Negotiating cultures in corporate procurement[1]

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Abstract

For a repeated procurement problem, we compare two stylized negotiating cultures which differ in how the buyer uses an entrant to exert pressure on the incumbent resembling U.S.–style and Japanese–style procurement. In each period, the suppliers are privately informed about their production cost, but only the incumbent can influence the buyer's procurement mechanism choice with a relationship–specific investment. The relative performance of the cultures depends non–monotonically on the importance of the investment relative to the value of selecting the lowest cost supplier. We use the model to explain stylized facts from the automotive industry.

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1. Introduction

In this article, we study the trade–offs between two stylized negotiating cultures and we identify factors which are crucial for their relative performance and ones which are not. Moreover, we argue that differences in the negotiating culture can be used to explain stylized facts from the automotive industry.

A buyer's tasks and objectives in corporate procurement processes are often similar across the world. Procurement is often repeated, switching from an incumbent to an entrant involves costs, the height of these switching costs can be affected by non–contractible relationship–specific investments, and there is little long–term commitment power. Despite these similarities, negotiating cultures differ strongly across the world. Presuming that a negotiating culture is a precommitment to a set of procurement mechanisms, this article compares a competitive culture resembling U.S.–style procurement with a protective culture resembling Japanese–style procurement. The cultures differ in the potential use of bidding competition to exert competitive pressure on the incumbent supplier. The competitive culture relies on tendering procedures with all potential suppliers whereas the decision about the continuation of the relationship with the incumbent is negotiated bilaterally in the protective culture (e.g., it may depend only on whether the incumbent can meet a cost target).

A prominent application is the automotive industry.[4] In the U.S. car industry, procurement relies on competitive auctions.[5] Stylized facts suggest that incentives to make relationship–specific investments are low and the identity of the incumbent changes frequently over time. By contrast, incumbents have a distinct standing in the Japanese car industry. The buyer terminates the relationship with her incumbent supplier only if he does not perform. Incumbents are willing to make significant relationship–specific investments and relationships tend to be long–term.[6] Although the differences may largely be rooted in industry history and business culture, both procurement systems can by now be seen as complex systems of incentives to which firms respond rationally.[7] The attempts of Western car producers to imitate their Japanese counterparts

[4] See Hahn et al. (1986), McMillan (1990), Dyer and Ouchi (1993), Dyer (1996a) and Liker and Choi (2004) for stylized facts and empirical evidence.

[5] According to McMillan (1990), "United States industry [. . .] has traditionally been less willing than Japanese industry to forego the benefits of bidding competition. [. . .] Incumbents and outside bidders were treated equally [. . .]. Lowering the price was the overriding objective."

[6] This view is supported by Dyer and Ouchi (1993) who state that "if the [incumbent] supplier performs up to expectations, it can usually win the business for the next model as well" and who cite a Toyota supplier as follows: "Once we win the business, it is basically our business unless we don't perform. It is our business to lose." A similar observation is made by McMillan (1990): "[In Japanese procurement] there is considerable stability in the contractor/supplier relationship, implying that new contracts are not simply awarded to the lowest bidder, but that incumbents receive some sort of special treatment." According to Dyer (1996b), this is also consistent with what Chrysler did when it tried to install an American Keiretsu at the beginning of the 1990s. Dyer cites Thomas Stallkamp, at that time head of purchasing at Chrysler, as follows: "The business is theirs [the incumbent suppliers'] to keep forever or until they elect to lose it".

[7] For the U.S., such an interpretation is evident. McMillan (1990) interprets also Japanese procurement in this way: "There

point at the Japanese system being superior.[8]

Given either of the negotiating cultures, we consider the infinite repetition of the procurement problem. Each period begins with the incumbent making a continuous investment which generates additional benefits for the buyer when the relationship is continued. Thereafter, the buyer observes the benefits and chooses a procurement mechanism which governs her decision to either buy from the incumbent or from an entrant. In the competitive culture, the buyer faces no restrictions. She can use the entrant at will to exert competitive pressure on the incumbent. In the protective culture, she is bound to mechanisms where she comes to an agreement with the incumbent about the continuation of their relationship before she starts negotiating with the entrant. Then, both suppliers learn their production cost as private information and play the chosen mechanism. The winner (resp. loser) becomes the next incumbent (resp. entrant) and the game proceeds with the next period.

The buyer's profit is in any period affected through two channels: profits attributable to the current period (=realized current period investment benefits net of current period procurement cost) and future rents which are extractable today. Intuitively, the first channel is affected through investment incentives and direct competitive pressure whereas the second channel is affected through indirect competitive pressure.

As there is typically little long–term commitment in corporate procurement, we study Markov Perfect Equilibria. Two implications of this are important: First, the buyer cannot credibly threaten a supplier to exclude him from the procurement process in future periods. She can extract the advantage of being the next incumbent from the winning supplier, but she has to leave to each supplier the expected value of starting into the next period as entrant. Indirect competitive pressure thus derives from expected asymmetries in the future.[9] Second, the buyer reacts rationally on any investment decision. The higher the incumbent's investment, the more to his advantage will the buyer construct the mechanism, i.e. the lower the competition he has to face. As the buyer is limited in the protective culture to use the entrance threat to exert pressure on the incumbent, direct competitive pressure is clearly higher in the competitive culture. However, investment incentives and indirect competitive pressure may be better in the protective culture.

Differences between the optimal allocation of the procurement contract in the two cultures derive from

need be nothing mysterious about how Japanese business practices work, nor need the success of the Japanese system be explained by reference to things uniquely Japanese like the Shinto–Confucian ethic or Japan's consensus culture. [...] Rather, Japanese industry can be understood as having attained, as the end–point of an evolutionary process, a complex system of incentives to which firms respond rationally."

[8] See Liker and Choi (2004) for an overview. See Hahn et al. (1986) and McMillan (1990) in particular for the attempts of U.S. manufacturers to implement just–in–time production at the beginning of the 1980s and Dyer (1996b) for Chrysler's attempt in the first half of the 1990s.

[9] A similar effect arises in Lewis and Yildirim (2005) in the context of switching costs. Large switching costs, like a large incumbency advantage, impose a high indirect pressure and allows for the extraction of significant future rents today. See also Lewis and Yildirim (2002) and Cisternas and Figueroa (2009).

the fact that the incumbent competes against the actual entrant in the competitive culture, whereas he competes only against the buyer's expectation thereof in the protective culture (see Proposition 1). Thus, if the incumbent wants that his relationship with the buyer is continued with certainty, he must choose an investment level which makes him in the competitive culture preferable to the entrant with the best conceivable cost realization, whereas in the protective culture it suffices for him to be preferable to the average entrant.

The structural differences in the contract allocation for the two cultures imply structural differences in investment incentives. For a linear relationship between the benefits and the cost of the investment, and for procurement cost distributed according to a power distribution function, our model becomes particularly tractable and interpretable. The parameter describing the distribution function measures then the likeliness of high and low production cost, and the marginal investment cost measure the importance of investment incentives relative to the value of selecting the supplier with the lowest production cost. Equilibrium investment is higher in the competitive culture when investment is cheap/important, it is higher in the protective culture when investment is intermediately expensive/intermediately important, and there is no investment in either culture when investment is very expensive/very unimportant (Proposition 2).

Our main result establishes that the relative performance of the two negotiating cultures from the buyer's perspective depends non–monotonically on the importance of the investment relative to the value of selecting the lowest cost supplier (Propositions 4 and 5). Whereas for very cheap/very important investment the competitive culture is superior because it implies better investment incentives, it is superior for very expensive/very unimportant investment because it induces more direct competitive pressure. However, for intermediately expensive/intermediately important investment the protective culture is superior because it implies better investment incentives. Interestingly, we obtain the non–monotonicity result for any power distribution function and for any importance of the repetition as measured by the discount factor. This is surprising to the extent that the repetition of the procurement problem adds non–trivial effects (Proposition 3) and that the factors determining the buyer's expected profit depend strongly on the importance of the future as measured by the discount factor.

As investments are important but investment cost are sizable for the most important parts in the automotive industry, this industry is best described by intermediate investment cost parameters. Our model generates for such parameters predictions regarding behavior and performance which are consistent with stylized facts. Although the setup of our base model is motivated by the procurement problem in the automotive industry, we discuss several variations of the model which might fit better the procurement problem in other industries. In particular, we discuss finitely repeated procurement (Proposition 6), exogenous instead of endogenous switching costs (Proposition 7) and the ability of the buyer to credibly exclude a supplier from the procurement process in the future (Proposition 8). For either variation, we find that there is a role for both negotiating cultures.

After discussing the related literature in Section 2, we introduce the model in Section 3. Then we derive and compare the equilibrium behavior for the two negotiating cultures in Section 4 before we compare the performance of the two cultures from the buyer's perspective in Section 5. We provide empirical evidence from the automotive industry for our modeling assumptions and results in Section 6. Finally, we discuss robustness and extensions of our model in Section 7 and we conclude in Section 8. All proofs are relegated to the appendix.

2. Literature

Our article is related to the literature analyzing investment incentives in procurement problems where a single supplier can make a cost–reducing investment.[10] Laffont and Tirole (1988) study a procurement problem where the buyer designs a mechanism to affect investment incentives and not vice versa. Arozamena and Cantillon (2004) analyze the efficiency properties of an observable investment when a first–price auction is exogenously given as procurement mechanism. The investment does not affect the mechanism. Cisternas and Figueroa (2009) investigate a two–period procurement problem where the first–period winner can make an observable investment and the buyer can not commit to the second–period mechanism prior to the investment decision. The considered model is related to our model of the competitive culture. As in our article, the incumbent can affect the mechanism choice with his investment. However, they derive results concerning the efficiency properties of the investment and about favoritism in second–period procurement which are not of direct interest for the comparison of different negotiating cultures.

Our article is further related to the literature on infinitely repeated procurement with asymmetries evolving over time. In particular, it is related to Lewis and Yildirim (2002) and Lewis and Yildirim (2005). Both articles employ similar commitment assumptions as we do and imply mechanism design problems which are related to the design problem which we obtain for the competitive culture. Which research questions are interesting depends strongly on what causes the asymmetries. Lewis and Yildirim (2002) consider asymmetries arising through learning–by–doing and study the effect of experience on favoritism

[10] Dasgupta (1990), Tan (1992), Piccione and Tan (1996) and Bag (1997) consider procurement problems where ex ante symmetric suppliers can all make unobservable investments.

and the evolution of learning. Lewis and Yildirim (2005) consider asymmetries through switching costs and study the comparative statics with respect to the switching technology and the buyer's preferences over switching costs. By contrast, we consider asymmetries arising through an endogenous investment decision by the incumbent and we are interested in assessing precommitments to different subsets of mechanisms from the buyer's perspective.

Calzolari and Spagnolo (2009) and Board (2011) study the incentivization of observable but non–contractible behavior in repeated procurement/trading problems through relational contracts.[11] Incentivization relies on the threat of exclusion from future interaction which we assume to be not credible. While we find that our buyer may benefit from a restriction of the set of feasible mechanisms, Calzolari and Spagnolo as well as Board find that the principal might interact only with a limited number of agents under the optimal relational contract. The articles present thus different reasons for why a principal might benefit in environments with repeated interactions from restrictions in her "freedom of action."

Finally, our article is related to the literature comparing procurement systems. This literature differs with respect to the considered procurement problem and the interpretation of the systems. Relationship–specific investments play an important role in most parts of this literature.[12] McLaren (1999) and Spencer and Qiu (2001) consider problems where the effect of investment on bargaining positions plays a crucial role,[13] whereas we are interested in a problem where the entire bargaing power lies in the hand of the buyer. Li (2013) considers a problem where the entire bargaining power at a final renegotiation stage lies also in the hand of the buyer. However, it is the buyer herself who can strategically affect the final mechanism design problem and not the incumbent as in the problem we are interested in.[14] Taylor and Wiggins (1997) consider a repeated procurement problem where the nature of the investment and the buyer's instruments

[11]In Calzolari and Spagnolo (2009) a supplier is selected in each period through a standard auction and can subsequently make an observable but non–contractible investment. The investment generates benefits which realize immediately (and not only when the relationship is continued as in our model). Investment incentives stem from the fear of being excluded from future procurement. The optimal relational contract may exhibit a restricted number of active suppliers as such a restriction increases the value of not being excluded and allows it thus to support higher investments.

In Board (2011) a principal can invest in each period in different trading partners at different cost. Due to a hold–up problem, she must leave a rent to partners which are selected. As she can backload payments, she must leave such a rent only once. The article provides a theory of endogenous switching cost which might imply that there is only trade with a restricted number of trading partners.

[12]Cabral and Greenstein (1990) consider a procurement problem in which a price–taking buyer is subject to exogenously given switching costs but in which there is no endogenous investment. They show that a precommitment to ignore the switching costs can be beneficial for the buyer as it induces more competitive pricing.

[13]McLaren (1999) considers a problem with two types of observable but non–contractible cost–reducing investments: a relationship–specific investment which requires effort by buyer and supplier, and a non–specific investment which the supplier can undertake alone. They compare procurement in the United States and Japan presuming that the former relies on fixed–price contracts chosen before the investment decisions are taken and the latter relies on bargaining thereafter. Spencer and Qiu (2001) consider an international trade problem with Japanese and American suppliers. Presuming that only Japanese suppliers can make relationship–specific investments for Japanese buyers, they analyze the effect of free trade on imports and relationship–specific investments.

[14]More precisely, ex ante, the buyer can make relationship–specific capacity investments and she can affect the suppliers' participation constraints through price commitments. Her decisions affect the final mechanism design problem directly as well

differ. The crucial problem lies in inducing an unobservable quality investment and the difference between the systems lies in the employed punishment mechanisms. In the American system, shipments are inspected by delivery and payment is withhold when quality is insufficient. In the Japanese system, the buyer accepts and pays any shipment, but she cuts off the supplier from future business when the quality turns out to be insufficient.

3. The model

3.1. The stage game

Our model features the infinite repetition of a stage game which represents one procurement period. In each period, a buyer B can realize a benefit $R > 0$ by purchasing an indivisible object from one of two suppliers, an incumbent I and an entrant E. We denote a generic supplier by k. I and E are symmetric except for that I has the opportunity to make a relationship–specific investment $y \in [0, \infty)$ at constant marginal cost $\gamma \in (0, 1)$. The investment generates an additional benefit of y to B when she continues her relationship with I.[15] Each supplier k privately knows his production cost x_k. Production cost are realizations of independent random variables X_k with support $[0, 1]$. X_k is distributed according to a cumulative distribution function $F(x_k) = x_k^{1/\alpha}$ with $\alpha > 0$. Let $f = F'$, $x = (x_I, x_E)$ and $X = (X_I, X_E)$. For the considered distributions, the virtual cost function $J(x_k) = x_k + F(x_k)/f(x_k)$ which is important for many procurement auction problems is linear: $J(x_k) = (1 + \alpha)x_k$. When we denote the probability with which the procurement contract is awarded to supplier k by q_k and the monetary transfer from B to k by t_k, the stage profit is $-\gamma y + t_I - q_I x_I$ for I, $t_E - q_E x_E$ for E and $(q_I + q_E)R + q_I y - t_I - t_E$ for B.

y is comprised of relationship–specific benefits which were created during the preceding relationship between B and I.[16] B can react with his procurement mechanism choice on the preceding investment, but the procurement mechanism cannot govern future investments. A procurement mechanism governs thus only the allocation of the procurement contract and the transfers in the current period. As the revelation principle will apply to our setting, we can restrict attention to direct mechanisms $M = (q, t)$ where $q : [0, 1]^2 \to [0, 1]^2$ and $t : [0, 1]^2 \to \mathbf{R}^2$. $q(x) = (q_I(x), q_E(x))$ describes the allocation rule and $t(x) = (t_I(x), t_E(x))$ the transfer rule. We are interested in the case where R is sufficiently large such that B has always an incentive

as indirectly through their effect on unobservable cost–reducing investments by both suppliers. Sole–sourcing in conjunction which prices which are not renegotiated (interpreted as Japanese procurement) and symmetric dual–sourcing in conjunction with prices which are renegotiated (interpreted as U.S. procurement) can both be optimal. Li (2013) contributes also to the literature described in Footnote 10 by allowing the buyer to strategically design asymmetries between the suppliers.

[15] When the benefits accrue to the incumbent, we obtain the same results. As long as the buyer observes the benefits and she has all bargaining power, it does not matter to whom they accrue to in the first place.

[16] This is in line with McMillan (1990) who emphasizes that "there are actions an incumbent can undertake during the course of the initial contract that improve productivity or quality."

to purchase.[17] Let thus $q_E(x) = 1 - q_I(x)$. We denote the set of all such mechanisms by $\mathcal{M}$. By not participating in the mechanism, each supplier k can ensure himself a zero probability of winning and a zero transfer. Without loss of generality, we can restrict attention to the case where each supplier always participates, but individual rationality constraints are satisfied.[18]

Our aim is the comparison of two negotiating cultures (or procurement systems), the competitive culture $S = C$ and the protective culture $S = P$. The two cultures differ in the set of procurement mechanisms which are feasible to B, $\mathcal{M}^S \subset \mathcal{M}$. In the competitive culture, B faces no restrictions in her procurement mechanism choice, i.e., $\mathcal{M}^C = \mathcal{M}$. Intuitively, she can use E at will to exert pressure on I. By contrast, in the protective culture, B decides about continuing her relationship with I before negotiating with E, i.e., $\mathcal{M}^P = \{(q,t) \in \mathcal{M} | \forall x'_E, x''_E \in [0,1] : q_I(x_I, x'_E) = q_I(x_I, x''_E)\}$.[19]

For a given negotiating culture S, the timing of the stage game is as follows: First, I chooses $y \geq 0$. Second, B observes y and chooses a procurement mechanism $M \in \mathcal{M}^S$. Third, the procurement mechanism is played after each supplier observes M and privately learns his production cost x_k.

3.2. The repeated game and the equilibrium concept

Given either negotiating culture $S \in \{C, P\}$, we consider the infinite repetition of the stage game with discount factor $\delta \in [0, 1)$. The winner (resp. loser) in any period becomes the incumbent (resp. entrant) in the subsequent period.[20] Production cost are serially independent.[21]

As equilibrium concept for the game implied by a negotiating culture we adopt the notion of Markov Perfect Equilibrium with anonymous mechanisms and supplier–symmetric strategies.[22] Two consequences of this are particularly important: First, behavior in previous periods affects the current period only through

[17] Think of a situation in which the buyer produces a complex product and the part in question is crucial for production. It can then be prohibitively costly for her not to purchase. Technically, the assumption corresponds to assuming $R \geq 1 + \alpha$.

[18] See Footnote 20 in Lewis and Yildirim (2005) for a description how participation can be ensured.

[19] The definition of $\mathcal{M}^P$ entails the implicit assumption that B can commit to how she will negotiate with E in case the negotiations with I break down. Such an assumption is not necessary. See the discussion after Proposition 1 in Subsection 4.1. Alternatively, we could assume that B chooses at first a mechanism which governs only her relationship with I and she chooses a mechanism which governs her relationship with E only after it turns out that her relationship with I is broken down.

[20] The identity of the winner will affect the other bidder, but not the buyer. We consider thus an auction framework with a simple type of externalities. Optimal auctions for environments with more complicated types of externalities are studied by Jehiel et al. (1996) and Jehiel et al. (1999).

[21] Serial independence rules out issues of strategic learning and signaling. It allows us to focus on the role of investment incentives and rent extraction through asymmetries in future competition. See Laffont and Tirole (1993) for strategic learning in dynamic regulation.

[22] A Markov Perfect Equilibrium is a Subgame Perfect Equilibrium in Markov strategies. We employ the definition where the state space derives from payoff–relevance. See Maskin and Tirole (2001) or Section 13.2.1 in Fudenberg and Tirole (1991). Anonymity requires that that the buyer's procurement strategy differentiates between the suppliers only based on their roles, incumbent or entrant, but not based on their identities. Supplier–symmetry requires that an agent's behavior depends on his role, but not on his identity. There are basically three states (I, E), (E, I) and (E, E). The first (resp. second) component of the vectors describes the role of the first (resp. second) supplier. The first two states imply a symmetric analysis. The third state describes the situation in which the buyer does not purchase such that the next period starts with two entrants, i.e. a situation where neither supplier can invest. As we are interested in the case where purchasing is so important for the buyer that the third state is irrelevant (see Footnote 17), this case can be ignored.

the current roles of the suppliers, but not through their identities. Second, behavior in future periods affects the players only through continuation values which depend on their future roles and which they take as given.

For a given negotiating culture, equilibrium behavior can be computed by considering the non–repeated stage game, however adjusted by continuation values reflecting the payoffs of equilibrium play in all future periods. To state the equilibrium conditions formally, we need to introduce some more notation. Let V_I and V_E be the continuation values of a supplier who starts the next period as I and as E, respectively. Let V_B be the continuation value of B. Let $V = (V_I, V_E, V_B)$. Let $\mathcal{M}^\star(V) := \{M \in \mathcal{M} | M$ is incentive compatible and individually rational given $V\}$.[23] The players' behavior is then for given $V \in \mathbf{R}^3$ completely specified by I's investment $y \in [0, \infty)$ and by B's mechanism choice for any possible investment $M(y) \in \mathcal{M}^\star(V)$.[24] For given continuation values, expected profits as function of $y \in [0, \infty)$ and $M \in \mathcal{M}^\star(V)$ are as follows:

$$\Pi_I(y, M) = \mathbf{E}_X[-\gamma y + t_I(X) - q_I(X)X_I + q_I(X)(V_I - V_E) + V_E] \quad (1)$$

$$\Pi_E(M) = \mathbf{E}_X[t_E(X) - q_E(X)X_E + q_E(X)(V_I - V_E) + V_E] \quad (2)$$

$$\Pi_B(y, M) = \mathbf{E}_X[R + q_I(X)y - t_I(X) - t_E(X) + V_B] \quad (3)$$

An equilibrium for negotiating culture $S \in \{C, P\}$ is given by $V^S \in \mathbf{R}^3$, $y^S \in [0, \infty)$ and $M^S : [0, \infty) \to \mathcal{M}^S \cap \mathcal{M}^\star(V^S)$ such that (EQ1) $M^S(y) \in \arg\max_{M \in \mathcal{M}^S \cap \mathcal{M}^\star} \Pi_B(y, M)$ for given continuation values V^S, (EQ2) $y^S \in \arg\max_{y \in [0,\infty)} \Pi_I(y, M^S(y))$ for given continuation values V^S, and (EQ3) $V^S = V(y^S, M^S(y^S))$ with $V(y, M) := (\delta\Pi_I(y, M), \delta\Pi_E(y, M), \delta\Pi_B(y, M))$.

3.3. Parametrization of the model

Our model depends on the three parameters α, γ and δ. $\alpha \in (0, \infty)$ determines the distribution of production cost. Distributions with a lower α first–order stochastically dominate distributions with a higher α. α can thus be interpreted as a measure for the likely height of production cost. Moreover, α determines the value of selecting the supplier with the lowest production cost instead of a random supplier, i.e. the maximum amount by which direct competitive pressure can reduce the production cost. $\gamma \in (0, 1)$ measures the expensiveness of the relationship–specific investment. Intuitively, for a given α, a lower γ increases the importance of investment incentives relative to exerting direct competitive pressure. Finally, $\delta \in [0, 1)$ measures the importance of repetition and therewith the importance of the extraction of future rents. The

[23]Note that incentive compatibility and individual rationality depend neither depend S nor on y. S affects the feasibility of mechanisms but not the suppliers' incentives. y affects B's preferences over mechanisms, but not the suppliers' incentives.

[24]Note that we do not need to specify how the mechanism is played as we can restrict attention to mechanisms where participation and truth–telling is optimal, i.e. where the reporting behavior of the suppliers is fixed.

three parameters allow us to vary the relative importance of the three factors affecting the buyer's profit: direct competitive pressure, investment incentives and indirect competitive pressure.

4. Equilibrium behavior and continuation values

B's expected stage profit in equilibrium can be decomposed into two parts, one which can be attributed to the purchasing in the current period and one which can be attributed to the extraction of future rents today. The equilibrium investment decision and the equilibrium procurement mechanism choice directly determine the first part and indirectly determine the second part through the continuation values which they imply. In this section, we derive the equilibrium behavior and compare it for the two cultures. We first analyze B's mechanism choice in Subsection 4.1 before we study I's investment decision in Subsection 4.2 and discuss the implied continuation values in Subsection 4.3.

4.1. The effect of investment on the procurement mechanism choice

In this subsection, we derive the optimal procurement mechanism for a given negotiating culture S, a given investment y and a given vector of continuation values V. We start with the characterization of the set of incentive compatible and individually rational mechanisms $\mathcal{M}^\star(V)$. For a given mechanism $M = (q, t)$, define $\overline{q}_k(x_k) = \mathbf{E}_X[q_k(X)|X_k = x_k]$ and $\overline{t}_k(x_k) = \mathbf{E}_X[t_k(X)|X_k = x_k]$. The subsequent lemma follows from standard reasoning in incentive theory (see, e.g., Baron and Myerson (1982)):

Lemma 1 (IC and IR mechanisms) *Fix any $V \in \mathbf{R}^3$. $M \in \mathcal{M}^\star(V)$ if and only if $\overline{q}_k(x_k)$ is non–increasing for any k and*

$$\overline{t}_k(x_k) = \overline{q}_k(x_k)(x_k - (V_I - V_E)) + \int_{x_k}^{1} \overline{q}_k(x_k')dx_k' + \kappa_k \text{ for some } \kappa_k \geq 0 \text{ and any } k. \tag{4}$$

The interim expected transfer from B to supplier k can be decomposed for any $M \in \mathcal{M}^\star(V)$ into three parts: If supplier k is awarded the contract, he is reimbursed the complete production cost, x_k, net of the advantage of being the incumbent in the next period, $V_I - V_E$. This entails that if the incumbency advantage is positive, the buyer can extract this future rent of the winning supplier today. If the incumbency advantage is negative, she has to compensate the winning supplier for this future disadvantage. Besides from this, each supplier k gets an informational rent which depends only on his interim expected winning probability $\overline{q}_k(\cdot)$ and a lump–sum payment $\kappa_k \geq 0$. There is no direct reimbursement of I's investment cost. Investment is only indirectly reimbursed through a higher informational rent which comes along with a favoring of I in the procurement mechanism.

The derivation of the mechanism from $\mathcal{M}^S \cap \mathcal{M}^\star(V)$ which maximizes $\Pi_B(y, M)$ is standard for $S = C$ (see Myerson (1981)) and follows from a simple adaptation of the standard procedure for $S = P$. Crucial for both derivations is that we can use for any $M \in \mathcal{M}^\star(V)$ the structure imposed by (4) to rewrite (3). By applying partial integration to the expectation of (4), we obtain

$$\mathbf{E}_X[t_k(X)] = \mathbf{E}_X[q_k(X)(J(X_k) - (V_I - V_E))] + \kappa_k. \tag{5}$$

Using this in (3) leads to

$$\Pi_B(y, M) = \mathbf{E}_X[q_I(X)(R + y - J(X_I)) + (1 - q_I(X))(R - J(X_E))] - \kappa_I - \kappa_E + V_I - V_E + V_B. \tag{6}$$

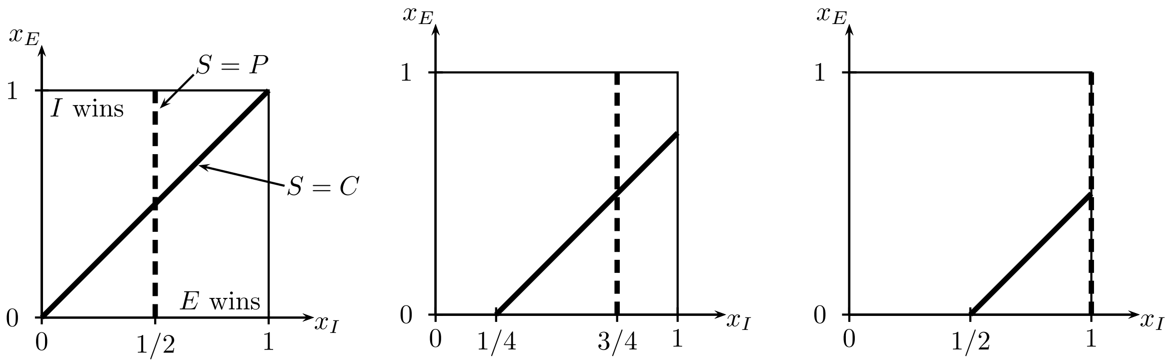
B's objective function depends only through $q_I(\cdot)$, κ_I and κ_E on the mechanism choice. As $\kappa_I = \kappa_E = 0$ is for either S clearly optimal, the determination of the optimal mechanism corresponds to the determination of the optimal $q_I(\cdot)$ subject to the monotonicity constraint and the feasibility constraint. The feasibility constraint differs for the two cultures. Consider first $S = C$. Any $q_I(\cdot)$ is then feasible. When we ignore the monotonicity constraint, maximization of (6) corresponds to pointwise maximization of $q_I(x)(R + y - J(x_I)) + (1 - q_I(x))(R - J(x_E))$. The buyer compares E's virtual cost $J(x_E)$ with I's virtual cost corrected by the benefits of the relationship–specific investment $J(x_I) - y$. As $J(\cdot)$ is increasing for the considered distributions, the ignored monotonicity constraint is satisfied for the optimal $q_I(\cdot)$. Consider now $S = P$. Feasibility requires then that $q_I(\cdot)$ depends only through x_I on x. We can rewrite (6) as

$$\begin{aligned}\Pi_B(y, M) &= \mathbf{E}_X[\mathbf{E}_X[q_I(X)(R + y - J(X_I)) + (1 - q_I(X))(R - J(X_E))|X_I]] + V_I - V_E + V_B \\ &= \mathbf{E}_X[q_I(X)(R + y - J(X_I)) + (1 - q_I(X))(R - 1)] + V_I - V_E + V_B. \end{aligned}\tag{7}$$

The first equality follows from the Law of Iterated Expectations. The second equality uses that we have $\mathbf{E}_X[q_I(X)|X_I] = q_I(X)$ for any feasible mechanism and that $\mathbf{E}_X[J(X_E)|X_I] = 1$. When we ignore the monotonicity constraint and the feasibility constraint, maximization of (7) corresponds to pointwise maximization of $q_I(x)(R + y - J(x_I)) + (1 - q_I(x))(R - 1)$. The buyer compares I's actual virtual cost corrected by the benefits of the investment $J(x_I) - y$ with E's expected virtual cost 1. The ignored monotonicity constraint is again satisfied as $J(\cdot)$ is increasing. Moreover, the ignored feasibility constraint is satisfied as the buyer's preferred allocation does not depend on x_E.

If $q_I(\cdot)$ is an optimal allocation rule for culture S and investment y, this allocation rule together with any transfer rules $t_I(\cdot)$ and $t_E(\cdot)$ which satisfy (4) with $\kappa_I = \kappa_E = 0$ specifies an optimal mechanism. As for any player all optimal mechanisms imply the same expected profit, we can restrict attention without loss of generality to allocation rules where B continues her relationship with I when she is indifferent. We denote this allocation rule by $q_I^{S,y}(\cdot)$.

Proposition 1 (Optimal allocation rule) *(a) $q_I^{C,y}(x) = 1$ if $y \geq J(x_I) - J(x_E)$ and $q_I^{C,y}(x) = 0$ if*



(a) $y = 0$ (b) $y = 1/2$ (c) $y = 1$

Figure 1: Optimal allocation for different investments [$\alpha = 1$]

$y < J(x_I) - J(x_E)$. (b) $q_I^{P,y}(x) = 1$ if $y \geq J(x_I) - 1$ and $q_I^{P,y}(x) = 0$ if $y < J(x_I) - 1$.

Note that although the optimal transfers depend on the discount factor through the incumbency advantage, the optimal allocation does not. Further, note that the proposition does not rely on our parametrization of the distribution. It relies only on monotonicity of the virtual cost function. The structure imposed by functions $F(x_k) = x_k^{1/\alpha}$ makes the optimal allocation rule linear. I wins if $y > (1+\alpha)(x_I - x_E)$ in culture $S = C$ and if $y > (1+\alpha)x_I - 1$ in culture $S = P$. As a side effect, the distributional assumption allows for a particularly simple indirect implementation of the optimal direct mechanism: A reverse second–price auction with a reserve price of $1 - y/(1+\alpha) - (V_I - V_E)$ and a constant bonus of $y/(1+\alpha)$ for I is optimal in culture $S = C$.[25] A sequence of two take–it–or–leave–it offers is optimal in culture $S = P$. B offers the procurement contract first to I at a price of $\min\{(1+y)/(1+\alpha), 1\} - (V_I - V_E)$. If I declines, she offers it to E at a price of $1 - (V_I - V_E)$. B makes the same offers irrespective of whether she can commit to her offer to E at the time she makes her offer to I or not. Comparing the competitive with the protective culture corresponds thus to comparing simultaneous with sequential negotiating.

Consider now how I's investment affects the optimal allocation in the two cultures. Figure 1(a) displays the optimal allocation in the two cultures for $y = 0$ and uniformly distributed cost. The solid (resp. dashed) curve describes the allocation in culture $S = C$ (resp. $S = P$). I wins in the northwest of this curve, E in the southeast. By investing (more), I gets favored (more) in either culture.[26] That is, the curves describing the allocation rules move to the southeast (see Figures 1(b) and 1(c)).

[25] This means that I obtains $y/(1+\alpha)$ more than the minimum of E's bid and the reserve price when he wins.

[26] Whether I gets favored can also be interpreted on an absolute instead of on a relative scale. From an efficiency perspective, I should win when $y \geq x_I - x_E$, but he wins in the competitive culture when $y \geq (1+\alpha)(x_I - x_E)$. When $y \in (0, 1+\alpha)$, he wins too seldom. In that respect, I is "disfavored". This kind of "disfavoring" arises also in Cisternas and Figueroa (2009) and Lewis and Yildirim (2002) for different investment technologies. For the protective culture and $y \in [0, \alpha)$, I wins from an efficiency perspective too often for low x_E and too seldom for high x_E.

When I wants his relationship with B to be continued with certainty, different investments are necessary in the two cultures. In culture $S = C$, I competes with the actual entrant. To win for sure, B must want to continue her relationship with I even when it turns out that E has the lowest possible (virtual) cost. By contrast, in culture $S = P$, I competes only with B's expectation of E. As this hurdle is easier to pass, the lowest investment for which I wins to sure, say $\overline{y}^S$, is lower in culture $S = P$ (see Figure 1(c) again).

Corollary 1 (Investment necessary to win for sure) $\overline{y}^C = J(1)$ *and* $\overline{y}^P = J(1) - 1$.

$\overline{y}^C > \overline{y}^P$ will play an important role for our analysis. The inequality does not rely on our distributional assumption, it derives from the differences in the negotiating culture. For functions $F(x_k) = x_k^{1/\alpha}$, we obtain $\overline{y}^C = 1 + \alpha$ and $\overline{y}^P = \alpha$.

4.2. Differences in investment incentives

In this subsection, we take S, V and B's reaction on y, $M^S(y)$, as given and we study I's optimal investment decision. We can use the structure imposed by $M^S(y)$ to rewrite I's expected profit. Define

$$R_k^S(y) := \mathbf{E}_X[q_k^{S,y}(X)F(X_k)/f(X_k)]. \tag{8}$$

$R_k^S(y)$ corresponds to supplier k's expected information rent. By using (5) with $\kappa_I = 0$ in (1), we get $\Pi_I(y, M^S(y)) = -\gamma y + R_I^S(y) + V_E$. I's expected profit can be decomposed into three parts: First, I has to bear the cost of his investment in the current period γy. Second, I obtains a revenue from this period's investment, $R_I^S(y)$. Third, as the incumbency advantage is extracted from the winning supplier, the present value of I's future profits corresponds to the present value of the future profits of a supplier who starts into the next period as an entrant, V_E. The investment has no effect on I's expected profits in the future. A higher investment affects I only through an increase in his expected information rent from procurement in the current period. As the allocation rule $q_I^{S,y}(\cdot)$ which determines I's expected information rent is not affected by the discount factor, investment incentives are not affected by δ.

Investment affects the revenue term differently in the two cultures. This is illustrated for uniformly distributed cost in Figure 2. The solid (resp. dashed) curve depicts revenue from investment in culture $S = C$ (resp. $S = P$). Three features which extend to more general distributions are important: First, the maximum possible revenue $\mathbf{E}_X[F(X_I)/f(X_I)]$ is obtained for any investment $y \geq \overline{y}^S$ in culture S. Because $\overline{y}^P < \overline{y}^C$, it is already reached for a smaller investment in culture $S = P$. Revenue is in each culture strictly increasing in investment before it gets constant. Second, on the strictly increasing part, revenue is convex in culture $S = P$ whereas it is (at least eventually) concave in culture $S = C$. Third, the maximal gain

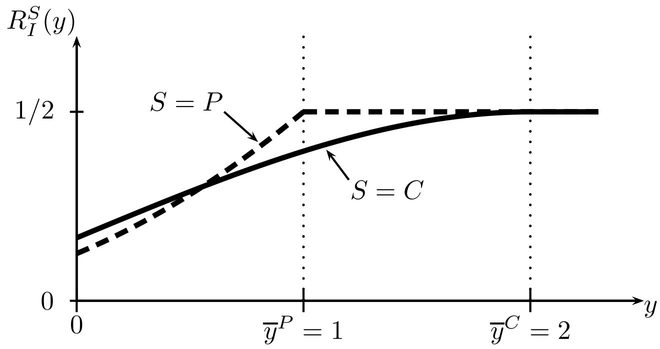


Figure 2: Revenue from investment [$\alpha = 1$]

from investment, $R_I^S(\overline{y}^S) - R_I^S(0)$, is higher in culture $S = P$. The following lemma states the properties for general α.

Lemma 2 (Revenue from investment) *(a) $R_I^S(y)$ is for either culture continuous, strictly increasing on $[0, \overline{y}^S]$ and constant on $[\overline{y}^S, \infty)$. (b) In culture $S = P$, marginal revenue is strictly increasing on $[0, \overline{y}^P]$. (c) In culture $S = C$, marginal revenue is continuous on $[0, \overline{y}^C]$. It is strictly positive for $y \in [0, \overline{y}^C)$ and it converges to zero as $y \to \overline{y}^C$. If $\alpha \leq 1$, marginal revenue is strictly decreasing. (d) $R_I^C(\overline{y}^C) - R_I^C(0) < R_I^P(\overline{y}^P) - R_I^P(0)$.*

Part (a) follows directly from the preceding subsection. To get an intuition for parts (b) and (c), consider how an increase of y by Δ changes I's revenue in culture S, $R_I^S(y + \Delta) - R_I^S(y)$. The question is why a change in y affects the revenue difference in the two cultures differently. We can decompose the revenue difference as follows:

$$\begin{aligned} R_I^S(y+\Delta) - R_I^S(y) &= \mathrm{Prob}_X(I \text{ wins for } y+\Delta \text{ but not for } y) \\ &\qquad \times \mathbf{E}_X[F(X_I)/f(X_I) | I \text{ wins for } y+\Delta \text{ but not for } y]. \end{aligned}$$

The revenue difference corresponds to the increase in I's winning probability times the marginal effect which the additional winning has on his expected information rent. Intuitively, additional winning for higher cost realizations has a stronger effect on the expected information rent than additional winning for lower cost realizations as $F(x_I)/f(x_I)$ is increasing. As the cases where I additionally wins are in either culture cases where his cost are higher, the marginal effect is for either culture increasing in y. The difference in the structure of the revenue difference comes from differences in the probability term.

To build an intuition for how y affects the probability term, consider uniformly distributed cost. Figure 3 displays how the allocation changes when the investment increases stepwise by $\Delta = 1/4$ in the two cultures. The allocation for the different investment levels is described by the dashed lines. The area between two adjacent lines corresponds to the increase in winning probability. For example, the dark grey areas (resp.

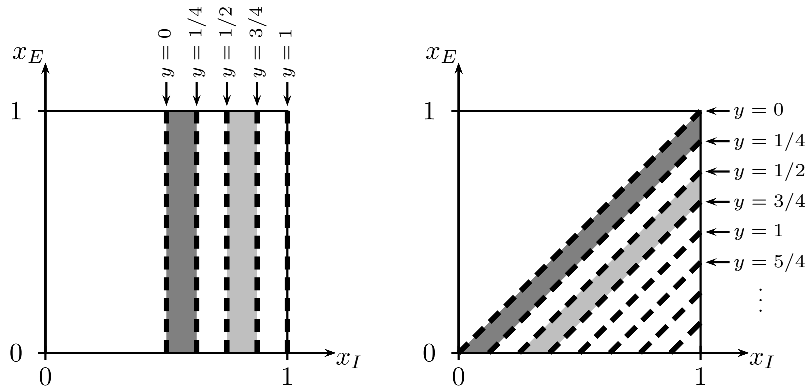


Figure 3: Changes in allocation for investment increments Δ [$\alpha = 1$, $\Delta = 1/4$]

light grey areas) in Figures 3(a) and 3(b) illustrate the probability increases when the investment increases from 0 to $0+\Delta$ (resp. from 1/2 to $1/2+\Delta$) in culture $S = P$ and $S = C$, respectively. In culture $S = C$, each step yields a lower and lower increase in the winning probability. Intuitively, an increase in the investment leads to an additional favoring of I only when x_E turns out to be low. If x_E is high, I wins anyway. The set of values of x_E for which the investment has an effect becomes smaller as y increases and vanishes as $y \to \overline{y}^C$. Because the marginal effect is bounded, also the revenue difference must eventually vanish, i.e. revenue must eventually be concave. The major difference in culture $S = P$ is that x_E has no effect on the allocation. Each step yields the same increase in winning probability. Because the marginal effect of this increase becomes however larger, the revenue difference is increasing, i.e. revenue is convex.

It remains to argue why the maximal revenue increase $R_I^S(\overline{y}^S) - R_I^S(0)$ is larger in culture $S = P$. As $R_I^C(\overline{y}^C) = R_I^P(\overline{y}^P)$, this is equivalent to $R_I^C(0) > R_I^P(0)$. For uniformly distributed cost, we can apply again an entirely graphical reasoning. When there is no investment, the area where I wins is equally large in both cultures (see Figure 1(a) again). I wins with probability 1/2 in either culture. However, I wins in culture $S = C$ relative to culture $S = P$ in more cases where his cost are high, but in less cases where his cost are low. Since the effect of winning on the information rent is larger for higher cost realizations, it follows $R_I^C(0) > R_I^P(0)$.

The different structure of the revenue from investment in the two cultures causes structural differences in the investment behavior. First, if investment is cheap, it is higher in culture $S = C$. In particular, if investment cost are (almost) zero, I wants to win (almost) for sure in either culture. As winning for sure requires a higher investment in culture $S = C$, investment is higher in this culture. Second, if investment is intermediately expensive, it is higher in culture $S = P$. Because revenue is convex in culture $S = P$,

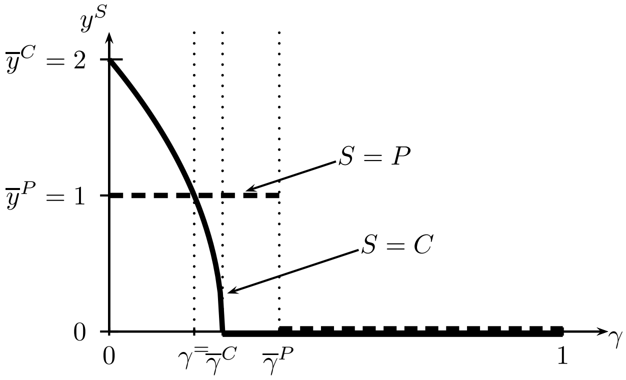


Figure 4: Optimal investment [$\alpha = 1$]

the optimal investment problem has a corner solution. I invests either $y = \overline{y}^P$ or $y = 0$. This has the consequence that the highest possible investment $y = \overline{y}^P$ is still induced for relatively expensive investment. It occurs as long as the revenue increase from investment exceeds its cost: $R_I^P(\overline{y}^P) - R_I^P(0) \geq \gamma\overline{y}^P$. When γ is so high that $R_I^P(\overline{y}^P) - R_I^P(0) = \gamma\overline{y}^P$, it follows from Lemma 2 (d) that I strictly prefers no investment to any investment $y \geq \overline{y}^P$ in culture $S = C$. This implies that investment is higher in culture $S = P$. Interestingly, there exists a region of intermediate cost parameters γ for which investment incentives are so much stronger in culture $S = P$ such that the highest possible investment $y = \overline{y}^P$ is induced in this culture, whereas no investment is induced in culture $S = C$. Third, if investment is very expensive, there is neither investment in culture $S = C$ nor in culture $S = P$. The properties of the optimal investment y^S are stated in the following proposition. To simplify the exposition of our subsequent results, we assume that whenever I is indifferent between two investment levels, he chooses the higher one.

Proposition 2 (Optimal investment) *Define*

$$\overline{\gamma}^P := \frac{1}{1+\alpha} - \left(\frac{1}{1+\alpha}\right)^{2+1/\alpha} \text{ and } \overline{\gamma}^C := \begin{cases} \frac{1}{2}\frac{1}{1+\alpha} & \text{if } \alpha \leq 1 \\ \frac{1}{1+\alpha}\left(\frac{1+\alpha}{4\alpha}\right)^{1/\alpha} & \text{if } \alpha > 1 \end{cases}.$$

(a) $y^P = \overline{y}^P$ if $\gamma \leq \overline{\gamma}^P$ and $y^P = 0$ if $\gamma > \overline{\gamma}^P$. (b) y^C is decreasing with $y^C < \overline{y}^C$ for any $\gamma \in (0,1)$, $\lim_{\gamma\to 0} y^C = \overline{y}^C$ and $y^C = 0$ if $\gamma \geq \overline{\gamma}^C$. (c) $\overline{\gamma}^C < \overline{\gamma}^P$.

Note that the optimal investment depends on α and γ, but not on δ. For any α, the proposition implies the existence of three investment regions (see Figure 4). Investment is higher in culture $S = C$ when investment is cheap, whereas it is higher in culture $S = P$ when it is intermediately expensive. When investment is very expensive, neither culture induces investment. We denote the cost parameter which separates the first two regions by $\gamma^=$.

Corollary 2 (Investment regions) *$y^C > y^P$ if $\gamma \in (0, \gamma^=)$, $y^P > y^C$ if $\gamma \in (\gamma^=, \overline{\gamma}^P]$ and $y^P = y^C = 0$ if $\gamma \in (\overline{\gamma}^P, 1)$.*

The relationship between I and B is continued in culture S with probability $\rho^S := \mathbf{E}_X[q_I^{S,y^S}(X)]$. A further consequence of Proposition 2 is that the continuation probability is higher in culture $S = P$ when investment is not too expensive. I.e., the protective culture is indeed more protective. If investment is however such expensive that there is no investment in the equilibrium of either culture, it depends on the specifics of the distribution function where the continuation probability is higher.

Corollary 3 (Continuation probability) *(a) Consider $\gamma \in (0, \overline{\gamma}^P]$. $\rho^P = 1 > \rho^C$ for any α. (b) Consider $\gamma \in (\overline{\gamma}^P, 1)$. $\rho^C > \rho^P$ if $\alpha < 1$, $\rho^C = \rho^P$ if $\alpha = 1$ and $\rho^C < \rho^P$ if $\alpha < 1$.*

Interestingly, even though protection has a clear effect on the continuation probability for $\gamma \in (0, \overline{\gamma}^P]$, it can deteriorate as well as enhance investment incentives in this region. If investment is cheap, I mainly sees the benefits from investment. He invests as long as this brings him advantages in the competition with E. Protection of I deteriorates investment incentives as less investment is needed until B is willing to continue her relationship with I for sure. By contrast, if investment cost are sizeable but not too large, protection enhances investment incentives. In particular, if $\gamma = \overline{\gamma}^P$, investment $y = \overline{y}^P$ is profitable for I if and only if it entails winning for sure. When I is protected, he invests indeed $y = \overline{y}^P$, otherwise, any investment $\gamma \geq \overline{\gamma}^P$ is definitely unprofitable.

4.3. Extractability of future rents

Knowing the equilibrium investment and the equilibrium mechanism choice for the two negotiating cultures, we are now able to study the implied equilibrium continuation values, $V^S = V(y^S, M^S(y^S))$.

$V_I^S - V_E^S$ describes the incumbency advantage which B can extract. Using $V_I^S = \delta\Pi_I(y^S, M^S(y^S))$ and $V_E^S = \delta\Pi_E(M^S(y^S))$, we obtain

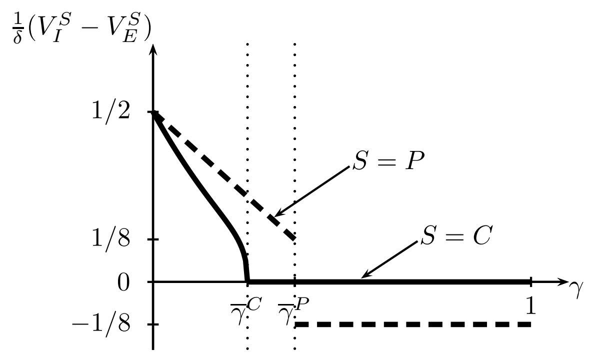
$$V_I^S - V_E^S = \delta(-\gamma y^S + R_I^S(y^S) - R_E^S(y^S)). \tag{9}$$

Although becoming the next period's incumbent may have persistent effects, the incumbency advantage is only affected by the investment cost and the expected information rents in the next period. This is because the suppliers anticipate that advantages which lie further ahead in the future will be extracted through the procurement mechanism in the period that precedes it.

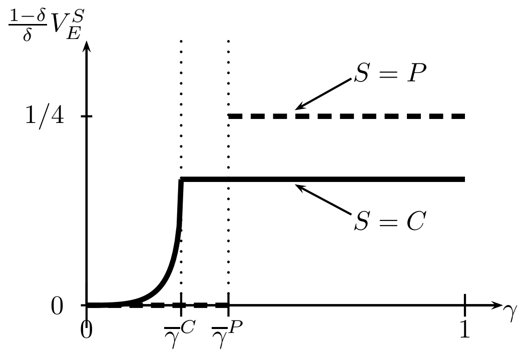
V_E^S describes the rent which B must leave to each supplier due to her lack of commitment power. By using (5) with $\kappa_E = 0$ in (2), we obtain $\Pi_E(M^S(y^S)) = R_E^S(y^S) + V_E^S$. Because $V_E^S = \delta\Pi_E(M^S(y^S))$,

$$V_E^S = \frac{\delta}{1-\delta} R_E^S(y^S). \tag{10}$$

Even though the next period's entrant might be the incumbent in some of the future periods, V_E^S corresponds to the present value of obtaining the expected information rent of an entrant in each future period, $R_E^S(y^S)$.



(a) Incumbency advantage



(b) Value of being an entrant

Figure 5: Extractable and non–extractable future rents [$\alpha = 1$]

Again, this is because any potential advantage of being the incumbent in some future period is extracted in the period which precedes it.

The discount factor δ affects $V_I^S - V_E^S$ and V_E^S only through a multiplicative factor which does not depend on the negotiating culture. The comparison of $V_I^S - V_E^S$ and of V_E^S for the two negotiating cultures is thus not affected by δ. Normalized versions of $V_I^S - V_E^S$ and V_E^S are displayed for uniformly distributed cost in Figures 5(a) and 5(b), respectively. The figures indicate that whether γ is smaller or larger than $\overline{\gamma}^P$ plays a crucial role for the comparison of extractable and non–extractable rents in the two cultures. For $\gamma \leq \overline{\gamma}^P$, the incumbency advantage is higher and the value of being an entrant is lower in culture $S = P$. For $\gamma > \overline{\gamma}^P$, the converse is true. The following proposition states that this property holds for general α.

Proposition 3 (Comparison of extractable and non–extractable future rents) *(a)* $\lim_{\gamma\to 0}(V_I^C - V_E^C) = \lim_{\gamma\to 0}(V_I^P - V_E^P)$*,* $V_I^P - V_E^P > V_I^C - V_E^C \geq 0$ *if* $\gamma \in (0, \overline{\gamma}^P]$ *and* $V_I^C - V_E^C = 0 > V_I^P - V_E^P$ *if* $\gamma \in (\overline{\gamma}^P, 1)$*. (b)* $\lim_{\gamma\to 0} V_E^C = \lim_{\gamma\to 0} V_E^P = 0$*,* $V_E^C > V_E^P = 0$ *if* $\gamma \in (0, \overline{\gamma}^P]$ *and* $V_E^P > V_E^C > 0$ *if* $\gamma \in (\overline{\gamma}^P, 1)$*.*

Note that part (b) is not a trivial implication of part (a) as the sum of extractable and non–extractable rents differ in general for the two cultures. Nevertheless, a similar intuition applies for parts (a) and (b). If $\gamma \leq \overline{\gamma}^P$, the relationship between I and B is continued with certainty in culture $S = P$, whereas it is dissolved with positive probability in culture $S = C$. This drives the value of being an entrant (resp. the incumbency advantage) in culture $S = P$ relative to culture $S = C$ down (resp. up). If $\gamma > \overline{\gamma}^P$, the effects are more involved. As there is no investment, I and E are symmetric, asymmetries arise only through asymmetries in the negotiation protocol. As I and E are treated symmetrically in culture $S = C$, the incumbency advantage is zero in this culture. By contrast, in culture $S = P$, B treats the suppliers asymmetrically by negotiating sequentially with them. Thereby it is an advantage of negotiating second. Intuitively, B becomes less aggressive as his options fade away. Hence, protection of I entails a disadvantage

	$\gamma \to 0$	$\gamma \in (0, \gamma^{=})$	$\gamma \in (\gamma^{=}, \overline{\gamma}^{P}]$	$\gamma \in (\overline{\gamma}^{P}, 1)$
1. relationship–specific benefits in current period	$S = C$ better	$S = C$ better	$S = P$ better	equally bad
2. procurement profits attributable to the current period (conditional on benefits)	equally good in the limit	$S = C$ better	$S = C$ better	$S = C$ better
3. extraction of rents from future periods	equally good in the limit	$S = P$ better	$S = P$ better	$S = C$ better
total effect	$\forall \delta : \widehat{\Pi}_B^C > \widehat{\Pi}_B^P$	?	?	$\forall \delta : \widehat{\Pi}_B^C > \widehat{\Pi}_B^P$

Table 1: Comparison of the negotiating cultures from the buyer's perspective

for I when there is no investment. This drives the incumbency advantage (resp. value of being an entrant) in culture $S = P$ relative to culture $S = C$ down (resp. up).

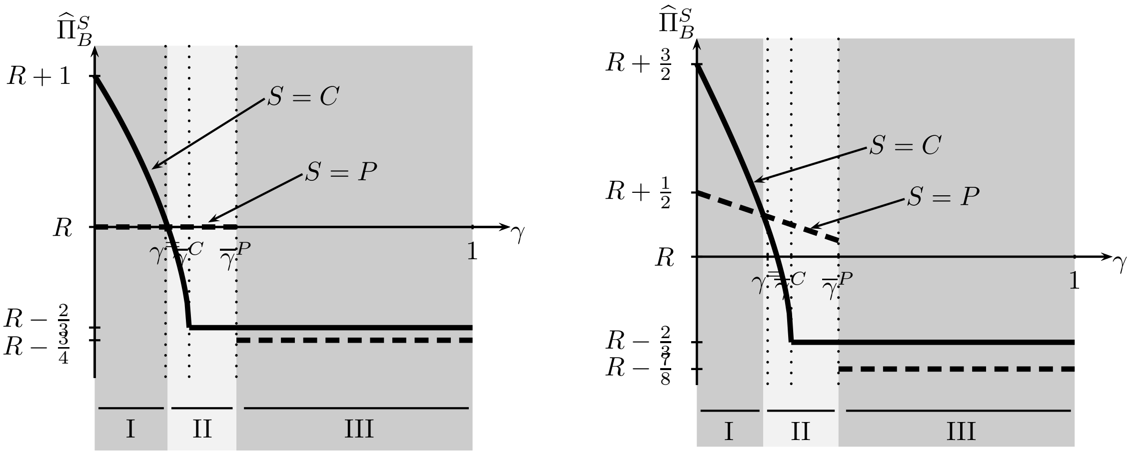
5. Assessment of the negotiating cultures from the buyer's perspective

We are now set to compare the two negotiating cultures from B's perspective. As B does not care about the identity of I and E, every period is basically the same for her. Comparing B's expected stage profit

$$\widehat{\Pi}_B^S := R + \mathbf{E}_X[q_I^{S,y^S}(X)(y^S - J(X_I)) + (1 - q_I^{S,y^S}(X))(-J(X_E))] + (V_I^S - V_E^S) \tag{11}$$

is equivalent to comparing her expected profit $\Pi_B(y^S, M^S(y^S)) = \widehat{\Pi}_B^S + V_B^S$. The equilibrium for either culture is completely characterized by an investment level y^S and an allocation rule $q_I^{S,y^S}(x)$. On the one hand, the equilibrium behavior directly affects $\widehat{\Pi}_B^S$ through the relationship–specific benefits and the procurement cost in the current period. Benefits and cost together determine the procurement profit that can be attributed to the current period procurement. On the other hand, the equilibrium behavior affects $\widehat{\Pi}_B^S$ indirectly through the incumbency advantage and therewith through the extraction of future rents today.

In Section 4, we have analyzed the three determinants of B's expected profit in isolation. Conditional on γ, we obtained clear–cut results. Table 1 summarizes the findings from Propositions 1, 2 and 3. The rows describe the determinants. The columns describe the relevant regions of the parameter γ. The effect of α and δ is not directly apparent from the table. α affects the boundaries of the regions and the strength of the effects within the regions. δ scales the importance of the third determinant. For $\delta = 0$ it is mute, whereas it is very important for $\delta = 1$.



(a) $\delta = 0$

(b) $\delta = 1$

Figure 6: B's expected stage profit [$\alpha = 1$]

If investment is very cheap or very expensive, there is no trade–off involved. Culture $S = C$ is clearly superior. What happens for intermediately expensive investment is a priori unclear as trade–offs are involved. Figures 6(a) and 6(b) display B's expected stage profit in the two negotiating cultures for uniformly distributed cost and discount factors $\delta = 0$ and $\delta = 1$, respectively. In both cases, there exists an intermediate region where culture $S = P$ is superior. Further, the figures show that the difference in B's expected stage profit $|\widehat{\Pi}_B^C - \widehat{\Pi}_B^P|$ can be quite sizeable. In the remainder of this section we show that the displayed non–monotonicity result holds for general δ and general α.

5.1. The competitive culture is superior when investment is very cheap or very expensive

Suppose first investment is very cheap. I benefits then in either culture from increasing his investment as long as this brings him further advantages in the procurement mechanism choice. Investment is higher in culture $S = C$ as the higher direct competitive pressure in this culture necessitates a higher investment to win with certainty. As for investments which entail winning with certainty the procurement cost that can be attributed to the current period and the future rents which are extractable today coincide in the two cultures, culture $S = C$ is superior.

Suppose next that investment is so expensive that I refrains from investing in either culture. The higher direct competitive pressure in culture $S = C$ implies that this culture is better in the extraction of current period rents. As being incumbent is a disadvantage in culture $S = P$ whereas incumbent and entrant are treated equally in culture $S = C$, culture $S = C$ is also better in the extraction of future rents. The future rent effect thus reinforces the current rent effect rendering culture $S = C$ superior for any discount factor δ.

Proposition 4 (Competitive culture superior) *(a) There exists $\gamma' \in (0, \overline{\gamma}^C)$ such that $\widehat{\Pi}_B^C > \widehat{\Pi}_B^P$ for any $\gamma \in (0, \gamma')$. (b) $\widehat{\Pi}_B^C > \widehat{\Pi}_B^P$ for any $\gamma \in (\overline{\gamma}^P, 1)$.*

5.2. The protective culture is superior when investment is intermediately expensive

There exists a region of intermediate investment cost parameters for which investment incentives are particularly good in culture $S = P$ ($y^P = \overline{y}^P$) whereas they are particularly bad in culture $S = C$ ($y^C = 0$). As a side–effect, the incumbent is strongly favored in culture $S = P$ whereas he is treated like the entrant in culture $S = C$ implying that also the incumbency advantage is higher in culture $S = P$. The incumbent faces a trade–off between exerting more direct competitive pressure ($S = C$) and realizing relationship–specific benefits as well as extracting more future rents ($S = P$). It turns out that the protective culture is superior. The result is driven by the better investment incentives. The better extractability of future rents reinforces the already better performance of culture $S = P$, but the result holds even for $\delta = 0$, i.e. when the effect of future rent extraction is mute.

Proposition 5 (Protective culture superior) $\widehat{\Pi}_B^P > \widehat{\Pi}_B^C$ *for any* $\gamma \in [\overline{\gamma}^C, \overline{\gamma}^P]$.

The non–dependence of the result on δ is surprising to the extent that B has quite different objectives depending on the importance of the future. To see this, we can use (9) in (11) to consolidate the direct and the indirect effects of the equilibrium behavior. For $\delta = 0$, we obtain

$$\widehat{\Pi}_B^S = R + \mathbf{E}_X[q_I^{S,y^S}(X)(y^S - J(X_I)) + (1 - q_I^{S,y^S}(X))(-J(X_E))]. \tag{12}$$

B cares about the realized relationship–specific benefits net of the expected virtual cost. By contrast, for $\delta = 1$, we obtain

$$\widehat{\Pi}_B^S = R - \gamma y^S + \mathbf{E}_X[q_I^{S,y^S}(X)(y^S - X_I) + (1 - q_I^{S,y^S}(X))(-X_E)] - 2R_E^S(y^S). \tag{13}$$

B cares about social welfare net of twice the information rent of an entrant which is what she has to leave to each supplier in order to induce participation.

6. Empirical evidence: Procurement in the automotive industry

This article was developed in the context of broader research on supply networks in the automotive industry. One centerpiece is a series of deep case interviews with suppliers and car manufacturers on their strategic supply and purchasing behavior.[27] 15 suppliers and three car manufacturers were interviewed on issues concerning the parts supplied, the organization of purchasing, the supply strategies, the information about other players in the market, the contractual arrangements, and the competitive situation. Our modeling assumptions are motivated by the empirical evidence drawn from this case study.

[27] The case study was conducted by Florian Mueller, Konrad Stahl and Frank Wachtler.

In the automotive industry, the bargaining power lies mostly in the hand of the manufacturer. Asymmetric structures where incumbents compete against entrants are very common. The incumbency advantage due to idiosyncratic process knowledge is sizeable. A switch from one supplier to another is legally possible without complications as the manufacturer mostly owns the tools to produce the parts. However, in practice switching is very expensive, as the tools come together with very specific process knowledge, that cannot easily be replicated by a new supplier (e.g., a well–functioning just–in–time production). Thus, the bigger part of the incumbency advantage is constituted by a special type of switching costs. The level of these switching costs is endogenous and can be affected by the incumbent. As investments happen while the incumbent and the manufacturer are working together, for instance through the exchange of technicians or the learning and adjusting to the other's production process, investment is observable by the buyer but hard to quantify and thus non–contractible. Furthermore, the case study suggests that modeling infinite repetition of a stage game is adequate. The manufacturers as well as the suppliers are long–lived and the possible interactions should not induce end game behavior. The commitment to a certain negotiating culture is also long–term as a negotiating culture becomes only effective if the manufacturer is able to build up reputation for it.[28] By contrast, the case study shows evidence for a widely opportunistic behavior of all players in the short–run. Usually, supply contracts become binding only when the first part has been delivered, long after sizable investments in development, capacity, and idiosyncratic tools have been made. On the other hand, the number of potential suppliers is often very small. For some parts there might be as little as two potential suppliers. The belief in opportunistic behavior by the buyer in the future makes the threat of excluding a supplier from the procurement process in the future incredible.

6.1. Discussion of our equilibrium behavior results in the light of the automotive application

The case with intermediately expensive investment describes the procurement of parts for which investment cost are sizeable but where investment is important, like it is the case for the most important parts in the automotive industry. When we identify the protective culture with Japanese–style procurement and the competitive culture with U.S.–style procurement, our behavioral predictions imply properties which resemble stylized facts from the automotive industry. Relationships in the protective culture are continued with certainty and are thus very long–term. By contrast, incumbent and entrant are treated equally in the competitive culture implying that relationships are much shorter. Both properties are consistent with stylized

[28]Trying to change a culture can be very costly. The coexistence of different cultures can be consistent with equilibrium behavior (in an extended model with endogenous culture choice). Attempts to change the culture should only be observed when an other culture is sufficiently much better. See Dyer (1996b) for a discussion of the transition cost when Chrysler tried to switch to a more protective culture.

facts.[29] The protective culture endows the incumbent thus with a high security that relationship–specific investments will be rewarded which in turn leads to a willingness to make substantial relationship–specific investments. The much lower security in the competitive culture implies much worse investment incentives. This is in line with McMillan (1990) who finds that "In the case of specific investment, therefore, the evidence corroborates common belief: the Japanese system uses continuing relationships more successfully than the U.S. system." and Dyer and Ouchi (1993) who state that "Most U.S. companies are simply not willing to take the risk in making customized investments."[30] Furthermore, the fact that the protective culture relies more on indirect instead of direct pressure is in line with the observation that Japanese car producers are highly demanding and exert high competitive pressure without using the market.

6.2. Discussion of our comparison results in the light of the automotive application

Hahn et al. (1986) come to the conclusion that "[...] the use of a competitive or a cooperative approach in dealing with suppliers is not always a clear–cut choice. A sound purchasing management strategy generally requires a good mix of both approaches for an optimal result." We make a similar finding: Different negotiating cultures are optimal for parts with different investment properties. In the automotive industry, investments are important and investment cost are sizable for the most important parts. Our article asserts thus that there exists a single culture which is optimal for the most important parts in the automotive industry, while it does not assert that the same culture is optimal for all parts.

Empirical studies find that the complexity of the produced product plays a key role in the relative performance of procurement systems (see Dyer (1996a)). In particular, Japan's success seems to be greatest for complex product industries like the automotive industry, whereas for mature industries producing less complex products U.S. firms perform better. In mature industries, benefits from relationship–specific investments play typically a minor role relative to purchasing from the lowest cost supplier. Major cost savings or quality improvements through investments are either prohibitively costly or not feasible. By contrast, for complex product industries, investment cost are typically sizeable, but investment is important. In our modeling framework, procurement in mature industries is best described by a high γ, whereas procurement in complex product industries is best described by an intermediate γ. The empirical evidence is thus consistent with our model predictions.

[29] According to Dyer and Ouchi (1993), "Japanese suppliers in our sample indicated that historically, they have a more than 90 percent probability of winning the contract again when the model changes." Regarding equal treatment, see Footnote 5.

[30] Moreover, this is in line with Dyer (1996b) who describes what changed after Chrysler created an American Keiretsu at the beginning of the 1990s. In particular, "Minimal supplier investments in coordination mechanisms and dedicated assets" changed into "Substantial investments", and "No guarantee of business relationship beyond the contract" changed into "Expectation of business relationship beyond the contract."

Liker and Choi (2004) come to the conclusion that the Japanese system is superior for the automotive industry. As the most important parts in the automotive industry are best described by intermediate γ, this is again consistent with our model predictions. Moreover, Liker and Choi give an overview of (by and large unsuccessful) attempts of U.S. car producers to imitate their Japanese counterparts.[31] Presuming that an attempt to change the system involves large transition cost and may be unsuccessful, this further strengthens the hypothesis that the Japanese system is superior by a revealed preferences argument.[32]

7. Robustness and extensions

The main force behind our non–monotonicity result (Proposition 4 and 5) is the structural difference in the marginal revenue from investment that is implied by the two negotiating cultures. This difference relies on that the incumbent competes against the best entrant in the competitive culture while he competes only against the buyer's expectation thereof in the protective culture. This property neither relies on the number of entrants nor on the considered investment cost functions (or the considered production cost distributions). Considering a single entrant and our specific class of investment cost functions improves the tractability of the problem and allows us to derive the non–monotonicity result theoretically. In an earlier working paper version of this article, we numerically obtain similar results for more than two entrants, linear or quadratic cost functions and other distributional assumptions.

Moreover, our modeling assumptions endow us with a tractable framework which can be used to study different extensions. The remainder of this section discusses three of them.

7.1. Finitely repeated procurement

When the procurement problem is only $N \in \{2, 3, \ldots\}$ times repeated, continuation values are time–dependent. However, as continuation values affect neither investment incentives nor the optimal allocation,

[31] See Dyer (1996b) for an exception. Chrysler seemed for some time to be successful, but the process was reverted when Chrysler merged with Daimler–Benz in 1998.

[32] Interestingly, also the decisions to imitate Japanese business practices (from the 1980s till the turn of the millennium and since the beginning of the 2000s) and to revert to practices relying heavily on competitive bidding (at the turn of the millennium) are consistent with shocks of the parameter γ in our model. The quality movement of the 1980s made relationship–specific investments more important relative to selecting the lowest cost supplier. This might correspond to a decrease of γ into the region where the protective culture is superior. Then, at the turn of the millennium, global sourcing became much easier and advances in internet–based technologies allowed for more efficient competition between suppliers. This corresponds to a shock which increases γ again. However, apparently the size of the shock was perceived differently by U.S. and Japanese car producers. According to Liker and Choi, the U.S. car producers believed that "the immediate benefits of low wage costs outweighed the long–term benefits of investing in relationships" and "manufacturer–supplier relations in America have deteriorated so much that the're worse than before the quality revolution began." By contrast, Liker and Choi state that "Toyota and Honda don't source from low–wage countries much; their suppliers' innovation capabilities are more important than their wage costs." In the meanwhile, it became evident that global sourcing comes along with many difficulties and Japanese car makers were quite successful in establishing Japanese–style partnerships with U.S. firms supporting the hypothesis that U.S. firms overestimated the increase in γ and that γ still resides in the region where the Japanese system is superior.

equilibrium investment and equilibrium allocation do not vary over time. From B's perspective, the periods differ only in the extractability of future rents. As only information rents and investment cost of the subsequent period matter for future rent extraction, B's expected stage profit is in any non–final period as in the infinitely repeated procurement problem, i.e. $\widehat{\Pi}_B^S|_\delta$. In the final period, her expected stage profit is as in the infinitely repeated procurement problem with the effect of future rent extraction being mute, i.e. $\widehat{\Pi}_B^S|_{\delta=0}$. Hence, B's expected stage profit is as her expected stage profit in the infinitely repeated procurement problem but with a time–dependent discount factor. As our non–monotonicity result is robust with respect to the discount factor, it extends.

Proposition 6 (Finitely repeated procurement) *There exist three regions of cost parameters, $(0, \gamma')$, $[\overline{\gamma}^C, \overline{\gamma}^P]$ and $(\overline{\gamma}^P, 1)$, such that B's preferences over the negotiating cultures are time–consistent and cultures $S = C$, $S = P$ and $S = C$ are optimal in the respective regions.*[33]

7.2. Switching costs

Our framework can also be used to study the performance of the two negotiating cultures when there are exogenously given switching costs instead of an endogenous relationship–specific investment. Suppose switching causes in either culture costs $y_{sc} \in [0, \overline{y}^C)$ to B. Let R be B's benefit from purchasing the object net of the switching costs. I.e., when B decides not to switch, an additional benefit of y_{sc} realizes on top of R. The switching costs problem corresponds then to our model with $\gamma = 0$ and exogenously given $y^S = y_{sc}$. B's expected profit in culture S is then $\Pi_B(y_{sc}, M^S(y_{sc}))$ and the corresponding stage profit is $\widetilde{\Pi}_B^S := (1-\delta)\Pi_B(y_{sc}, M^S(y_{sc}))$.[34]

As in our original model, $\widetilde{\Pi}_B^S$ can be decomposed into two parts: a procurement profit which can be attributed to the current period procurement and future rents which are extractable today. As the relationship–specific benefit y_{sc} is the same for both cultures and as direct competitive pressure is by construction higher in culture $S = C$, the part of B's profit which can be attributed to the current period procurement is clearly higher in culture $S = C$. Culture $S = P$ can only be superior if it is better in extracting future rents and if the future is sufficiently important. Hence, if $\delta = 0$, culture $S = C$ is clearly superior. Consider $\delta = 1$. The consolidated version of B's expected stage profit corresponds then to (13) with $\gamma = 0$ and $y^S = y_{sc}$:

$$\widetilde{\Pi}_B^S = R + \mathbf{E}_X[q_I^{S,y_{sc}}(X)(y_{sc} - X_I) + (1 - q_I^{S,y_{sc}}(X))(-X_E)] - 2R_E^S(y_{sc}) \tag{14}$$

[33]Note that there exist $\delta > 0$ and $\gamma \in [\gamma', \overline{\gamma}^C)$ for which preferences are not time–consistent. B prefers then in the last period negotiating culture $S = C$ whereas she prefers in the remaining periods culture $S = P$.

[34]With switching costs instead of an investment, our model of the competitive culture is like the special case of the model in Lewis and Yildirim (2005) where learning and forgetting of skills occurs with certainty after a switch of suppliers. The analysis in this subsection transfers our research question of comparing different negotiating cultures into their framework. See Farrell and Klemperer (2007) for a survey of the classical switching costs literature.

It corresponds to social welfare net of twice the expected information rent of the entrant. If y_{sc} is close to zero, culture $S = C$ allocates almost efficiently and it implies a lower information rent of E than culture $S = P$ (see the discussion after Proposition 3; the same argument as for V_E^S when $\gamma > \overline{\gamma}^P$ applies). Culture $S = C$ is clearly superior. By contrast, if y_{sc} is high, the stronger favoring of I in culture $S = P$ drives the entrant's expected information rent in this culture down relative to culture $S = C$. As for high y_{sc} it is also efficient that I is strongly favored, culture $S = P$ is superior.[35] Hence, when the future is sufficiently important, there is also in the switching costs problem a role for both negotiating cultures.

Proposition 7 (Switching costs) *(a) Suppose* $\delta = 0$. $\widetilde{\Pi}_B^C > \widetilde{\Pi}_B^P$. *(b) Suppose* $\delta = 1$. $\widetilde{\Pi}_B^C > \widetilde{\Pi}_B^P$ *if* y_{sc} *is close to zero and* $\widetilde{\Pi}_B^P > \widetilde{\Pi}_B^C$ *if* $y_{sc} \in [\max\{\overline{y}^P, 1\}, \overline{y}^C)$.

7.3. Suppliers can be excluded from the procurement process in the future

We assumed that the buyer has no long–term commitment power within a negotiating culture. In particular, she could not commit to exclude a supplier from the procurement process in the future. This had the consequence that the individual rationality constraint of supplier k in B's mechanism design problem was $U_k(x_k, x_k) \geq V_E$ (see Section 4.1). That is, B had to leave the rent V_E to each supplier in order to induce participation. In this section, we consider what happens when B can commit to the exclusion of a supplier from the procurement process in all future periods, i.e., when she can also extract V_E.

The change in the assumption neither affects investment incentives nor the allocation rule of the optimal mechanism. It affects only the extractability of future rents. If $\delta = 0$, B cannot extract any future rents anyway. All results extend. If $\delta > 0$, the incumbency advantage is as under the original model, but E's continuation value becomes her discounted expected information rent of the next period as she anticipates that rents which lie further ahead in the future will be extracted through the procurement mechanism of the future period which precedes it. B's expected stage profit increases relative to the original version of the model by twice this rent.

Consider $\delta = 1$. B maximizes then social welfare. If γ is close to zero, the allocation does (almost) coincide in the two cultures but the investment is more efficient in culture $S = C$[36] rendering culture $S = C$ superior. If $\gamma > \overline{\gamma}^P$, there is no investment in either culture. Only efficiency of allocation matters. As culture $S = C$ allocates efficiently when there is no investment, it is again superior. The case in which $\gamma \in [\overline{\gamma}^C, \overline{\gamma}^P]$ is more involved. In the original model, the entrant earns no rent in culture $S = P$, but he

[35] Cabral and Greenstein (1990) argue that committing to ignore switching costs can be beneficial in a model where prices are set by suppliers. We find here that a commitment to a negotiating culture which implies higher switching costs can be beneficial in a model where the procurement mechanism is designed by the buyer. This is in line with the comparative statics analysis in Lewis and Yildirim (2005) who find that measures which increase switching costs can be beneficial for the buyer.

[36] Since $\gamma < 1$ and since the benefits materialize (almost) with certainty in both cultures, more efficient means here higher.

does so in culture $S = C$. Hence, culture $S = C$ becomes relatively better for B through the extractability of V_E^S. However, we find that culture $S = P$ is at least for high α still superior.

Proposition 8 (Suppliers can be excluded from future procurement) *If $\delta = 1$ and $\alpha \geq 1$, our non–monotonicity result extends to the case where also V_E^S is extractable by B.*[37]

8. Conclusion

For a procurement problem featuring three economic problems—hold–up, asymmetric information and repetition—we compare two stylized negotiating cultures: a competitive culture resembling U.S. style procurement practices and a protective culture resembling Japanese style procurement practices. Our main result establishes that the relative performance of the two cultures depends non–monotonically on the expensiveness/importance of relationship–specific investments relative to the potential benefits from competitive bidding. The competitive culture is superior when the investment is very cheap/very important or very expensive/very unimportant, whereas the protective culture is superior for intermediately expensive/intermediately important investment. The non–monotonicity result is robust with respect to the importance of repetition as measured by the discount factor and the distribution of production cost.

The contribution of this article is twofold. First, the main part of the article is tailored to an important application. Our base model is set up such that it fits best the procurement problem in the automotive industry. The results for intermediately expensive investment generate predictions which are consistent with stylized facts from the automotive industry regarding longevity of relationships, investment incentives and overall performance of the cultures. Second, the article introduces a tractable framework for studying negotiating cultures in corporate procurement from a more general perspective. We demonstrate three directions in which our model can be modified to better fit the procurement problem in other industries: finite repetition of the procurement problem, exogenous instead of endogenous switching costs and stronger commitment power on the buyer's side. As for the original model, we obtain for either modification that there is a role for both negotiating cultures.

[37] With considerably more effort it can be shown that the result extends to the case with any δ and with any $\alpha \geq 1/8$. We do not prove the more general result here as the general message should be already clear from the stated result with the more restrictive conditions.

Appendix A. Proofs

Proof of Lemma 1. The interim expected profit of supplier k after a potential investment is sunk is in either culture $U_k(x_k, \widehat{x}_k) = \overline{t}_k(\widehat{x}_k) - \overline{q}_k(\widehat{x}_k)(x_k - (V_I - V_E)) + V_E$ when he has private information x_k, announces $\widehat{x}_k$ and the other supplier announces his private signal truthfully. M is incentive compatible if $x_k \in \arg\max_{\widehat{x}_k \in [0,1]} U_k(x_k, \widehat{x}_k)$ for any x_k and any k. M is individual rational if $U_k(x_k, x_k) \geq V_E$ for any x_k and any k. Incentive compatibility is by an Envelope Theorem equivalent to $U_k(1) - U_k(x_k) = -\int_{x_k}^1 \overline{q}_k(x_k')\mathrm{d}x_k'$ and the monotonicity condition. For incentive compatible mechanisms, individual rationality is equivalent to $U_k(0) \geq V_E$. Using the definition of $U_k(x_k)$ then yields (4).

Proof of Proposition 1. The result follows directly from the text.

Proof of Corollary 1. The result follows directly from Proposition 1 and $J(0) = 0 + F(0)/f(0) = 0$.

Proof of Lemma 2. (a) By using the structure imposed by Proposition 1 in (8), by writing the expectation expression as an integral, and by using that $J(x_k) = (1+\alpha)x_k$ for distributions $F(x_k) = x_k^{1/\alpha}$, we obtain

$$R_I^S(y) = \begin{cases} \int_0^{(y+1)/(1+\alpha)} F(x_I)\mathrm{d}x_I & \text{if } S = P \\ \int_0^{y/(1+\alpha)} F(x_I)\mathrm{d}x_I + \int_{y/(1+\alpha)}^1 (1 - F(x_I - y/(1+\alpha)))F(x_I)\mathrm{d}x_I & \text{if } S = C \end{cases} \tag{A.1}$$

for $y \leq \overline{y}^S$ and $R_I^S(y) = \int_0^1 F(x_I)\mathrm{d}x_I$ for $y \geq \overline{y}^S$. The claimed continuity and monotonicity properties follow straightforwardly.

(b) Consider $S = P$. It follows from (A.1) that marginal revenue is for $y \in [0, \overline{y}^P]$ given by $F((y + 1)/(1+\alpha))/(1+\alpha)$. As this expression is strictly increasing in y, marginal revenue is strictly increasing on $[0, \overline{y}^P]$.

(c) Consider $S = C$. It follows from (A.1) that marginal revenue is for $y \in [0, \overline{y}^C]$ given by

$$\frac{1}{1+\alpha}\int_{y/(1+\alpha)}^1 f(x_I - y/(1+\alpha))F(x_I)\mathrm{d}x_I \tag{A.2}$$

$$= \frac{1}{1+\alpha}\int_0^{1-y/(1+\alpha)} F(x_I + y/(1+\alpha))f(x_I)\mathrm{d}x_I$$

$$= \frac{1}{1+\alpha}\mathrm{Prob}_X(X_I \leq 1 - y/(1+\alpha)) \times \mathbf{E}_X[F(X_I + y/(1+\alpha))|X_I \leq 1 - y/(1+\alpha)]. \tag{A.3}$$

The first equality follows from an index transformation. The second equality follows from rewriting the integral as a conditional expectation. Both, the probability term and the conditional expectation term, are bounded on $[0, \overline{y}^C]$. Moreover, both terms are continuous by continuity of the distribution function implying boundedness of marginal revenue. As the probability term and the conditional expectation term are both strictly positive on $[0,\overline{y}^C)$, marginal revenue is strictly positive on $[0,\overline{y}^C)$. As the probability expression goes to zero as $y \to \overline{y}^C$ and as the conditional expectation expression is bounded, marginal revenue goes to zero as $y \to \overline{y}^C$.

Consider now $\alpha \leq 1$. Under this condition, $f(\cdot)$ is continuously differentiable. This allows us to compute the curvature of revenue by differentiating (A.2):

$$\frac{1}{(1+\alpha)^2}\left(-f(0)F(y/(1+\alpha)) - \int_{y/(1+\alpha)}^{1} f'(x_I - y/(1+\alpha))F(x_I)\mathrm{d}x_I\right)$$

If $\alpha = 1$, revenue is concave because $f(0) = 1$ and $f'(\cdot) = 0$. If $\alpha < 1$, revenue is concave because $f(0) = 0$ and $f'(\cdot) > 0$.

(d) As $R_I^S(\overline{y}^S)$ does not depend on S, we need to show that $R_I^C(0) > R_I^P(0)$. By (A.1) with $y = 0$ and by using $F(x_I) = x_I^{1/\alpha}$ to compute the integrals, we obtain

$$R_I^C(0) = \int_0^1 (1 - F(x_I))F(x_I)\mathrm{d}x_I = \frac{\alpha}{1+\alpha}\frac{1}{2+\alpha} \tag{A.4}$$

and

$$R_I^P(0) = \int_0^{1/(1+\alpha)} F(x_I)\mathrm{d}x_I = \frac{\alpha}{1+\alpha}\left(\frac{1}{1+\alpha}\right)^{(1+\alpha)/\alpha}. \tag{A.5}$$

By simplifying, we obtain that $R_I^C(0) > R_I^P(0)$ is equivalent to $(1+\alpha)\ln(1+\alpha) > \alpha\ln(2+\alpha)$. Using that concavity of $\ln(\cdot)$ implies $\ln(2+\alpha) < \ln(1+\alpha) + (\ln(1+\alpha))' \cdot 1$, we get that $(1+\alpha)\ln(1+\alpha) > \alpha(\ln(1+\alpha) + 1/(1+\alpha))$ is a sufficient for what we have to show. This inequality can in turn be written as $\xi(\alpha) := (1+\alpha)\ln(1+\alpha) - \alpha > 0$. As $\lim_{\alpha\to 0}\xi(\alpha) = 0$ and $\xi'(\alpha) = \ln(1+\alpha) > 0$ for any $\alpha > 0$, we are done.

Proof of Proposition 2. (a) Consider $S = P$. As marginal revenue is zero for $y \geq \overline{y}^P$ by Lemma 2 (a), $y^P \leq \overline{y}^P$. As marginal revenue is convex for $y \leq \overline{y}^P$ by Lemma 2 (b) and as marginal cost are constant, the optimal investment problem has a corner solution. We obtain $y^P = \overline{y}^P$ if $-\gamma\overline{y}^P + R_I^P(\overline{y}^P) \geq R_I^P(0)$ and $y^P = 0$ otherwise. Finally, note that (A.1) implies $R_I^P(\overline{y}^P) - R_I^P(0) = \int_{1/(1+\alpha)}^1 x_I^{1/\alpha}\mathrm{d}x_I$. By computing the integral, we get $R_I^P(\overline{y}^P) - R_I^P(0) = \overline{\gamma}^P\overline{y}^P$. This implies the result.

(b) Consider $S = C$. (b.i) Suppose that monotonicity is violated. I.e., suppose there exists $\gamma_1 < \gamma_2$ such that $y_1^C > y_2^C$. Optimality requires $-\gamma_1 y_1^C + R_I^C(y_1^C) + V_E \geq -\gamma_1 y_2^C + R_I^C(y_2^C) + V_E$ and $-\gamma_2 y_2^C + R_I^C(y_2^C) + V_E \geq -\gamma_2 y_1^C + R_I^C(y_1^C) + V_E$. By adding the left–hand sides and the right–hand sides up and simplifying, we obtain that $-(\gamma_2 - \gamma_1)(y_1^C - y_2^C) \geq 0$ is necessary for the two inequalities to hold. However, this contradicts the supposition. This establishes that y^C is decreasing. (b.ii) As marginal revenue is zero for $y \geq \overline{y}^C$ by Lemma 2 (a), $y^C \leq \overline{y}^C$. Suppose there exists $\gamma \in (0,1)$ such that $y^C = \overline{y}^C$. Optimality requires $-\gamma\overline{y}^C + R_I^C(\overline{y}^C) + V_E \geq -\gamma y + R_I^C(y) + V_E$ for any $y \in [0, \overline{y}^C]$. However, as Lemma 2 (c) implies that there exists $y' \in [0, \overline{y}^C)$ such that marginal revenue is below marginal cost on $[y', \overline{y}^C]$, $y^C = \overline{y}^C$ cannot be optimal. Hence. $y^C < \overline{y}^C$ for any $\gamma \in (0,1)$. (b.iii) Let any sequence $(\gamma_n)_{n=1}^\infty$ with $\lim_{n\to\infty}\gamma_n = 0$ be given. Let $(y_n^C)_{n=1}^\infty$ be any sequence where y_n^C is an optimal investment for marginal cost γ_n. We need to show that $\lim_{n\to\infty} y_n^C = \overline{y}^C$. As $(y_n^C)_{n=1}^\infty$ is bounded by the first argument in (b.ii), it suffices to show that any convergent subsequence of $(y_n^C)_{n=1}^\infty$ converges to $\overline{y}^C$. Let any convergent subsequence of $(y_n^C)_{n=1}^\infty$ be given by $(y_{\tau(n)}^C)_{n=1}^\infty$ where $\tau : \mathbf{N} \to \mathbf{N}$ is an increasing function. Optimality requires that $-\gamma_{\tau(n)}y_{\tau(n)}^C + R_I^C(y_{\tau(n)}^C) + V_E \geq -\gamma_{\tau(n)}\overline{y}^C + R_I^C(\overline{y}^C) + V_E$ for any n. As $\lim_{n\to\infty}\gamma_{\tau(n)} = 0$ by the supposition, necessary for this is $\lim_{n\to\infty} R_I^C(y_{\tau(n)}^C) \geq R_I^C(\overline{y}^C)$. However, as $R_I^C(\cdot)$ is strictly increasing by Lemma 2 (a), this requires $\lim_{n\to\infty} y_{\tau(n)}^C = \overline{y}^C$. Hence, $\lim_{n\to\infty} y^C = \overline{y}^C$. (b.iv) Consider first $\alpha \leq 1$. By Lemma 2 (c), marginal revenue is strictly decreasing. It follows from (A.2) with $y = 0$ that $\int_0^1 f(x_I)F(x_I)\mathrm{d}x_I/(1+\alpha) = 1/2 \cdot 1/(1+\alpha) = \overline{y}^C$ is an upper bound of marginal revenue. If marginal cost γ are higher than the upper bound on marginal revenue $\overline{y}^C$, investment $y = 0$ is optimal. Consider now $\alpha > 1$. $F(\cdot)$ is then concave. By applying Jensen's inequality to the marginal revenue expression in (A.3), we obtain the following upper bound on marginal revenue:

$$
\begin{aligned}
& \frac{1}{1+\alpha}F(1-y/(1+\alpha))F(\mathbf{E}_X[X_I|X_I \leq 1-y/(1+\alpha)] + y/(1+\alpha)) \\
= \; & \frac{1}{1+\alpha}F(1-y/(1+\alpha))F(1/(1+\alpha) + \alpha/(1+\alpha)^2 y) \\
= \; & \frac{1}{1+\alpha}F((1-y/(1+\alpha))(1+\alpha/(1+\alpha)y)/(1+\alpha)) \qquad \text{(A.6)}
\end{aligned}
$$

The first equality follows from using that $\mathbf{E}_X[X_I|X_I \leq 1-y/(1+\alpha)] = (1-y/(1+\alpha))/(1+\alpha)$ and from simplifying. The second equality follows from using that $F(z_1)F(z_2) = F(z_1 z_2)$ for the considered distributions. We obtain an upper bound of (A.6) by maximizing over y. As $F(\cdot)$ is strictly increasing, the maximum of (A.6) is assumed for the value of y that maximizes $(1-y/(1+\alpha))(1+\alpha/(1+\alpha)y)$. This is $y = (\alpha^2-1)/(2\alpha)$. By plugging this into (A.6) and by simplifying, we obtain the following upper bound on marginal revenue:

$$
\frac{1}{1+\alpha}F((1+\alpha)/(4\alpha)) = \overline{\gamma}^C
$$

If γ is larger than the upper bound on marginal revenue $\overline{y}^C$, investment $y = 0$ is again optimal.

(c) Consider first $\alpha \leq 1$. By rearranging and simplifying, we obtain that $\overline{\gamma}^P > \overline{\gamma}^C$ is equivalent to $(1/(1+\alpha))^{1+1/\alpha} < 1/2$ which in turn is equivalent to $\xi_1(\alpha) := (1+\alpha)\ln(1+\alpha) - \alpha\ln(2) > 0$. As $\xi_1(0) = 0$, a sufficient condition for $\overline{\gamma}^P > \overline{\gamma}^C$ is $\xi_1'(\alpha) > 0$ for any $\alpha \in (0,1]$. As we have $\xi_1'(\alpha) = \ln((1+\alpha)/2) + 1$, $\ln((1+\alpha)/2) > \ln(1/2)$ for $\alpha \in (0,1]$ and $\ln(1/2)+1 > 0$, we obtain the result. Consider now $\alpha > 1$. Define $\mathcal{F} : \mathbf{R}_+ \to \mathbf{R}_+$ by $\mathcal{F}(z) := z^{1/\alpha}$. We can use this to rewrite $\overline{\gamma}^P > \overline{\gamma}^C$ as $1/(1+\alpha) - \mathcal{F}(1/(1+\alpha))/(1+\alpha)^2 > \mathcal{F}((1+\alpha)/(4\alpha))/(1+\alpha)$. By multiplying both sides of the inequality with $(1+\alpha)$ and by rearranging, we obtain $\xi_2(\alpha) := 1/(1+\alpha) \cdot \mathcal{F}(1/(1+\alpha)) + \mathcal{F}((1+\alpha)/(4\alpha)) < 1$. We get

$$\begin{aligned}
\xi_2(\alpha) &= \frac{1}{1+\alpha} \cdot \mathcal{F}(1/(1+\alpha)) + \frac{\alpha}{1+\alpha} \cdot \mathcal{F}(1/4 \cdot (1+\alpha)^{\alpha+1}/\alpha^{\alpha+1}) \\
&\leq \mathcal{F}(\frac{1}{1+\alpha} \cdot 1/(1+\alpha) + \frac{\alpha}{1+\alpha} \cdot 1/4 \cdot (1+\alpha)^{\alpha+1}/\alpha^{\alpha+1}) \\
&= \mathcal{F}(1/(1+\alpha)^2 + (1+1/\alpha)^\alpha \cdot 1/4) \\
&\leq \mathcal{F}(1/4 + (1+1/\alpha)^\alpha \cdot 1/4) =: \xi_3(\alpha).
\end{aligned}$$

The first equality uses that $\mathcal{F}(z_1) = z_2 \mathcal{F}(z_1/z_2^\alpha)$ for any $z_2 > 0$. The inequality in the second line follows from concavity of $\mathcal{F}(\cdot)$ for $\alpha > 1$ and Jensen's Inequality. The second equality follows from simplifying. The inequality in the last line follows from monotonicity of $\mathcal{F}(\cdot)$ and $1/(1+\alpha)^2 < 1/4$ for $\alpha > 1$. It follows that $\xi_3(\alpha) < 1$ is a sufficient condition for $\xi_2(\alpha) < 1$. Using that $\mathcal{F}(\cdot)$ is invertible with $\mathcal{F}^{-1}(1) = 1$, we get that $\xi_3(\alpha) < 1$ is equivalent to $(1+1/\alpha)^\alpha < 3$. As the left–hand side of this inequality is increasing with limit $\exp(1) < 3$, we obtain the result.

Proof of Corollary 2. The corollary is a direct consequence of Proposition 2.

Proof to Corollary 3. (a) The result for $\gamma \in (0, \overline{\gamma}^P]$ is a direct consequence of Propositions 1 and 2.

(b) Consider $\gamma \in (\overline{\gamma}^P, 1)$. By Proposition 2, $y^P = 0$ and $y^C = 0$. By Proposition 1, I wins in culture $S = P$ if $x_I \leq J^{-1}(\mathbf{E}_X[J(X_E)])$ and in culture $S = C$ if $x_I \leq x_E$. When we use notation $G := F \circ J^{-1}$, we obtain

$$\rho^P = \mathbf{E}_X[q_I^{P,0}(X)] = F(J^{-1}(\mathbf{E}_X[J(X_E)])) = G(\mathbf{E}_X[J(X_E)])$$

and

$$\rho^C = \mathbf{E}_X[q_I^{C,0}(X)] = \mathbf{E}_X[\mathbf{E}_X[q_I^{C,0}(X)|X_E]] = \mathbf{E}_X[F(X_E)] = \mathbf{E}_X[F(J^{-1}(J(X_E)))] = \mathbf{E}_X[G(J(X_E))].$$

By Jensen's inequality, we get that $G(\mathbf{E}_X[J(X_E)]) < \mathbf{E}_X[G(J(X_E))]$ if G is convex, $G(\mathbf{E}_X[J(X_E)]) = \mathbf{E}_X[G(J(X_E))]$ if G is linear and $G(\mathbf{E}_X[J(X_E)]) > \mathbf{E}_X[G(J(X_E))]$ if G is concave. As $J(\cdot)$ is linear for the considered distributions, the curvature of $F \circ J^{-1}$ corresponds to the curvature of $F(\cdot)$. $F(\cdot)$ is convex, linear and concave if $\alpha < 1$, $\alpha = 1$ and $\alpha > 1$, respectively. This yields the result.

Proof of Proposition 3. It is useful to prove part (b) before part (a).

(b) Consider $\gamma \in (0, \overline{\gamma}^P]$. Proposition 2 (a) implies $y^P = \overline{y}^P$ and Proposition 1 (b) implies that I wins for this investment for sure in culture $S = P$. By (8), $R_E^P(\overline{y}^P) = 0$ and thus by (10), $V_E^P = 0$. Moreover, $\lim_{\gamma \to 0} V_E^P = 0$. Proposition 2 (b) implies $y^C < \overline{y}^C$ and Proposition 1 (a) implies that I loses with positive probability for such investments in culture $S = C$. By (8), $R_E^C(\overline{y}^P) > 0$ and thus by (10), $V_E^C > 0$. As I wins by Proposition 2 (b) in the limit as $\gamma \to 0$ also for sure in culture $S = C$, $\lim_{\gamma \to 0} V_E^C = 0$. Hence, $V_E^C > V_E^P = 0$ and $\lim_{\gamma \to 0} V_E^C = \lim_{\gamma \to 0} V_E^P = 0$.

Consider now $\gamma \in (\overline{\gamma}^P, 1)$. We obtain $y^P = 0$ and $y^C = 0$ by Proposition 2. By (10), we need to show $R_E^P(0) > R_E^C(0) > 0$. We obtain from (8) for $S = P$

$$\begin{aligned} R_E^P(0) &= \text{Prob}_X(X_I \geq 1/(1+\alpha))\mathbf{E}_X[F(X_E)/f(X_E)|X_I \geq 1/(1+\alpha)] \\ &= (1 - F(1/(1+\alpha))) \int_0^1 F(x_E)\mathrm{d}x_E = \left(1 - \left(\frac{1}{1+\alpha}\right)^{1/\alpha}\right) \frac{\alpha}{1+\alpha}. \end{aligned} \tag{A.7}$$

The first equality uses that $(1 - q_I^{P,0}(x)) = 1$ if $x_I > 1/(1+\alpha)$ and $(1 - q_I^{P,0}(x)) = 0$ if $x_I \leq 1/(1+\alpha)$ by Proposition 1 (b) with $y = 0$. The second equality uses that $\mathbf{E}_X[F(X_E)/f(X_E)|X_I \geq 1/(1+\alpha)] = \mathbf{E}_X[F(X_E)/f(X_E)]$ by independence of X_I and X_E. The third equality follows from computing the integral. We obtain from (8) for $S = C$

$$\begin{aligned} R_E^C(0) &= \mathbf{E}_X[(1 - F(X_E))F(X_E)/f(X_E)] \\ &= \int_0^1 (x_E^{1/\alpha} - x_E^{2/\alpha})\mathrm{d}x_E = \frac{1}{1/\alpha + 1} - \frac{1}{2/\alpha + 1} = \frac{1}{(2+\alpha)} \frac{\alpha}{(1+\alpha)}. \end{aligned} \tag{A.8}$$

The first equality uses that $(1 - q_I^{C,0}(x)) = 1$ if $x_I > x_E$ and $(1 - q_I^{C,0}(x)) = 0$ if $x_I \leq x_E$ by Proposition 1 (a) with $y = 0$. The second equality follows from writing the expectation term as an integral and simplifying. The third equality follows from computing the integral. The fourth equality follows from simplifying. As (A.7) and (A.8) are obviously strictly positive, it remains only to show that $1/(2+\alpha) < 1 - (1/(1+\alpha))^{1/\alpha}$. By rearranging, we obtain that this is equivalent to $(2+\alpha)^\alpha < (1+\alpha)^{1+\alpha}$ which in turn can be rewritten as $\xi_4(\alpha) := (1+\alpha)\ln(1+\alpha) - \alpha \ln(2+\alpha) > 0$. As $\xi_4(0) = 0$, $\xi_4'(\alpha) > 0$ for any $\alpha > 0$ is sufficient for the result. We have $\xi_4'(\alpha) = \ln(1+\alpha) + 1 - \ln(2+\alpha) - \alpha/(2+\alpha)$. Because concavity of $\ln(\cdot)$ implies $\ln(2+\alpha) < \ln(1+\alpha) + (\ln(1+\alpha))' \cdot 1$, sufficient for $\xi_4'(\alpha) > 0$ is $\ln(1+\alpha) + 1 - (\ln(1+\alpha) + 1/(1+\alpha)) - \alpha/(2+\alpha) > 0$. As the left–hand side corresponds to $\alpha/(1+\alpha) - \alpha/(2+\alpha)$ which is strictly positive, we are done.

(a) Consider first $\gamma \in (\overline{\gamma}^P, 1)$. By Proposition 2, $y^P = 0$ and $y^C = 0$. As the allocation is for this investment by Proposition 1 (a) symmetric in culture $S = C$, $V_I^C - V_E^C = 0$. It remains to show $V_I^P - V_E^P > 0$. By (9), this is equivalent to $R_I^P(0) > R_E^P(0)$. By Proposition 1 (b), I wins for investment $y = 0$ in culture

$S = P$ if $x_I \geq 1/(1+\alpha)$ and loses otherwise. Using this in (8), we obtain

$$R_I^P(0) = \int_0^{1/(1+\alpha)} x_I^{1/\alpha} \mathrm{d}x_I = \frac{\alpha}{1+\alpha} \left(\frac{1}{1+\alpha} \right)^{1/\alpha+1}. \tag{A.9}$$

It remains to show that (A.7) exceeds (A.9). By rearranging, we obtain that this is equivalent to $(1+\alpha)^{1/\alpha+1} - (1+\alpha) > 1$ which in turn is equivalent to $(1+\alpha)^{1+\alpha} > (2+\alpha)^\alpha$. This is however what we have already proven in part (b) of this proposition above. Hence, $V_I^P - V_E^P > 0$.

Consider now $\gamma \in (0, \overline{\gamma}^P]$. $V_I^C - V_E^C \geq 0$ follows from a revealed preferences argument: If I does not invest in culture $S = C$, he is treated like an entrant. If he decides to invest, he must be better off. It remains to show that $V_I^P - V_E^P > V_I^C - V_E^C$. By Proposition 2 (a), $y^P = \overline{y}^P$. By Proposition 1 (b), I wins for this investment for sure in culture $S = P$. By using this in (8) for $k = I$ and $k = E$, we obtain

$$R_I^P(\overline{y}^P) - R_E^P(\overline{y}^P) = \int_0^1 F(x_I)\mathrm{d}x_I \tag{A.10}$$

By Proposition 1 (a), I wins in culture $S = C$ if $x_E \geq x_I - y/(1+\alpha)$ and loses otherwise. By using this in (8) for $k = I$ and $k = E$, we obtain for $y \leq \overline{y}^C$

$$\begin{aligned} R_I^C(y) - R_E^C(y) &= \left(\int_0^1 F(x_I)\mathrm{d}x_I - \int_{y/(1+\alpha)}^1 F(x_I - y/(1+\alpha))F(x_I)\mathrm{d}x_I \right) \\ &\quad - \int_0^{1-y/(1+\alpha)} (1 - F(x_E + y/(1+\alpha)))F(x_E)\mathrm{d}x_E \\ &= \int_0^1 F(x_I)\mathrm{d}x_I - \int_0^{1-y/(1+\alpha)} F(x_I)\mathrm{d}x_I = \int_{1-y/(1+\alpha)}^1 F(x_I)\mathrm{d}x_I \end{aligned} \tag{A.11}$$

The second equality follows from using that the second integral becomes $\int_0^{1-y/(1+\alpha)} F(x_I)F(x_I + y/(1+\alpha))\mathrm{d}x_I$ after an index transformation, and by consolidating then the last two integrals. By using (A.10), (A.11) and (9), we obtain that $V_I^P - V_E^P > V_I^C - V_E^C$ is equivalent to

$$-\gamma(\overline{y}^P - y) + \int_0^{1-y/(1+\alpha)} F(x_I)\mathrm{d}x_I > 0 \tag{A.12}$$

with $y = y^C$. $y = y^C$ does not necessarily minimize the left–hand side of (A.12). We show that the inequality holds even for the $y \in [0, 1+\alpha]$ which minimizes the left–hand side of (A.12). First, note that if the left–hand side is strictly positive for some $\gamma \in (0, \overline{\gamma}^P]$ and any $y \in [0, 1+\alpha]$, then it is also strictly positive for any smaller γ and any $y \in [0, 1+\alpha]$. We need thus only to show that the left–hand side of (A.12) with $\gamma = \overline{\gamma}^P$, that is $\varphi(y) := -\overline{\gamma}^P(\alpha - y) + \int_0^{1-y/(1+\alpha)} F(x_I)\mathrm{d}x_I$, is strictly positive for any $y \in [0, 1+\alpha]$. We have $\varphi'(y) = \overline{\gamma}^P - 1/(1+\alpha)F(1 - y/(1+\alpha))$. It is easily verified that $\varphi(y)$ is strictly convex, $\varphi'(0) = \overline{\gamma}^P - 1/(1+\alpha) < 0$ and $\varphi'(1+\alpha) = \overline{\gamma}^P > 0$. $\varphi(y)$ possesses thus an interior global minimum which is characterized by $\varphi'(y) = 0$. The minimizer is given by $y^* = (1+\alpha)(1-((1+\alpha)\overline{\gamma}^P)^\alpha)$ and we obtain

$$\begin{aligned}
\varphi(y^*) &= -\overline{\gamma}^P \left(\alpha - (1+\alpha)(1-((1+\alpha)\overline{\gamma}^P)^\alpha)\right) + \int_0^{((1+\alpha)\overline{\gamma}^P)^\alpha} F(x_I)\mathrm{d}x_I \\
&= -\overline{\gamma}^P \left((1+\alpha)((1+\alpha)\overline{\gamma}^P)^\alpha - 1\right) + \alpha\overline{\gamma}^P((1+\alpha)\overline{\gamma}^P)^\alpha \\
&= \overline{\gamma}^P \left(1 - ((1+\alpha)\overline{\gamma}^P)^\alpha\right).
\end{aligned}$$

The second equality follows from computing the integral, the third equality follows from simplifying. It follows immediately that $\varphi(y^*) > 0$ is equivalent to $\overline{\gamma}^P < 1/(1+\alpha)$. As this is by the definition of $\overline{\gamma}^P$ in Proposition 2 clearly true, we are done.

Proof to Proposition 4. (a) It follows from Proposition 2 (b) that there exists $\gamma'' \in (0, \overline{\gamma}^C)$ such that y^C is continuous on $(0, \gamma'')$. By Proposition 2 (a) and (c), y^P is constant on $(0, \overline{\gamma}^C)$ and thus also continuous on $(0, \gamma'')$. As $\widehat{\Pi}_B^S$ is continuous in y^S, $\lim_{\gamma\to 0} \widehat{\Pi}_B^C > \lim_{\gamma\to 0} \widehat{\Pi}_B^P$ implies $\widehat{\Pi}_B^C > \widehat{\Pi}_B^P$ for any γ in some interval $(0, \gamma')$ with $\gamma' \leq \gamma''$. Three properties are important: First, by Proposition 2 (a) and (b), $\lim_{\gamma\to 0} y^P = \overline{y}^P$ and $\lim_{\gamma\to 0} y^C = \overline{y}^C$. Second, by Proposition 1, the incumbent wins in the limit as $\gamma \to 0$ in either culture for sure. Third, by Proposition 3 (a), $\lim_{\gamma\to 0}(V_I^C - V_E^C) = \lim_{\gamma\to 0}(V_I^P - V_E^P)$. The three properties together imply $\lim_{\gamma\to 0}(\widehat{\Pi}_B^C - \widehat{\Pi}_B^P) = \overline{y}^C - \overline{y}^P > 0$.

(b) Consider $\gamma > \overline{\gamma}^P$. By Proposition 2, $y^P = 0$ and $y^C = 0$. (11) differs thus for the two cultures only in the expected procurement cost $\mathbf{E}_X[-q_I^{S,0}(X)J(X_I) - (1-q_I^{S,0}(X))J(X_E)]$ and the incumbency advantage $V_I^S - V_E^S$. As the expected procurement cost are lower in culture $S = C$ by construction of the culture and as the incumbency advantage is higher in culture $S = C$ by Proposition 3 (a), we obtain the result.

Proof to Proposition 5. Consider $\gamma \in [\overline{\gamma}^C, \overline{\gamma}^P]$. By Proposition 3 (a), $V_I^P - V_E^P > V_I^C - V_E^C$. This and (9) imply that $(V_I^P - V_E^P) - (V_I^C - V_E^C)$ is increasing in δ. As δ affects $\widehat{\Pi}_B^S$ only through $V_I^S - V_E^S$, $\widehat{\Pi}_B^P > \widehat{\Pi}_B^C$ for $\delta = 0$ is sufficient for $\widehat{\Pi}_B^P > \widehat{\Pi}_B^C$ for any $\delta \in [0,1)$. Consider thus $\delta = 0$. Using that $y^P = \overline{y}^P$ by Proposition 2 (a) and that $q_I^{P,y^P}(x) = 1$ by Proposition 1 (b), (11) becomes for $S = P$

$$\widehat{\Pi}_B^P = R + \overline{y}^P - \mathbf{E}_X[J(X_I)] = R + \alpha - \int_0^1 \frac{1+\alpha}{\alpha} x_I^{1/\alpha} \mathrm{d}x_I = R + \alpha - 1.$$

Using that $y^C = 0$ by Proposition 2 (b) and that the allocation is symmetric by Proposition 1 (a), (11) becomes for $S = C$

$$\widehat{\Pi}_B^C = R - 2\mathbf{E}_X[(1-F(X_I))J(X_I)] = R - 2\int_0^1 (1 - x_I^{1/\alpha})\frac{1+\alpha}{\alpha} x_I^{1/\alpha} \mathrm{d}x_I = R - \frac{2}{2+\alpha}.$$

It follows that $\widehat{\Pi}_B^P > \widehat{\Pi}_B^C$ is equivalent to $\alpha - 1 > -2/(2+\alpha)$. As the inequality becomes $\alpha^2 + \alpha > 0$ after rearranging, it is satisfied for any $\alpha > 0$. This yields the result.

Proof to Proposition 6. Propositions 4 and 5 establish the existence of three regions, $(0, \gamma')$, $[\overline{\gamma}^C, \overline{\gamma}^P]$ and $(\overline{\gamma}^P, 1)$ with the desired properties of B's preferences over the negotiating cultures for the given δ. It remains to argue why the same regions yield the same preferences for $\delta = 0$. As neither the construction of the second and the third region depends on δ nor do the buyer's preferences within this regions, we obtain time consistency for the second and the third region. By contrast, the upper bound of the first region may depend on δ. As by Proposition 3 (a) future rent extraction makes the buyer's preference for culture $S = C$ only weaker, the buyer still prefers culture $S = C$ in the for δ constructed region $(0, \gamma')$ when $\delta = 0$.

Proof to Proposition 7. (a) For $\delta = 0$, B's expected profit corresponds to (12) with $y^S = y_{sc}$. B cares only about the expected profit accruing to the current period conditional on $y = y_{sc}$. By construction of the cultures, this is clearly higher in culture $S = C$.

(b) For $\delta = 1$, B's expected stage profit corresponds to (13) with $y^S = y_{sc}$. Consider first y_{sc} close to zero. The expectation term is then clearly higher in culture $S = C$ by construction of the cultures. It suffices thus to show that $R_E^P(y_{sc}) - R_E^C(y_{sc}) > 0$ for y_{sc} close to zero. As $\lim_{y_{sc} \to 0}(R_E^P(y_{sc}) - R_E^C(y_{sc})) = R_E^P(0) - R_E^C(0)$ and as $R_E^P(0) - R_E^C(0) > 0$ follows from the last statement in Proposition 3 (b) (recall that $\gamma > \overline{\gamma}^P$ implies $y = 0$) and (10), we obtain the result.

Consider now $y_{sc} \in [\max\{\overline{y}^P, 1\}, \overline{y}^C)$. Note that because $\overline{y}^C = 1 + \alpha > 1$, the set $[\max\{\overline{y}^P, 1\}, \overline{y}^C)$ is non–empty. By Proposition 1 (b), $q_I^{P,y_{sc}}(x) = 1$ for the considered switching costs. (14) becomes for $S = P$

$$\widetilde{\Pi}_B^P \quad := \quad R + y_{sc} - \mathbf{E}_X[X_I].$$

Using Proposition 1 (a) with $y = y_{sc}$, (14) becomes for $S = C$

$$\begin{aligned}\widetilde{\Pi}_B^C \quad &:= \quad R + \mathbf{E}_X[q_I^{C,y_{sc}}(X)(y_{sc} - X_I) + (1 - q_I^{C,y_{sc}}(X))(-X_E)] - 2R_E^C(y_{sc}) \\ &= \quad R + y_{sc} - \mathbf{E}_X[X_I] + \mathbf{E}_X[(1 - q_I^{C,y_{sc}}(X))(-y_{sc} + X_I - (1 + 2\alpha)X_E)]\end{aligned}$$

As $y_{sc} \geq 1$, the second expectation term is clearly negative. Hence, $\widetilde{\Pi}_B^P > \widetilde{\Pi}_B^C$.

Proof to Proposition 8. Note first that the modification of the model affects only the continuation values, equilibrium investment and equilibrium allocation are not affected. E's continuation value (10) becomes $V_E^S = \delta R_E^S(y^S)$ whereas the incumbency advantage (9) is not affected. B's expected stage profit becomes

$$\begin{aligned}\widehat{\Pi}_B^S \quad &:= \quad R + \mathbf{E}_X[q_I^{S,y^S}(X)(y^S - J(X_I)) + (1 - q_I^{S,y^S}(X))(-J(X_E))] + \delta(-\gamma y^S + R_I^S(y^S) + R_E^S(y^S)) \\ &= \quad R - \delta\gamma y^S + \mathbf{E}_X[q_I^{S,y^S}(X)(y^S - X_I) + (1 - q_I^{S,y^S}(X))(-X_E)] - (1 - \delta)(R_I^S(y^S) + R_E^S(y^S))\end{aligned}$$

$$\overset{\delta=1}{=} \quad R - \gamma y^S + \mathbf{E}_X[q_I^{S,y^S}(X)(y^S - X_I) + (1 - q_I^{S,y^S}(X))(-X_E)].$$

The first equation follows from using (9) and the modified version of (10) in (1). The second equation follows from using (8) and $J(X_I) = X_I + F(X_I)/f(X_I)$.

Consider $\delta = 1$. By Proposition 2, $\lim_{\gamma\to 0} y^C = \overline{y}^C$ and $\lim_{\gamma\to 0} y^P = \overline{y}^P$. By Proposition 1, $\lim_{\gamma\to 0} q_I^{S,y^S}(x) = 1$ for either culture. Hence, $\lim_{\gamma\to 0}(\widehat{\Pi}_B^C - \widehat{\Pi}_B^P) = \overline{\gamma}^C - \overline{\gamma}^P > 0$. Consider now $\gamma > \overline{\gamma}^P$. By Proposition 2, $y^C = y^P = 0$. B's expected stage profit becomes $\widehat{\Pi}_B^S = R - \mathbf{E}_X[q_I^{S,y^S}(X)X_I + (1 - q_I^{S,y^S}(X))X_E]$. By Proposition 1, the allocation in culture $S = C$ minimizes just this expression whereas the allocation in culture $S = P$ does not. Hence, $\widehat{\Pi}_B^C > \widehat{\Pi}_B^P$. Finally, consider $\gamma \in [\overline{\gamma}^C, \overline{\gamma}^P]$. By Proposition 2, $y^P = \alpha$ and $y^C = 0$. Using Proposition 1 (b),

$$\widehat{\Pi}_B^P = R + (1-\gamma)\alpha + \mathbf{E}_X[X_I] \geq R + (1 - \overline{\gamma}^P)\alpha - \frac{1}{1+\alpha} = R + (\alpha - 1) + \left(\frac{1}{1+\alpha}\right)^{2+1/\alpha} \alpha.$$

The inequality follows from $\gamma \leq \overline{\gamma}^P$ in the considered region and from computing the expectation term. The second equality follows from using the definition of $\overline{y}^P$ and simplifying. Using Proposition 1 (a), we obtain

$$\widehat{\Pi}_B^C = R - 2\mathbf{E}_X[(1 - F(X_I))X_I] = R - \frac{2}{2+\alpha}\frac{1}{1+\alpha}.$$

The first equality uses symmetry of the allocation. The second equality follows from computation of the expectation term. $\widehat{\Pi}_B^C < R$ whereas $\widehat{\Pi}_B^P > R$ for $\alpha \geq 1$ imply the result.

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