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A BARGAINING PERSPECTIVE ON RESOURCE ADVANTAGE

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Whereas prices serve to allocate many resources in market economies, there remain vast reservoirs of unpriced resources to be managed. Business management and strategy concerns the creation, evaluation, manipulation, administration, and deployment of unpriced specialized scarce resource combinations. This paper applies the formalism of cooperative game theory to these concerns. In cooperative game theory, rents appear as the negotiated payments for the services of scarce valuable resources. The division of surplus is determined by the relative values created by different use combinations of resources. Within this framework, the strategy problem is clearly seen as one of discovering or estimating the value of various resource combinations. New wealth can be created by trade in resources as long as there are hitherto unexamined combinations.

In 1416, Henry the Navigator, a prince of Portugal, established a program for the development of navigation, including an observatory, the first school for navigators, and a program for improvements in ship design. These investments led to the first great voyages to the west coast of Africa (Madeira in 1420, Cape Verde in 1445) and eventually India (1499), Malaysia (1511), and Hormuz (1515).[1] Prince Henry's 'technology' also was instrumental in the Spanish discovery of North America.

Henry's ultimately far-reaching navigational development was motivated by the problem of going south of Cape Bojador, in Africa near the Canaries. The waters near Cape Bojador were an unnavigable swirl of rocks and currents: the only way to get past was by going far out to sea. But conventional wisdom was to stay within sight of land and navigate by linking landmarks together on a daily basis. Prince Henry's revolutionary navigational methods were developed so captains would know how to travel out of sight of land and know when and where to come back to shore.

Theoretical researchers in competitive strategy, like medieval navigators, have stayed within the sight of land—our 'land' being standard neoclassical microeconomics. However, the question of fundamental interest to strategy researchers is not the same as the one shaping the economics shoreline we watch so carefully. Those who designed neoclassical theory were interested in the efficiency of the price system, given the assumption that firms are rational value maximizers. Like Prince Henry's, our problem is different. We are interested in what a manager should *actually do* to maximize

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[1] Portuguese traders established first-mover advantages along these routes and helped make Portugal a leading power in the sixteenth and seventeenth centuries. Traditions of secrecy, first-mover advantages, including exclusive treaties and the construction of armed forts to impede second movers, helped prevent others from duplicating Portugal's gains from the specialized knowledge.

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wealth. The neoclassical system, taught every day to students in business schools, is a logic for relating prices to one another—for navigating in a 'sea' of prices. Again, our problem is different. Most of the resources of critical interest to the strategist are unpriced. *Strategists must create, deploy, combine, manage, and exchange such resources without the help of market prices*.

Breaking away from shoreline navigation does not mean abandoning all seamanship (i.e., neoclassical knowledge). It does mean that some concepts and tools must be set aside and other new concepts and tools developed. The limitations of the standard neoclassical concepts for the resource-based view are illuminated by an alternate point of view. *Cooperative game theory* (CGT) provides a valuable alternative perspective. In particular, CGT separates the issues of opportunity cost, value, and the distribution of rents. It replaces the conceptual looseness surrounding the economic profit concept with a formal system in which surplus is known, but its division is subject to negotiation.

In a companion paper[2] we critiqued the neoclassical concepts of economic rent and economic profit and introduced the Payments Perspective as an alternative framework. What the Payments Perspective offers is the radical view that *all* of the firm's revenues are payments to resources. A rich vein of ore or a prime location is just as much a resource as the skill of an entrepreneur, a firm's know-how, or brand image. The simple rent payments[3] for the services of these resources are the outcomes of competition and bargaining. In contrast to the neoclassical view, in the Payments Perspective there are no difficult-to-define economic profits: the payments to the firm's resource base are the observed cash flows. Whereas neoclassical doctrine focuses on the fact that 'economic profits' are zero once the 'cost' of valuable factors is taken into account, the Payments Perspective focuses on the actual sources of wealth—valuable resources. A resource such as a rich silver mine isn't 'just a factor,' it is the source of wealth in a competitive economy. If it is more productive than other mines, it will receive a larger payment for its services. The payments garnered by resources arise because they add value to the economy and capture that value by having few substitutes. The fact that the mine is marketable or tradeable or valued by another does not lessen (but typically increases) its ability to capture surplus.

Neoclassical theory is quite capable of dealing with a firm as a bundle of resources as long as two key conditions are met: the resources are not co-specialized and there are large numbers of buyers and sellers for each product and input. However, when these conditions are not met, alternative approaches are needed. In this paper we analyze such situations using cooperative game theory. The view we espouse sees the firm as a coalition of resources. No resource is 'firm specific.' Rather, there are co-specialized resources that exist within the legal shell of the firm. Using this framework, we address a number of questions: (a) Given a setting, what is the feasible set of payments to resources? What payments can be expected? (b) Given the appearance of a new resource or a new complementarity, what surplus is generated and what is the expected impact of this change on the structure of resource payments? What expected gains to trade in assets result from this change? (c) What opportunities for increased wealth exist through the reassembly of resources to increase coalitional power?

In the next section we introduce the *formalism* of cooperative game theory. We adapt this formalism to our needs by identifying each individual resource as an economic agent. Our bargaining parties are not firms or products, but rather the individual resources that lie behind them. After illustrating our approach with several examples, we turn to the question of gains to trade in marketable resources. We then bring these threads together by describing our adaptation of CGT, which provides a micro-foundation for the resource-based view. Finally, we offer our views on further work in the sources of resource advantage, and exhibit a simple model of the search for advantage.

The closest progenitor to our use of cooperative game theory is Brandenburger and Stuart's (1996, 2001) work on fitting industry analysis into a cooperative game setting. Teece's (1986) insights on complementarities and appropriation regimes anticipate much of our treatment of gains to trade in resources. Another basic stimulus has been the path-breaking insights of Makowski and Ostroy (2001). They have worked to reformulate marginal productivity theory on a new basis that

[2] Lippman and Rumelt (2003).

[3] We define *simple rent* to be the full payment (rather than *excess* payment) for the services of a scarce resource. For a single owned resource, *simple rent* = *net revenue* ≡ *revenue* − *direct cost*, where *direct cost* is the cash cost of priced inputs consumed in production.

has relevance to the study of business strategy. Equating perfect competition with full capture of value created, they call attention to the virtually unquestioned identification of perfect competition with price-taking. They note, 'This identification hides the remarkable properties of perfect competition itself.' They go on to argue that in true perfect competition, each person actually does not take prices and markets as given, but rather is able to create new value and even *create new markets*. The primary condition of 'perfection' is not price-taking, but that individuals fully appropriate the value they create. While subtle, Makowski's and Ostroy's adjustment of the micro-foundations of perfect competition opens the door to new ways of thinking.

BARGAINING: DIVIDING SURPLUS

Consider the standard neoclassical textbook example of opportunity costs. An entrepreneur, **E**, can earn 60 in salary outside a business. The business generates net revenues, before **E**'s wages, of 100 when **E** runs it. Textbook economics tells us that **E**'s opportunity cost is 60, leaving 40 economic profit for the firm.

Recast as a bargaining situation, there is a surplus of 40 created by the conjunction of **E** and the firm. Imagine **E** bargaining with the rest of the firm, as **E** would have to do if **E** were a hired resource. How much pay could **E** get? At least 60 must be received, or **E** will not work for the firm; in addition, the firm cannot afford to pay **E** more than 100. Given no other information, bargaining theory says that **E**'s pay will be in the interval [60, 100]. The precise wage will depend upon the details of the bargaining: it is formally indeterminate.

The formal indeterminacy in bargaining theory replaces a conceptual looseness in neoclassical theory. In neoclassical theory, the 'cost' of the entrepreneur is 60—what could be earned in alternate employment. But, given an equilibrium in which the entrepreneur earns 100, of what relevance is the out-of-equilibrium alternate value? (If you prefer Coke to Pepsi, do you suffer the cost of a foregone Pepsi each time you drink a Coke?) The lack of conceptual clarity about opportunity cost is a defect in neoclassical theory.[4] General equilibrium theory takes a step towards repairing this defect. Given a Walrasian tâtonnement process, *any* price for the entrepreneur in the range 60–100 will produce an efficient outcome. That is, any price in this range will force the entrepreneur to 'do the right thing.' As we shall see, this range is what is known as the *core* of the game.

In this two-person case, there is a standard solution developed by Nash (1953). With money payments, the Nash bargaining solution has the two sides divide the surplus equally,[5] each receiving one-half. That is, the Nash bargaining solution entails a wage of 80 for **E**.

By putting the situation into a bargaining context, we have replaced the *conceptual indeterminacy* surrounding the notion of opportunity cost with a *formal indeterminacy* regarding the size of **E**'s wage payment. In the bargaining framework, we know the surplus available is 40. We also know the outside values: if no agreement is reached, **E** will earn 60 and the firm will earn nothing. Because any wage in the range 60–100 would force the best-use outcome, each share of this difference could be called an economic rent. If the agreed-upon wage turns out to be 85, **E** gets a surplus of 25 (a total payment of $60 + 25 = 85$) and the firm receives a simple rent payment of 15.

What are missing from the bargaining context are the extraneous neoclassical concepts of opportunity cost and economic profit. Instead of finding arguments to drive profits to zero, the bargaining framework starts with the assumption of a surplus and then examines how it will be divided. Just as importantly, *price is the outcome of the model, not an input to it.*

Cooperative game theory

Two-person bargaining games have been studied for over 100 years. However, the study of n-agent games is a more recent phenomenon.[6] In the two-person game, the range of feasible outcomes is clear. In an n-person game, agents can act against

[4] See our companion paper, Lippman and Rumelt (2003).

[5] More precisely, suppose that the parties will receive a and b, respectively, if they fail to come to an agreement. If they come to an agreement, then they will split (in some not yet determined manner) the value v, where $v > a + b$. The surplus generated by their agreement is $v - (a + b)$. The Nash bargaining solution splits the surplus evenly: the first party receives $a + [v - (a + b)]/2 = (v + a - b)/2$, and the second party receives $b + [v - (a + b)]/2 = (v + b - a)/2$.

[6] Critical contributions were made by Shapley (1953), Shubik (1959), and Harsanyi (1963).

one another, form coalitions, or simply negotiate. This makes the range of feasible outcomes a more complex question and solution concepts less robust. Nevertheless, cooperative game theory provides a natural setting for examining resource-based view. It is natural because it addresses the central question of how surplus is divided among agents (resources). Instead of 'subtracting' the payments to resources from receipts as 'factor payments,' CGT puts all such payments at the center of the analysis. The entire surplus in the game—net revenues of the firm, net revenues of other firms, net revenues of suppliers, consumer surplus—is up for grabs: the question is, 'Who gets what?' There are no mysterious economic profits which must be driven to zero nor opportunity costs that can be calculated in a myriad of ways. There is simply surplus to be divided. The division allocates *all* surplus; there is nothing is left over in some residual account.

The neoclassical tradition sees economic rent as price-determined. That is, the amount of resource supplied is insensitive to incremental changes in the payment amount. CGT sees this insensitivity in a different way. In a standard bargaining context, the problem is the division of a surplus between agents: the amount of surplus is insensitive to how it is divided.[7] The bargaining problem is isomorphic to the problem of joint cost allocation and is closely related to the concept of the *core* of an economy. CGT has been used to model exchange economies and generalized features of competition.[8]

CGT differs from non-cooperative game theory in that it does not posit a detailed model of move and countermove. The distinction between cooperative and non-cooperative game models alludes not to cooperation, but rather to the amount of structure the game designer provides, with less structure provided by CGT. CGT characterizes the feasible and/or expected outcomes of self-interested bargaining and competition among a group of actors. A so-called 'cooperative' game can embody a situation of unbridled competition.

The CGT formalism

A general cooperative game is completely specified by a set $\mathbf{N}$ of players having $n = \#\mathbf{N}$ members, and a characteristic function v mapping any subset of $\mathbf{N}$ to a non-negative real number. For any subset of agents $\mathbf{G} \subseteq \mathbf{N}$, $v(\mathbf{G})$ is the maximum value available to that group working on its own. Note that v is defined as the maximum over an implicit optimization problem. The standard assumption is superadditivity: the value created by a group is at least as large as the sum of the values created by any disjoint pair of subgroups. A solution to the game is a vector $\mathbf{x} = (x_1, \ldots, x_n)$ of payoffs, called *imputations*, such that: (1) each agent obtains at least what could be obtained on his own; (2) the sum of all payoffs is the total value of the game $V = v(\mathbf{N})$. By making additional assumptions about the pattern of payoffs, particular solution concepts are obtained. For example, if one requires that the sum of payoffs to any subset of players $\mathbf{G}$ is no less than $v(\mathbf{G})$, the set of payoffs satisfying this condition is called the *core* of the game. Many cooperative games do not have a core.

Given a group $\mathbf{G}$ containing an agent i, define the *value added* $V_{i:G}$ by i to the group by $V_{i:G} = v(\mathbf{G}) - v(\mathbf{G}\backslash i)$.[9] The value added to the game by agent i is $V_i = V_{i:N}$. If $\sum V_i = V$ it seems reasonable that $x_i = V_i$ should be the unique solution to the game: all agents receive their marginal products. Ostroy (1984) and Makowski and Ostroy (2001) have shown that such a condition is a refinement of perfect competition. This insight suggests that neoclassical concepts begin to fray at the edges when applied to situations where the value-added (or marginal product) of the agents do not sum to the total value of the game. If the marginal products sum to more, there will be bargaining over the distribution of the surplus. If they sum to less, there will not only be bargaining, but the game will have an empty core. In other words, CGT helps us see that competition cannot be perfect if complementarities or externalities yield surplus that can be divided by negotiation.

Brandenburger and Stuart (2001) model general competition as taking place among three layers of agents: buyers, firms, and suppliers. The couplings between buyers and firms influence willingness-to-pay, and the couplings between firms and suppliers

[7] If Williamson's (1985) 'fundamental transformation' is placed in an equilibrium setting, the potential difference between the *ex ante* contracted division of surplus and the *ex post* opportunistic redivision can alter the size and type of investment, and, consequently, the amount of surplus to be divided.

[8] Shapley and Shubik (1969), Mas-Collel (1982), Quinzii (1984), Makowski and Ostroy (1995), Hart (1979), and others.

[9] $\mathbf{X}\backslash\mathbf{Y}$ denotes the intersection of $\mathbf{X}$ with the complement of $\mathbf{Y}$. That is, $\mathbf{X}$ with all $\mathbf{Y}$ in $\mathbf{X}$ removed.

influence cost. Brandenburger and Stuart use the concept of the core to define solutions. In particular, they note that a player who does not add value to the game (i.e., $V_i = 0$) cannot receive a payment in the core. MacDonald and Ryall (2002) prove this and related theorems. Additional explication of these ideas has been accomplished by Ghemawat (1999) and by Saloner, Shepard, and Podolny (2001).

The 2 : 1 exchange game: Solution concepts

As an example of CGT's applicability, a simple multi-party exchange game can be built by extending the 60–100 entrepreneur's wage game. To wit, let there be two entrepreneurs, $\boldsymbol{h}$ and $\boldsymbol{\ell}$. Both could run the firm, each yielding 100 in net revenue. Their outside salaries, or values, are 60 and 70, respectively. It is clear that pure price competition between the two entrepreneurs would drive the wage to 70 or less, with $\boldsymbol{h}$ getting the job for a wage in the range [60, 70]. Indeed, the restricted Nash bargaining solution and the Nucleolus solution to this game entail the firm hiring $\boldsymbol{h}$ at a wage of 65; similarly, the Vickery solution finds $\boldsymbol{h}$ receiving a wage of 70. But the Shapley solution (known as the Shapley value) is quite different in character. The Shapley value finds the firm paying a wage of 75 with $\boldsymbol{h}$ and $\boldsymbol{\ell}$ receiving surpluses (over their outside salaries) of 10 and 5, respectively. Because this is a cooperative game, the precise manner by which these surpluses come about is left unspecified. We can, however, imagine that the firm always hires $\boldsymbol{h}$, and $\boldsymbol{h}$ makes a side payment of 5 to $\boldsymbol{\ell}$.

To introduce the Nucleolus and Vickery solution concepts, we generalize the two-entrepreneur game involving $\boldsymbol{h}$ and $\boldsymbol{\ell}$, to a 2 : 1 exchange game. The 2 : 1 exchange illustrates the structure of a cooperative game that has elements of both bargaining and competition. In this game one buyer faces two sellers. The buyer, labeled $\boldsymbol{a}$ (for 'apex'), cannot buy from both. Buying from seller $\boldsymbol{h}$ generates total surplus H. Buying from seller $\boldsymbol{\ell}$ generates total surplus L, $L \leq H$. In this game, the differential $D = H - L$ measures the *resource advantage* of $\boldsymbol{h}$ over $\boldsymbol{\ell}$. Agent $\boldsymbol{h}$'s resource advantage might be due, say, to lower costs or to a more attractive product. Using the figures from the two-entrepreneur game, $H = 100 - 60 = 40$, $L = 100 - 70 = 30$, and $D = 10$.

The characteristic function of the 2 : 1 exchange game can be written as

$$v(\boldsymbol{a}) = v(\boldsymbol{h}) = v(\boldsymbol{\ell}) = v(\boldsymbol{h\ell}) = 0$$

$$v(\boldsymbol{ah}) = H, v(\boldsymbol{a\ell}) = L, v(\boldsymbol{ah\ell}) = H$$

The values added by players are $V_a = H$, $V_h = D$, and $V_\ell = 0$.

Notice that although we have described this game as a buyer facing two sellers, the characteristic function is also that of a game in which a seller faces two buyers, with buyer $\boldsymbol{h}$ valuing the item more than $\boldsymbol{\ell}$, or with the anchor's cost of serving buyer $\boldsymbol{h}$ being lower. Thus the game is named a *2 : 1 exchange*. Bilateral bargaining is a 1 : 1 exchange and a buyer (seller) facing k sellers (buyers) is a k : 1 exchange.

Five solutions to the 2 : 1 exchange game are summarized in Table 1. The *core* is one basic solution concept for a cooperative game. The core is the set of surplus allocations such that no subcoalition can do better, as a group, than the core imputation. In the present example, all the surplus is generated by $\boldsymbol{h}$ and $\boldsymbol{a}$. Because $H \geq L$, surplus is maximized if $\boldsymbol{a}$ deals with $\boldsymbol{h}$. So the question becomes how $D = H - L$ is divided. Any solution giving more than zero to $\boldsymbol{\ell}$ is outside the core. Any imputation $\boldsymbol{y}$ giving $\boldsymbol{h}$ more than D is outside the core because $\boldsymbol{a}$ and $\boldsymbol{\ell}$ could then do better together than they do in $\boldsymbol{y}$.

- A *Vickery* auction (English auction) solution entails $\boldsymbol{h}$ and $\boldsymbol{\ell}$ bidding against one another in a noncollusive open setting. Agent $\boldsymbol{h}$ can pay more to $\boldsymbol{a}$ than can agent $\boldsymbol{\ell}$, so the solution

Table 1. 2 : 1 exchange solution concepts

	Core	Vickery	NBS/Nucleolus	Shapley
Anchor	$H - x$	$H - D = L$	$H - D/2$	$H - D/2 - L/3$
$\boldsymbol{h}$	$X = [0, D]$	D	$D/2$	$D/2 + L/6$
$\boldsymbol{\ell}$	0	0	0	$L/6$
Two-entrepreneur wage	[60, 70]	70	65	75

finds ***h*** paying L to ***a*** and keeping the difference $D = H - L$.

- The (restricted) *Nash bargaining solution* (NBS)[10] has agents ***a*** and ***h*** bargaining over the preferred point in the core. Dividing D in half, ***h*** receives $D/2$.
- The *Nucleolus* is a solution concept developed by Schmeidler (1969). It always exists as a unique point and lies in the core, if the core is nonempty.
- The *Shapley* value explicitly considers the power of each possible coalition in the game. It is unique and need not lie within the core. The Shapley value for a player is computed as the weighted average value added of the player in every possible coalition. The weights are the probabilities of the coalition forming. Given n agents in the game, the probability of any coalition of size r forming is given by $r!(n-r-1)!/n!$ Roth (1978) has shown that the Shapley value is a utility measure of each player's position in the game. Here, and interestingly, 'position' sums up a player's inherent endowment and the endowments of other players.

Which solution is most reasonable? Some argue that the Vickery solution is the natural result of price competition: the buyer pays the low-cost supplier the costs of the higher-cost supplier, because the high-cost supplier cannot bid any lower than that. Others say that the NBS recognizes that it is really a bilateral game between ***a*** and ***h***, because ***ℓ*** adds no value to the game and hence gets nothing in the core. But if ***h*** and ***ℓ*** recognize their interdependence, ***ℓ*** can say to ***h***, 'If I were out of the game, you would get half of the total surplus, instead of just $D/2$. Let us agree that I will stand aside and you will then give me some of the gains thereby achieved. Alternatively, I will buy the item from you for something more than D, making you immediately better off, and then I will sell the item to ***a*** for an additional profit to me.' The core says that such a solution is 'not stable' because players ***a*** and ***h*** can always do better as a coalition without ***ℓ***, than by either of them listening to the schemes of ***ℓ***. But ***h*** and ***ℓ*** do better by scheming than they do in the core, ... and so on.

In the case of the two competing entrepreneurs, $H = 100 - 60 = 40$ and $L = 100 - 70 = 30$. The surplus to be divided is $H = 40$. The Shapley solution has ***h***, ***ℓ***, and ***a*** receiving 25, 10, and 5, respectively. As noted earlier, this can be interpreted as ***h*** taking the job with ***a*** and ***ℓ*** keeping the outside job plus a side payment. One rationalization of such a result would be to say that ***h*** and ***ℓ*** colluded to extract more from the firm, and then split the gain. A more general rationalization sees these sums as the *expected* payoffs from the situation.

Opportunity cost and bargaining

In a companion paper (Lippman and Rumelt, 2003) we introduced a problem that it is useful to restate here. Pindyck and Rubinfeld (1992: 268) describe the competitive advantage of a firm with a special location in these terms:

> One firm is located on a river and can ship its products for \$10,000 a year less than the other firm, which is inland. Then the \$10,000 higher profit of the first firm is due to the \$10,000 per year economic rent associated with its river location. The rent is created because the land along the river is valuable, and other firms would be willing to pay for it. Eventually, the competition for this specialized factor of production will increase its value to \$10,000. Land rent—the difference between \$10,000 and the zero cost of obtaining the land—is also \$10,000. Note that while the economic rent has increased, the economic profit of the firm on the river has become zero.

Let us analyze this situation as a cooperative game. An entrepreneur has discovered that a very special location near a river provides lower costs of distribution. The net revenue increment from this location to the entrepreneur's firm is 10. To apply CGT, we must specify how many alternative locations there are and how many alternative firms there are, and take the value of each potential combination into account. To begin, suppose that no other location provides an incremental net revenue benefit to the entrepreneur's firm, and no other firm can use this location to create this benefit. We thus have two resources: the river location and whatever resource underlies the rest of the firm. CGT predicts that the landowner of the river location

[10] The NBS is not well defined for more than two players. In general, it is defined with respect to a feasible set and a disagreement point, but the disagreement point is not obviously the outside values in most n-person settings. Here, we take the core as restricting the feasible set of players and payoffs and the player's outside values as their disagreement points. Were the feasible set not limited to the core, the NBS would be for each player to receive $H/3$ without regard to the size of L, a clearly unreasonable outcome.

and the entrepreneur's firm will share the surplus of 10. The Nash bargaining and Shapley solutions have rent to the landowner rising by 5, leaving the firm with a surplus of 5.

The bargaining framework is sensible if someone else owns the land. If the entrepreneur's firm owns the river location, there is still a good reason to impute surplus to the location as if the land were somehow bargaining within the firm for its fair share. It is not the imputation of surplus itself, but the logic behind seeing the land as a 'player' that clarifies the situation. In the neoclassical framework, surplus or economic rent is defined as the difference between inside (best-use) and outside (forgone-use) values—the operation determining a resource's surplus is subtraction (inside value—outside value). Because the operation is subtraction, the concept of outside value is inseparable from the calculation of surplus. *Bargaining logic, on the other hand, separates the concepts of outside value from the division of surplus.* In the bargaining framework, the value of the outside option is only a parameter in the ensuing bargaining. The division of surplus between parties depends upon the value of the outside option *and* upon the value propositions offered by other agents and their outside options.

It may seem arbitrary to allocate one-half of the surplus to the land and the other half to other firm resources. However, suppose that the 'other' resources could be further subdivided and use-values assigned to each sub-combination (coalition). Then the mechanics of CGT could be used to impute a value to each resource. That is why we identify the active agent in our approach as the resource rather than the firm.

In the river location problem, the neoclassical framework would see an economic rent of 10 due to some scarce factor—the good location and the firm. It would be silent on any split between them and, in the case of a single outside bid, it would 'cost' the land at that bid. However, when we switch to the bargaining framework, a payment to the land is deduced from the degree of competition in the factor market. Economic rent reappears as the bargained-for portion of the surplus, and it is quite clear that competition from substitute land is bad for the river location and good for the rest of the entrepreneur's firm. Competition from substitute firms is good for the river location and bad for the rest of the entrepreneur's firm. Competition from substitutes for both the entrepreneur's firm and the river location is bad for both.

Now, let there be a second firm that can use the land to create the same increase in net revenues as the original entrepreneur's firm. This means one land agent bargains with two firms, a 2 : 1 exchange problem. Because the firms are identical, the core gives the entire surplus to the land.[11] The Shapley solution is 'softer,' predicting that with n identical entrepreneurs the simple rent earned by the land will be $10n/(n+1)$.[12] With two bidders, the land rent (cost) is $6\frac{2}{3}$. Taking into account the possibility of coalitions, the expected 'cost' of using the land rises with the number of competing bidders.

The existence of additional bidders for the land does not change the net revenue of the firm owning the land and business. The simple rent available for division, the surplus, is unchanged by these bids. However, these bids do alter the division of the surplus between land and business, altering the *relative* values of land and business within the entrepreneur's portfolio.

With only one potential user, the land's share of the surplus is indeterminate within the core. The NBS splits the surplus evenly between land and business. If there is one outside bidder for the land, the imputation depends upon the solution concept chosen. Under norms of full price competition, the land appropriates the entire surplus if there are two or more firms bidding on the land. On the other hand, the Shapley solution finds the imputed value of the land rising with the number of bidding entrepreneurs. *By replacing the concept of 'economic profit' with the idea of 'imputing a division of the surplus,' we recognize the standard neoclassical position is simply one of many possible solutions.*

This analysis also suggests a clear piece of strategy advice. The advice follows by aligning this bargaining framework with Teece's (1986) ideas about the gains to innovation, complementary assets, and the importance of the appropriability regime. If the entrepreneur is contemplating a business on this land, based on low-cost access to

[11] Note that if one adopts the core solution in the product market, two identical competitors would be sufficient to drive all profits to zero.

[12] In our practical strategy course we ask the students to use 'dog' arithmetic. Reportedly, dogs can tell the difference between 0, 1, 2 and 3 people in the room, but not more. We suggest that 3 or more competitors is 'many.'

the river, whether or not the entrepreneur buys the land in advance depends on the relative imitability of the land and the business. If the land is unique, the entrepreneur will split the surplus with the land owner (unless the entrepreneur buys the land before the surplus is revealed). If the business idea is imitable, the landowner will garner the entire surplus (unless the entrepreneur buys the land first). The property right to the land, obtained in advance of revealing the business idea, guarantees that the entrepreneur will capture the surplus generated even though the business idea is fully imitable.

If the land is not quite unique, there being a limited number of similar parcels, the entrepreneur can profit from the innovation by buying these parcels before the imitable business idea is well understood. The entrepreneur can then profit, via land ownership, from business imitation by others. If the land is not unique, but the business idea resists imitation, the entrepreneur will have to self-expand the business. If the land is not unique, there are many similar parcels, and the business idea is imitable, then the entrepreneur cannot appropriate any surplus. The CGT framework renders obvious what may have appeared counterintuitive, namely, the entrepreneur may be better off creating an imitable business than one that is not. If the entrepreneur can buy up the limited co-specialized assets beforehand, the entrepreneur can profit as much from the efforts of others as the entrepreneur would from self-expanding the business.

Resources such as land are not just commodity factors. Because some of these resources are scarce, and because property rights are well defined, they can, under certain conditions, provide the means for appropriating the returns to (otherwise) imitable innovation.

The assignment game

Our central theme is that strategy involves working with unpriced resources. We use the assignment game to further illustrate this point of view. In an assignment game there are a set of tasks and a set of resources that must be assigned to tasks. After the optimization problem is solved, it is possible to assign 'payments' and 'costs' to various elements of the game, but these quantities are deduced from the solution and do not guide it. A second reason for looking at this problem is to clarify the issue of how 'outside values' are chosen within CGT. In the neoclassical treatment of economic rent, it is necessary to specify 'alternative use.' CGT helps by mapping this question to a different question that may be easier to answer: Which resources (players) are *in* the game?

A CGT setting requires clear specification of obtainable values in the game. In particular, a player's 'outside value' is the payment received in the game by a player in a one-player coalition (no transactions or cooperation with any other player). The outside values must be independent of any action by players in the game. That is, the outside values should not be the outcomes of bargaining; if they are, the definition of the game must be expanded to include such bargaining.

To see how this works, consider a simple two-person game. A firm, NY, is interested in hiring a professional, Alan. Alan's pay in his current job is 0 and NY can use him in a task generating net revenue (before Alan's wages) of 100.[13] Given just this information, it appears that NY will offer Alan a wage in the range [0, 100], say 50. A neoclassicist would say that the opportunity cost of Alan to NY is 0.

But there is a second bidder for Alan's services. The firm LA wants to hire Alan for a job generating net revenue of 90. The expanded game over hiring Alan is now a three-person game (2 : 1 exchange). NY will have to offer at least as much as LA to hire Alan. The core of this game is the range [90, 100]. At this point, a neoclassicist would probably say the opportunity cost of Alan to NY is 90, but within the CGT framework we say that the payment to Alan is the outcome of bargaining.

But, there is more. A second professional, Betty, is worth 70 to NY and 50 to LA. This is a separate, three-person 2 : 1 exchange game with a core of [50, 70].

Further, suppose that Alan's and Betty's values to each firm are mutually exclusive: there is only one job at each firm, and the numbers quoted reflect their values in that job. The implication of this constraint is that NY can not 'win' both Alan and Betty; it must cede one of them to LA. To take account of the interactions, we now have to merge the two separate three-person games into a larger four-person 2 : 2 exchange game. If we

[13] Setting Alan's outside wage to zero is simple normalization. If his outside wage were 50, we could subtract 50 from each situation involving Alan without changing the problem. Setting his outside wage to zero assumes that normalization has already been accomplished.

don't enlarge the game to include all four players, the analysis begins to go around in circles because we can't decide who to hire based on a wage because the wages will be the *outcome* of the hiring-negotiation process.

In this context, the idea of a 'market wage' vanishes. It is replaced by bargaining among the four parties involved. Of course, there is never any clear line demarking the inside and outside of a real-world game, but it is useful to know that the payments to resources derived will depend, in general, upon the scope of the game.

This situation, assigning resources to mutually exclusive uses, is called an *assignment game* and it always has a nonempty core. The payoff structure is summarized in Table 2. Total surplus is maximized if Alan works for LA and Betty works for NY: $90 + 70 = 160$. If this assignment doesn't occur, additional gains to trade are possible.

It is useful to consider the Walrasian prices in this exchange. These are the prices that would force LA and NY to make the efficient decisions. To force LA to hire Alan it must be that LA's surplus from hiring Alan will be at least as large as its surplus from hiring Betty. Labeling the wages to Alan and Betty as A and B, respectively, we require:

$$90 - A \geq 50 - B \Rightarrow A \leq B + 40$$

$$70 - B \geq 100 - A \Rightarrow A \geq B + 30$$

These conditions, together with $A \geq 0$, $B \geq 0$, $A \leq 90$, and $B \leq 70$, define the core of the game. The core is illustrated in Figure 1. The smallest vector of imputations in the core is $A = 30$ and $B = 0$; the largest is $A = 90$ and $B = 60$.

As noted earlier, the core is sometimes thought to be too strong a solution concept: when there are substitutes, it treats the competition as Bertrand. A little computation reveals that the Shapley value produces wages of $A = 1260/24 = 52.5$ and $B = 740/24 = 30^5/_6$. As can be seen from Figure 3, the Shapley solution is not in the core. The Shapley solution reflects the value of every possible coalition. In that sense, it combines consideration of the 'endowment' of the resource with its bargaining position. In this game, A captures the most value. Between the firms, NY more captures more than LA ($1020/24 = 42.5$ vs. $820/24 = 34^1/_6$).

Table 2. Values of employee/firm combinations

Firms	Team leaders	
	Alan	Betty
NY	100	70
LA	90	50

In this context, the opportunity cost or 'value forgone' to LA in hiring Alan is not a meaningful concept unless it is much more carefully specified. From the bargaining results, one could calculate the expected social value of Alan's presence, the expected value to NY of Alan's presence, and the expected loss to NY were it barred from hiring Alan, as well as numerous other measures.[14] (Notice that these numbers are a *result* of knowing the solution to the problem; they do not help solve anything.)

Coalitional power

We now consider the gains to bringing the job resources represented by NY and LA into a single coalition. That is, assume NY and LA are not competing firms, but are branch offices of a single firm. The tableau of Table 2 now shows the expected value of hiring Alan and Betty in each branch office. In this new context all the job positions are specialized resources owned or controlled by one firm. If each office acts independently, there is no change in the game situation. However, if the firm manages the projects as a whole, the branch offices do not necessarily compete with one another in hiring, and it is possible that because of this the firm will pay less for its resource inputs. Indeed, in this case, assuming that the firm acts as a unit, the Shapley values are $A = 280/6 = 46^2/_3$ and $B = 190/6 = 31^2/_3$. The net pay to both Alan and Betty drops from $83^1/_3$ to $78^1/_3$, a gain of 5 for the firm. The firm's extra value is the result of its increased bargaining power. The combination of NY and LA into a single firm skews rent payments in favor of the now-combined NY–LA firm. In the firm, NY and LA stop actively competing with one another for employees.[15] The delicacy of

[14] In our companion paper (Lippman and Rumelt, 2003) we note that opportunity cost arguments contain many such SPOVs (shifts in point of view).

[15] In pure split-the-pie all-or-none bargaining, it is well known that players cannot increase their shares by forming coalitions. This is the Harsanyi (1977) 'joint-bargaining paradox.' This paradox does not hold in situations where coalitions smaller

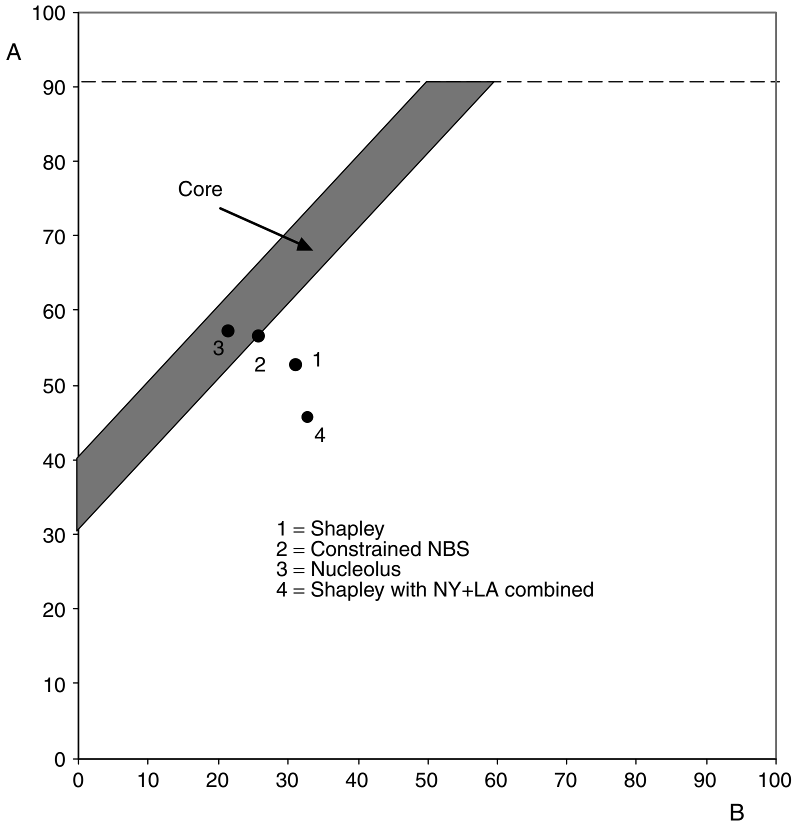

Figure 1. Graph of imputations in the employee assignment game

the real-life business situation is such that much depends upon whether or not the firm treats the imputation of costs to the projects as a market process or as a joint cost allocation problem. That is, if it rewards branch managers on branch profits, its attempts to negotiate centrally will be subverted. We hasten to add that combining agents does not, in general, increase the surplus gained by those agents; the effect of such a combination depends upon the details of the situation.

This increased bargaining power could be labeled pejoratively as 'monopoly power' because the increased bargaining power in our example is indeed the result of reducing competition. Had we named the two buyers of services to be large firms such as IBM and Intel, the increased bargaining power from joining the two would probably elicit the monopoly label. Had we instead begun with one small firm, as a *fait accompli*, and asked whether or not its two divisions should compete or cooperate, it would evoke a different response. Had we pointed out that when LA and NY were separate, a social loss of 10 would occur if their technical interdependencies were not recognized, it would evoke a third response. The varying responses depend upon the particular identities of the players in the game. As long as there is disposable surplus created by complementarities, there is a problem of division that is unsolved by 'market' prices.

Complex imputations

The neoclassical process of imputation of value is subtraction. This logic fails when there is co-specialization. When resources are co-specialized, subtracting the value of each resource, considered alone, leaves an unexplained residual that must be labeled synergy or entrepreneurial skill. Subtracting the values of pairs of resources can leave

than the grand coalition can, by themselves, generate surplus. Nevertheless, whether or not there are gains to forming coalitions depends upon the detailed structure of the game. For example, it is well known that mergers of Cournot firms can reduce total profits.

either a positive or negative residual. Subtracting the value of the whole bundle of resources always leaves zero but is uninformative.

The mechanics for studying a co-specialized bundle of resources is the characteristic function, which specifies the value of each possible combination. To fully analyze a bundle of n resources requires knowledge of the $2^n - 1$ values in the corresponding characteristic function.

Absent complementarities, the characteristic function is additive. The economic problem that complementarities induce resides in the fact that there are neither markets nor market prices for many of the possible combinations of resources. In other words, markets are incomplete. This issue almost passes without notice when we work with two co-specialized resources because the three values correspond to likely market prices: the values of each resource taken alone plus the value of the combination. With four resources, however, 10 intermediate values for bundles with two or three resources are required for a full characterization of the situation. The long history of analyzing co-specialization in bilateral settings has produced many valuable insights, but it has diverted attention from the fact that specification of each resource's outside value by itself is not sufficient to analyze n-resource problems when $n > 2$.

Empty cores

Not all cooperative games have a core. Consider three managers, X, Y, and Z. Each has an outside value of zero. When any given pair of managers work together, their partnership generates a value of 100. When all three managers work together, their partnership generates a value of 120.

This game has a Shapley value (each manager receives 40), but it has no core. If each gets 40, for example, any pair will note that they can do better by dropping the third partner. As a pair, they can each get 50! In this game there are no payments that resist this kind of instability.

The social inefficiency inherent in a game without a core is that the three should work together, because the highest value is produced this way. Nonetheless, the three may not be able to agree on a division of the surplus, whence a three-way coalition may never come to exist. Of course, if X and Y can first sign a binding contract to work together, each getting 50, then there is only an increment of 20 from adding Z. If the contract is a binding commitment, Z will work for some number between 0 and 20, with X and Y extracting some of his marginal contribution simply because they 'were there first.'

Generating surplus in a game without a core requires the formation of a stable coalition. If, for example, X and Y already work for a firm, there is much less problem in adding Z to the game. Alternatively, if none of the three can generate surpluses without the presence of some fourth resource, say a company's reputation, stability is established. A resource that acts as a veto player (nothing works without it) ensures a nonempty core.[16] When partners in brokerage or consulting firms leave, taking key client relationships with them, it is evidence of an empty core. A strong firm reputation, proprietary technology, or large fixed asset base can act as the veto resource, stabilizing the situation.

Hold-ups

The games we have looked at thus far, and most games studied within the CGT tradition, are timeless. When coalitions make coalition-specific investments, the *ex post* situation encourages recontracting the division of surplus. Such game contexts model the hold-up problems studied in the transactions cost tradition (Williamson, 1985). But the CGT frame also shows that similar recontracting problems arise, absent investment, whenever any agent's *ex ante* outside value differs from his *ex post* outside value. For example, if singers form a group, their values alone and together define the bargaining set. After performing as a group, one becomes more popular than the others. At that point, their outside values have shifted and the popular singer will seek to recontract. Think Diana Ross and the Supremes. This kind of problem is endemic in the entertainment business and does not necessarily involve investment. Anticipation of this problem reduces the willingness of individuals to form coalitions.

GAINS TO TRADE IN RESOURCES

The extent to which there are excess returns associated with gains to trade in assets or resources

[16] One stable imputation, for example, is to give all surplus to the veto resource.

has been a subject of controversy in the resource-based view. Barney's (1986) original argument was that gains from implementing strategies could only come from imperfections in factor markets, else the expected gains would be reflected in factor prices. Dierickx and Cool (1989) asserted that tradeability limits the advantage conferred by a resource: 'the deployment of such assets does not entail a sustainable competitive advantage, precisely because they are freely tradeable.' In contrast, Conner (1991) showed that tradeability of a resource was not a barrier to wealth-enhancing trades if there are complementarities between the resource and the acquirer which are greater than those that would pertain to other acquirers. Peteraf (1993) conjoined inalienability and complementarities in her definition of factor immobility, arguing that both inhibit tradeability. Our view is that absent complementarities, the only gains to trade in the asset market arise from asymmetric information. In the examples studied here, complementarities drive the results.

In this section we present two short examples of gains to trade in the market for resources. In each case, all agents have common knowledge of the situation, yet wealth is created by the trade. As in Conner's examples, wealth is created in both instances by the existence of asymmetric synergies with the traded resource, even when the traded resource is non-unique.

Consider competition for baseball players in major league baseball. The New York Yankees is the team with the best geographical location (and history) to generate profits. Given free agency, the Yankees are able to bid more than any other team for baseball talent, the tradeable resource. Almost any ball player with great talent will generate more profit for the Yankees than for any other team. Consequently, subject to the ensuing bilateral bargaining (and the Yankees' need for talent in this particular player's position), the Yankees will (tend to) purchase this player's services[17] because the player's value added is greatest with the Yankees. Because the Yankees value this player more than any other team, they need not pay his full value added to obtain his services. They must, at a minimum, pay his value added to the franchise wherein he adds the second most value. The larger this gap in valuations, the greater value the Yankees can expect to capture by acquiring the player.

Within Barney's (1986) framework, the gains to this trade will have been anticipated by those who granted the Yankees their franchise in New York. Within our framework, unless the franchise grantors own the Yankees' trademark and reputation, they will be forced to split the anticipated surplus. We also point out that even if the cost of the franchise perfectly capitalized future gains, it would nevertheless be incumbent upon the Yankees to actually *earn* the expected gains by seeking out and accomplishing such trades. Just as the value of a rent-yielding resource anticipates the gains-to-trade it will provide in the product-market, so would a perfect franchise price anticipate gains to trade in the resource market. The price anticipates, but does not nullify, such gains. Similarly, the market price of Dell Computer's common stock anticipates, but does not nullify, that company's competitive advantage in the PC industry.

For a second example in which a freely tradeable asset generates differential value depending upon where it is deployed, consider the 1909s VDB, the most valuable U.S. penny. It is needed to complete one's penny collection. But its value is greatest in that (about to become complete) penny collection which is of the highest quality.

Thus, we have argued that it is possible to capture value when the source of the surplus is tradeable, scarce, yet non-unique. We agree with Conner (1991) that what is required is that the synergy between the resource and the acquiring firm is higher than its synergy with any other potential acquirer. The idea of synergy is clear in the case of several fixed resources. Where inputs can vary in quality or quantity, the more general condition of supermodularity produces the parallel result.

Supermodularity

The general case of interspecialization of resources requires the solution of complex mathematical programming problems. The large linear programming solutions to vehicle routing and the like are noteworthy examples of resource assignment problems. Resource assignment problems take on an especially simple 'matching' form when certain regularity conditions are met. As will be shown, that condition is supermodularity.

[17] While slavery is illegal, a contract for labor is, like a leasehold interest, an ownership interest.

To begin, assume that the value of a firm's output is a function of one variable y. This variable measures the factor or resource's quality or quantity. Given the factor input y, the dollar value of firm x's output is $f(x, y)$. Note carefully that the first variable x measures the quality of the firm's unique resource whereas the second variable y measures the quality of a resource to be utilized by the firm in combination with x. We seek to study the situation in which some firms have endowments making them intrinsically more efficient than others. In particular, we say that firm x_1 is more efficient than firm x_2 if $f(x_1, y) \geq f(x_2, y)$ for all values of y. A second strong, though not heroic, assumption is that the factors can also be ranked as to their quality. If $y_1 > y_2$, then $f(x, y_1) \geq f(x, y_2)$ for all values of x. That is, if one firm prefers factor y_1 to factor y_2, then all firms share this preference for y_1. Thus, we have assumed that firm efficiency and firm preference for the factor input are increasing in x and in y, respectively: $f(x, y)$ is nondecreasing in x and in y.

As an elementary example, suppose there are two possible inputs A and B, with B preferred to A (i.e., $B \succ A$), and n firms, labeled 1, 2, $\ldots, n$, and suppose for each i that $f(i, A) = i$ and $f(i, B) = i^2$. That is, firms 2 and 3 have outputs 2 and 3, respectively, from input A and outputs 4 and 9, respectively, from input B. No firm can utilize both inputs. As is obvious, economic efficiency (social welfare) requires that firms n and $n - 1$ employ factors B and A, respectively. (The other firms are idle as there are no other factor inputs available.) This assignment matches firm efficiency with factor efficacy.

Taking another case, suppose $f(n, A) = 10$, $f(n, B) = 9$, $f(n - 1, A) = 6$, $f(n - 1, B) = 3$, and $f(i, A) \leq f(i, B) \leq 2$, for $i = 1, 2, \ldots, n - 2$. Again, the optimal assignment is clear, but this time B is assigned to $n - 1$ and A is assigned to firm n. Obviously, just as in the problem of assigning Alan and Betty to jobs, it is not always the case that placing the most efficient factor in the hands of the most efficient firm maximizes social welfare. In particular, notice when $y_1 > y_2$ that the differences $f(x, y_1) - f(x, y_2)$ are increasing in x in the first example but not in the second example (there, $f(n, B) < f(n, A)$). This condition—*supermodularity*—is needed to ensure that the more efficient the firm the better its assigned factor input. If f is a differentiable function, then f is supermodular if and only if $\partial^2 f/\partial x \partial y \geq 0$. The following are examples of supermodular functions which are nondecreasing in x and in y:

$$f(x, y) = x^\alpha y^\beta, \qquad \text{for } \alpha, \beta, x, y > 0,$$

$$f(x, y) = \alpha x + \beta y, \quad \text{for } \alpha, \beta > 0,$$

$$f(x, y) = \min(x, y).$$

It is easy to prove[18] that if f is supermodular and factors $y_1 \geq y_2 \geq \cdots \geq y_n$ are to be assigned to m firms where $x_1 \geq x_2 \geq \cdots \geq x_m$, then social welfare is maximized by assigning factor i to firm $i, i = 1, 2, \ldots, k$, where $k = \min\,(m,\ n)$.

The patent game

To illustrate the generality of a supermodular value function, consider the following example embodying innovation and an array of specialized complementary assets. Suppose 1, 2, and 3 are pharmaceutical firms, and firm A, best thought of as the factor input, owns a valuable patent on a new drug. Firm A has absolutely no ability to manufacture, market, or distribute drugs. For simplicity consider the cooperative game $\langle \mathbf{N}, v \rangle$ in which $\mathbf{N} = \{1, 2, 3, \text{A}\}$ is the set of players. The value of each resource, by itself, is normalized to zero. Hence,[19] $v(A) = v(1) = v(2) = v(3) = 0$. The value of the patent combined with firm i is: $v(\{A, i\}) = i$. This models the idea that firm 3 is better at marketing and distributing the drug than firm 2, which is better at it than firm 1. There are no complementarities between pharmaceutical firms: $v(\{A,\ i,\ j\}) = \max(i, j)$. The most surplus is generated when the patent is used with firm 3, hence $v(\mathbf{N}) = 3$.

In this case the core $\mathbf{C}$ of the game is the set of allocations $x = (x_1, x_2, x_3, x_A)$ with $\mathbf{C} = \{x : x_1 = x_2 = 0, x_A = r, x_3 = 3 - r, 2 \leq r \leq 3\}$. Notice that firm A, the patent holder, and firm 3 will share the total surplus of 3. Because firms 1 and 2 add no value to the game, only a breakdown in bargaining wherein A and 3 fail to come to agreement

[18] The proof is obtained by contradiction. If the best factor were assigned to firm i and firm 1 were assigned factor k, then interchange these two factors between firms 1 and i and note that social welfare does not decrease. Continue this procedure with firm 2 (but don't make any switch if firm 2 is assigned the second best factor, etc.).

[19] The function v operates on sets. The argument is understood to be a set denoted either by a symbol or by its elements.

would permit players 1 or 2 to garner positive profit. Instead, the core allocates profit r to firm A and profit of $3 - r$ to firm 3, where $2 \leq r \leq 3$. The restricted NBS and nucleolus payoffs in this game are 0.5 to firm 3 and 2.5 to the patent holder.

In the patent game, firm 3 'expects' to capture new value from patents taken out by others that derive more value from its critical resources than from those held by other firms. While its advantage (over firms 1 and 2) derives from a sustained resource asymmetry, it remains able to exploit that advantage through combinations with outside tradeable resources.

GENERALIZED RESOURCE COMPETITION

As noted earlier, Brandenburger and Stuart (1996) have applied CGT to industry analysis. Their basic result is that the ability to capture value in the game requires a favorable asymmetry vs. other firms. The frame (or micro-foundation) we propose here is similar, except that we do not distinguish between the resources of firms and those of suppliers—all are resources. Additionally, we are not convinced that imputations must lie within the core. The fact that many, seemingly plausible real-world games have empty cores makes this solution concept less than fully compelling.[20] Perhaps the core is an appropriate model for the outcome of price competition; however, it seems inappropriate for representing small-numbers bargaining over idiosyncratic resources. Hence, we are unconvinced by the theorems relating value capture to obtaining a nonzero payment in the core. In contrast, we can construct examples in which value capture depends instead upon coordinating the bargaining efforts of resources.

In the gains-to-trade games we have analyzed in this paper, we have treated each firm or agent as possessing one resource of interest. In the assignment problem, we first looked at such a model and then constructed a more complex firm by combining resources. In the general setting we envision, all resources, both those within the firm and those outside the firm, are represented. The firm is not a resource itself. Rather, the firm is seen as a legal shell containing property rights to a set of resources (or, in the case of humans, resource-services). When it is advantageous, the firm's resources act as a coalition in bargaining with outside agents. The total surplus in the game is divided among all resources in the game: there is no residual. In this setting, the value of the firm *is* the total amount of payments to its resources. Of course, the payments to the resources owned outright by the firm accrue to the firm itself.

Resource assembly and strategic equilibrium

We have presented a view of resources that highlights the idea that competitive advantage is obtained from the possession of a resource that is especially efficient or especially valued in some use. In addition, we have stressed that additional value can be generated, and perhaps captured, by combining this resource with others, even though they are tradeable or even homogeneous (on one side of the trade). While the extant literature correctly stresses the importance of the entrepreneurial creation of uniquely valuable resources, we note that under conditions of supermodularity resource combinations and recombinations can be a significant source of value. Finally, in such resource assembly, skill at bargaining and negotiation would further enhance value creation.

We believe that it is important to incorporate this perspective into the RBV. In its current state, the RBV predicts that firms will focus their energies on the development of complex 'home-grown' resources, taking time and care to develop knowledge, know-how, social capital, and other socially complex, difficult-to-transfer resources. Yet a glance at corporate reality reveals that much more effort is devoted to combinations, deals, mergers, acquisition, joint ventures, and the like. Which is more right: the current state of the RBV or corporate reality?

To help frame this issue, define *strategic equilibrium* as the state in which all possible feasible resource transfers that create value have taken place. This concept of equilibrium focuses not upon prices, but rather upon the maximization of total surplus through the assignment of complex, interspecific, unpriced resources to tasks. We offer a simple proposition concerning strategic equilibrium:

[20] Telser (1978) provides an excellent treatise on economics and the core, proving that the standard textbook Viner industry, with its 'U-shaped' average cost curve, has an empty core.

Proposition (resource assembly): Absent strategic equilibrium, it is always possible to create additional value by a reassignment of resources to tasks.

Argument: The accomplishment of full strategic equilibrium maximizes surplus across the set of all possible assignments of all possible resources to all possible tasks. The number of such combinations, in the real world, is literally noncomputable. The idea that firms actually operate at the maximum within this space is not credible.

We note that such reassignments can take place inside a firm, or via the transfer of ownership of resources across firms.

THE WAY FORWARD

Thus far we have emphasized the distribution of payments among resources. Our recommended approach breaks with the idea that prices are known and therefore serve as cost signals. CGT instead seeks to discover the distribution of payments among resources. This shift in perspective reveals the inherent power of the RBV and also clarifies reasoning about resource advantage. Nevertheless, in exchange for abandoning the neoclassical assumption that prices are known, the CGT frame introduces a new assumption: the characteristic function is known.

Once we break the assumption that decisions can be based on known prices, a raft of alternative approaches appear. Operations research and mathematical programming tend to deal with problems of design and allocation wherein the values of combinations can be determined, and where there is no direct modeling of competition. Standard non-cooperative game theory tends to focus on problems of rivalry when the action sets, beliefs, and values can be described clearly. CGT deals with joint problems of rivalry and allocation when the characteristic function is specified.

Breaking the assumption that the choices, actions, and values are given yields areas of management study; resource allocation and general administration are parallel to operations research; business strategy is parallel to cooperative and non-cooperative game theory. Consequently, the CGT approach to resource analysis, as developed in this paper, serves to clarify the subject of business strategy, but it does not strike at its heart. At the center of the subject is the problem of judging, discovering, and creating the values of resources. For example, the problem faced by AOL–Time Warner is more complex than calculating the value of its resources.[21] It is, rather, *discovering* the best use of this resource. Were there complete markets, the firm would have accurate price data on the value in every alternative use of each component of its resource bundle. Such information, of course, does not exist. *The strategy problem is that of attempting to estimate the best use of the resources in hand without such a schedule*.

Of the many approaches to further research on resource advantage, we call out two for special mention. First, it seems evident that it would be useful to have a better understanding of the properties of certain classes of resources. Whereas it is easy to classify intangibles such as brand image and know-how as resources, the properties of such resources are less well established. Brand image appears to be reputation in some cases and a focal equilibrium in others. It appears to have network externality properties in some cases, whereas in others some of the brand's value stems from the fact that it is unrecognized by the mass audience. Looking at know-how, the CGT view immediately reveals that to be a valuable resource know-how must not be simply amalgamated separable human capital, else each person would appropriate his contribution. Know-how must, therefore, be a social phenomenon such that each individual can be replaced but the properties of the whole retained. A number of researchers have contributed to our present understanding of knowledge as a resource.[22] Yet, much work remains to be done. In particular, whereas knowledge has the basic scale economies properties of any information resource, it also has the properties of a self-reinforcing belief system that may, in fact, be 'wrong.'[23]

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[21] This is in the spirit of the many writings of Hayek (1978) and Kirzner (1985). For example, in his chapter entitled 'Competition as a discovery procedure,' Hayek (1978: 182) speaks to 'the absurdity of the usual procedure of starting the analysis with a situation in which all the facts are supposed to be known. This is a state of affairs which economic theory curiously calls 'perfect competition.' It leaves no room whatever for the activity called competition.' He speaks of competition 'as a process of exploration in which prospectors search for unused opportunities' to advance knowledge. (1978: 188).

[22] See Grant and Spender's (1996) Special Issue of the *Strategic Management Journal* on 'Knowledge and the Firm.'

[23] A clear example is the recent telecommunications bubble, where the dominant logic used by investment bankers, venture

A second approach to research on resource advantage is to concentrate directly on the process of deciding on the best 'use' of a resource. Field research on resource allocation has not been framed in this way, but can be seen as addressing this question. At the theoretical level, there remain deep questions about proper administrative processes and the treatment of heterogeneous beliefs.

We illustrate via a simple model one step towards modeling the discovery of resource value. When searching amongst alternative uses, firms understand that it may not be economical to attempt to find the single best alternative use: the cost of locating the best use may be prohibitive. Label uses by their values so that use x generates value-in-use of x, and let F be the cumulative distribution of values-in-use found by the firm when it examines one new previously untested use. Finally, let this search be timeless, and let $k > 0$ be the cost of examining (or locating or considering) a new use. We have thus produced the standard search model with no discounting.

The search problem is well understood. Optimal search is guided by a fixed reservation value ξ and proceeds until a use with value $x \geq \xi$ is found. The reservation value ξ equates the expected gain of one more search, given that ξ is in-hand, with the cost k of search. In particular, ξ satisfies

$$k = \int_{\xi}^{\infty} (y - \xi) dF(y). \quad (1)$$

The value ξ is not only the minimal acceptable use value to this firm, it is the net expected value of the use it finds when the firm concludes its search. The reservation use value ξ is decreasing in k.

Some firms may be more adept than others at locating good uses. More productive search might take the form of a smaller inspection cost k or a (stochastically) better distribution F to draw from. The simpler concept of a smaller inspection cost is adequate to sketch out the argument we wish to make. The more adept firm (with smaller value of k) engages in (stochastically) more search for alternative uses, has a larger reservation use value, has greater expected net profit, and, on average, concludes its search having located a better alternative use.

If one firm is very adept at searching for best resource use, is that skill a resource? After all, each x in the above model represents the expected payment in a complex cooperative game. Not only is there a vast set of games, but there is the possibility that other firms are similarly searching and that there may be interactions between these searches. That is, given a set of uses $\mathbf{U}_1$ discovered by firm 1 and another set $\mathbf{U}_2$ discovered by firm 2, the value of any particular use to firm 1 may depend upon the use selected by firm 2.

The model just sketched is a brief version of a number of 'dynamic' theories of resource advantage that have been developed. We suggest that the justified interest in such theories should not blind us to the fact that the concept of a 'meta-resource' appears empty. In the end, after the analysis is done, we shall always find that future heterogeneity in performance is induced by a combination of present heterogeneity in some parameters (call it endowment) plus random factors. Once research and analysis help us discover the values attached to that form of endowment, the RBV framework applies: attention turns to the source of endowment scarcity, the conditions governing appropriability, and its future imitability.

CONCLUSION

Strategy scholars have been exploring a market failures framework for understanding the source of sustainable rents. We propose that the neoclassical framework is inadequate to that task. The problem of sustainable rents gains richness and clarity by being posed within a form of cooperative game. In CGT, rents appear as the negotiated payments for the services of scarce valuable resources. The use of CGT permits analysis of the division of surplus as determined by the relative values created by different use combinations of resources. Within this framework, the strategy problem is clearly seen as one of discovering or estimating the value of various resource combinations. Wealth can be created

capitalists, and entrepreneurs was an analogy between the past development of the PC industry and the future development of telecommunications. This widely adopted analogy was wrong because it ignored critical differences. Whereas excess capacity in computing does not depress the price of a PC (you cannot use my PC while it is idle), excess capacity in telecommunications networks does. Whereas the Intel and Microsoft standards were proprietary, the new telecommunications technologies were not. Whereas new technologies dramatically cut the cost of long-haul data transfer, the limiting factor was the price of last-mile connectivity, which rose rather than fell.

(and destroyed) as long as there are changes and/or unexamined combinations.

The central holding of market economics is that prices drive economic behavior. To the extent that prices serve resource allocation purposes, there remains a vast reservoir of unpriced resources and *resource combinations* to be managed. Indeed, the heart of business management and strategy concerns the creation, evaluation, manipulation, administration, and deployment of *unpriced* specialized resource combinations. The fact that resource bundles are unpriced does not make them more valuable or of greater efficacy in attaining advantage. Other things equal, intuition suggests that a resource bundle will be more valuable if it can be accurately priced.

Being unpriced means that a resource or resource bundle's best use cannot be accurately guided by prices—by established market values in this and other uses. However, lack of price information does not preclude rational decision-making: witness the efficacy of large-scale linear programming, network flow, and simulation models in arranging the activities and resources of many firms. Accordingly, to sail farther from the shore we advocate drawing more deeply on the rich tapestry of nonprice nonmarket models. We have attempted to do this via application of CGT. Strategy scholars can find stimulation to enhance these models in many allied disciplines such as operations research, management science, information systems, network theory, and human resource management.

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