

SPECIAL ISSUE ARTICLE

A property rights theory of competitive advantage

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Research Summary: This article proposes a formal organizational economics approach to strategic management. Using a Property Rights Theory (PRT) framework, it rationalizes and provides a constructive contribution to two of the main strategy theories: the Resource-Based View (RBV) and Porter Generic Strategies (PGS). The article shows that the welfare maximizing PRT conditions that characterize the existence and boundaries of a firm parallel both the RBV and Porter conditions for a sustainable competitive advantage, and provides a formal rationalization of Barney's categorization of resources and Porter's generic strategies. The article reveals some underexplored aspects of current informal theories, and extends their scope with the integration of strategic networks of complementors and social welfare considerations, opening up new avenues for research.

Managerial Summary: This article brings two new insights for managers. First, showing that a firm can garner rents when it is a socially optimal form of organization for the assets it controls, it rationalizes the importance of control and adds a social welfare perspective to strategy. The Resource-Based View (RBV) and Porter Generic Strategies (PGS), besides theories of competitive advantage, can also be viewed as theories of control. Second, taking into consideration the growing importance of networks and complementors in the knowledge economy, this article highlights the strategic importance of two resource characteristics—collaborative and easy to combine—and opens up new doors for the consideration of two business strategies for managers—platform and coordination—in addition to the traditional cost, differentiation, and focus strategies.

KEY WORDS

competitive advantage, porter generic strategies, property rights theory, resource-based view, strategy theory

“Essentially, all models are wrong, but some are useful.” (Box & Draper, 1987, p. 424)

1 | INTRODUCTION

This article formalizes a theory of control that parallels theories of competitive advantage and offers extension and correctives to prior work. Current prominent strategy theories, in particular, Porter's Generic Strategies (PGS; Porter, 1985, 1996) and the Resource-Based View (RBV; Barney, 1986, 1991; Peteraf, 1993; Wernerfelt, 1984), have been refined over time to provide an analysis of the sources of competitive advantage. While useful, these theories still present several shortcomings, and there is a need for a different approach that provides formalism, clear definitions and analytic precision (Priem & Butler, 2001), integrates the existence of value nets (Brandenburger & Nalebuff, 1996) and strategic networks of complementors (Gulati, Nohria, & Zaheer, 2000), and takes into account the social consequences of strategic actions (Barney, 1991; Porter, 1981). Building on the modern Property Rights Theory (PRT; Grossman & Hart, 1986; Hart & Moore, 1990), this article draws a parallel between securing control and sustaining a competitive advantage, formalizes a theory of control that integrates those aspects, and positions it against the prominent strategy theories. The systematic character of mathematical modeling reveals underexplored aspects of current informal theories, opening up new avenues for research.

There have been many attempts at linking organizational economics theories, such as PRT or Transaction Costs Economics (TCE; Williamson, 1985), to strategy management theories, such as RBV or PGS. Whereas the first group is considered theories of the firm concerned with the existence and the boundaries of the firm, the second type is viewed as theories of competitive advantage more concerned with the creation of economic rents and the question on why firms outperform others. The first type is governance-based, whereas the second type is competence-based (Makadok, 2003; Williamson, 1999). Although those theories focus on distinctive problems, have their own specialized language, and attend to different goals, parallels exist between those streams, which are closely linked (Mahoney & Pandian, 1992).

For Mahoney and Qian (2013, p. 1020), “there is a shared organizational logic [between TCE, PRT, Real options, and RBV] that enables us to coherently tie various strands of the research literature into one cord.” They suggest that recombining market frictions from different theoretical streams may advance theory development in the strategic management field. The concepts of asset specificity and opportunism as well as the contractual and incentives approaches brought about by PRT and TCE are necessary not only for understanding the existence of the firm and its boundaries (Foss, 1996), but also to explain the rent-generating firm achieving a competitive advantage (Mahoney, 2001). Among the theories of the firm, we choose to build on PRT because it is a formal

theory of control¹ (Gibbons, 2005). Formal models have value for both theory and empirical work. They check the internal consistency of informal arguments, help to specify empirical tests, and allow pushing the analysis beyond the limits of informal approaches² (Gibbons, 2005).

Combining the market frictions characterizing the three theories, the present article uses formal theory to generate insights about factor markets and product markets under the assumption of value nets. It investigates the link between the sustainability of firm existence and the sustainability of its competitive advantage, and argues that a firm garners rents when it is a socially optimal form of organization for the assets it controls. RBV and PGS, beside theories of competitive advantage, can also be viewed as theories of control. The model provides a formal rationalization of Barney's (1991) categorization of resources and Porter's (1985) generic strategies, and reveals some underexplored aspects of current informal theories, opening up new avenues for research in strategic management theory.

2 | THEORETICAL BACKGROUND

2.1 | Combining market frictions

In the RBV, a firm is a bundle of complementary and specialized resources and capabilities. The set of core resources and capabilities that are scarce, valuable, and difficult to imitate and substitute bestow the firm's competitive advantage (Barney, 1991) and are the sources of economic rents. For Porter (1980), firms compete within industries characterized by the firms that produce close substitutes. Given the industry structure and the "five forces" that determine its profitability, a firm should pursue one of three possible generic positioning strategies—cost, differentiation, and focus—to build a competitive advantage (Porter, 1985).³ RBV, on the other hand, identifies strategic resources that can be used to base the firm's strategy on (Barney, 2001b). Resources are not valuable in and of themselves, but because they allow firms to perform activities that create competitive advantages in particular markets. Indeed, resources link strategy and competitive advantage as managers operationalize firm strategy through resource management decisions. We will not argue here about the respective merits of RBV and PGS (see, e.g., Barney, 1991, 2001b; Porter, 1991; Priem & Butler, 2001; Spanos & Lioukas, 2001; Williamson, 1991), but will just consider that firms can both choose their resources and choose how to invest on their resources (their strategies), deriving their competitive advantage from either external industry sources or from internal resources and capabilities (Gulati et al., 2000).

In the economic theory of the firm, especially PRT, the firm is a nexus of contracts where "property rights, incentives and contracts occupy a central stage" (Foss, 1996) and ownership of an asset provides residual rights of control. PRT brings a formal approach and focuses on *ex ante* incentives to invest in a context of contract incompleteness.

Those two approaches—theories of the firm and strategic theories—are complementary (Kim & Mahoney, 2002; Mahoney & Pandian, 1992) and "any effort to understand success must rest on an

¹Gibbons (2005) compared four theories of the firm. PRT and incentive-system theory are formal theories and focus on *ex ante* incentive alignment, whereas TCE and adaptation theory are informal and focus on *ex post* decision governance, but incentive-system focuses on incentives, whereas PRT blends incentives and control. PRT requires noncontractible specific investments *ex ante*, while TCE is compatible with contractible specific investments *ex ante*, and adaptation theory requires noncontractible *ex post* decisions.

²However, formalization may obscure some of the central ideas of an informal theory (Gibbons, 2005).

³Porter's work encompassed two separate causal mechanisms (Makadok, 2010, 2011; Makadok & Ross, 2013): rivalry restraint at the industry level (five forces; Porter, 1980) and competitive advantage at the firm level (generic strategies; Porter, 1985). We focus here on the second aspect.

TABLE 1 Comparison of the three theoretical frameworks

	PRT	PGS/RBV
Market frictions	Asset specificity	Resource complementarity/heterogeneity
	Contract incompleteness	Bargaining power (PGS)
Theories	Theories of the firm	Strategy theories
Explain	Existence and boundaries of firms (existence relative to the market)	Superiority of firms (existence relative to other firms)
Concept	Socially optimal control of assets (value higher than if another firm would control the asset)	Sustained competitive advantage (SCA) (value higher than what can be achieved by marginal competitor)
Commonality	Increasing welfare implies that assets are controlled by the firm that can make the best use of them over the long run, that is, the firm that can build a SCA	If the firm generates rents in the long run, it creates value and justifies its existence. Firms with a SCA are less likely to surrender control over their resources

underlying theory of the firm and an associated theory of strategy." (Porter, 1991, p. 95). Both RBV/PGS and PRT are concerned with market frictions, which impede market efficiency and explain why firms exist and why firm-level rents are realized. By combining market frictions, theories typically regarded as informing the organizational boundary question can be used to explain economic rents, and theories regarded as informing the economic rents question can help explain organizational boundary questions (Mahoney & Qian, 2013).⁴ This article develops a theory that combines the market frictions from PRT—asset specificity and contract incompleteness—to those of RBV/PGS—resource heterogeneity, resource complementarity, and bargaining power⁵ (Table 1).

PRT integrates market frictions and transaction costs such as asset specificity and contract incompleteness. Asset specificity is a necessary condition for isolating mechanisms that sustain rents (Rumelt, 1984) and a firm can achieve a sustainable competitive advantage (SCA) precisely because it reduces opportunistic behavior and allows for firm-specific investments (Mahoney, 2001). Moreover, PRT focuses on the agents/firms' incentives to invest in a context of contract incompleteness. This is important because, in most cases, the efforts of the parties involved are not observable or verifiable, so the incentive problem cannot be solved by a (complete) contract. In the presence of uncertainty and incomplete contracts, firms must make investments on these assets today whose future return will depend on their bargaining position tomorrow. Hence, a way for the firm to protect its investment is to secure control on its strategic assets through ownership. PRT brings a corporate governance perspective to strategy. Corporate governance and the ability to incentivize management may be a source of competitive advantage (Barney, 2001a). Resources require that incentives to invest and produce effort be fostered (Castanias & Helfat, 1991) and governance choices have a significant impact on how rents created through strategic resources are appropriated (Barney, 2001a). The PRT also adds to the RBV by considering other aspects to ex post competition such as hold up, bargaining power, or outside options (Foss & Foss, 2005), and by investigating the optimal ways of allocating property rights in response to transaction costs since competitive advantage depends on transaction costs (Foss & Foss, 2005).

The present article shows that the welfare maximizing PRT conditions that characterize the existence and boundaries of a firm parallel both the RBV and PGS conditions for a SCA. Overall, the separation between the existence of the firm relative to the market and its existence relative to other

⁴Grahovac and Miller (2009, p. 1193) went even further: "a more complete theory is not attainable simply by combining the extant approaches but likely requires the development of a unifying framework."

⁵The main market frictions of RBV and PGS are well known and will not be developed here. In the RBV, the main sources of firm heterogeneity are inherent to efficiencies of resources (Peteraf, 1993) and differences in resource complementarities (Dierickx & Cool, 1989). In PGS, market structure elements and bargaining power of the different agents play a key role.

firms “is a nonissue” (Foss, 1996).⁶ The set of market frictions that explain sustainable economic rents in RBV or PGS is sufficient to explain the existence and boundaries of the firm in PRT (Mahoney, 2001; Makadok, 2003); after all, if the firm generates rents in the long run, it creates value and that justifies its existence. Moreover, the conditions that explain the existence (and long run survival) of a firm in PRT are sufficient to explain its ability to generate sustainable rents, as determined by RBV and PGS. Indeed, increasing welfare for the PRT implies that property rights on resources are allocated to the agents that can make the best use of them over the long run, that is, to those that can build a SCA. This result can be interpreted as describing a “post-shakeout” equilibrium. In a new industry, there is usually an initial period of disequilibrium where resources are distributed widely among a larger set of entrants than the market can ultimately support. Some of them cannot survive the resulting competition, which then produces a “shakeout” period that redistributes resources from failing firms to survivors, thereby concentrating resources to fewer firms in the subsequent equilibrium.

2.2 | Overcoming weaknesses of current strategy theories

2.2.1 | Value net, complementors, and strategic networks

Firms compete in a *value net* (Brandenburger & Nalebuff, 1996) composed of competitors with substitute assets, but also firms with complementary assets, that is, other firms in the value chain (e.g., suppliers, distributors) and complementors—sellers of complementary goods (Nalebuff & Brandenburger, 1997). Complements are important because coordinated investments on complementary assets may yield to lower costs and higher returns compared to the sum of uncoordinated investments (Milgrom & Roberts, 1990), and to positive externalities and network effects,⁷ leading to competitive advantage and increased welfare. “Thinking in complements is a different way of thinking about business, it is about finding a way to make the pie bigger rather than fighting with competitors over a fixed pie” (Brandenburger & Nalebuff, 1996, p. 24).

Nevertheless, extent strategy theory does not integrate the full potential of complementarities. PGS focuses on interrelationships within the value chain and among a firm’s business units or activities (Porter, 1985; Porter & Siggelkow, 2008), and the discussion on complementary products is mostly focused inward. The RBV insists on the complementarity of resources to create firm value, but the traditional framework deals with competitive advantage resulting from complementary resources controlled by a single firm (Barney, 1991; Dierickx & Cool, 1989; Wernerfelt, 1984).

An extension of the RBV, the relational view, explains that a competitive advantage is essentially based on network relations and that firms should look for complementarity in their network, see their network as a resource, and manage it (Ahuja, 2000; Dyer & Singh, 1998; Gulati et al., 2000). Since the 2000 *Strategic Management Journal*’s special issue calling for incorporating a relational or network perspective into the mainstream of strategy research, some progress has been made in that direction (see, e.g., Boudreau & Jeppesen, 2015; Dyer & Hatch, 2006; Lavie, 2006; Zaheer & Bell, 2005). Nevertheless, the dominant strategic frameworks have been little affected because the relational view takes a parallel and complementary approach (Dyer & Singh, 1998), focusing on the

⁶For Foss (1996, p. 474), the concepts of asset specificity and opportunism as well as the contractual and incentives approaches brought about by PRT and TCE can explain both the existence of the firm relative to the market and its existence relative to other firms. Foss argued that, in this sense, Conner’s (1991, p. 139) separation of the two aspects is a nonissue.

⁷Network effects arise when consumption benefits depend positively on the total number of consumers who purchase compatible products (Farrell & Saloner, 1985; Katz & Shapiro, 1986). Network effects generate interesting strategic effects and “traditional principles of strategy, while helpful, need to be supplemented to account for the peculiar economics of network effects” (Shapiro & Varian, 1999, p. 14).

network instead of the firm and on collective interorganizational rents rather than competitive firm rents; network—not firm—resources lead to a competitive advantage (Gulati et al., 2000).

However, the relational capabilities of a firm and its resource compatibility and complementarity with the network might themselves be a source of competitive advantage, different from value, rareness, and inimitability. Similarly, firms might design their strategies to maximize the benefits they extract from their embeddedness in a network of complementary assets, a type of strategy very different from cost or differentiation.

2.2.2 | A social welfare perspective

Organizational economics theories have a social focus (i.e., increasing welfare), whereas strategy theories are concerned with private performance (Porter, 1981). Yet, if earlier strategy theorists abandoned the social welfare concern right away to focus on the competitive advantage of a particular firm (Porter, 1980), RBV tenants consider that exploiting resource advantages is behaving in an efficient and effective manner and contributes to maximizing welfare (Barney, 1991). In the RBV, a competitive advantage is sustained if it continues to exist after efforts to reduce or duplicate it have ceased (Barney, 1991) or when all possible feasible resource transfers that create value have taken place, leading to a *strategic equilibrium* where total surplus is maximized (Lippman & Rumelt, 2003). Although the frameworks' assumptions are different, this RBV notion of strategic equilibrium parallels the search for welfare maximizing equilibrium in the PRT, where resources are bargained over by firms and, at equilibrium, ownership of a resource goes to the firm that can make the best—most efficient—use of it.

Controlling the “right” resources and implementing a clear corporate strategy is not enough. A firm should also justify ownership of a business (Collis & Montgomery, 1998), requiring that the value created be greater than which could be achieved if the business were generated by another firm. A competitive advantage can only be sustained if the firm creates more value with the asset than any alternative governance structure (Saloner, Shepard, & Podolny, 2001); otherwise, the asset would be bought by another firm that would make better use of it as there would be gains from trade to be shared between the seller and the buyer. Firms with a SCA are less likely to surrender control of their assets.

We adopt the following definitions. A firm is the *optimum owner* of its resource if it is the owner at equilibrium, that is, if transferring ownership to another firm would not increase value creation (welfare)—it is socially efficient for the firm to own the resource. A *competitive advantage* is obtained by the ability to create more total surplus and be more efficient than the marginal (least efficient) competitor capable of breaking even, which implies that a competitive advantage may be held by several firms in a given industry (Peteraf & Barney, 2003). This formalization of competitive advantage as superior value creation provides a simple and yet compelling foundation for strategy theorizing (Adner & Zemsky, 2006, p. 234). It is now clear that a firm will have a SCA with a resource when it is its optimum owner (Collis & Montgomery, 1998), drawing a parallel between keeping control and sustaining a competitive advantage, and a marginal competitor in an industry is never the optimum owner of any resource at the “post-shakeout” equilibrium.

2.2.3 | Formalism

Advances in strategy theory have often relied on industrial organization or organizational economics, but formal developments are scarce despite calls from several scholars (Brandenburger & Stuart, 2007; Foss & Foss, 2005; Lippman & Rumelt, 2003; Priem & Butler, 2001). Formal modeling is necessary to further (Foss & Foss, 2005) or unravel (Peteraf & Barney, 2003) the RBV, to increase the analytic precision and testability of strategy theories (Brandenburger & Stuart, 2007; Lippman &

Rumelt, 2003; Porter, 1981; Priem & Butler, 2001), to provide sharper definition of terms such as competitive advantage (Peteraf & Barney, 2003), to uncover implicit assumptions in existing theory (Foss & Knudsen, 2003), to conceptualize resources and capabilities (Kim & Mahoney, 2002, 2005), and to help integrating the RBV with strategic theory that is more concerned with the external environment such as PGS (Foss & Foss, 2005).

However, formal developments are lacking in the strategy literature.⁸ Noticeably, most PRT-inspired papers in strategy develop interesting but informal theoretical arguments without using the formal approach of the modern PRT. Yet, the tools used by the modern PRT—bargaining and game theory—can improve both the RBV, by providing a way to deal with co-specialized unpriced resources that are at the heart of strategy (Lippman & Rumelt, 2003), and PGS, by producing a model of competitive interaction (Porter, 1981) that offers a direct analysis of the power of the different agents and of how the value is created and the pie divided among them (Brandenburger & Stuart, 2007).

Combining a competitive stage and a cooperative stage (using cooperative game theory—CGT), this article is nevertheless distinct from most of the recent biform game and CGT-based strategy literature (Brandenburger & Stuart, 2007; see Gans & Ryall, 2017, for a survey) that tends to focus on the last-stage, CGT part of the model (Gans & Ryall, 2017) and uses the core as a solution concept (e.g., Chatain & Zemsky, 2011; Lippman & Rumelt, 2003; MacDonald & Ryall, 2004). Here, the first stage is critical as we study how the resource holder's preliminary strategic decisions depend on her expectations of value creation and capture in the later stages. Moreover, given that the core may not be a compelling solution since many real-world games have empty cores (Lippman & Rumelt, 2003), we follow most of the PRT literature in using the Shapley value as a solution concept, which provides more clear-cut results.

3 | MODEL AND ASSUMPTIONS

We follow Hart and Moore (1990; HM) and consider an industry with a set $N = \{1, \dots, n\}$ of risk-neutral firms and a set $A = \{a_1, \dots, a_n\}$ of strategic resources. Resources include all assets, capabilities, or firm attributes controlled⁹ by a firm, which enable the firm to conceive and implement strategies that improve its efficiency and effectiveness (Barney, 1991), and each “resource” a_i can be seen as a unique resource or a bundle of co-specialized resources. In the initial endowment, each firm i owns a resource a_i , and resources are heterogeneous with respect to their efficiency. Resources are complementary and combining them creates value. Firms/agents are opportunistic and resources/investments are specific (or co-specialized) in a sense that the value generated by investing on combined resources is lower outside the relationship or in alternative uses. Hence, control over resources is important to avoid being “held-up” after investment.

Figure 1 illustrates the timing of the model.

There are three stages: (1) a resource building stage in which each firm independently chooses its resources or its positioning strategies, (2) a resource recombination stage in which firms cooperatively redistribute ownership and control to maximize value creation and total welfare, and (3) a resource deployment stage in which firms noncooperatively choose their investment level to maximize their individual value capture.

⁸Makadok (2001, 2003), Lippman and Rumelt (2003), or Brandenburger and Stuart (2007) are exceptions.

⁹Control is important because it allows the controlling party to dictate how the asset is used (Gibbons, 2005). This is especially important in presence of asset specificity as it allows the controlling firm to dictate (and benefit from) the use of the asset in alternative relationships, should the present relationship end up. In PRT, control is provided by ownership, and in this article, the words *control* and *ownership* are used indifferently.

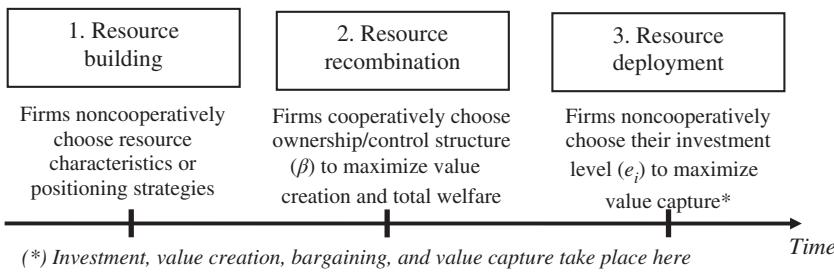


FIGURE 1 Timing of the model

3.1 | Resource deployment (stage 3)—Maximizing value capture

Agents create value by investing their human capital and deploying their resources on the product market. The level of investment of each firm depends on their anticipation of the value they can capture given the prevailing distribution of resource ownership.

The value generated by a coalition $I \subseteq N$ controlling a set of resources $A \subseteq \underline{A}$ is given by $v_I(A|e)$, where $e = (e_1, \dots, e_n)$ is the vector of ex ante investments undertaken by the firms of N . Coalition I 's marginal return on firm i 's investment¹⁰ is given by $\partial v_I(A|e)/\partial e_i \equiv v_I^i(A|e)$. The only difference with the HM model is that, here, resources can be complementary or substitute at the margin (more on this below). We keep all HM's technical assumptions (slightly relaxing their Assumption 6 to cope with substitute resources¹¹), and like them, focus on human capital investment, only affecting the value of coalitions of which the firm is a member: $v_I^i(A|e) = 0$ if $i \notin I$. Contracts are incomplete, and besides ownership, agents cannot contract on other variables such as their level of investment. Once ownership is allocated, production takes place and the surplus is shared by the firms through an ex post efficient bargaining process, using the Shapley value.¹²

Given a distribution of ownership β , firm i 's share of total value (i.e., the value it can capture), anticipating that the ex post value will be shared through bargaining, is:

$$B_i(\beta|e(\beta)) = \sum_{I|i \in I} p(I)[v_I(\beta(I)|e(\beta)) - v_{I \setminus i}(\beta(I \setminus i) | e(\beta))], \quad (1)$$

¹⁰This formulation is adopted rather than HM's *firm i's marginal return on its investment in coalition I* to make the distinction between the agent's and the coalition's returns clearer (HM distinguish between the agent's marginal return of investment in a coalition and the agent's private marginal return of investment).

¹¹We keep their Assumptions 1–5, in particular, the marginal return without any resource is equal to zero, the cost functions $C_i(e_i)$ are convex in e_i , the value function is concave in e , and superadditive ($v_I(A|e) \geq v_I(A'|e) + v_{N \setminus I}(A \setminus A'|e)$), and investments are complementary ($\partial v_I^i(A|e)/\partial e_j \geq 0$). Assumption 6 is partly relaxed ($v_I^i(A|e) \leq v_I^j(A|e) \leq v_N^i(A|e)$, $\forall I \subseteq I'$, $\forall A \subseteq \underline{A}$, as in Bel (2013), to cope with assets that can be substitute at the margin (see below), whereas HM requires systematic complementary at the margin; either way, the same underinvestment results. These assumptions ensure that combining resources creates value, driving the need to access other resources (superadditivity) and to increase investment (Assumption 6), providing a role for ownership to efficiently increase investment incentives.

¹²In CGT, the Shapley value (SV) gives any firm in the bargaining game its expected contribution (its added value) to all coalitions to which it may belong. We use the SV to stick to the HM framework, but our results would generalize to any fixed probabilistic distribution of the value. Furthermore, adding a convexity condition would make this superadditive game supermodular and the set of random-order values resulting from probabilistic distributions would then coincide with the core. Besides the advantages of using the SV over the core mentioned earlier (more clear-cut results and avoidance of empty-core situations), the SV has a noncooperative justification, as noncooperative bargaining games may give rise to the SV (see HM).

where $p(I) = (\#I - 1)! (n - \#I)! / n!$ are the coefficients of the Shapley value, and $\beta(I)$ are the resources owned/controlled by coalition I . Each firm then noncooperatively sets its investment level to maximize value capture net of investment costs $C_i(e_i)$:

$$R_i = \sum_{I|i \in I} p(I)[v_I(\beta(I)|e(\beta)) - v_{I \setminus i}(\beta(I \setminus i) | e(\beta))] - C_i(e_i(\beta)). \quad (2)$$

We obtain the following result (as in Proposition 1 in HM).

Result 1 *Given a distribution of ownership β , the Nash equilibrium level of investment $e^*(\beta)$ that maximizes value capture for each firm is characterized by the first order conditions $\frac{\partial B_i(\beta|e^*(\beta))}{\partial e_i} = \sum_{I|i \in I} p(I)v_I^i(\beta(I)|e^*(\beta)) = C'_i(e_i^*(\beta))$ for all firms; it is unique and entails lower levels of investment than the first best (there is underinvestment).*

Result 1 shows that there is a unique self-enforcing investment equilibrium for each β , determined by the maximization of value capture by each firm.

3.2 | Resource recombination (stage 2) – Maximizing value creation

Firms have a tendency to underinvest relative to a welfare-maximizing Pareto optimum (a first-best situation where the agents cooperate to maximize overall welfare) because some of the benefits from their investment may be dissipated in future bargaining. A reallocation of ownership may mitigate this underinvestment and (as in HM) we obtain this result.¹³

Result 2 *If changing the distribution of ownership β results in an increase of every firm's marginal return at any level of investment, then the equilibrium investment and the total value created increase.*

Firms endowed with initial resources can create value by recombining resources (Lippman & Rumelt, 2003), in particular, by acquiring additional resources on strategic factor markets (SFMs) (Barney, 1986; Dierickx & Cool, 1989; Makadok & Barney, 2001) or by acquiring the firms that own them on the market for corporate control (Jensen & Ruback, 1983). Superior performance is based on a firm's ability to create and capture value (Saloner et al., 2001) and firms are interested in increasing value creation as it increases the potential for value capture. Efficiency is the best strategy (Williamson, 1991) and the potentially appropriable share of a larger surplus will exceed the appropriable share of a smaller surplus. If the initial endowment does not maximize value creation, then a firm can propose a new distribution of ownership β that increases value such that everyone is better off. The firms cooperatively redistribute ownership, and when all possible resource transfers that create value have taken place, the firms reach a “post-shakeout” equilibrium in which value created is maximum. β then describes the distribution of ownership, that is, which firm owns (controls) which asset. It is the result of inter-firm asset transfers, through which firms acquire resources from

¹³Comparing value creation under different ownership allocations boils down to a problem of comparative statics in which the endogenous equilibrium investment levels by all firms e^* are a function of the exogenous parameter β . The total value created and the value added of each firm are important here, not so much the value that a firm could generate independently. Result 2, similar to HM's Proposition , provides a convenient (ordinal) way of comparing investment equilibria (see Milgrom & Roberts, 1994) and value creation under different ownership allocations. Alternatively, the impact of β could be assessed by comparing the relative effect of each firm's investment on all potential acquirers and resorting to one on one comparisons between firms' investments. Given the endogeneity of investments, this goes beyond our scope.

other firms because acquirers have a better ability to generate rents.¹⁴ Ownership is contractible, and can be enforced ex post. In stage 2, the industry adopts the optimal β to maximize returns.

3.3 | Resource building (stage 1) – Choosing or positioning resources

In this stage, each firm noncooperatively chooses its resources and positioning strategies in order to maximize value creation in the next stage while protecting its bargaining power through ownership and control, that is, ensuring it will remain the optimum owner. Indeed, firms position themselves for value appropriation long before their capabilities are fully developed and make decisions that balance value creation potential against rent appropriation (Coff, 2010). However, the type of resource synergies affects marginal returns, and hence, the conditions for becoming an optimum owner.

Although resources are complementary (an additional resource increases the overall value produced *for a given level of investment*), they may be substitute at the margin, that is, an additional resource may decrease the *marginal* return of investment. Indeed, two assets are generally viewed as complementary [substitutes] when the *marginal* return with one asset increases [decreases] in the presence of the other (Milgrom & Roberts, 1990). Substitution (henceforth, we often omit the terms *at the margin* to simplify the exposition) may occur because merging the assets generates costs of coordination or because the presence of an additional asset crowds out the incentive to invest (Bel, 2013).

4 | SUBSTITUTE RESOURCES

We first make the following assumption.

A1: Resources are substitutes at the margin, that is, $v_I^i(\{a_n, a_m\} | e) \leq v_I^i(a_m | e), \forall I \ni i, \forall i, a_m, a_n$.

This leads to the following result (the proof is in the Appendix).

Proposition 1 *When assumption A1 holds, a firm i will be the optimum owner of a resource a_i at equilibrium if:*

$$(i) \quad v_{\{i\}}^i(\{a_i\} | e) \geq \frac{n-2}{2} \max_{A, I} [v_I^i(A | e) - v_I^i(A \cup \{a_i\} | e)], \forall A, I$$

$$(ii) \quad v_I^k(A | e) - v_I^k(A \cup \{a_i\} | e) = v_{I'}^k(A' | e) - v_{I'}^k(A' \cup \{a_i\} | e), \forall k \neq i, \forall a_k, \forall I, I', \forall A, A' \ni a_k.$$

A firm maximizes value creation and value capture with its resource if the marginal return of *all* firms is higher when it controls the resource (Result 2). It is the optimum owner of the resource and another firm would not generate more surplus by taking ownership. In a world of substitute resources, it is always best for a firm—say j —not to take control of the substitute resource a_i of another firm i . In addition, the first and second conditions ensure, respectively, that it is best for firm

¹⁴Although trading markets might not necessarily be efficient (see, e.g., Gans, 2005), we follow both HM and Lippman and Rumelt (2003) in assuming efficient trading of resources, since our emphasis is on the parallelism between the PRT and strategy theories. Relaxing this assumption might nevertheless provide a fruitful direction for further development.

i and for other firms (different from i and j) that i keeps control on a_i . In condition (i), the left-hand-side of the inequality represents the individual marginal return of firm i with its resource, the right-hand-side represents the maximum level of substitution between a_i and any other set of resources A , the coefficient $(n - 2)/2$ aggregating the probabilities of belonging to coalitions with other firms.¹⁵ In condition (ii), the substitution effect of a_i with the resource a_k of a firm k must be independent of other firms and resources to ensure the neutrality of k .

The above conditions are sufficient to legitimate ownership by the focal firm, but might not be unique. They characterize at least one, but not necessarily all, of the distributions of control that maximize value creation. Moreover, a firm might be indifferent to be the optimum owner since it would be compensated anyway in case of loss of ownership. However, when a firm chooses its resource (or positioning), it might as well choose it for being the optimum owner at the welfare maximizing equilibrium.

4.1 | Positioning strategies

To draw a parallel between the PRT-based framework and PGS, the focus will move from becoming the optimum owner into obtaining a SCA, and in particular, to the sources of competitive advantage. This involves the actions that the firm takes to create the most value *with* its resource, which necessitates to own the resource in equilibrium. We acknowledge that maximizing profit does not necessarily involve developing a SCA and that an exit strategy can sometimes be a viable alternative. Yet, “the fundamental basis of above-average performance in the long run is *sustainable competitive advantage*” (Porter, 1985, p. 11) and “the strategic mandate to business units should be to achieve competitive advantage” (Porter, 1985, p. 26). It is conceivable that a firm aiming at maximizing profit tries first to build a SCA and become the optimum owner of its asset.¹⁶ If that fails, the firm will resort to an exit strategy, selling the asset on the SFM market or selling itself on the market for corporate control.¹⁷

Firms use the resources they control to conceive and implement value creating strategies that improve their efficiency and effectiveness (Barney, 1991; Porter, 1981). Hence, to translate the results of the PRT-based framework into insights for PGS, we investigate the case in which firms endogenously choose their positioning strategies, given an exogenous endowment of resources. Although the focus is on the sources of competitive advantage at the firm level (Porter, 1985) rather than at the industry level (Porter, 1980), industry and market power considerations are still present in the PGS approach. Positioning may involve an action on firm as well as industry characteristics, and a firm can contribute to actively structure its industry, sometimes taking a strategic rather than

¹⁵This condition compares the marginal return of player i in his outside option alone with his marginal return in all other possible coalitions with or without the asset, to maximize R_i . It applies to cases where the focal asset does not necessarily require other assets to be productive ($v_{\{i\}}^i(\{a_i\}|e) > 0$), but also to cases where it does ($v_{\{i\}}^i(\{a_i\}|e) = 0$). In the latter case, the condition can still be realized, provided that the asset is not substitute to any other asset (as is the case in HM's yacht example; see the Appendix).

¹⁶There is ample evidence that firms are concerned about keeping control over their resources, often resisting selling them to other firms that could add value (Collis & Montgomery, 1998). Reasons range from inertia (Shimizu & Hitt, 2005), to the possibility of hold-up (Hart & Moore, 1990), or the risk of those resources being used against them in the product market (Asmussen, 2015; Chatain, 2014), or to managerial preferences for ownership (Williamson, 1991) due to entrenchment motives (Shleifer & Vishny, 1989), reputation concerns (Stein, 1988), the fear of losing jobs (Manne, 1965), or simply the pleasure of “enjoying the quiet life” with the existing assets (Bertrand & Mullainathan, 2003), leading them to develop defense tactics against acquisition by other firms (Harris, 1990).

¹⁷“When a firm's position is not ultimately sustainable, the best defensive strategy is to ‘take the money and run’.” (Porter, 1985, p. 512). Yet, exit can also be an element of entrepreneurial firms' strategy (Decker & Mellewigt, 2007), an alternative to competing on the market and developing a SCA (Cefis & Marsili, 2011).

an economic approach (Makadok & Ross, 2013), potentially leading to an inefficient equilibrium (see below), in contrast with PRT, which restrains its attention to efficiency.

Corollary 1a *In an industry with substitute resources (A1 holds), a firm i will have a SCA with a resource a_i if it follows one of the following positioning strategies:*

- i. *Maximizing the marginal return with the resource ($v_{\{i\}}^i(\{a_i\}|e)$).*
- ii. *Lowering the substitution with other resources ($\text{Max}_{A,I} [v_I^i(A|e) - v_I^i(A \cup \{a_i\}|e)]$).*
- iii. *Choosing an industry with the minimum number of firms ($n = 1$).*

In addition, the substitution of a_i with another resource a_k ($v_I^k(A|e) - v_I^k(A \cup \{a_i\}|e)$, $A \ni a_k$) must be independent of other firms and resources.

This is reminiscent of Porter's cost, differentiation, and focus strategies, but where Porter focuses on products and markets, our approach is concerned with investment on resources. However, by specifying an investment strategy on resources, an optimal product-market strategy can be developed. The Corollary reveals three types of strategies and a condition.

i. Increasing the marginal return on strategic assets

Firms competing in imperfect markets earn efficiency rents from the use of their resources (Caves, 1980), and here, efficiency is formalized by the marginal return of investment on resources. An efficient firm should not surrender control on its resources. Hence, a strategy for the firm could be to maximize the marginal return of investment on its resources.

ii. Lowering the level of substitution

The level of substitution $v_I^i(\{a_j\}|e) - v_I^i(\{a_ia_j\}|e)$ between two resources a_i and a_j somehow represents the amount of "overlap" or similarity between the resources. When two assets are closely related, for example, two overlapping sales channels, the advantage of controlling both assets is small and tends to be outweighed by coordination and monitoring costs. As the overlap gets larger, the negative resulting effect gets stronger. At the extreme, with a complete overlap, the marginal return $v_I^i(\{a_ia_j\}|e)$ with both resources is equal to zero and the substitution effect is maximum. Differentiation has the opposite effect. A differentiated asset, for example, a unique technology, brings a substantial additional benefit that more than compensates for additional coordination costs. At the extreme, a fully differentiated resource has no overlap with other resources (it is independent, i.e., $v_I^i(\{a_ia_j\}|e) = v_I^i(\{a_j\}|e)$) and the substitution effect is equal to zero. Thus, differentiation reduces the benefit of removing control from the firm.

iii. Minimizing the number of firms

Since the gains from bargaining are divided among the firms in the industry, a firm may increase the value it can capture with its resource by limiting the number of firms to which it is exposed. By selecting a focus strategy, it reduces the opportunities for substitution.

In addition to these strategies, the substitution with another resource must be independent of other firms and resources. Value creation is maximized if the focal firm follows one of the above strategies, *and* if no other firm would benefit from a transfer of control. If the substitution with another resource is independent of other resources and agents,¹⁸ the incentives of an agent k are insensitive to the transfer of control from i to another firm j , higher returns in the presence of i being compensated by lower returns in the presence of j . A transfer of ownership would not affect the investment of other (external) firms. With human capital investment, this is a relatively weak condition as the firms' investments are not embodied in the resource and only benefit the investor.

The above strategies parallel Porter's generic strategies, but raise several questions.

1. Strategizing or economizing? If stages 2 and 3 are all about efficiency and efficient equilibrium, stage 1 allows for "strategizing." Cost leadership strategy may involve using bargaining leverage or persuasive capabilities (Ryall, 2013) through purchasing policies for example, differentiation affects both rivalry restraint and efficiency (Makadok & Ross, 2013), and a focus strategy maximizes profit by limiting rivalry. Indeed, "strategic ploys can be used to promote economizing outcomes" (Williamson, 1991, p. 76).¹⁹
2. Should strategies be mutually exclusive as advocated by Porter with the "stuck-in-the-middle" hypothesis? Here, investment is one-dimensional and investing to increase efficiency may undermine differentiation, justifying Porter's assertion. However, hybrid strategies are sometimes efficient (Hill, 1988). Specializing on an essential asset (a_i is essential to i if $v_i^i(A \setminus \{a_i\} | e) \equiv 0$) is a way to decrease cost and increase differentiation at the same time. A firm specializing in servicing a particular brand of equipment (essential because the investment in learning the equipment would be lost should the firm not have access to it) may become particularly efficient at it while increasing its differentiation against other firms. The rationalization of hybrid strategies such as investment in quality (Prajogo, 2007), innovation, service, or lean manufacturing is left for further research.

4.2 | Resource characteristics

Beside their positioning strategies, firms may also choose the type of resources to own,²⁰ and in this second version of the model, resources characteristics are chosen endogenously.

If PRT and RBV both view asset specificity or complementarities as key to generate above-normal rents, the RBV, as a theory of the firm, does not necessarily require opportunism (Conner, 1991). This key PRT feature generates transaction costs in presence of incomplete contracts. The fear of hold-up prevents optimal investments in relation-specific assets to be realized, leading to a second-best efficient equilibrium, whereas the Lippman-Rumelt strategic equilibrium is first-best.²¹

¹⁸Even though interactions can be contextual, that is, they depend on other resources/activities (Porter & Siggelkow, 2008), traditional literature has generally assumed noncontextuality.

¹⁹Strategic behavior may lead to an efficient equilibrium, *given the new industry structure*, although it might not be the most efficient overall, as the focal firm may not internalize the effect of changing the industry structure on total welfare (e.g., raising barriers to entry might lead to a bigger share of a smaller pie). A promising extension would compare the marginal returns from strategizing and economizing in the first stage.

²⁰PGS and RBV are complementary as the type of resources controlled by a firm may determine the type of strategy (Barney, 2001b). However, "the link between resources and strategies is not always obvious, as several strategies may be consistent with a given set of resources" (Barney, 2001b, p. 53).

²¹Overall, the RBV entails a first-best equilibrium, whereas PGS does not necessarily generate an efficient equilibrium, and PRT is somehow in between, highlighting a second-best equilibrium given transaction costs.

Interestingly, we will see that the main RBV insights will not be significantly altered, confirming that the RBV framework does not rule out opportunism (Conner, 1991).

Corollary 1b *In an industry with substitute resources (for which A1 holds), a firm i will have a SCA with its resource a_i if a_i possesses the following characteristics:*

- i. *The marginal return with the resource ($v_{\{i\}}^i(\{a_i\}|e)$) is maximum.*
- ii. *There is a minimum number ($n - 1$) of substitute resources.*
- iii. *The substitution with other resources ($\text{Max}_{A,I} [v_I^i(A|e) - v_I^i(A \cup \{a_i\}|e)]$) is minimum.*
- iv. *The bilateral substitution with any other resource a_k ($v_I^k(A|e) - v_I^k(A \cup \{a_i\}|e), A \ni a_k$) is idiosyncratic to the two resources.*

These resource characteristics relate to the RBV framework.

- i. *The marginal return with the resource is maximized*

This reminds us the RBV, where resources are valuable²² when they enable a firm to conceive or implement strategies that improve its efficiency and effectiveness (Barney, 1991). However, even though the firm is relatively efficient, the right-hand-side of the inequality may be higher than the left-hand-side leading the firm to surrender control. Thus, the resource must also exhibit additional characteristics.

- ii. *There are a minimum number of substitute resources*

If the number of substitute resources is small (i.e., if the resource is rare), the firm's efficiency might compensate for the negative effect of substitution.

- iii. *The level of substitution with other resources is minimized*

Not only is the number of substitute resources relevant, but the level of substitution may also affect the likelihood of keeping control. To keep control, the substitution with other resources must be low enough, that is, the resource must be difficult to substitute.

- iv. *Bilateral substitution is idiosyncratic*

When bilateral substitution is idiosyncratic²³ to the two resources involved, that is, is unaffected by the presence of other resources and agents, the marginal return of external agents is insensitive to a change of ownership, as the losses in coalitions with new owners would be compensated by gains with previous owners. Again, this condition is likely to be satisfied in most environments with human capital investment.

²²Note that, here, the criterion for “value” is formally parameterized (the marginal return that the firm can generate with the resource), alleviating one of the main criticisms of the RBV (Priem & Butler, 2001).

²³We can draw a parallel with the notion of idiosyncratic bilateral synergy for complementary resources (Mahoney & Pandian, 1992), which occurs when the enhanced value is idiosyncratic to the combined assets.

These results resemble the value, rarity, and nonsubstitutability resource characteristics of the RBV. Their formalism alleviates the parameterization issue highlighted by some scholars (Priem & Butler, 2001), but raises other questions.

1. Can value be independent of organization? Here a resource is valuable if it is exploited efficiently by the firm, that is, if the marginal return of investment by firm i is high, and there seems to be little point separating the concept of value from the ability of the organization to exploit it (VRIO; Barney, 1995). Moreover, this resource value does not represent the value that the firm can capture, nor its competitive advantage or the value creation potential for the industry, which integrate the effect on the other firms, and a firm may not necessarily adopt a “valuable” resource if it can be easily substituted or imitated.²⁴
2. Number of substitute resources or degree of substitution? In the RBV, rarity, imitability, and substitution refer to the number of strategically equivalent resources, and describe *how* another resource became strategically close: because it was similar—not rare—at the origin or because it has become similar by imitation or substitution. Rather than focusing on the reasons that may lead to strategic equivalence, our framework highlights the result in terms of degree of substitution at equilibrium. A higher number of little substitute resources may sometimes be preferable to a smaller number of strong substitutes. The framework loses in descriptive power on the sources of competitive advantage, but gains in assessing the strength of the competitive advantage, provided that the degree of substitution can be operationalized (see, e.g., Makri, Hitt, & Lane, 2010). Whether it is more relevant for the practice of strategic managers remains to be seen.

Overall, the model partially rationalizes the VRIN framework (Barney, 1991). To generate a SCA, resources must be Valuable (making the firm efficient), Rare (with few substitute or similar resources), and difficult to Substitute (low level of substitution). However, absent complementarities, the difficulty to Imitate is pointless.

5 | SUBSTITUTE AND COMPLEMENTARY RESOURCES

Assumption A1 is now relaxed. In the general case, the presence of complementary assets changes the analysis, because now, owning two resources may increase marginal returns.

Proposition 2 *In the presence of n_c firms with complementary resources and $n - n_c - 1$ firms with substitute resources, a firm i will be the optimum owner of a resource a_i at equilibrium if, $\forall A, I$:*

$$(i) \quad v_{\{i\}}^i(\{a_i\} | e) + \frac{n_c - 1}{2} \underset{A, I}{\text{Min}} [v_I^i(A \cup \{a_i\} | e) - v_I^i(A | e)] \geq \frac{n - n_c - 1}{2} \underset{A, I}{\text{Max}} [v_I^i(A | e) - v_I^i(A \setminus \{a_i\} | e)]$$

$$(ii) \quad v_I^k(A | e) \equiv v_I^k(A \setminus \{a_i\} | e), \forall k \neq i.$$

²⁴This parallels the argument of Grahovac and Miller (2009), who showed that an innovative firm may not necessarily adopt a valuable resource because its profit potential may not be attractive due to imitation (their notion of competitive advantage is different from ours, though).

In an equilibrium perspective, the resource a_i of firm i at a given time is the set of resources controlled by the firm after ownership of a series of complementary resources have previously been transferred to the firm. At that point, the firm is the optimum owner and maximizes value if it satisfies the above conditions. Integrating complements leads to significant alterations in both RBV and PGS frameworks. In particular, a condition that the resource be irrelevant to the marginal return of other agents other than i is necessary to guarantee that the owner of a complementary resource will not have incentives to buy a_i .

5.1 | Positioning strategies

With complementary resources, the number of available strategies increases.

Corollary 2a A firm i will have a SCA if it raises barriers to imitation by other firms ($v_I^k(A|e) \equiv v_I^k(A \setminus \{a_i\}|e), \forall k \neq i$) and follows one of the following strategies:

- i. Maximizing the marginal return with a_i .
- ii. Lowering the level of substitution with other resources.
- iii. Choosing an industry with the minimum number of firms.
- iv. Maximizing the number of firms n_c with complementary resources.
- v. Increasing the complementarity with other resources ($\text{Min}_{A,I} [v_I^i(A \cup \{a_i\}|e) - v_I^i(A|e)]$).

The ability to complement other resources emerges as an important way to create a competitive advantage and it gives rise to two new types of strategies.²⁵ But complementarity also drives the need for barriers to imitation and replication. To mute the benefits of acquisition by the owner of a complementary resource, the focal firm should develop a proprietary approach by developing skills that are both advanced and proprietary enough to be beyond the capabilities of competitors, making policy choices to create proprietary products or processes, or developing special linkages or interrelationships, proprietary learning, substantial scale advantages, or other barriers to imitation that ensure the sustainability of a generic strategy (Porter, 1985, 1996). It could also make the activity strategy-specific and contextual to the firm, adding to the difficulty of imitation and replication (Porter & Siggelkow, 2008). As an alternative to barriers to imitation or duplication, the focal firm could as well develop barriers to acquisition.

In addition to the three strategies covered in the case of substitute resources, complementarity entails two new types of strategies.

- iv. Maximizing the number of firms with complementary resources

Firms exist in networks of complementary resources, vertically in the value chain (owned by suppliers or distributors) or horizontally (suppliers of complementary products, science partners, third parties such as professional associations, etc.), and there is an increasing number of studies showing the importance of networking strategies on the competitiveness of firms, and in particular,

²⁵In a chapter on “complementary products and competitive advantage,” Porter (1985) focused on how controlling complements (or bundling or cross subsidizing them) may increase competitive advantage in cost or differentiation. Light bulbs being complement to lamps, he discussed whether light bulbs have an impact on the differentiation of a lamp or the cost of marketing it, rather than studying whether making a lamp complementary to a maximum types of light bulbs might be a strategy susceptible to generate a SCA.

their ability to innovate (see Pittaway, Robertson, Munir, Denyer, & Neely, 2004 for a review). Among the owners of complementary resources, complementors are of special interest.

Complementors may foster the sales of the focal product and generate a competitive advantage. A firm may choose to develop its own complements—as IBM did with Linux or Google with software applications²⁶—or promote the development of complements by others—Apple’s apps spurred the success of iPhone and IBM’s encouragement to the peripheral and software development community to develop compatible products drove the success of IBM PC (Gandal, Greenstein, & Salant, 1999). A firm may also increase the number of links with existing complementors—the sales growth of start-up firms is associated with the number of links with venture capital firms (Lee, Lee, & Pennings, 2001)—or increase the number of complements indirectly when it makes its product or technology compatible through standardization with other competing products in order to benefit from network effects in a combined system of complements. This is the case when Sony and Philips adopt a common standard for CD players and license it quite liberally (Gandal, Kende, & Rob, 2000), or when a particular model of automobile uses standard parts and requires common repair skills, thus increasing the likelihood of a more extensive service network, which in turn, increases the customer willingness to pay for the model.

Maximizing the number of complements—a “platform” strategy—is different from cost or differentiation, for producing compatible designs may both raise production costs (Katz & Shapiro, 1986) and decrease differentiation. It may lead to a SCA even though the standard is not the most efficient and has several substitutes, as was the case for the QWERTY keyboard versus the Dvorak keyboard (David, 1985), or the IBM DOS operating system versus Apple O/S (Gandal et al., 1999). However, these platform strategies may sometimes generate a crowding effect and reduce investment incentives (Boudreau & Jeppesen, 2015), and a high number of collaborative agreements may increase the risk of redundancy, generating diminishing marginal returns on innovative performance (Deeds & Hill, 1996). Indeed, not only the number of complements, but also the level of complementarity may affect the ability to sustain a competitive advantage.

v. Increasing the level of complementarity

When assets are substitutes, differentiation decreases the similarity between them, and the negative effect of controlling both assets. When assets are complementary, coordination increases the complementarity between them, and the positive effect of controlling them.

This is what happens with partnerships or alliances that provide a competitive advantage, based on the ability to combine complementary, but scarce, resources or capabilities, typically through multiple functional interfaces (Dyer & Singh, 1998). For example, Toyota develops idiosyncratic interfirm linkages and maximizes the sharing of knowledge and know-how with a relatively small number of suppliers, which results in the joint creation of unique new products, services, or technologies. They even pay for consultants to improve the production methods of the suppliers and enhance the coordination with their own manufacturing process (Dyer & Ouchi, 1993). By increasing its dependence on these suppliers, it increases their incentives to make performance-enhancing investments in relation-specific assets (Dyer & Singh, 1998). This is in sharp contrast with a platform strategy and with the classical PGS framework, which would recommend increasing the number of suppliers to maximize network effects and bargaining power respectively.

²⁶In 2001, IBM invested \$1 billion to develop Linux, an open-source operating system, with the view of developing the sales of its core servers (that run Linux) and services, and Google develops software applications, online auctions, or telephone services, to promote the use of the Internet, and hence, drive the sales of its core Internet advertising business.

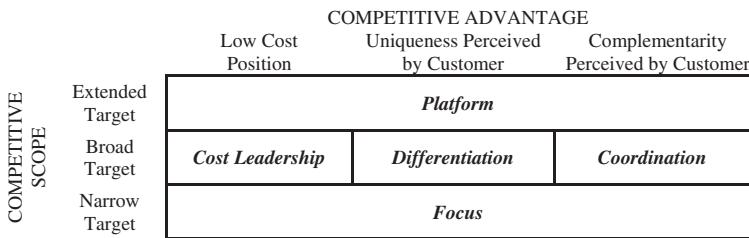


FIGURE 2 Extended Porter Framework

Overall, coordination increases the strength of the ties with owners of complementary resources rather than their number, and strong ties differ from weak ties on their effect on firm performance (Rowley, Behrens, & Krackhardt, 2000). Coordination is an opposite strategy to differentiation: Instead of reducing the negative impact of substitutes, it increases the positive impact of complements. Coordination may be preferred to differentiation when the later may hinder the adoption of new technologies as was the case for 56K modems (Augereau, Greenstein, & Rysman, 2006).

With these two new types of strategies—"platform" and "coordination"—Porter's framework can then be extended to display five different types of strategies (Figure 2).

5.2 | Resource characteristics

Corollary 2b A firm i will have a SCA if its resource a_i has the following characteristics:

- i. The marginal return with a_i is maximum.
- ii. There is a minimum number of substitute resources.
- iii. The substitution with other resources is minimum.
- iv. a_i is idiosyncratic to i : $v_I^k(A|e) \equiv v_I^k(A \{a_i\}|e), \forall k \neq i$.
- v. a_i complements a maximum number (n_c) of other resources.
- vi. The complementarity with other resources ($\text{Min}_{A,I} [v_I^i(A \cup \{a_i\}|e) - v_I^i(A|e)]$) is maximum.

With complementary resources, our framework extends the set of resource characteristics.

- iv. a_i is idiosyncratic to i

Other firms (including owners of complementary resources) are indifferent to the transfer of ownership if the resource is idiosyncratic or specialized to firm i , that is, if the resource is irrelevant to their marginal return.²⁷ The role of idiosyncratic resources in creating a SCA is largely covered in the RBV literature and is associated with unique historical conditions, causal ambiguity, or social

²⁷In a context of complementary assets, HM show that an agent should own an asset if it is idiosyncratic to the agent or the agent is indispensable to the asset (Propositions 5 and 6). With substitute assets, Propositions 1 and 2 show that idiosyncrasy is not sufficient and must be complemented with condition (i) because ownership might actually decrease the marginal return of the owner in the presence of other substitute assets (in Proposition 1, idiosyncrasy implies condition (ii) because the substitution impact of an idiosyncratic asset is null for the other agents, hence independent of other assets/agents). Indispensability (when an asset has no impact on the marginal return of a coalition without the indispensable agent) is also not sufficient with substitute assets, even with condition (i), because ownership by an indispensable agent would lower the marginal returns of coalitions containing the agent without increasing it in coalitions with an alternate owner. With both substitute and complementary assets, the impact of indispensability is less straightforward.

complexity, making the resource difficult to imitate (Barney, 1991), with time compression diseconomies making it difficult for a newcomer to catch up by simply “throwing money” at acquiring or developing the input (Dierickx & Cool, 1989), and with specialization to firm-specific needs, making it imperfectly mobile and difficult to trade (Conner, 1991; Peteraf, 1993). Idiosyncratic resources can also include capabilities (Dierickx & Cool, 1989), that is, organizationally embedded nontransferable firm-specific resources (Makadok, 2001), core competencies, such as the collective learning in the organization (Prahalad & Hamel, 1990), and various intangible assets such as knowledge or the mechanisms by which firms learn and accumulate new skills and capabilities, or “invisible assets” such as consumer trust, brand image, control of distribution, corporate culture, and management skills (Conner, 1991). Thus, tacit knowledge is difficult to imitate and import, making it an important resource for securing competitive advantage (Grant, 1966). Idiosyncrasy creates difficulty for the acquirer of imitating or duplicating the processes and strategies that the original firm used, that is, our notion of imitation includes acquiring the resource, not merely copying it.

v. *The resource complements a maximum number of other resources*

The ability of a firm’s resource to be “collaborative,” that is, to be compatible and to produce value with external resources, is important. The network of a firm’s contacts with its environment (Tomer, 1987), its network of prior alliances (Gulati, 1995), or the capability of forming alliances (Balakrishnan & Koza, 1993) are all linked with higher competitiveness. Open innovation (Chesbrough, 2003), the capability to draw technology ideas and knowledge from external resources, is a mean to develop competitive advantage in innovation (Laursen & Salter, 2006), and the number of direct and indirect ties has a positive effect on innovation (Ahuja, 2000).

vi. *The level of complementarity with other resources is maximized*

To increase their complementarity, the focal firm may make its resources easy to combine with other resources. For example, a Western technology company will have greater chances of developing a competitive advantage in China if its technology can be easily adapted to the constraints of the local manufacturers there. KUKA, a German robotics company, has become a market leader in China by developing a specific branch—“KUKA Flexible Manufacturing Systems”—that tailors robotic systems and provides flexible solutions to the specific and evolving demands of local automakers. It has modified its existing resources, for example, making its design process more modular, to increase their complementarity with the manufacturing processes of their customers.

In a system with complementary resources and firms, resource usefulness must be appreciated not only through the internal organization (as in the VRIO framework), but also through the external system of complements. The relational view literature (Dyer & Singh, 1998; Gulati, 1999; Gulati et al., 2000) investigates the impact of network resources on the competitive advantage of a firm, but does not always distinguish between the *number* of complementary resources and the *level* of complementarity. There are some exceptions though. In an alliance context, Hoffmann (2007) showed that the number of alliances and linkage intensity affect differently the alliance strategy of the focal firm, while Laursen and Salter (2006) pointed out that both the breadth and depth of external relationships matter for innovation. Dyer and Hatch (2006) showed that Toyota was able to develop a competitive advantage in quality over U.S. automakers despite using an identical supplier network (same breadth), thanks to a better knowledge sharing (higher complementarity) with the

suppliers. Yet, it may not be always easy to separate the two characteristics, and adapting a firm's assets may increase both their complementarity and the number of complements.

In the RBV framework extended with relational view, linkages with network resources affect the competitive advantage of the focal firm, whereas here, the mere possibility of future relationships is enough to increase the *ex post* bargaining position of the focal firm, and its incentive to invest. The model can explain the competitiveness of firms that facilitate the development of complementors (through standardization or the development of platforms) without formally entertaining relationships with them.

Those differences notwithstanding, a parallel with RBV leads to an extended VRINCC framework exhibiting these resource characteristics: valuable for the organization, rare, difficult to imitate and substitute, collaborative, and easy to combine/complement.

6 | CONCLUDING REMARKS

The work here is highly incomplete and opens up several areas of research. In particular, two possible conclusions might be drawn from our framework. First, if the premises of the PRT can be used in the RBV and the PGS, then we have come up with formal definitions for the main concepts of those theories. Our article then raises several questions on the existing strategy frameworks and calls for confronting those formal definitions to the informal characterizations of extent literature, thus rationalizing existing ideas or reconsidering previously accepted concepts. However, if the premises of the PRT are not considered to be applicable to the RBV and PGS, then the parallelism revealed here between our PRT-based framework and the strategy frameworks is striking and calls for a further investigation of the common underlying logic behind those theories.

The model sketched here opens up new doors for a more precise evaluation of the structure and impact of strategic networks. For instance, in the core inequality, A represents the network of resources in which the focal firm is embedded. It would certainly be interesting to study how the structure of the network—the complementarity, similarity, or independence (structural holes) among the elements of the network—impacts A and affects the competitive advantage of the focal firm. The framework could also be extended using recent developments in the PRT, where ownership is unbundled into access and veto rights in the presence of unrivalrous or rivalrous assets (Bel, 2013). Passing decision rights rather than ownership (i.e., contracting for control) might provide a more accurate analysis of situations in which firms may simply want to access, rather than own, resources, potentially leading to a theory of strategic alliances and hybrid organizations in general, or help analyzing the impact of scale-free (nonrivalrous) resources not only on their pricing on SFMs (Asmussen, 2015), but also on the *ex ante* strategic investments. Contracting for control and “hybrid organizations” are two promising areas in the theory of the firm (Gibbons, 2005), but also for strategy theory. Comparing the marginal returns from strategizing and economizing in the first stage could also shed light on the relative effects of power and efficiency mechanisms, potentially leading to a formal rationalization of efficiency as “the best strategy.” Finally, this work can also trigger informal theoretical developments, empirical studies, and the development of empirical proxies to the concepts used here in order to test the pertinence and predictive power of the model.

Formalizing has a cost, and our highly stylized model is not immune to the usual limitations that govern any attempt to formalize the complex realities of firm behaviors in mathematical expressions. It is also hampered by the usual impediments of the HM model: relationship specificity, contract incompleteness, unverifiability of investments, linearity of Shapley value, absence of wealth constraints, focus on *ex ante* investments, efficient trading markets, and *ex post* bargaining. Freeing

from the HM model while using the mathematical framework of CGT and biform games may allow plunging into the blind spots of existing strategy theories without most of those constraints. The growing literature around the value capture model is promising in this respect.

These issues notwithstanding, this formal approach sparks a more precise characterization of concepts in the prominent strategy theories and extend their scope, with the integration of strategic networks of complementors and social welfare considerations, leading to a richer set of strategies and resource characteristics. This study probably raises more questions than it solves. For brevity, we just touched on some of the many issues that the framework raises, and much remains to be done to explore the multiple research avenues that have been opened by this formal approach.

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APPENDIX

Proof of Proposition 1²⁸

We compare a control structure β' , in which firm i owns a_i (i.e., $\beta'(i) = \{a_i\}$, $\beta'(j) = \{a_j\}$, $\beta'(k) = \{a_k\}$, $\forall k$) to a control structure β in which another firm – say j – owns a_i (i.e., $\beta(i) = \{\emptyset\}$, $\beta(j) = \{a_i, a_j\}$, $\beta(k) = \{a_k\}$, $\forall k$).

From HM's Proposition (and Result 2 here), we know that total surplus (welfare) is higher when i owns a_i if every firm's marginal return is higher under β' than under β .

- a. For firm i , it means $\partial B_i(\beta' | e) / \partial e_i \geq \partial B_i(\beta | e) / \partial e_i$, $\forall e$, that is, $\sum_{I|i \in I} p(I) v_I^i(\beta'(I)) \geq \sum_{I|i \in I} p(I) v_I^i(\beta(I))$ or $f(i) = \sum_{I|i \in I} p(I) [v_I^i(\beta(I)) \cup \{a_i\} - v_I^i(\beta(I))] \geq 0$, that is:

$$f(i) = \frac{1}{n} v_i^i(a_i) + \sum_{I \subset N | i \in I, j \notin I} p(I) [v_I^i(\beta(I)) \cup \{a_i\} - v_I^i(\beta(I))] \geq 0$$

(the change of ownership has no effect when i and j belong to the same coalition).

Assume $v_i^i(a_i) \geq \frac{n-2}{2} \text{Max}_{A,I} (v_I^i(A) - v_I^i(A \cup \{a_i\})) \geq 0$ (condition (i))

then $v_I^i(\beta(I) \cup \{a_i\}) - v_I^i(\beta(I)) \geq \frac{-2}{n-2} v_i^i(a_i)$, $\forall I, \beta(I)$, hence:

$$f(i) \geq \frac{1}{n} v_i^i(a_i) - \frac{2}{n-2} \sum_{I \subset N | i \in I, j \notin I} p(I) v_i^i(a_i) = v_i^i(a_i) \left[\frac{1}{n} - \frac{2}{n-2} \sum_{I \subset N | i \in I, j \notin I} p(I) \right] = v_i^i(a_i) \left[\frac{1}{n} - \frac{2}{n-2} \times \frac{n-2}{2n} \right] = 0$$

$\sum_{I \subset N | i \in I, j \notin I} p(I) = \frac{n-2}{2n}$ because $\sum_{I|i \in I} p(I) = 1 = p(i) + \sum_{I \subset N | i \in I, j \notin I} p(I) + \sum_{I \subset N | i \in I, j \in I} p(I) + p(N)$

(the sum of probabilities in the Shapley value equals 1), $p(i) = p(N) = \frac{1}{n}$ and $\sum_{I \subset N | i \in I, j \notin I} p(I) = \sum_{I \subset N | i \in I, j \in I} p(I)$.

$$\left(\sum_{I \subset N | i \in I, j \notin I} p(I) \right) = \sum_{|I|=1}^{n-1} \frac{(|I|-1)!(n-|I|)!}{n!} = \sum_{|I|=2}^n \frac{(|I|-1)!(n-|I|)!}{n!} = \sum_{I \subset N | i \in I, j \in I} p(I).$$

²⁸The Mathematica code is available from the author upon request.

b. For j , marginal return is higher under β' than under β if $\sum_{I|j \in I} p(I)[v_I^j(\beta'(I)) - v_I^j(\beta(I))] \geq 0$, that is, if $\sum_{I|i \in I, j \in I} p(I)[v_I^i(\beta'(I)) - v_I^i(\beta(I))] + \sum_{I|i \notin I, j \in I} p(I)[v_I^i(\beta'(I)) - v_I^i(\beta(I))] \geq 0$

or $\sum_{I|i \notin I, j \in I} p(I)[v_I^i(\beta(I)) \setminus \{a_i\} - v_I^i(\beta(I))] \geq 0$ (the change of ownership has no effect when i and j belong to the same coalition), which is verified since assets are substitutes by assumption.

c. For k , the marginal return is higher under β' than under β if $\sum_{I|k \in I} p(I)[v_I^k(\beta'(I)) - v_I^k(\beta(I))] \geq 0$, that is, if $\sum_{I|i, k \in I, j \notin I} p(I)[v_I^k(\beta(I) \cup \{a_i\}) - v_I^k(\beta(I))] + \sum_{I|j, k \in I, i \notin I} p(I)[v_I^k(\beta(I) \setminus \{a_i\}) - v_I^k(\beta(I))] \geq 0$ (the change of ownership has no effect when both i and j are in I and when none of them is in I) or if

$$\sum_{I|i, k \in I, j \notin I} p(I)[v_I^k(\beta(I) \cup \{a_i\}) - v_I^k(\beta(I))] - \sum_{I|j, k \in I, i \notin I} p(I)[v_I^k(\beta'(I) \cup \{a_i\}) - v_I^k(\beta'(I))] \geq 0. \quad (\text{A1})$$

(because $\beta'(I) = \beta(I) \setminus \{a_i\}$ when $j \in I$)

Assume $v_I^k(A) - v_I^k(A \cup \{a_i\}) = v_{I'}^k(A') - v_{I'}^k(A' \cup \{a_i\})$, $\forall I, I' \ni k, \forall A, A' \ni a_k$ (condition (ii))

then $v_I^k(\beta(I)) - v_I^k(\beta(I) \cup \{a_i\}) = v_{I'}^k(\beta(I')) - v_{I'}^k(\beta(I') \cup \{a_i\})$,

$\forall I \ni i, k, I \neq j, \forall I' \ni j, k, I' \neq i, \forall \beta(I), \beta(I') \ni a_k$

and $\sum_{I|i, k \in I, j \notin I} p(I)[v_I^k(\beta(I) \cup \{a_i\}) - v_I^k(\beta(I))] = \sum_{I|j, k \in I, i \notin I} p(I)[v_I^k(\beta'(I) \cup \{a_i\}) - v_I^k(\beta'(I))]$

The difference in the left-hand-side of Equation (A1) is equal to zero and k 's marginal return is unaffected by the change of ownership.

Hence, when moving from β' to β , the marginal return is increased or unaffected for the agents; thus, from *Result 2*, total surplus is increased, and i should own a_i .

The proof proceeds the same way for Proposition 2.

Hart and Moore's (1990) yacht example

Let i, j, k be, respectively, the tycoon, the chef, and the skipper, a_i is the yacht, and $a_j = a_k = \emptyset$.

When the tycoon owns the yacht, the optimal value capture for the tycoon and the chef is:

$$i: 1/3v_i^i(a_i) + 1/6v_{ij}^i(a_i) + 1/6v_{ik}^i(a_i) + 1/3v_{ijk}^i(a_i) = C'_i(e_i) \quad (\text{A2})$$

$$j: 1/3v_j^j(\emptyset) + 1/6v_{ij}^j(a_i) + 1/6v_{jk}^j(\emptyset) + 1/3v_{ijk}^j(a_i) = C'_j(e_j).$$

On the other hand, if the skipper owns the yacht, the optimal value capture is:

$$i: 1/3v_i^i(\emptyset) + 1/6v_{ij}^i(\emptyset) + 1/6v_{ik}^i(a_i) + 1/3v_{ijk}^i(a_i) = C'_i(e_i) \quad (\text{A3})$$

$$j: 1/3v_j^j(\emptyset) + 1/6v_{ij}^j(\emptyset) + 1/6v_{jk}^j(a_i) + 1/3v_{ijk}^j(a_i) = C'_j(e_j).$$

Comparing the set of Equations (A2) and (A3), it is better for the tycoon to own the yacht if: $v_i^i(a_i) \geq 1/2[v_{ij}^i(\emptyset) - v_{ij}^i(a_i)]$, which is condition (i) and is satisfied.

On the other hand, it is better for the chef that the tycoon owns the yacht if:

$$1/6v_{ij}^j(a_i) + 1/6v_{jk}^j(\emptyset) + 1/3v_{ijk}^j(a_i) \geq 1/6v_{ij}^j(\emptyset) + 1/6v_{jk}^j(a_i) + 1/3v_{ijk}^j(a_i) \quad (\text{A4})$$

$$\text{or } v_{jk}^j(\emptyset) - v_{jk}^j(a_i) \geq v_{ij}^j(\emptyset) - v_{ij}^j(a_i).$$

If condition (ii) is realized, this turns out to be an equality and the chef is indifferent. Thus, overall it is better that the tycoon owns (omitting the effect for the skipper). However, HM adds the critical condition that the tycoon be “indispensable” (pp. 1123–1124). In other words, without the tycoon, asset a_i has no effect on the other agents’ marginal return (p. 1133), and inequation (A4), becomes $1/6v_{ij}^j(a_i) + 1/3v_{ijk}^j(a_i) \geq 1/3v_{ijk}^j(a_i)$. In the left-hand-side, the tycoon owns and the skipper can be cut out of the bargaining (p. 1123), thus $v_{ijk}^j(a_i) \equiv v_{ij}^j(a_i)$ and the inequation becomes $1/2v_{ij}^j(a_i) \geq 1/3v_{ijk}^j(a_i)$. Hence, for the chef, it is better that the tycoon owns because he just has to bargain with the tycoon rather than with both the skipper and the tycoon, as highlighted by HM.