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The Value Capture Model: A Strategic Management Review

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Abstract

This paper provides the first review of recent work that uses cooperative game theory to deepen our understanding of persistent performance heterogeneity among firms. Since its initiation in 1996, this stream has grown considerably. The work it contains is notable on several dimensions, including its mathematical foundation, its aggregate cohesion, its interplay between theory and empirical work, the subtlety of its insights, and its potential for idea migration from strategy to other disciplines. Here, we: provide a careful discussion of the theory; review the key theoretical findings; highlight a number of insights that both challenge and clarify the conventional wisdom; spotlight the associated, recently emerging empirical work; and provide some thoughts on the challenges that lie ahead.

1 Introduction

Understanding the phenomenon of persistent heterogeneity in firm performance has been a central objective, perhaps *the* central objective, in the field of strategy. The seminal contribution of Brandenburger and Stuart (1996) initiated a unique stream of work designed to deepen our understanding of this phenomenon through the development of a mathematical theory of value creation and capture under competition. Since then, this literature has quietly and steadily grown to the point where it now represents a substantial body of work. Due to its mathematical nature, the collection of findings build upon each other, thereby creating a coherent, interlocking set of theoretical claims. These claims reveal subtleties of competition that were not previously apparent, pushing strategy scholars to rethink some fundamental ideas about value capture under competition. Moreover, recent advances in empirical methods have opened the door to empirical investigation of these subtleties.

One aspect of this work worth highlighting is that the theory we review is entirely published in strategy journals. Moreover, rather than locating mathematical results outside our field and importing them via reinterpretation and analogy, this literature contains novel propositions, the implications of which extend well beyond the boundaries of strategy. That said, the efforts in this area have been largely confined to a relatively small community of scholars. The purpose of this paper is to provide a review of this stream for the broader strategy audience. Our goals include identifying the specific issues this work is intended to address, explaining the mathematical framework upon which it is built, highlighting the central theoretical insights thus far, describing notable applications (both theoretical and empirical) and concluding with some thoughts about open issues and future directions for this line of work.[1]

[1] By "this line of work" we mean to focus our attention on papers published in management journals and that make use of *cooperative game theory*. These papers primarily derive novel mathematical propositions but also serve as the basis for explicit empirical analysis. Invariably, this means passing over a number of thought-provoking papers in strategy that build their discussion around ideas from cooperative game theory without actually using the formalism to contribute any new results. Examples include papers based upon qualitative discussions, such as Lippman and Rumelt (2003) and Gans, MacDonald, and Ryall (2008), as well as papers that adopt the *language* of cooperative game theory in the context of some other formalism (e.g., Cournot or Bertrand models), such as Grahovac and Miller (e.g, 2009). Attention is restricted to management publications to give readers a sense of the novelty and substance of the stream within strategy. Thus, e.g., Grennan (2013) is excluded but Grennan (2014) is included.

By adopting this unifying theme, the scope of our paper is manageable, permits a coherent discussion and allows us to treat key ideas with a reasonable degree of depth. Our intended audience includes those looking for an overview of the central concepts and latest results associated with this line of work as well as those considering entering and contributing to it. Therefore, this paper is constructed to be self-contained within the content constraint of a single journal article – the formalism, relevant assumptions, associated interpretations and important results to date are all covered, albeit concisely, with citations to more in-depth sources for those interested in pursuing them.

This being a literature review, it is also worth pointing out that the issues elaborated below were the product of a discovery process: theorists built models that seemed sensible; based on these models, formal propositions were proven; mathematical claims led to insights about value capture under competition in the real world; these insights led to a grasp of the kinds of issues that the dominant paradigms missed. This paper proceeds in reverse order: here, we summarize the (now) apparent issues; we then present the formalism and trace the line of results derived from it; this should spark insights in the reader regarding competition; which, cumulatively, we hope, will lead to a deeper understanding not only of this line of work but also to new questions for future research.

2 Sources and limitations of early theories

The modern era of strategy scholarship dates to the famous collection of papers appearing in the 1980s, all of which offer explanations for the phenomenon of persistent performance heterogeneity among firms. These include Porter (1979, 1980), which initiated the "industry positioning" stream; Wernerfelt (1984), the paper that sparked the "resource-based view" line of work; and Williamson (1981), an early paper advocating his "transactions cost" approach to organizational analysis. Over the years since their advent, these foundational ideas have branched, evolved and combined into a body of conventional wisdom. In this section, we highlight some general features of this collection of ideas and explain how they create several important theoretical blind spots. Before proceeding, we warn readers that any generalization of large, complex streams of scholarly work will, by its nature, blur their finer and more subtle points. Our purpose is not to gloss over these subtleties. Rather, we wish to provide a persuasive illustration of the areas in which value capture theory expands our explanatory horizon regarding firm performance under competition.

Before diving into the blind spots in the traditional explanations of firm performance heterogeneity under competition, let us note a salient difference between them and the value capture work reviewed here. The central theoretical claims of the traditional streams are not mathematically articulated or derived. Many scholars have weighed in on both sides of the argument regarding the efficacy of mathematical theory in management research. Our purpose here is not to engage those arguments. Rather, we simply pause to point out that, for better or worse, depending upon one's philosophical sensibilities, a unique feature that distinguishes the value capture stream from other approaches in strategy is that its theoretical claims are formulated using a single, overarching mathematical framework. The literature in value capture theory present a collection of rigorously derived, complementary findings that build upon one another. The result is a coherent body of interconnected theoretical and empirical findings, work that transcends being a string of loosely related, one-off propositions. In this sense, the literature answers the call in Oxley, Rivkin, and Ryall (2010).

The free-entry blind spot Because strategy is about the performance of firms in free markets, competition is always a central concern. In proposing their explanations for firm performance heterogeneity, traditional theories share the premise (often implicit) that wherever positive profits are to be found, competitors are attracted like a swarm of locusts to a luscious crop of wheat. Thus, "competition" is conceived as an ever-present threat to those enjoying the capture of positive economic profit.[2] This intuition continues to run deep. Unfortunately, it is overly simplistic and, as a result, gives rise to a limited descriptive validity.

The entrants-as-a-swarm-of-locusts intuition is one inherited from neoclassical economics. As Makowski and Ostroy (2001) explain: "Neoclassical economists borrowed from their classical predecessors the view that, in a production economy, perfect competition is the simple,

[2]See, for example, the comments by Porter (1980, p. 5 and elsewhere).

inescapable conclusion of free entry. And with free entry comes zero profits."(p.484) The founders of modern strategy, whose interest was to explain the apparently universal occurrence of persistent performance heterogeneity, were bound to reject the validity of the free entry assumption. Hence, each proposes a class of competitive *barrier* to free entry (industry position, resource mobility, asymmetric information, etc.). Yet, a moment of reflection reveals that, even while rejecting the essential conclusion of the standard neoclassical model, this "barrier view" retains its essential premise – that entry is an ever-present threat whenever positive profits are present.[3] Hence, the neoclassical logic regarding the natural operation of competition is retained in this way of thinking about competition (see Gans et al., 2008, for elaboration).

The challenge we now pose is: why not discard the neoclassical premise altogether? Suppose the world's stock of economically productive resources (raw materials, capital, human beings, time, etc.) is finite. Of all the assumptions one might entertain, the finitude of resources strikes us as supremely axiomatic – a universal feature of our shared economic experience. This premise has serious implications. In a world in which a finite number of owners of finite quantities of resources are free to allocate them to their most productive ends, logic does *not* dictate that the moment one of those resources becomes a source positive value capture for its owner, other agents will reallocate their own resources against it in a tsunami of competition. Rather, economic logic implies that agents allocate *away* from less profitable to more profitable settings, and resource finitude implies that such settings need not be exhausted – *in a finite world, economic profit may well be the rule rather than the exception.*

The importance of this point cannot be overemphasized in the context of strategy: resource finitude implies that special barriers to competition are neither necessary nor sufficient for the existence of persistent economic profit. To be sure, there may be settings in which special barriers are a proximate cause of profit persistence.[4] That said, a body of theory focused only upon this aspect of competition must, in itself, be incomplete. This carries with it the empirical implication that variation in the strength of special barriers is unlikely

[3]Here, we use "standard neoclassical model" in the specific sense of Makowski and Ostroy (2001).

[4]By "special" we mean barriers to the allocation or reallocation of market resources which, themselves, are already presumed to be in finite supply.

to be a robust predictor of variation in firm performance. Decades of inconclusive empirical results in strategy, not to mention in the earlier "structure-conduct-performance" economics literature, are consistent with this observation. As we show below, the finite agent/resource assumption is embedded in the value capture model, even when scaling up to economy-level scope.

The competitive-determinism blind spot Theorists prefer to avoid models whose conclusions are ambiguous. The two economic models with which most strategy scholars are familiar are Cournot and Bertrand, the workhorse models of industrial organization economics. Their attractiveness stems from several features, including their flexibility in modeling a wide range of interactions as well as a focus on variables of particular interest to economists – product prices and quantities. In addition, no small part of their popularity stems from their tractability, in particular their ability to provide exact, point-estimate solutions for these variables once their parameters are fixed. In what follows, we show that the value capture model suggests that competition is properly construed as placing *bounds* on the quantity of value an agent might capture without fully determining them. Taking the premises of the model seriously, this is a feature (not a "bug"): it says that competition defines a precise interval within which an agent's value capture lies; within that interval *where* actual capture lands is due to factors other than competition. As we discuss in greater detail below, the theory points toward a new conception of "competitive intensity" as well as the existence and possible importance of "persuasive" resources.[5]

The product-price blind spot Harkening back to modern strategy's founding corpus, Wernerfelt (1984) argues that, in order to develop a deeper understanding of persistent performance heterogeneity, analysis must shift from the price-product unit of analysis to an agent-appropriation one. The massive, resource-based view literature, which arose from this observation, extends the issue by positing that persistent performance heterogeneity is

[5] On the issue of generality, it is worth reminding readers of Kreps and Scheinkman (1983) who illustrate the sense in which the Cournot results are consistent with a Bertrand game with capacity commitments. Similarly, Stuart (2005) shows that Cournot can also be thought of as a special case of a cooperative game with capacity pre-commitments. In other words, both Cournot and Bertrand can be thought of as special cases of a cooperative game. A related line of research is contained in Byford (2007).

due to the existence of unpriced resources (a result of "market failure"). The blind spot here is not in arguing that the product-price unit of analysis is problematic but, instead, in not taking the agent-appropriation perspective sufficiently seriously. When the agent is the unit of analysis, the quantity of value it captures is, in essence, a price. It is the price of engaging that agent – including its resources and capabilities, themselves priced or not – in the activities required to produce value. Market failure at one level does not imply failure at the other. The value capture model shifts away from products and prices toward agents, the myriad value creation opportunities available to them, the value actually produced, and what it takes in terms of value capture to engage them in the associated productive activities.

The competition-hurts blind spot The central insight of Porter (1979, 1980) is that understanding competition requires a broad view of who counts as a competitor. In his famous "Five Forces" model, Porter (1979) argues that the set of active market participants – those agents whose decisions are aimed at appropriating a share of the value produced within an industry – must include buyers, suppliers, rivals, even *potential* rivals and the producers of substitute goods outside the industry. Extending this insight to its logical conclusion, Porter's (1979) model itself is incomplete: a firm's appropriation ultimately depends upon the Five Forces groups, as well as *suppliers of suppliers*, *substitute buyers in other markets*, *potential entrants into distribution channels*, and so on and so on. One gets a sense of the larger picture from Figure 1, though this too falls short. In any given industry, value is created and appropriated through complex webs of transactions pursued by multiple layers of active, intelligent agents. Returning attention to market models like Bertrand and Cournot, the problem is that the only active agents (i.e., the only agents whose decisions are taken into account) are typically the firm and its direct rivals. They too are incomplete, often making implicit, ad hoc assumptions that leave price-setting power in the hands of the firms, with all other market participants playing a passive role.

[FIGURE 1 HERE]

With these issues in mind, we move on to the next section in which we present the general biform model setup that has become the standard for work in strategy on the issue of value appropriation under competition. As we describe the model, we will be careful to highlight how this approach deals with the issues elaborated in this section.

3 The biform model

The biform model of Brandenburger and Stuart (2007) is presently the state-of-the-art model for analytical work in strategy on value capture under competition. The “biform” model is so-called because it synthesizes two distinct areas of game theory – noncooperative (NGT) and cooperative (CGT) – into a single model. The great strength of NGT is its ability to capture strategic behavior; i.e., situations in which agent actions interact in the generation of outcomes and, therefore, in which assessing the behavior of others is important. The power of CGT is in its ability to analyze value creation and capture in markets, especially in settings where agents’ dealings do not follow some predefined process. In a biform model, each type of theory plays a role consistent with its strengths, thereby creating a complementary whole.

Biform models consist of two stages. The first stage, NGT, includes all the agents whose actions have a significant impact upon the outcomes for a focal firm. In an industry, this typically includes direct rivals as well as, e.g., the agents in the other categories of Porter’s Five Forces framework (buyers, suppliers, etc.). In the NGT stage, agents take actions designed to “prepare the competitive battlefield” to their advantage – that is, to structure their competitive environments in a way that permits them to capture the most value possible. Such actions include initiatives like marketing projects, capacity decisions, new product or technology introductions, mergers, recruiting policies, market entry and so on. The joint actions taken by the agents in the first stage induce a particular market environment in the second stage, CGT. Here, agents engage in organizing and executing the “free-form” deals that result in the production and capture of value. Essentially, the value captured in second stage competition serves as the the payoff to the strategic action taken in the first. We begin by elaborating the second (cooperative game) stage.

3.1 Cooperative game stage

A *cooperative game* consists of a pair (N, v) where $N \equiv \{1, \ldots, n\}$ indexes the $n < \infty$ *agents* participating in the market, and v is a map, referred to as the *characteristic function*, from subsets of agents to the quantities of economic value they can produce on their own. The scope of analysis is broad; it can be used for small interactions (e.g., n equal two to several, such as firms competing for an acquisition or contemplating a strategic alliance for technology development) up to very large situations (e.g., the global economy). Given a subset of agents $G \subseteq N$, $v(G)$ denotes the amount of value the agents in G could produce if their transactions were limited to those in the group – i.e., if the members of G choose to limit themselves to transacting only with each other, then they create economic value equal to $v(G)$. Thus, the starting point for the CGT stage is the collection of feasible opportunities to create value via mutually agreeable transactions. Given these opportunities, some deals occur, some value is produced, and some share of it (possibly zero) is captured by each of the agents. A *distribution of value*, denoted $\pi \equiv (\pi_1, \ldots, \pi_n)$, is a list indicating how much each agent captures in return for its productive activities (i.e., agent i captures π_i).

The central idea behind this setup is to be able to say something about how the productive opportunities in a market shape a firm's ability to capture value. This requires linkages between v, which describes the former, and π, which describes the latter. The first step is to identify how much value is actually produced. The answer is straightforward: $v(N)$ is, by definition, the aggregate value generated by the agents in N. In strategy applications, $v(N)$ represents the actual, aggregate quantity of economic value that will be created (in the case of a theoretical claim) or was created (in the case of an empirical analysis). It is an observable associated with the model. The strategy literature commonly uses the special label $V \equiv v(N)$ to emphasize this distinction. The other values, i.e., the $v(G)$s for groups other than N, also represent the real-world value that these groups would produce if left to their own devices, though they are not necessarily observed.[6]

Note that V and the $v(G)$s are real numbers. The usual interpretation is that $v(G)$ is the economic value created by the transactions that would actually arise were transactions restricted to the agents in G. However, depending upon the application, they can also represent cash, expected value, net present value, etc. Frequently, authors assume that v is *superadditive*: the union of two disjoint groups produces at least as much as the sum of what the groups produce independently. The rationale is that whatever transactions two

[6] To the extent that $v(N)$ arises as the summation of productive activities by distinct groups, then the values created by those groups are observed.

groups engage in independently can always be implemented within the larger group, hence the value produced by the union must be at least that large.[7]

How do the value creation opportunities shape value capture? Typically, two assumptions are made. The first is a *feasibility* assumption:

$$\sum_{i \in N} \pi_i \leq V, \tag{1}$$

i.e., the amount of value captured must be less than or equal to the amount produced. The second is a competitive *consistency* assumption: for every group $G \subset N$,

$$\sum_{i \in N} \pi_i \geq v(G), \tag{2}$$

i.e., the aggregate value captured by the agents in G must be at least as large as the value they could produce on their own. The idea is that, faced with payoffs $\sum_{i \in N} \pi_i < v(G)$ in return for their roles in producing V, the self-interested agents in G would eschew those deals and, instead, figure out a set of transactions designed to produce $v(G)$ under terms that would make each and every one of them strictly better off.[8] In the strategy literature, a distribution of value that meets the feasibility and consistency conditions is said to be *competitive*. The set of all such distributions is referred to as the *core*.[9]

In what sense are distributions of value that meet (1) and (2) "competitive"? The answer lies in thinking of V as the aggregate value arising from a *specific set of actual transactions*. Think of these transactions, the value they create, and the shares of value captured by the agents involved in them as observables that will, or did, happen (i.e., as data or potential data). The $v(G)$s, then, are the feasible values produceable through alternative transactions

[7]In most strategy applications, this assumption is innocuous – although it does rule out cases in which some subset of agents creates negative externalities with others (and, additionally, in which economic activities cannot be organized in such a way as to neutralize them).

[8]Some authors refer to this as the "stability" condition, the idea being that aggregate production of V is assured only if this condition is, by necessity, met.

[9]This term is imported from economics which, like most economics terminology associated with CGT, is not especially helpful or clarifying. There are many other approaches to analyzing the solutions to cooperative games in strategy settings. For example, de Fontenay and Gans (2008) use the Shapley value, which has the feature of providing point-estimates in place of core intervals. As we explain below, however, the identification of intervals is a useful feature with respect to understanding competitive intensity.

and groupings. In this context, $v(G)$ should reflect the actual economic value that would be produced, via some other specific set of transactions, including any costs associated with organizing them (e.g., switching costs, etc.). Then, the alternative transactions compete with those anticipated in the production of V. Or, as viewed from the agent perspective, the members of G provide competition *for one another* and *against their respective transaction partners* in the creation of V.

It should be noted that assumptions (1) and (2) are not without controversy (see Lippman and Rumelt, 2003). When V is not sufficiently large relative to the $v(G)$s, a competitive distribution does not exist. The frequency of such situations in the real world is an open empirical question. What determines value capture in such situations is an open theoretical question. That said, these concerns strike us as too strong for several reasons. First, the conditions under which problems arise are fully characterized and well-known (Bondareva, 1962). Thus, such situations can be identified when necessary. Second, as theoretical premises, (1) and (2) provide deep insights into how competition operates in free markets. Even if there are real-world cases in which the core is empty, gaining these insights is a worthwhile exercise. Third, there are two reasonable ways by which competition may be softened to admit existence. One is through the institutional features of a market. For example, if the law prohibits some agents from transacting, then the value they can produce is effectively zero. The other is through bounded rationality. For example, if the agents in a group are unaware of that productive possibility then, again, the associated value is effectively zero. Either way, competition would work as expected, only with weaker effect.

To interpret competitive distributions in a concrete strategy context, bring the expanded Five Forces diagram of Figure. 1 to mind. The firm engages in specific transactions with a specific network of suppliers and buyers resulting in the creation actual economic value. At the same time, rivals, potential entrants and producers of substitute products offer the firm's transaction partners valuable alternatives. These agents compete against the firm and for its partners. Simultaneously, rivals, potential entrants, and substitutes operate at every level of the value chain, thereby providing competition for the firm and against its partners. The characteristic function v provides a summary of all these competitive alternatives. This leads to the following insight.

Insight 1 There is only *one* force of competition, not five or some other number. Competition is implied by a tension between having to neutralize all the competing alternatives in (2) using the limited value produced in (1). These conditions impose value capture consequences on every agent in the market. That is, while its value capture implications may vary from agent to agent, the set of competitive consistency conditions from which those implications arise is the same for every agent. All agents face a tension between (2) and (1). From the firm's point of view, the effects of this tension run in two directions: one in its favor, the other against it (Gans et al., 2008). Thus, the CGT conceptualization of competition acts as a single force, with symmetric structure and two effects, one good and one bad, on each agent.

Insight 2 Competition has the overall effect of *bounding* an agent's range of value capture possibilities. Mathematically, it can be shown that (1) and (2) result in a *range* of value capture possibilities for an agent. That is, for every agent i, competition determines an interval, with bounds $\pi_i^{\min} \leq \pi_i^{\max}$, such that π_i is part of a competitive distribution of value if and only if it is contained in $[\pi_i^{\min}, \pi_i^{\max}]$. This is contrary to the point-estimate intuition inherited from familiar models like Cournot and Bertrand. Competition *for* an agent pushes up $\pi_i^{\min}$, while competition *against* it drives down $\pi_i^{\max}$. By way of analogy to bilateral trade, $\pi_i^{\max}$ is the market's "willingness-to-pay" for agent i's involvement in the creation of V. Similarly, $\pi_i^{\min}$ is, loosely, i's "willingness-to-sell" that involvement to the market. Both values are pinned down by competition – implicit in the feasible alternatives to producing V available to market participants.

Insight 3 Competitive intensity with respect to agent i should be conceptualized with respect to the length of $[\pi_i^{\min}, \pi_i^{\max}]$. At its most intense, $\pi_i^{\min} = \pi_i^{\max}$. While the usual conception of extreme competitive intensity (i.e., "perfect competition") may hold ($\pi_i^{\min} = \pi_i^{\max} = 0$), so may competitive intensity at the other end of the spectrum ($\pi_i^{\min} = \pi_i^{\max} = V$), and everything in between (Montez, Ruiz-Aliseda, and Ryall,2013). Thus, extreme competitive intensity is neither good nor bad per se. At the same time, the model admits situations in which $\pi_i^{\min} = 0$ and $\pi_i^{\max} = V$; i.e., competition plays no role in determining who captures how much value. Thus, strategy scholars and practitioners alike must give serious consideration to the possibility that these distinctions are features of real-world industries.

Insight 4 Value capture depends upon two classes of resources – competitive and persuasive. Which of these is most salient varies with the competitive intensity faced by the firm. The theory implies that the value captured by firm i must be the sum of a competitively guaranteed minimum plus a portion of its feasible interval obtained via extra-competitive means – i.e., all ways of persuading transaction partners to part with value beyond the implications of (2). Formally,

$$\pi_i = \pi_i^{\min} + \alpha_i(\pi_i^{\max} - \pi_i^{\min}), \tag{3}$$

where $\alpha_i \in [0, 1]$ is called i's *appropriation factor*; α_i summarizes the effect of all super-competitive determinants of firm i's ability to get others to part with value other than arguments that rely on (2).[10] When competitive intensity is slack, the control of superior "persuasive resources" is the key to value capture (Ryall, 2013). From a positive perspective, the prediction here is that high-performing firms in low-intensity industries either control superior persuasive resources or enjoy institutional advantages (e.g., bidding norms) vis-à-vis the other agents. At the other end of the spectrum, when intensity is at its most extreme, persuasive resources play no role. Accordingly, empirical analyses that fail to account for variation in intensity/control of superior persuasive resources are unlikely to provide consistently good explanations of firm performance heterogeneity.[11]

3.2 Noncooperative game stage

Ultimately, strategy scholars and practitioners alike are interested in understanding how agent behavior affects the distribution of value within a market. To investigate this issue, Brandenburger and Stuart (2007) propose linking the competitive (CGT) stage to a preceding strategic (NGT) stage by way of a "biform game." The goal is to admit a model in which the agents vie with one another to alter the competitive landscape (i.e., the second-stage co-

[10]When used prospectively, the appropriation factor can be thought of as a subjective estimate of an agent's own ability to persuade its transaction partners to part with value, by all means other than pointing out the implications of v.

[11]We are presently unaware of any investigations into the intensity/resource class dichotomy.

operative game) to their advantages. For example, firm strategies may involve investments in cost-reducing process technologies, capacity expansion, new market development, personnel practices, attempts to adjust corporate culture and so on. Simultaneously, distributors may adopt new technologies, end users may hire negotiation experts, suppliers may implement new information systems, etc. All of these activities, presumably the result of each agent's business strategy, interact to determine the actual value creation opportunities available in the marketplace.

Formally, each agent $i \in N$ begins with a set of *feasible actions*, A_i, with typical element a_i, an *action*. Action sets can be finite or infinite, scaler or multidimensional, depending upon the application. Since the first stage is a noncooperative game, it can take strategic or extensive form. The latter is appropriate for investigating situations in which move timing and information issues are important. To keep it simple, we will describe the general strategic form: each agent chooses its action without knowledge of the other agents' choices (i.e., simultaneous-moves). The result is a list containing each agent's action, referred to as an *action profile* and denoted $a \equiv (a_1, \ldots, a_n)$. The set of all such profiles is denoted A.

The idea is that the joint actions of the market participants interact to influence both the characteristic function, v, as well as each agent's *appropriation factor*, $\alpha_i \in [0, 1]$, ultimately determining each agent's appropriation equaion (3). Thus, the parameters describing value capture in the second stage can be identified by action profile superscripts. For example, two different action profiles a and a' induce cooperative games (N, v^a) and $(N, v^{a'})$ as well as appropriation factors α_i^a and $\alpha_i^{a'}$ for agent i, etc. Then, each agent's payoff in the second stage is assessed according to (3). Thus, the value captured in the market stage is the payoff to an agent's action in the strategic stage, given the effects of everyone's actions. Formally, agent i's value capture given action profile a can be written

$$\pi_i(a) = \pi_i^{\min}(a) + \alpha_i(a)(\pi_i^{\max}(a) - \pi_i^{\min}(a)), \tag{4}$$

where $\pi_i^{\max}(a)$ and $\pi_i^{\min}(a)$ are the bounds implied by v^a and $\alpha_i(a)$ is the net effect on i's persuasive effectiveness implied by the actions in a.

In closing this section, it is worth pointing out that the biform setup opens strategy analysis to the entire toolbox of NGT. For example, most strategy applications to date have used Nash, or Bayesian Nash, as a solution concept in making theoretical claims in specific settings. However, those interested in strategic settings of bounded rationality might employ subjective equilibrium (Kalai and Lehrer, 1995; Ryall, 2003, for a strategy application) or ambiguity-averse Nash equilibrium (Ellsberg, 1961; Ryall, 2009, for a strategy application). On issues of persistent performance heterogeneity, the model can be expanded into a repeated game. In addition, methods used in studies of cheap talk, information asymmetry and behavioral economics can all be adapted to this framework. All of these powerful modeling techniques can be brought to bear to examine how firms in a wide variety of settings behave and how those behaviors affect value capture under competition.

4 General principles

The extant theoretical literature using cooperative or biform games to investigate issues in business strategy can be categorized into two substreams. The first takes characteristic functions as given, operating at the general, abstract level to develop general principles with respect to value creation, competition, "persuasive" resources and firm performance. The second builds up the characteristic function from primitives that are relevant to a particular issue. For example, the analysis may be specific to two-sided markets, productive networks or differentiated products. These studies begin with specific assumptions about agents and their roles, buyer preferences, production technologies, costs, capacities, etc. The primitive assumptions are then used to construct the implied characteristic functions that arise from the agents' various strategic choices (i.e., in a biform game). In this section, we focus upon the historical development of the former and highlight its most significant findings.

The first paper to use CGT to examine value capture in strategy is Brandenburger and Stuart (1996). This paper introduces the strategy audience to the formal notion of *agent added value*.[12] Informally, an agent's added value is the difference between the aggregate

[12] This idea arises in economics at least as early as Edgeworth (1881). More recently, economists Makowski and Ostroy, in a substantial line of joint work, demonstrate the importance of understanding that, in a general equilibrium model, agents and the value they capture is the mathematical dual to solutions based upon products and prices (see, e.g., Makowski and Ostroy, 1995). They refer to added value as "agent marginal product." Brandenburger and Stuart (1996) cite this work as having had in important influence

value created in a market in which the agent participates and the amount of value that could be created were that agent to be removed from the market (alternatively, were all the other agents to shun transactions with that agent). Formally, the added value of agent i is:

$$av_i \equiv V - v(N_{-i}), \tag{5}$$

where N_{-i} denotes the set of agents other than i.

Principle of the Added Value (GP1) From (5), it follows immediately that added value places an upper bound on what an agent can appropriate. This is easy to see: if $\pi_i > av_i$, then satisfaction of (1) implies $\sum_{j \in N_{-i}} < v(N_{-i})$, which violates (2). In words: *positive added value is a necessary condition for value capture.* Here, competition works against i in the sense that, the agents on the other side of the transactions with i that contribute to V must be induced to freely accept these and not some other set of transactions from which i is excluded – in this case, the ones involved in the production of $v(N_{-i})$. The added value of i is an upper bound on the other agents' "willingness-to-pay" for i's involvement in the production of V. When $\pi_i = av_i$, agent i is said to be a *full appropriator.*

Principle of Adding Up (GP2) Brandenburger and Stuart (1996) clearly state that added value is a necessary but insufficient condition for value capture (p. 14). Nevertheless, their analysis proceeds (from p. 15) under the premise that achieving positive added value "is the path to value appropriation" (i.e., rather than being one step *on* that path). They then illustrate several examples in which every agent captures exactly its added value – no more, no less. These examples are built on an interesting condition known as the "adding-up" property: *if the agent added values themselves sum to V, then every agent captures precisely its added value.* Formally, if $\sum_{i \in N} av_i = V$ then, for all i, $\pi_i^{\min} = \pi_i^{\max} = av_i$.

The preceding result corresponds to what general equilibrium theorists Makowski and Ostroy (1995, 2001) define as "perfect competition." Strategy scholars who are used to identifying "perfect competition" with the zero profit world induced by free entry may find this definition jarring: here, perfect competition implies everyone is a full appropriator. Note

on their paper (p. 23). See Makowski and Ostroy (2001) for a wide-ranging, highly accessible review.

that this definition includes the traditional meaning of perfect competition as a special case: under free entry, added values are driven to zero and, hence, so is value capture (agents are, trivially, full appropriators). Now, competition is "perfect" in the sense that it squeezes everyone's core interval to a single point (equal to the added value).

Principle of the Minimum Residual (GP3) A grasp of the preceding, counterintuitive conceptualization of perfect competition invites scholars to stop thinking of competitive intensity as a force of pure badness. GP2 shows that, under the right circumstances, competitive intensity actually guarantees full appropriation. This finding naturally leads one to wonder about cases in which competition is not so intense as to induce trivial intervals. MacDonald and Ryall (2004) note the absence of attention in strategy research on the good side of competition – namely, its potential effect of guaranteeing positive value capture ($\pi^{\min} > 0$). They define agent i's *minimum residual*: $mr_i = V - \sum_{j \in N_{-i}} av_j$. It follows that *every agent must capture an amount of value at least as great as its minimum residual.* Formally, $\pi_i \geq mr_i$. This is implied by the straightforward logic of GP1: since added value is an upper bound to value capture, if the sum of everyone else's added values (i.e., besides i's) is less than V, then i must receive (at least) the difference. While GP3 is simple to derive, its interpretation is subtle. Agent i's minimum residual is an indirect consequence of the $n - 1$ alternatives to exclude precisely one of the other market participants from the transactions that produce V. When other participants add meagre value compared to i, implicit competition *for* i is high, guaranteeing i positive value capture.

Principle of the Essential Tension GP1-GP3 are all based upon added value, an intuitive and technically simple idea. However, added value ignores the lion's share of the feasible opportunities to create value elaborated in competitive consistency condition (2). The agent added values depend upon the n groups of the form N_{-i}. More generally, however, there are $2^n - 1$ possible groups that can be formed from the n agents in N. If the number of agents in a market is even moderate, added value is unlikely to account for much of the competition's overall impact on value capture. Having established GP3, MacDonald and Ryall (2004) go on to examine the effect of *all* the alternatives on an agent's competitive minimum. Specifically, they seek to characterize the conditions under which competition alone guarantees that an agent *must* capture a positive share of value. In service of this goal, they define an agent's *minimum value* and use it in their main proposition.

Agent i's minimum value, denoted mv_i, is the solution to the following optimization problem: minimize the aggregate amount of value required to make sufficient payments to agents other than i such that i receives zero and, yet, cannot induce any group to deviate from the production of V. Formally, mv_i is the solution to the following linear program:

$$mv_i \equiv \min_{\pi \in \mathbb{R}^n_+} \left\{ \sum_{j \in N} \pi_j \middle| \pi_i = 0 \text{ and } \sum_{k \in G} \pi_k \geq v(G_{+i}) \text{ for all } G \subset N_{-i} \right\}, \tag{6}$$

where G_{+i} is the group G with i added. The important thing to note is that, the more productive i is with the various groups, the more the aggregate value required to pay off the other agents such that i – facing zero value capture – cannot organize a deal with the members of *some* that makes everyone in it (including i) strictly better off than what they would get by participating in the production of V. Put differently, if "the market" proposes that highly productive agent i receive a "price" of zero economic value in return for its participation in creating V, the other agents will need to receive large quantities of value if i is to be prevented from inducing them to deviate to some other activities.

Once the concept of minimum value is grasped, it is easy to see that $V < mv_i$ if and only if $\pi_i > 0$. In words, *competition guarantees an agent strictly positive value capture when a sufficient tension exists between the value that agent creates with different groups and the actual quantity of value created in the market.* Note that mv_i depends only upon the groups in which i is a member. Thus, mv_i is an important measure of competition *for* i. Macdonald and Ryall (2014) explore whether the entry of any new agent (direct competitor, supplier, employee, buyer, etc.) affects the firm's competitively guaranteed value capture – under what conditions is this guarantee created, destroyed or maintained? In particular, they identify which categories of value-creating groups – those that include the entrant, exclude it, include only the firm and the entrant, and so on – matter for the creation, destruction or maintenance of the guarantee.

Extended example ending in a paradox Before moving on to the last general principle in this section, it may be instructive to illustrate these various results with a series of related examples in the simplest context possible – a small, two-sided market. To start, assume there are two firms, f and r (for "rival"). Each firm has one unit of capacity with which to make a product at constant marginal cost c_f and c_r, respectively, with $c_f < c_r$. There are two buyers, 1 and 2, who each wish to consume exactly one unit of product. Suppose each buyer views the firms as indistinguishable u_i denotes the utility enjoyed by buyer i from consuming one unit of either firm's product. At the same time, assume the buyers are heterogenous in their utilities such that $u_1 > u_2 = c_r$. Since the buyers view the firms' products as identical, which buyer buys from which firm is not a critical issue: the overall value created in this market should be $V = u_1 + u_2 - c_f - c_r$ or, since $u_2 = c_r$, $V = u_1 - c_f$. Assume the agents' outside options are normalized to zero.[13] See Figure 2.

[INSERT FIGURE 2 ABOUT HERE]

The first step is to compute added values. It should be easy to see that removing r or buyer 2 from the market has no effect on the aggregate value produced. Therefore, $av_r = av_2 = 0$. In the absence of f, r and buyer 1 transact to produce $v(\{r, 1\}) = u_1 - c_r > 0$. Therefore, f's added value is $av_f = c_r - c_f$ (the incremental effect of its superior cost position). Similarly, removing buyer 1 results in a transaction between f and buyer 2, which implies $av_1 = u_1 - u_2$ (the incremental effect of the greater value it places on these products). The implications of the Principle of the Added Value are summarized in Table 1.

	Firm f	Firm r	Buyer 1	Buyer 2
Added Value	$c_r - c_f$	0	$u_1 - u_2$	0
Implication for $\pi_i^{\max}$	$\pi_f^{\max} \leq c_r - c_f$	$\pi_r^{\max} = 0$	$\pi_1^{\max} \leq u_1 - u_2$	$\pi_2^{\max} = 0$
Implication for $\pi_i^{\min}$	none	$\pi_r^{\min} = 0$	none	$\pi_2^{\min} = 0$

Table 1: Implications of added values.

As it turns out, there is much more we can say. A moment of reflection indicates that

[13] Setting $v(\{i\}) = 0$ is without loss of generality.

the "Principle of Adding Up" applies:

$$\sum_{i \in N} av_i = c_r - c_f + 0 + u_1 - u_2 + 0$$
$$= u_1 - c_f.$$

Since $u_1 - c_f = V$, we know that each agent must receive *exactly* its added value. Competition is fully determinative; there is no room for extra-competitive value appropriation.

	Firm f	Firm r	Buyer 1	Buyer 2
Added Value	$c_r - c_f$	0	$u_1 - u_2$	0
Implication for $\pi_i^{\max}$	$\pi_f^{\max} = c_r - c_f$	$\pi_r^{\max} = 0$	$\pi_1^{\max} = u_1 - u_2$	$\pi_2^{\max} = 0$
Implication for $\pi_i^{\min}$	$\pi_f^{\min} = c_r - c_f$	$\pi_r^{\min} = 0$	$\pi_1^{\min} = u_1 - u_2$	$\pi_2^{\min} = 0$

Table 2: Implications of adding up.

Notice that, when adding up is satisfied, an agent's minimum residual equals its added value. This is another way of seeing that each agent must receive exactly its added value in such circumstances: an agent can get no less than its minimum residual and no more than its added value; therefore, when $av_i = mr_i$, the agent must get exactly this amount. Competition for each agent (as measured by minimum residual) is perfectly balanced with the competition against them (as measured by added value), thereby guaranteeing that every agent is a full appropriator.

Principle of the Essential Tension also holds. To see this, begin by imposing $\pi_f = 0$ and ask how much value is required to ensure that f cannot offer the buyers a profitable side deal. In this case, the answer is straightforward. If $\pi_f = 0$, then buyer 1 must capture at least $\pi_1 = u_1 - c_f$. Otherwise competitive consistency fails since, i.e., it would be the case that $\pi_f + \pi_1 < v(\{f, 1\}) = u_1 - c_f$. Similarly, it must also be that buyer 2 captures at least $\pi_2 = u_2 - c_f > 0$. Happily for f, $V = u_1 - c_f$ is not sufficient to make both payments, which is what is required to neutralize f's ability to upset the production of V in the event that $\pi_f = 0$: if the buyer transacting with f insists on $\pi_f = 0$, f can always make a deal with the other buyer that makes both it and the other buyer strictly better off. Therefore, we know that $\pi_f^{\min} > 0$ – competition for f is too intense for it to capture no value (which we already knew, but now see as a result of the essential tension). The same reasoning applies to buyer 1. Finally, it is not hard to see that $mv_r = mv_2 = V$. There is exactly enough value available to assure that r and buyer 2 receive no economic value.

The paradox Assume everything is as before, with the exception that now the buyers are identical – each values one unit of consumption from either firm at $u > c_r$. Now, $V = 2u - c_f - c_r$, arising from two transactions, one each between a buyer and a firm. Focus attention of f. The competitive distribution in which f captures its maximum is the one in which the firms are full appropriators. That is, $\pi_f^{\max} = av_f = u - c_f$. The worst f can do is to capture $\pi_f^{\min} = c_r - c_f$. The reason is that r's buyer competes with f's buyer to do a deal with f because it is the efficient producer. Thus, if f's buyer insists on leaving it with less than $c_r - c_f$, r's buyer can agree to a deal that makes both strictly better off.

Now, suppose f is not happy with 50% market share and, being the efficient producer, decides to "own" the market by expanding capacity to two units. How much better off is f following such a move? Both buyers transact with f to produce $V' = 2(u - c_f)$. If f is removed from the market, one buyer will still be able to transact with r. Therefore, its added value is $av_f' = 2(u - c_f) - (u - c_r) = u - c_f + c_r$. Note well that $av_f' > av_f$.

In this situation, there is nothing preventing the buyers from being full appropriators: feasibility and competitive consistency conditions are all satisfied in such a scenario. Therefore, $\pi^{\min\prime} = 0$. Moreover, the buyers must each appropriate $u - c_r$. Any amount less than this allows the buyer to cut a deal with r that makes both better off. Therefore, $\pi_f^{\max\prime} = 2(u - c_f) - 2(u - c_r) = 2(c_r - c_f)$.[14] Suppose f's efficiency advantage is small relative to the quality of its product – specifically, that $2(c_f - c_r) < (u - c_f)$ – then, $\pi_f^{\max\prime} < \pi_f^{\max}$.

In other words, reasonable parameters can be found for this example such that f unambiguously (i) increases its added value through the capacity expansion, and (ii) worsens its situation with decreases in *both* its minimum and maximum. This outcome is so counterintuitive that it has been used by some in economics to argue against the use of the core as a solution concept.[15] As we now show, the result is actually quite sensible once the shifting effects of competition in this example are properly understood.

[14] Firm r is still in the market. Obviously, the persistent lack of revenue must induce exit. However, it is sufficient that r's capacity utilization drops to less than 100% (i.e., and possibly greater than 0%).

[15] See, e.g., Postlewaite and Rosenthal (1974).

Principle of Competitive Intensity Montez et al. (2013) are motivated by Insights 1-3 of the earlier section. In particular, they investigate increasingly complex notions of "competitive intensity," each of which is consistent with the thrust of these insights. As it turns out, the simplest of these fully explains why the preceding result, though counterintuitive, is economically intelligible.

To see this, begin by defining a *focal value partition*, denoted $\mathcal{P}^*$, for a cooperative game. Mathematically, $\mathcal{P}^*$ is a collection of subsets of agents with the following properties: (i) $\mathcal{P}^*$ is a partition of N and (ii) $\sum_{G^* \in \mathcal{P}^*} v(G^*) = V$.[16] The groups in $\mathcal{P}^*$ are called *value networks*.[17] This structure is meant to represent industries containing distinct value chains – each value network is a set of agents linked to one another through their transactions, with the value created by the industry being equal to the aggregate of the value created by each network. For any particular game, there may be many candidates for $\mathcal{P}^*$ (i.e., many ways to allocate the agents into groups such that the group values add up to V). The label "focal" is intended to convey the idea that $\mathcal{P}^*$ corresponds to a real situation; e.g., the actual transactions an empiricist would identify upon observation of the industry.

To understand the simplest notion of competitive intensity and grasp its implications for value capture, assume an industry is decomposable into two or more value networks. The notion of competitive intensity is based upon added value. Symbolically, if G^* is a value network in which firm f is not a member, then f's *added value to* G^* is given by $av_f(G^*) = v(G^*_{+f}) - v(G^*)$. If $av_f(G^*) > 0$, then the value network G^* competes *for* f – the members of that network would like f to join because, in that way, more value will be produced. Competition of this kind raises f's minimum. Indeed, $\pi_f \geq av_f(G^*)$. The reason is that the agents in a value network must, in aggregate, capture exactly the value produced by that network; i.e., $\sum_{i \in G^*} \pi_i = v(G^*)$. If, in addition, $\pi_f < av_f(G^*)$, then the group comprised of G^* and f violates the competitive consistency condition.

An agent's "first-order competitive intensity" (FOCI) is defined as the maximum value that agent adds to a value network outside its own. The general principle is that *every agent must capture value at least as large as its first-order competitive intensity.* The economic

[16] A partition of N is a collection of disjoint groups, the union of which equals N.
[17] The asterisks on the groups indicate their status as value networks.

intuition is immediate from the preceding logic. Consistent with Insight 1, the logic applies symmetrically to all the other agents in f's own value network. The greater the competitive intensity for f's transaction partners in that network, the less value is left over for f – its maximum is driven down. This is consistent with Insight 2. As competitive intensity for f and its transaction partners increases, f's competitive interval is squeezed, consistent with Insight 3.

The paradoxical example is fully explained by this simple notion of competitive intensity. Let us see how by assuming the parameters are such that the unintuitive outcome arises; i.e., $2(c_f - c_r) < (u - c_f)$. Consider the focal value partition prior to the capacity expansion. Suppose f sells to buyer 1 and r to buyer 2. Then, the value networks can be denoted $F^* = \{f, b_1\}$ and $R^* = \{r, b_2\}$. These represent simple transactions, with $v(F^*) = u - c_f$ and $v(R^*) = u - c_r$. This implies $V = v(F^*) + v(R^*)$. Therefore, $\mathcal{P}^* = \{F^*, R^*\}$ fulfills the requirements for a value network. We loosely conceive of buyer 2 creating competition *for* f because it provides an opportunity to create more value than does transacting with r. FOCI quantifies this: the added value of f to R^* is $c_r - c_f$ (in the group containing f, r, and b_2, b_2 simply deals with f rather than r). Therefore, $\pi_f \geq c_r - c_f$. At the same time, buyers 1 and 2 are interchangeable. As a result, there is no FOCI for b_1: inserting b_1 to R^* does not create any additional value. Thus, $\pi_f \leq u - c_f$.

How do the economics change when f expands capacity? First, both buyers transact with f. We have $F^{*\prime} = \{f, b_1, b_2\}$ and $R^{*\prime} = \{r\}$ with $v(F^{*\prime}) = 2(u - c_f)$, $v(R^{*\prime}) = 0$ and $V = v(F^{*\prime}) + v(R^{*\prime})$. Now, having moved b_2 into its actual transaction network, competition for f *disappears*. Simultaneously, the empty capacity in $R^{*\prime}$ *creates* competition for both of f's buyers. The loss of competition for f drops its minimum and the appearance of competition for f's buyers raises it to its maximum. The FOCI for the post-capacity expansion of f is zero, while the FOCI for *each* buyer is $u - c_r$.

Beyond the economic insights provided, there are a couple of additional points worth mentioning with respect to this novel conceptualization of competitive intensity. First, the definition of FOCI presents an alternative solution concept to the core. Second, unlike the core, it always exists. Third, the concept is simple – it relies on a very small number of groups, as compared to the core. Moreover, it is set up to facilitate reference to actual transactions (i.e., as embodied in the focal value networks). These features make it much friendlier to empirical analysis than findings that rely on the core. Finally, it also provides a basis for additional insights about the operation of competition, several of which are investigated (including a notion of indirect competition called second-order competitive intensity).

5 Applications to special settings

In this section, we turn our attention to papers that approach their analysis from the bottom up. That is, whereas the work cited in the previous section begins with an arbitrary characteristic function (and, hence, provides abstract but general findings about the nature of value creation and capture in markets), the following work starts with specific assumptions that are relevant to a specific setting of interest, and then analyzes performance in light of the resulting characteristic function.[18]

The application papers reviewed below are a significant complement to those focused on the development of general principles – from them, a deeper understanding emerges of the theoretical links from variation in agent resources, skills, strategies and contexts to variation in the force of competition and effectiveness of persuasive abilities (and, hence, in performance itself). In the following discussion, the connections made from the specific findings of these papers to the general principles elaborated above are our own, with the intention of illustrating how the latter illuminate the former and, thus, of conveying a sense of the overall coherence of this line of work.

A demand-based perspective One of the important messages in the value capture literature, that arises implicitly from the formalism, is that end-users are integral to the value creation and capture story: without them, there is no value creation. While it is possible to construct a biform game that shunts buyers into the background (à la the demand curve in a Cournot model), there is nothing in the formalism that requires it. Indeed, the modeler is encouraged to treat buyers on an equal footing, in terms of model inclusion, as any other kind of agent. Thus, the approach is a natural choice for Adner and Zemsky (2006) who are

[18]In some papers, the characteristic function is explicitly derived from the more primitive assumptions. In others, it is left implicit to operate behind the scenes.

motivated to study demand-side influences on sustained competitive advantage.

Specifically, Adner and Zemsky (2006) set up a model in which consumers vary in terms of their preference for quality as well as the extent to which they have decreasing marginal utility (DMU) for performance. Firm heterogeneity is captured on four dimensions: (i) rate of technology acquisition; (ii) technology lead (or lag); (iii) a fixed quality component; and (iv) marginal cost of production. In this model, value capture is assumed to be proportional to value added.

The analysis goes on to relate competitive advantage to the interaction between firm strategies and the degree of DMU inherent in consumer preferences for product performance. For example, they show that the ability of a challenger to unseat an incumbent through innovation depends subtly upon a firm's cost position and the degree of DMU. If the new technology comes with a cost advantage, higher DMU speeds adoption. However, if the challenger has a cost disadvantage, higher DMU retards adoption.

The paper goes on to explore the Principle of the Added Value under the effects of different types of resources (process, product, innovation), the effects of imitation, multisegment competition and strategic diversity. Throughout, the focal issue is on the interaction between firm strategies and the features of consumer preferences (primarily DMU). Because the model assumes value capture is proportional to added value, competitive intensity and the distinctions between competitive versus persuasive sources of performance advantage are not a feature of the analysis.

Value capture in productive social networks A persistent empirical finding with respect to productive social networks is that network brokers – agents who intermediate transactions between two or more parties – tend to enjoy higher levels of value capture than agents with similar characteristics but less central network positions (see Burt, 2000, for a review of empirical findings). A question that naturally arises is whether the superior performance is due to a broker's network position, or whether the agent's position is due to its superior productive characteristics. In the latter case, network centrality and superior performance are due to the common cause of the agent's ability to create superior value.

Ryall and Sorenson (2007) build a biform game in which second-stage value creation possibilities depend upon a collection of possible projects which, themselves, require subsets of connected agents for completion. For example, an action movie requires a set of agents – director, actors, producers, special effects artists and so on – with complementary abilities to come together for its completion. The key feature of the model is that agents must be connected within a productive network in order to work on a project. The formation of network relationships occurs in the first stage of the biform game, in which agents make and accept (or reject) offers to work with one another.

The analysis demonstrates that brokers can, in fact, enjoy guaranteed value capture purely by virtue of the competition for them generated by their network position, viz. the Principle of the Essential Tension. However, the paper goes on to illustrate the insight that attaining such a position is problematic: if an individual really has no effect on value creation per se, the agents who *are* required for the creation of value have no interest in accepting a set of relationships that have the end-effect of installing that individual into a value-soaking position of network scarcity.

Vertical integration De Fontenay and Gans (2008) examine firms' decisions to outsource functions and transact under separate ownership. In their analysis the NGT part of the biform game is a market where real assets are traded while the CGT part of the game is based on the Shapley value. While it is well known that consolidation of ownership can allow those owners to capture more value, this must be traded off against any value creation that might arise form outsourcing (that is, vertical disintegration or separation of ownership). What de Fontenay and Gans (2008) show is that, consistent with our earlier blind spot regarding the harm generated by competition, it matters *who* you outsource to.

For instance, if you outsource and use that to create competition, that improves value capture in the CGT part of the game relative to outsourcing to an existing firm that keeps competition (at least structurally) the same. But, precisely because of this, the NGT part of the game that involves a transaction with the outsourcing firm (which acquires assets to provide services), involves several parties which care about the degree of competition that results. The paper shows that, in fact, the NGT incentives dominate the CGT outcomes and, in equilibrium, a firm will end up outsourcing to an established firm (keeping competition structurally the same) rather than an independent firm that creates more competition. Thus, the bi-form structure of value capture theory – by forcing us to understand the full consequences of an outsourcing relationship – can turn traditional intuition about the competition-creating effects of outsourcing on its head.

Strategic factor markets The resource-based view claims that sustained superior performance must arise from control of resources and capabilities that are rare, valuable and inimitable. Barney (1986) and Makadok and Barney (2001) go further to assert that, de facto, inimitability arises from superior understandings of resource value. To frame the idea in the logic of this paper: competition for the transaction partners of a superior performer may fail to appear because the agents required to provide such competition simply do not understand the value creation possibilities of their resources in that context. Heterogeneous expectations, then, become the basis for "strategic factor markets" (SFM) – markets in which value-creating resources are demanded and supplied as a result of heterogeneous expectations regarding their value.

In elaborating the free-entry blind spot, we explained why material finitude implies that resource mobility barriers are neither necessary nor sufficient for sustained performance advantage.[19] Adegbesan (2008) explores the substance of this implication explicitly in the context of strategic factor markets. The setup is an assignment model: a cooperative game representation of a two-sided market in which sellers offer units of an undifferentiated product to buyers. While the sellers' products are identical, buyers do not value them identically.[20] The interpretation here is that the products are resources which offer heterogeneous complementarities to the firms on the buy-side of the market. Thus, performance heterogeneity does not arise as a result of heterogeneous expectations but, rather, of heterogeneous resource complementarities. Note well the implicit premise that the features of the buy-side firms which create the complementarities are, themselves, in finite supply.

[19]See also Pacheco-de Almeida and Zemsky (2007, pp. 651-2) for a discussion of other issues that have been raised with respect to the theoretical underpinnings of the RBV.

[20]The canonical example is a housing market in which all the sellers offer houses which, for all relevant purposes, are identical. However, buyers may have different willingness-to-pay due to their individual preferences for house features.

Adegbesan (2008) demonstrates a number of interesting findings. First, the analysis shows that the resource acquirers with greater complementarities are guaranteed greater value capture (via the Principle of the Essential Tension). Second, the paper highlights the traditionally overlooked fact that a portion – potentially significant – of superior performance may be due to persuasive capabilities (relating to Insight 4 and to the Principal of Competitive Intensity). This latter issue is in the context of SFMs themselves. At the top end, of course, the importance of persuasive capabilities is capped according to the Principle of the Added Value. Here, added value is also computed in context of the SFM and arises as a consequence of complementarities.

Value chain frictions Chatain and Zemsky (2011) study what happens with respect to value creation and capture when frictions arise in industry value chains. The issue arises as a natural consequence of conditions (1) and (2) for a competitive distribution of value. The number of possible value-creating groups that one must, theoretically, consider is exponentially increasing in the number of agents, n. In most real-world situations, search and switching costs may prevent agents from being aware of or, equivalently, being unable to act on a large portion of these possibilities.

The model examines two firms competing for a single buyer, in which each firm fails to meet the buyer with some probability. This probability quantifies the firm-specific "friction" inherent in the market. A number of results are presented, as the analysis proceeds to examine the effects of friction in the context of each of the five "forces" in the famous model of Porter (1979). An important, cumulative insight arising from these findings is that Porter's Five Forces cannot be considered in isolation. For example, changes in persuasive capabilities affect threshold friction levels that induce entry. This message is consistent with our earlier Insight 1: there is only *one*, highly interactive force of competition. Changing any one of the value actually created, relative persuasive advantage or the value of productive alternatives has the potential to alter the balance of competition throughout the system in subtle and counterintuitive ways.

6 Empirical work

Value capture theory has recently led to empirical work that utilizes both the theory's insights and, equally importantly, its methodological innovations. Here, we review these papers, highlighting how value capture theory has given researchers a way of endogenizing elements – particularly regarding multi-agent interactions – that were previously held exogenous when formulating hypotheses. This has led both to cleaner hypothesis specification as well as new ways of looking at the identification of causal relationships in explanations of firm performance.

Consider, first, the papers that use value capture theory for hypothesis formulation. One example is Marx, Gans and Hsu (2014), who examine the commercialization choices of start-up firms in the speech recognition industry. In their model, start-ups face a choice between competing with established firms or cooperating with them. However, what makes this a complex interaction is that the choice is exercised over time and start-ups can pivot between different commercialization strategies. Their model uses value capture theory by explicitly modeling the amount of value created through a cooperative choice relative to a competitive choice taking into account the fact that those choices may impact on future value creation and also the value that each party can guarantee to appropriate. This allows them to hypothesize how technological characteristics impact the sequence of observed commercialization choices of start-ups. For instance, for disruptive technologies that are initially of low value to incumbents and are difficult to integrate, competition will be preferred. However, following the resolution of uncertainty over the future trajectory of the technology, a switch to cooperation may be observed. As that uncertainty is actually resolved to the empirical observer, Marx et al. (2014) can actually test whether those pivots occurred – and whether they related to the technology being commercialized in the fashion anticipated by the theory. They found that the data were, indeed, consistent with the theory.

Chatain (2011) uses value capture theory to investigate an important new area regarding the resource-based view of the firm: namely, how does competition itself impact on the relationship between capabilities and performance? This is a subtle issue. As noted earlier, while improved capabilities improve value creation (in general), they may not improve a firm's ability to appropriate that value precisely because the terms of competition change. Chatain (2011) distinguishes between certain actions that improve total value creation between a firm (in his application law firms) and its clients but in a way that is specific to a client (for instance, knowledge of a law firm of third party contract specifics or the details of manufacturing operations) and those that are more generic. For the former, the very action reduces the set of agents which can compete effectively for the client's business. He finds that if a client requires new services, then those are more likely to be provided by the client's existing law firm when client-specific knowledge is an important component of those new services. By contrast, the aggregate level of expertise in the firm does not spur a similar bias in a client's choices for new services. Finally, the agglomeration of services is related positively to the client-specific relationships of a firm and also negatively to the client-specific relationships of rivals. Using data on US law firms, Chatain (2011) confirms the predicted hypotheses from value capture theory in this context.

One of the primary empirical challenges posed by the theory – especially since it represents one of the theory's essential features – is how to work with the inequality constraints posed by competitive consistency conditions (2). Chatain (2013) breaks new methodological ground in this stream by implementing value capture estimates based upon an estimation approach that admits the use of inequality constraints. This approach was introduced to economics by Fox (2008) and first applied in strategy by Mindruta (2012) in her study of the drivers of researcher-firm matching. Applying this new methodology to the two-sided market between law firms and their corporate clients, Chatain (2013) uses law firm quality rankings to construct implicit willingness-to-pay on the part of firms which, in turn, implies inequalities (2). He finds that law firms with broader client scope appropriate less and, moreover, at an equal cost per lawyer as those with narrrower scope – results that run counter to the prevailing wisdom of practitioners in this industry.

Also ambitious is Grennan (2014). His paper examines negotiations between suppliers and buyers (usually hospitals) of medical devices. Grennan (2014) is able to observe total value created computed from observed prices and market shares for coronary stents. Importantly, the prices are negotiated prior to quantity being chosen with doctors doing that depending on demand and relative costs. This allows Grennan (2014) to identify key elasticities that drive willingness to pay for these stents because some of the later variation in demand are not observed or anticipated when prices are negotiated (e.g., a large study taking place in a hospital). Grennan (2014) also observes the supplier costs of stents based on their type. He then uses the Nash bargaining solution, simultaneously solved and applied across the market, to generate a structural equation for the determinants of supplier appropriation. As he shows, this is equivalent to the value capture model based on the core in the context of his setting. Critically, this allows him to decompose the determinants of value capture by suppliers into their competitive options (namely, computed added value) and also bargaining ability. He finds that 79 percent of the variation in appropriation across suppliers is explained by bargaining ability. Moreover, this ability is itself correlated with firm identity. It differs across hospitals, improving over time as hospitals learn how to negotiate with suppliers.[21] This suggests the long-anticipated efficacy of trying to consider firm organization and performance as embedded in their competitive environments.

A related, although non-structural, approach is undertaken by **?**. He exploits variation in the organizational design of car dealerships to examine the impact of this on subsequent bargaining outcomes in a biform game. In particular, in some car sales negotiations, a salesperson owns the entire deal (a parallel process) while in others (a serial process) deals are closed by a, persumably, more expert salesperson. Recall that the price eventually negotiated will be, under value capture theory, a function of competitive options for the seller and the seller's relative bargaining ability. Because bargaining ability is likely to be higher when an expert salesperson is brought in, then it is also the case that the impact of competitive options on the final price is lower in this organizational form. Bennett shows, consistent with the theory, that as the inventory of cars diminishes (a proxy for competition or scarcity), prices increase under the serial sales process by relatively less. In addition, using the college education of buyers as a proxy for Internet search savviness, Bennett finds that in this situation the serial process performs worse than the parallel one; i.e., the costs of that more drawn out process are not translated into pricing benefits.

In summary, the empirical work based on value capture is very new but has already

[21] Adegbesan and Higgins (2011) also find a similar impact on bargaining ability in their study of biotech-pharmaceutical company alliances, although their analysis is not structural in nature nor is it causally identified in the way Grennan (2014) is able to do in his setting.

yielded insights that support the theory. In particular, the broad predictions of the theory do appear in the data in a variety of applications. Moreover, some empirical work has demonstrated that competition alone cannot explain all of the variation in firm performance and that, in fact, some idiosyncratic factors that drive relative bargaining power can be very significant. It will be interesting to see how that assists in focusing out attention on the drivers of those factors as well as how far the theory can be pushed to assist in quantifiable structural modeling.

7 Future Directions

While the cooperative game theory has a long history in economics, it is relatively recently that this methodology began being applied to the central questions in strategic management. That theory reviewed here grounds the issue of firm performance in both a market setting and in a setting where resource constraints are endogenous to overall economic activity. This allows the researcher to fully characterize how the force of competition provides bounds on a firm's appropriability and how these bounds relate to value capture by other firms, customers and suppliers. This approach not only provides insights into the robustness of predictions stemming from more conventional models of market competition, but also provides entirely new insights that are not available from those models. Here, we have highlighted areas where the theory provides both nuance and challenge to existing preconceptions.

At the same time, we must stress that these insights have yet to be broadly tested by our empirically motivated colleagues. Indeed, as excited as we are by with the promise posed by the recent flurry of empirical work, the surface has only been scratched. In our view, the most important issue is specifically identifying and measuring the impact of "persuasive" versus "competitive" resources. That is, how do firm strategies affect the value capture equation (3)? What, exactly, are "persuasive" resources? Do they operate as predicted? Are they more or less likely to convey durable advantages to their owners? Of course, these questions are closely related to competitive intensity. The theory predicts that persuasive resources are important when competitive intensity is low, competitive resources more so when intensity is high. However, the extent to which competitive intensity varies across markets and firms is an open empirical question. If the typical firm faces strong intensity (and, hence, a narrow competitive interval), then claims about persuasive resources are a theoretical curiosity without real-world relevance. In either event, the answer will provide a deeper understanding of persistent performance heterogeneity among related firms.

Another important opportunity, as highlighted by Grennan (2014), is the ability to use value capture theory to bring structural modeling to strategy – in a fashion distinct from the present approaches used in the empirical industrial organization (based on dynamic, NGT). Combined with a refined understanding of how firms' actions affect their value capture equations, structural models along the line of Grennan (2014) permit researchers to explore the drivers of firm performance in a market setting. Moreover, they permit "what-if" assessment of business policy counterfactuals. The formal approach requires precision but with that precision, comes a more subtle set of hypotheses that can be tested and examined.

Finally, the theory is far from settled. The empricist's ability to classify resources to capabilities into persuasive versus competitive categories will be greatly facilitated by further theoretical work on this issue. This suggests a need for more theory that avails itself of the full biform formalism (in contrast to much of the theoretical work to date, which focuses primarily upon the second-stage, CGT part of the model). While the early focus on understanding this less familiar side of the theory is justifiable, the pressing questions for strategy transcend it. Critically, we must understand how the implications of value capture drive actual firm behavior – how do managers formulate strategies to capture value given their competitive environments? What *should* they do? In thinking seriously about managerial action in the real world, issues of bounded rationality inevitably arise. Many tools have been developed for the study of bounded rationality using NGT. Here we have in mind evolutionary game theory, subjective rationality, game theoretical learning and behavioral economics. All of these are available to biform game analysis. Hence, we are optimistic that future strands of this work will take such issues seriously and explore their implications for strategy. In summation, there is much, much more to be done.

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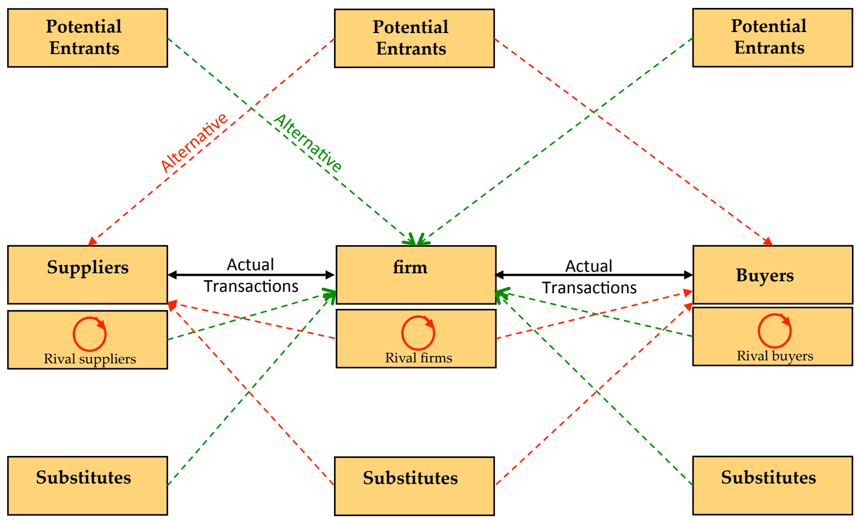

Figure 1: A Balanced, but Tangled, View of the *one* Force of Competition

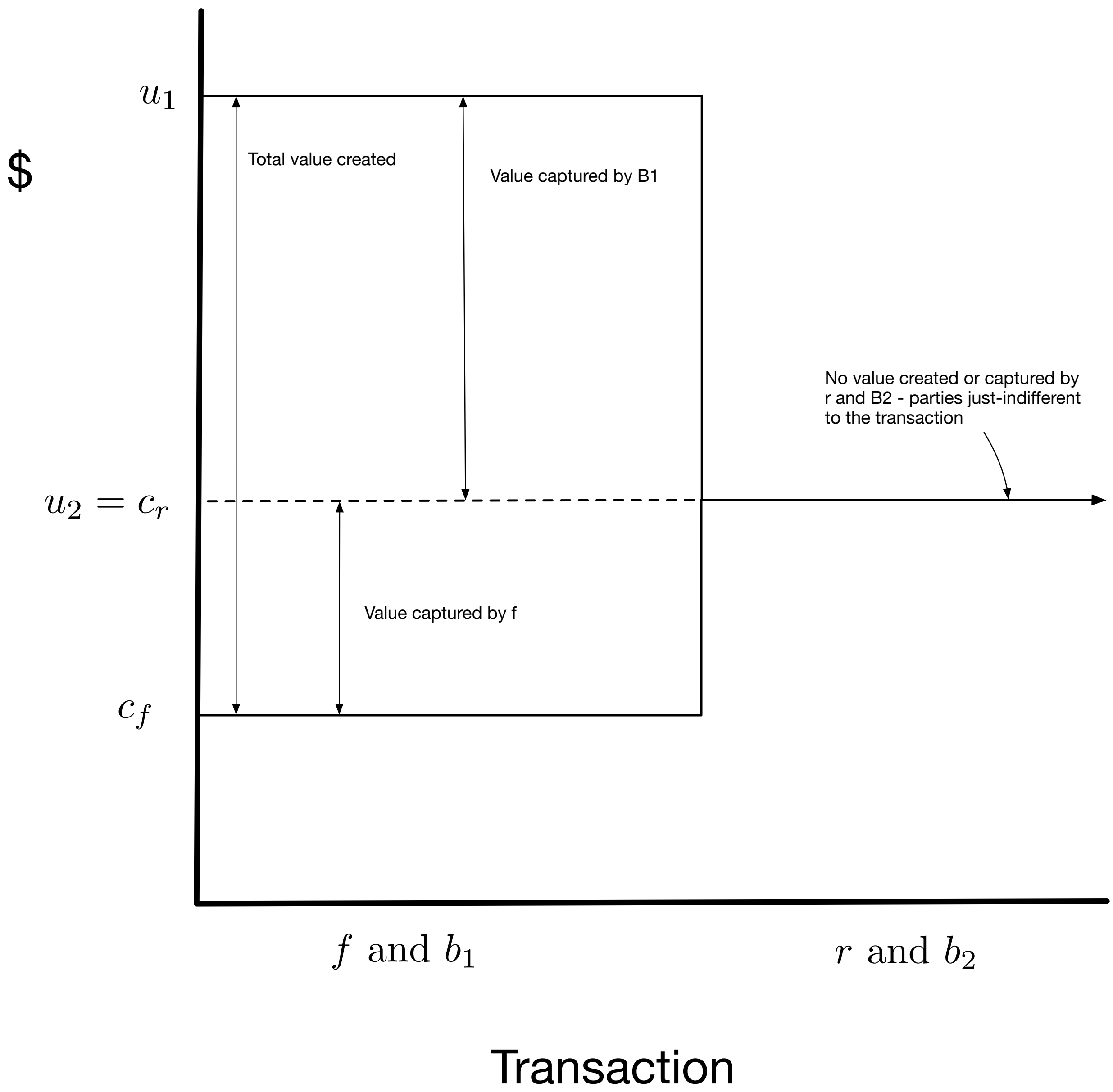

Figure 2: Value created and captured, f and r transact with b_1 and b_2, respectively