Operationalizing Value-Based Business Strategy

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Abstract

Brandenburger and Stuart (1996) identified coalitional games as a means of providing precise notions of value to evaluate strategic opportunities. In this paper, we show how coalitional game theory can be utilized to operationalize these approaches. In particular, we demonstrate the importance of considering full competitive interactions (rather than simply added value) when applying coalitional game theory and also how this can be employed to provide insights into the workings of an existing economic activity as well as to suggest ways that the activity might be altered to a firm's advantage. We illustrate with an application in which an innovator considers whether to commercialize a new technology.

*This paper builds on and replaces an earlier paper by MacDonald and Ryall (2003). We thank Douglas Hirai for his careful proof reading of the original version.

1 Introduction

'Value-based business strategy' is a term coined in a highly influential paper by Brandenburger and Stuart (1996) who offer an exact definition of the value that can be created by firms transacting with suppliers and buyers. This naturally leads to the notion of 'added value,' a measure of a firm's contribution to the aggregate value produced in a given market. As Brandenburger and Stuart (1996) argue, a firm's added value imposes an upper bound on the value it can appropriate. They go on to demonstrate how the use of certain strategies allow a firm to create favorable asymmetries within a market to ensure its added value is strictly positive. The notion that firms should focus on their added value is popularized in Brandenburger and Nalebuff (1996) has become a central feature of strategy and economics as taught in business schools.[1]

The added value logic described above is underpinned by coalitional game theory. In particular, application of the "core" as a solution concept reinforces the importance of positive added value as a necessary condition for positive appropriation.[2] However, as MacDonald and Ryall (2004) demonstrate, the core can also be used to characterize the maximum a firm might appropriate (something that is no greater than their added value but may be less than it) as well as the least amount guaranteed by participating in the market (something that is no less than their reservation price but may be greater than it). The latter notion is important because, regardless of how the indeterminacy in a firm's range of core-consistent appropriation levels is resolved (often by appealing to notions of "bargaining" strength; see Brandenburger and Stuart, 2004 for a formal treatment), the minimum is assured by competitive forces alone. For this reason, MacDonald and Ryall (2004) define a firm's *absolute competitive advantage* to be its minimum level of appropriation consistent with a core distribution. An absolute competitive advantage is sufficient to guarantee a firm's participation in the contemplated market (i.e., regardless of its relative bargaining skill, etc.).[3]

The purpose of this paper is to take the use of the core seriously as a means of opera-

[1]See, for example, Saloner, Shepard and Podolny (2001); Besanko, Dranove, Shanley and Schaefer (2004); and Gans (2005).

[2]See MacDonald and Ryall (2004) for a formal proof.

[3]Brandenburger and Stuart (1996) and MacDonald and Ryall (2004) both show how various strategic options may be used to guarantee a positive competitive advantage.

tionalizing value-based business strategy.[4] Our goal is to demonstrate how this methodology can be used analyze the efficacies of a firm's various strategic opportunities.[5] We go beyond qualitative speculation with respect to so-called "generic" strategies based upon incomplete analysis of the market to quantitative assessments of specific strategies in complex environments using the complete set of competitive restrictions implied by the given market. A key theme is that, while useful, focussing entirely on added value often comes up short when assessing strategic opportunities. In some cases, *a strategy that both creates value and increases a firm's added value unambiguously leads to a reduction in its potential range of appropriation.* Only a full and quantitative analysis of competitive interactions can uncover these risks and also illustrate the drivers of these seemingly counter-intuitive outcomes.

In this respect, this paper is completely distinct from MacDonald and Ryall (2004). That paper provides general necessary and sufficient conditions that determine whether the lower bound of a firm's core allocation is positive or not. In contrast, the present paper deals with the calculation of the entire set of core allocations and hence, a different set of issues. As such, it is presented more in the style of Brandenburger and Stuart (1996) – utilizing examples with the explicit goal of making that paper useful in practice. In this respect, it is a synthesis of MacDonald and Ryall (2004) (the competitive part) and Brandenburger and Stuart (2004) (the bargaining part); showing both how to apply them in practice and

[4]Hereafter, we follow the convention adopted in MacDonald and Ryall (2004) of substituting the term "competitive" for "core." The intention is to emphasize the effects of a firm's transaction opportunities (which are of central importance) and to help the intuition of those who may be unfamiliar with this framework.

[5]Lippman and Rumelt (2003a, 2003b) critique the traditional use of economic-based approaches in the evaluation of strategic opportunities and suggest coalitional game theory may overcome the perceived shortcomings. Their critique is based on the observation that models of perfect competition are unable to determine who might appropriate rents or quasi-rents (i.e., supra-normal profits) in a market. Moreover, the presumption of perfect competition may often be unwarranted and, hence, give rise to misleading answers to important questions of strategic interest. While suggesting that coalitional game methods may overcome this difficulty, they highlight deficiencies in current approaches. In particular, they find the core's generic indeterminacy problematic.

Typically, however, the core places significant bounds on the range of appropriation outcomes available to an agent in a given strategic interaction. Moreover, as we demonstrate here, it does so in ways that cannot be readily extracted from indicators of value creation and appropriation (such as the concept of added value). We conclude that examing strategy through the lense of coalition game theory can actually give very meaningful predictions and facilitate the evaluation of a firm's strategic opportunities.

demonstrating why a complete analysis (beyond simple added value) is necessary.

The paper proceeds as follows. In Section 2, we provide the basic notation necessary to assess strategic options. An essential feature of this material is the sharp distinction made among (*i*) the physical process of value creation, formally described by what we call a *value opportunity*; (*ii*) the competitive forces that influence how the value produced in a value opportunity is shared among the participating agents, described by a *competitive distribution* of value; and (*iii*) any other factors that influence how created value is ultimately distributed (e.g., bargaining, negotiation, luck, psychology,...), formalized by an *appropriation factor* (as in Brandenburger and Stuart, 2004).

Section 3 turns to the potential issues that arise when evaluating generic strategies (such as product differentiation and productivity improvements). In particular, we demonstrate that productivity improvements may be strategically risky for firms and provide an example whereby these unambiguously reduce a firm's appropriation possibilities. One of the issues stems from the fact that traditional speculation with respect to generic strategies seems to assume that firms begin from a position of zero appropriation. However, we see no good reason to restrict the analysis in this way. In our approach, firms may already be appropriating value at the time they consider new strategic moves. We also consider how strategic investments may change firms' competitive positions along a vertical value chain.

Section 4 provides an extended application of how to conduct a complete analysis of strategies using data based on real world decision problems. In particular, we examine whether commercialization of a process innovation is worthwhile when the innovator negotiates with large but asymmetric buyers. We show how to compute the returns to this commercialization as well as how to identify strategies that can enhance returns further. This illustrates the power of utilizing coalitional game theory in applied settings.

2 Notation and preliminary analysis

Following MacDonald and Ryall (2004), we consider a strategic interaction among n agents, one of which we refer to interchangeably as "the firm" and as "agent 1". To begin, we require some notation to keep track of groups of agents. Our notation for a group of agents that includes at least one, but not every, agent, is a vector g, consisting of zeros and ones, where a one in the i^{th} component of g indicates agent i belongs to g. Thus $(1, 0, ..., 0)$ is the group including only agent 1; $(0, 1, ..., 1)$ is the group of all agents except agent 1; etc. Since 2^n groups can be formed from n agents, one of which is empty and another that includes all agents, there are $2^n - 2$ groups that a vector g might describe. The group of *all* agents and the group of all agents *except agent* i, both of which play a special role, are denoted $\mathbf{1}$ and $\mathbf{1}_{-i}$, respectively.

The next element of our analysis is a formal description of the value creation possibilities available to the agents through arms-length transactions. This is done by defining the available *value opportunities* (hereafter, VO) to be a pair (V, v), where $V > 0$ is a scalar and v is a non-negative vector of length $2^n - 2$. The first component, V, is the aggregate value *anticipated* as a result of the economic activities of the agents. The second component, the vector v, describes the alternative value creation opportunities available to subsets of agents. Specifically, to every group, g, there corresponds a component of v, v^g, specifying the value that group could generate were it to do so independently of any additional agents.

The collection of agents and their value-producing alternatives, as summarized by (V, v), are the key inputs to our analysis; values each agent might appropriate are its output. Define a *distribution of value*, denoted π, to be a vector of length n whose i^{th} component, π_i, represents the value appropriated by agent i. Below, we detail how this value is to be calculated in applications. For the moment, it can be thought of simply as whatever value agent i ultimately appropriates.

Inner product is indicated by "$\cdot$"; for example, the number of agents in g is $\mathbf{1} \cdot g$. A distribution of value, π, is *competitive* if it meets the following two conditions:

$$\mathbf{1} \cdot \pi = V, \tag{1}$$

and for every group g,

$$g \cdot \pi \geq v^g. \tag{2}$$

Condition (1) is simply an adding up condition, i.e., a competitive distribution must distribute the value actually produced, V. Condition (2) requires that no group, g, be able to improve over what it would receive, given the competitive distribution, by creating value on its own. The logic behind this condition is that, if, instead, $g \cdot \pi < v^g$ for some group g, the agents in g could make themselves strictly better off by ignoring the other agents, doing whatever it takes to generate v^g, and then sharing this value among the group. Thus, if some distribution π involves $g \cdot \pi < v^g$ for some group g, it is difficult to see how the distribution of value π might occur. To put it the other way around, competitive distributions are those that might occur because the alternatives available to agents do not undermine value being distributed in the contemplated way. A distribution of value being competitive is a necessary condition for its being a plausible candidate for the outcome of a strategic interaction.[6]

Note that, in this context, "competition" has a very specific meaning: agents have alternatives and the freedom to act on them if they choose to do so. The alternatives are competing activities in which agents might engage. Conditions (1) and (2) formalize how competition limits the way value can be distributed.

Given a VO, there are numbers $\pi^{\min}$ and $\pi^{\max}$ with the feature that for any appropriation level by the firm, π_1, there is a competitive distribution of value in which the firm receives π_1 if and only if $\pi^{\min} \leq \pi_1 \leq \pi^{\max}$. Equivalently, $\pi^{\min}$ is the smallest value of π_1 that is consistent with both (1) and (2); and likewise for $\pi^{\max}$ being the maximum. More specifically,

$$\pi^{\min} \equiv \min_{\pi \in \mathbb{R}_+^n} \{\pi_1 | \mathbf{1} \cdot \pi = V, \text{ and for all } g, g \cdot \pi \geq v^g\} \tag{3}$$

and

$$\pi^{\max} \equiv \max_{\pi \in \mathbb{R}_+^n} \{\pi_1 | \mathbf{1} \cdot \pi = V, \text{ and for all } g, g \cdot \pi \geq v^g\}. \tag{4}$$

(3) and (4) describe $\pi^{\min}$ and $\pi^{\max}$ as the optimized value of a pair of linear programs.[7] Thus, once data have been gathered and (V, v) specified, $\pi^{\min}$ and $\pi^{\max}$ can be computed (e.g., by using the Excel solver). This computation is useful since it tells us the firm's appropriation possibilities, i.e., at least $\pi^{\min}$ but no more than $\pi^{\max}$. In addition it yields some ancillary information that, as we show below, can be very useful.

Solutions to (3) and (4) are competitive distributions that result in $\pi_1 = \pi^{\min}$ and $\pi_1 = \pi^{\max}$, respectively. These distributions (there might be several) describe the ways value can be distributed among agents such that the firm appropriates $\pi^{\min}$ or $\pi^{\max \cdot}$. Further,

[6] There is, of course, a generic issue regarding the existence of competitive distributions with these properties – the 'empty core' problem. In all of the examples considered in this paper, the core exists. Stuart (1997) provides a more comprehensive examination of existence issues in coalitional games of the form we consider here.

[7] Note that $\pi^{\min}$ and $\pi^{\max}$ vary across the agents. Given our focus on firm 1, we do not require additional notation to keep track of these values for other agents.

since each linear program has $2^n - 1$ constraints, associated with each solution is a $(2^n - 1)$-vector of "shadow prices," denoted $\lambda^{\min}$ and $\lambda^{\max}$, respectively. Each component of $\lambda^{\min}$ corresponds to a group (either **1** or some g), and quantifies the effect on $\pi^{\min}$ of loosening, by one unit, the constraint with which that group is associated. That is, if some v^g is reduced by \$1, or V increased by \$1, the corresponding components of $\lambda^{\min}$ tell us by how much $\pi^{\min}$ falls; $\lambda^{\max}$ is interpreted similarly. The majority of shadow princes turn out to be zero. These are associated with constraints that are not binding: varying them (within limits that are easily calculated) does not affect the outcome. The information embedded in $\lambda^{\min}$ and $\lambda^{\max}$ can serve a very useful role in the firm's evaluation of activities that might alter the VO. We have more to say on this subject below.

Firm 1's *added value* is defined as $av \equiv V - v^{\mathbf{1}_{-1}}$ (i.e., the aggregate value anticipated with the firm's participation minus the amount that can be produced without it). As argued by Brandenburger and Stuart (1996), and formally shown by MacDonald and Ryall (2004), $av_1 > 0$ is necessary for $\pi^{\max} > 0$. It is for this reason that Brandenburger and Stuart (1996) and, indeed, Brandenburger and Nalebuff (1996) argue that the firm should focus on strategies that lead to $av > 0$. Typically, however, $\pi^{\min} < \pi^{\max} < av$. This is the indeterminacy issue discussed above. Not only does the firm typically face a range of values other than av, but sometimes av is not even attainable as part of a competitive distribution. Limiting the analysis to av is only useful in the very special circumstances when $\pi^{\min} = \pi^{\max} = av$. Thus, a key focus on operationalizing value-based strategy must be a consideration of the *full* set of interactions between agents in a competitive situation. It is only by doing a complete analysis that one can specify how, when $\pi^{\min} < \pi^{\max}$, the firm should assess the opportunity to take part in some VO. The firm knows competition guarantees it at least $\pi^{\min}$ and no more than $\pi^{\max}$, but this may not be enough information for it to decide how *best* to proceed.

For example, suppose an outsider is considering making a tender offer for the firm. How should the firm be valued? Alternatively, suppose the firm considers taking some costly action that will alter the VO, possibly both lowering $\pi^{\min}$ and increasing $\pi^{\max}$. How should it evaluate this opportunity? Brandenburger and Stuart (2004) present a very useful solution. To see how it works, begin by considering, instead, the familiar von Neumann and Morgenstern approach to how agents value uncertain prospects, e.g., lottery tickets. In the risk neutral case (consistent with what we study below) the value of an uncertain prospect may be represented by its expected value, where the probabilities used to compute the expectation can be interpreted as the agent's subjective beliefs about the likelihood of the various possible outcomes. The agent behaves as if this expected value will be the outcome of the uncertain prospect. In a similar manner, Brandenburger and Stuart, applied to our setting, show that when facing the interval of possible appropriation, $[\pi^{\min}, \pi^{\max}]$, the value the firm attaches to this may be represented by

$$\hat{\pi} \equiv \alpha\pi^{\max} + (1-\alpha)\pi^{\min},$$

where $\alpha \in [0,1]$. $\hat{\pi}$ is interpreted as the firm's expectation about the result of factors in addition to competition. We refer to α as the firm's *appropriation factor* (AF), and write

$$\hat{\pi} \equiv \pi^{\min} + \alpha\left(\pi^{\max} - \pi^{\min}\right), \tag{5}$$

in which the first term is the minimum appropriation guaranteed by competition and the second is the additional value the firm believes will appropriate as a result of extra-competitive factors. For example, when $\alpha = 1$, the firm believes it will appropriate the maximum level of value consistent with competitive forces; i.e., $\hat{\pi} = \pi^{\max}$.

While the specification of (V, v) typically involves a fairly direct assessment of the underlying technology, consumer demand and other market data, identification of α may be more elusive. In some cases, as we demonstrate below, evaluation does not rely on knowledge of α (i.e., a firm's choice is invariant with respect to α). In others, the firm's current appropriation, say $\hat{\pi}_0$ (where the subscript indicates period zero), can be employed along with knowledge of the current VO, (V_0, v_0), to calculate the current AF, α_0 :

$$\alpha_0 \equiv \frac{\hat{\pi}_0 - \pi_0^{\min}}{\pi_0^{\max} - \pi_0^{\min}}.$$

With α_0 in hand, the firm can consider whether there is any good reason to expect that the AF for the ongoing interaction might be different.

Below, we show how our framework can be employed to uncover, explore, and evaluate any opportunities to change the AF or VO. There are a couple of key points that are critical to that discussion, but that are best discussed while attention is focused on (3) and (4).

First, observe that the unambiguous way for the firm to increase $\hat{\pi}$ is to raise both $\pi^{\min}$ and $\pi^{\max}$. Note, however, that the constraints in (3) and (4) are the same. Thus, the constraints that prevent $\pi^{\min}$ from being higher are the same ones that prevent $\pi^{\max}$ from being lower. Fortunately, projects designed to simultaneously increase $\pi^{\min}$ and $\pi^{\max}$ are not precluded; nonzero components of $\lambda^{\min}$ often correspond to alternatives that are different from the those identified by the nonzero components of $\lambda^{\max}$, in which case there may be scope for increasing both $\pi^{\min}$ and $\pi^{\max}$. Still, figuring out how to alter the VO to increase $\hat{\pi}$ may involve some cleverness. Experience confirms this, as well as the considerable value of having the nonzero components of $\lambda^{\min}$ and $\lambda^{\max}$ to light the way.

Second, the constraint corresponding to the adding up condition, (1), must always be met. Thus, if V increases, but v remains unchanged, $\pi^{\min}$ cannot rise and $\pi^{\max}$ cannot fall. This suggests, correctly, that actions increasing the overall value of the economic interaction are not necessarily those that increase $\hat{\pi}$. More generally, actions that alter the VO or AF change V and numerous alternatives in v. The calculations revealing the way $\pi^{\min}$, $\pi^{\max}$ and $\hat{\pi}$ are affected are essential to untangling what may be a very complicated collection of interactions.

MacDonald and Ryall (2004) provide necessary and sufficient conditions for $\pi^{\min} > 0$ and apply those insights in several applications. Here, our goal is not to demonstrate general theorems about generic strategies but to consider how to operationalize their model to evaluate potentially complex strategic opportunities using real, quantitative data.

3 Evaluating Generic Strategies

The key to operationalizing value-based business strategy is to formulate the competitive distribution problem as a linear program based on calculations of the value created by alternative groups as in (3) and (4). Doing so allows the analyst to consider market environments with many firms and multiple vertical stages. Here we demonstrate, using a simple example, that common qualitative prescriptions regarding the desirability of opportunities may not hold when the full range of potential transactions are taken into account. This implies that partial approaches to evaluating strategies – e.g., based on perfect competition or Brandenburger and Stuart's (1996) added value – may not only be insufficient but may actually be misleading as prescriptive decision-making tools.

Our example is as follows: we suppose there are two suppliers, S_1 and S_2, two buyers, B_1

and B_2, and two firms, F_1 and F_2, who intermediate between the buyers and suppliers. For a coalition to create value, at least one supplier, one firm and one buyer must be present. The following table provides the underlying parameters that generate value. Each agent has a capacity (in units of an homogenous good) and a (constant) value contribution (per unit of the homogeneous good). For the suppliers and firms, this value contribution is negative (implying a marginal cost) and for the buyers it is positive. These underlying parameters are used to calculate the maximum value that would be created by any given coalition but in a real world analysis, those values could be calculated based on actual industry information regarding the nature of production technologies and buyer demand.

Agent	S_1	S_2	F_1	F_2	B_1	B_2
Capacity	50	50	20	20	20	20
Unit value	−\$5	−\$5	−\$2	−\$2	\$10	\$10

Given these parameters and the fact that \$10 > \$5+\$2, both buyers' demand will be satisfied and there will be excess capacity in supply. The homogeneity of the products at each stage means that it is not relevant which buyer consumes output from which firms/suppliers. Thus,

$$V = (10 - 2 - 5)\min[K(S_1) + K(S_2), K(F_1) + K(F_2), K(B_1) + K(B_2)] = 3(40) = \$120.$$

where $K(i)$ is the capacity of agent i. In this case, alternative coalitions have a value \$120, \$60 or \$0 depending upon whether both firms and buyers are members, only one buyer or firm are members or there are no members from one vertical stage. Moreover, it is easy to calculate the following:

Agent	S_1	S_2	F_1	F_2	B_1	B_2
Added Value	0	0	60	60	60	60
$\pi^{\min}$	0	0	0	0	0	0
$\pi^{\max}$	0	0	60	60	60	60

The suppliers have excess capacity – both individually and jointly – and so can be easily substituted without any loss in coalitional value. Consequently, they do not have positive added value and cannot expect to appropriate any surplus. In unit pricing terms, the price for inputs will be \$5 per unit. In contrast, the total capacity of firms equals total buying capacity. Thus, each of those four agents has a positive added value equal to the total value their capacity generates. This implies that to create that value any firm and buyer pair must be receiving at least that value or else they could deviate and form a separate vertical chain. However, this means that the amount of surplus each receives is indeterminate; that is for any given buyer and firm, the sum of their distribution must be at least \$60 but there is no restriction on their individual payoff. So, for each, their expected return ranges from \$0 to \$60.[8]

Taking this as a base case, we now consider several alternative strategic opportunities for F_1 (our focus for this exercise). The idea is to consider strategies that are generally considered to create, in Brandenburger and Stuart's (1996) terminology, "favorable asymmetries." These are strategies that make firms different from their competitors. Here we consider (i) F_1 specializing its product to B_1 and (ii) an increase in F_1's productivity before turning to examine how vertical chain issues impact strategy evaluation.

3.1 Specialization

In the simple example, buyers are indifferent as to the firm they purchase from. However, one 'generic' strategy involves a firm improving the quality of its product in the eyes of one or more buyers. For instance, suppose that F_1 is considering an ex ante investment that would result in its product being more valuable to B_1 and only B_1; so that B_1 might value products bought from F_1 at \$11 (rather than \$10). Absent any other changes, this would lead to $V = \$140$ and the following:

Agent	S_1	S_2	F_1	F_2	B_1	B_2
Added Value	0	0	80	60	80	60
$\pi^{\min}$	0	0	0	0	0	0
$\pi^{\max}$	0	0	80	60	80	60

Thus, the specialization increases total value and also F_1's added value. However, it does

[8] In the context of competitive markets, value is apportioned through the "terms of trade" which certainly include prices but may also be more broadly construed. Although these specifics are outside our formalism, it may be instructive to note that unit pricing of the final good between \$7 – \$10 is consistent with this range of expected returns.

not change $\pi^{\min}$ as both F_1 and B_1 must participate in creating this additional value; the competitive constraints affect the *sum* of their payoffs only.

If, however, this specialization also increased B_1's demand for the product (say to 25 units), then it is straightforward to show that, while neither V nor F_1's added value changes (both are \$140 and \$80 respectively), as the following table indicates, F_1's $\pi^{\min}$ becomes \$15.

Agent	S_1	S_2	F_1	F_2	B_1	B_2
Added Value	0	0	80	60	80	45
$\pi^{\min}$	0	0	15	15	0	0
$\pi^{\max}$	0	0	80	60	65	45

This is primarily because the increased demand from B_1 reduces B_2's added value (to \$45). The fact that demand exceeds the firms' total supply means that F_2's minimum becomes \$15 even though its added value and maximum remain unchanged. Thus, both firms gain from F_1's investment as it expands the market. However, the maximum appropriation for B_1 falls to \$65 (below its added value).

Interestingly, this also allows us to analyze the likelihood of potential reactions from other players. For instance, it may be imagined that B_2 may encourage F_2 to make a similar specialization. The results of this are as follows:

Agent	S_1	S_2	F_1	F_2	B_1	B_2
Added Value	0	0	80	80	80	80
$\pi^{\min}$	0	0	15	15	0	0
$\pi^{\max}$	0	0	80	80	65	65

This follow-on investment would raise V and also F_2's added value (to \$160 and \$80). While B_2's added value would rise (and B_1's would fall to \$65), this would only raise its $\pi^{\max}$. So, for a given α, its gain is equivalent to B_1's initial gain. Overall, however, specialization benefits each firm but harms each buyer. So F_1 is not harmed if F_2 imitates its strategy.

Of course, this raises the question as to whether buyers might be better off if suppliers engaged in specialized investments to them. Those inputs would still be converted by firms to buyer products but those products would have more value. So starting from our base case, if S_1 specialized its inputs for B_1 expanding its demand by 5 units and increasing unit value by \$1, this could lead to $V = \$140$, B_1's, B_2's and S_1's added values becoming \$80, \$45 and \$20 respectively. It is easy to show that, while this raises S_1's $\pi^{\max}$ (to \$20), it does not change B_1's $\pi^{\min}$ and only raises its $\pi^{\max}$ to \$65 just as in the case of a similar investment by F_1.

The point here is that, while specialization may be just the kind of strategy that both creates value and can enhance the added value of the parties involved, it may have asymmetric effects if this changes the balance of supply and demand in a market. Moreover, the external effects of these changes can lead to imitative reactions from others that may change the overall balance of appropriability across the vertical chain.

3.2 Productivity increase

We turn now to consider another 'generic' business strategy: increasing productivity. An increase in a firm's productivity generally means being able to produce more at a lower unit cost. In our example, one interpretation of this may be a straight decrease in F_1's unit costs, say to \$1.8 per unit. In this case, V will increase to \$124 and as can be seen from the following table F_1's added value also rises, by \$4 to \$64 (that is, the entire level of the cost saving).

Agent	S_1	S_2	F_1	F_2	B_1	B_2
Added Value	0	0	64	60	60	60
$\pi^{\min}$	0	0	4	0	0	0
$\pi^{\max}$	0	0	64	60	60	60

In this situation, an investment to reduce unit costs is potentially profitable for F_1. Moreover, F_1 has to potential to appropriate the entire value of this increase because its $\pi^{\min}$ and $\pi^{\max}$ increase by the total increase in value.

However, it is rare that such a straight unit cost reduction would be what is achieved by a productivity increase. Starting from the basis where its unit costs were \$1.8, suppose that F_1 increased the operating efficiency of its business, not only reducing its unit costs further to \$1.5 but increasing production capacity to 35 units. In this case, the increase in value is even greater to $V = \$138$ and F_1's added value increases a further \$14 to \$78. Again, this investment has the quality of increasing F_1's added value by precisely the level of the increase in total surplus. From the following table, however, this does not translate into an increase in F_1's profits.

Agent	S_1	S_2	F_1	F_2	B_1	B_2
Added Value	0	0	78	15	68	68
$\pi^{\min}$	0	0	3	0	45	45
$\pi^{\max}$	0	0	33	15	68	68

Notice now that both $\pi^{\min}$ and $\pi^{\max}$ have decreased! While this productivity improvement has dramatically reduced F_2's added value and has slightly increased those of the buyer's, both buyer's $\pi^{\min}$ have risen considerably. This is because having both buyers in a coalition with F_1 is more valuable than before where a single buyer and F_1 could generate as much value. This means that any given buyer must receive more value to prevent them from forming a coalition with F_1 alone. This arises due to the combined effect of F_1's cost reduction and its effective capacity expansion.[9]

As discussed above, solutions to (1) and (2) have associated $(2^n - 1)$-vectors of shadow prices, $\lambda^{\min}$ and $\lambda^{\max}$. Each component of $\lambda^{\min}$ corresponds to a group (either **1** or some g) and quantifies the effect on $\pi^{\min}$ of loosening, by one unit, the constraint with which that group is associated; and likewise for $\lambda^{\max}$. We can get some insight into this effect by looking at the shadow prices when F_1 has unit costs of \$1.80 and capacity of 20. In this case, the computations leading to $\pi^{\min}$ and $\pi^{\max}$ yield the following shadow prices (omitting multipliers equal to zero and for groups not involving F_1):

Group	$\lambda^{\min}$
$S_1, S_2, F_1, F_2, B_1, B_2$	-1
S_2, F_1, F_2, B_1	1
S_1, F_1, B_2	1

Group	$\lambda^{\max}$
$S_1, S_2, F_1, F_2, B_1, B_2$	1
S_1, F_1, B_1, B_2	-1
S_2, F_1, B_1, B_2	-1

Looking at $\lambda^{\max}$ first, if characteristics can be adjusted so that more value is created overall,

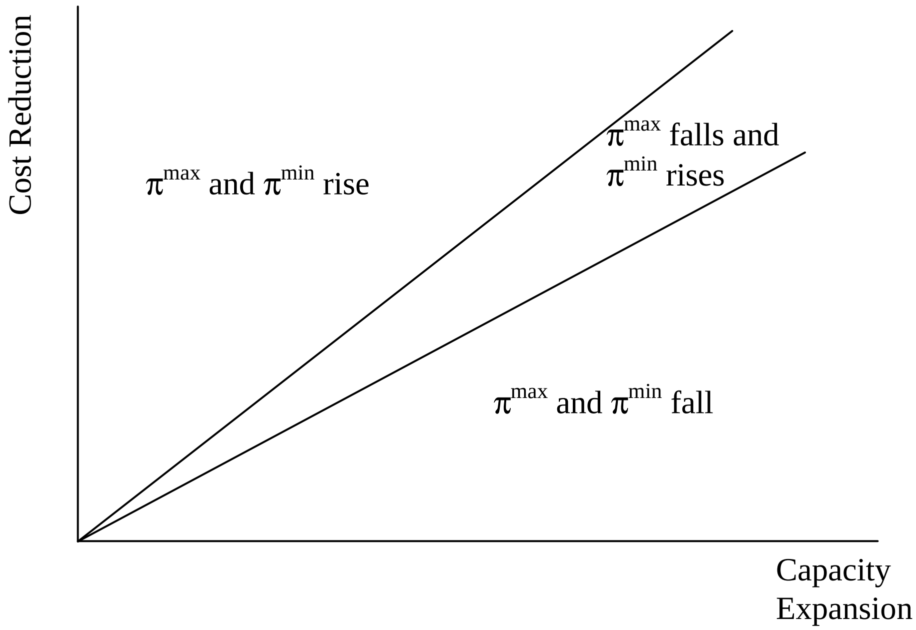
[9] In many respects, this is just another illustration of the "paradox of value" (Nelson, 1957). What is significant here (in contrast to examples provided by Lippman and Rumelt (2003a)) is that this paradox arises for a strategy which increases the firm's added value by the full amount of the increase it total value. This suggests that paradox may not be a curiousity but a significant issue in many strategic environments.

this will raise $\pi^{\max}$ so long as F_1's position as a monopoly supplier to both buyers is not itself significantly improved. Note that when F_1's capacity is 20, this group will have to permit F_1 to appropriate most value as groups with just F_1 and a single buyer create the same value. As capacity is expanded, however, this no longer the case. Hence, the value created by this coalition rises faster than others meaning that buyers will need to appropriate more value in any competitive distribution. Consequently, F_1's maximum appropriate must fall.

Turning to $\lambda^{\min}$, however, creating more value overall tends to lower $\pi^{\min}$. This suggests a potential difficulty in increasing $\pi^{\max}$ without reducing $\pi^{\min}$. But it also explains why $\pi^{\min}$ falls in this case. Simply put, total value rises by an amount greater than the coalitional values where just a single buyer is present. These coalitions tended to improve F_1's minimal appropriation as they created competition for it among the buyers. Examining the shadow prices illustrates how subtle some of the interactions can be even in a simple example. Below we consider a more realistic application and use shadow prices to identify more innovative strategic options.

To see all of this another way, note that, starting from our base case, had F_1 simply increased capacity (say to 25 units), this would not have increased total value nor F_1's added value but would have reduced F_2's added value (to $45). This too would not be a strategy worth pursuing although it is useful to note F_1's $\pi^{\max}$ in this case would be $45; greater than what it was for the higher productivity expansion considered above. The following figure illustrates what happens to F_1's added value and its $\pi^{\min}$ and $\pi^{\max}$ for various the ranges of unit cost reduction and capacity increases relative to our base case.

Figure: Change in F_1's Appropriation Relative to $K_1 = 20$ Base



This demonstrates a complete analysis of the outcomes of competition is necessary in order to evaluate proposed strategic investments appropriately. All of these productivity improvements increase total value and increase the investor's added value by the same amount. Ordinarily, this would be the idea investment from a business strategy perspective. However, when considering its full impact on coalitional values, we have been able to determine how this will translate into an investment return. First, the maximum return may not be a firm's added value and may even fall as that value rises. Second, the minimum return – i.e., the amount a firm is guaranteed from competition alone – may also fall as added value rises. This translates to a certain fall in profitability regardless of that firm's α. Thus, not only may firms not appropriate the full value of their investments but may diminish their ability to appropriate value altogether. Again, this suggests the importance of a complete analysis when evaluating business strategies – generic or otherwise.

3.3 Vertical Chain

The final issue to emphasize in the analysis of generic strategies is how value might flow along a vertical chain. Thus far, these issues have been suppressed by our assumption that suppliers are not capacity constrained and do not, therefore, have an added value or consequent claim on total surplus. What would a situation of constrained suppliers do to our evaluation of generic strategies?

Let's begin from a base case where suppliers have only 15 units of capacity each. In this case, $V = \$90$ and coalitional game outcomes are as follows:

Agent	S_1	S_2	F_1	F_2	B_1	B_2
Added Value	45	45	30	30	30	30
$\pi^{\min}$	15	15	0	0	0	0
$\pi^{\max}$	45	45	30	30	30	30

Now consider a situation where F_1 specialized its product to B_1 (increase B_1's willingness to pay by \$1 but now for 25 units) so that $V = \$105$.

Agent	S_1	S_2	F_1	F_2	B_1	B_2
Added Value	45	45	45	30	45	30
$\pi^{\min}$	15	15	0	0	0	0
$\pi^{\max}$	45	45	45	30	45	30

Note that in contrast to our earlier unconstrained suppliers example, while F_1 and B_1's added values and $\pi^{\max}$ increase, F_1's $\pi^{\min}$ stays at \$0. This is because the increase in B_1's demand does not make F_1's product any scarcer relative to the suppliers. Moreover, as the suppliers were already scarce, their expected appropriation does not change. Hence, the expected return to F_1 is relatively lower.

A similar effect occurs for productivity improvements. Even taking a 'good' improvement that only reduced F_1's unit costs (say to \$1.80), the outcome is as follows (where $V = \$94$):

Agent	S_1	S_2	F_1	F_2	B_1	B_2
Added Value	46	46	34	30	30	30
$\pi^{\min}$	15	15	2	0	0	0
$\pi^{\max}$	46	46	34	30	30	30

In this case, while total value and F_1's added value increase by the full amount of the cost saving – i.e., \$4 – $\pi^{\min}$ for F_1 does not rise by that much. Thus, part of the increased surplus from this productivity improvement would flow back up the vertical chain to the suppliers.

The more pronounced is the suppliers' capacity constraint, the stronger this 'leakage' of value. Moreover, these effects only exacerbate the negative impacts of productivity improvements that also effectively increase F_1's capacity.

This demonstrates that vertical chain effects can also be critical in evaluating business strategies. Put simply, by considering all stages of value creation, the analyst can consider where critical resource bottlenecks lie. This will have important implications for the expected appropriation of value from investments by others along the vertical chain; something that cannot be seen by focussing on value creation and added value alone.

3.4 Summary

Brandenburger and Stuart (1996) note that added value imposes an upper bound on an agent's ability to appropriate value. They then focus upon the evaluation of how generic strategies might improve added value from a base case where a firm has no added value at all. However, in many business environments, firms under analysis already have a positive added value. In this case, it might have been presumed that actions that both increased total value and increased added value would be unambiguously profitable for the firm.

The simple example considered here has demonstrated the difficulties associated with this presumption. Put simply, in a complete analysis of appropriation in a coalitional game, generic strategies that raise added value do not necessarily translate into higher profits. First, the benefits from an investment may flow along the vertical chain to other agents and even to competitors – as was the case with an improvement in buyer willingness to pay. Second, some value creating investments that raise the investor's added value may lead to increases in effective capacity and reduce the scarcity of an agent's resources and capabilities. We have demonstrated that this effect can be so large as to reduce both the maximum and the minimum an agent can expect to appropriate.

This highlights the critical importance of utilizing complete models of coalitional value when evaluating business strategies. Even 'safe and sound' strategic presumptions can be undone by difficult to predict swings on coalitional value.

4 Application: Technology Commercialization

We now employ an extended example to illustrate our methodology. Our objectives for the example are three-fold: first, to illustrate some of the mechanics of the analytical procedure detailed above; second, to show how the methodology may enable critical steps in the firm's decision process to become comparatively straightforward; and finally, to demonstrate how some of the exploratory thinking emphasized above can be applied. This is admittedly not a complete analysis of even this situation but it does demonstrate the main benefits and practicality of employing these methods in a real world environment.[10]

4.1 Facts

A firm is considering commercialization of a new technology that it has intellectual property protection over. It is estimated that commercialization may involve investments up to $100 million. The new technology is a process innovation that will drastically reduce the production cost for a special type of digital product (hereafter, DP) already with a considerable market presence.

There are four large producers of DPs, and a larger number of small producers. The firm has already decided to transact only with the large OEMs (hereafter, simply "OEMs"). The OEMs currently serve 85% of the market, distributed as:

OEM	**Share**
A	40
B	25
C	15
D	5

The OEMs sell machines directly to downstream firms who, in turn, provide services to retail customers. The downstream market has many firms, low concentration, and millions of retail customers. The new technology is related to the innovator's core business, but is just one, albeit important, part of a complicated system making up the DP. For this reason,

[10]The example is based on a strategic analysis conducted for a major technology company by one of the authors. The details are altered to produce an example that retains realism while having only a "family similarity" to the actual situation.

the innovator has already decided not to enter the DP market directly. Instead, if it elects to commercialize, the innovator will patent the technology and license its use to one or more of the OEMs.

The OEMs are believed to have similar cost structures for manufacturing DPs. Specifically, under the existing processes, marginal cost is estimated to be (over the relevant range of production) a constant \$150k per DP. The innovation provides a cost-effective replacement for the most costly component of the DP and allows simplification of numerous other components. Estimates are that the new technology will reduce marginal cost to about \$50k.

Developing the technology, despite the potential \$100 million up-front expenditure, has some very appealing features: given patents and commercialization, the innovator will possess a valuable, unique, non-imitable asset for which multiple firms can compete. The firm's researchers, based on their knowledge of the technology, professional activities, etc., are confident there is no technology that might threaten uniqueness for several years, conceivably a decade.

The DP is itself a second-generation machine that will surely replace the first generation analog product; the latter is relatively costly to produce, offers slower and poorer performance, and has inferior environmental characteristics. So, while each of the four OEM producers made their DPs available relatively recently, sales of DPs are accelerating.

The retail segment of the market is projected to grow at 5% per year (i.e., new retail locations requiring a DP). Aside from market growth, demand for DPs also comes from replacement of the first generation. Retailers have shown no interest in replacing first generation products during their useful life. Given setup costs, even attempts to unload older machines on eBay® have been unsuccessful. Thus, given the 10 year useful life of this equipment, downstream users are expected to replace about 10% of their existing base per year; OEMs anticipate penetration will be below 10% in the first few years due to end-user awareness and early adoption issues. The estimated diffusion path is factored into the calculations below.

4.2 Calculating group values

As noted above, if an OEM licenses the process innovation its unit costs will fall significantly. Some of this will be passed through to its customers. Let m be an OEM's margin with the older technology and $M(> m)$ its margin if it licenses the new technology.[11] In addition, adopting the innovation will have an impact on an OEM's market share. Suppose that i's current market share is s_i. Then it is assumed that if the combined market share of non-adopting firms is S, i's post-adoption market share will be $s_i(1+\gamma(1-S))$ where $\gamma \in [0,1]$. Here γ is a parameter that captures how much of the non-adoptees' market share those who adopt will attract. Not surprisingly, this increased share will be lower, the more OEMs there are who acquire a license.

Let us label the innovating firm as 1. We can represent the group values, $v_t(g)$, for time t, as follows:

$$v_t(g) = M(\sum_{i \in g} s_i + \gamma(1 - \sum_{i \in g} s_i))D_t \text{ if } 1 \in g$$

$$v_t(g) = m(\sum_{i \in g} s_i)(1-\gamma)D_t \text{ if } 1 \notin g$$

where D_t is the total demand for DP units at time t. Based on market enquiries it was determined that the following represented reasonable working assumptions: (i) $M = \$75$, (ii) $m = \$50$, (iii) $\gamma = 0.2$ and (iv) D_t is determined by the following table (where 5 years was regarding as a conservative time horizon for this analysis):[12]

Year	Unit Demand (000s)
1	0.7
2	1.0
3	5.0
4	8.0
5	11.0

Here demand assumptions build in a 5% growth in the market plus additional growth due to the attractiveness of the second-generation product. Clearly, these are working assumptions

[11] In reality, both of these margins would themselves be determined by negotiations between OEMs and their customers. However, a lack of information as to some of the key parameters in those relationships has led us to consider a reduced form approached; albiet one informed by industry consultations and experience.

[12] MacDonald and Ryall (2003) provide an extended discussion of these assumptions and some of the issues in calculating group value for this application.

and a complete analysis would explore the robustness of any conclusions to changes in those assumptions.

The new technology implies significant changes in the DP market. In order to decide whether commercialization is advisable, assumptions must be made about the post-commercialization environment. We began with assumptions that were relatively conservative/pessimistic. If commercialization appears attractive under these assumptions, then a positive decision is straightforward; otherwise, a more careful look at the specific assumptions is called for.

4.3 Analysis

Given the facts and assumptions, we turn to answering the question of immediate interest to the innovator.

4.3.1 Is commercialization worth $100 million?

The first question in setting up the analysis is which agents should be explicitly included in the analysis? As we mention above, the retail market is large, both in terms of the number of consumers and the number of retail firms providing services. Modelling these agents explicitly is impractical and, according to the innovator, unnecessary. Therefore, we begin the competitive analysis with only the innovator and the four OEMs; the others, e.g., retailers, customers, etc., are incorporated indirectly.

How do we calculate the VO? In line with the discussion above, we assume that the innovation will ultimately be used efficiently. That is, if the innovator is imagined to restrict efficient access to the technology, there is an offer the excluded OEMs could make for the technology that would be acceptable to the innovator and the other OEM(s). In this example, the most efficient use of the technology involves all four OEMs using it. The annual value that the innovator and OEMs can share is therefore

$$V_t = \frac{1}{4}\left(\$350 - \$50\right)(.88)\, D_t.$$

Allowing for replacement of old machines and the 5% growth in demand, we have ($ millions):

Year	V_t
1	46.2
2	66.0
3	330.0
4	528.0
5	726.0

Given these data, solving the linear programming problems yields the $\pi^{\min}$ and $\pi^{\max}$ values in the table following. Assuming, for example, an discount rate of 12%, the present discounted value of the innovator's *assured* appropriation is $244.6 million.

	Year					
($ millions)	1	2	3	4	5	PV (12%)
$\pi_t^{\min}$	10.5	15.0	75.0	120.0	165.0	244.6
$\pi_t^{\max}$	16.5	23.5	117.5	188.0	258.5	383.2

Thus, even under what is argued to be a very conservative of assumptions, OEM competition to use the new technology should allow the innovator to appropriate about $144 million beyond the up-front cost of commercialization. The OEMs' alternatives to using the innovation bound the innovator's appropriation at $383.2 million.

Note that, in this case, assessment of the innovator's AF is unnecessary to answer whether commercialization should proceed. The forces of competition alone are sufficient to guarantee a positive NPV. Essentially, this arises because OEMs without a license not only lose the potential cost reduction but market share as well. As MacDonald and Ryall (2004) demonstrate, in the absence of this type of externality, $\pi^{\min} = 0$ and the AF would be critical in determining whether commercialization should proceed. Indeed, in the next section, which contemplates an actual mechanism by which to implement the expected appropriation, the AF does play a role.

4.3.2 What are the license fees, by OEM?

In applications such as this, it is not enough simply to identify the anticipated appropriation stream; management must find a means by which these appropriation levels will be achieved.

Given the widely divergent market positions of the four OEMs, a volume-based licensing scheme seems a good candidate. The innovator plans to license to all four OEMs. Anticipated unit sales of DPs by the four OEMs are as summarized below.

	DP Unit Sales (000s)					
Year	OEM A	OEM B	OEM C	OEM D	All Other	Total
1	0.29	0.18	0.11	0.04	0.08	0.7
2	0.41	0.26	0.16	0.05	0.12	1.0
3	2.07	1.29	0.78	0.26	0.60	5.0
4	3.31	2.07	1.24	0.41	0.96	8.0
5	4.56	2.85	1.71	0.57	1.32	11.0

Recall that the OEMs expect to appropriate \$75k per machine on sales to retailers. Beginning with year 1, the minimum level of innovator appropriation consistent with competition is \$10.5m. In this year, the four OEMs are expected to sell 616 DPs, which comprise an 88% share of the market (i.e., of the 700 units projected to be sold in year 1). To appropriate \$10.5m through volume-based licensing fees, the innovator must charge \$10.5m/616, or \$17.0k per unit.

At the high end, a \$26.7k per unit fee delivers a total of \$16.5k, the competitive maximum, to the innovator in the first year. While the innovator has no experience negotiating deals in this specific market, it is an established firm with substantial bargaining experience in similar transactions. Based on this history, as well as an analysis of the specific OEM business units, the innovator believes it can negotiate a licensing fee between \$24.8k/unit and \$26.7k/unit. With a licensing fee of \$24.8k/unit, the innovator's appropriation stream is as presented in the following table.

	Year					
(\$ millions)	1	2	3	4	5	PV (12%)
$\hat{\pi}_t$	15.3	21.8	109.0	174.4	239.8	355.5

All of these values, as should be expected, fall within the innovator's competitive appropriation range. What is not yet clear is whether a \$24.8k/unit fee results in annual distributions of value (i.e., among all the agents) that satisfy competitive requirements (1) and (2). If not, the innovator will need to fashion some other licensing arrangement in order to be consistent with competition. The annual distributions implied by a licensing fee of \$24.8k/unit are presented in the following table. It is easy to show that these satisfy all the constraints implied by (1) and (2).

	Distributions of Value by Year (\$ millions)					
Year	Firm	OEM A	OEM B	OEM C	OEM D	Total
1	15.3	14.5	9.1	5.5	1.8	46.2
2	21.8	20.8	13.0	7.8	2.6	66.0
3	109.1	103.9	65.0	39.0	13.0	330.0
4	174.6	166.3	103.9	62.4	20.8	528.0
5	240.1	228.7	142.9	85.8	28.6	726.0

Therefore, the proposed licensing fee of \$24.8k/unit is consistent with competition and results in a net present value for the project of (\$000,000): $355.5 - 100.0 = 255.5$.

The estimation of actual value streams (as shown in the preceding two tables) is based upon management's specific judgment regarding its ability to negotiate licensing fees with these four OEMs. Of course, the figures in the preceding table do imply a AF. This is calculated as in equation (**??**). For example, in year 1,

$$\alpha_1 = \frac{15.3 - 10.5}{16.5 - 10.5} = 0.8.$$

As it turns out, the innovator's implied VF is constant over the five year period.

4.3.3 Experimentation

The preceding analysis indicates that commercialization should proceed. One question that can be asked is whether anything can be done to enhance the project; i.e., are there initiatives available to the innovator that will improve its competitive position and, thereby, increase its appropriation stream? The following tables summarize the shadow prices, by year, for the innovator's minimum and maximum appropriations levels, respectively (groups with shadow prices of zero in every year are omitted).

Shadow Prices on Minima									
Group					Year				
Firm	A	B	C	D	1	2	3	4	5
1	1	1	1	1	−1.0	−0.5	−2.0	−2.0	−0.5
1	1	1	1	0	0.5	0	1.0	1.0	0
1	1	1	0	1	0	0	0	1.0	0
1	1	1	0	0	0	0.5	0	0	0
1	1	0	1	0	0	0.5	0	0	0
1	1	0	0	1	0.5	0	1.0	0	0.5
1	0	1	1	1	0	0	1.0	0	0
1	0	1	0	0	0.5	0.5	0	0	0.5
1	0	0	1	1	0.5	0	0	1.0	0
1	0	0	1	0	0	0	0	0	0.5

Shadow Prices on Maxima									
Group					Year				
I	A	B	C	D	1	2	3	4	5
1	1	1	1	1	1.0	1.0	1.0	1.0	1.0
0	1	1	1	0	0	0	−1.0	0	−1.0
0	1	1	0	1	0	0	0	−1.0	0
0	1	0	0	0	−1.0	−1.0	0	0	0
0	0	1	0	1	−1.0	0	0	0	0
0	0	1	0	0	0	−1.0	0	0	0
0	0	0	1	0	−1.0	−1.0	0	−1.0	0
0	0	0	0	1	0	−1.0	−1.0	0	−1.0

The general patterns in the shadow prices are consistent with the theory: the innovator's minimum is increased by increasing the tension between the available value and the value producible by groups including the innovator; the innovator's maximum is increased by decreasing the tension between the available value and the value producible by groups that do not include the innovator. Thus, any initiative that tends to increase the value of groups including the innovator while decreasing the value of those without it should, provided the overall effect on the available value is not too great one way or the other, increase both the maxima and minima.

Given these observations and the nature of the new technology, management considers a marketing campaign aimed at the OEMs' retail customers. The idea is to establish a brand identity for the new technology in a fashion similar to the marketing programs by Intel and Nutrasweet (i.e., market the quality of a key product component or, in this case, a key technology).

After some analysis, management concludes that a sustained, properly funded marketing campaign – $60 million in present value outlays – will have the effect of increasing the share attracted by OEMs using the technology from those not using it from 20% to 40%. Factoring this change into the calculations for the innovator's min, max and anticipated appropriation levels yields

	Year					
($ millions)	1	2	3	4	5	PV (12%)
$\pi_t^{\min}$	21.0	30.0	150.0	240.0	330.0	489.2
$\pi_t^{\max}$	21.0	30.0	150.0	240.0	330.0	489.2
$\hat{\pi}_t$	21.0	30.0	150.0	240.0	330.0	489.2

There are two striking features of this result: 1) the marketing campaign succeeds in substantial increases in both the minimum and maximum appropriation levels consistent with competition; and, 2) under this plan, bargaining (α) ceases to play a role. Previously, the innovator indicated a fairly high degree of confidence in its ability to appropriate on the high end of its competitive range, with its estimated present value of $355.5 much closer to the maximum of $383.2 then the minimum of $244.6. Of course, confidence notwithstanding, the actual future outcome of price negotiations with the OEMs is uncertain. Under this marketing plan, the uncertainty surrounding the innovator's true AF is essentially eliminated, a potentially significant side benefit of implementing the marketing campaign. The difference in anticipated present value between the original commercialization plan and the one with enhanced marketing is $489.2 - 355.5 = 133.7$. Given the estimated investment of $60m required to achieve this level of appropriation, the marketing enhancement appears to be a very promising course of action.

5 Conclusion

Coalitional games have proved to be a useful framework within which general principles governing value appropriation can be developed, e.g., the factors determining $\pi^{\min}$ and $\pi^{\max}$. The framework has also shown power as a tool for assessing specific assertions about value appropriation, e.g., whether competition assures appropriation for the owner of an unique, valuable and inimitable resource. The goal of this paper was to show how the same framework can be employed as a decision making tool. We discussed how the ingredients the theory identifies as important can be quantified, described the relevant calculations, and then illustrated with an application to a commercialization of technology decision. Throughout, we emphasized both the iterative process required to ensure the framework is being employed as effectively as possible, and the way the framework and its calculations focus the decision maker's attention on opportunities for improvement.

References

[1] Besanko, D., D. Dranove, M. Shanley and S. Schaefer (2004), *Economics of Strategy*, 4th Ed., Wiley: New York.

[2] Brandenburger, A. and B. Nalebuff (1996), *Coopetition*, Harper Collins: New York.

[3] Brandenburger, A. and H. Stuart (1996), "Value-based Business Strategy," *Journal of Economics & Management Strategy* 5: 5-24.

[4] Brandenburger, A. and H. Stuart (2004), "Biform Games," *mimeo.*, New York University.

[5] Gans, J.S. (2005), *Core Economics for Managers*, Thomson: Melbourne, forthcoming.

[6] Lippman, S.A. and R.P. Rumelt (2003a), "The Payments Perspective: Micro-Foundations of Resource Analysis," *Strategic Management Journal*, 24: 903-27.

[7] Lippman, S.A. and R.P. Rumelt (2003b), "A Bargaining Perspective on Resource Advantage," *Strategic Management Journal*, 24: 1069-86.

[8] MacDonald, G., and M. D. Ryall (2003), "New Methods for the Identification and Evaluation of Strategic Initiatives," *Working Paper*, Washington University in St. Louis.

[9] MacDonald, G., and M. D. Ryall (2004), "How do value creation and competition determine whether a firm appropriates value?" *Management Science*, 50 (10): 1319-33.

[10] Nelson, R.R. (1957), "Increased Rents from Increased Costs: A Paradox of Value Theory," *Journal of Political Economy*, 65: 387-93.

[11] Saloner, G., A. Shepard and J. Podolny (2001), *Strategic Management*, Wiley: New York.

[12] Stuart, H. (1997), "The Supplier-Firm-Buyer Game and Its M-sided Generalization," *Mathematical Social Sciences*, 34: 21-7.

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