ENTREPRENEURSHIP AND FIRM BOUNDARIES: THE THEORY OF *A* FIRM

Michael G. Jacobides
Assistant Professor of Strategic and International Management
London Business School
and Sumantra Ghoshal Fellow, Advanced Institute for Management Research
Sussex Place, Regent's Park, London NW1 4SA, United Kingdom
mjacobides@london.edu; Tel (+ 44 20) 7706 6725; fax (+ 44 20) 7724 7875

Sidney G. Winter
Deloitte and Touche Professor of Management
The Wharton School of the University of Pennsylvania
Suite 2000, SH-DH, 3620 Locust Walk, Philadelphia PA 19104-6370, USA
winter@wharton.upenn.edu; Tel (215) 898 4140; fax (215) 898 0401

Version 1.3 – October 26th , 2005

.

ENTREPRENEURSHIP AND FIRM BOUNDARIES: THE THEORY OF *A* FIRM

Abstract

In this paper, we consider how a better understanding of entrepreneurial activities can help explain how firm and industry boundaries change over time; and how a more complete understanding of boundary setting can help us understand where entrepreneurial activities are directed. We argue that while entrepreneurs believe themselves to have superior ideas in one or multiple parts of the value chain, they often are short of cash – or of the ability to convince others to provide them cash / capital. On the basis of this observation we construct a simple model in which the entrepreneur has a value-adding set of ideas for "upstream" and "downstream" parts of a value chain, as well as for the ways to make these two parts of the value chain work together even better. Assuming that the entrepreneur's objective is to maximize her wealth , we observe that even in the presence of transactional risks or other factors that might make integration preferable to specialization, scope depends on factors that theory has not explored: in particular (a) how severe the entrepreneur's cash constraint is, and (b) how much value the entrepreneur's ideas add at each part of the value chain. Entrepreneurs will focus on the areas that provide the maximum profit yield per available cash – a criterion which implies that scope choices depend on cash availability and the depth of the demand for the new idea along the value chain. We also consider the implications of admitting that entrepreneurs make money not only from the operating profits of their firms, but also from sale of the assets the firm has accumulated. This can change the optimal choice of the firms' boundaries, as entrepreneurs must be sensitive to choosing the segment that will enable them to benefit not only in terms of profit, but also in terms of asset appreciation. In conclusion, we propose that rather than speaking generically about firm boundaries and the theory of "the" (representative) firm, we should instead focus on the considerations affecting the choice of boundaries for "a" firm – the choices made by an individual entrepreneur, taking into account all the conditions that face him. Scope, then, will depend on the entrepreneur's own theory of "how to make money".

Academic division of labour has much to offer. By creating focused areas of expertise, knowledge can accumulate and our understanding of individual topics can be greatly enhanced. Yet, as with any other division of labour, such specialization can create blinders that make us oblivious to important connections and to regularities that do not neatly fit any of the focused sub-fields of study. A prime example of the risks of such extensive specialization is the separate development of the field of entrepreneurship and of the study of firm boundaries, and more broadly of the theory of the firm. We argue that a better understanding of the nature and function of entrepreneurship can augment our understanding of how firm boundaries are chosen, perhaps revising standard theoretical predictions on when we should expect integrated production to trump a vertically co-specialized ecosystem. Likewise, a better appreciation of how firm boundaries are chosen can help us better understand (and prescribe) the direction of entrepreneurial activities, and the scope of entrepreneurial ventures. Our paper is an effort to provide such a synthetic account.

First, we briefly consider why entrepreneurial activities are critical in shaping firm and industry boundaries. They help change the transactional and institutional structures of a sector. Through the creation or strengthening of new markets along the value chain, entrepreneurs catapult integrated sectors into vertical dis-integration, or help build new, all-in-one integrated markets.

Second, and more central to our inquiry, we consider how individual entrepreneurs decide the scope of their ventures, given the transactional and financial conditions they face. We think of entrepreneurial action as intentional effort to seize a profit opportunity – or, more accurately, to seize an opportunity to create private wealth for the entrepreneur. We consider such effort to be entrepreneurial when it goes beyond the ordinary effort to seek out the most favourable deployment of the ordinary human (and perhaps financial) capital of the entrepreneurial individual.[1] So, virtually by definition, entrepreneurial activity (be it carried out through a start-up or within a large corporation) must be extraordinary, idiosyncratic, unusual and/ or

---

[1] This viewpoint warns against any general propensity to identify entrepreneurship with "small business" in general. Many owner-operated small businesses are best viewed as a manifestation of the ordinary functioning of labour market institutions. They are responses to the diverse reasons why operating such an enterprise might offer an attractive way for an individual to derive income from a particular skill set, by comparison with the other institutional / organizational arrangements for making use of those skills (e.g., employment in established corporations). Such enterprises, and the acts of founding them, are not within the scope of "entrepreneurship" as we understand it. The entrepreneur we are concerned with is trying to make money not just from his skills, but from his insight – insight in recognizing an economic role that could be filled and that promises returns well in excess of the prevailing opportunity costs of the resources required to fill it.

peculiar. What the entrepreneur sees, few others can see, else the opportunity would not be there.

A theory of entrepreneurial behaviour, then, must be founded on the recognition that the distinctive common themes in the behaviour of diverse entrepreneurs cannot be "common" in an ordinary, first-order sense. Such a theory is an effort to capture what is common to the uncommon. We propose that the key commonality across entrepreneurial situations is the difficulty of convincing the rest of the world that the entrepreneurial vision is correct. Such difficulty has the direct (and common) implication that it may be difficult to persuade the rest of the world to help finance the entrepreneurial effort, except perhaps on onerous terms. On the basis of this principle, our paper explores the indirect implications for entrepreneurial decisions about firm scope.

We start with a brief discussion of how entrepreneurs transform the boundaries of their industries on the basis of their new ideas. We then delve more deeply into the narrower question, considering how entrepreneurs choose the boundaries of their own firms. To do so, we prepare a simple model as our baseline. We focus in particular on the nature of the cash constraint that the entrepreneur faces; on the types of returns that she expects from the venture; and on the types of transactional difficulties associated with being vertically specialized as opposed to integrating along a value chain. Our analysis suggests that transactional conditions alone are not sufficient predictions of the venture's scope; and that other factors unexplored by current research, have to be taken into account. We show how these factors interact to drive scope, assuming that the objective is to make profits. We then expand our analysis by looking at how additional ways of making money (through increases in value of the assets used at each part of the value chain) affect the appropriate choice of vertical scope. Our results highlight the role of asset appreciation, which, we argue, should be better incorporated in our analysis of what motivates economic activity, including but not limited to the choice of firm boundaries. Finally, we discuss how our analysis of the entrepreneur's problem, and the results of our model point to gaps or inconsistencies in existing theory in entrepreneurship, strategy and economics, that can be constructively filled.

Existing theory on firm boundaries

The question of the boundaries of the firm, and in particular of vertical scope, was first raised by Coase, (1937), who observed that in deciding how to set their firms' boundaries, entrepreneurs and managers weighed up the benefits of relying on internal production against

the costs and risks of using the market. However, it was not until almost forty years later that the pioneering work of Klein, Crawford, & Alchian, (1978) and Williamson, (1971, 1975), led to what we now know as transaction cost economics (TCE). TCE showed that, under certain conditions, the costs of using the market would be such that the firm would decide to internalize a transaction through producing in-house. The question of vertical scope was central to TCE (Williamson, 1985), and a firm's decision about its boundaries became synonymous with deciding whether to integrate a particular transaction within its own governance structure: to make rather than buy. Commitments to relation-specific assets, TCE pointed out, could lead a party to a market transaction to become vulnerable to opportunistic *post hoc* renegotiation pressures from the other side. To safeguard such assets, firms might have had no better choice than to integrate, especially if uncertainty exacerbated the risks involved in renegotiation. Therefore, to understand a firm's boundary decisions it is necessary to understand the determinants of asset specificity, as a huge body of empirical and theoretical research has tended to confirm (David & Han, 2004; Shelanski & Klein, 1995).

Various researchers have critiqued, elaborated on and expanded beyond the TCE viewpoint. Kogut & Zander (1996), for instance, suggested that firms provided more than transactional havens; they provided loci of identification, and the organizational backdrop against which knowledge and experience could be shared and applied, a theme amplified by Ghoshal & Moran (1996). Conner & Prahalad (1996) built on earlier work and suggested that integrating not only saves on transaction costs (helps "avoid the negatives"), but also helps create value through better information flow, coordination, and concerted problem solving (Arrow, 1974; Nickerson & Zenger, 2001; Pelikan, 1969).

Over the last decade attention has shifted towards examining how the capabilities and idiosyncratic aspects of firms might affect their boundaries. Drawing on Barney (1984); Penrose, (1959); Richardson, (1972), and research in evolutionary economics (Nelson & Winter, 1982), researchers have recognized that firms might be packages of competence , whose scope is path-dependent. It thus became accepted that the decision about whether to integrate or not may be related to the firm's capabilities, and how best to profit from them (Chesbrough & Teece, 1996; Barney, 1999; Teece, 1986). Argyres (1996) found that the decision about whether to make or buy was based on both capabilities and transaction costs, a finding replicated in large-scale studies by Combs & Ketchen (1999); Leiblein & Miller (2003); Schilling & Steensma (2001), and Jacobides & Hitt (2005). These studies suggest that in setting their boundaries, firms have to take account of their own particular conditions and

circumstances (Madhok, 2002; Williamson, 1999). In this regard, the most seminal contribution undoubtedly comes from Teece (1986), who considers how an innovator or entrepreneur should organize the scope of his venture on the basis of transactional characteristics.

Entrepreneurship and industry boundary formation

All the research referred to above, though, does not directly consider how and why firms change their boundaries, in the absence of an exogenous change in transactional features. So, as we have argued elsewhere (Jacobides & Winter, 2005), to understand a firms' vertical scope we have to understand not only the way they perform the "make-or-buy" calculus on the margin, but also consider how firms shape the menu of transactional alternatives in an industry. A casual perusal of industry histories suggests that they undergo periods of integration, followed by dis-integration, perhaps followed again by re-integration. So the crucial question becomes, what drives the emergence of new ways to organize an industry's value chain? Or, in ecological terminology , what enables speciation of new vertical participants along an industry's value chain?

Consider first the process of vertical dis-integration. In his study of the mortgage banking sector in the US, Jacobides (2005) demonstrates how vertical dis-integration transformed a set of fairly similar, integrated players, to a host of vertically co-specialized entities (mortgage brokers, mortgage bankers, securitizers, asset holders, specialized servicers, support providers) that would co-exist with the more integrated firms. This process, which allowed for latent gains from trade to be realized through industry transformation, was based on entrepreneurial intervention partly originated from entrants, including those who could quit their existing employers and team up with others to serve the emerging, specialized needs in the sector. It was also partly driven by entrepreneurial participants who stood to win from the new, vertically co-specialized structure, such as technology vendors and infrastructure providers.[2].

---

[2] This concerted effort, the entrepreneurship in both coming up with new ways of organizing, and of identifying the way in which these conceptions can be turned to reality, is often direly needed. For an industry to be broken off in different constituent pieces, all sorts of issues need to be addressed: Interdependencies between previously integrated parts of the value chain must be reduced, or systematized so that coordination can still take place, despite dis-integration; information must often become more standardized so as to facilitate market exchange (Baldwin & Clark, 2003; Jacobides, 2005); and "discontinuities" must be found so that intermediate products can be duly measured and assessed (Barzel, 1981). For that to happen, not only do entrepreneurs need to find ways to make businesses connect to each other in new, effective ways; they also often have to participate in the change of the legislative and administrative framework which affects or regulates their behaviour, thereby ensuring that their activities can become formally institutionalized. Finally, in addition to the formal, legal and administrative

Similar evidence of entrepreneurship can be found in the process of the new, integrated "all-in-one" market emergence, such as the one that occurred in the UK construction sector, and pushed it from a fully dis-integrated structure to a market dominated by vertically re-integrated players (Cacciatori & Jacobides, 2005). In this setting, entrepreneurs understood the potential value from re-organizing the bits and pieces of the production process into a new offering. To do so, the firms that spearheaded re-integration had to work with regulators to ensure that constraints on integrated service provisions were lifted, and devise new means of connecting with customers and financing the buildings that would allow this new structure to be feasible. Thus, firms found new ways to leverage existing skills and to ensure that old roles and structures would be changed in their favour.

The analysis of *industry* boundaries thus highlights a crucial element that was lacking in our understanding of scope, the role of entrepreneurship in the process of discovery or creation of new alternatives (cf. Alvarez & Barney, 2005). To understand how firm and industry boundaries alike change over time, we have to consider the conscious agency of entrepreneurs, be they parts of an existing business establishment or ambitious outsiders, who can potentially transform the vertical structure of production.[3] Such research would bring us full circle back to the writings of Knight (1921) and Schumpeter (1911), and also Veblen and the Austrians, who identified the importance of entrepreneurs as agents of significant change in their environments.

Yet while the research surveyed above points to the need to integrate entrepreneurship in our theories of firm and industry boundaries and makes some headway in our understanding of how industry boundaries are formed and evolve, it still does not inform us much on how entrepreneurs set the scope of their own ventures. The remainder of this paper will be focused on this narrower question, and will seek to explain how boundaries are chosen by entrepreneurs.

---

changes, entrepreneurs often have to mobilize their efforts to ensure that they also change the "social" institutions, i.e. lead to a greater acceptance of their proposed new ways of organizing the value chain

[3] Entrepreneurs might also come up with new ways of using the overall boundaries of a firm, to reinvigorate their companies. Through partially opening up a firm to intermediate markets along the value chain, e.g., entrepreneurs can improve benchmarking, calibrate managerial incentives, assist the resource allocation process, and support "open innovation" while nurturing systemic capabilities (Jacobides & Billinger, 2005). Thus, they can also promote new, potentially useful organizational architectures.

How is scope chosen in entrepreneurial ventures? A positive framework

As we mentioned in the previous section, existing research has generally focused on a small number of factors (in particular, transaction costs) with a view to confirming their statistical significance. The question of how these factors intertwine with other considerations affecting firms' scope has been relatively neglected. Over the last few years, however, the healthy interest in the specificities of each firm has led to the inclusion of factors that describe a firm's capabilities and history / path-dependent context, as well as to the consideration of the potential role of "real options" value represented by institutional arrangements. Our contribution is to continue down that productive path, focusing on the specificities of the entrepreneurial setting. We thus develop a set of propositions that provide a reasonable characterization of the problem the entrepreneur faces – and how that relates to firm boundaries. Because entrepreneurial situations are intrinsically diverse, such an analysis is inevitably highly contingent – and its purpose is to get the relevant contingencies in view. So rather than starting with the theory to consider our setting, we give primacy to the setting – the entrepreneur and her decision, using the theoretical tools that seem to suit the problem.

The entrepreneur is, in general, rich in ideas and poor in cash. This could apply both for "traditional" entrepreneurs – individuals who would want to undertake new projects, ostensibly by forming a new firm or changing the direction of their current firm; and for corporate entrepreneurs, individuals who would want to develop a new project in the context of an existing organization, for which funding is problematic. The challenge that the entrepreneur faces is that she has some unique insights (though these are possibly derided as folly by others) but, on the other hand, cannot easily prove that these insights are right. (If she could, then we would not be dealing with an entrepreneurial setting). Or it may just be that the entrepreneur has a very different read from the rest of the world. So, in addition to the confidence she has in what she believes to be superior ideas, another component of an entrepreneurial setting is a relative cash shortage, at least a compared to her preferred plans.

Were the entrepreneur's ideas readily fundable by a financial institution, the capital market, an outside party, or by the institution where she is employed, then again we would probably not be talking about an entrepreneurial venture.[4] While funding may well exist (e.g. from venture

---

[4] Indeed, it is the fact that the entrepreneur has a particular set of beliefs about what "will work" which differs from others' beliefs, and that there is uncertainty about whether these beliefs make sense that underlies the very opportunity for entrepreneurial profit. As Knight noted, "true uncertainty which by preventing the theoretically perfect outworking of the tendencies of competition gives the characteristic for of 'enterprise' to economic organization as a whole and accounts for the peculiar income of the entrepreneur" (1921: 232)

capitalists, other specialized providers, etc.), its terms of access and relative costs (in terms of the share of ownership that the entrepreneur might need to give up) qualify the attractiveness of resorting to this option.[5] It is also worth stressing that while we treat cash as the principal constraint on choice of scope, there might be other relevant scarce resources to which a similar logic applies – capabilities, attention of the entrepreneur and other key personnel, etc. The role of these is likely to be quite variable from one case to another, while the cash constraint is a recurrent theme that may be expected to impact scope quite generally.

The entrepreneur's idea, then, may span several parts of an industry's value chain. The idea might be industry-transforming, as in the case of a newly dis-integrated service (e.g. a new outsourcing offering to existing firms, or a new role for a vertical specialist); or in the case of a newly re-integrated market, an idea for an "all-in-one" service which did not exist before. But, for simplicity's sake, we leave instances of industry transformation outside the current analysis, and consider an entrepreneur contemplating entry to a two-segment industry. She could have a great idea for improving the operations, or creating a new service or product upstream, downstream, or both. The two-segment setting will allow us to examine the basic logic of boundary choice, which can be extended to any number of vertical segments.

To illustrate, consider the restaurant business - suppose the entrepreneur is contemplating entry to the high-end, trendy restaurant segment, in sophisticated urban settings. The entrepreneur could have a great idea with regards to the identification and running of the property – i.e. being able to identify a new trend, a new area and style that might transform, say, a previously run-down building into a swish, trendy locale. The entrepreneur's new insight idea could also apply to the restaurant "concept", that is both with the actual cooking, and with the running of the place- the style of the restaurant, the nature of the offering, etc. Obviously, co-specialization between cooking and property yields some additional benefits from integration. Identifying the locale and turning it into exactly what fits the restaurant

---

[5] To make our analysis simpler, we will focus on the case of the entrepreneur as an individual; most of our analysis, though, does apply to corporate entrepreneurship as well. That being said, corporate entrepreneurship gives rise to new firms that begin life with a substantially different set of advantages, especially resource availabilities, than is characteristic of personal entrepreneurship. Typically, the enterprise exists because one or more corporate parents has already been persuaded that this effort makes sense, and may well have taken a financial stake reflecting that judgment. However, recent scholarship has made very clear that that there is a continuum of cases with respect to the role played by some pre-existing enterprise in a startup. E.g. consider the Klepper analysis of the U.S. automobile and tire industries, which are shown to be populated by firms founded by former employees of existing firms – and who evidently derive important advantages from this historical connection. Thus, the analysis of personal entrepreneurship must often reach within the gates of an established business, even if that business is not an actual sponsor or financial participant in the new one.

"style" and "concept" would yield better results than just having a "concept" and looking for a property to house it. Likewise, having the ability to identify and turn around a property might not work out that well if the style of the restaurant and the cooking were not well-aligned to the property and its location. . In addition, Williamsonian (1985) transaction costs may emerge should a restaurateur focus on only one of the two parts of a value chain: The property owner at a (newly) swish locale, made prosperous not by its own merits but largely through the skills of the vertically focused restaurateur, would have the incentive to raise the rent of the property. Promises to abstain from this would be subject to opportunistic default, given the highly specific commitments of the restaurateur to the location. Thus, the vertically focused restaurateur would face the risk of a hold-up.

Given this setup, existing theory would largely focus on the nature of interdependencies between the two vertically linked stages. The questions would then become, what are the transaction costs that would emerge should our restaurateur decide to focus on only one of the two parts of the value chain? Will there be a risk of hold-up, especially if she focuses on the area she can improve the best? Can she devise effective arrangements with arm's length spot contracting? Or should she instead consider long-term contracting to try to ensure that she her transaction partners are not the principal beneficiaries of her ideas? Is it that transactional conditions are so tough that nothing short of integration will protect her? (See Williamson, 1985; and especially Teece, 1986, for a thorough analysis of the pros and cons of different actions). The analysis of such transactional conditions has done much to improve our understanding. It is however, more relevant to understanding the broad patterns in well established activities than it is to the specifics of entrepreneurial choice. That is, the question that is answered by the literature is typically , "do the transactional conditions, and the nature of the idea of the entrepreneur, make governance choice A (e.g. vertical specialization with arms'-length contracting) superior to choice B (e.g. alliance) or C (e.g. full integration)? And, what determines when A is better than B or C"?   Important as this question is, it is *not* the question that a resource- and finance-constrained entrepreneur asks. Rather, the entrepreneur asks, "how can I make the most return on my limited resources (cash in particular) given the nature of my idea, as well as the transactional conditions that exist?" This is a fundamentally different question, where the consideration of transactional hazards is subordinated to the broader challenge of making money. We need an approach that considers the full gamut of considerations that influence scope- not one that aspires to prove or disprove the significance of a particular partial determinant of scope (see Jacobides & Hitt, 2005).

Understanding entrepreneurship: conceptual foundations

Before describing our specific model of the scope choice, we present our view of the conceptual foundations of the broader subject. We propose that the most promising starting point for an analysis of entrepreneurial behaviour is to make a particular assumption about the entrepreneur's objectives and motivations – namely, to posit a desire to increase personal wealth. This proposal is hardly original or controversial at this point, since this same basic assumption has been adopted by countless scholars and commentators, both famous and obscure, over a period of centuries. Neither could one advance the discussion much by offering a critique of this familiar assumption on the ground that it is not "the whole truth." Of course it is not the whole truth, but that point too has been well made. We understand that the unyielding constraint at 24 hours per day necessarily imposes other motivations, that "personal" should oftentimes be replaced by "family," that the thrill of the chase may matter a lot, that a quest for fame or vindication of judgment, or solidarity with the venture team, may also play a role in the psychology of entrepreneurship. Regarding our example case, we acknowledge that many restaurateurs choose their ventures partly as a means of personal gratification or hobby. Yet we cannot build an effective positive theory of entrepreneurship if we do not consider something that is common to most, even if not all, ventures. If logic is to be an effective tool for clarifying matters, there has to be a clear and unequivocal starting point. From this instrumental viewpoint, there clearly is no sensible alternative to the idea that "this is about getting rich."

Yet the problem of "getting rich", simple as it seems as a principle, is not examined as carefully as it might be in most (economic) analyses (see Lippman & Rumelt, 2003). In particular, a failing of "textbook orthodoxy" in economics (see Winter, 1988) has been the absence of any discussion of the role of asset price changes as a driver or consequence of economic and strategic activities – itself an unintended side-effect of the consistently forward-looking perspective of price theory (Arrow & Hahn, 1971).[6] And, despite the attention that

---

[6] The objective of that theory is to explain why things carry the prices they do, and the resource allocations that are antecedent to or entailed by those prices. Toward these ends, neoclassical economic theory adopts a powerful simplifying assumption involving a strictly forward-looking view of cost as opportunity cost (in some sense). This means that realized changes in asset values are always "bygones" and have, *per se*, no consequence for future prices -- beyond perhaps some wealth or income effects on consumption patterns, which are typically ignored. Foreseeable future changes, on the other hand, are linked to current prices by no-arbitrage conditions that themselves directly declare the absence of opportunities for abnormal profits. In an important sense, therefore, asset price changes play no role in the theory. And because they are not in the theory, they are also not on "the books" in the economist's version of "the firm" (to the minimal extent that anything resembling books is actually visible in that picture).

resources and capabilities have attracted in the field of strategic management over the last decade or two , the important distinction between *having* strategically significant resources and *acquiring* such resources on advantageous terms has tended to resist full clarification (but see Barney, 1986, 1989, 1991; Dierickx and Cool, 1989; Winter, 1995; Denrell, Fang and Winter, 2003).

Financial accounting principles make their own distinctive contribution to the potential for confusion, because asset values on balance sheets are typically reflective of historical acquisition costs (not current market prices or unreliable assessments of an unknown future). Changes in market prices of assets do not impact accounting versions of cost and income in any direct way –the rules of depreciation accounting, as well as the specific temporal patterns of production and asset acquisition, intervene. This generally means that today's success in "buying low" in the asset market will be transformed by accounting procedures into apparent operating cost savings in the future, as under-priced assets on the books are notionally allowed to flow through into productive use. Such savings become virtually indistinguishable, in accounting consequence, from technical operating efficiencies. [7]

Consider, for instance, the case of an oil refiner. According to textbook economics an oil refiner is hit hard when its key input, crude oil, rises sharply in price. This is quite true for the refiner qua producer – and producers is what firms *are* in textbook theory. The textbook analysis delivers clear and correct implications for the future price of refined products, for revisions of existing plans to build more refineries, and so forth. In reality, however, many of these refiners are also holding large amounts of related assets – particularly crude oil reserves, but also inventories of crude and refined products. In that role, they benefit from a large speculative gain when the price of crude rises sharply, and certainly are not "hard hit." Paradoxically, the oil refiner/reserve holder companies described above may look profitable *as refiners* for years to come as a result of the cost accounting for the expensive crude they are using, whereas in fact the crude price increase is a setback for them *as refiners*. [8] Meanwhile, the speculative success goes unrecorded.

---

[7] It is true that there has been a recent trend to "mark-to-market" or "fair value" accounting., which has acquired some momentum. This trend, however, seems to relate primarily to accounting for financial assets, where current valuations are more readily available and the distortions produced by historical costs are more egregious. We should also note that, beyond the problem of historical costs, there is the even more fundamental point that key strategic resources such as capabilities and reputations are not recognized as balance sheet assets at all.

[8] It is not clear who is actually misled by the accounting conventions, but it is quite clear that not *everyone* is misled; also, occasionally some re-appraisals of assets do happen, yet they are few and far between. Either way,

This point has substantial implications, which go far beyond the need for terminological consistency or analytical clarity (cf. Lippman & Rumelt, 2003). As Hirshleifer (1971) noted in his seminal paper, the asset appreciation path to entrepreneurial wealth can remain open even when the direct financial success of the venture itself is compromised by imitation. Indeed, the bigger the swarm of imitators, the more likely that any underlying scarcity of the relevant specialized assets will be reflected in value appreciation. In terms of our example, even if an entrepreneur who has found a successful new formula for attracting high-end diners in newly trendy locales gets emulated, and if competition intensifies, her wealth may increase, as the intensification of competition will increase the price of the assets that the restaurateur has – such as prime location in the newly appreciated locales. If she has the cash available at an early stage, she might sensibly take an equity interest in a few nearby properties. Thus the same idiosyncratic information that drives the productive venture also has implications for the asset portfolio; the two paths compete for attention in the entrepreneur's single budget constraint, and also interact. Perhaps paradoxically, the entrepreneur may find herself *wishing* that her idea becomes more widely recognized, inasmuch as potential wealth from asset appreciation may more than compensate lost profit from intensified competition.[9]

In the analysis that follows, we first consider the scope choice under the condition where the entrepreneur anticipates no asset value changes, and then introduce that consideration into the picture, showing that the inclusion of asset appreciation can be a potent predictor of the direction of entrepreneurial scope.

Summing up, our approach suggests (a) that the transactional elements, which have been studied extensively to date, are a part of the entrepreneur's calculus; (b) that other factors in addition to transactional considerations, go into that calculus; (c) that cash constraints are expected to affect the scope of the enterprise; (d) that the objective the entrepreneur has is to maximize returns; (e) that returns may not be limited to "profits" as that term is understood in economics, hence understanding what different types of returns enter the equation is

---

much as we might like to take credit for a new insight, this is not the case. The point is "well known," yet probably more so in practice than in theory.

[9] There are further implications that caution against the baleful influence of the price theory textbook. Whereas entrepreneurs are commonly conceived as pursuing "profit," the profit that the textbook has in view is the excess of operating revenues over costs, with costs at opportunity cost values. An entrepreneur who actually set out to maximize this sort of profit might make the same contribution to society as one who took a broader view of the problem, perhaps even a larger contribution -- but the one who takes the broader view is likely to wind up wealthier. Thanks to the accounting conventions, the distinction between these two paths will be partially obscured by the fact that, so far as the assets supporting his own operations are concerned, the second entrepreneur's speculative success is transformed in appearance into operating efficiency.

important; and (f) that some factors that have not been thoroughly explored to date, such as the nature of the benefits and capital intensity of the new idea; or the extent of latent demand will also need to be included in the entrepreneur's calculation. With this background, we can provide a simple stylized model that brings these ideas to life, while remaining tractable and putting them in understandable order.

A stylized model of scope determination for the entrepreneur

Here we describe a simple model of the entrepreneur's choice of scope for her venture. It is framed as a linear programming (LP) problem – drawing on a body of technique once in vogue but more recently neglected in economic theorizing (see the Appendix and references cited there for a review). The particular virtue of the LP framework in the present context is that it provides a way to organize a large number of quantitative considerations that all bear on a single decision, far more considerations than can feasibly be handled in a tractable analytical model of the more familiar kind. The drawback is that, beyond its organizing and logic-clarifying aspects, the model is essentially an engine for exploring numerical examples. It can therefore address the question of what *could* happen, but is not at all forthcoming with conclusions about what *must* happen. We argue that this open-endedness is actually a virtue in the context of entrepreneurship studies since, as we have emphasized, the individual cases of necessarily are necessarily idiosyncratic and collectively form a highly diverse population. Valid propositions are therefore highly contingent, with a lot of specific "ifs" preceding the "then."

The basic form of the calculation is this: The calculation covers a single period, which is assumed to be a year. The entrepreneur has various alternatives available to implement her idea, which differ in vertical scope. She has limited initial cash available to spend on the necessary capital equipment, which we simply call "capacity." We assume that it is only capacity that imposes a financing requirement, i.e., there no financing is needed for working capital (as, e.g., in the case that accounts receivable and accounts payable work on a similar cycle). Furthermore, we allow for the entrepreneur to invest any cash she does not use for her venture and earn a return from such a portfolio investment, so that cash allocation will need to take into account outside opportunities. Then, at the end of the period, the firm recovers the value of depreciated capacity, plus the net proceeds from its transactions in inputs and outputs, plus any potential interest earnings from lending (portfolio investment). Thus, if the rate obtainable from lending (investing) exceeded the rate of return on the entrepreneurial venture,

the venture would not be undertaken. The formula for the value of depreciated capacity reflects the possibility of price appreciation. It is this last feature of the model that represents our point that (operating) profit is not the only path to the creation of new private wealth.

Summing up, the criterion for the optimization is the entrepreneur's final cash – which corresponds one-to-one with net present value to the entrepreneur at the start of the period, since initial cash and the interest rate are fixed. This differs from the economic profit from operations in that it includes price appreciation or depreciation on the assets held during the period.[10]

As noted above, the entrepreneur can choose alternative modes of implementation of her ideas; and it is that choice we focus on. In modelling this, we assume first that there are two vertical stages. The entrepreneur can choose from a range of participation modes spanned by four basic approaches, called *Hollow*, *New Int*, *New Fin* and *Full*. In the LP formulation, these are the activities, and linear combinations of them (with positive coefficients) are also available, subject to the limitations imposed by the constraint system; in other words, the entrepreneur can opt for "tapered" or "mixed form" solutions spreading her capacity between different choices (see Harrigan, 1985).

Specifically, "*Hollow*" (for Hollow corporation) involves no fixed capacities or assets on either part of the value chain, and hence no cash outlay; it involves buying the intermediate product and outsourcing the final stage, which we call "assembly." Thus *Hollow* represents the potential value added that obtains from the idea alone, without the added benefit of implementing each of them "right" in each stage of the value chain, and with the added challenge of the potential TC on both segments. "*New Int*" (for New Intermediate product

---

[10] We should point out that the structure of our model has the advantage of parsing out issues that are usually considered jointly in standard economic theory. For instance, we consider the operating profit independently of the opportunity cost of capital, which is represented in our calculations through the lending rate. Economists would have typically included an 8% cost of capital in the calculus, whereas for reasons of tractability we provide a separate analysis for the potential returns on operations, and the alternative uses of capital. Our results will be consistent with those of standard theory, as in our model the entrepreneur will only invest as long as the "apparent" MROR is higher than the opportunity cost of capital, i.e. the returns from portfolio investment. The MROR can be viewed as an *internal* opportunity cost of funds, relevant to understanding the allocation of funds among activities. Similarly, the cost of capacity services is a year's interest and depreciation on the cost of the capacity itself, divided by the annual units of capacity services per unit capacity. The interest rate here is the lending rate, and any value appreciation that may be anticipated is ignored in the cost calculation.

In conceptual terms, this approach allows us to treat "cost" as a determinant of behavior rather than as an outcome jointly determined with the behavior itself (see Lipmann and Rumelt, 2003, for related discussion). To illustrate, we can look at the entrepreneur's average and marginal rates of return on initial cash (ROR and MROR), which are typically above the lending rate. But the value of MROR is not known until the calculation is done; it is part of the answer rather than part of the question.

method) involves manufacturing capacity and capabilities at the upstream stage only. It yields a unit of the intermediate product, and does not involve participation in the final product market at all. "*New Fin*" (New Final product method) is symmetric with *New Int*; it involves new manufacturing capacity at the downstream stage and requires a unit of intermediate product as input, which may come from either external or internal sources. In the latter case, there are no transaction costs. "*Full*" (Full integration) is the entrepreneur's new, fully integrated method. It does not involve participation in the intermediate product market or even separately identifiable intermediate product, but does incur additional variable costs of production corresponding to the need to produce the intermediate product. It also requires the combined capacity investments of *New Int* and *New Finl*.

For comparison purposes, we also show the numbers for an activity that is the sum of *New Int* and *New Fin*. This combination is, of course, available to the entrepreneur if its two constituent activities are available, and in that sense need not be introduced explicitly. We call it "*Pseudo*" (integration) because it involves balanced participation upstream and down – without, however, taking advantage of the systemic re-organizations possible to the entrepreneur, themselves represented by *Full*. Also included in the model for comparison purposes is the activity "*Old Base*". This is the integrated production technique for the final product that is assumed to define the market standard that the entrepreneur aspires to beat.[11]

Table 1 displays the coefficients describing the four entrepreneurial and two comparison activities, with the sign convention that output carries the negative sign (like an easing of the constraints limiting input). It also shows the unit costs discussed above, and the capacity cost component of those costs.

Insert Tables 1 and 2 about here

The general idea of "cash leverage" is intuitively understandable and apparently familiar in discussions of entrepreneurship; we here give it a (narrow) technical meaning. We define the "cash leverage" of an activity as the ratio of its unit profitability to the capacity costs per unit that it entails. First the numerator: the unit profitability is the price of the activity's output minus the unit cost of production implied by that activity. While the unit cost calculation is

---

[11] Representing *Old Base* explicitly – with its own technical coefficients and type of specialized equipment – has the advantage of providing a parameterized competitive standard: it responds to changes in input prices as well as interest and depreciation rates. The market price assumed for the final product should correspond to the production cost of final product using *Old Base* – reflecting a competitive equilibrium with "normal returns", i.e., zero economic profit. If a new method offered by the entrepreneur is not competitive with *Old Base*, it does not represent an attractive opportunity at all.

mostly of the obvious kind (e.g., price of ground beef times .25 lbs ground beef per hamburger), there is one subtlety. These are *economic* costs, and that means that the services of durable equipment include an interest component, the legendary "normal return" on capital. Now the denominator: By "capacity costs per unit" we mean the initial cash outlays for capacity, divided by the number of annual capacity service units provided by a unit of capacity.[12] So for example, the durable equipment used for *New Fin* costs $20,000 and is good for 1000 units of capacity service per year, giving $20 per service unit as the denominator. Continuing with the example of *New Fin,* the unit profitability of *New Fin* is $25- $18.40 = $6.60 (Table 1). So the cash leverage is 6.60/20 = .330, and its dimensions are "per year". The unit costs and cash leverage values for the activities are at the foot of Table 1. In Table 2 we show the various price parameters of the model, and the characterization of the three types of capacity. The transaction cost shown there relates to market transactions in the intermediate product, and the calculation assumes that the burden of this TC falls in equal proportion on the buying and selling sides.

In the LP array describing the model, the four entrepreneurial activities and two reference activities (*Old Base* and *Pseudo*) are accompanied by (1) Sale activities for both final and intermediate product, with the latter potentially affected by transaction costs, (2) purchase activities for the variable input (labor, etc.), intermediate product, and the "assembly" services required to transform intermediate product to final, (3) a purchase activity for each of the types of capacity (the old integrated type and the new upstream and downstream types), which create the availability of the corresponding capacity services and also "produce" used capacity of the same type, (4) sale activities for each of the three (used) capacity types, which convert the physically depreciated capacity into cash, and (5) activities for lending cash and borrowing it (at a higher rate). This amounts to 19 activities in all.

There are 13 constraint equations, corresponding to final product, variable input, intermediate product, assembly services, services of the three types of capacity, the used versions of the three capacity types, plus the three important scale-determining constraints for initial cash, final product quantity demanded at the final product price, and intermediate quantity demanded at the intermediate product price.

---

[12] This cost in terms of initial outlay is not the capacity *service* cost, which is an hourly rate computed as a year's interest and depreciation on the value of the machine, divided by the normal number of hours of service per year.

What we will examine with the aid of the model is whether the entrepreneur will choose to go into the upstream segment, the downstream segment, or both- the latter being possible both on the zero cash basis of *Hollow* and the heavy cash basis of *Full*. In our example, the question is whether the entrepreneur will go into (1) restaurant location management, upkeep and decoration, or (2) concept design, food preparation and kitchen management; or both.

The first issue which matters is *the relative magnitude of the opportunity in the up-stream, the down-stream, and the integrated segment*- that is, what is, the relative cost advantage (when compared to other established players) that the entrepreneur's unique ideas could have if implemented, at least according to the entrepreneur's expectations.[13] This can be decomposed into two components: First, the advantages created (a) upstream (only) and (b) downstream (only); and second, the extent to which there the advantages up-stream and down-stream are super-additive, that is, the extent of productive advantages conferred by integration.

In our model, we distinguish between "productive super-additivity"-- that is, the extent to which an idea, once implemented in both segments jointly, can yield more benefits that if implemented in each segment separately-- and transaction costs which result from the potential frictions and hold-up opportunities if an entrepreneur is in only one segment. While the "productive advantages from integration" are characterized by the net improvement over the potential new ideas upstream and downstream, when implemented separately, transaction costs act as a welfare loss, as a friction which taxes the productive system. Both the benefits of super-additivity and the transaction costs in the intermediate product market point to the advantages of integration.

To clarify this distinction, consider the entrepreneur's options. The entrepreneur can participate in both segments as an integrated entity, expending whatever cash is needed to do so and fully implement her new concept. Alternatively, she can or invest only upstream (or only downstream), thus bearing the TC of the intermediate market as well as foregoing the benefits of productive co-specialization. She can also, however, choose to be "pseudo-integrated", by investing in both the upstream and the downstream segments separately (say, because the "real integration" could be more scale intensive or require greater learning investments). This would allow her to avoid the TC to the extent that upstream and downstream participations are balanced; yet she would forego the potential real synergies of

---

[13] Of course, the advantage might be and often is expressed in terms of superior quality as opposed to cost; however, if we assume that we adjust prices for qualities, we can simply translate a quality advantage into an equivalent cost advantage in a quality-adjusted basis, without loss of generality.

productive integration, such as those driven by the need to have capabilities that span through a value chain and are not modular (Jacobides & Winter, 2005: 49). With full integration (as opposed to pseudo-integration, which is advantageous only because it economizes TC), the exploitation of the potential synergy/super-additivity between the stage investments may mean that a discrete intermediate product stage does not even exist, i.e., there may be no punctuation of the novel internal value chain that corresponds to the market interface.

Per our example, the entrepreneur could have a set of new ideas with regards to the "restaurant concept" (the nature of the offering, the organization of the kitchen, etc); the nature of the property (choice, style, design, location, configuration); or the way in which restaurant and location form an integral part. She can focus on either of the two alone, in the one case by renting the property and implementing her restaurant plan, and in the other by owning the property and leasing it, perhaps to another restaurateur. But doing so would lead her to forego the potential productive synergies; and, if she does not opt for "pseudo-integration" she will also have to bear the TC, which is a cost to be added to production.[14]

In our illustrative calculations we posit that there are *both* productive synergies, i.e., benefits from full integration relative to pseudo integration; and that there are TC, so that specializing also entails additional costs from all the problems associated with market interface. Yet, the fact that there might exist reasons to integrate will not inescapably lead to interception, and nor should it. There are other considerations that might point the other way, and the trade-offs are a quantitative matter. So what are these other factors?

First, a key consideration is the *size of the market opportunity* in each segment (that is, how much more can the entrepreneur produce before the market becomes saturated and the potential returns decline.) We might call this the "effective niche size," and a number of considerations can affect it. In our example, the entrepreneur is contemplating activity in a specific geographically market with a maximum potential that is relatively determinate. If she is successful, she might ultimately be attracting customers from the remote suburbs, or even remote cities. But in the near term, she is in a neighbourhood with ascertainable demand characteristics, and these set some limits to plausible initial ambitions. We posit that there may be different niche sizes in the upstream only, the downstream only, and the integrated offering, and we consider what happens to scope as we vary these niche sizes.

---

[14] This is in keeping with the Williamson, 1985) where total costs are the sum of production and transaction costs. We thus add TC as a parameter, and we will consider their impact on scope. For a more elaborate analytical treatment of varying TC conditions on scope, see Jacobides (2006).

There is one other major element we will feature in our model calculations – the availability of cash to support the new venture. For simplicity's sake, we can consider this cash as being the entrepreneurs', although in practice it is more likely than not to also include investment by Friends, Family & Fools (or those whom the outside world considers fools). The discussion of how that initial pile of equity is formed, and what are, in this pile, the relative contributions of the entrepreneur and his entourage, or the terms of return that the entrepreneur has promised to FF&F, is left outside the scope of this analysis – save for the provision that the terms given these other participants are not such as to qualify the entrepreneur's determination to maximize the overall return to the total of initial cash. In any case, as we note in the discussion, we consider it misleading to try to isolate separate roles for the ideas of the entrepreneur and her finances in the situation in hand. All that matters is that we have an entrepreneur, who (even after her deals with FF&F) has more ideas than cash, and cannot readily convince the outside world for the value of her idea. What we will do is vary the level of the initial cash, and see how changing the level of available cash affects the venture's scope. The general answer is easily summarized: at low levels of cash, alternatives with high cash leverage are preferred. At higher levels of cash, the entrepreneur accepts lower cash leverage in the interest of higher total profitability. We will subsequently postulate a more flexible structure, allowing the entrepreneur to dilute the ownership of her value so as to obtain additional cash – for instance, from Venture Capitalists or other equity financiers. We will consider whether this even makes sense for the entrepreneur, and how this might affect the results with regard to the boundaries of the entrepreneurial venture.

Parametrization and the model's potential contribution

Before presenting our illustrative calculations, it is important to qualify our remark above that the model is an "engine for generating numerical examples." It is that, but its "logic-clarifying aspects" are also significant. In particular, we note that the model does produce a number of propositions of the "other things equal" type that are independent (or largely so) of the particular values of parameters. For example, it is unambiguous that a sufficiently high opportunity cost of capital (the lending rate) will make it optimal to forego the new opportunity. Given the characteristics of the productive opportunity, a sufficiently low prevailing price of the final product has the same effect. Perhaps more interestingly, sufficiently high transaction costs in the intermediate product market will rule out every

participation mode except full integration or a balanced combination of *Hollow* and *New Int*.[15] We view such propositions as valuable mainly because they offer reassuring testimony that the model formulation gets simple things right. What is more interesting, and less simple, is the exploration of the trade-offs when a number of considerations bearing on the scope decision are relatively closely balanced, as we now discuss.

The parameter values underlying the calculations reported here were chosen with a number of qualitative considerations in view. First, obviously, we characterize the entrepreneurial venture as profitable. Further, in a special "equilibrium" sense (unlimited finance available at the lending rate, and 0 TC as well as 0 asset appreciation), each of the four basic participation modes is independently profitable – in the sense that, in the absence of the others, it could generate an above-normal return on the entrepreneur's investment. Thus, if a particular mode does not appear in an optimal solution, it is because one or more of the others are more advantageous in the disequilibrium context, which is what we are interested in.

We choose the profitability values of each type of scope to be different when measured by profit per unit output (final or intermediate), with *Full* the highest, *New Fin* next, followed by *New Int* and *Hollow*. The cash leverage values are also different, with *Hollow* ranked first (with an infinite value), followed by *New Fin, Full*, and *New Int*. The transaction cost in the intermediate product market is not trivial – about 10% of product value – but is not overwhelming. (We seek to illustrate the theoretical point that other things could outweigh the TC considerations, even if the force of TC is in the presumed direction.) Finally, the super-additivity advantages of *Full* are also not overwhelming, representing only about a 7% saving in variable cost alone, relative to *Pseudo*. Such differentials are certainly big enough to be controlling in an equilibrium context; we show that in a disequilbrium context they are readily overbalanced.

The foregoing says implicitly that the entrepreneur has a number of different things to offer the world, but they are not all equally important. In particular, we assume it is in the downstream stage that the most distinctive contribution lies – our restaurateur has more special talent for cuisine than for property management. Although we cannot present quantitative bounds of validity for the lessons of our numerical examples, we have sought to characterize in qualitative terms the sort of situation we have in view – and for which we

---

[15] This is on the assumption that there are no TC involved in accessing final assembly services – or if there are, they are among the things held constant as TC in the intermediate product market are notionally increased.

expect the conclusions of our analysis to be quite robust.

Model results: TC, financing, and a venture's scope

Table 3 summarizes our calculations that show how optimal scope depends upon initial cash. Not surprisingly, when cash is severely limited, the participation alternative that requires none (Hollow) is favored. The small amount of available cash finances modest entry via the mode that offers the highest (finite) cash leverage (New Fin). Importantly, our assumptions imply that the entrepreneur could fill the demand niche without any cash at all, by using Hollow. Higher cash levels are therefore important to the venture only because they permit more efficient ways of serving that limited demand niche for the final product. As Table 3 shows, higher cash levels permit the choice of superior ways of meeting the demand, but as a better way phases in, an inferior way is phasing out. With available cash of a million dollars, full integration is the right answer. So far as the final product market is concerned, full integration is the least costly way to meet the demand of the niche, and it can be fully met. But this is not the end of the story, for we have specified an available niche in the intermediate product market that is much larger. At still higher levels of cash, it becomes optimal to meet some of the intermediate product demand, while continuing to meet the final product demand fully. This option remains available until the intermediate product niche is saturated, when $4 million of initial cash is available. Additional cash beyond that can only be lent out at the 8% rate, as the final column of the table shows.

Insert Tables 3 and 4 around here

We note that as additional cash is made available to our entrepreneur, the Rate of Return (ROR) declines and the Marginal Rate Of Return (MROR) also weakly diminishes, while the Net Present Value (NPV) as well as the total returns increase. These patterns reflect the fact that the entrepreneur applies her cash wherever it has the most leverage. With more cash available, she would apply it in alternatives with the most leverage.[16]

To return to our variables of theoretical interest, *specialization may still emerge if it is more advantageous given the entrepreneur's cash constraints.* The reason is that the entrepreneur does not, like the TCE theorist, care about TC and the efficiency of her structure. She cares

---

[16] Of course, this property is only weakly true in the real world, largely because of indivisibilities. That is, if there are lumpy investments that are needed in each segment, then the ROR may increase, before it starts decreasing again; we have abstracted from lumpiness and fixed cost for expositional ease, and, more importantly, because even with the proviso of lumpiness the major findings of our model still hold true, and the logic of our analysis is not altered.

about making money. And making as much money as possible given a set of constraints does not lead to choosing what is most "economically efficient". Interestingly, even at extreme levels of productive advantage from integration, specialization might ensue if it provides clear benefits in terms of cash leverage. Likewise for "frictional" or Williamsonian TC: All that is needed for specialization to emerge is for the value added of the idea of the entrepreneur in any one vertical segment (when compared to the status quo) to be proportionately larger than the cost imposed from the TC. If this condition is satisfied, even with substantial TC, the gains from trade are such that they can justify the transaction and ensuing vertical co-specialization (Jacobides & Hitt, 2005; Jacobides, 2006).

Introducing the option of financing at some (non-prohibitive) rate extends our results in an intuitive manner. We find that as cash becomes available, it will be used up to the point where the MROR is equal to the cost of the extra cash, and that borrowing increases the NPV while decreasing the marginal returns. It generally tends to help shift from specialization, inasmuch as (a) with additional cash at hand, more opportunities are explored, and as such specialization might be more restrictive than enabling; (b) the entrepreneur can have the luxury of using the most effective technology along the value chain – but that "effectiveness" is a function of total cash in hand. Table 4 illustrates the point, showing how the availability of borrowing at increasingly attractive rates not only changes the scale of production, but also creates a shift in terms of the firms' boundaries, pushing from hollow, to full integration, to both serving the fully integrated market and providing for the intermediate product, as well. So clearly, scope can and should be substantially affected by the availability of credit.

Insert Table 4 about here

Finally, we should note that even with an infinite amount of potential borrowing, the venture will *not* always opt for integration, despite the fact that integration is indeed more productive than specialization. It will only opt for integration if the benefits that result from integration are superior to the costs of capital; else, despite the fact that integration would yield additional benefits, the entrepreneur would have no reason to undertake it if it requires an investment which costs more than what the entrepreneur will yield. Especially given that the cost of cash in entrepreneurial ventures is non-trivial (as it must incorporate the ability of the funding body to assess or accept risk), this is an important proviso.

These results, taken together, suggest that *the exclusive emphasis of the literature on transactional considerations may be misleading*. TC and gains from productive integration are

important elements of the calculus of the scope of a venture, and especially of an entrepreneurial venture, but they only become binding (that is, they only matter) under some quite particular circumstances. What also emerges is that cash leverage, and the extent of the opportunity along different parts of the value chain, play an important role. The answer to the question "what is good about this entrepreneurial idea?" cannot be provided independent of the level of available financing or the difficulties of obtaining it.

While our model relates to a single period, and is thus suited to comparing alternative initial cash situations of the entrepreneur, it points to a plausible story about the evolution of a venture's scope over time. In the earlier days a venture would focus on the area that provides the highest cash yield. However, as profit would lead to the option of re-investment; and as success would increase the potential borrowing capability, or improve the credit terms (i.e. the cost of cash), the scope of the firm would likely expand. That is, the entrepreneurial venture might start off specialized, largely as a function of its tight cash or credit, and expand where it can only as available cash or capital becomes available.[17] The potential speed with which the firm shifts from one specialized part of the value chain to the next is itself a function of the extent of the existing, unfulfilled demand in the specialized segment: If the venture finds itself busy making money in the specialized setting, it will happily side-step the potential benefits from integration, until this pocket of demand is exhausted (or, otherwise put, until some competition kicks in), at which point the opportunities offered from a systemic re-configuration become particularly attractive.

This pattern, which we alluded to in our earlier work (Jacobides & Winter, 2005: 49), may also explain why several new sectors start as a patch-work of existing sectors, before going through a phase of integration. Take the US automobile industry for example (Langlois & Robertson, 1995), which started as a specialized set of producers who would use intermediate inputs from carriages around the turn of the century. Initially, the producers either did not have the finances to benefit from a systemic re-organization of the value chain (through re-integration), and / or were simply busy making money as assemblers. However, once cash became more widely available, the opportunities from a systemic reorganization (the potential super-additivity in integrated intra-firm production, and the TC that plagued any inter-firm co-

---

[17] This is not to neglect other features that explain when and why firms move from one part of the value chain to the next. For instance, presence in one part of the value chain may either build awareness of the opportunities that exist in a vertically related segment, or highlight the prospect of integrated production. We acknowledge that a host of other factors can explain the evolutionary patterns of changing positions along the value chain (e.g. Helfat & Raubitschek, 2000), but still believe that this simple explanation provides fresh insights.

specialization) became more salient, and integration ensued. In other words, the latent efficiency gains from integrating, which had been there all along, only became "relevant" once the lower-hanging fruits of specialization had been picked; when spending money and time in rationalizing production became privately efficient for the entrepreneurs involved; and when sufficient funding became available to these entrepreneurs.

Profit vs. wealth: What is the entrepreneur after, and why does this matter?

While the previous section summarized the results, it did so with one key assumption, shared with the vast majority of research on such matters. Namely, it assumed that the objective of the entrepreneur is to make money through *profits*. Yet, as we pointed out, in the real world (or in the world of theory, appropriately constructed) money is not only made from profit; it is also (and, often, largely) made from *asset appreciation*. Even a casual perusal of entrepreneurs will show that the majority of their wealth comes from assets that have appreciated. And this points to the conspicuously under-estimated (or mistreated) factor in entrepreneurship, strategy, and economics research- the role of asset appreciation.

The potential for some types of assets to appreciate introduces yet another set of considerations into the analysis of scope: That is, much as we expect variation in terms of how much cash is needed to operate in each of the vertical segments, we also expect that each segment will differ with regards to the extent to which the assets in place will appreciate. Specifically, in Table 5 we show how our "base" results (reported in Table 3) change once we introduce different values of the "asset appreciation" parameter, which we consider only for the intermediate product (e.g., the real estate / location of the restaurant, i.e. the upstream part of the business). We assume that the downstream segment will not appreciate, and see how changing the asset appreciation parameter from 0% (our baseline) to 50% changes the appropriate scope of the firm, which shifts from "final only" to "full integration" to "pseudo integration" to "intermediate only" as the appreciation rate in the intermediate stage increases. So through changing the asset appreciation factor in one stage of the value chain alone we observe that the appropriate scope of the firm changes accordingly, moving through the entire gamut of scope choices.

Insert Table 5 about here

To illustrate our results, consider our restaurateur. In the previous setup, when we had set the asset appreciation parameter to zero (or, equivalently, we simply excluded it from the

23

optimand), the cash-strapped entrepreneur chose to focus downstream , on the running of the restaurant, the provision of the cooking, etc, where solid margins could be made with only little cash outlay. If, however, asset appreciation were to come into this picture, our restaurateur may be induced to do the exact inverse, inasmuch as the assets needed for the restaurant design and the cooking will not appreciate as much (or will not be as easily sellable) as the assets associated with the restaurant and the real estate itself. This means that the entrepreneur, mindful for her own total returns, may not look at profit, focusing on the promise of asset appreciation instead. Similarly, she would also not be particularly bothered about inefficiencies of vertical specialization, and about either the foregone benefits of integration or the transactional risks from finding someone to "run the place". The issue is that going into the cooking side of the business as well, while potentially beneficial as an idea, would inevitably distract from the opportunity to buy some more assets that will appreciate, and as such, in terms of total returns, will not be a wise choice.

Introducing asset appreciation into our optimand, and acknowledging that the extent to which assets appreciate along the value chain differs, means we should consider a neglected set of factors: Our restaurateur, then, should consider whether the assets accumulated in order to operate in one or another part of the value chain are more likely to gain and retain value; whether the expertise in cooking and the recipes will be easier to sell and profit on than the locations bought before the market niche was identified. This set of considerations may, in and of itself, be substantial enough to drive the choice of scope, and we show as much in our model.

The role of assets that will appreciate, and the extent to which they might drive entrepreneurial action (from individuals and corporations alike) becomes even more evident when we consider competitive dynamics. That is, if the entrepreneur's idea will become ultimately imitated or emulated, then we know that, prospectively, profits are likely to reduce. However, should the entrepreneur have locked in key resources that are associated with the new offerings (e.g. the trendy locations, with charm and character, that cannot be reproduced), then the entrepreneur's success will be less self-defeating. As the market will grow, and as imitators will come in, the value of the assets is likely to remain at very high levels, and if the assets are unique enough, the entrepreneur will be able to leverage them by selling them and obtaining the benefits in that way.

Extending the model: Equity finance, competition, dynamics and scope

Having explored the implications of a range of initial cash levels and a range of borrowing opportunities, we turn to a third mode of entrepreneurial finance. What would happen if some form of equity finance became available?

The first point we should make is that it is *not* in the entrepreneur's self-interest to let anybody else participate as an equity holder on a par with himself, provided that (a) the gross payoff is a concave function of investment, i.e. that there are no indivisibilities or areas of increasing returns leading to convex pay off sections; and (b) that the entrepreneur's cash would be valued exactly at par with any other cash to be used as equity. Under these two conditions, letting even benign investors or FF&F, say, match an entrepreneur's investment in exchange for a 50% share is a bad idea. Of course, it could be a good idea if there were indivisibilities (such as initial setup or fixed costs) or increasing returns in the picture.

That being said, if the entrepreneur can get investors (relatives or not) to pay a price $p > 1$ for the same equity share for which the entrepreneur pays \$1, that *could* be advantageous if p is big enough. Indeed, having such a premium for the entrepreneur's money (or, alternatively put, set aside a part of the equity for the entrepreneur's "idea") is the rule. Specifically, in our model calculus indicates that it is advantageous (at the margin) to dilute the entrepreneur's ownership of a venture, taking on investments if p (the ratio of the "price" for equity for an outsider as compared to the "price" of equity for the entrepreneur) is bigger than the ratio of the ROR to the MROR. From the entrepreneur's viewpoint, and in the context of our model, the decision to dilute is broadly analogous borrowing at a rate higher than the lending rate – you get more money in, but have to share some of the proceeds with the new investor. However, should investors demand that the price of equity is lower than ROR / MROR, then the entrepreneur will and should not accept any such investment.[18]

Should such a dilution be indeed profitable, the implications in terms of scope are analogous to the ones outlined earlier in the case of debt financing. In terms of our example, such financing will simply act as a relaxation of the cash constraint, potentially leading to changes in scope. As we can see from Table 6, the entrepreneur shifts from focusing on the cash-

---

[18] Our analysis also does not explicitly consider issues of risk aversion, or the problems of adverse selection and moral hazard that usually plague entrepreneurial finance. We chose to set such issues apart largely because they do not interfere with the major point in our model / paper, and would unduly complicate the exposition and logic. However, we feel that our analysis could complement some of the work currently done in entrepreneurial finance.

preserving final good, to mixed procurement and then to full integration; then, given additional equity finance, she maintains the level of integrated production and also gets involved in the stand-alone production of intermediate good with the additional finances. So scope does change with the availability of equity finance, and the appropriate scope is itself a function of the funding constraints the entrepreneur faces.

Insert Table 6 about here

An interesting and perhaps surprising feature of Table 6 is that the rates of return of entrepreneur and the outside investors *both* rise as the size of the stock issue is increased, whereas the overall ROR decreases(as we would expect). This is counter-intuitive (and we resisted it ourselves at first), but it is correct – as in fact is readily demonstrated from the table. The correct intuition is to recognize that the overall ROR (which declines) is a *weighted* average of the rates for the entrepreneur and the outside investors. While an un-weighted average cannot decline when all the quantities averaged are increasing, this is perfectly possible with a weighted average – providing that the weight shifts from the higher of the two quantities to the lower. That is what is happening in Table 6, the larger stock issues means that the weight shifts away from the entrepreneur, as the last line of the table indicates. The MROR of the incremental investment is intermediate to the two return levels, and assigning the incremental payoff disproportionately to the outside investors raises the average for both. Of course, it is a relevant background fact that these incremental investments, made possible by the stock issue, do have a return above the opportunity cost of capital, and in that sense are efficient investments.

Another element we treated somewhat summarily for the sake of simplicity was the time dimension – and competition. Our model has one period, which of course can be run for yet another time. More realistically, the single period analysis can easily be converted to a multi-period one, in which transaction costs for capacity make it unlikely that there would be a "cash out" at the end of every period, and would allow for the continuity of the financial position as well. Also, we have greatly simplified the role of competition by assuming a limited market opportunity, at a given price, in each of the vertical segments. That is, we assumed that there is only a given part of the market that the venture can capture on the basis of the new idea. So, the question becomes, how would things change if we allowed for a setting whereby (a) there is more than one period, and (b) competitors could come in and thus reduce profitability? First, we should note that our basic, one-period results would not change;

the same factors would affect the choice of scope and the related calculus. The only thing that would change would be the magnitude of the opportunity in each part of the value chain, as well as the "extra margin", both of which can change as a function of competition, and accumulated competition over time. Still, the logic for determining scope would not be affected.

Introducing competition – and, in particular, imitators, would reduce the extent to which firms can extend their profitable operations in the future; but would, by the same token, increase the potential value of the assets in successful ventures, to the extent there is some scarcity. This would tilt the balance even more towards specialization in the segment that assets that appreciate more (proportionately).

What did we learn about boundaries of entrepreneurial ventures from this model?

This model has provided a simple analysis of how entrepreneurs set the boundaries of their ventures. While it incorporates the insights gained from TCE, it provides a more balanced view of the different factors that combine to shape an entrepreneurial venture's scope. In particular, we show how financing constraints and the extent and depth of different opportunities along the value chain shape the firms' scope, so that transactional considerations may or may not affect the chosen scope. Our analysis shows that even if both TC and productive synergies along the value chain exist, integration is far from certain to occur.

We observe that entrepreneurs will focus on the segments with the highest cash leverage, and then as the financing constraint is relaxed will consider shifting onto more segments or adopting integrated solutions. But, even in the presence of an effective capital and credit market, integration (i.e. transactional alignment) is far from certain. We also identify market niche size as an important factor, in addition to the terms of access to capital and credit markets, and show how they combine to shape scope. This suggests that the transactional approach (e.g. Teece, 1986; Williamson, 1985), while important in its own right, is not able to provide adequate guidance, since it does not consider the key question the entrepreneur (whether in an established firm with a budget to spare, or striving to put a venture together in her garage) is interested in: How can I make more money?

The second major contribution of this model is to illustrate the importance of an adequate characterization of what "making money" comes down to, and point out that in addition to profitability (which is what most of the analyses in economics, strategy and accounting focus

on), total wealth creation through asset appreciation plays a role; and, occasionally, its role is even more important than that of profits, so that entrepreneurial activities are driven by the desire to accumulate assets that will appreciate. Crucial to our analysis was the oft-forgotten point that the same beliefs and information that frame the entrepreneurial opportunity are likely to frame, at the same time, the vision of future asset values. While it is conceivable that the contemplated entrepreneurial action actually has no implications for asset values, it is quite likely that the types of assets that are most specific to the venture will appreciate under the same conditions of the economic environment that are conducive to the success of the venture itself. Which then means that it may quite likely be in the interest of an entrepreneur to forego immediate profits and even invite some competition in order to maximize her own wealth.

Thus, this analysis allows us to combine Hirshleifer's (1971) insight with more recent analyses of the nature and potential value of different types of resources (Barney, 1990). The subtle difference with the RBV, though, is that we do not only focus on resources as a basis of future profitability; rather, we accept that their value appreciation is an important strategic issue as well (Winter, 1995). The juxtaposition of asset appreciation and profitability is, of course, a broader issue, important not only for helping us understand the direction of entrepreneurial activity and how scope evolves, but also for assessing and prescribing in the context of entrepreneurial and established firms alike. The substantial confusion with regards to different definitions of profit, and the potential inconsistencies or challenges in the accounting standards that affect reported profits and asset values, make a better understanding of the different means of profiting even more important. We think that a careful consideration of the role of the optimand, and of how different economic participants may profit will move us toward a view of strategic success that goes beyond profits and their sustainability and treats alternative paths to wealth in a balanced way.

To return to the narrower issue of scope, our approach, while accepting that each venture is unique, tried to consider what is common in the uniqueness of entrepreneurial efforts. And it also articulated a framework that explained how different factors relate – as opposed to simply positing that everything connects to everything else, tangled in a complex web of relations. It provides a positive account of how scope is determined and how it evolves. Yet it does so without "parsing out" entrepreneurship from its context.

Our analysis shows that, for the purpose of understanding entrepreneurial behavior, it is particularly necessary to reject the role separation analysis that notionally distinguishes the

entrepreneurial role (innovator, uncertainty bearer) from the other economic roles of that individual.[19] Three key things are indivisible and inseparable from the identity of the individual (or corporate group engaged in entrepreneurship): (1) beliefs and information, which underlie the perception of the entrepreneurial opportunity among other things, (2) the time constraint, which shapes the application of the individual's or group's skills and energy to the entrepreneurial task, (3) the personal budget constraint, which both limits the financial contribution of the entrepreneur to the enterprise and (in the hoped-for future) records the success in accumulating wealth. The influence of these considerations cuts across the identified roles; so our theory about how entrepreneurial ventures set their boundaries should be attuned to the specificities that *each entrepreneur or entrepreneurial unit* faces.

Coda: From the theory of *the* firm to the theory of *a* firm

So far, in this paper, we have made two claims. First, we have argued that a better understanding of entrepreneurship can help us appreciate how and why firm and industry boundaries change. And second, that a thorough understanding of how firm boundaries are chosen (especially in the context of entrepreneurial ventures) can help us better comprehend the direction of entrepreneurial activity. Both of these claims essentially revolve around a key difference in approach between existing theory, and what we propose: That is the shift *away* from trying to consider the "pure" theory of "the" firm, and towards trying to understand the factors that go into the "theory of *a* firm" – i.e., the theory and belief that an entrepreneur might have vis-à-vis their own venture and the way in which the venture can create and capture value. We believe that it is high time we make that shift, and that we change the way we conduct theoretical and empirical research on the institutional structure of production. Rather than being primarily driven by the appropriateness of particular theoretical approaches, as they highlight parts of reality, we may want to consider the problems and challenges faced by entrepreneurs, and see what we can learn, in terms of theory, by providing a structured

---

[19] This position is disconcertingly novel; indeed, from Say through Mill and on to Schumpeter and modern agency theory, the quest for clarity in economic theory and entrepreneurial studies has involved, as one manifestation, an effort to parse the multiple roles (and returns) of the sole proprietor (see Schumpeter 1954, esp. pp. 554-557). In reality, (the story generally goes) an individual businessperson may combine the roles of worker (participating directly in productive activity), manager (directing, coordinating, running the business on a routine, day-to-day basis), capitalist/investor (providing finance for the business), and entrepreneur. Various theorists have long emphasized that, while the various roles may often be combined in a single individual, they are distinguishable as a matter of economic analysis. Also, they are in varying ways and degrees delegable to, or substitutable by, other actors. Most importantly, the roles involve different scarcities that command different sorts of returns, and it is the desire to understand the determination of those returns that fundamentally motivates the whole parsing exercise. Indeed, the very idea of the "entrepreneurial" role and its returns is often derived from the parsing, as a residual category. For example, Schumpeter (1911/1934) is particularly diligent and orderly in pursuing the distinctions and isolating his particular conception of entrepreneurship.

representation of their problem setting. It might be worth taking the "problem-driven research" programme of the Carnegie School more seriously (Cyert & March, 1963; Simon, 1945).

Doing so opens up new venues for research. For instance, there is much to be learnt by studying how entrepreneurs change the boundaries of their own industries or organizations, potentially changing the institutional environment for all involved. Such research, along with work being carried out in "institutional entrepreneurship", a small but growing field, can help not only better explain the institutional change (Scott, 2001).

Also, as our model shows, the near-exclusive focus on some factors (e.g. transactional issues), may lead us astray by shifting our attention away from some critical issues. We have identified other issues that affect a firms' scope, such as the depth of demand in any vertical segment, and the extent of the entrepreneur's cash constraints to explain how scope is chosen, but also to explain why it may be that firms change their position along the value chain over time, or why new industries going through integration after a brief period in which firms specialize only in their "novel" component (Langlois & Robertson, 1995).

Yet our model does more than just explain how scope evolves and why – highlighting factors that have not yet received due attention. It also considers the impact of focusing on different optimands, and underlines the role of resources and their ownership, bridging entrepreneurship research to the RBV. We do not follow the usual structure in the RBV, though, considering how *future profitability* should be based on particular types of resources; rather, we argue that we need to incorporate the role of asset value changes as *an objective and motivator of economic activity.* Much activity, all too readily dismissed as "rent-seeking" revolves around the quest for asset appreciation. Our paper underscores the need to take this more seriously, not only to explain the scope of entrepreneurial activities but also to explain actions of new and established firms alike.

While our analysis is far from complete, we do hope that it is a step in the right direction, and that it will engender follow-on work. A rich agenda lies ahead for theorists, analysts, strategists, accountants and policy-makers interested in how value-added and wealth generation should be measured and assessed and how this motivates economic and entrepreneurial behavior.

Table 1: Production Activities of the Scope LP Model

	Old Base	New Int	Hollow	New Fin	Full	Pseudo
Final Product	-1	0	-1	-1	-1	-1
Variable Input	1.5	0.6	0.4	0.15	0.7	0.75
Intermediate Prod		-1	1	1		0
Final Assembly svc*				1		
Old Capacity svc	1					
New Assembly cap svc				1	1	1
New Interm cap svc		1			1	1
Memo: cost and profit						
Unit Cost	$25.00	$10.20	$24.00	$18.40	$15.60	$16.10
Capacity svc cost/ unit	$10.00	$4.20	$0.00	$4.40	$8.60	$8.60
Cash leverage	0.00	0.077	infinite	0.330	0.188	0.178

* outsourced

Table 2: Scope LP: Prices and Related Parameters

				Price	dep/yr	svc units/yr
Final Product	$25.00	Capacity:				
Variable Input	$10.00	Old		$43,480	0.15	1000
Intermediate Prod	$12.50	Final		$20,000	0.14	1000
Final Assembly svc (OS)	$7.50	Intermediate		$30,000	0.06	1000
Transaction Cost/ unit	$1.00					
Interest rate (lend)	8.00%					

31

Table 3: How Optimal Scope Differs Depending on Initial Cash								
(Cash, payoff and NPV in thousands of dollars, activity levels in thousands of units)								
Initial Cash	20	200	400	700	1000	1300	1600	4200
Activity Level: New Int	0	0	0	0	0	10	20	100
Activity Level: Hollow	19	10	0	0	0	0	0	0
Activity Level: New Fin	1	10	20	10	0	0	0	0
Activity Level: Full	0	0	0	10	20	20	20	20
Payoff	37.2	282.0	554.0	911.0	1268.0	1610.0	1952.0	4904.0
NPV *	14.44	61.11	112.96	143.52	174.07	190.74	207.41	340.74
ROR**	86.0%	41.0%	38.5%	30.1%	26.8%	23.8%	22.0%	16.8%
MROR***	36.0%	36.0%	19.0%	19.0%	14.0%	14.0%	14.0%	8.0%
Free Cash(inv @ 8%)	0	0	0	0	0	0	0	200
* Payoff/(1+rout)- initial cash								
** (Payoff/initial)-1								
*** cash constraint dual value - 1								

Table 4: How Optimal Scope Changes with Borrowing Opportunities
(Varying Borrowing Rates, Base Case at 20 K Cash)
Cash, borrowing, payoff and NPV in thousands of dollars, activity levels in thousands of units

Interest rate (borrrowing)	40.0%	35.0%	20.0%	17.5%	15.0%	12.5%	10.0%
Amount borrowed	0	380	380	980	980	3980	3980
Activity Level: New Int	0	0	0	0	0	100	100
Activity Level: Hollow	19	0	0	0	0	0	0
Activity Level: New Fin	1	20	20	0	0	0	0
Activity Level: Full	0	0	0	20	20	20	20
Payoff	37.20	41.00	98.00	116.50	141.00	210.50	310.00
NPV *	14.44	17.96	70.74	87.87	110.56	174.91	267.04
ROR**	86.0%	105.0%	390.0%	482.5%	605.0%	952.5%	1450.0%
MROR***	36.0%	35.0%	20.0%	17.5%	15.0%	12.5%	10.0%

* Payoff/(1+rout)- initial cash

** (Payoff/initial)-1

*** cash constraint dual value - 1

Table 5: How Optimal Scope Changes with Asset Appreciation
(Appreciation of Intermediate Capacity, Base Case at 700 K Cash)
Cash, payoff and NPV in thousands of dollars, activity levels in thousands of u

Price appreciation, new int cap	0.0%	10.0%	20.0%	25.0%	30.0%	50.0%
Activity Level: New Int	0	0	0	15	23.3	23.3
Activity Level: Hollow	0	0	6	15	20	20
Activity Level: New Fin	10	10	0	0	0	0
Activity Level: Full	10	10	14	5	0	0
Payoff	911.00	939.20	969.50	993.50	1025.40	1157.00
NPV *	143.52	169.63	197.69	219.91	249.44	371.30
ROR**	30.1%	34.2%	38.5%	41.9%	46.5%	65.3%
MROR***	19.0%	28.4%	37.1%	38.5%	42.2%	61.0%

* Payoff/(1+rout)- initial cash
** (Payoff/initial)-1
*** cash constraint dual value - 1

Table 6: How Share Issue Affects Scope and Entrepreneurial Returns
Shares issued at 1.33… per $1 share, Base Case at 400 K cash

Shares (K)	0	300	450	600	750
Total cash	400	800	1000	1200	1400
Activity Level: New Int	0	0	0	6.7	13.3
Activity Level: Hollow	0	0	0	0	0
Activity Level: New Fin	20	7	0	0	0
Activity Level: Full	0	13	20	20	20
Total payoff	554	1030	1268	1496	1724
Total ROR	38.50%	28.75%	26.80%	24.67%	23.14%
Ent payoff	554.0	588.6	596.7	598.4	599.7
Inv payoff	0	441.4	671.3	897.6	1124.3
Ent NPV	113.0	145.0	152.5	154.1	155.2
Ent ROR	38.50%	47.14%	49.18%	49.60%	49.93%
Inv ROR	NA	10.36%	11.88%	12.20%	12.43%
Note: Ent share in payoff	1.00	0.57	0.47	0.40	0.35

Appendix:

Linear Programming Analysis of the Firm

Linear programming is the optimization of a linear function subject to linear equality and inequality constraints. Considered as a subject in the setting of economic theory, it is the computational optimization branch of the broader body of theoretical technique known as linear models of production. It has an alternative existence as a branch of the much larger body of techniques for computational optimization, a subject of continuing interest in theoretical and applied operations research. The two branches were closely intertwined in the historical origins of the subject (Koopmans, 1951, 1977), but tended to diverge in more recent years as economists have largely lost interest in the analysis of production. Arguably, that interest is undergoing a revival, at least in the economic analysis of problems in strategic management (Langlois and Foss, 1999). Also, as noted below, advances in computer hardware and software have made the technique vastly more powerful and easy to use. Thus, a reconsideration of its uses may be timely.

In matrix notation, one mathematical form for a linear programming problem is the following

$$\text{Max} \quad c \cdot x$$

$$\text{Subject to}$$

$$Ax \leq b$$
$$x \geq 0$$

Here, A is an M by N matrix, c is an N-vector, b is an M-vector, and x is the N-vector that is subject to choice. In a typical application to production, the columns of A are the inputs required (+) and outputs produced (-) per unit of the activity for each of N production activities, b is a vector of M initial resource availabilities, the elements of vector c are profit or other "payoff" amounts per unit of the activity, and x is the vector of activity levels. The first M inequalities say that the amount used of any resources cannot exceed the amount produced plus the amount initially available, the N non-negativity constraints say that activities cannot be run backwards. This formulation is, however, canonical in the sense that algebraic tricks can convert any LP problem (Max or Min, equalities or inequalities, nonnegative or unrestricted variables) into this mathematical format. And the interpretation of the mathematics as relating to production is, of course, optional. For example, in our application

in this paper, activities represent not only production but also buying and selling, borrowing and lending, etc.

Substantial practical and theoretical interest in linear programming really dates from the invention of the first effective computational technique for solving such problems. This was the simplex algorithm, invented by mathematician George B. Dantzig (1914-2005) in 1947. Subsequently, other quite different algorithms have been invented, which are more effective with larger and less well-behaved problems.

Linear programming was recognized to be not merely a practical tool and a way of representing production problems, but also a source of insight into the fundamental economics of resource allocation and valuation. Particular interest was found in the "duality" aspect of linear programming problems – the fact that problem of profit maximization characterized above is intimately associated with the related problem of assigning sensible valuations to the resources represented by the vector b. This line of development was epitomized by the book *Linear Programming and Economic Analysis*, by Robert Dorfman, Paul A. Samuelson and Robert M. Solow, published in 1958. A related expository article by Dorfman (1953) was long a staple of graduate economics reading lists.

Today, very large problems are routinely solved for purposes of operations management. For work on a smaller scale, there are spreadsheet programs. The **What's *Best*!** ® software from Lindo Systems, Inc. functions as an add-in to an Excel spreadsheet -- and is said to be capable of handling 100,000 variables. It also solves integer and nonlinear optimization problems. As used in the current paper, the features of the program that matter are high flexibility, transparency and ease of use – and the scale is such that the downloadable trial version (from www.lindo.com) is more than adequate.

References

Alvarez, S. & Barney, J. 2005. How do entrepreneurs organize under conditions of uncertainty? Journal of Management, Forthcoming.

Argyres, N. 1996. Evidence on the role of firm capabilities in vertical integration decisions. Strategic Management Journal, 17(2): 129-150.

Arrow, K. & Hahn, F. 1971. General Competitive Analysis. Amsterdam ; New York : New York, N.Y. : North-Holland: Elsevier Science Pub. Co.,.

Arrow, K. 1974. The limits of organization. New York: Norton.

Baldwin, C. Y., Clark, K. B., 2003. Where do Transactions Come from? A Perspective from Engineering Design. HBS Working Paper, February.

Barney, J.B., 1999, How a Firm's Capabilities Affect Boundary Decisions, Sloan Management Review, 40(3):137-146.

Barney, J. 1990. Research Notes and Communications: Management Objectives in Mergers and Acquisitions. Strategic Management Journal.

Barney, J.B., 1986, Strategic Factor markets: Expectations, Luck and Business Strategy, Management Science, 32(10):1231-1241.

Barney, J. B. 1984. Organizational economics. Toward a new paradigm for understanding and studying organizations. San Francisco: Jossey-Bass.

Barzel, Y. 1982. Measurement cost and the organization of markets. Journal of Law and Economics, 25: 27-48

Cacciatori, E. & Jacobides, M. G. 2005. The Dynamic Limits of Specialization: Vertical integration reconsidered. Organization Studies 26(12)

Chesbrough, H. W. & Teece, D. J. 1996. When is virtual virtuous? Organizing for innovation. Harvard Business Review, 74(1): 65-73.

Coase, R. H. 1937. The nature of the firm. Economica, 4: 386-405.

Combs, J. G. & Ketchen Jr., D. J. 1999. Explaining interfirm cooperation and performance: Toward a reconciliation of predictions. Strategic Management Journal, 20(9): 867-888.

Conner, K. R. & Prahalad, C. K. 1996. A resource-based theory of the firm: Knowledge versus opportunism. Organization Science, 7(5): 477-501.

Cyert, R. M. & March, J. G. 1963. A behavioral theory of the firm. Englewood Cliffs, NJ: Prentice-Hall.

David, R. J. & Han, S.-K. 2004. A systematic assessment of the empirical support for transaction cost economics. Strategic Management Journal, 25(1): 39-58.

Dorfman, R. 1953. Mathematical or 'linear' programming: A nonmathematical exposition. American Economic Review, 43: 797-825.

Dorfman, R., Samuelson, P.A., & Solow, R.M.. 1958. Linear Programming and Economic Analysis. New York: McGraw Hill.

Dosi, G. 1982. Technical Paradigms and technical trajectories: the determinants and directions of technical change and the transformation of the economy. Research Policy, 11: 147-162.

Garud, R., Jain, S., & Kumaraswamy, A. 2002. Orchestrating institutional processes for technology sponsorship: the case of Sun Microsystems and Java. Academy of Management Journal, 45: 113-137.

Ghoshal, S. & Moran, P. 1996. Bad for practice: A critique of the transaction cost theory. Academy of Management Review, 21(1): 13-47.

Helfat, C. E. & Raubitschek, R. S. 2000. Product sequencing: co-evolution of knowledge, capabilities and products. Strategic Management Journal, 21(10/11): 961-979.

Hirshleifer, J. 1971. The private and social value of information and the reward to inventive activity, American Economic Review 61: 561-574

Jacobides, M. G. 2005. Industry change through vertical disintegration: How and why markets emerged in mortgage banking. Academy of Management Journal, 48(3): 465-498.

Jacobides, M.G. 2006. A systemic model of how capability differences, learning and transaction costs interact to drive vertical scope.

Jacobides, M.G. & Billinger, S. 2005. Designing the boundaries of the Firm: From "make, buy or ally" to the dynamic benefits of vertical architecture. forthcoming, Organization Science.

Jacobides, M. G. & Hitt, L. M. 2005. Losing sight of the forest for the trees? Productive capabilities and gains from trade as drivers of vertical scope. Strategic Management Journal (forthcoming): 1-44.

Jacobides, M. G. & Winter, S. G. 2005. The co-evolution of capabilities and transaction costs: Explaining the institutional structure of production. Strategic Management Journal, 26(5): 395-413.

Klein, B., Crawford, R. G., & Alchian, A. A. 1978. Vertical integration, appropriable rents, and the competitive contracting process. Journal of Law & Economics, 21(2): 297-326.

Knight, F., 1921. Risk Uncertainty and Profit: Houghton Mifflin Company.

Kogut, B. & Zander, U. 1996. What firms do? Coordination, identity, and learning. Organization Science, 7(5): 502-518.

Koopmans, T.C., ed. 1951. Activity Analysis of Production and Allocation. New York: Wiley.

Koopmans, T.C. 1977. Concepts of optimality and their uses. American Economic Review, 67: 261-274.

Kuhn, T. 1962. The Structure of Scientific Revolutions. Chicago: University of Chicago Press.

Langlois, R.N., and Foss, N.J. 1999. Capabilities and governance: the rebirth of production in the theory of economic organization. Kyklos, 52: 201-218.

Langlois, R. N. & Robertson, P. L. 1995. Firms, markets and economic change: A dynamic theory of business institutions. London and New York: Routledge.

Leiblein, M. J. & Miller, D. J. 2003. An empirical examination of transaction- and firm-level influences on the vertical boundaries of the firm. Strategic Management Journal, 24(9): 839-859.

Lippman, R. & Rumelt, R. P. 2003. A bargaining perspective on resource advantage. Strategic Management Journal, 11(1069 - 1086).

Madhok, A. 2002. Reassessing the fundamentals and beyond: Ronald Coase, the transaction cost and resource-based theories of the firm and the institutional structure of production. Strategic Management Journal, 23(6): 535-550.

Munir, K. & Phillips, N. 2004. The Birth of the Kodak Moment: Institutional Entrepreneurship and the Adoption of New Tecnologies. University of Cambridge - Judge Business School and University of Cambridge.

Nelson, R. R. & Winter, S. G. 1982. The Schumpeterian Tradeoff Revisited. American Economic Review, 72(1): 114-132.

Nickerson, J. & Zenger, T. R. 2001. A knowledge-based theory of governance choice. unpublished paper, David Eccles School of Business, University of Utah: 1-37.

Pelikan, P. 1969. Language as a limiting factor for centralization. American Economic Review, 59: 625-632.

Penrose, E. T. 1959. The theory of the growth of the firm. Oxford: Blackwell.

Richardson, G. B. 1972. The organisation of industry. Economic Journal, 82(327): 883-896.

Schilling, M. A. & Steensma, H. K. 2001. The use of modular organizational forms: An industry-level analysis. Academy of Management Journal, 44(6): 1149-1168.

Schumpeter, J. 1911. The Theory of Economic Development. Cambridge: Mass.

Shelanski, H. A. & Klein, P. G. 1995. Empirical research in transaction cost economics: A review and assessment. Journal of Law, Economics & Organization, 11(2): 335-361.

Teece, D. J. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. <u>Research Policy</u>, 15: 285-305.

Williamson, O. E. 1971. The vertical integration of production: market failure considerations. <u>American Economic Review</u>, 61(2): 112-127.

Williamson, O. E. 1975. <u>Markets and hierarchies: analysis and antitrust implications</u>. New York: Free Press.

Williamson, O. E. 1985. <u>The economic institutions of capitalism: firms, markets, relative contracting</u>. New York, London: The Free Press.

Williamson, O. E. 1999. Strategy research: Governance and competence perspectives. <u>Strategic Management Journal</u>, 20(12): 1087-1108.

Winter, S. G. 1988. On Coase, competence, and the corporation. <u>Journal of Law, Economics, and Organization</u>, 4(1): 163-180.

Winter, S.G. 1995. The Four R's of Profitability: Routines, Resources, Rents and Replication," in C. Montgomery (Ed.), <u>Resource-based and Evolutionary Theories of The Firm: Towards a Synthesis.</u> Boston: Kluwer Academic Publishers