, in Stage 2 the manager bargains with the supplier, and finally in Stage 3, production occurs according to the announced transfer price scheme (in Stage 1) and the outcome of the bargaining stage (in Stage 2). Compared with our main model, the crucial difference appears in Stage 1 when the HQ announce the observed transfer price scheme at which internal divisions trade. We use H to denote actions and payoffs when the HQ delegates procurement and uses transfer prices strategically.

If HQ commits to a menu of transfer prices in Stage 1, delegating procurement through strategic transfer pricing becomes a very powerful mechanism. The HQ can obtain the following outcome: (1) There are no efficiency distortions in equilibrium, obtaining $\Pi(c_1)$; and (2) the profit center can negotiate a fee $F^H = 0$, leaving of the surplus to the firm. This outcome can be achieved by announcing the efficient transfer price under the efficient source of the input, $p^H(c_1)$, and setting an exaggerated high transfer price in case of procuring from the alternative. This higher transfer price is set to artificially inflate the profits of the division under the alternative source of the input, and eventually allowing the manager to be tough during negotiations with the efficient supplier. Such a situation, although theoretically possible, seems to be empirically difficult to implement: First, observability of internal transfer pricing is typically justified in the literature by the existence of guidelines in the OECD (Susaría and Glaize, 2012) that recommend the use of the same transfer price for both internal evaluation and tax purposes; these guidelines push firms to use a

unique transfer price for all transactions, because they fear regulatory scrutiny otherwise. In other words, attempting to render transfer prices observable potentially constrains the HQ's discretion to announce different transfer prices.[12]

A more realistic situation is one in which the firm can only commit to a single transfer price policy. In this case, delegating procurement through strategic pricing becomes less appealing. It remains true that the firm can freely announce any transfer price; however, since the transfer price is unique and announced before bargaining, it cannot be adapted to the outcome of the negotiation stage. Indeed, the optimal strategic transfer price trades off these two effects and is intentionally set too low, $p^H < R'(q(c_1))$. This price creates some inefficiencies at the production level, but it allows a reduction in the profits of the division that translates into a reduction of the fee paid to the supplier. In other words, the HQ uses prices strategically to shift profits away from the bargaining stage to reduce the relevance of an agreement over the division's profits. It can be shown that, even if there are production distortions, the firm strictly prefers to use transfer prices strategically rather than keeping procurement centralized. The following proposition summarizes these findings.

Proposition 2 *If HQ can commit to a single transfer price, then the optimal transfer price satisfies* $p^H < R'(q(c_1))$ *and profits under Delegated procurement are higher than under Centralized procurement.*

Both Proposition 1 and 2 state that delegated procurement is preferred to centralized procurement. It is not necessarily true, however, that distorting the transfer price always leads to greater profits than those obtained when the only strategic element is the orga-

[12] See the very nice discussion of this issue in Arya and Mittendorf (2008, p.719).

nization. There are two circumstance in which firms' profits increase in HQ, in addition to delegating procurement, can commit to a transfer price. The first reason circumstance is when, under non distorted transfer prices, the use of the efficient input increases the profits of the division and the profits of the whole firm similarly; then in order to gain substantial leverage against the supplier, HQ must distort the transfer price. As an extreme case, suppose revenues are linear, $R'' = 0$, then delegating procurement provides no benefit since profits of the division are the same as those of the whole company (note that, in this extreme case, Proposition 1 does not apply). By committing to a unique transfer price, some rents are diverted from the negotiation stage and delegating becomes profitable. The second circumstances in which a commitment to a distorted transfer price is profitable is when the firms lacks a profitable alternative source of the input. The cost of a strategic transfer price is the inability to adapt to the outcome of the negotiation stage. When this is irrelevant, which occurs when the alternative is highly inefficient (or, in an extreme case, when the firm does not have any alternative), then profits under the alternative are relatively small or even zero, so there is a small distortion in these profits when setting an inefficient transfer price.

We can illustrate this discussion in the linear demand and quadratic cost case. Under strategic transfer prices, the optimal transfer price and profits are[13]

$$p^H = \begin{cases} \frac{\theta(2-c)}{2} \text{ if } c \leq \frac{2\theta}{2+\theta} \\ \frac{2\theta}{2+\theta} \ otherwise \end{cases} \text{ and } \Pi^H(p^H) = \begin{cases} \frac{\theta(2-c)^2}{8m} + \frac{c^2}{4m} \text{ if } c \leq \frac{2\theta}{2+\theta} \\ \frac{\theta}{m(2+\theta)} \ otherwise \end{cases} \tag{18}$$

[13]By distorting the transfer price, profits under the alternative could become zero or even negative. We do not allow for these unreasonable cases, and we stick to cases in which the firm's profits are nonnegative in all scenarios.

We know from Section 3 that delegation under nonstrategic transfer prices leads to profits Π^D in (18). The comparison of profits, equations (16) and (18), is represented graphically in the following figure. On the vertical axis, we represent the marginal cost of the alternative supplier (bounded between 0 and 1), whereas on the horizontal axis we represent $\theta \in (0,1)$, i.e., the share of profits retained by the profit center. Finally, the solid function that separates the plane into two regions is

$$f(\theta) = \begin{cases} \left(1 - \sqrt{\frac{\theta}{2+\theta}}\right) & \text{if } 0 < \theta < \frac{2}{3} \\ \frac{4\theta(1-\theta)}{2(1-\theta^2)+\theta} & \text{if } \frac{2}{3} < \theta < 1 \end{cases}$$

and represents the combinations of parameters such that, if $c \geq f(\theta)$, the firm prefers using a single strategic transfer prices (and the opposite otherwise).

Figure 2 about here

4.2 Extensions: Forces that favor centralized procurement

Until now, all of the effects favor the decentralization of procurement (perhaps under the form of vertical separation). In this last section we present two effects that moderate this result. The first appears when input contracts are nonrenegotiable. We show the existence of incentives of the manager to collude with the efficient supplier. The second effect appears when the factory is not essential for the firm because the firm have an alternative for production activities.

Nonrenegotiable contracts As emphasized previously, effective delegation of procurement to the profit center implies some common knowledge that the manager is invested with the necessary authority to accept or not an agreement with the efficient supplier

(achieved through firm's internal organization). The benefits from delegation comes from the manager and the HQ optimizing different objective functions. However, this difference could come along with a drawback: There might be incentives for the delegated agent to collude with the efficient supplier.[14]

To account for this case, we slightly modify the timing of our model as follows:[15] First, HQ announces the allocation of authority over procurement decisions. Second, either the HQ or the profit center bargains with the supplier. When the profit center is in charge of the negotiation, *it announces a particular tariff* $T(q)$ *that is not renegotiated afterward.* Finally production takes place.

We can see that delegating procurement to the profit center becomes less profitable. First, note that, under centralized procurement, there are no incentives to reach any agreement different from $T^C(q) = F^C + c_1 q(c_1)$, which implies that production is set at efficient levels, $q(c_1)$, and the firm's profits are Π^C. Instead, under delegated procurement, and unlike the benchmark case, joint rents are not maximized at $w = c_1$. Now, commitment to the input price allows the supplier and manager to effectively influence the transfer price. A higher input price induces the HQ to set a higher transfer price ($p = R'(q(w)) > R'(q(c_1))$) to compensate for the increase in production costs, in turn increasing profit center and supplier rents. Indeed, both the manager and the supplier finds it always optimal to distort the input price, setting $w^S > c_1$, and as a consequence, production is inefficiently low.

Now centralizing procurement allows for more efficiency in production; however, cen-

[14] This collusion could imply the existence of 'kickbacks', 'bribes' or other non-monetary favors (Tirole, 1986). Indeed, Bloom et al. (2013, p.40), noted that Indian firm owners are "concerned if they let their plant managers procure yarn they may do so at inflated rates from Friends and receive kickbacks".

[15] In this part, we only include the basic arguments. Claims in this discussion have been obtained by solving the model and are available upon request.

tralization still reduces the firm's bargaining strength. The decision to centralize procurement lies then in comparing these two opposing forces. When the firm's alternative source of input is quite efficient, gains from producing efficiently under centralization overcome the potential benefits of increasing bargaining strength under delegation; thus centralizing procurement activities becomes the best organization.

Nonessential facilities. One informal recurrent argument in the literature in favor of centralizing procurement is that HQ might have more clout in negotiating than local managers because HQ usually has more alternatives than local managers (Arnold, 1999).[16] For instance, if the firm owns different facilities, the manager could accept or reject an agreement with the supplier, but the HQ can threaten the efficient supplier with shutting down of the factory and produce the output externally (in another facility), as well.

We account for this case by introducing an external alternative only available to HQ. This external alternative allows the firm to achieve profits Π^{ext}, assumed to be less than those that can be achieved with the efficient use of the factory. For simplicity, we write $\Pi^{ext} = \alpha\Pi(c_1)$ where $\alpha \in (0,1)$ measures the value of the external alternative. Thus, under centralized procurement, two different alternatives are available to the HQ. First, the firm can always operate with the inefficient alternative (producing at a higher marginal cost, c_2). We call this alternative the internal alternative, and, as in the rest of the paper, it is used as a disagreement point when bargaining. The second alternative, the external one, allows the firm to move production to another location by closing the factory. From a bargaining point of view, such an alternative is credible when the HQ can unilaterally cease negotiations, and therefore, it is better treated as an outside option rather than as a

[16] Arnold (1999) provides other explanations in favor of centralizing procurement, such as the construction of a group purchasing and procurement strategy, establishing a global supply view, efficient use of available purchasing skills, less administrative work and reduction of purchasing organization expenses.

disagreement (see Binmore et al., 1986).[17]

In this new setup, the timing is similar to the one described in Section 2: first, the HQ decides whether to centralize or delegate procurement, then a deal with the efficient supplier is negotiated, and the production stage starts once negotiations are over. Production decisions are optimal given a marginal cost of the input by correctly setting the transfer price. Moreover, bargaining is efficient, $w = c_1$, and as a consequence in equilibrium the factory is in operation, but we show that the existence of an alternative could have consequences for the organization of procurement.

Under centralized procurement, the HQ has two available alternatives. When the external alternative is very inefficient (α low), the agreement between the firm and the supplier mimics that obtained in Section 3: The contract leads to efficient production and HQ pays $F^C = \frac{\Pi(c_1)-\Pi(c_2)}{2}$, achieving profits $\Pi^C = \Pi(c_1) - F^C$. Using the outside option makes sense in cases in which threatening to cease negotiations can allow the HQ to achieve larger profits, that is, when $\Pi^{ext} \geq \Pi(c_1) - F^C$. When this condition holds, the outside option guarantees the firm profits Π^{ext} paying the remaining rents as a fee $\Pi(c_1) - \Pi^{ext}$. Therefore, payments and profits under centralized procurement are:

$$F^{C,ext} = \begin{cases} \frac{\Pi(c_1)-\Pi(c_2)}{2} \text{ if } \alpha \in \left(0, \alpha^C\right) \\ (1-\alpha)\,\Pi(c_1) \text{ if } \alpha \in (\alpha^C, 1) \end{cases} \Pi^{C,ext} = \begin{cases} \frac{\Pi(c_1)+\Pi(c_2)}{2} \text{ if } \alpha \in \left(0, \alpha^C\right) \\ \alpha\Pi(c_1) \text{ if } \alpha \in (\alpha^C, 1) \end{cases}$$

where $\alpha^C = \frac{1}{2}\left(1 + \frac{\Pi(c_2)}{\Pi(c_1)}\right) \in (0,1)$ and the superscript ext refers to the existence of an additional alternative (external).

Under *delegated procurement,* the manager has available only the internal alternative

[17] If this external alternative is not available during negotiations, HQ cannot effectively use it as a threat and therefore either the firm delegates procurement or shuts down the factory and produces using this external alternative.

when negotiating with the efficient supplier. Thus, the outcome of the negotiation between the profit center and the supplier is a tariff that features a marginal price $w = c_1$, a fee as in (11), and profits as in (12) [18], that is,

$$F^D = \frac{\Pi_f(c_1) - \Pi_f(c_2)}{2} \text{ and } \Pi^D = \Pi(c_1) - \frac{\Pi_f(c_1) - \Pi_f(c_2)}{2}$$

Comparison of profits under delegated, Π^D, and under centralized procurement, $\Pi^{C,ext}$, leads to the following result.

Proposition 3 *Assuming $R'' < 0$ holds, the firm's profit are greater under centralized procurement whenever the external alternative is sufficiently attractive, that is, when $\alpha \in (\alpha^*, 1)$, where $\alpha^* = 1 - \frac{1}{2}\left(\frac{\Pi_f(c_1)-\Pi_f(c_2)}{\Pi(c_1)}\right) \in \left(\alpha^C, 1\right)$.*

This proposition provides several insights for the evaluation of best procurement practices. First, when using external production does not bring much benefit, $\alpha \in \left(0, \alpha^C\right)$, the bargaining clout of HQ does not improve at all, and the fee paid when procurement is centralized is the same as in Section 3, $F^C = \frac{\Pi(c_1)-\Pi(c_2)}{2}$. Therefore, the result in Proposition 1 directly applies to the case where the HQ owns a poor external alternative and delegating is then the best way to organize procurement. Second, note that Delegated procurement is still chosen for values of the alternative $\alpha \in \left(\alpha^C, \alpha^*\right)$, for which the external alternative improves the bargaining clout of HQ in centralized bargaining; only when this external alternative is sufficiently attractive (and therefore HQ can ask for a low fee) is centralized procurement selected.

[18] We implicitly assumed that, if delegated, the manager agreements do not have HQ's approval. Including this ratification assumption would modify the subgame played in the delegating procurement case, but it does not affect the organization of procurement in equilibrium.

5 Concluding remarks

The main goal of this paper is to understand the benefits of delegating procurement to a profit center in charge of production. We show the existence of those benefits under nonstrategic transfer prices. Further, we show that the use of strategic transfer prices does not necessarily improve the firm's profits, and they may even be counterproductive. We extend the initial framework by introducing other aspects that can moderate the decision to decentralize the firm's procurement.

There are at least two natural extensions of our analysis worth to be followed in future research. First is, the multiplant case in which the firm owns more than one factory In this case, it might not always be optimal to maintain delegation of these activities at the factory level, and the firm could partly centralize its procurement by building an intermediate layer in charge of procurement and production. Second is, the introduction of uncertainty on the demand's side. If the sales manager knows the true realization of the demand but cannot communicate it to the HQ, the problem faced by the HQ is determining whom to provide authority over quantity: To the sales division, and taking advantage of local information knowledge (as in Weitzman, 1974); or to the factory, reinforcing the bargaining position against the supplier.

References

Alles, M., & Datar, S. (1998). Strategic transfer pricing. *Management Science*, 44(4), 451-461.

Arnold, U. (1999). Organization of global sourcing: ways towards an optimal degree of

centralization. European Journal of Purchasing & Supply Management, 5(3-4), 167-174.

Arya, A., & Mittendorf, B. (2007). Interacting supply chain distortions: The pricing of internal transfers and external procurement. *The Accounting Review*, 82(3), 551-580.

Arya A. and B. Mittendorf. Pricing Internal Trade to Get a Leg up on External Rivals (2008) *Journal of Economics and Management Strategy* 709-731

Binmore, K., Rubinstein, A., & Wolinsky, A. (1986). The Nash bargaining solution in economic modelling. The RAND Journal of Economics, 176-188.

Bloom, N., Eifert, B., Mahajan, A., McKenzie, D., & Roberts, J. (2013). Does management matter? Evidence from India. *The Quarterly Journal of Economics*, 128(1), 1-51

Crawford, G. S., Lee, R. S., Whinston, M. D., & Yurukoglu, A. (2018). The welfare effects of vertical integration in multichannel television markets. *Econometrica*, 86(3), 891-954.

Dessein, W., Garicano, L., & Gertner, R. (2010). Organizing for synergies. *American Economic Journal: Microeconomics*, 2(4), 77-114.

Ernst and Young, Transfer Pricing Global Survey:Practices, Perceptions and Trends in 22 Countries Plus Tax Authority Approaches in 44 Countries (2003). Washington, DC: *Ernst and Young International*

Fershtman, C., & Gneezy, U. (2001). Strategic delegation: An experiment. *RAND Journal of Economics*, 352-368.

Fershtman, C., & Kalai, E. (1997). Unobserved delegation. *International Economic Review*, 763-774.

Gerratana, E., & Koçkesen, L. (2012). Strategic effects of renegotiation-proof contracts. *The BE Journal of Theoretical Economics*, 12(1).

Gerratana, E., & Koçkesen, L. (2015). Commitment without reputation: renegotiation-proof contracts under asymmetric information. *Review of Economic Design*, 19(3), 173-209.

Göx, R. F. (2000). Strategic transfer pricing, absorption costing, and observability. Management Accounting Research, 11(3), 327-348.

Göx R. and Schiller U. An Economic Perspective on Transfer Pricing (2007), Chapter 9 Volume 2 in *Handbook of Management Accounting Research*

Hamman, J. R., Loewenstein, G., & Weber, R. A. (2010). Self-interest through delegation: An additional rationale for the principal-agent relationship. *American Economic Review*, 100(4), 1826-46.

Hirshleifer, J. . On the economics of transfer pricing (1956). *Journal of Business*, 29, 172–184.

Katz, M. L. (1991). Game-playing agents: Unobservable contracts as precommitments. *The RAND Journal of Economics*, 307-328.

Koçkesen, L., & Ok, E. A. (2004). Strategic delegation by unobservable incentive contracts. *The Review of Economic Studies*, 71(2), 397-424.

KPMG/Economist Intelligence Unit (2008) Beyond purchasing: Next steps for the procurement profession. *Report, KPMG International*, Amsterdam.

Marin, D., & Verdier, T. (2014). Corporate hierarchies and international trade: Theory and evidence. *Journal of International Economics*, 94(2), 295-310.

Matsa, D. A. (2010). Capital structure as a strategic variable: Evidence from collective bargaining. *The Journal of Finance*, 65(3), 1197-1232.

Perotti, E. C., & Spier, K. E. (1993). Capital structure as a bargaining tool: The role of leverage in contract renegotiation. The American Economic Review, 1131-1141.

Quadrini, V., & Sun, Q. (2017). Credit and Firm-Level Volatility of Employment. *Journal of the European Economic Association*.

Schelling, T. C. (1960). The strategy of conflict. Cambridge, Mass.

Sengul, M., Gimeno, J., & Dial, J. (2012). Strategic delegation: A review, theoretical integration, and research agenda. *Journal of Management*, 38(1), 375-414.

Susaría, K., & Glaize, A. (Eds.). (2012). OCDE Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations: 2010 Edition; and Transfer Pricing Features of Selected Countries 2012. IBFD.

Tang, R. Current Trends and Corporate Cases in Transfer Pricing. Westport, CT: Quorum Books, 2002.

Tirole, J. (1986). Hierarchies and bureaucracies: On the role of collusion in organizations. *Journal of Law, Economics & Organization*, 2, 181.

Weitzman, M. L. (1974). Prices vs. quantities. *The review of economic studies*, 41(4), 477-491.

Zhao, L. (1998). Labour-management bargaining and transfer pricing in multinational corporations. *Canadian Journal of Economics*, 817-829.

6 Appendix A. Proofs.

Proof of Proposition 1. (i) we show that the optimal procurement contract under centralized procurement leads to $w = c_1$ and $F^C = \frac{1}{2}[\Pi(c_1) - \Pi(c_2)]$. In (ii) we show that the optimal procurement *renegotiation-proof* contract is $w = c_1$ and $F^D = \frac{1}{2}[\Pi_f(c_1) - \Pi_f(c_2)]$ and finally in (iii) we compare both organizational structures.

(i) The optimal contract between the supplier and the headquarter is the solution to the following problem

$$\max_{\{F,w\}} [\Pi(w) - F - \Pi(c_2)]^{\frac{1}{2}} [F + (w - c_1)q(w)]^{\frac{1}{2}}$$

Taking logs first, first order conditions are

$$\begin{aligned}
\frac{\partial}{\partial F} &= 0 \Longleftrightarrow -\frac{\frac{1}{2}}{\Pi(w) - F - \Pi(c_2)} + \frac{\frac{1}{2}}{F + (w - c_1)q(w)} = 0 \\
\frac{\partial}{\partial w} &= 0 \Longleftrightarrow \frac{\frac{1}{2}\frac{\partial \Pi(w)}{\partial w}}{\Pi(w) - F - \Pi(c_2)} + \frac{\frac{1}{2}\left((w - c_1)\frac{\partial q(w)}{\partial w} + q(w)\right)}{F + (w - c_1)q(w)} = 0
\end{aligned}$$

Note first that from $\frac{\partial}{\partial F} = 0$ we obtain the fixed component F^C

$$F^C = \frac{1}{2}[\Pi(w) - \Pi(c_2)] - \frac{1}{2}(w - c_1)q(w)$$

By plugging $F^C(w)$ into $\frac{\partial}{\partial w} = 0$, and simplifying

$$\frac{\partial \Pi_f(w)}{\partial w} + (w - c_1)\frac{\partial q(w)}{\partial w} + q(w) = 0$$

and noting that $\frac{\partial \Pi_f(w)}{\partial w} = -q(w)$ the previous equation can be simplified to $(w - c_1)\frac{\partial q(w)}{\partial w} = 0$.

Note that this equation holds if and only if $w = c_1$ since $\frac{\partial q(w)}{\partial w} = \frac{1}{R''-C''} < 0$. Thus, $w = c_1$ and therefore $F^C = \frac{1}{2}\left[\Pi(c_1) - \Pi(c_2)\right]$.

(ii) We first need to show that the contract renegotiated in stage 3 features $w = c_1$ since it has not formally proved in Section 3.2. The effect of w in their joint profits is $\frac{\partial JP(p^{\exp},w)}{\partial w} = (p^{\exp} - c_1 - C'(q(p^{\exp}, w)) \frac{\partial q(p^{\exp},w)}{\partial w} = (w - c_1) \frac{\partial q(p^{\exp},w)}{\partial w}$ where the last equality uses the fact that $q(p^{\exp}, w)$ satisfies $p^{\exp} - w - C'(q(p^{\exp}, w)) = 0$. Finally, since $\frac{\partial q(p^{\exp},w)}{\partial w} < 0$, their joint profits are maximized at $w = c_1$. In Stage 2, the supplier and the manager bargain a procurement contract $T(q)$ that satisfies $w = c_1$, that is, they choose F that maximize joint profits $\left[\Pi_f(c_1) - F - \Pi_f(c_2)\right]^{\frac{1}{2}} \left[F\right]^{\frac{1}{2}}$. First order conditions of this program leads almost directly to $F^D = \frac{1}{2}\left[\Pi_f(c_1) - \Pi_f(c_2)\right]$

(iii) It is left to show that if $R'' < 0$, then $F^D < F^C$. First, we know that production levels are always $q(c_1)$ if negotiations succeed and $q(c_2)$ otherwise. Second, according to the expressions of the fees F^C in (7) and F^D in (11) $F^D < F^C \iff \frac{1}{2}\left(\Pi_f(c_1) - \Pi_f(c_2)\right) < \frac{1}{2}\left(\Pi(c_1) - \Pi(c_2)\right) \iff R'(q(c_1))q(c_1) - R'(q(c_2))q(c_2) < R(q(c_1)) - R(q(c_2))$ and rearranging

$$F^D < F^C \iff R\left(q(c_2)\right) - R'(q(c_2))q(c_2) < R(q(c_1)) - R'(q(c_1))q(c_1).$$

where $R(q(c_i)) - R'(q(c_i))q(c_i) > 0$ $i = 1, 2$, since $R'' < 0$. Let us define the function $f(q) = R\left(q\right) - R'(q)q$. This function is increasing in q since $\frac{df(q)}{dq} = -R''(q)q > 0$ and $f(0) = 0$. To prove the result it is left to remind that $q(c_1) > q(c_2)$, since $\frac{\partial q}{\partial w} = \frac{1}{R''-C''} < 0$.

QED ■

Proof of Proposition 2. We first see that at the transfer price that maximizes total surplus, $p(c_1) = R'(q(c_1))$, profits under Delegated procurement when price is strategic are greater than under centralized procurement. In equilibrium total surplus is $\Pi(c_1)$,

the supplier charges a fee $F^H(p(c_1)) = \frac{1}{2}\{\Pi_f(c_1) - \pi^f(p(c_1), c_2)\}$ and the firm has profits $\Pi(c_1) - F^H(p(c_1))$. Thus these profits are higher than under Centralized procurement if the fee $F^H(p(c_1))$ is lower than the fee under Centralized procurement $F^C = \frac{1}{2}(\Pi(c_1) - \Pi(c_2))$. Indeed, $F^H(p(c_1)) = \frac{1}{2}\int_{c_1}^{c_2} q(p(c_1), w)dw < F^C = \frac{1}{2}\int_{c_1}^{c_2} q(w)dw$ since $q(p(c_1), w) < q(w)$ if $w > c_1$. Second, we show that the HQ can obtain even higher profits by setting a lower transfer price than $p(c_1)$. To see why, note that, in Stage 1, the HQ chooses p to maximize firm's profits. Formally, the HQ maximizes

$$\Pi^H(p) = \pi(p, c_1) - F^H(p),$$

being $F^H(p) = \frac{1}{2}\{\pi^f(p, c_1) - \pi^f(p, c_2)\}$. The optimal strategic transfer price p^H solves the first order condition of the previous program, that is:

$$[R'(q(p, c_1)) - p]\frac{\partial q(p, c_1)}{\partial p} - \frac{1}{2}\{q(p, c_1) - q(p, c_2)\} = 0.$$

Note that at the efficient transfer price, $p(c_1) = R'(q(p, c_1))$, do not maximizes profits since the derivative of profits evaluated at this price is negative, $-\frac{1}{2}\{q(p, c_1) - q(p, c_2)\} < 0$, which implies that the price that satisfies the first order condition must be lower. QED ■

Proof of Proposition 3. First, from Proposition (1) we know that $\Pi^D > \Pi^C$ when $\alpha \in (0, \alpha^C)$. It is left to show that that $\alpha \geq \alpha^* \iff \Pi^C \geq \Pi^D$ and that $\alpha^* = 1 - \frac{1}{2}\left(\frac{\Pi_f(c_1) - \Pi_f(c_2)}{\Pi(c_1)}\right) \in (\alpha^C, 1)$. When $\alpha \geq \alpha^C$, $\Pi^C \geq \Pi^D \iff \alpha\Pi(c_1) \geq \Pi(c_1) - \frac{\Pi_f(c_1) - \Pi_f(c_2)}{2} \iff \alpha \geq \alpha^* = 1 - \frac{1}{2}\left(\frac{\Pi_f(c_1) - \Pi_f(c_2)}{\Pi(c_1)}\right)$. Now, $\alpha^* < 1$ since $\Pi_f(c_1) - \Pi_f(c_2) > 0$ and $\alpha^* > \alpha^C$ if $1 - \frac{1}{2}\left(\frac{\Pi_f(c_1) - \Pi_f(c_2)}{\Pi(c_1)}\right) > \frac{1}{2}\left(1 + \frac{\Pi(c_2)}{\Pi(c_1)}\right) \iff 1 - \frac{\Pi_f(c_1) - \Pi_f(c_2)}{\Pi(c_1)} > \frac{\Pi(c_2)}{\Pi(c_1)} \iff \Pi(c_1) - \Pi(c_2) > \Pi_f(c_1) - \Pi_f(c_2)$ where the last inequality holds if $R'' < 0$. ■

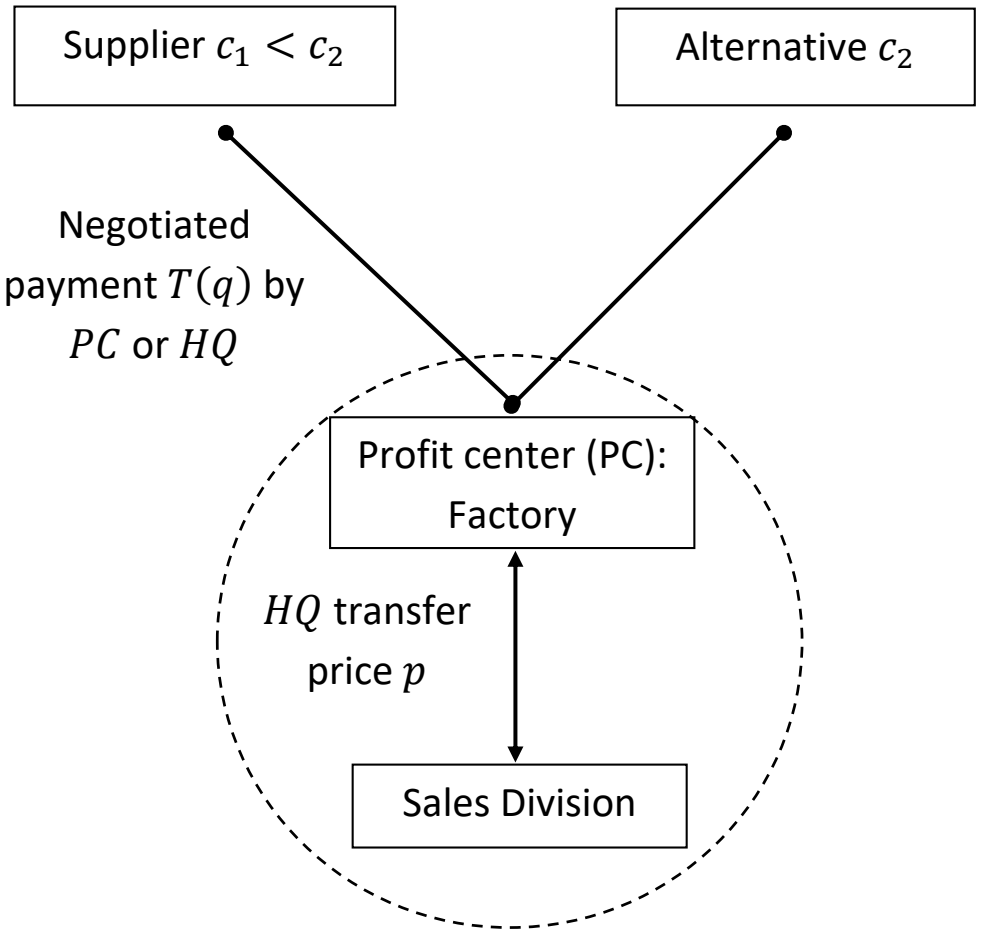

Figure 1: Industry representation.

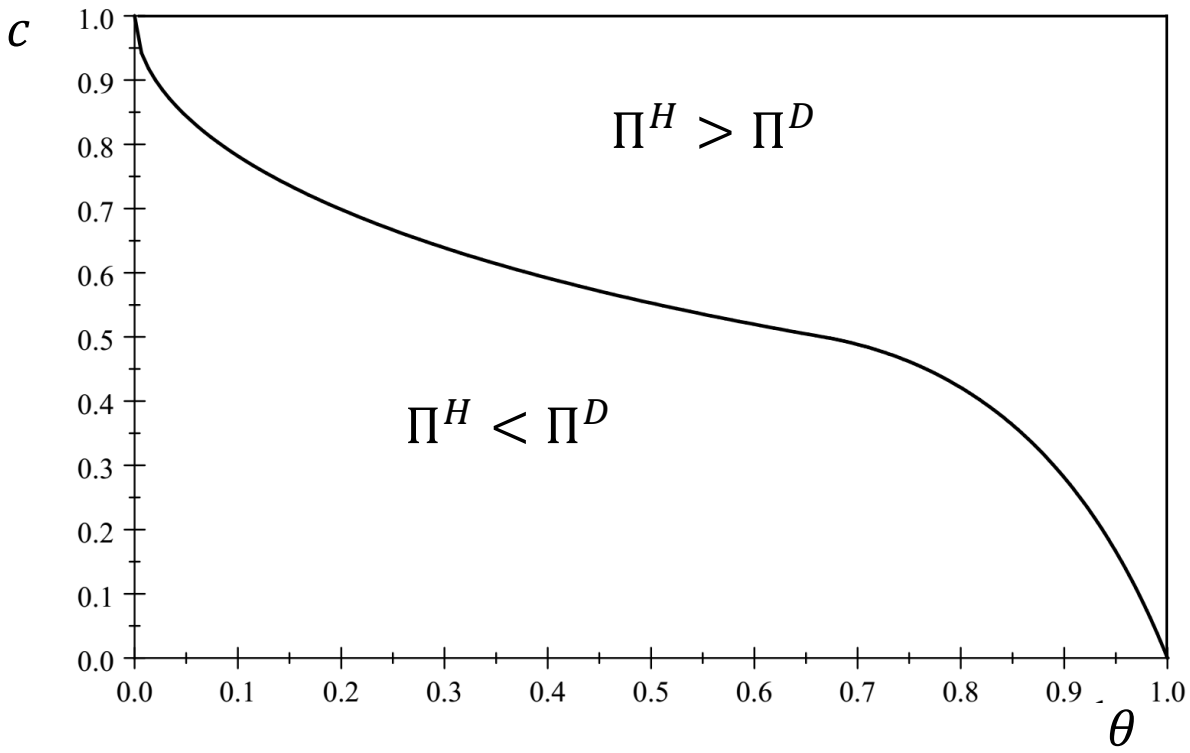

Figure 2: Strategic vs. nonstrategic transfer prices: the linear demand and quadratic cost case.