Discussion Paper Series

RIEB

Kobe University

DP2013-20

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RIEB Junior Research Fellow

Yusuke MORI

June 10, 2013

* This Discussion Paper won the Kanematsu Fellowship Prize (FY 2012).

Research Institute for Economics and Business Administration

Kobe University

2-1 Rokkodai, Nada, Kobe 657-8501 JAPAN

A Formal Theory of Firm Boundaries:

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Abstract

We develop a theory of firm boundaries in the spirit of transaction cost analysis, in which trading parties engage in *ex post* value split. We show that *ex post* inefficient bargaining under non-integration creates a trade-off between rent seeking and bargaining costs: while non-integration incurs lower rent-seeking costs than integration, it suffers from bargaining delay and breakdown, which never occur under integration. This result explains why rent-seeking activities within firms are likely to be more costly than those between firms, and offers a formal justification for the "costs of bureaucracy" in Williamson (1985).

Keywords: Transaction costs; haggling; integration; rent seeking; influence activity; bargaining costs

JEL Classification: D23; L22

*I am grateful to Reiko Aoki, Eric Chou, Lewis Davis, Makoto Hanazono, Junichiro Ishida, Shinsuke Kambe, Simon Lapointe, Hodaka Morita, Fumitoshi Moriya, Sadao Nagaoka, Dan Sasaki, and Takashi Shimizu for their beneficial suggestions, and especially to Hideshi Itoh for his guidance and encouragement. I also thank the participants at Contract Theory Workshop, Contract Theory Workshop East, the Osaka Workshop on Economics of Institutions and Organizations, ESNIE 2012, 2012 Japanese Economic Association Spring Meeting, and 6th Annual Organizational Economics Workshop for their helpful comments. An earlier version of this paper received the Kanematsu Fellowship from the Research Institute for Economics and Business Administration, Kobe University in 2013. Any errors are my own.

†Research Fellow of the Japan Society for the Promotion of Science. Institute of Social Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan. E-mail: moriyu@lake.dti.ne.jp

1 Introduction

Transaction cost economics (TCE), such as Williamson (1985, 1996), approaches make-or-buy decisions by focusing on disputes over trade value, which are invited by *ex post* adaptation to unanticipated changes in trade circumstances. Non-integrated parties settle such disputes through bilateral bargaining (haggling), which entails bargaining costs (e.g., delay in reaching agreement), and bilateral dependency between the parties due to relationship-specific assets or other reasons makes haggling more costly. Integrated firms, on the other hand, settle the disputes over trade value by fiat without incurring haggling costs. Students of TCE then make the following prediction concerning the choice of governance structure: firms are likely to choose vertical integration when the trade in question requires relationship-specific assets.

A number of empirical studies on TCE have been conducted, such as Monteverde and Teece (1982) and Masten, Meehan, and Snyder (1989), and "virtually all predictions from transaction-cost analysis appear to be borne out by the data" (Lafontaine and Slade, 2007, p. 658). Nevertheless, a satisfactory formalization of TCE is yet to be achieved.

This paper develops a theory of firm boundaries in the spirit of Williamson's transaction cost analysis. That is, we focus on *ex post* dispute over trade value (i.e., value split between trading parties) and examine which governance structure minimizes the inefficiencies due to the value split: non-integration or integration. To focus on *ex post* inefficiencies, we do not examine *ex ante* inefficiency, which includes under-investment problems that have been extensively analyzed in the literature on a property-rights theory. For the formal models of the property-rights theory, see Grossman and Hart (1986), Hart and Moore (1990), and Hart (1995).

Our theory focuses on two sources of *ex post* inefficiencies (transaction costs): rent seeking and private information (e.g., whether each party is rational or obstinate). Rent seeking does not create any value, but improves the rent-seeker's bargaining power or share of surplus at the cost of precious resources. Rent seeking within firms is also known as influence activity (i.e., the activities which influence the decisions of those who have decision rights in rent-seeker's favor). Private information, on the other hand, is used to realize individual advantage, which leads to bargaining costs (bargaining delay or breakdowns).

Some existing theoretical literature (reviewed in the next section) studies these inefficiencies (i.e., rent-seeking costs and the bargaining costs) separately. We contribute to this literature by providing a formal TCE model to study them simultaneously.

In our theory, following the arguments of TCE, processes of the value split differ between non-integration and integration. Under non-integration, trading parties engage in bilateral bargaining, and if the bargaining is terminated without agreement, litigation takes place (a court decides how to divide trade value). Under integration, on the other hand, a third party who has authority (i.e., a boss) determines the division of the value, and thus there is no bargaining.[1]

We assume that decisions of third parties (the court and the boss) are affected by each party's rent seeking. The parties are thus eager to undertake rent seeking so as to improve their payoffs, which causes rent-seeking costs.

Furthermore, the parties are assumed to have private information about their types, which are either rational or obstinate (irrational). The obstinate type always demands a large specific share of the value, accepts any offer greater than or equal to that share, and rejects all smaller offers. The rational type then has an incentive to mimic the obstinate type in an attempt to obtain a larger share of the value. Such opportunistic use of the private information leads to bargaining costs.

Our theory points out an important trade-off between rent seeking and bargaining costs: *ex post*

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[1]Mori (2012) offers a formal explanation as to why integrated firms can avoid costly *ex post* bargaining by employing behavioral assumptions. For a brief review of Mori (2012), see Conclusion.

inefficient bargaining, which takes place only under non-integration, can cause bargaining costs, which never occur under integration, but lowers each party's rent-seeking incentive. There are two reasons why rent-seeking incentives are lower under non-integration than under integration. First, rent seeking under non-integration indirectly affects rent-seekers' payoffs by improving their threat points (their expected litigation payoffs), while rent seeking under integration (influence activity) affects payoffs directly. Thus, when the aggregate litigation payoff must be smaller than the original trade value (e.g., because of time-consuming litigation), the parties' incentives for rent seeking under non-integration become smaller than those under integration. Second, the bargaining provides parties with opportunities to concede (i.e., to let their partners obtain a large share of the value). When each party becomes obstinate with high probability, any behavior other than concession is likely to delay agreement, and hence the rational type can optimally concede. Since concession terminates the game, in which case no litigation takes place, the rational type, expecting this outcome, chooses a low level of rent seeking. Our results explain why rent seeking within firms (influence activity) is likely to be more costly than rent seeking between firms, and provide a formal justification for the "costs of bureaucracy" in Williamson (1985).[2]

The rest of the paper is organized as follows. Section 2 relates our theory to existing literature. In Section 3, we present two simple models that focus on rent-seeking costs and highlight why rent seeking between firms is likely to be less costly than rent seeking within firms (influence activity). In Section 4, by constructing a more general model, we examine both rent-seeking costs and bargaining costs, show the trade-off between them, and discuss some extensions. Section 5 contains concluding comments.

[2] The aim of this paper is to formalize Williamson's informal arguments on firm boundaries and we do not intend to assert that rent seeking under non-integration is always less costly than rent seeking under integration. In fact, this remark on rent-seeking costs between and within firms needs to be examined empirically. However, to our knowledge, there is no empirical study that compares rent-seeking costs before and after integration and we still await one.

2 Related Literature

This paper studies *ex post* inefficiencies by combining the rent-seeking model and the non-cooperative bargaining model in the bargaining and reputation literature. We then review, in order, the literature on rent seeking both between and within firms, bargaining and reputation, bargaining with endogenous outside options, and *ex post* inefficiencies.

Rent Seeking and Influence Activity: Tullock (1980) develops a basic model of rent seeking in the context of lottery purchase, which Gibbons (2005) extends to study firm boundaries (i.e., to analyze haggling). In Gibbons (2005), two symmetric parties undertake rent seeking, each hoping to obtain a larger portion of trade value. Gibbons shows that larger trade value makes non-integration more costly, which is consistent with the assertion of TCE.

Milgrom and Roberts (1988) and Meyer, Milgrom, and Roberts (1992) develop formal models of influence activity. In these studies, a principal requires information that is valuable for efficient decision making but is possessed by agents; this information asymmetry provides agents with incentives to manipulate the information in order to influence the decision in their favor. Powell (2013) develops an influence-cost model which illustrates the costs and benefits of integration and demonstrates both the costs of integration and non-integration.

Unlike the literature on influence activity, we focus on value-distribution aspect of influence activity rather than information-manipulation aspect of it. We thus apply Tullock's model to rent seeking both between and within firms. Some readers might think that the boss in our model is unreasonably naive in the sense that he never ignores employees' influence activities (i.e., he never forms any institutional arrangement to avoid influence activities). However, applying Tullock's model to rent seeking both between and within firms is reasonable for three reasons. First, as Meyer, Milgrom, and Roberts (1992) discuss, influence activity is the private sector analog of rent seeking. Second, in our theory, the boss's decision only determines the division of fixed-size trade value and does not affect *ex post* efficiency (the size of the value), and hence he has no incentive to introduce an arrangement to prevent rent seeking. Lastly, and most importantly, in this setting, we can deal with rent-seeking costs both between and within firms in a unified and comparable way, which is consistent with the following statement by Williamson (1996, p. 228): "One of the tasks of transaction cost economics is to assess purported bureaucratic failures in comparative institutional terms."

Bargaining and Reputation: To examine bargaining costs due to private information (each party's type), we borrow the setting and results from Abreu and Gul (2000) and Compte and Jehiel (2002). Abreu and Gul (2000) analyze a bargaining game with two-sided player-type uncertainty. More specifically, they introduce the obstinate "irrational type," who always demands a fixed share θ, accepts any offer greater than or equal to that share, and rejects all smaller offers. They show that the presence of such an irrational type provides rational type with an incentive to build a reputation for obstinacy, which leads to bargaining delay.

Compte and Jehiel (2002) introduce exogenous outside options into Abreu and Gul's (2000) model. They show that when players have access to stationary outside options that yield shares larger than $1-\theta$, these outside options may cancel out the effect of obstinacy; that is, each player reveals himself as rational as soon as possible.

We adopt the symmetric version of their approaches and results to examine bargaining delay and breakdown due to private information. Nevertheless, as we will show in Section 4.5, our results hold under an asymmetric setting.

Endogenous Outside Option: As we will show in the following sections, decisions of the third parties (the court under non-integration and the boss under integration) endogenously determine trading parties' outside options. While we assume that the parties' outside options are determined by their rent seeking, there are several other approaches.

Atakan and Ekmekci (2010) and Özyurt (2010) develop the bargaining game in a searching market, which serves as an endogenous outside option. Unlike them, we consider a situation in which the parties are locked in and cannot search for other possible partners.

Lee and Liu (2010) assume that if parties cannot reach agreement in voluntary bargaining, a third party is called upon to determine how much one party pays to the other. While the third party in their model is unbiased, the court and the boss in our models can be biased (their decision is affected by rent seeking).

***Ex Post* Inefficiencies**: Some studies have focused on *ex post* inefficiencies using approaches other than TCE, including the property-rights theory and the "contracts as reference points" approach. However, few efforts to formalize the arguments of TCE can be found.

Matouschek (2004) analyzes the optimal ownership structure that minimizes *ex post* inefficiency due to too much or too little trade. He shows that when the expected gain from trade is large (resp. small) relative to the aggregate disagreement payoff, disagreement is less (resp. more) likely to occur, and hence joint ownership (resp. either non-integration or integration) that minimizes (resp. maximizes) the aggregate disagreement payoff is optimal. While Matoushek (2004) emphasizes how ownership structure, which is determined by the choice of governance structure, affects disagreement payoffs, our study does not focus on the ownership structure and assumes that the choice of governance structure only affects the way in which the trade value is distributed.

Hart and Moore (2008) and Hart (2009) develop the "contracts as reference points" approach to analyze inefficiencies due to *ex post* adaptation and present implications for firm boundaries. They point out that *ex ante* contract provides players with reference points for *ex post* entitlement and assume that each player engages in shading, which reduces his partner's payoff, if he does not obtain the most favored outcome within the contract. This setting leads to the following trade-off: the more flexible the *ex ante* contract becomes, the easier the *ex post* adaptation will be, but the more likely it is that shading will take place. Both their studies and ours are concerned with how *ex post* efficiencies affect firm boundaries. However, while they focus on the inefficiencies that occur after contract renegotiation (i.e., shadings), we focus on the inefficiencies that arise during renegotiation (i.e., rent-seeking costs and bargaining costs).

Bajari and Tadelis (2001) focus on construction procurement and compare two forms of contracts: fixed-price contracts and cost-plus contracts. They show a trade-off between cost-reducing efforts and *ex post* inefficiencies due to maladaptation: while fixed-price contracts lead to high seller incentive for cost-reducing efforts, their inflexibility prevents efficient adaptation. Tadelis (2002) extends their model to address firm boundaries and show that more complex products are more likely to be internally procured under low cost-reducing incentives, while more simple products are more likely to be procured through the market under high cost-reducing incentives. Unlike these papers, we do not focus on *ex ante* incentives, and analyze bargaining costs rather than maladaptations as *ex post* inefficiencies.

Wernerfelt (2011) examines efficient mechanisms for labor procurement and points out a trade-off between specialization and bargaining cost (cost of information gathering). Market mechanism (multilateral matching) allows a buyer, who needs a sequence of different tasks, to hire the most suitable seller to each task, but sellers have to incur specific set-up costs for each buyer they serve. Bilateral relationships where a buyer and a seller are randomly matched up (sequential contracting and employment), on the other hand, economize on set-up costs, but are burdened by two-sided incomplete information and the cost of information gathering. Unlike his study, we do not deal with *ex ante* investment and bargaining costs are delay in reaching agreement and bargaining breakdown. Furthermore, while Wernerfelt (2011) does not necessarily deal with bilateral monopoly (i.e., bilateral monopoly does not arise in market mechanism), we focus on transactions between firms and within a firm under bilateral monopoly.

Zhu (2009) attempts to develop a formal model of TCE and compares spot contracting, long-term contracting, and vertical integration, focusing on *ex ante* specific investment, productive action, and asset maintenance as well as bargaining friction. While both his model and ours deal with bargaining delay, the sources of the delay are different. In Zhu (2009), bargaining delay stems from the strategic choice of the timing of a contract offer and random delay in offer transmission. In our study, on the other hand, delay is caused by the opportunistic use of private information and there is no random delay.

3 The Model

This section introduces two simple models which explain why rent seeking under non-integration is less costly than rent seeking under integration (influence activity). There are two factors which lead to rent-seeking reduction under non-integration. One model points out that rent seeking under non-integration affects each party's payoff less directly than rent seeking under integration, and the other shows that only non-integration provides an opportunity for each party to concede (i.e., to let his partner obtain a large share of trade value and settle the value split immediately). While this section deals with rent-seeking costs only and examines each factor separately, the next section analyzes both rent-seeking costs and bargaining costs and focuses on both factors by introducing a more general framework (the third model). For explanatory convenience, we call the model introduced in Section 3.1 (resp. Section 3.2) to examine the first (resp. second) factor Model 1 (resp. Model 2) and the general model presented in the next section Model 3.

3.1 Model 1: Indirect Effects of Rent Seeking between Firms on Payoffs

In this subsection, we point out that rent seeking under non-integration is less costly than rent seeking under integration (influence activity) because the former affects each party's payoff less directly than the latter.

There are two risk-neutral symmetric trading parties (parties 1 and 2) who are locked in due to relationship-specific investment or other reasons (there is no other possible trading partner). These parties engage in *ex post* division of trade value V. (An asymmetric case will be discussed in Section 4.5.) Such value split is invited by *ex post* adaptation, which is required because *ex ante* contract cannot be complete due to bounded rationality or other reasons.

Note that we focus on *ex post* value split and its inefficiencies, and thus assume that there is no *ex ante* inefficiency such as under-investment problems, which have been extensively analyzed in the literature on the property-rights theory. Specifically, we assume that the relationship-specific investment has been efficiently sunk and our theory does not include *ex ante* investment stage.

The game proceeds as follows. First, a governance structure is chosen (whether to integrate or not) to minimize *ex post* inefficiencies. Second, the parties simultaneously choose their levels of rent seeking, and the value split is then initiated. After the value split, the trade occurs. Figure 1 summarizes how the value V is divided between the parties under each governance structure.[3]

The processes of the value split depend on the governance structure chosen at the beginning. Under non-integration, the parties engage in bilateral bargaining; if the bargaining is terminated without agreement, litigation takes place (i.e., a court decides how to divide the value). If disagreement occurs, the aggregate litigation payoff shrinks to δV where $\delta \in (0, 1)$ denotes a common discount factor.[4] Intuitively, litigation requires cumbersome processes that block immediate settlement. Nevertheless, in Model 1, we assume that the parties agree to the Nash bargaining solution, and hence *ex post* bargaining that takes place only under non-integration is efficient and there is no litigation. Under integration, on the other hand, there is no bargaining between the parties, and the division of V is determined by the third party who has authority (the boss).[5] The reason why bargaining does not take place under integration is intuitively explained as follows: since the boss cannot commit not to overcontrol, she might exercise fiat to override the agreement of bilateral bargaining between the parties, which spoils each party's incentive to engage in bilateral bargaining. For a formal justification for the assumption that integrated firms can

[3] All figures are located at the end of the main text. Figure 1 is based on Figure 1 in Tadelis and Williamson (2012)

[4] We can instead assume that the aggregate litigation payoff is $V - K$ $(K>0)$ without changing our main result.

[5] The view that integration means the use of third-party coordinator can also be found in Tadelis and Williamson (2012).

avoid costly bargaining, see Conclusion or Mori (2012).

The value split by the third party (the court's or the boss's decision making) is assumed to be affected by each party's rent seeking. Such rent seeking includes securing competent lawyers to obtain an advantage over the other party in litigation and flattering the boss. Under non-integration, party i's rent seeking increases his bargaining power by raising his expected litigation payoff, which serves as his endogenous outside option.[6] Under integration, on the other hand, party i's rent seeking increases his expected share of V by influencing the decision of the boss, and hence we interpret it as influence activity according to Milgrom and Roberts (1988).

We formalize rent seeking both between and within firms by employing Tullock's (1980) rent-seeking model. $d_i \in \mathbb{R}_+$ denotes the level of party i's rent seeking $(i = 1, 2)$ and is unobservable to the trading partner. When party i (resp. party j) provides the level of rent seeking d_i (resp. d_j), a third party distributes a share $d_i/(d_i + d_j)$ to him.[7] If neither party provides rent seeking ($d_1 = d_2 = 0$), each party receives half of V. Party i incurs rent-seeking cost $C(d_i) = kd_i$ where k is a positive constant.

We then examine each party's optimal rent-seeking level under non-integration. Party i can improve his payoff by increasing his threat point payoff (his litigation payoff), which is increasing in his rent-seeking level, d_i. Hence, i's optimal rent-seeking level d_i^* solves the following problem:

$$\max_{d_i} \frac{d_i}{d_i + d_j}\delta V + \frac{1}{2}(1 - \delta)V - kd_i.$$

Note that the parties agree to the Nash bargaining solution. The first term represents i's threat point payoff, the second term denotes his share of the remaining surplus $(1 - \delta)V$, and the last term is his rent-seeking cost. From symmetry assumption, we obtain $d_1^* = d_2^* = \delta V/4k \equiv d^*$.

[6]It is worth noting that our result continues to hold even if rent seeking is undertaken after bargaining breaks down. It follows because disagreement never occurs and rent seeking is completely avoided under non-integration. Since this discussion is somewhat trivial, we do not deal with this case.

[7]Note that the parties choose who is to be rent-sought by choosing governance structure (the court or the boss). In our models, the third parties are not players of the game, and hence we ignore their welfare.

Under integration, on the other hand, the parties affect their payoffs by undertaking influence activities. Let d_i^{**} denote party i's optimal influence level. d_i^{**} thus solves the following problem:

$$\max_{d_i} \frac{d_i}{d_i + d_j} V - kd_i.$$

We then find that $d_1^{**} = d_2^{**} = V/4k \equiv d^{**}(>d^*)$. Since rent-seeking cost $C(d) = kd$ is increasing in d, we can determine that non-integration incurs lower aggregate rent-seeking cost than integration (i.e., $2C(d^*)<2C(d^{**})$).

Model 1 presents the following observation: rent seeking between firms indirectly affects a rent seeker's payoff by increasing his threat point payoff. Thus, when the value V shrinks due to litigation, each party's incentive to provide rent seeking under non-integration becomes smaller than rent seeking under integration. In other words, when the aggregate threat point payoff must be smaller than the original V, non-integration can feature lower rent-seeking costs than integration.

3.2 Model 2: Opportunities to Concede

In the last subsection, we pointed out that indirect effect of rent seeking between firms on rent seeker's payoff makes each party less eager to undertake rent seeking. Nevertheless, if $\delta = 1$ holds, the result of Model 1 fails: if litigation triggers no shrinkage in the trade value, the choice of governance structure does not affect rent-seeking costs.

This subsection introduces the second model (Model 2) and shows that the presence of private information (each party's type) makes each party less willing to engage in rent seeking under non-integration even if $\delta = 1$ holds. This result stems from the fact that *ex post* inefficient bargaining, which occurs only under non-integration, provides each party with an opportunity to concede (i.e., to let his partner obtain a large share of the trade value). When each party becomes obstinate with high probability, any behavior other than concession is likely to delay agreement, and hence the rational type can optimally concede.

Since concession leads to no litigation, the rational type, expecting this outcome, chooses a low level of rent seeking.

There are some differences between Models 1 and 2: bargaining procedure and cost of delay. First, while the parties agree to the Nash bargaining solution in Model 1, the *ex post* bargaining in Model 2 is assumed to be a take-it-or-leave-it offer game. More specifically, in Model 2, either party sends an offer $x \in (0, 1)$, which denotes his demanded share of the value V, and the other party decides whether to accept it.[8] The right to make the offer is assigned to each party with equal probability at the beginning of the bargaining stage. If they reach agreement, the game ends. Otherwise, litigation takes place. Second, unlike Model 1, we assume that there is no cost of delay (i.e., disagreement does not prevent immediate settlement: $\delta = 1$ holds) in Model 2. As mentioned above, in Model 1, if $\delta = 1$ holds, the result fails. Thus, Model 2 is more than just an extension of Model 1 to non-cooperative bargaining and offers a completely different insight into how non-integration economizes rent-seeking costs.

Furthermore, in Model 2, to focus on the effect of private information on each party's rent-seeking behavior, we assume that the parties may be obstinate with probability $\varepsilon \in (0, 1)$ (and rational with probability $1 - \varepsilon$). This probability of being obstinate is common knowledge. The obstinate type always demands a share $\theta(>1/(1 + \delta))$ for himself and never accepts any offer or the division specified by the third party unless he can obtain at least θ of V.[9] The rational type, on the other hand, accepts any division larger than or equal to 0, but can strategically mimic the obstinate type. (Since the parties do not have time to build a reputation for obstinacy, reputation effect plays little role in this model. We will deal with the reputation effect in Model 3.) As mentioned previously, the parties are symmetric, and hence share the parameters θ and ε.

[8] We refer to the proposer as "he" and the responder as "she" for the purpose of identification only.

[9] Existing literature typically assumes that θ is larger than the equilibrium share of a complete information Rubinstein offers game. $1/(1+\delta)$ is the equilibrium share of an infinite-horizon, symmetric offers game. Although Model 2 deals with one-period bargaining, the assumption $\theta>1/(1 + \delta)$ does not affect our main result.

The parties are uncertain about their own types before the value split is initiated. That is, they behave rationally in the rent-seeking stage, although with probability ε they can be obstinate in the stages following the rent-seeking stage (e.g., the bargaining stage). Intuitively, once each party faces his opponent (i.e., his partner), he can lose control of himself.[10]

We adopt the same setting for rent seeking as in Model 1 and focus on symmetric rent-seeking equilibrium. Given symmetric rent-seeking behavior, the third party (the court or the boss) determines the equal division of the value V, and hence the rational type obtains the expected payoff $(1-\varepsilon)V/2$ from the third party's division. Note that since $1/2<\theta$ holds, the obstinate type rejects the division specified by the third party and terminates the relationship, in which case both parties obtain nothing.

In order to show our result clearly, we make the following assumption in this subsection:

$$2\theta - 1 \leq \varepsilon < \theta. \tag{1}$$

The first inequality implies that $(1-\theta)V \geq (1-\varepsilon)V/2$, which means the rational responder prefers to accept the offer $x = \theta$ rather than reject it, given that both parties choose the same rent-seeking level. By the second inequality, which can be rewritten as $1-\theta<1-\varepsilon$, the parties prefer litigation to concession if they can obtain the whole value V in litigation against their rational partners. "Concession" means a party either accepts $(1-\theta)V$ for herself or offers $x = 1-\theta$.

We begin in Section 3.2.1 by specifying each party's optimal offer and acceptance decision in the bargaining stage. Section 3.2.2 then determines each party's optimal rent-seeking level, given the optimal behavior in the bargaining stage. In Section 3.2.3, we show the result that non-integration features lower rent-seeking costs than integration and explain its intuition.

[10] For the case in which the obstinate type is assumed to behave obstinately throughout the game (e.g., the obstinate type chooses irrationally high rent-seeking level which the rational type cannot match), see Section 4.5.

3.2.1 The Bargaining Stage

We here examine the bargaining stage, which takes place only under non-integration. Since the obstinate type behaves mechanically in the bargaining stage, we must only specify the behavior of the rational type. Furthermore, for simplicity, we focus on pure strategies and do not consider mixed strategies. There are two cases to be analyzed separately.

Case 1. We first analyze the case in which the rational proposer concedes even if his rational partner concedes; that is, the case in which the following condition holds:

$$(1-\theta)V \geq (1-\varepsilon)\theta V. \tag{2}$$

The right-hand side of the condition is the proposer's expected payoff when he mimics the obstinate type (offers $x = \theta$) and his rational partner concedes. Intuitively, when ε is sufficiently high, his inflexible offer $x = \theta$ is likely to be rejected and lead to trade termination. Hence, even though $x = \theta$ is accepted by the rational responder, the rational proposer voluntarily concedes.

We then study the acceptance decision by the rational responder. The rational responder accepts the offer $x = \theta$ because $x = \theta$ means the proposer is obstinate given the equilibrium offer of the rational proposer. Any offer other than $x = \theta$ reveals the proposer as rational, and thus the rational responder obtains $(1/2)V$ in litigation. Hence, the rational responder accepts any offer $x \leq 1/2$ and $x = \theta$ and rejects any offer $x>1/2$ and $x \neq \theta$.

Case 2. Suppose condition (2) does not hold. The rational proposer then optimally offers $x = \theta$. The acceptance decision by the rational responder, on the other hand, is the same as in Case 1 because condition (1) holds, namely $(1-\theta)V \geq (1-\varepsilon)V/2$. That is, she accepts any offer $x \leq 1/2$ and $x = \theta$ and rejects any offer $x>1/2$ and $x \neq \theta$.

3.2.2 The Rent-Seeking Stage

Non-Integration

We now determine each party's optimal rent-seeking level in Cases 1 and 2 given the behavior in the bargaining stage specified above. Note that both parties choose their rent-seeking levels rationally in the situation in which each party receives the right to make an offer with equal probability and becomes obstinate with probability ε in the bargaining stage. As mentioned above, we focus on symmetric rent-seeking equilibrium.

Section 3.2.1 implies that the game ends with either concession by the rational type or termination by the obstinate type. However, this does not imply that the parties have no incentive to undertake rent seeking. Suppose party i undertakes small but positive rent seeking but party j does not. When party i is the proposer in the bargaining, i offers $x = 1$ because i prefers litigation (to obtain the whole V) to concession from condition (1), $1 - \varepsilon > 1 - \theta$. When party i becomes the responder in the bargaining stage, on the other hand, i rejects j's offer $x = 1 - \theta$ because it reveals party j as rational and hence party i can obtain the whole value V in litigation.

Case 1: Let d_1^* represent the optimal rent-seeking level in Case 1. The equilibrium payoff to party i, denoted by u_i, is then given by

$$\begin{aligned} u_i =& \frac{1}{2}[(1-\varepsilon)(1-\theta)V + \varepsilon(1-\varepsilon)\theta V] \\ &+ \frac{1}{2}[(1-\varepsilon)\{(1-\varepsilon)\theta V + \varepsilon(1-\theta)V\} + \varepsilon(1-\varepsilon)\theta V] - kd_1^*. \end{aligned}$$

The first line (resp. second line) represents i's expected payoff when i is the proposer (resp. the responder) given that each party can be obstinate with probability ε in the bargaining.

In Case 1, there are two possible deviations: (i) a party chooses high rent-seeking level and triggers litigation (i.e., offers $x = 1$) if he becomes the rational proposer in the bargaining stage or (ii) a party provides high rent-seeking level, rejects the rational proposer's equilibrium offer $x = 1 - \theta$, and goes to court when she becomes the rational responder. Let $d_{(i)}$ (resp. $d_{(ii)}$) denote the rent-seeking level that prevents deviation (i) (resp. deviation (ii)). Since the parties are uncertain whether they will be the proposer or the responder in the bargaining stage, they choose the rent-seeking level that prevents the deviations, no matter what role they play in the bargaining. That is, each party provides $d_1^* = \max[d_{(i)}, d_{(ii)}]$. We can easily determine that $d_{(i)} > d_{(ii)}$, since the smaller the payoff party i wants party j to accept, the more i has to engage in rent seeking to prevent j's deviation. We thus find that $d_1^* = d_{(i)}$ and both deviations are prevented.

Consider rational party i's deviation (i): i chooses $d_1^* + e^*$ instead of d_1^* and, if i becomes the rational proposer, offers $x = 1$ to trigger litigation. Such e^* solves

$$\max_e \frac{1}{2}(1-\varepsilon)\frac{(1-\varepsilon)(d_1^*+e)}{d_1^*+(d_1^*+e)}V - k(d_1^*+e).$$

Note that this deviation occurs when party i is the rational proposer, which occurs with probability $(1-\varepsilon)/2$, and the trade is not terminated when i's partner is rational, which occurs with probability $1-\varepsilon$. If i deviates, i's expected payoff u_i' is given by

$$\begin{aligned} u_i' =& \frac{1}{2}\left[(1-\varepsilon)\frac{(1-\varepsilon)(d_1^*+e^*)}{d_1^*+(d_1^*+e^*)}V + \varepsilon(1-\varepsilon)\theta V\right] \\ &+ \frac{1}{2}[(1-\varepsilon)\{(1-\varepsilon)\theta V + \varepsilon(1-\theta)V\} + \varepsilon(1-\varepsilon)\theta V] - k(d_1^*+e^*). \end{aligned}$$

In order to prevent such a deviation, d_1^* must keep party i indifferent about whether to deviate in the situation in which i is uncertain about his type and role in the bargaining.[11] That is, d_1^* satisfies $u_i = u_i'$. We thus obtain

$$d_1^* = \frac{(1-\varepsilon)\left\{\sqrt{1-\varepsilon} - \sqrt{1-2\theta+\varepsilon}\right\}^2}{8k}V.$$

Case 2: We next derive each party's optimal rent-seeking level in Case 2, d_2^*. The expected equilib-

[11]We assume that in such a situation, the parties choose not to deviate.

rium payoff to each party j is given by:

$$u_j = \frac{1}{2}[(1-\varepsilon)^2\theta V + \varepsilon(1-\varepsilon)\theta V] + \frac{1}{2}(1-\varepsilon)(1-\theta)V - kd_2^*.$$

The first term (resp. second term) represents j's expected payoff when j is the proposer (resp. the responder). Note that each party can be obstinate with probability ε and becomes the proposer with equal probability in the bargaining.

As in Case 1, there are two possible deviations: (iii) a party chooses high rent-seeking level and triggers litigation ($x = 1$) when he becomes the rational proposer or (iv) a party provides high rent-seeking level and rejects the proposer's equilibrium offer $x = \theta$ if she becomes the rational responder. Let $d_{(iii)}$ (resp. $d_{(iv)}$) denote the rent-seeking level that prevents deviation (iii) (resp. deviation (iv)). Since the equilibrium payoff of the rational responder is smaller than that of the rational proposer (i.e., condition (2) does not hold), we obtain $d_{(iv)} > d_{(iii)}$. The parties thus choose $d_2^* = d_{(iv)}$ to prevent both deviations no matter what role they play in the bargaining.

Consider party j's deviation (iv): j chooses $d_2^* + e'$ and, if j becomes the rational responder, rejects $x = \theta$ to trigger litigation, where e' solves

$$\max_e \frac{1}{2}(1-\varepsilon)\frac{(1-\varepsilon)(d_2^*+e)}{d_2^* + (d_2^*+e)}V - k(d_2^*+e).$$

Note that the deviation occurs when party j becomes the rational responder with probability $(1-\varepsilon)/2$ and the probability with which the trade is not terminated (namely, j's partner is rational) is $1-\varepsilon$. j's expected payoff from deviation, defined as u_j', is given by

$$\begin{aligned} u_j' =& \frac{1}{2}\left[(1-\varepsilon)^2\theta V + \varepsilon(1-\varepsilon)\theta V\right] \\ &+ \frac{1}{2}(1-\varepsilon)\frac{(1-\varepsilon)(d_2^*+e')}{d_2^* + (d_2^*+e')}V - k(d_2^*+e'). \end{aligned}$$

As in Case 1, d_2^* must satisfy $u_j = u_j'$, and thus

$$d_2^* = \frac{(1-\varepsilon)\left\{\sqrt{1-\varepsilon} - \sqrt{1-2\theta+\varepsilon}\right\}^2}{8k}V = d_1^*.$$

Integration

Since there is no bargaining under integration, the parties only undertake influence activities to improve the final division in their favor. That is, party i solves the following problem:

$$\max_{d_i} \frac{(1-\varepsilon)^2 d_i}{d_i + d_j} V - k d_i.$$

In equilibrium, the boss distributes V equally to each party and the obstinate type terminates the relationship, and thus the trade takes place if both parties are rational, which occurs with probability $(1-\varepsilon)^2$. We then find that each party chooses d_I^*:

$$d_I^* = \frac{(1-\varepsilon)^2}{4k} V.$$

3.2.3 Rent-Seeking Reduction under Non-Integration

We can determine that $d_I^* > d_1^*$ and $d_I^* > d_2^*$. Since $C(d) = kd$ is increasing in d, this implies that integration features higher rent-seeking costs than non-integration (i.e., $C(d_I^*) > C(d_1^*)$ and $C(d_I^*) > C(d_2^*)$). This result stems from the presence of *ex post* inefficient bargaining. That is, the bargaining stage provides the parties with opportunities to concede.

The intuition of the result is as follows. When the parties are obstinate with high probability (ε is high), the rational type's litigation payoff $(1-\varepsilon)V/2$ is likely to be smaller than the concession payoff $(1-\theta)V$. Given that ε is high, the rational type thus prefers to concede rather than behave obstinately. Since concession terminates the game and litigation never takes place, the parties, expecting this outcome, choose low rent-seeking levels. As discussed, under non-integration, the parties provide the minimum rent-seeking level, which prevents their partners' deviations (if rational) no matter what roles they play in the bargaining.

3.3 Interim Summary

In this section, we presented two reasons why rent seeking between firms is less prevalent than rent seeking within firms (influence activity). First, rent seeking between firms affects the parties' payoffs indirectly, while rent seeking within firms affects them directly. Second, *ex post* bargaining, which occurs only under non-integration, provides the parties with opportunities to concede.

The analyses in this section offer some important implications for the theory of firm boundaries. First, larger trade value V makes both non-integration and integration more costly. Models 1 and 2 showed that rent-seeking costs under non-integration are increasing in the size of V. This corresponds to the main prediction of TCE: larger trade value makes non-integration more costly. Furthermore, we can show that influence costs are also increasing in V. This observation is consistent with Williamson (1973), who argues, "Substantially the same factors that are ultimately responsible for market failures also explain failures of internal organization" (p. 316).

Second, rent seeking within firms is likely to be more costly than rent seeking between firms. As discussed above, rent-seeking costs under integration are always higher than those under non-integration. This result offers a formal justification for the "costs of bureaucracy" in Williamson (1985, Chapter 6). Williamson (1985) submits that internal operating is more subject to politicization, which our result is consistent with.

In this section, we analyzed two factors, which make rent seeking under non-integration less costly than rent seeking under integration, separately to show their effects starkly. The next section presents Model 3, in which both factors are at work and not only rent seeking but also bargaining costs (delay and breakdown) affect firm boundaries.

4 The Trade-off between Rent Seeking and Bargaining Costs

This section presents a general model (Model 3) in which (i) both of the previously discussed factors leading to more prevalent rent seeking within firms co-exist and (ii) bargaining costs (delay and breakdown) are introduced. We show that there is a trade-off between rent seeking and bargaining costs by applying the results of Abreu and Gul (2000) and Compte and Jehiel (2002).

In Model 3, unlike Models 1 and 2, the bargaining stage is assumed to be an infinite-horizon, alternating-offers bargaining game with private information (each party's type), and hence the reputation effect plays a central role. That is, the rational type has an incentive and an opportunity to build a reputation for obstinacy, which leads to bargaining costs.

The modified bargaining stage proceeds as follows. At the beginning of the stage, the right to make the first offer is assigned to each party with equal probability. Consider period t in which party i is the proposer ($t = 0, 1, 2, \dots$). Party i either takes legal steps or makes party j an offer $x_i^t \in (0, 1)$, which denotes his demanded share of the trade value V. If party i takes legal action, litigation occurs in period $t + 1$ and the court specifies the division of V.[12] If party i makes an offer x_i^t, party j either accepts it, rejects it (and postpones the negotiation), or takes legal action. If party j accepts the offer, the game ends. When party j rejects the offer, the game continues and j makes the next offer in period $t + 1$. If party j takes legal action, litigation takes place and the court determines the division of V in period $t + 1$. The game continues unless the parties can reach agreement or one takes legal steps. Party i's payoff when the parties reach agreement in period t is given by $\delta^t \alpha_i V$, where δ denotes a common discount factor and α_i is his share specified by the accepted offer or the third party (the court or the boss).

As in the previous section, litigation endogenously determines the parties' outside options. Since we continue to focus on a symmetric rent-seeking equilibrium, each party's litigation payoff when one of

[12] If litigation occurs without such a time lag, the parties take legal steps immediately, which means the choice of governance structure does not matter.

the parties takes legal steps in period t is given by $(\delta^{t+1}/2)V$. For notational convenience, we define $w \equiv \delta/2$. Figure 2 summarizes the modified bargaining stage.[13]

We further make the following five additional assumptions. First, the obstinate type never takes legal action, which means perpetual disagreement (bargaining breakdown) occurs if both parties are obstinate. Second, the obstinate type accepts any division determined by the third party.[14] Intuitively, the obstinate parties behave obstinately against people of equal rank (their partners), but reconcile to the third parties in authority (the court and the boss). These two assumptions imply that, when both parties are obstinate, while an agreement cannot be reached under non-integration, it is guaranteed under integration. Third, δ is sufficiently close to 1. Specifically, $\delta > v^*(= 1/(1+\delta))$ holds, which means each party does not accept the equilibrium share of a complete-information, symmetric Rubinstein offers game, v^*, if he can obtain the whole value V in litigation. Fourth, mixed strategies are available to the parties. Finally, as in Compte and Jehiel (2002), $(1-\varepsilon)v^*V + \varepsilon\delta wV > wV$ holds. This implies that each party prefers to obtain the litigation payoff in period $t+2$ with probability ε (the probability of being obstinate) and the Rubinstein equilibrium share in period t with probability $1-\varepsilon$ rather than take legal action in period t when both parties choose the same rent-seeking level.

Note that two factors we presented in the previous section are included in the model: (i) litigation loss (the aggregate litigation payoff is smaller than V) and (ii) private information. In addition, there can be bargaining delay due to reputation building and bargaining breakdown.

Section 4.1 shows that our bargaining stage has two structures similar to those developed in Abreu and Gul (2000) and Compte and Jehiel (2002). Sections 4.2 and 4.3 analyze the bargaining stage and the rent-seeking stage respectively. In Section 4.4, we explore the trade-off between rent seeking and bargaining costs and present a comparative static analysis of the result. Section 4.5 briefly discusses two

[13]Figure 2 is based on Figure 1 in Atakan and Ekmekci (2010).

[14]Although our result would continue to hold without this assumption, the analyses become a bit messy. We discuss the issue in Section 4.5.

extensions: asymmetric parties and strong obstinacy.

4.1 Two Structures in the Bargaining Stage

Our bargaining model has two game structures developed in previous studies: one corresponds to the structure of Abreu and Gul (2000) and the other is similar to the model of Compte and Jehiel (2002). We hereafter refer to these respectively as the AG structure and the CJ structure.

AG Structure: The AG structure describes the situation in which the rational type prefers to concede rather than take legal steps (i.e., $wV \leq (1-\theta)V$ holds, where θ denotes the obstinate type's inflexible demand). Hence, no litigation takes place in equilibrium. Given that each party's litigation payoff serves as his outside option, our bargaining stage corresponds to the bargaining game developed in Abreu and Gul (2000): an infinite-horizon, alternating-offers bargaining *without* outside options.

CJ Structure: The second structure considers the situation in which $wV>(1-\theta)V$ holds. Since the rational type prefers litigation to concession, he is willing to take legal action when his partner is obstinate with high probability. Thus, our bargaining game is equivalent to an infinite-horizon, alternating-offers bargaining game *with* outside options (i.e., the bargaining game that Compte and Jehiel (2002) analyze).

4.2 The Bargaining Stage

We here study the bargaining stage that occurs only under non-integration. Since the obstinate type behaves mechanically, we focus on the rational type's behavior under each structure.

AG structure ($wV \leq (1-\theta)V$): The AG structure corresponds to the symmetric version of the game developed in Abreu and Gul (2000). Hence, we can apply their result.

LEMMA 1 (The Symmetric Version of Abreu and Gul's (2000) Proposition 4 and Compte and Jehiel's (2002) Proposition 3): *Consider the symmetric bargaining game described above and the case in which the rational type prefers concession to litigation (i.e., $wV \leq (1-\theta)V$ holds). The equilibrium payoff of* *the rational type converges to* $(1-\theta)V$ *as* δ *goes to 1 in any Perfect Bayesian Equilibrium of the game.*

PROOF: See Abreu and Gul's (2000) Proposition 4 or Compte and Jehiel's (2002) Proposition 3. □

Under AG structure, the rational type tries to build a reputation for obstinacy because if his partner (if rational) concedes, he can obtain a large share θ. However, he prefers concession if his partner never concedes (namely, if his partner is obstinate). He then concedes only at the constant rate that keeps his partner (if rational) indifferent between revealing himself as rational and mimicking the obstinate type, which causes delay in equilibrium.

As Abreu and Gul (2000) and Compte and Jehiel (2002) note, the delay emerges clearly in the symmetric case because "parties are equally strong (weak), and thus no party is prepared to give in first with a significant probability" (Compte and Jehiel, 2002, p.1486). To see this, it is worth discussing the asymmetric case in terms of θ, ε, and δ. In the asymmetric case, one of the parties (e.g., party i) needs more time to build a reputation for obstinacy than the other (party j). That is, $T_i < T_j$, where T_i denotes the period in which party i's belief about party j's obstinacy reaches 1. Hence, in order that both parties will be known to be obstinate by the same time $T \equiv \min[T_i, T_j]$, the weaker party i has to reveal himself as rational (i.e., concede) immediately with positive probability, which is denoted by π.[15] Party j then does not concede immediately because he has the chance to get θ. Since only party i immediately concedes with probability π and the rational type randomizes his behavior after time 0, as δ goes to 1, the equilibrium payoff of the rational party i (resp. party j), which is denoted by u_i (resp. u_j), converges to $u_i = (1-\theta)V$ (resp. $u_j = \pi\theta V + (1-\pi)(1-\theta)V$).

In the symmetric case, however, both parties will be known to be obstinate by the same time without such an immediate concession ($T = T_i = T_j$). Since no immediate concession occurs ($\pi = 0$), the

[15]See Abreu and Gul (2000) or Compte and Jehiel (2002) for detailed descriptions of T_i (T^j in Abreu and Gul (2000) and ϕ_i in Compte and Jehiel (2002)) and π ($\hat{F}^i(0)$ in Abreu and Gul (2000)).

expected payoff of the rational type becomes $(1-\theta)V$ when δ is close to 1.

CJ Structure ($wV>(1-\theta)V$): Under the CJ structure, the bargaining stage is equivalent to the game developed by Compte and Jehiel (2002). Hence we can apply the symmetric version of Compte and Jehiel's (2002) Proposition 5 to our bargaining stage.

LEMMA 2 (The Symmetric Version of Compte and Jehiel's (2002) Proposition 5): *Consider the case in which the rational type prefers litigation to concession (i.e., $wV>(1-\theta)V$). The game then has a unique Perfect Bayesian Equilibrium. Let μ_i^h denote the current equilibrium probability that party i $(=1,2)$ is obstinate given history h. Whatever history h, $\mu_i^h \in \{0, \varepsilon, 1\}$.*

(i) If both parties are known to be rational (i.e., $\mu_i^h = \mu_j^h = 0$), they behave as in the complete information strategy profile in a symmetric alternating-offers game. That is, in each period, the proposer (e.g., party i) offers $x_i^t = v^*$ and the responder accepts an offer x_i^t iff $x_i^t \leq v^*$.

(ii) Consider a period t with history h in which party i is the proposer. If $\mu_j^h = \varepsilon$, party i (if rational) offers $x_i^t = v^*$ to party j. If $\mu_j^h = 1$, i takes legal steps.

(iii) Consider a period t in which party j is the proposer. Party i (if rational) accepts any offer $x_j^t \leq v^*$, rejects any offer greater than v^*, and takes legal action if i receives $x_j^t = \theta$.

PROOF: See Proposition 5 in Compte and Jehiel (2002) $\square$

This lemma suggests that the rational type reveals himself as rational immediately. In equilibrium, if party i makes an offer $x_i^t = \theta$, his partner j (if rational) believes that i is obstinate with probability 1, and thus takes legal steps because j prefers litigation to concession (i.e., $wV>(1-\theta)V$ holds). Party i (if rational) thus obtains only $\delta^t wV$ by mimicking the obstinate type. Since $wV<v^*V$, i has no incentive to mimic the obstinate type.

4.3 The Rent-Seeking Stage

We next analyze the rent-seeking stage and examine each party's optimal rent-seeking level under each governance structure given the equilibrium behavior in the bargaining stage. As mentioned earlier, we continue to focus on a symmetric rent-seeking equilibrium.

Non-Integration: AG Structure

Lemma 1 implies that no litigation occurs in equilibrium (the game ends with concession or perpetual disagreement). Nevertheless each party must undertake rent seeking because if party i does not undertake rent seeking (i.e., $d_i = 0$), his partner j chooses a low but positive rent-seeking level and immediately takes legal steps, which yields i nothing. Thus, in equilibrium, each party's litigation payoff must be smaller than or equal to his concession payoff $(1-\theta)V$.

Given that only the rational type triggers litigation, litigation is prevented if each party's choice of rent-seeking level d_{AG} satisfies the following condition:

$$(1-\varepsilon)(1-\theta)V - kd_{AG} = (1-\varepsilon)\frac{\delta(d_{AG}+e_{AG})}{d_{AG}+(d_{AG}+e_{AG})}V - k(d_{AG}+e_{AG})$$

where e_{AG} solves

$$\max_e (1-\varepsilon)\frac{\delta(d_{AG}+e)}{d_{AG}+(d_{AG}+e)}V - k(d_{AG}+e).$$

This condition suggests that party i's choice d_{AG} makes his partner j indifferent about whether to choose d_{AG} (to play the equilibrium strategy in the bargaining) or $d_{AG}+e_{AG}$ (to deviate from the equilibrium behavior in the bargaining stage). d_{AG} is thus given by

$$d_{AG} = \frac{(1-\varepsilon)\left\{\sqrt{\delta} - \sqrt{2(1-\theta)-\delta}\right\}^2}{4k}V.$$

Non-Integration: CJ Structure

Lemma 2 suggests that litigation takes place if one party is rational but the other is not. Suppose that each party provides symmetric rent-seeking level d. Party i's expected payoff is then given by

$$\begin{aligned} u_i =& \frac{1}{2}\left[(1-\varepsilon)\left\{(1-\varepsilon)v^*V + \varepsilon\delta wV\right\} + \varepsilon(1-\varepsilon)wV\right] \\ &+ \frac{1}{2}\left[(1-\varepsilon)\left\{(1-\varepsilon)(1-v^*)V + \varepsilon wV\right\} + \varepsilon(1-\varepsilon)\delta wV\right] - kd. \end{aligned}$$

The first line (resp. second line) represents i's expected payoff when i is the first proposer (resp. the first responder) given that each party can be obstinate with probability ε in the bargaining.

We then specify the optimal rent-seeking level, d_{CJ}. There are two possible deviations: (v) a party chooses high rent-seeking level in the rent-seeking stage and takes legal action immediately if he becomes rational and the first proposer in the bargaining stage or (vi) a party provides high rent-seeking level and immediately sues the proposer when she becomes the rational responder in period 0. Let $d_{(v)}$ (resp. $d_{(vi)}$) represent the rent-seeking level that prevents deviation (v) (resp. deviation (vi)).

To prevent deviation (v), each party's rent-seeking level $d_{(v)}$ must keep his partner indifferent about whether to deviate, which means it must satisfy the following conditions:

$$\begin{aligned} &\frac{1-\varepsilon}{2}\{(1-\varepsilon)v^*V + \varepsilon\delta wV\} + \frac{\varepsilon(1-\varepsilon)}{2}wV + \frac{(1-\varepsilon)\varepsilon}{2}wV + \frac{\varepsilon(1-\varepsilon)}{2}\delta wV - kd_{(v)} \\ =& \left\{\frac{1-\varepsilon}{2} + \frac{\varepsilon(1-\varepsilon)}{2} + \frac{(1-\varepsilon)\varepsilon}{2}\right\}\frac{\delta(d_{(v)}+e_{(v)})}{d_{(v)}+(d_{(v)}+e_{(v)})}V + \frac{\varepsilon(1-\varepsilon)}{2}\frac{\delta^2(d_{(v)}+e_{(v)})}{d_{(v)}+(d_{(v)}+e_{(v)})}V - k(d_{(v)}+e_{(v)}) \end{aligned}$$

where $e_{(v)}$ satisfies

$$\max_e \left\{\frac{1-\varepsilon}{2} + \frac{\varepsilon(1-\varepsilon)}{2} + \frac{(1-\varepsilon)\varepsilon}{2}\right\}\frac{\delta(d_{(v)}+e_{(v)})}{d_{(v)}+(d_{(v)}+e_{(v)})}V + \frac{\varepsilon(1-\varepsilon)}{2}\frac{\delta^2(d_{(v)}+e_{(v)})}{d_{(v)}+(d_{(v)}+e_{(v)})}V - k(d_{(v)}+e_{(v)}).$$

Suppose party i chooses the rent-seeking level $d_{(v)} + e_{(v)}$ instead of $d_{(v)}$. Such a deviation improves i's litigation payoff, which is exercised in the following four cases. First, if i is rational and becomes the first proposer, he immediately takes legal action (probability $(1-\varepsilon)/2$). Second, if i becomes obstinate and sends the first offer, his rational partner immediately sues him (probability $\varepsilon(1-\varepsilon)/2$). Third, if i becomes rational and receives the first offer, she sues her obstinate partner immediately (probability

$(1-\varepsilon)\varepsilon/2)$. Lastly, if i is obstinate and receives the first offer, her rational partner takes legal action in period 1 (probability $\varepsilon(1-\varepsilon)/2$).

Similarly, to prevent deviation (vi), each party's rent-seeking level $d_{(vi)}$ must make his partner indifferent about whether to deviate (namely, to choose high rent-seeking level and sues him immediately). That is, $d_{(vi)}$ satisfies

$$\frac{(1-\varepsilon)\varepsilon}{2}\delta wV + \frac{\varepsilon(1-\varepsilon)}{2}wV + \frac{(1-\varepsilon)}{2}\{(1-\varepsilon)(1-v^*)V + \varepsilon wV\} + \frac{\varepsilon(1-\varepsilon)}{2}\delta wV - kd_{(vi)}$$

$$= \left\{\frac{1-\varepsilon}{2} + \frac{\varepsilon(1-\varepsilon)}{2}\right\}\frac{\delta(d_{(vi)}+e_{(vi)})}{d_{(vi)}+(d_{(vi)}+e_{(vi)})}V + \left\{\frac{(1-\varepsilon)\varepsilon}{2} + \frac{\varepsilon(1-\varepsilon)}{2}\right\}\frac{\delta^2(d_{(vi)}+e_{(vi)})}{d_{(vi)}+(d_{(vi)}+e_{(vi)})}V$$
$$-k(d_{(vi)}+e_{(vi)})$$

where $e_{(vi)}$ satisfies

$$\max_e \left\{\frac{1-\varepsilon}{2} + \frac{\varepsilon(1-\varepsilon)}{2}\right\}\frac{\delta(d_{(vi)}+e_{(vi)})}{d_{(vi)}+(d_{(vi)}+e_{(vi)})}V$$
$$+ \left\{\frac{(1-\varepsilon)\varepsilon}{2} + \frac{\varepsilon(1-\varepsilon)}{2}\right\}\frac{\delta^2(d_{(vi)}+e_{(vi)})}{d_{(vi)}+(d_{(vi)}+e_{(vi)})}V - k(d_{(vi)}+e_{(vi)}).$$

We thus obtain

$$d_{(v)} = \frac{(1-\varepsilon)\left[\sqrt{\delta(1+2\varepsilon+\delta\varepsilon)} - \sqrt{\delta(1+2\varepsilon+\delta\varepsilon) - 2\{\delta+\delta\varepsilon-(1-\varepsilon)v^*\}}\right]^2}{8k}V$$

and

$$d_{(vi)} = \frac{(1-\varepsilon)\left[\sqrt{\delta(1+\varepsilon+2\delta\varepsilon)} - \sqrt{\delta(1+\varepsilon+2\delta\varepsilon) - 2\{\delta+\delta^2\varepsilon-(1-\varepsilon)(1-v^*)\}}\right]^2}{8k}V.$$

Since the parties are uncertain what role they will play in period 0, they choose $\max[d_{(v)}, d_{(vi)}]$ to prevent every possible deviation.

We next examine the rent-seeking level each party provides given that no one deviates. Let d_n denote such a level. d_n maximizes party i's expected payoff, and thus solves

$$\max_{d_i}\frac{1}{2}\left[(1-\varepsilon)\left\{(1-\varepsilon)v^*V + \varepsilon\delta\frac{\delta d_i}{d_i+d_j}V\right\} + \varepsilon(1-\varepsilon)\frac{\delta d_i}{d_i+d_j}V\right]$$
$$+\frac{1}{2}\left[(1-\varepsilon)\left\{(1-\varepsilon)(1-v^*)V + \varepsilon\frac{\delta d_i}{d_i+d_j}V\right\} + \varepsilon(1-\varepsilon)\delta\frac{\delta d_i}{d_i+d_j}V\right] - kd_i.$$

From player symmetry, we obtain

$$d_n = \frac{(1-\varepsilon)\varepsilon(1+\delta)\delta}{4k}V.$$

Since each party is uncertain whether he can send the first offer in the bargaining stage, he provides rent-seeking level $d_{CJ} = \max[d_{(v)}, d_{(vi)}, d_n]$.

Integration

The process of the value split under integration is the same as in Model 1. Hence, party i chooses rent-seeking level d_I, which solves the following problem:

$$\max_{d_i} \frac{d_i}{d_i + d_j}V - kd_i.$$

From symmetry assumption, we obtain $d_I = V/4k$.

4.4 Markets versus Hierarchies: A Comparison of Transaction Costs

We first focus on rent-seeking costs. From the discussion above, we can derive the following fact: $d_I > d_{AG}$ and $d_I > d_{CJ}$. Since $C(d) = kd$ is increasing in d, this implies $C(d_I) > C(d_{AG})$ and $C(d_I) > C(d_{CJ})$, which suggests that non-integration always incurs lower rent-seeking cost than integration. We thus find that the results shown in Section 3 continue to hold in Model 3. Let Δd_{AG} (resp. Δd_{CJ}) represent an excess of the aggregate influence cost over the aggregate rent-seeking cost under the AG structure (resp. the CJ structure); that is,

$$\Delta d_{AG} \equiv 2C(d_I) - 2C(d_{AG}) = 2k(d_I - d_{AG}) > 0$$

and

$$\Delta d_{CJ} \equiv 2C(d_I) - 2C(d_{CJ}) = 2k(d_I - d_{CJ}) > 0.$$

We next analyze bargaining costs. From the existing literature (e.g., Kambe, 1999), under the AG structure, each party's expected payoff, denoted by u^{AG}, is approximately given by[16]

$$u^{AG} = (1-\theta)V - \varepsilon^2\delta^T(1-\theta)V = (1-\varepsilon^2\delta^T)(1-\theta)V.$$

Since no one concedes immediately and the rational type employs the mixed strategy, each party expects a payoff $(1-\theta)V$ (Lemma 1). However, if both parties are obstinate (with probability ε^2), perpetual disagreement occurs and each party loses the chance to obtain $\delta^T(1-\theta)V$. Let Δb_{AG} represent the total bargaining cost under the AG structure. Δb_{AG} is then given by

$$\Delta b_{AG} = V - 2u^{AG} = \{1-2(1-\varepsilon^2\delta^T)(1-\theta)\}V > 0.$$

Under the CJ structure, on the other hand, no rational party has an incentive to build a reputation for obstinacy (Lemma 2). Nevertheless, bargaining costs occur if either or both parties are obstinate. There are three cases in which bargaining costs arise. First, if the first proposer is obstinate but the responder is not, which occurs with probability $(1-\varepsilon)\varepsilon$, the game ends with litigation in period 1 (the rational party takes legal steps in period 0). Second, if the first proposer is rational but the responder is not, litigation takes place in period 2 because the rational party takes legal steps in period 1. The probability with which such a case occurs is $\varepsilon(1-\varepsilon)$. Lastly, if both parties are obstinate, which arises with probability ε^2, perpetual disagreement occurs. Thus the expected payoff to each party, defined as u^{CJ}, is given by

$$\begin{aligned} u^{CJ} =&(1-\varepsilon)\left[(1-\varepsilon)\left\{\frac{1}{2}v^*V + \frac{1}{2}(1-v^*)V\right\} + \varepsilon\left\{\frac{1}{2}\delta wV + \frac{1}{2}wV\right\}\right] \\ &+ \varepsilon\left[(1-\varepsilon)\left\{\frac{1}{2}wV + \frac{1}{2}\delta wV\right\} + \varepsilon 0\right]. \end{aligned}$$

The first line (resp. the second line) represents each party's expected payoff when he is rational (resp. obstinate). Notice that each party becomes the first proposer with equal probability and obstinate with

[16]Note that $T \equiv \min[T_i, T_j]$ and T_i denotes the period in which party i's belief about party j's obstinacy reaches 1.

probability ε. Hence, the total bargaining cost, denoted by Δb_{CJ}, is given by

$$\Delta b_{CJ} = V - 2u^{CJ} = [1 - (1-\varepsilon)\{(1-\varepsilon) + \varepsilon\delta(1+\delta)\}]V > 0.$$

We then have the following proposition:

PROPOSITION: *The optimal governance structure is summarized as follows.*

(i) When the litigation payoff is smaller than or equal to the concession payoff,

$$\begin{cases} \textit{Non-integration} & \textit{if } \Delta d_{AG} \geq \Delta b_{AG}, \\ \textit{Integration} & \textit{otherwise.} \end{cases}$$

(ii) When the litigation payoff is larger than the concession payoff,

$$\begin{cases} \textit{Non-integration} & \textit{if } \Delta d_{CJ} \geq \Delta b_{CJ}, \\ \textit{Integration} & \textit{otherwise.} \end{cases}$$

This proposition highlights an important trade-off which has never been focused on: while non-integration incurs lower rent-seeking costs than integration, it suffers from bargaining delay and breakdown that never occur under integration. In other words, the presence of inefficient bargaining can create a trade-off between rent-seeking costs and bargaining costs.

We now conduct comparative static analysis under each structure.

AG Structure Under the AG structure, non-integration is chosen if the following condition holds:

$$\Delta d_{AG} \geq \Delta b_{AG} \quad \Leftrightarrow \quad 2k\left[\frac{1}{4k} - \frac{(1-\varepsilon)\{\sqrt{\delta} - \sqrt{2(1-\theta)-\delta}\}^2}{4k}\right]V \geq \{1 - 2(1-\varepsilon^2\delta^T)(1-\theta)\}V.$$

We obtain the following results with respect to δ, θ, and ε. First, higher δ makes integration more likely to be chosen. There are two reasons for this. First, higher δ makes litigation loss $(1-\delta)V$, which leads to low rent-seeking levels, smaller, and hence the rent-seeking reduction also becomes smaller. Second, higher δ makes bargaining breakdown more costly ($2\varepsilon^2\delta^T(1-\theta)V$).

Second, larger θ makes non-integration less likely to be chosen. When θ is large, parties are apt to prefer litigation to concession under non-integration, and hence a high rent-seeking level is required to prevent deviations. In addition, larger θ leads to higher incentives to build a reputation for obstinacy because each party enjoys a share θ if his partner concedes.

Lastly, as ε decreases, both Δb_{AG} and Δd_{AG} decrease. The effect on Δb_{AG} is intuitive. When both parties are obstinate, while an agreement cannot be reached under non-integration (i.e., perpetual disagreement occurs), it is guaranteed under integration, which is the benefit of integration. As ε decreases, each party is less likely to be obstinate, and hence the benefit of integration becomes less significant. Nevertheless, lower ε also makes rent seeking under non-integration more costly. Under the AG structure, the only purpose of rent seeking is to prevent deviations by the rational type. Thus, the lower ε becomes, the more likely each party is to be rational, and hence the more careful he must be about his rational partner's deviation.

CJ Structure Under the CJ structure, on the other hand, if non-integration is chosen, then the following condition must hold:

$$\Delta d_{CJ} \geq \Delta b_{CJ} \quad \Leftrightarrow \quad 2k\left(\frac{1}{4k}V - d_{CJ}\right) \geq [1-(1-\varepsilon)\{(1-\varepsilon)+\varepsilon\delta(1+\delta)\}]V$$

where

$$d_{CJ} = \max[d_{(v)}, d_{(vi)}, d_n],$$

$$d_{(v)} = \frac{(1-\varepsilon)\left[\sqrt{\delta(1+2\varepsilon+\delta\varepsilon)} - \sqrt{\delta(1+2\varepsilon+\delta\varepsilon) - 2\{\delta+\delta\varepsilon-(1-\varepsilon)v^*\}}\right]^2}{8k}V,$$

$$d_{(vi)} = \frac{(1-\varepsilon)\left[\sqrt{\delta(1+\varepsilon+2\delta\varepsilon)} - \sqrt{\delta(1+\varepsilon+2\delta\varepsilon) - 2\{\delta+\delta^2\varepsilon-(1-\varepsilon)(1-v^*)\}}\right]^2}{8k}V,$$

and

$$d_n = \frac{(1-\varepsilon)\varepsilon(1+\delta)\delta}{4k}V.$$

We obtain the following comparative static results with respect to δ and ε. First, as δ increases, both Δd_{CJ} and Δb_{CJ} decrease. The higher δ becomes, the more directly rent seeking between firms affects the rent seeker's payoff, and hence the more eager each party becomes to engage in rent seeking (Δd_{CJ} decreases). Furthermore, higher δ makes loss due to bargaining delay smaller (Δb_{CJ} decreases).

Second, while Δb_{CJ} is increasing in ε, Δd_{CJ} is non-monotonic. The effect on Δb_{CJ} is straightforward. That is, if ε is high, the case in which both parties are obstinate occurs with high probability, and hence integration is likely to be chosen to avoid perpetual disagreement. The effect of ε on Δd_{CJ} is illustrated in Figure 3, which describes the case in which $\delta = 4/5$ and $k = 1$, and the upper envelope curve represents d_{CJ}. (Since d_I does not depend on ε, we only need to focus on the effect on d_{CJ}.) When ε is low, since the parties become rational with high probability, litigation is less likely to occur in equilibrium. Hence, if no one deviates, the parties have low incentives to undertake rent seeking (d_n is low). However, low ε makes deviations by the rational type more likely. Since the equilibrium payoff of a rational responder $\{(1-\varepsilon)(1-v^*)+\varepsilon w\}V$ is smaller than that of a rational proposer $\{(1-\varepsilon)v^*+\varepsilon\delta w\}V$ when ε is low, the rational responder is more eager to deviate than the rational proposer. Thus, $d_{(vi)}$ is high and $d_{CJ} = d_{(vi)}$ holds when ε is low. When ε is intermediate, the parties are equally likely to become either rational or obstinate. Hence, situations in which one party is rational but the other is not are likely to occur. In such situations, the game ends with litigation (i.e., the rational type takes legal action in period 0 or 1). Thus, d_n is high and $d_{CJ} = d_n$ holds. If ε is high (i.e., each party is very likely to be obstinate), the rational type's equilibrium offer $x_i^0 = v^*$ is likely to be rejected, which makes the rational proposer prefer to deviate (namely, choose high rent-seeking level and take legal action immediately). To prevent such a deviation, $d_{(v)}$ becomes high and $d_{CJ} = d_{(v)}$ holds if ε is high.

It is worth noting that d_{AG}, d_{CJ}, d_I, Δb_{AG}, and Δb_{CJ} are all increasing in the size of V. This implies that larger trade value makes both non-integration and integration more costly, which is consistent with the assertion of Williamson (1973).

4.5 Extensions: An Asymmetric Case and Strong Obstinacy

In concluding this section, we examine two extensions: an asymmetric case and strong obstinacy. Although these extensions are important, they are beyond the scope of the paper. Hence, we make brief comments on them and leave further analysis for future research. In both extensions, the trade-off between rent seeking and bargaining costs would continue to occur.

First, extending our model to the asymmetric case in terms of θ, ε, and δ is straightforward. Abreu and Gul (2000) and Compte and Jehiel (2002) whose frameworks we have employed analyze the asymmetric game, and hence we can extend our model and results to the asymmetric case. When each party's litigation payoff is incompatible with his obstinate partner's demand (i.e., when the case that corresponds to the CJ structure arises), we can employ Proposition 5 in Compte and Jehiel (2002). When the rational type has no incentive to take legal steps (namely, when the case equivalent to the AG structure occurs), on the other hand, we can apply Abreu and Gul's (2000) Proposition 4 or Compte and Jehiel's (2002) Proposition 3.

In the asymmetric case, the third game structure arises. This structure is characterized as a one-sided outside-option case, in which only one party has the litigation payoff incompatible with his obstinate partner's inflexible demand. Under this structure, we can apply the result of Atakan and Ekmekci (2010).[17]

LEMMA 3 (Atakan and Ekmekci's (2010) Lemma 1): *Consider the asymmetric version of the bargaining game and the situation in which $w_i > (1-\theta_j)V$ and $w_j \leq (1-\theta_i)V$ hold. Then (i) party i always demands θ_i, (ii) party j reveals himself as rational in period 0 or 1, and (iii) i's share (resp. j's share) conditional on facing the rational type is approximately θ_i (resp. $1-\theta_i$) in any Perfect Bayesian Equilibrium.*

PROOF: See Atakan and Ekmekci's (2010) Lemma 1. □

[17] Atakan and Ekmekci (2010) allow that $v^* > \theta$.

Since party i prefers litigation to concession, party j cannot improve his payoff by mimicking the obstinate type. Thus, j reveals his rationality as soon as possible. Once j reveals himself as rational, the bargaining game with one-sided uncertainty emerges and party i obtains a payoff close to θ_i if δ_i (party i's discount factor) and δ_j are close to 1 (Myerson, 1991, Theorem 8.4).

From this lemma, it is enough for party i to undertake rent seeking to prevent his rational partner's deviation from the equilibrium behavior. Furthermore, there is a positive probability that agreement cannot be reached immediately. Thus, the trade-off between rent seeking and bargaining costs will also emerge in the one-sided outside-option case.

The second extension includes the modification of the definition of the obstinate type. In Model 3, the obstinate type demands θV in the bargaining, but accepts any division that the third parties determine. Some readers might then think that the obstinate parties should be defined as those who will not accept any offer unless they can obtain more than or equal to θV, both in the bargaining and the third-party settlement. Even if we adopt the modified definition of the obstinate type, the trade-off between rent seeking and bargaining costs occurs because the AG and CJ structures continue to emerge.

However, this extension leads to an additional bargaining structure that has not been dealt with by the existing literature. The structure is characterized as follows: while the rational type prefers litigation to concession when there is uncertainty about his partner's type (and hence we cannot apply Lemma 1), he prefers the latter to the former when he knows his partner is obstinate with probability 1 (and thus we cannot apply Lemma 2 either).[18]

[18]Similarly, in the case where the obstinate type is assumed to behave obstinately throughout the game (e.g., the obstinate type chooses irrationally high rent-seeking level which the rational type cannot match), while the additional bargaining structure emerges, our trade-off between rent seeking and bargaining cost continues to hold for some ε and δ.

5 Conclusion

We have developed a theory of firm boundaries in the spirit of Williamson's transaction cost analysis, in which the parties engage in *ex post* value split. We presented three results. First, when the trade value shrinks due to delay in reaching agreement, non-integration incurs lower rent-seeking costs than integration. Second, when the parties are obstinate with high probability, the rational type voluntarily concedes in the bargaining, and hence has small incentive to undertake rent seeking under non-integration. Lastly, and most importantly, the presence of *ex post* inefficient bargaining creates a trade-off between rent seeking and bargaining costs (bargaining delay and breakdown). These results explain why rent seeking within firms is likely to be more costly than rent seeking between firms, and offer a formal justification for the "costs of bureaucracy" in Williamson (1985). Furthermore, we showed that larger trade value makes both non-integration and integration more costly, which is consistent with the argument of Williamson (1973).

There are some important topics left untouched. First, our models do not explain how internal organizations avoid costly renegotiations. That is, we assumed that the boss's order is enforceable. As Van den Steen (2010) notes, however, "Being an employee does not mean abandoning free will: the employee decides whether or not to obey the boss's directives" (p. 466). In fact, TCE does not provide any formal answer on the issue. Nevertheless, this issue has been dealt with in Mori (2012). Mori (2012) formally explores why entering authority relation helps trading parties immediately settle *ex post* dispute over trade value (i.e., avoid bargaining costs) by employing three behavioral assumptions: reference-dependent preference, self-serving bias, and shading (punishment for unfair treatments). Mori (2012) points out that, under integration, a subordinate expects to obey his boss's order, and hence it is likely to be optimal for him to comply, which leads to immediate settlement of the dispute.

Second, we did not deal with the situation in which the parties negotiate the decision right at the beginning of the game. Some existing literature on firm boundaries, including Grossman and Hart (1986), assumes that one of the parties becomes a boss (the owner of the relevant assets) under integration. Under such an assumption, the decision right of *ex post* value split is transferred to party 1 or 2, and thus there is no third party. The party who has authority can then observe the other party's influence level, which means that influence activities can be used as signaling tools. That is, the level of influence activity might affect the reputation of its provider (for example, what type the provider is).

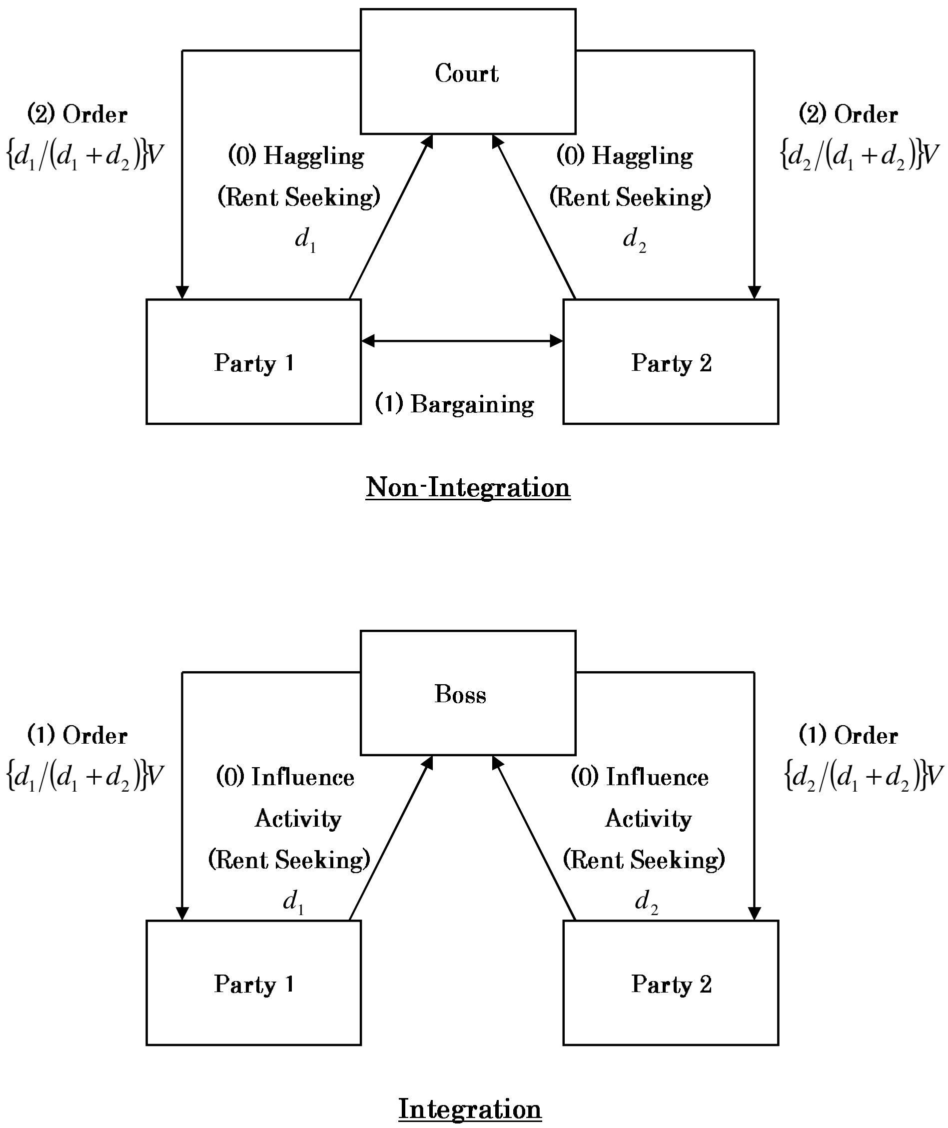

Figure 1: Processes to Divide Trade Value V

Under non-integration, court ordering is required only if the bargaining is terminated without agreement.

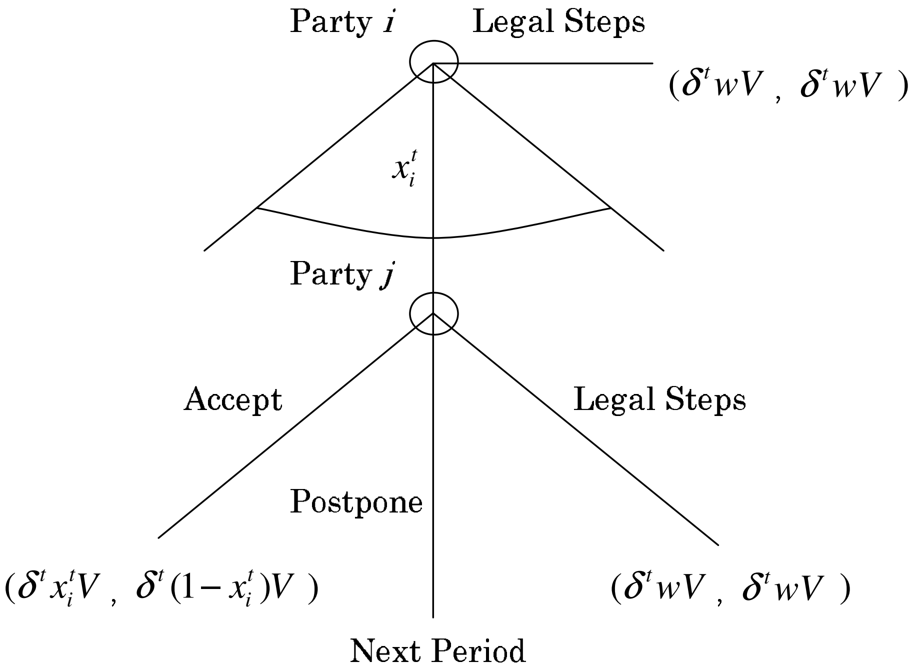

Figure 2: The Modified Bargaining Game

Party i's payoff is listed first and party j's second.

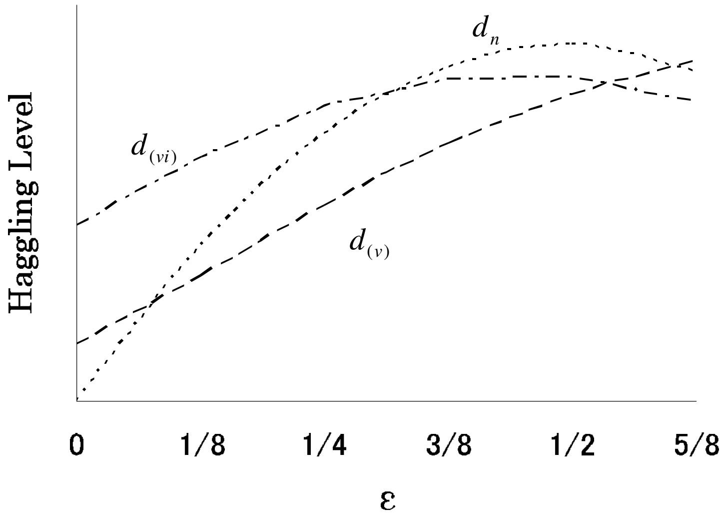

Figure 3: The Effect of ε on d_{CJ} ($\delta = 4/5$ and $k = 1$)

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