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Value Creation and Value Capture with Frictions

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by

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Abstract

We use a formal value-based model to study how frictions in the product market affect value creation and value capture. We define frictions as incomplete linkages in the industry value chain that keep some parties from meeting and transacting. Frictions, which arise from search and switching costs, vary across markets and over time as, for example, products commoditize and competition becomes more global. Importantly, frictions moderate the intensity of industry rivalry, as well as the efficiency of the market. We find that firms with a competitive advantage prefer industries with lower levels of frictions than their disadvantaged rivals. We show that the effect on industry attractiveness of different competitive forces, such as rivalry and barriers to entry, cannot be analyzed independently. We introduce resource development in our model to study the emergence and sustainability of competitive advantage. Firm heterogeneity emerges naturally in our model. We show that the extent of firm heterogeneity falls with the level of frictions, but sustainability increases. Overall, we show that introducing frictions makes value-based models of strategy even more effective at integrating analyses at the industry, firm and resource levels.

Key words: value-based strategy, biform games, industry analysis, rivalry, barriers to entry, firm heterogeneity, sustainable competitive advantage, formal modeling
1. Introduction

As a field of study, strategy is to a large extent defined by its overarching concern with understanding the drivers of firm performance. In particular, the field seeks to understand relative performance: what allows some firms to outperform their rivals. The focus on superior performance nicely complements the other overarching concern of the strategy field, namely the emergence and sustainability of firm heterogeneity (Rumelt, Schendel and Teece, 1994). While understanding the drivers of firm performance would seem to lend itself well to formal theorizing based on microeconomic concepts, there has so far been little such work within the mainstream strategy literature.\(^1\) Recently, however, a formal literature has developed in strategy that seeks to develop value-based foundations of superior performance (Brandenburger and Stuart, 1996, 2007; Lippman and Rumelt, 2003; MacDonald and Ryall, 2004; Adner and Zemsky, 2006; Chatain and Zemsky, 2007).\(^2\) In this paper we seek to build on this emerging literature and integrate it with traditional strategy perspectives on superior performance.

There is extensive verbal theorizing in strategy on the drivers of superior performance. While early work in the field emphasized fit between a firm and its environment (e.g., Learned et al., 1965) subsequent work has tended to emphasize one level of analysis at the expense of others. The work of Michael Porter (1980) drawing on the industrial organization literature in economics focused much attention on industry-level drivers of performance. Pushing in the opposite direction, the rise of the resource-based view lead to considerable emphasis on rents accruing to valuable internal resources and capabilities (Rumelt, 1984; Dierickx and Cool, 1989; Barney, 1991).\(^3\) An important stream of empirical work (Rumelt, 1991; McGahan and Porter, 1997) has sought to quantify the relative influence of different levels of analysis on the variability of profitability. A key finding is that both industry and firm effects are important drivers of firm profitability, but these works also suggest the existence of complex interactions between the different levels (McGahan and Porter, 2003).

The distinction between different levels of analysis is a common organizing principle in strategy courses which often start with industry analysis before proceeding to a consideration

\(^1\)Even highly relevant and influential papers like Lippman and Rumelt (1982) on uncertain imitability are published in the economics literature.

\(^2\)More generally, there has been a marked increase in interest in formal methods in management research in general (Adner et al., 2009) and in strategy in particular (Ghemewat and Cassiman, 2007).

\(^3\)In addition to the industry and resource levels of analysis emphasized in this paper, there is also work at the level of strategic groups (e.g., Porter, 1979; Dranove, Peteraf and Shanley, 1998; Porac et al, 1995) and competitive positions (Porter, 1985).
of firm level advantage and sustainability. However, although conceptually convenient, the distinction is in many ways artificial. For example, Priem and Butler (2001) argue that the resource-based view of sustainable competitive advantage (Barney, 1991) suffers from ignoring product market interactions that ultimately determine the value of resources. One can often criticize any strategy analysis that is limited to a single level. For example, barriers to entry at the industry level such as the existence of network externalities or learning curves would be expected to impact performance to the extent that firms have differential abilities to detect and leverage these forces to develop sustainable positions. In this paper, we develop a formal analysis of the drivers of firm performance that incorporates critical elements of both industry, firm and resource levels of analysis.\footnote{Multi-level theorizing engenders complexity. Formal theory can be an effective way to keep track of potentially complex interactions among different constructs (Adner et al., 2009) and hence can be well suited to multi-level theorizing.}

The Importance of Competitive Frictions for Strategy

There is a long tradition in strategy of linking superior performance to the existence of imperfect competition (Yao, 1988) and competitive frictions play a central role in both the industry-level and resource-level of analysis. In particular, Mahoney (2001) argues that the resource-based view is fundamentally about the set of frictions that enable the capture of sustainable rents. Without any frictions, perfectly competitive product and factor markets assure that all rents are dissipated. We build a unified model to elucidate how industry and resource outcomes vary with the level of product market frictions.

We consider a specific, but important, class of frictions, namely frictions that gives rise to incomplete linkages in the industry value chain. As perfect competition arises when all buyers are always able to play all suppliers off against one another, the introduction of such frictions serves to moderate the level of rivalry in the market. Figure 1.1 illustrates this for a market with two suppliers and four buyers. The left-hand panel shows a situation of perfect competition where each supplier is linked to each buyer and hence competes for its business. The right-hand panel shows a market with frictions in that many of the linkages are missing. While one buyer still has access to both suppliers, the others are served by at most one supplier.\footnote{Another possible competitive friction is that suppliers tacitly collude in order to lessen price competition. While this may also be important for some markets, especially ones with a stable set of competitors and observed terms of sale, it is not our focus. We focus on suppliers that compete intensely with each other whenever they are both linked to a buyer.} In addition to moderating the degree of rivalry, frictions also affect market efficiency as buyers are not
necessarily served by the supplier that creates the most value.

There are many possible sources of frictions in real markets. Imperfect information and search costs can cause some buyers and sellers to be unaware of each other or unwilling to transaction because of uncertainty about product quality. Agency problems and limits to managerial attention within firms can reduce the incentives of busy managers to seek out and qualify additional suppliers. Moreover, firms may limit themselves to suppliers in their existing social network, especially when trust is important for the transaction. Finally, switching costs may mean that new suppliers are not worth seeking out. Empirically, Chatain (2009) shows that competition among law firms in the UK is largely limited to the set of suppliers with whom a given buyer has an existing relationship.\footnote{Although we are not focusing on frictions related to tacit collusion, there is one type of collusive practice that does relate to the sort of friction we seek to study, namely where firms split the market and refrain from actively competing for each others captive customers.}

We are interested in how competitive outcomes vary with the level of frictions, a topic that should be of interest to empirical strategy scholars as frictions vary both over time and across markets. Markets with low frictions are those where little or no information has to be acquired for transactions and negotiations to take place. Everyone knows who is selling and what is to be sold. For example, commodity markets show very little frictions. Markets
with high frictions are those where it is costly to ascertain the quality of what is to be sold to buyers and suppliers need to spend time to search for each other. Matching between supply and demand is hence imperfect. Markets for new innovative products could be characterized by high frictions as buyers need to understand if the new product fits their needs and suppliers need to understand who constitutes their demand. Professional services could also be characterized as high frictions as there are both high switching costs and services can be difficult to evaluate. Obviously, as markets evolve over time, the level of frictions can change. The definition of standards, the establishment of reputations and the maturation of technologies can contribute to reduce frictions. The increased availability of information through the internet for products can be seen as lowering frictions; more generally advances in information and communications technologies can be seen as allowing buyers to work with a larger and more dispersed set of suppliers.\(^7\)

We have three main research questions. First, how do frictions affect value creation and value capture at the firm and industry level? Second, to what extent does the effect of rivalry (as determined by the level of frictions) depend on other competitive forces such as the threat of entry and bargaining power? Third, how do frictions affect the emergence and sustainability of resource-based competitive advantages? To build a theory to address these questions, we extend recent work on a value-based approach to strategy.  

**Prior Work on Value-Based Strategy**  
As originally developed by Brandenburger and Stuart (1996), the value-based approach incorporates key elements of both industry-level and firm-level analyses. A value-based approach starts with the set of players in the industry value chain and the “characteristic function,” which specifies the value created by any group of industry players that work together. Different groups create different amounts of value, which reflects the heterogeneity in the underlying resources and capabilities of the different players. The central focus in a value-based analysis is on value capture: how total industry value creation is divided among the various players. Following Brandenburger and Stuart (1996), the literature usually focuses on competitive outcomes in the “core,” which is the set of divisions of total industry value creation such that no industry

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\(^7\)Particular exogenous shifts can have ambiguous impacts on industry frictions that could benefit from empirical investigation. For example, on the one hand the financial crisis creates cost pressures on buyers, which would be expected to increase the number of sellers they seek to access and effectively reduce the level of frictions. On the other hand, the need for information on the financial viability of exchange partners would be expected to raise the level of frictions.
subgroup can split off and make all of their members better off. The interactions among the players in the industry value chain are assumed to be frictionless, which has two critical implications. First, outcomes are efficient in that the maximum possible industry value creation is realized. Second, the rivalry among the players is intense: without any frictions to limit subgroup formation, the calculation of the core has all possible subgroups competing with each other to attract members. As a result, the value capture of any player is limited by its "added value," which is the amount of total value creation that would be lost if the player were not to participate in the industry.

We extend value-based analysis to allow for varying levels of industry rivalry. Competitive pressures are so intense in the core that competing firms can capture even less value than in Bertrand price competition, which is a standard way to model extreme rivalry. Given the extreme rivalry imbedded in the core, Lippman and Rumelt (2003) criticize its use in strategy research. Most students of competitive strategy are explicitly taught how to assess the level of rivalry in any given industry and to analyze how rivalry is likely to shift with changes in the underlying industry structure (e.g., Grant 2005). Received value-based analysis does not incorporate varying levels of rivalry in a simple and transparent way. Our view is that value-based strategy would be more consistent with existing approaches to industry analysis if it incorporated a parameter to allow for varying levels of rivalry among firms at a given stage of the industry value chain. This is what we aim to achieve in this paper by introducing a parameter representing frictions.

Overview of our Results

A central question we address is how the degree of frictions in the market affects the value that competing firms are able to capture. We find an inverted U-shaped relationship, with firm profits maximized for intermediate levels of frictions. When frictions are low, intense rivalry pushes most value to the buyers and the main effect of increases in frictions is to reduce rivalry,

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8In the core, the free form negotiation between a buyer and its suppliers allows the buyer not only to play its suppliers off against each other (as in Bertrand price competition) but then to potentially negotiate an even better deal with the most efficient supplier. See Section 2 for an illustrative example.

9To realize the original promise of Brandenburger and Stuart (1996) to integrate industry-level and firm-level analyses, value-based strategy should ideally accommodate all the competitive forces traditionally emphasized in industry analysis. Pressure from substitutes and complements are reflected in the characteristic function (Brandenburger and Stuart). Building on Brandenburger and Stuart (2007), Chatain and Zemsky (2007) introduce a parameterization of bargaining power and barriers to entry. Thus, rivalry is the one competitive threat outside the scope of current value-based analysis.

10The most common approach to limiting competition in prior value-based papers is to impose capacity constraints. See the Appendix for an example and critique of this approach.
which increases firm value capture. Conversely, for high levels of frictions, rivalry is low and a lot of value goes to the firms, who then care more about the effect of frictions on lowering total value creation.

Frictions do not impact all firms the same. In particular, the impact depends on a firm’s competitive position. It is natural in a value-based model to say that a firm that creates more value than its competitors has a position of competitive advantage. We find that a firm with a competitive advantage prefers less frictions than its disadvantaged rival. The reason is that the advantaged firm with its greater market share has more to lose when frictions keep buyers from finding suppliers.\footnote{Makadok (2009) first considers the interaction of competitive advantage and rivalry on firm performance.}

Textbook treatments of the five competitive forces implicitly suggest that one can analyze their impacts independently. We extend our basic model to include a parameterization of barriers to entry and consider the interactions with the degree of rivalry. We show that there are important interactions that give rise to additional non monotonicities in the effect of market frictions on firm value capture. This is a consequence of the inverted U-shape of firm value capture. At both low and high levels of friction, the barriers to entry cause a reduction in the number of firms and an increase in value capture.

Our final analysis considers the critical issue of the emergence and sustainability of firm heterogeneity. Specifically, we extend the model to allow firms to develop new resources and capabilities that serve to increase their ability to create value. We are interested in two questions. First, does heterogeneity emerge naturally when identical competitors have equal access to resource development opportunities? We find that it does, precisely because expectations of market leadership are self-fulfilling: Suppose that one firm expects to have a competitive advantage because it is expected to invest more in resource development. Because of the competitive advantage, this firm expects to have a greater market share, which feeds back and gives it a greater incentive to invest in the resources to serve them thus justifying the original expectation of competitive advantage.

The second fundamental question we ask is whether a leader sustains or loses its competitive advantage in the face of a new resource development opportunity. If the advantaged firm has a sufficiently great initial advantage, we find that there are necessarily positive feedbacks. The advantaged firm, with its greater market share, invests more in resource development and
hence increases its advantage. For lower levels of advantage, however, it is possible that a disadvantaged firm can use the new resource development opportunity to surpass the leader. As with the emergence of heterogeneity, such leapfrogging relies on self-fulfilling expectations, in this case, that the follower will out invest the leader. We provide a precise characterization of how sustainability depends on the initial level of advantage, the frictions in the market, and the costliness of resource development.

The paper proceeds as follows. Section 2 provides a motivating example that allows us to review value-based analysis and to illustrate some elements of our theory. In Section 3, we present our base model with frictions. We analyze the effect of these frictions on value creation and value capture in Section 4. Section 5 extends the base model to allow for barriers to entry. Section 6 extends the base model to allow for resource development and considers the emergence and sustainability of competitive advantage. The paper ends with a discussion of the results and thoughts on future work.

2. Frictions and Rivalry

2.1. A Motivating Example

We now consider a simple example that introduces key concepts from value-based strategy including value creation, added value and the core as a solution concept. We then explain how we add frictions to the value-based approach.

We start with the simplest case of a single supplier and buyer. A key input into a value analysis is a specification of the value created by exchange. In this example, suppose that the value created when the supplier serves the buyer is $V_1 = 10$. We assume that a buyer or supplier on its own has no value creation. A player’s added value is what is lost were it to leave the industry. In this simple example, each player is required for the exchange and hence each player’s added value is 10. An outcome is in the core if it divides up the value created and assures that any subgroup of players cannot do better on its own. Because the subset of a single buyer or a single supplier does not create any value, the core allocation for both the buyer and the supplier is anything from 0 to 10, which we write as $[0, 10]$.

An important feature of the core is that the outcome can be indeterminate, even in simple

\[12^{th}\text{The value created can be decomposed into the difference between the willingness-to-pay of the buyer and the opportunity cost of the supplier; see Brandenburger and Stuart (1996) for details. Throughout this paper, we reason directly in terms of value created.}\]
situations like this one. This leaves scope for bargaining power to determine how joint value creation is split. Brandenburger and Stuart (2007) introduce a parameter $\alpha$ in $[0,1]$ that determines which specific division players expect to negotiate within the core interval. In this example, we take $\alpha = \frac{1}{2}$: each player expects to be at the mid-point of its core allocation. This gives an expected value capture of 5 for both the supplier and the buyer. In simple settings such as this example, the $\alpha$ parameter is naturally interpreted as an industry-level parameter of the bargaining power of buyers relative to suppliers.\textsuperscript{13}

To introduce competition to the example, suppose there is a second supplier. The buyer only needs one unit, which it can now get from either the first or second supplier. Suppose that the second supplier is not as efficient as the first and its value creation is $V_2 = 8$. The efficient outcome is still for the first supplier to serve the buyer, which leads to a value creation of 10. However, now the added value of the first supplier is only 2, since the buyer can create 8 by going to the other supplier. As first emphasized by Brandenburger and Stuart (1996), added value gives an upper bound on the value capture of a player. In particular, the core now has the first supplier capturing value in the interval $[0,2]$ and the buyer capturing value in the interval $[8,10]$. The second supplier has no added value and hence captures nothing. With $\alpha = \frac{1}{2}$, payoffs are still at the mid-points which yields 9 for the buyer, 1 for the first supplier and 0 for the second supplier.

As one would expect, competition has increased the value capture of the buyer, in this case from 5 to 9. To benchmark this outcome, note that extreme rivalry is often captured as Bertrand price competition with undifferentiated products. In the example, Bertrand competition would lead to payoffs of 8 for the buyer and 2 for the first supplier. This illustrates that the core as a solution concept incorporates extreme rivalry (Aumann, 1985). This would seem to be a restrictive assumption for strategy analysis. Moreover, it raises a logical question: given the zero expected profit of the inefficient second supplier, why is it active in the market as this serves only to shift value capture to the buyer? If there are any fixed costs to serving these buyers, then the supplier would naturally drop out of the market and the monopoly outcome would prevail. Given the importance of firm heterogeneity for the strategy field, a modeling

\textsuperscript{13}In general, in coalitional games, the $\alpha$ parameter need not reflect bargaining power. In particular, the expected outcome may not actually lie in the core (Brandenburger and Stuart, 2007). Chatain and Zemsky (2007) provide general conditions under which the $\alpha$ parameter can be naturally interpreted as reflecting bargaining power. These conditions imply the absence of capacity constraints, of externalities, and of complementarities in added value. The examples and models in this paper satisfy these general conditions and hence we interpret $\alpha$ as relative bargaining power.
approach where all firms need to be efficient is clearly restrictive.

2.2. Introducing Frictions

A central aim of this paper is to introduce frictions into value-based analysis. We define frictions as impediments to the free form negotiations among all players that are assumed in the received value-based approach. The key implication of the presence of frictions is to break the assumption that all buyers are able to negotiate with all sellers. As perfect competition arises when all buyers are always able to play all suppliers off against one another, the introduction of frictions serves to moderate the level of rivalry.

Concretely, suppose that a buyer is unaware of a given supplier with probability \( f \), which parameterizes the level of frictions. We take these probabilities as independent across suppliers. These frictions serve to partition the market. There are now two segments that are aware of one supplier but not the other. There is still a segment that is able to negotiate with both suppliers. Finally, there is a segment that is unaware of either supplier. In the example, we set \( f = \frac{1}{2} \). The buyer is equally likely to fall into each of the four segments. It is straightforward to generalize the example to include many buyers, in which case each segment would be of approximately the same size.

How do frictions affect value creation and value capture? Without frictions value creation is 10. Now only half the time does the buyer have access to supplier 1 and the value creation of 10. One quarter of the time the buyer has access to just supplier 2 for a value creation of 8. In expectation, the value creation is reduced to \( \frac{1}{2}V_1 + \frac{1}{4}V_2 = 7 \). There are two sources of the fall in value creation: some buyers are served by a less efficient supplier and some buyers go unserved.

A key impact of the frictions is that the inefficient supplier 2 now has some value capture. In particular supplier 2 now captures \( \frac{1}{4}\alpha V_2 = 1 \).

Does the shrinking pie and increasing share of supplier 2 negatively impact supplier 1? Not in this example. The first supplier captures value whether or not supplier 2 is in the choice set, but it captures more (\( \alpha V_1 \)) when it is alone than when it is in competition (\( \alpha(V_1 - V_2) \)). The first supplier’s expected value capture is then \( \frac{1}{4}\alpha V_1 + \frac{1}{4}\alpha(V_1 - V_2) = 1.5 \), which is more than the value capture of 1 without frictions. The reduction in rivalry more than makes up for the fact that supplier 1 is now only able to serve half the market.

The shrinking value creation and falling rivalry among its suppliers leaves the buyer unam-
biguously worse off. Its expected value capture falls from 9 to 3.5.

Consider now the incentives of suppliers to invest in resources that increase their ability to create value. If a supplier expects to be the less efficient firm, its profits depend on its value creation according to \( \frac{1}{2} \alpha V_2 = \frac{1}{5} V_2 \). If a supplier expects to be the more efficient firm, its profits depend on its value creation according to \( \frac{1}{4} \alpha V_1 + \frac{1}{4} \alpha V_1 = \frac{1}{4} V_1 \). Hence, a supplier that is expected to be more efficient indeed has greater incentive to invest in resource development. When embedded in an equilibrium analysis (see Section 6), these differential incentives give rise to asymmetric positions in the market where expectations of market leadership are self-reinforcing even in the case when firms start out homogeneous (i.e., \( V_1 = V_2 \)) and with equal access to investment opportunities.

Next, we formally specify the model and generalize the above analysis to arbitrary values of \( V_1, V_2, f \) and \( \alpha \).

3. The Model

We specify the model in two steps. We first characterize profits of one or two suppliers competing for a given buyer. We then introduce frictions that segment the market based on the number of competing suppliers.

3.1. Buyer-Suppliers Interactions

There are two competing suppliers which we label by \( i = 1, 2 \). We start by specifying the value creation possibilities when there is a single buyer, which we denote by \( B \). The characteristic function \( v(s) \) gives the value creation for any set of players \( s \). We assume

\[
\begin{align*}
v(B) &= v(1) = v(2) = v(\emptyset) = 0, \\
v(B, 1) &= V_1, \\
v(B, 2) &= V_2, \\
v(B, 1, 2) &= V_1.
\end{align*}
\]

Supplier 1 can create weakly more value than supplier 2, i.e., \( V_1 \geq V_2 \).

We now characterize core allocations. The core is the set of allocations of value such that
no subset of player can appropriate more value by breaking away from the grand coalition. Formally, write $x_i$ the value captured by player $i$. The core is defined by two conditions:

$$\sum_{i \in N} x_i = v(N),$$

$$\sum_{i \in G} x_i \geq v(G), \text{for all } G \subset N.$$ 

where $N$ is the set of all players and $G$ is a subset of $N$. The first condition assures efficiency: the maximum possible value is created and then divided among the players. The second condition assures stability: all subset of players is receiving at least as much as it can make independently of the rest of the players.

Consider the case where both suppliers are competing for the buyer so that $N = \{1, 2, B\}$. It is easy to show that the set of core allocations are:

$$x_1 + x_2 + x_B = V_1,$$

$$x_1 \in [0, V_1 - V_2],$$

$$x_2 = 0,$$

$$x_B \in [V_2, V_1].$$

The interpretation is straightforward. The total value created is $V_1$. Supplier 2, which is the less efficient supplier, cannot appropriate anything because it has no added value. The buyer can play the two suppliers off against each other and hence is guaranteed at least $V_2$. The remaining value ($V_1 - V_2$) depends on negotiations between the buyer and supplier 1.

Following Brandenburger and Stuart (2007) we map the core allocations into expected value capture by introducing a parameter $\alpha_i$ representing each player’s expectations regarding its ability to capture value through bargaining. We set $\alpha_B = \alpha$ and $\alpha_1 = \alpha_2 = 1 - \alpha$, which allows us to interpret $\alpha$ as the bargaining power of buyers relative to suppliers. Expected value

---

14Our model satisfies the general conditions in Chatain and Zemsky (2007, assumptions A1, A2 and A3) such that the $\alpha_i$ parameters can be naturally interpreted as relative bargaining power.
capture is then:

\[ \Pi_1 = (1 - \alpha)(V_1 - V_2), \]
\[ \Pi_2 = 0, \]
\[ \Pi_B = V_2 + \alpha(V_1 - V_2). \]

The second case we examine is when a buyer is facing a single supplier so that \( N = \{i, B\} \) for \( i \in \{1, 2\} \). The core allocation is characterized by:

\[ x_i + x_B = V_i, \]
\[ x_i \in [0, V_i], \]
\[ x_B \in [0, V_i]. \]

This is a bilateral monopoly. Neither player has an effective threat it can use to guarantee itself a minimum of value capture and the allocation of value is therefore completely indeterminate. With relative bargaining power still given by \( \alpha \), we get the following expected value capture:

\[ \Pi_i = (1 - \alpha)V_i, \]
\[ \Pi_B = \alpha V_i. \]

For those readers familiar with the classic theories of industrial organization, it is worth noting that Bertrand competition is a special case of this model with \( \alpha = 0 \).

### 3.2. Frictions and Product Market Competition

In a standard value-based analysis, all players would be assumed to negotiate and all possible coalitions would be allowed to form. We assume that frictions may limit the set of available suppliers for a given buyer. We model this by introducing a probability \( f \) that supplier \( i \) fails to meet a given buyer. Hence \( f \) is a measure of the degree of frictions in the market. These probabilities are identical and independent across suppliers.\(^{15} \) Another way to interpret the

\(^{15}\text{Grossman and Shapiro (1984) use a similar partition of the market in their pioneering theory of informative advertising. In their model, the proportion of customers that is reached by each firm is endogenous and firms compete on price in a circular city, this allowing for horizontal differentiation. In contrast, we take the proportions as exogenous, the products in our model are vertically differentiated, and we allow for negotiated prices.}
role of this probability is to envision an additional player in the game (nature) which randomly
determines which suppliers are available to each buyer – and therefore which characteristic
function is used to compute the payoffs.\footnote{The possibility of introducing uncertainty on the nature of the characteristic function is mentioned by Brandenburger and Stuart (2007:541, footnote 14).}

With two possible suppliers, there are four buyer segments, which have the following expected relative sizes:

<table>
<thead>
<tr>
<th>Set of Suppliers Competing for a Buyer</th>
<th>Expected Size of the Buyer Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier 1 and Supplier 2</td>
<td>$(1 - f)^2$</td>
</tr>
<tr>
<td>Supplier 1 only</td>
<td>$(1 - f) f$</td>
</tr>
<tr>
<td>Supplier 2 only</td>
<td>$(1 - f) f$</td>
</tr>
<tr>
<td>None</td>
<td>$f^2$</td>
</tr>
</tbody>
</table>

Table 3.1: Size of customer segments served by suppliers

The right-hand panel of Figure 1.1 illustrates. In the first segment, the two suppliers are both competing for the buyers. In the second and third segments, suppliers are shielded from competition and enjoy a monopoly position. Finally, the fourth segment is made up of buyers that are left unserved by the supplier. This latter segment can be interpreted in a variety of ways. In all cases, the assumption is that the buyer is going with the next best alternative. This could be by (i) entirely doing without the input, (iii) producing it internally or (iii) using a generic input (where the two focal suppliers are assumed to offer a differentiated product).

As frictions increase, the extent of head-to-head competition falls and inefficiency due to unserved buyers and inefficient matching increases.

If there are $M$ buyers, then the size of each segment is given by the product the expected relative segment size and $M$. For example, there are $(1 - f)^2 M$ buyers where the two suppliers compete. For simplicity and without any loss of generality we take $M = 1$.

4. The Mapping from Value Creation to Value Capture

Value-based strategy provides an explicit mapping from the value creation possibilities of participants in an industry value chain to their value capture. We now characterize how the frictions in our model moderate this mapping.
The expected total value creation is given by the following formula:

\[ V_G = (1 - f)V_1 + (1 - f)fV_2 \]

Supplier 1 creates \( V_1 \) of value whenever it is in the choice set of a buyer, which occurs with probability \( 1 - f \). Supplier 2 creates \( V_2 \), but only when it is in the choice set and supplier 1 is not, which occurs with probability \( (1 - f)f \).

Using the value capture expression from Section 3.1 and the segment sizes from Section 3.2, the expected value capture of supplier 1 is

\[
\Pi_1 = (1 - f)^2(1 - \alpha)(V_1 - V_2) + (1 - f)f(1 - \alpha)V_1
\]

Value captured in the segment
where supplier 1 is in competition with supplier 2

Value captured in the segment
where supplier 1 is sole supplier

\[
= (1 - f)(1 - \alpha)(V_1 - (1 - f)V_2).
\]

Active in only one segment, the value capture of supplier 2 is \( \Pi_2 = (1 - f)f(1 - \alpha)V_2 \). The value capture of the buyers is given by \( V_G - \Pi_1 - \Pi_2 \).

We now have expressions showing how value creation and value capture vary with the level of frictions. We illustrate the general results in the paper graphically using the parameter values \( V_1 = 10, \ V_2 = 9, \ \alpha = .3 \). Figure 4.1 plots value creation (solid line) and value capture (dashed lines). Value creation decreases in the level of friction. However, supplier value capture is non-monotonic in the level of frictions, first increasing and then decreasing. This pattern is quite general as shown in the following proposition.\(^{17}\)

**Proposition 4.1.**

(i) Value creation decrease monotonically with market friction \( f \).

(ii). Value capture for supplier 2 follows an inverted U-shaped relationship and there is an optimal level of frictions \( f_2^* \) strictly between 0 and 1 that maximizes supplier 2’s value capture.

(iii). For \( V_2 > V_1/2 \), value capture for supplier 1 follows an inverted U-shaped relationship and there is an optimal level of frictions \( f_1^* \) strictly between 0 and 1 that maximizes supplier 1’s value capture. For \( V_2 \leq V_1/2 \), value capture for supplier 1 is monotonically decreasing in \( f \).

\(^{17}\)The proofs of all propositions are in Appendix 2.
Figure 4.1: Value Creation (Plain Line) and Value Capture (Dotted Lines) for $V_1 = 10$, $V_2 = 9$, $f_i = f$, $\alpha = .3$.  

and $f_1^* = 0$.

(iv) Weaker suppliers prefer more frictions, i.e., $f_1^* < f_2^*$.

In part (i), value creation falls with frictions for two reasons. First, the size of the unserved segment increases. Second, the fraction of the served buyers who are served by the less efficient firm increases as well. The results in parts (ii) and (iii) arise because an increase in frictions has two impacts on supplier value capture. First, it reduces rivalry, which serves to increase value capture. This effect is largest when frictions are low. Second, frictions reduce total value creation to zero, which must ultimately lead value capture to be falling in frictions. This gives rise to an inverted U-shaped relationship between frictions and value capture as long as the effect of head-to-head competition is sufficiently strong. For supplier 2, head-to-head competition reduces value capture to 0 and there is always an inverted U-shaped relationship. For supplier 1, competition is greater the greater is $V_2$ and there is an inverted U-shaped relationship as long as $V_2$ is not too small. Value capture following an inverted U-shaped relationship implies that there is an optimal level of frictions for a supplier. Because the effect of head-to-head competition is sufficiently strong for supplier 2, there is always an inverted U-shaped relationship.
competition is stronger for supplier 2, we find in part (iv) that it always prefers a higher level of frictions than supplier 1.

The industry-level approach to superior performance emphasizes taking actions to reduce competitive pressures. On the other hand, firm-level approaches emphasize developing a competitive advantage. Makadok (2009) considers the interaction between these two prescriptions. Across a variety of models, he finds that the interaction is negative for a firm with a competitive advantage. Formally, he shows that the cross-partial on an advantaged firm’s profits of rivalry reduction and efficiency increases is negative. The intuition is that the lower the level of rivalry the less the returns to investing in greater efficiency. We find an equivalent result in our model, and extend his analysis to the disadvantaged firm.

**Proposition 4.2.** (i) For the advantaged supplier 1, value creation and friction have a negative interaction effect on supplier value capture. Formally, \( \frac{\partial^2}{\partial V_1 \partial f} \Pi_1 < 0 \).

(ii) For the disadvantaged supplier 2, value creation and friction have a negative interaction effect on supplier value capture only if frictions are sufficiently high. Formally, \( \frac{\partial^2}{\partial V_2 \partial f} \Pi_2 > 0 \) if \( f < \frac{1}{2} \) and \( \frac{\partial^2}{\partial V_2 \partial f} \Pi_2 \leq 0 \) if \( f \geq \frac{1}{2} \).

We find that there is no clear interaction effect for the disadvantaged firm. A firm’s incentive to invest in value creation depend on its market share, which for supplier 2 first increases with frictions and then decreases.

5. Barriers to Entry

In the previous section, we saw that a simple friction parameter extended the value-based approach to allow for varying degree of industry rivalry. With this addition, value-based analysis now incorporates the classic competitive pressures from industry analysis. Competitive pressures from complements and substitutes are reflected in the definition of value creation. Relative bargaining power of buyers and suppliers is reflected in the \( \alpha \) parameter.

Missing from the base model is the threat of entry. This is easily rectified and we do so in this section. We follow Chatain and Zemsky (2007) and a long tradition in industrial organization by first assuming that suppliers have an entry decision and then parameterizing the extent of barriers to entry by the size of the fixed costs required to serve the market. Our main focus in extending the industry-level analysis is to examine the extent to which one can actually analyze different competitive forces in isolation as is suggested by textbook treatments of this subject.
Suppliers choose whether to enter and incur a fixed cost $F$. Suppliers and buyers meet in the market according to friction parameter $f$. Buyer and supplier(s) bargain over the value to be created. Value is created and shared.

Figure 5.1: Stages of the Game

5.1. The Entry Barriers Model Extension

We add an initial stage to the game where suppliers decide whether or not to enter. This gives rise to a biform game (Brandenburger and Stuart, 2007) where an initial stage using traditional non cooperative game theory. The second stage, where those suppliers that have entered negotiate with buyers, is the coalitional game described in the base model, where one also needs to treat the case where only a single supplier enters.

The time line is illustrated in Figure 5.1. In the initial stage, suppliers decide whether to enter. If they enter, they incur a fixed cost $F$. After this, buyers and suppliers meet in the market, according to the friction parameter $f$ and then negotiate and share the value created.

We have the following value capture functions. A supplier who enters and is alone in the market expects to reach a fraction $1 - f$ of the buyers and has no competition. Thus, the supplier’s value capture is:

$$\Pi_i^M = (1 - f)(1 - \alpha)V_i.$$  

When both suppliers enter the market, the expected value capture is as before:

$$\Pi_1^D = (1 - f)(1 - \alpha)(V_1 - (1 - f)V_2),$$  
$$\Pi_2^D = (1 - f)f(1 - \alpha)V_2,$$

where we maintain the assumption that $V_1 \geq V_2$. Finally, a supplier that does not enter has a value capture normalized to zero $\Pi_i^{NE} = 0$. Note that firm profits are value capture net of the fixed costs of entry $F$. 

17
We solve the first stage for pure strategy Nash equilibria. This requires that firms that enter have non-negative profits and that any supplier that stays out does not have a positive profit from entering. For example, it is an equilibrium for only supplier 1 to enter if and only if $\Pi_1^M \geq F$ and $\Pi_2^D \leq F$ so that supplier one covers its entry costs but supplier 2 would not if it were to enter.

We want to restrict the parameters such that it is possible for the market to sometimes support both suppliers. This requires that the fixed costs are not too large, specifically $F \leq \frac{1}{4}(1 - \alpha)V_2$.\(^{18}\)

5.2. The Interaction between the Threats of Entry and Rivalry

Figure 5.2 illustrates the joint effect of rivalry reducing frictions and barriers to entry on the mapping from value creation to value capture. The figure shows supplier value capture under both monopoly and duopoly, as well as the fixed cost of entry.

\(^{18}\)To derive this expression, we need to assure that for some values of $f$ both $\Pi_1^D$ and $\Pi_2^D$ are at least $F$. Note that $\max_f \Pi_2^D = \frac{1}{2}(1 - \alpha)V_2$ and $\Pi_1^P \geq \Pi_2^D$ for any $f$. Hence, the market can support both suppliers for some values of $f$ as long as $F \leq \frac{1}{4}(1 - \alpha)V_2$. 

Figure 5.2: Critical values of $f$ with $V_1 = 10$, $V_2 = 9$, $\alpha = .3$, $F = 1$. 

![Figure 5.2: Critical values of $f$ with $V_1 = 10$, $V_2 = 9$, $\alpha = .3$, $F = 1$.](image-url)
Because of the inverted U-shape of supplier 2’s duopoly profits, the market supports both firms only for intermediate levels of frictions. In the figure, this is the region between $f^D_L$ and $f^D_H$. For low levels of frictions, rivalry is too high to support both suppliers. For high frictions, rivalry is low but the market size is decreased to a point where the market cannot support both firms. When frictions become very high, $f > f^M$, then no supplier enters because even the value capture of supplier 1 as a monopolist does not justify the fixed costs of entry. The pattern for the example graphed in the figure holds more generally, as the following proposition shows.

**Proposition 5.1.** Consider the extension of the model with entry decisions. There exists three critical friction levels $0 < f^D_L \leq f^D_H < f^M < 1$ such that:

- if $0 < f < f^D_L$, only one supplier enters;
- if $f^D_L < f < f^D_H$, both suppliers enter;
- if $f^D_H < f < f^M$, only one supplier enters;
- if $f^M < f$ no supplier enters.

The main conclusion so far is that frictions in our model have a non-monotonic effect on industry structure: first increasing the number of competitors and then decreasing the number of competitors. This happens due to the interaction of the frictions with the barriers to entry. This means that at the critical thresholds (i.e., $f^D_L$) there can be a jump in rivalry with increases in frictions, rather than the continuous reduction we have in the base model without endogenous entry. In addition, there are critical thresholds (i.e., $f^D_H$) where there is a discontinuous decrease in rivalry.

Even in our simple model, the effect of frictions on firm value capture becomes quite complex when there are barriers to entry. For low levels of friction, there is a monopoly supplier with high profits that are falling in the level of friction. At the critical value $f^D_L$ rivalry is sufficiently reduced so the market can support a second supplier. This leads to a discontinuous reduction in industry profit. Profits then increase in frictions before starting to fall again. When frictions reach the critical level $f^D_H$ market size becomes too small to support both firms and industry profits jump up as supplier 2 is no longer viable. Profits then fall as frictions increase. This is illustrated by figure 5.3 where the thick line shows the profits of supplier one (assuming it always enter as a monopolist). Our results bring home the danger of considering in isolation the effect of different competitive forces on industry attractiveness.

Entry decisions creating discontinuities and non-monotonicities is not limited to the effect
Figure 5.3: Profits for supplier 1 (thick line) under the assumption that it is always the monopoly supplier of frictions. For example, an increase in buyer power is usually thought of as negative for the supplying industry. In our model, an increase in buyer power ($\alpha$) results in a fall in all of the value capture curves. This can potentially cause the value capture of the supplying industry to increase in the bargaining power of buyers due to a shift in industry structure.

Proposition 5.2. (i) The region where both firms enter is decreasing in the relative bargaining power of buyers. That is, $\frac{\partial f_D^L}{\partial \alpha} > 0$ and $\frac{\partial f_H^D}{\partial \alpha} < 0$. (ii) An increase in $\alpha$ when $f$ is above but arbitrary close to the critical threshold $f = f_L^D$ leads to an increase in the total value capture of the suppliers.

Given that monopoly profit opportunities are particularly attractive here, it is interesting to consider the extent to which the more efficient supplier 1 is better positioned to earn these rents.

Proposition 5.3. The region with a monopoly supplier can be split into two subsets, one where only supplier 1 can be the monopoly supplier and one where either supplier could be the monopolist.
We find that sometimes the greater efficiency of supplier 1 assures it the position as monopoly supplier. This is either because supplier 2 is not able to cover its fixed costs even as a monopolist or because supplier 1 can cover its fixed costs whether or not supplier 2 enters.\(^{19}\)

6. **Endogenous Heterogeneity**

The strategy literature often takes as given the existence of firm heterogeneity. For example, such an assumption is at the roots of the resource-based view, where firms are seen as endowed with different resource bundles. Following in this tradition, our base model takes firm heterogeneity – as reflected in differences between \(V_1\) and \(V_2\) – as given. Of course, the source of firm heterogeneity is a fundamental question in the strategy field (Rumelt, Schendel and Teece, 1994) and this is where we turn now.

We extend our theory to consider situations where firms can invest in resources and capabilities that increase their value creation. We can then elucidate two fundamental questions in strategy. First, when firms are initially the same, to what extent does heterogeneity arise endogenously when firms have equal access to resource development opportunities? Second, when firms are initially heterogeneous, to what extent do additional resource development opportunities reinforce and sustain a leader’s competitive advantage? Or, can a follower potentially leapfrog the leader and establish a competitive advantage?

6.1. **The Resource Development Model Extension**

We again consider a biform game. The first stage of the biform game now involves resource development by the two suppliers. The suppliers have an initial value creation of \(V_1 \geq V_2\). Supplier \(i\)’s final value creation is \(V_i + r_i\) where \(r_i\) is the extent of resource development. There is an increasing and convex cost of resource development given by \(c(r_i) = cr_i^2\), where \(c\) parameterizes the costliness of resource development. We do not consider entry decisions in this extension.

The second stage of the biform game is given by the original base model described in Section 3 with two differences. First, supplier \(i\)’s value creation is now \(V_i + r_i\) (rather than \(V_i\)). Second, profits are net of resource development costs.\(^{20}\) Supplier \(i\)’s profit function depends on whether

---

\(^{19}\)In Figure 5.2, the critical values \(\hat{f}_1\), \(\hat{f}_2\), and \(\hat{f}_3\), determine which firm can be the monopolist. For \(0 < f < \hat{f}_1\) and \(\hat{f}_2 < f < \hat{f}_3\), both suppliers can become the monopolist. Otherwise, only supplier 1 can become the monopolist.

\(^{20}\)We define profits as value capture in the second stage net of costs born in the first stage. In this section we use \(\Pi_i\) to denote these profits, while in previous sections we used \(\Pi\) to denote value capture.
it has the higher value creation. In particular, for $i \neq j$ we have that

$$
\Pi_i = \begin{cases} 
(1 - f)(1 - \alpha)((V_i + r_i) - (1 - f)(V_j + r_j)) - cr_i^2 & \text{if } V_i + r_i \geq V_j + r_j, \\
 f(1 - f)(1 - \alpha)(V_i + r_i) - cr_i^2 & \text{otherwise.}
\end{cases}
$$

The key difference in the two parts of the profit function is that a supplier that is at a disadvantage only captures value when it is present and the other supplier is not. We solve the first stage of the biform game for pure strategy Nash equilibrium resource developments.

6.2. The Emergence and Sustainability of Competitive Advantage

The incentive of a supplier to invest in resources depends fundamentally on its expectations about market leadership. Recall that the supplier that has a competitive advantage (i.e., for whom $V_i + r_i > V_j + r_j$) serves a buyer segment of size $(1 - f)$ while the disadvantaged supplier serves a smaller buyer segment of size $f(1 - f)$. The greater the segment size, the greater the incentive of the supplier to invest in resources to increase its value creation for those buyers. As a result, there are two possible investment levels for a supplier.

**Lemma 6.1.** In the resource development extension, a supplier’s optimal level of resource development takes one of two values, $r^H > r^L$, where

$$
r^H = \frac{(1 - f)(1 - \alpha)}{2c} = \frac{r^L}{f}.
$$

A supplier invests in resource level $r^H$ if it expects to end up with a competitive advantage and in resource level of $r^L$ if it expects to be disadvantaged. Moreover, the difference in resource development, $r^H - r^L$, is falling in the level of frictions.

If suppliers have different expectations about whether or not they will have a competitive advantage, then they will invest differently. Figure 6.1 illustrates how the two possible levels of resource development vary in the level of frictions in the market.

In standard game theoretic equilibria, the expectations of players must be consistent and this leads to a result that suppliers invest differently even if they start out homogeneous.

**Proposition 6.2.** Consider the resource development extension where the two firms are initially homogeneous (i.e. $V_1 = V_2$). (i) Pure strategy Nash equilibria are asymmetric. One supplier expects to end up with a competitive advantage and develops resources $r^H$ and the
other expects to be disadvantaged and develops resources \( r^L \). (ii) The absolute performance difference between the two firms is falling in the level of friction.

Our simple market exhibits the emergence of firm heterogeneity. There is an important caveat to this result. The suppliers do have an important initial asymmetry: the expectation about which is to be the market leader. What our result elucidates is how expectations of market leadership can be self-fulfilling and consistent with rationality. When one supplier is expected to be a market leader it has an incentive to invest more in resources, which makes the expectations self-fulfilling. In terms of practical implications, this result suggests that managing expectations about market leadership can make an advantageous equilibrium focal (Schelling, 1960) and hence it can be a driver of superior performance.

Once a firm has developed a competitive advantage, a central question in strategy is whether it is sustained over time. The flip side of this question is whether a disadvantaged firm can catch up and establish its own advantage. We can address this question by considering the case where initially heterogeneous firms can invest in new resources. Lemma 6.1 still applies to this situation as well. If supplier 1, which we are assuming to have the initial competitive advantage, is expected to maintain its advantage then it will invest more than supplier 2 and
its advantage will not only be sustained but reinforced. However, it is also sometimes possible that the disadvantaged supplier 2 can leapfrog the leader. Formally we have the following.

**Proposition 6.3.** In the resource development extension, there exists either one or two pure strategy Nash equilibria. (i) There always exists a “sustaining” equilibrium where \( r_1^* = r^H \) and \( r_2^* = r^L \) so that the initial market leader increases its competitive advantage. (ii) A “leapfrogging” equilibrium where \( r_1^* = r^L \) and \( r_2^* = r^H \) exists when these investments allow supplier 2 to have a competitive advantage. This occurs if and only if

\[
V_1 - V_2 < \frac{(1 - \alpha)(1 - f)^2}{4c}.
\]

(6.1)

In our setting, it is always an equilibrium for an initial competitive advantage to be sustained.\(^{21}\) However, when condition 6.1 holds, the leader’s initial competitive advantage is vulnerable if the follower can create expectations that it is the one to more aggressively exploit the opportunity to invest in the new resource. Figure 6.2 illustrates how the leader’s competitive advantage is more likely to be secure the greater is the initial heterogeneity \( V_1 - V_2 \), the greater the frictions in the market \( f \), and the more costly it is to develop new resources \( c \).

Our analysis of sustainability illustrates the importance of integrating multiple levels in strategy analysis. Our condition on sustainability depends at the industry level on the extent of competitive frictions \( f \), at the firm level on the level of initial advantage \( V_1 - V_2 \), and at the resource level on the ease of developing resources \( c \).

### 7. Discussion and Conclusion

In this paper, we started with a simple model of value creation and value capture in a product market based on a coalitional game. We then added a simple friction parameter to reflect that incomplete linkages between buyers and suppliers can give rise to imperfect competition. This allows us to soften the intensity of competition in the standard value-based framework while keeping the benefits that this framework brings for strategy theorizing. Given the importance of frictions in strategy scholarship, we see this as a useful extension of value-based analysis.

\(^{21}\)While much work in strategy operationalizes sustainability in terms of the interval of time over which an advantage is sustained, our emphasis is different. We focus on a definition of sustainability based on strategic incentives, specifically whether a follower can have an incentive to outinvest the leader given the leader’s optimal reaction.
Figure 6.2: Domain of sustainability for $c$, $f$ and different levels of $V_1 - V_2$

Our model brings together in a unified way elements that are traditionally thought of as different levels of analysis. We incorporate in our model structural determinants of the industry’s profitability (barriers to entry, frictions affecting the intensity of competition, buyer and supplier power). At the same time, our model explicitly allows for firm-level heterogeneity in value creation and investment in resources.

Our analysis reveals that, far from being separable, industry-level and firm-level factors are in fact deeply intertwined. First, the mapping between firm value creation and value capture is moderated by industry-level factors. For instance, we find that the extent of frictions in the product market is always negatively related to value creation, but has a U-shaped relationship with value capture.

Second, firm heterogeneity depends both on features of the resource development process, but also on features of the industry. In our model, endogenous differences in value creation appear as the outcome of strategic interactions. A leader with high value creation and a follower with low value creation emerge due to the conjunction of two factors. The first factor, which is due to the underlying cooperative game theoretic model, is that free form negotiation allows buyers to make suppliers compete harshly against each other. Solely on the basis of free form negotiation this would be a winner-take all market, with room for only one supplier, as two
identical suppliers would both earn zero profits. The second factor, which we introduced in this paper, is the friction parameter which shields the weaker supplier from the brunt of competition from the stronger one. Because of frictions, which prevent some buyers from negotiating with both suppliers at the same time, there is a niche available in the market for a weaker supplier and which justifies this supplier’s investment in some capabilities.

More generally, our model is consistent with the idea that firms should seek a positioning that fits their competitive environment. To this, we add that firm positioning – even when it is fitting the environment – is also determined by competitive interactions, themselves moderated by the structure of the environment, which may in the end generate substantial heterogeneity.

In addition to shedding light on possible sources of firm heterogeneity, our model also speaks to the conditions under which heterogeneity may persist. In our model, a firm starting with a handicap in terms of value creation can take the opportunity of resource development to catch up and leapfrog a leader. Hence, firm positions are not necessarily determinate. Moreover, our model also gives boundary conditions for the fluidity of firm relative positions. If the initial value creation difference between firms is above a certain threshold, the current relative positions cannot change. This threshold depends on characteristics of the industry such as the relative bargaining power of buyers versus suppliers and the level of frictions. While a lot of the strategy literature on sustainability of competitive advantage has looked into resource characteristics (Dierickx and Cool, 1989) to explain sustainability, we complement that approach by elaborating on the role of strategic incentives.

Third, our model explores how the height of barriers to entry interacts with the presence of frictions and the cost of resource development to shape industry structure. What may seem as two independent factors – barriers to entry, and frictions – affecting the industry in fact can have a complex interaction. For a given level of entry cost, increasing frictions on the product market can either increase or decrease the number of active suppliers depending on what critical threshold is crossed.

Our results suggest that there are complex interactions between elements usually thought of as playing out at different levels of analysis. This implies that firm- and resource-level analyses on the one hand, and industry-level analysis, on the other hand, cannot be easily separated. We hope that this type of analysis will contribute to the central thrust of strategy research: to better understand the mapping between value creation and value capture. A formal analysis like the one we presented here does not provide rules for riches. However it is useful by being able to
uncover some drivers of the emergence and sustainability of firm heterogeneity by identifying the sometimes complex mechanisms that creates incentives for firms to occupy different positions in the market. This model is admittedly highly stylized and future work can extend this analysis in a variety of ways. We would particularly highlight the need to add horizontal differentiation and allowing the set of linkages in the industry to be at least partially endogenous.

References


8. Appendix 1: Capacity Constraints and Value Capture

In this appendix we take a look at how capacity constraints matter for value capture in cooperative games through two examples. The first example is the classic glove market example, and highlights how the assumption that all coalitions can equally form, irrespective of the number of agents, can lead to extreme results in terms of value appropriation. In the second example we look at suppliers of product of different quality facing a fixed demand and vary their production capacity to see how different assumptions affect the core allocation and their added value.


Consider a market with two sides: owners of one right glove and owners of one left glove. A unit of value is created only when one right and one left glove are put together. Suppose there are 1001 owners of one left glove each and 1000 owners of one right glove each. A total value of 1000 can be created. The core allocation is such that each owner of a left glove appropriates
and each owner of a right glove appropriates zero. The result is driven by the fact that one side of the market is longer by one unit (i.e., there is an excess supply of one right glove), which is enough to prevent players on the longer side to appropriate any value because none of them has a strictly positive added value. The glove market result is an example of how the core can embody “extreme cut throat competition” (Aumann, 1985). It can be noted that the extreme result given by the core is driven by the implicit assumption that all possible coalitions can form, even if this assumption may not be reasonable with that number of players.

8.2. Production Capacity and Value Capture

One way to allow a weaker supplier to capture value is to introduce capacity constraints. We now explore in an example the joint effect of differences in value creation and capacity constraints on value capture. In this scenario, we have two suppliers with value creation per unit respectively equal to $V_1 = 10$ and $V_2 = 8$. There are three buyers, each in need of at most one unit. In table 8.1, we look at different scenarios for the capacity (i.e., the number of units each supplier can produce) of the suppliers, holding everything else (value creation per unit and number of buyers) constant. For each supplier, we present the lower and upper bounds of the core as well as the added value. For instance, the first column considers the case where each supplier can produce one unit. The upper and lower bounds of the core for supplier 1 coincide and are equal to 10.

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Supplier 1</th>
<th>1</th>
<th>2</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier 2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Core bounds [Lower,Upper]</td>
<td>Supplier 1</td>
<td>[10,10]</td>
<td>[4,20]</td>
<td>[6,10]</td>
<td>[4,4]</td>
<td>[0,6]</td>
<td>[4,4]</td>
<td>[0,6]</td>
</tr>
<tr>
<td>Supplier 2</td>
<td>[8,8]</td>
<td>[0,8]</td>
<td>[8,16]</td>
<td>[0,0]</td>
<td>[0,0]</td>
<td>[0,0]</td>
<td>[0,0]</td>
<td></td>
</tr>
<tr>
<td>Added Value</td>
<td>Supplier 1</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Supplier 2</td>
<td>8</td>
<td>8</td>
<td>16</td>
<td>8</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Table 8.1: Value Capture by Suppliers Depending on Capacity Constraints

In this simple setting, we see that capacity constraints at the industry level lead to high value capture. As long as the sum of the capacities of supplier one and two is less or equal to 3, they can both potentially capture a lot of value. Once there is extra capacity on the market, supplier 2 cannot hope to capture anything, even when it may have strictly positive added value. Although supplier 1 fares better than supplier 2, it would be in some cases better off if it reduced its production capacity. Consider the last two columns of the table. In both columns, supplier 2 has a capacity of 3 units. If supplier 1 has a capacity of 2 units, it is assured
to capture 4 (see second to last column). If supplier 2 has a capacity of three, its value capture will be in the interval [0,6]. Depending on the bargaining power of the buyers, supplier 1 can hope to capture less or more than 4.

This example suggests that, absent frictions, there are two paths to value capture for a supplier. The first involves the ability to create superior value compared to competitors. The second involves the ownership of production capacity that are scarce enough in comparison to the demand. The less efficient producer (supplier 2) can only appropriate value when there is demand that is not satisfied by the more efficient firm. This is reminiscent of the mechanism leading to Ricardian rents, with the difference that here the distribution of value is determined by multilateral negotiations involving all possible coalitions, rather than by a unique market price.

9. Appendix 2: Proofs

9.1. Proof of Proposition 4.1

Value creation is given by \( V_G = (1-f)V_1 + f(1-f)V_2 \). We have \( \frac{dV_G}{df} = V_2 - V_1 - 2fV_2 \), which is negative or equal to zero since \( V_1 \geq V_2 \) and \( 0 \leq f \leq 1 \). Hence \( V_G \) is monotonically decreasing as \( f \) increases within the interval \((0,1)\).

The influence of the friction parameter \( f \) on value capture is given by the derivative of the profit function.

\[
\Pi_1 = (1-f)(1-\alpha)(V_1- (1-f)V_2),
\]
\[
\Pi_2 = f(1-f)(1-\alpha)V_2.
\]

From these, we get:

\[
\frac{\partial \Pi_1}{\partial f} = (1-\alpha)(2V_2(1-f) - V_1),
\]
\[
\frac{\partial \Pi_2}{\partial f} = (1-\alpha)(1-2f)V_2.
\]

Since \( 1-\alpha > 0 \), we have \( \frac{\partial \Pi_1}{\partial f} \geq 0 \) if and only if \( f < 1 - \frac{V_1}{2V_2} \). Define \( f_1^* = 1 - \frac{V_1}{2V_2} \), the value of \( f \) for which \( \Pi_1 \) is maximal.
Note that $f_1^* > 0$ if and only if $V_1 < 2V_2$. Moreover, because $V_1 \geq V_2$, we also have $f_1^* \leq \frac{1}{2}$. Similarly, we have $\frac{\partial \Pi_1}{\partial f} \geq 0$ if and only if $f \leq \frac{1}{2}$. Define $f_2^* = \frac{1}{2}$, the value of $f$ for which $\Pi_2$ is maximal. We then have $f_1^* < f_2^*$.

9.2. Proof of Proposition 4.2

From the profit function $\Pi_1$ and $\Pi_2$ we get $\frac{\partial^2}{\partial V_1 \partial f} \Pi_1 = \alpha - 1 < 0$ and $\frac{\partial^2}{\partial V_2 \partial f} \Pi_2 = 1 - 2f$. We have $\frac{\partial^2}{\partial V_2 \partial f} \Pi_2 > 0$ if and only if $f < 0$.

9.3. Proof of Proposition 5.1

Equilibrium with Duopoly

First, let us find out the parameters $f$ that allow two suppliers to enter and be profitable. For this, we need that the weaker supplier has weakly positive profits, conditional on the presence of a stronger supplier in the market. The thresholds for the entry of a second supplier are therefore defined the equation $f(1-f)(1-\alpha)V_2 - F = 0$. There are two roots to this equation:

$$ f_D^L = \frac{1}{2V_2(1-\alpha)} \left( (1-\alpha)V_2 - \sqrt{(1-\alpha)V_2 - 4F} \right), $$

$$ f_D^H = \frac{1}{2V_2(1-\alpha)} \left( (1-\alpha)V_2 + \sqrt{(1-\alpha)V_2 - 4F} \right). $$

which define the upper and the lower bound of the parameter $f$ that support entry by both firm. Notice that $\Pi_1 > \Pi_2$, so it is also optimal for supplier 1 to enter. In summary, in $f_D^L > f > f_D^H$, both firms are profitable from entry.

Equilibrium with no entry

An equilibrium with no entry can obtain when neither supplier can be profitable upon entry even in the most favorable case where they are alone in the market. We know that supplier 1’s monopoly profits are superior to supplier 2’s monopoly profit. The boundary of the no entry area is defined by $\Pi_1^M - F = 0$, i.e., for $(1-\alpha)V_1 - F = 0$. The threshold at which the first supplier is indifferent between entering and not entering is therefore defined by $f_M = 1 - F/((1-\alpha)V_1)$. As profits go to zero as $f$ reached 1, the region where neither suppliers enter is the interval $(f_M, 1]$.

Equilibria with entry by a single supplier
For entry by a single supplier to be an equilibrium it has to be that the supplier that enters is profitable, while the supplier that enters would have negative profits upon entry and hence prefers to stay out.

Multiple equilibria with entry of only one of the two suppliers are possible only when supplier 1’s profits under competition are negative, while the profits under monopoly of supplier 2 are positive.

The condition for zero profits of supplier 1 \(((1 - f)(1 - \alpha)(V_1 - (1 - f)V_2) - F = 0)\) defines two thresholds \(\hat{f}_1\) and \(\hat{f}_2\) such that:

\[
\hat{f}_1 = \frac{1}{2(1 - \alpha)V_2} \left( (1 - \alpha)(2V_2 - V_1) - \sqrt{(1 - \alpha)\left((1 - \alpha)V_1^2 - 4FV_2\right)} \right),
\]

\[
\hat{f}_2 = \frac{1}{2(1 - \alpha)V_2} \left( (1 - \alpha)(2V_2 - V_1) + \sqrt{(1 - \alpha)\left((1 - \alpha)V_1^2 - 4FV_2\right)} \right).
\]

Moreover, there is a threshold \(\hat{f}_3\) is defined by supplier 2 making exactly zero profit when it is alone in the market, which means \(\hat{f}_3 = 1 - F/((1 - \alpha)V_2)\).

Taking all these thresholds together we can characterize the different equilibria in function of the value of \(f\).

For very low levels of frictions \((0 < f \leq \hat{f}_1)\), there are two possible equilibria: either supplier 1 or supplier 2 enters and the other supplier stays out. The reason is that neither supplier can make a profit if the other is in the market, but both can make a profit if they are alone in the market.

If \(\hat{f}_1 < f \leq f^D_L\), supplier 1 always enter and supplier 2 stays out. Supplier 1 will be profitable regardless of whether supplier 2 has entered while supplier 2 cannot make a profit if supplier 1 has entered. Thus to enter is a dominant strategy for supplier 1.

If \(f^D_L < f < f^H_L\), both suppliers enter, as they are always making strictly positive profits regardless of the other supplier’s decision.

If \(f^H_L \leq f < \hat{f}_2\), supplier 1 enters alone. Supplier 1 is always making while if supplier 2 entered it would suffer a loss.

If \(\hat{f}_2 \leq f < \hat{f}_3\), then there is another region of multiple equilibria, as either supplier can enter and if it does so it makes the other supplier unprofitable.

If \(\hat{f}_3 \leq f < f_M\), only supplier 1 can enter and make a profit while being alone, leading to a unique equilibrium.
Finally, if \( f_M \leq f \), then there is no entry at all.

It is easy to show that \( \hat{f}_1 < f^D_L < f^H_L < \hat{f}_2 < \hat{f}_3 < f_M \).

Moreover, note that \( \hat{f}_1 > 0 \) if and only if:

\[
(1 - \alpha)(2V_2 - V_1) > \sqrt{(1 - \alpha)((1 - \alpha)V_1^2 - 4FV_2)}.
\]

This is impossible if \( 2V_2 \leq V_1 \). If \( 2V_2 > V_1 \), it is easy to show that we need \( F \geq V_1 - V_2 \) to ensure \( \hat{f}_1 \geq 0 \). Note that \( \hat{f}_1 < 0 \) simply means that there is no multiplicity in the concerned region.

### 9.4. Proof of Proposition 5.2

(i) Take the threshold \( f^D_L \) and \( f^D_H \) and differentiate them according to \( \alpha \).

We have \( \frac{\partial f^D_L}{\partial \alpha} = \frac{F}{(1 - \alpha)\sqrt{V_2(a-1)(4F-V_2+aV_2)}} > 0 \) and \( \frac{\partial f^D_H}{\partial \alpha} = -\frac{F}{(1 - \alpha)\sqrt{V_2(a-1)(4F-V_2+aV_2)}} < 0 \).

(ii) Denote \( f^D_L(\alpha) \) the lower threshold for the entry of a second supplier given buyer bargaining power \( \alpha \). Take a value of the friction parameter \( f^T \) and an arbitrary small \( \varepsilon > 0 \) such that \( f^D_L(\alpha) < f^T < f^D_L(\alpha + \varepsilon) \). From (i) we know that \( f^D_L(\alpha) \) is strictly increasing in \( \alpha \) for \( \alpha > 0 \). Holding frictions constant, an increase \( \varepsilon \) of the buyer bargaining power leads to a change in entry equilibrium from entry by both suppliers 1 and 2 (\( f^D_L(\alpha) < f^T \)) to entry by supplier 1 alone (\( f^T < f^D_L(\alpha + \varepsilon) \)). Industry profits with only supplier 1 are equal to

\[
(1 - f^T)(1 - \alpha - \varepsilon)V_1 - F.
\]

Industry profits for the two-supplier entry equilibrium are equal to:

\[
(1 - f^T)(1 - \alpha)(V_1 - (1 - f^T)V_2) + (1 - f^T)f^T(1 - \alpha)V_2 - 2F.
\]

Hence, the difference in industry profits between after the increase of \( \varepsilon \) of the buyer bargaining power and before is:

\[
(1 - f)(1 - \alpha)(1 - 2f)V_2 - \varepsilon(1 - f)V_1 + F.
\]

Note that by definition \( f^D_L \leq \frac{1}{2} \) since the highest profit of supplier 2 is at \( f = \frac{1}{2} \), hence \( f^T \leq \frac{1}{2} \). Given this, \( V_1 \geq V_2 \) and \( \varepsilon > 0 \), the above expression is strictly positive for an arbitrary small \( \varepsilon \). Therefore, there are values of \( f \) strictly above \( f^D_L(\alpha) \), an increase in buyer bargaining
power can lead to an increase in total supplier profits.

9.5. Proof of Lemma 6.1

Suppliers will invest in developing a resource until the marginal value capture from the resource equalizes the marginal cost of building the resource. In this model marginal value capture can only take two values, depending on whether the supplier expects to be the higher value creating firm or the lower value creating firm. If a supplier expects that its overall value creation \( V_i + r_i \) will be lower than that of its competitor \( V_j + r_j \) it will invest in a low level of extra value creation ability. This is because this investment will provide extra value capture only for a fraction of the buyer base equal to 

\[ f(1 - f) \]

In contrast, a supplier expecting to be ahead (i.e., \( V_i + r_i > V_j + r_j \)) will be able to increase its marginal value capture on a fraction \( (1 - f) \) of the buyer base. As the marginal increase of value capture can only take two values, the optimal investment can only be at two levels: high \( r^H = \frac{(1-f)(1-\alpha)}{2c} \) or low \( r^L = \frac{f(1-f)(1-\alpha)}{2c} \).

The difference between the two levels of resource development is 

\[ r^H - r^L = \frac{1}{2c} (1-\alpha)(1-f)^2, \]

which is decreasing in \( f \) for values of \( f \) in \([0,1]\).

9.6. Proof of Propositions 6.2 and 6.3

(i) Without loss of generality, assume \( V_1 > V_2 \). We know from lemma 6.1 that a supplier’s investment can only take two values \( r^H = \frac{(1-f)(1-\alpha)}{2c} \), or \( r^L = \frac{f(1-f)(1-\alpha)}{2c} \). Let us first show that symmetric equilibria cannot exist.

Denote \((r_1, r_2)\) a candidate equilibrium. Assume symmetric strategies \((r_1 = r_2)\). Note that \( V_1 + r_1 \geq V_2 + r_2 \), since \( V_1 > V_2 \). Supplier 1 will always create more value.

If \( V_1 + r_1 \geq V_2 + r_2 \), we have the following profit functions:

\[
\Pi_1(r_1, r_2) = (1 - f)(1 - \alpha)((V_1 + r_1) - (1 - f)(V_2 + r_2)) - c(r_1)^2,
\]

\[
\Pi_2(r_1, r_2) = f(1 - f)(1 - \alpha)(V_2 + r_2) - c(r_2)^2.
\]

Case 1: Suppose the equilibrium are \((r^H, r^H)\), then we will show that supplier 2 always wants to deviate, resulting in a contradiction.

Assume that strategies \((r_1, r_2)\) are \((r^H, r^H)\). Then supplier 1 has higher value creation. In this situation, supplier 1’s profits are:

\[ \Pi_1(r^H, r^H) = (1 - f)(1 - \alpha)((V_1 + r^H) - (1 - f)(V_2 + r^H)) - c(r^H)^2, \]

\[ \Pi_2(r^H, r^H) = f(1 - f)(1 - \alpha)(V_2 + r^H) - c(r^H)^2. \]
\[
\Pi_2(r^H, r^H) = f(1 - f)(1 - \alpha)(V_2 + r^H) - c(r^H)^2
\]

\[
= f(1 - f)(1 - \alpha) \left( V_2 + \frac{(1-f)(1-\alpha)}{2c} \right) - c \left( \frac{(1-f)(1-\alpha)}{2c} \right)^2
\]

While the supplier 2’s profits upon deviation to \(r^L\) are:

\[
\Pi_2(r^H, r^L) = f(1 - f)(1 - \alpha)(V_2 + r^L) - c(r^L)^2
\]

\[
= f(1 - f)(1 - \alpha) \left( V_2 + \frac{f(1-f)(1-\alpha)}{2c} \right) - c \left( \frac{f(1-f)(1-\alpha)}{2c} \right)^2
\]

Hence:

\[
\Pi_2(r^H, r^L) - \Pi_2(r^H, r^H) = \frac{1}{4c} (1 - \alpha)^2 (1 - f)^4 > 0.
\]

So supplier 2 will always deviate.

Case 2. If the equilibrium is \((r^L, r^L)\), then we show that supplier 1, always want to deviate, resulting in a contradiction.

Supplier 1’s profit at strategy \((r^L, r^L)\) are:

\[
\Pi_1(r^L, r^L) = (1 - f) (1 - \alpha) ((V_1 + r^L) - (1 - f)(V_2 + r^L)) - c(r^L)^2
\]

\[
= (1 - f) (1 - \alpha) \left( V_1 + \frac{f(1-f)(1-\alpha)}{2c} \right) - (1 - f) \left( V_2 + \frac{f(1-f)(1-\alpha)}{2c} \right)
\]

\[
- c \left( \frac{f(1-f)(1-\alpha)}{2c} \right)^2
\]

The profits upon deviation to \(r^H\) are:

\[
\Pi_1(r^H, r^L) = (1 - f) (1 - \alpha) ((V_1 + r^H) - (1 - f)(V_2 + r^L)) - c(r^H)^2
\]

\[
= (1 - f) (1 - \alpha) \left( V_1 + \frac{(1-f)(1-\alpha)}{2c} \right) - (1 - f) \left( V_2 + \frac{f(1-f)(1-\alpha)}{2c} \right)
\]

\[
- c \left( \frac{(1-f)(1-\alpha)}{2c} \right)^2
\]

However:

\[
\Pi_1(r^H, r^L) - \Pi_1(r^L, r^L) = \frac{1}{4c} (1 - \alpha)^2 (1 - f)^4 > 0.
\]

So supplier 1 will always deviate.
3. For any $V_1 > V_2$, $(r^H, r^L)$ is always an equilibrium.

Since $r^H > r^L$, we still have $V_1 + r^H > V_2 + r^L$. Given this, each firm has no incentive to deviate by definition of the investment levels $r_H$ and $r_L$ since any deviation would not change which firm is creating more value.

4. For $V_1 > V_2$, $(r^L, r^H)$ is an equilibrium if and only if:

1. The positions can switch and supplier 2 can come on top by investing at the high level, given $r_2 = r^H$

   This is possible if and only if:

   $$V_1 + r^L < V_2 + r^H$$
   $$V_1 - V_2 < \frac{1}{2c} (1 - \alpha)(1 - f)^2$$

2. Supplier 2 doesn’t want to deviate.

   Here, supplier 2’s deviation is to fall back on $r^L$. Without deviation, We have $V_1 + r^L < V_2 + r^H$

   \[
   \Pi_2(r^L, r^H) = (1 - f)(1 - \alpha)(V_2 + r^H - (1 - f)(V_1 + r^L)) - c(r^H)^2 \\
   = (1 - f)(1 - \alpha)
   \left[
   \left(V_2 + \frac{(1 - f)(1 - \alpha)}{2c}\right) - (1 - f)
   \left(V_1 + \frac{f(1 - f)(1 - \alpha)}{2c}\right)
   \right]
   - c\left(\frac{(1 - f)(1 - \alpha)}{2c}\right)^2
   \]

   The deviation to $r^L$ would put supplier 2 behind supplier 1 in terms of value creation. Hence profits would be:

   \[
   \Pi_2(r^L, r^L) = f(1 - f)(1 - \alpha)(V_2 + r^L) - c(r^L)^2 \\
   = f(1 - f)(1 - \alpha)
   \left[
   V_2 + \frac{f(1 - f)(1 - \alpha)}{2c}\right]
   - c\left(\frac{f(1 - f)(1 - \alpha)}{2c}\right)^2
   \]
\( \Pi_2(r^L, r^H) - \Pi_2(r^L, r^L) = \frac{1}{4c} (1 - \alpha) (f - 1)^2 ((f - 1)^2 (1 - \alpha) - 4cV_1 + 4cV_2) \)

Deviation is not profitable if and only if \( \Pi_2(r^L, r^H) - \Pi_2(r^L, r^L) > 0 \), i.e.:

\[
(f - 1)^2 (1 - \alpha) - 4cV_1 + 4cV_2 > 0
\]

\[
V_1 - V_2 < \frac{1}{4c} (1 - \alpha) (f - 1)^2
\]

3. Supplier 1 doesn’t want to deviate either.

\[
\Pi_1(r^L, r^H) = f(1 - f)(1 - \alpha)(V_1 + r^L) - c(r^L)^2
\]

\[
= f(1 - f)(1 - \alpha) \left( V_1 + \frac{f(1 - f)(1 - \alpha)}{2c} \right) - c \left( \frac{f(1 - f)(1 - \alpha)}{2c} \right)^2
\]

The deviation would be to increase development to \( r_H \). Deviation would give:

\[
\Pi_1(r^H, r^H) = (1 - f) (1 - \alpha) ((V_1 + r^H) - (1 - f)(V_2 + r^H)) - c (r^H)^2
\]

\[
= (1 - f) (1 - \alpha) \left( (V_1 + \frac{(1 - f)(1 - \alpha)}{2c}) - (1 - f) \left( V_2 + \frac{(1 - f)(1 - \alpha)}{2c} \right) \right)
\]

\[
- c \left( \frac{(1 - f)(1 - \alpha)}{2c} \right)^2
\]

Deviation not profitable if and only if \( \Pi_1(r^L, r^H) - \Pi_1(r^H, r^H) > 0 \), i.e.:

\[
V_1 - V_2 < \frac{1}{4c} (1 - \alpha) (1 - f)^2
\]

Which is the same condition as in 2, but is weaker than the “non-leapfrog” condition.

In summary, the “leapfrogging” equilibrium exists if and only if \( V_1 - V_2 < \frac{1}{16c} (1 - \alpha) (1 - f)^2 \).

(ii) a. In the “Sustaining” equilibrium, the difference in profits between the highest value firm and the lowest value firm is equal to:

\[
\Pi_1(r^H, r^L) - \Pi_2(r^H, r^L) = \frac{1}{4c} (1 - \alpha) (1 - f) (1 - \alpha + 4cV_1 - 4cV_2 + (1 - \alpha)(-f^3 + 3f^2 - 3f)).
\]
The derivative in $f$ of this difference is of the sign of $(1-\alpha)(f^3-3f^2+3f)-(1-\alpha)-cV_1+cV_2$.

The derivative is strictly negative if and only if $\left(\frac{1-\alpha}{c}\right)(f^3-3f^2+3f-1) < V_1 - V_2$, which is always true on $f \in (0,1)$ as $f(f^2-3f+3)-1 < 0$ in $(0,1)$.

b. In the “Leapfrogging” equilibrium, the difference in profits between the two firms is equal to:

$$
\Pi_2(r^L, r^H) - \Pi_1(r^L, r^H) = \frac{1}{4c} (1-\alpha)(1-f) \left( 1 - \alpha - 4cV_1 + 4cV_2 + (1 - \alpha)(-f^3 + 3f^2 - 3f) \right).
$$

The derivative in $f$ of this difference is of the sign of $cV_1 - cV_2 - (1-\alpha) + (1-\alpha)(f^3-3f^2+3f)$.

The derivative is negative if and only if $\left(\frac{1-\alpha}{c}\right)(-f^3 + 3f^2 + 3f + 1) < V_1 - V_2$, which is always true under the assumption $V_1 - V_2 < \frac{1}{4c} (1 - \alpha)(1-f)^2$ which is necessary for the existence of the “Leapfrogging” equilibrium as shown in part (i) of this proposition.
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