EMPLOYMENT, MARKETS, CONTRACTS, AND THE SCOPE OF THE FIRM

by

Birger Wernerfelt*

January 6, 2015

JEL Codes: D02, D23, L23

Key Words: Organization, Labor, Institutions

* MIT Sloan School of Management, Cambridge, MA 02142, bwerner@mit.edu. This paper was started while the author visited the Department of Economics at the University of Copenhagen, whose hospitality is gratefully acknowledged. It reflects discussions with Tore Ellingsen, Bob Gibbons, Oliver Hart, Heikki Rantakari, Michael Rauh, John Roberts, and Steve Tadelis, as well as comments by seminar audiences at the 2015 AEA meetings, Berkeley, Chicago, CBS, Harvard, Imperial College, IIOC, MIT, NBER, Stockholm School of Economics, Toronto, and the University of Copenhagen. The usual disclaimer applies.

EMPLOYMENT, MARKETS, CONTRACTS, AND THE SCOPE OF THE FIRM

Abstract

We look at the economic functions of firms, markets, and contracts, and characterize the optimal scope of the firm. Governance structures appear as equilibria and are compared in terms of production costs - determined by a tradeoff between specialization and adaptation, - and bargaining costs – incurred in connection with adaptation in bilateral settings. Under natural conditions, employment, markets, or sequential contracting weakly dominate all other equilibria. As firms become larger, gains from specialization come at the cost of increasingly poor adaptation, ultimately bounding their scope. The model rests on standard assumptions, is consistent with the managerial literature on the scope of the firm, and makes predictions based on factors that do not play a role in contemporary theories of the firm.

I. INTRODUCTION

The advantages of specialization and the role of markets in supporting it have played a central role in economic reasoning at least since Adam Smith. A more recent, but still old stream of work has compared employment and contracts in terms of their adaptive properties (Coase, 1937; Simon, 1951). Noting that both traditions fundamentally are about savings in costs of adaptation, we introduce slight variations in both to develop a unified theory in which different governance structures emerge as equilibria. Specifically, we find conditions under which employment, markets, or sequential contracting weakly dominate all other equilibria, characterize the types of services, entrepreneurs, and workers for which each is most efficient, and give an explicit formula for the optimal scope of the firm.

To get an intuitive sense of the argument and the novel twists, suppose that a business needs a worker for a specific service. (For example, an apartment building wants to have a bannister fixed.) The worker could be a service specialist (a carpenter) who enjoys efficiencies from focusing on a single service. This is Adam Smith's concept of specialization. However, there are also advantages of doing continued work for a single business. The worker will know the preferences of the business (speed, cost, looks, reliability), where things are, who to ask for clarification, etc. So there are also advantages of focusing on a single business (a superintendent).

Workers are most efficient when they can perform the same service for the same business in every period: Perfect adaptation to both service and business with no changes from period to period. This creates incentives to expand a firm into related businesses to the point where it can employ such business-and-service-specialists (as when very big landlords have their own carpenters). If the opportunities for such growth are limited, some "different but similar" businesses can combine and use a service-specialist whose standard way of doing things is imperfectly adapted to the businesses, but still not too far off.[1] (Property companies with a mixed portfolio of real estate.) The scope of the firm is determined by the point at which the resulting

[1] For example, Newell justified its acquisition of Rubbermaid based on, among other things, anticipated cost savings stemming from the fact that the two companies used the same sales channels (Bain & Co, 2013).

mal-adaptation becomes too severe.[2] (It may not be appropriate to use the same approach to carpentry in a barn and a high end office building.)

Business-specialists can be on a single long term - or a series of short term contracts. Since payments have to be determined in a bilateral setting, haggling costs will be incurred whenever the parties have to agree on payment for a service not previously negotiated over. This is Ronald Coase' concept of adaptation costs. Extending this, we will argue that there are economies of scale in bargaining costs such that a blanket contract, allowing the business to choose any of *n* services, will cost less than *n* times the cost of bargaining over a single service. The advantages of such bargaining-in-advance will depend on how soon the new needs materialize.

While the argument thus is simple, it is different from those in the recent literature. First, it does not depend on non-standard assumptions such as behavioral biases, bounded rationality, heterogeneous beliefs, or the distinction between observability and verifiability.[3] Secondly, the predictions of the model turn on forces that play limited roles in economic theories of organization: Markets are preferred over bilateral trading for services that are in less demand and require less local customization, while employment is more efficient than sequential contracting when needs change more frequently. Third, the considerations involved in determining the optimal scope of the firm are the same as those highlighted in the managerial literature on the subject.

We start looking at a model in which services, workers, and businesses are statistically identical and all trades thus are governed in the same way. We find weak conditions under which three classes of equilibria, suggestively labeled as the "Market", "Employment", and "Sequential Contracting", weakly dominate a large class of alternatives. (1) In the "Market" equilibrium, entrepreneurs trade with service-specialists who can meet their needs at low costs. The Market functions without bargaining costs, but a since workers have to be ready to serve many different entrepreneurs, their standard way to approach a service may be quite poorly adapted to some customers. (2) In the "Employment" equilibrium, an entrepreneur-worker pair agrees once-and-for-all on all components of a trading relationship. So there is only one round of bargaining, but

[2] For example, DaimlerChrysler discussed the divestment of its financial services unit, Debis, in this way (Milwaukee Journal Sentinel, p. 39, April 5, 1999).
[3] C. f. Maskin and Tirole, 1999.

since the worker has to be ready to perform many very different services, his way of doing things may fit some of them rather badly. (3) In the "Sequential Contracting" equilibrium, the two players agree to maintain a relationship for a while, but renegotiate each time the entrepreneur needs a new service. Used instead of Employment when adaptations are infrequent, it is subject to the same pros and cons. In particular, the worker becomes a business-specialist.

Some Related Literature. The most direct building blocks are found in the author's own previous works. Wernerfelt (1997, first drafted in 1984) contains the first proposal that sub-additive "communication"-cum-bargaining costs can be used to motivate the use of employees vs. contractors. The basic idea is that employment contracts give the "boss" the right to demand any one of a large set of services without further negotiation.[4] So the agreement covers a lot of possible services but is postulated to be less than proportionately costly to negotiate. On the other hand, the parties can defer some bargaining costs by engaging in item-by-item negotiations on an "as needed" basis. This then leads to the prediction is that employees are used when needs change more frequently. Wernerfelt (forthcoming, 2015) takes a further step by bringing in markets as an alternative to employment and sequential contracting. (That paper also offers a micro-foundation for the sub-additivity of bargaining costs, but that is less important for our present purposes.[5]). The choice between markets and bilateral trading relationships depends on the interplay between two forces, with markets taking advantage of technological/learning advantages of specialization and bilateral relationships economizing on workers' (exogenously postulated) costs of switching between entrepreneurs. Both of these two papers briefly discuss the scope of the firm: The early paper invokes diseconomies in organizational information processing and the later paper simply lists questions of scope as topics of future research. Since the theory of the firm is incomplete without bounds on the firm, this leaves an important gap. The contribution of the present paper is exactly to complete the theory by making the scope of

[4] This is not too different from Simon (1951).

[5] The present paper uses a reduced form representation of sub-additive bargaining costs, but these can be micro-founded on standard assumptions. One possible such micro-foundation starts with two-sided incomplete information. While this often leads to strategic bargaining costs (Myerson and Satterthwaite, 1983), these are typically not sub-additive. However, if we allow bargainers to engage in costly attempts to learn the private information of their opponents, the resulting search costs may well be sub-additive. So in the region in which bargainers chooses to search, we can have complete information bargaining with sub-additive bargaining costs, just as assumed here (Wernerfelt, 2015). Of course, the use of such contracting/bargaining costs have other recent precedents in the literature (Bajari and Tadelis, 2001; Matouschek, 2004). More generally, the theme of adaptation has received a lot of recent attention in the literature on the firm (e. g. Alonso, Dessein, and Matouschek, 2015)

the firm an integral part of it. This is done by generalizing the concept of specialization such that workers gain from performing a single service, trading with a single entrepreneur, and by approaching all tasks in the same way. Importantly, the cost of changing from one service to another is not fixed, but depends on the "similarity" between the two services. This means that a worker can be efficient if he works on similar services for a single entrepreneur but that the efficiency tails off as the job, and the entrepreneur's firm, becomes too "unfocussed". It is worthwhile noting that the managerial literature of the scope of the firm (Montgomery and Hariharan, 1991; Wernerfelt, 1984) makes exactly the same point.

Seen in a much broad context, the present paper links the classical literature on the division of labor with some strands of the modern literature on the theory of the firm. The former literature has considered the effects of specialization and indivisibilities (Smith, 1965; Stigler, 1951; Rosen, 1978, 1983), and Becker and Murphy (1992) introduce the idea that firms expand to take advantage of gains from specialization. These papers typically justify specialization on technological grounds such as scale advantages or learning. The argument here is quite different: We argue that adaptation by workers, whether to different services or different buyers, is costly, and that specialization is the outcome of attempts to economize on adaptation.[6] It is this connection between specialization and adaptation that allows us to make the linkage to the optimal scope of the firm.[7] Compared to the works of Oliver Williamson (e.g. 1985), we here rely on a much smaller set of forces, all of which can be given a standard micro-foundation.

The contrast between the perspective proposed here and other micro-founded theories of the firm is sharpest for large firms. We bound the scope of the firm by showing that it eventually becomes too unfocused and thus loses the advantages of standardization. This has more face validity than many other proposals. For example, a merger between two Fortune 500 firms should give rise to more costs than one more person having poor incentives (Grossman and Hart, 1986).

Unlike the Property Rights Theory, the argument here treats vertical and horizontal integration as driven by two different forces. The model defines the firm by the employment relationship and one firm is part of another if one top-manager is an employee of the other. The prediction is then

[6] Stigler (1939) made a similar argument about adaptation to different levels of demand for a single product, noting that high costs of ramping up and down might lead firms to keep levels of production more constant.
[7] Gibbons, Holden, and Powell (2012) and Legros and Newman (2013) also look at the interaction between firms and markets, though not on the contrast between employment and bilateral contracting.

that the attractiveness of vertical integration depends on the frequency with which needs change and the relative advantages of business- and service-specialization.

There role of asset ownership is also different. The present analysis does not depend on assets or holdup, but the nature of the employment relationship has direct implications for asset ownership. Specifically, one could argue that the boss should own most productive assets since his decisions typically are the main determinant of their rates of depreciation.[8]

In terms of topic, Spulber (2009) is the closest analogue to the present paper. He defines firms and markets differently, but the aim is the same: To develop a theory in which they appear endogenously. Spulber's theory depends on the existence of transactions cost but admits all kinds and does not depend on their exact make up. For example, he defines the firm as an entity that maximizes a different objective and thus behaves differently from other actors in the economy. The question raised in the present paper, whether workers are employees, is of secondary importance and his theory just needs employees to be used whenever it is cheaper (Spulber, 2009, p. 247). In contrast, we are here interested in understanding when it is cheaper to use employees. So the two theories are complementary in the sense that we look at the components of transaction costs while he looks at their implications. On a more methodological level, the present paper is driven by differences in costs of adaptation and specialization across periods, while Spulber's argument can be made in a static model.

We formulate a workhorse model and use it justify the focus on Markets, Employment, and Sequential Contracting in Section II. In Section III, we look at different kinds of heterogeneity and characterize the market and employment sectors of an economy. The optimal scope of the firm and the allocation of talent in the economy are characterized in Sections IV and V, while further research is discussed in Section VI. All proofs are relegated to the Appendix.

II. WORKHORSE MODEL – FIXED FIRM SIZE

The model covers two time periods, $t = 1, 2$, and a unit payment in period *2* is worth $\delta \in (0, 1)$ in period *1*. There is a set S of services with generic element s, a large set W of workers with generic element w, a set E of entrepreneurs with generic element e, and a set B of businesses with

[8] This is tested in Simester and Wernerfelt (2005).

generic element *b*. All players are risk neutral. Entrepreneurs use workers to perform services thereby producing output in different businesses. In each period, every business *needs* a single service which, if performed by a worker, results in one unit of output, valued at *v*. Specifically, at the start of each period, nature randomly divides the entrepreneurs into $|S|$ equally sized sets such that $|E| / |S|$ entrepreneurs will need each service in that period. It is important that realized business needs are unknown until the start of each period.[9]

In this Section, each entrepreneur has one business (so $|B| = |E|$ for now) and we will say that entrepreneur *e* needs the service that her business needs. The numbers of workers and entrepreneurs would be endogenous in a general equilibrium model, but we simply assume the relevant markets clear such that $|W| = |E|$.

We endow the model with two frictions: A tradeoff between adaptation and specialization and bargaining costs.

Adaptation versus Specialization. A worker can perform any service, but only one per period and production cannot be expanded by performing a needed service more than once, or by performing an unneeded service. Production costs depend on an action being adapted to the unique characteristics of the business and the service.

We model changes and costs of mal-adaptation in a simple, yet rich, way. The unique characteristics of business *b* are summarized in the random variable $\varepsilon_b \in R$, and those of service *s* are summarized by $\varepsilon_s \in R$. No two businesses have the same ε_b and these values are drawn from a discrete uniform distribution with support on $|B|$ points with maximum β and minimum - β. Similarly, no two services have the same ε_s and their values are drawn form a discrete uniform distribution with support on $|S|$ points with maximum φ and minimum $-\varphi$. The realizations are public information.

While modelled in one dimension, we think of ε_b as reflecting the competitive environment of business *b* by indicating the best way, in terms of quality, speed, reliability, appearance etc., to perform any service in *b*. Similarly, ε_s can be thought of as indicating the best technology (tools, degree of mechanization, computerization, etc.) with which to perform *s* for any business.

[9] This will mean that employment relationships are the only worthwhile long term contracts.

When performing service *s* at business *b* in period *t*, worker *w* ideally wants to adapt to both *s* and *b*, and we model the advantages of adaptation as reduced costs. Specifically, whenever *w* performs *s* for *b* at *t*, the way he works can be summarized by an *approach*, $(a_{wst}, a_{wbt}) \in R^2$, and his effort costs will be $c + (a_{wst} - \varepsilon_s)^{\alpha} + (a_{wbt} - \varepsilon_b)^{\alpha}$ in period *t*, where $0 < \alpha < 1$. Heuristically, the upper bound on α reflects the intuitively appealing idea that there are decreasing marginal costs to maladaptation. For example, it is more efficient to adapt perfectly on one dimension and be *1* off on the other compared to being ½ off on both of them. It will be convenient to use the "moments" $\sum_{x=-\varphi}^{\varphi}(1/|S|)|x|^{\alpha} \equiv \sigma_S$ and $\sum_{x=-\beta}^{\beta}(1/|B|)|x|^{\alpha} \equiv \sigma_B$ as measures of the heterogeneity of services and businesses, respectively. Production will be ex ante attractive if $Min\{\sigma_S, \sigma_B\} < v - c$.

We capture the cost of adaptation by assuming that *w* cannot adapt in every period, but has to *standardize* in the sense that $a_{ws1} = a_{ws2} \equiv a_{ws}$ and $a_{wb1} = a_{wb2} \equiv a_{wb}$. Workers make their standardization decisions after the realization of the ε_s and ε_b vectors, but before business needs for the first period are known. Since they cannot perform the same service for the same business in both periods, the best way to reduce expected cost is to specialize in a specific business *b'* or a specific service *s'*. So adaptation is difficult and this gives rise to advantages of specialization.

<u>*Bargaining cost.*</u> Prices are determined in assemblies that we will call *bargaining bins*. A bargaining bin specifies two sets $(S', B') \in \{0, 1\}^{|S|} \times \{0, 1\}^{|B|}$. By selecting the bin *(S', B'),* workers and entrepreneurs intend to negotiate a binding contract specifying a single price in exchange for which any of the workers will perform any service in *S'* for any business in *B'*.[10] Prominent examples of bargaining bins are *(s', B), (s', b'), (S, b')* and *(Ø, Ø)*. We will later associate the first three with markets, sequential contracting, and employment.

Bargaining is costless except if negotiations are bilateral.[11] In that case, both worker and entrepreneur incur *bargaining costs*. These costs are sub-additive in the cardinality of the set covered by the price. Let *S'* be a subset of *S*. If a worker-entrepreneur pair makes an agreement

[10] Since *S* is so big that a complete contingent claims contract is infeasible, we make the extreme assumption that contracts can specify a single price only.

[11] This is clearly an abstraction, but consistent with the general idea that more participants help discipline bargainers are reduce transaction costs (see also Spulber, 2009).

of the form "I will pay you this for any one of the services in *S'*", each incur bargaining costs $K(|S'|)/2$, where $K(|S'|)$ is positive, increasing, sub-additive, and reaches its maximum $\bar{K}$ at $|S_K| < |S|$.[12] It will be convenient to use $\underline{K}$ to denote $K(1)$. To rule out a perhaps less interesting case in the following, we assume that $(1/4+\delta)\sigma_B > \delta\underline{K}$.[13]

We put no restrictions on the games played inside the bargaining bins except that their outcomes meet three natural conditions: (i) All efficient trades are consummated. (ii) If equal numbers of entrepreneurs and workers arrive at a bargaining bin, they all get strictly positive payoff.[14] (iii) Otherwise, players on the long side of a bin get zero payoffs.

Strategies. The strategy of an entrepreneur has two components: In each period she selects a bargaining bin as a function of her need in the period $(S \rightarrow \{0,1\}^{|S|} \times \{0,1\}^{|B|})$. The bin with "no services" is selected in period *2* if a price covering that period's need has been agreed upon in period *1*.

The strategy of a worker has three components: At the start of period *1* he decides on the approach on which he standardizes as a function of the ε_s and ε_b vectors $(S \times B \rightarrow R^2)$. In each period he selects a bargaining bin consistent with his approach $(S \times B \rightarrow \{0,1\}^{|S|} \times \{0,1\}^{|B|})$. The bin with "no services" is selected in period *2* if a price covering all relevant second period services has been agreed upon in period *1*. The sequence of events is as follows:

0. Entrepreneurs are randomly and permanently matched with businesses. All ε_b, ε_s are realized and publicly observed.

In period *1*:

1. Workers choose an approach (a_{ws}, a_{wb}) on which to standardize.
2. Business needs for period *1* are realized and publicly observed.

[12] While this clearly is an unusual premise, it is not unreasonable: Most people prefer not to bargain, but if they have to, would rather bargain once over a $300 pie than 30 times over $10 pies. From a theoretical perspective, this is consistent with the rent-seeking literature (Tullock, 1967). More directly, Maciejovsky and Wernerfelt (2011) report on a laboratory experiment in which bargaining costs are found to be positive and sub-additive.

[13] See discussion in Appendix.

[14] So there is no holdup in the model.

3. Entrepreneurs and workers distribute themselves into bargaining bins and negotiate as indicated. Entrepreneurs and workers in each bin are randomly matched. Workers perform the agreed upon services.

In Period *2*:

4. Business needs for period *2* are realized and publicly observed.
5. Entrepreneurs and workers may distribute themselves into bargaining bins and negotiate as indicated. Entrepreneurs and workers in each bin are randomly matched. Workers perform the agreed upon services
6. All payoffs are distributed.

Note that there are a lot of equilibria because there are many ways to balance the bargaining bins. However, we will be looking for the most efficient sub-game perfect equilibria.

We now define and discuss three particularly interesting classes of equilibria:

A Market is a bargaining bin of the type (s', B), selected by the $|E|/|S|$ *entrepreneurs needing s' and* $|E|/|S|$ *workers standardizing on* (ε_s*', 0).* There are no bargaining costs in markets and workers only perform services on which they are specialists. On the other hand, since they are not specialists in the business of the entrepreneurs for whom they work, they incur adaptation costs. The expected value of total costs will thus be $(1 + \delta)(c + \sigma_B)$. We will use the term *professionals* as shorthand for workers who sell their services in Markets and say that the economy is in *Market equilibrium* when all non-empty bargaining bins are Markets.

An Employment relationship is a bargaining bin of the type (S, b'), selected by the entrepreneur b' and one worker standardizing on (0, ε_b*').*[15] In this case, workers only work for entrepreneurs in whose businesses they are specialists. On the other hand, they are not specialists on the services they perform, and therefore incur adaptation costs. Since workers engage in bilateral negotiation over a single price for any service in *S*, they also incur bargaining costs $\overline{K}$ in period

[15] Consistent with common terminology, Employment is a relationship in this model (Bartling, Fehr, and Schmidt, 2013). Linking to the famous example of Alchian and Demsetz (1972), the relationship between a boss and an employee is one in which a single wage has been agreed upon on a once-and-for-all basis, while a buyer in a grocery store is confronted with new market prices in every period.

1. The expected total (worker plus entrepreneur) costs are thus $(1 + \delta)(c + \sigma_S) + \overline{K}$. Workers and entrepreneurs who trade services in an Employment relationship will be called *employees* and *firms*, respectively. We say that the economy is in *Employment equilibrium* when all non-empty bargaining bins are Employment relationships.

A Sequential Contracting relationship is a bargaining bin of the type (s', b'), selected by the entrepreneur b' and one worker standardizing on (0, $\varepsilon_{b'}$). This is similar to Employment except that the members of a bargaining bin negotiate twice, but each time over a price for a single service. The expected total costs are $(1 + \delta)(c + \sigma_S + \underline{K})$. We will use the term *contractors* for workers who sell their services in Sequential Contracting relationships and say that the economy is in *Sequential Contracting equilibrium* when all non-empty bargaining bins are sequential contracting relationships.

PROPOSITION 1: *There exists three regions in $[\sigma_B, \sigma_S, \overline{K}, \underline{K}, \delta]$ where Markets, Employment, and Sequential Contracting are weakly more efficient that all other sub-game perfect equilibria of the economy*.

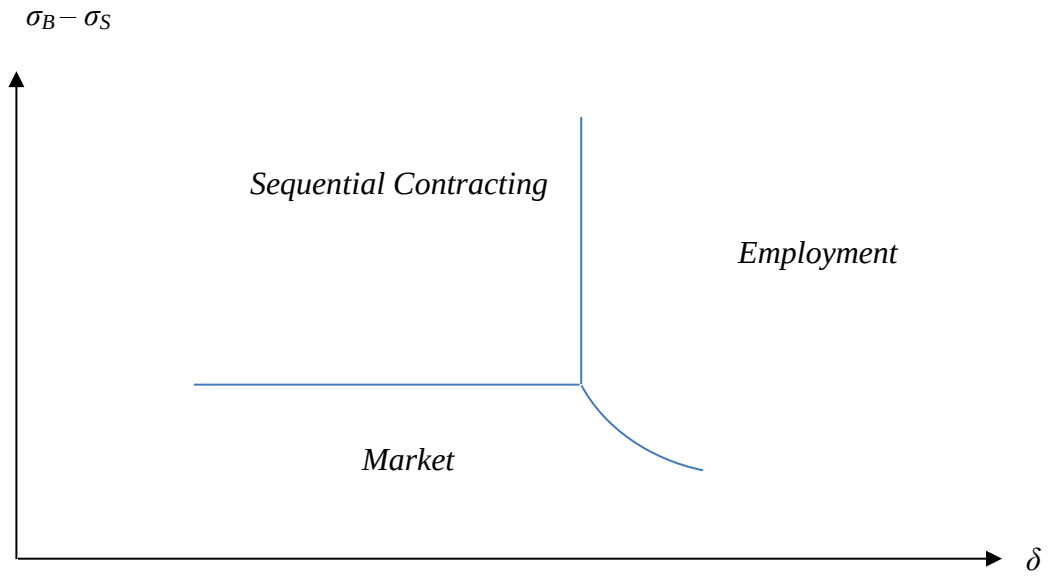
Proof: See Appendix.

Consistent with intuition and casual observation, the Market is better when the gains from service-specialization are larger, when gains from business-specialization are smaller, and when bargaining costs are larger. Employment is better than Sequential Contracting when trade is frequent.[16] This is illustrated in Figure 1 below.

[16] This is tested by Novak and Wernerfelt (2012)

Figure 1

Most Efficient Equilibria by Frequency of Change and Relative Gains from Specialization



Some possible empirical implications of this are that professionals are more likely to perform services requiring more unique approaches, that less work will be performed inside firms in areas where differences between businesses are smaller, and that needs subject to frequent change are more likely to be met by employees.

Since the workhorse model is based on ex ante identical services, workers, and entrepreneurs, all workers will use the same strategy as will all entrepreneurs. We now introduce different kinds of heterogeneity to look at economies with both market and employment sectors.

III. COMPOSITE EQUILIBRIA

We label Market, Employment, and Sequential Contracting as *elementary equilibria* and look for the most efficient *composite equilibrium* to govern an economy with heterogeneous services, workers, and/or entrepreneurs. To keep things simple, we assume that $(1+\delta)\underline{K} > \overline{K}$ and thus focus on the choice between Market and Employment. In a *composite equilibrium with Market*

and Employment each worker chooses an elementary equilibrium in which to sell his services and each entrepreneur decides which services to source from which elementary equilibrium.

The workhorse model can be enriched with many different types of heterogeneity, and we will only look at a few. To balance supply and demand while keeping the model simple, we make strong distributional assumptions. However, given those, the proofs are simple and thus omitted. Suppose, for example, that half of all services are very heterogeneous in the sense that $\overline{\sigma}_S$ is high, while the other half are homogeneous and have $\underline{\sigma}_S < \sigma_B + \overline{K}/(1+\delta) < \overline{\sigma}_S$. Suppose further that half of all businesses only need services in the heterogeneous class, while the other half only need services in the homogeneous class. In this case the former type of business will use the market, while the latter class will hire employees. Similar arguments can be made for heterogeneous σ_S and δ. So we have:

FINDING 1: *Suppose that σ_S, σ_B, and δ differ between services and businesses: Under appropriate distributional assumptions, the Market is used for those services for which service-specialization is more important than business-specialization and Employment is used for frequently changing services.*

Similarly if these parameters differ appropriately between workers:

FINDING 2: *Suppose that σ_S, σ_B, and δ differ between workers and businesses: Under appropriate distributional assumptions, the Market is used by workers for whom gains from service-specialization are more important than gains from business-specialization and Employment is used by those who can finish services quickly.*

While these results are very similar to those in Proposition 1, we can get a new insight by looking at simultaneous heterogeneity in the demand for services and the efficiency of workers. For example, suppose that S_L is two-thirds of all services and assume that half of the businesses only need services from S_L while the other half only need services from $S \backslash S_L$. Suppose furthermore that individual workers have different costs for different services, but that the aggregate supply curve is the same for all services. The market price for low demand services would then reflect only the costs of the more efficient service-specialists, and thus be lower than

that for high demand services. This will make it more attractive for entrepreneurs to source from the Market.

FINDING 3*: Assume that demand differs between services and businesses and that costs differ between workers: Under appropriate distributional assumptions, the needs for the services with smaller demand will be met in the Market, while services with the higher demand will be performed by Employees.*

We can look at the effects of trade by comparing our economy with one in which workers and entrepreneurs are isolated into two clusters that are unbalanced in the sense that the number of entrepreneurs with a certain need and the number of service-specialists on that service are different. In this case, some service-specialists in the two-cluster economy cannot sell their expertise in the market in every period and instead have to perform a variety of different services as employees. So trade agreements may lead to more Market governance.

FINDING 4: *If barriers between initially unbalanced clusters are reduced, weakly more workers become professionals and weakly fewer remain employees.*

Beyond increasing specialization, trade also affects the elementary equilibria through which workers sell their labor. Specifically, the making of tariff agreements and the emergence of trains, cars, and electronic communication should cause a shift towards market governance.

IV. THE SCOPE OF THE FIRM

So far, we have kept entrepreneurs' sizes exogenously fixed such that each of them has one business and thus needs one service and one worker in every period. We now look at situations in which each entrepreneur is active in several businesses. To keep the formulae uncluttered, we assume that $\delta = 1$.

Suppose that an entrepreneur has two businesses, *b'* and *b",* and assume, arguendo, that *b'* first needs service *s'* and then s'', while *b"* first needs s'' and then s'. Two employees, a service-specialist on s' and a service-specialist on s'', can then both standardize on their areas of specialization and the mean business characteristic, such that $a_{1s} = \varepsilon_{s'}$, $a_{2s} = \varepsilon_{s''}$, and $a_{1b} = a_{2b} = (\varepsilon_{b'}$

$+ \varepsilon_{b''})/2$. If $\varepsilon_{b'}$ and $\varepsilon_{b''}$ are random draws, expected total costs are $2c + \sigma_B + \bar{K}$ per worker, but as $|\varepsilon_{b'} - \varepsilon_{b''}| \to 0$, $|\varepsilon_{b'} - (\varepsilon_{b'} + \varepsilon_{b''})/2|^{\alpha} \to 0$ and costs decrease to $2c + \bar{K}$ per worker. So the entrepreneur will prefer to select businesses *b'* and *b''* such that $\varepsilon_{b'}$ and $\varepsilon_{b''}$ are close to each other.

If we, in line with the workhorse model, assume that the needs of *b'* and *b''* are random and independent, the two employees will only be able to utilize their service expertise in a small fraction of all realizations. However, the gains from standardizing their business approaches will remain. So we can define "similarity" by the difference between the ε_bs, to get:

FINDING 5: *Entrepreneurs prefer to enter businesses that are as similar as possible.*

To find the optimal scope of firms, it is convenient to look at a case with a continuum of businesses in which the ε_bs are uniformly distributed on *[-1/2, 1/2]*.[17] Aiming for simplicity, we assume that the needs of the businesses are exactly negatively correlated (as in the paragraph above Finding 5) such that an entrepreneur can meet all needs from *n* businesses by hiring *n* service-specialists as employees, where $n \in [0, 1]$.[18]

PROPOSITION 2: *The optimal scope of the firm is an interval of length* $Argmax = n(2v - 2c - \bar{K}) - \int_0^n [|n/2 - x|^{\alpha}]dx$. *It is increasing in the profitability of the core business,* $2v - 2c - \bar{K}$.

Proof: See Appendix.

As an entrepreneur grows her enterprise, her businesses become less similar, eventually eroding the efficiency advantages.

The result suggests that costs decrease with volume within an industry, but increase with the extent of inter-industry diversification, in line with empirical results (Hortacsu and Syverson, 2007; Atalay, Hortacsu, and Syverson, 2014; Montgomery and Wernerfelt, 1988; Wernerfelt and Montgomery, 1988). They also suggest that a firm enter businesses that, on important attributes, are as similar as possible to those the firm already is in (Montgomery and Hariharan, 1991).

[17] The reader will have no problem generalizing this to more general distributions although the answer then varies across the support.
[18] As discussed in the paragraph above Finding 5, the gains will be smaller when needs are less perfectly correlated. This will reduce the optimal scope.

Remark. While the arguments made here rely on different forces than those used in recent theories of the firm, they are consistent with the managerial literature on corporate diversification. In particular, the incentives to expand and yet stay in businesses that are as similar as possible are reminiscent of prescriptions from the very influential "Resource-Based View of the Firm" (Barney, 1991; Wernerfelt, 1984). The two main prescriptions of this literature are that firms should expand their scope to leverage excess capacity of productive resources ,[19] and that they should concentrate on "what they are good at", and thus stay in similar businesses.

Taking the correspondence further, one could possibly think of the decision to standardize approaches on the mean business characteristic, $(\varepsilon_{b'} + \varepsilon_{b''})/2$, as the "management strategy" of a firm. This is often articulated in broad guidelines such as "Do what helps the brand the most" (Gucci), "Quality is job one" (Ford), or "What would Sam have done?" (Wal-Mart). If followed, these guidelines systematically bias actions in a particular direction and allow the workers to follow efficient standard operating procedures. ■

V. THE ALLOCATION OF TALENT

Assume that some workers benefit more from specialization than others, such that worker w's period *2* cost when standardizing, c_w, is drawn from a distribution with support $[\underline{c}, \underline{c} + 1]$, and consider a specific service. The total two-period costs if w is a service-specialist employee, a generalist employee, and a professional are $2c_w + \bar{K}$, $2c + 2\sigma_S + \bar{K}$, and $2c + 2\sigma_B$, respectively. The social return to lower c_w is the same for service-specialist employees and professionals, but, the former create more surplus when $\bar{K} < 2\sigma_B$. Since the stronger worker types can offer entrepreneurs more, the most (second most) efficient workers will work as service-specialist employees and the second most (most) efficient group will then be market professionals, if $\bar{K} <$ $(>)$ $2\sigma_B$. In any case, generalist employees come last.

More completely, for this model we have

[19]In Edith Penrose's (1959) formulation of this idea (in a the context of firms' growth within a single business), the excess capacity is tied to the time of individual managers; much like the above argument is driven by the efficiency gains from fully utilizing service-specialists as employees.

FINDING 6: *There exists an equilibrium in which*

(a) If $\bar{K} < 2\sigma_B$*, entrepreneurs use service-specialist employees when possible.*

(b) *If* $\bar{K} > 2\sigma_B$*, entrepreneurs use professionals when possible.*

The first part of this prediction appears to contrast with that of Garicano (2000). In his model, legal skills are ordered along a single dimension and the best lawyers perform the most difficult services. If we make the additional assumption that the most difficult problems come up infrequently, the best lawyers will work as professionals rather than in firms. In the present model, there are entrepreneurs with full-time needs for each skill. Assuming that condition *(a)* holds, service-specialist employees will be the best lawyers in areas of law in which many firms use them. However, in those branches of law in which only very large firms can sustain service-specialists as employees, the best lawyers work in law firms. (See also Finding 3.)

The Finding could be applied to an individual worker and used to make predictions about career paths. This would explain why more focused firms employ service-specialist labor, such as lawyers and plumbers, while more diverse firms hire professionals on a case-by-case basis.

VI. CONCLUSION

We have characterized the use of markets, employment, and sequential contracting, as well as the services, workers, and entrepreneurs for which each is the most efficient way to economize on costs of adaptation. Many of the predictions are easily testable and factors like the advantages of specialization, the frequency of change, the magnitude of demand, and the size of firms, are particularly interesting since they do not appear in contemporary economic theories of organization. On the other hand, the factors determining the optimal scope of the firm are strongly reminiscent of those stressed in the management literature.

In terms of future research, the workhorse model is deliberately very simple and can easily be extended in any number of directions. One could, with very little effort, look at multiple categories of needs, complementarities between needs, covariance between the types,

investments in physical assets, investments in skill, and incomplete information. A more difficult, but seemingly doable, extension is to cast the model in a general equilibrium setting.

A less direct extension would be to look at the economy's ability to absorb various shocks. The fixed up front cost of employment makes it less responsive to demand than the market (Rosen, 1968). Anticipating problems in case of a negative shock, entrepreneurs may thus be reluctant to invest in hiring, preferring instead to fill in with professionals. The workhorse model in the present paper cannot be used to investigate this in any detail, but it is conceivable that a suitable extension could contribute some foundations to the study of labor demand over the business cycle.

APPENDIX: PROOFS

PROPOSITION 1: *There exists three regions in [σ_B, σ_S, $\overline{K}$, $\underline{K}$, δ] where Markets, Employment, and Sequential Contracting are weakly more efficient that all other sub-game perfect equilibria of the economy*.

Proof: We first show that we can confine attention to two types of bins: Those with one pair in which the worker is a business-specialist in the business, and those with $|E|$ pairs in which the workers are service-specialists in the service needed by the entrepreneurs.

Unbalanced bargaining bins, with unequal numbers of workers and buyers, are inefficient, since they imply that some production is lost and $v - c > \sigma_B$. Among balanced bins in which all entrepreneurs have the same need, those in which all workers are service-specialists on that service weakly dominate all others, and such bins with less than $|E|/|S|$ pairs do not perform better those bins with $|E|/|S|$ pairs. The performance of a mixed balanced bin, consisting of entrepreneurs with different needs and corresponding numbers of service-specialists, is the same as that of a set of smaller bins constructed by breaking up the mixed bin according to entrepreneur needs. Finally, bins in which all workers are business-specialists in all businesses are inefficient if they have more than one pair.

This implies that we can look at six classes of equilibria with the following numbers of pairs in (period*1*, period *2*): *(*$|E|/|S|$*,* $|E|/|S|$*), (*$|E|/|S|$*, 1), (1,* $|E|/|S|$*), (1, 1), (*$|E|/|S|$*, 0),* and *(1, 0).*The first, fourth and sixth of these are Markets, Sequential Contracting, and Employment, respectively. We can find values of σ_M, σ_S, $\overline{K}$, $\underline{K}$, and δ such that either of these is more efficient than the others. The second, third, and fifth classes are inefficient because the workers can do no better than standardizing on a ε_s or ε_b which are valid for the first period only. In contrast, Markets, Sequential Contracting, and Employment allow standardization on approaches that are valid for both periods.

Existence is easy to prove. Since all services, workers, and entrepreneurs are ex ante identical, each type of player will use only one strategy. Any unilateral deviation (participating in the "wrong" bargaining bin or refusing to negotiate) will lead to zero payoff. The non-negativity of equilibrium payoffs follows from $v > c + \sigma_B$ and the fact that equilibria only are used if their costs are weakly lower than those in the Market, $(1 + \delta)(c + \sigma_B)$.

Q.E.D.

PROPOSITION 2: *The optimal scope of the firm is an interval of length Argmax= n(2v –2c - $\bar{K}$) – $\int_0^n$[$\left| n/2 - x \right|^{\alpha}$]dx. It is increasing in the profitability of the core business, 2v –2c - $\bar{K}$.*

Proof: Consider an entrepreneur who wants to expand from the business for which $\varepsilon_{b'} = -1/2$. If she expands until $\varepsilon_{b''} = n - 1/2$, her profits will be $2nv - \int_0^n [2c + 2\left| n/2 - x \right|^{\alpha} + \bar{K}]dx = n(2v - 2c - \bar{K}) - \int_0^n [\left| n/2 - x \right|^{\alpha}]dx$. The value of *n* that maximizes this is increasing in $2v - 2c - \bar{K}$. If the scope is not an interval, the cost can be reduced by dropping the extreme businesses in favor of connecting the support.

Q.E.D.

REFERENCES

Alchian, Armen A., and Harold Demsetz, "Production, Information Costs, and Economic Organization", *American Economic Review,* 62, no. 5, pp. 777-95, 1972.

Alonso, Ricardo, Wouter Dessein, and Niko Matouschek, "Organizing to Adapt and Compete", *American Economic Journal: Microeconomics,* forthcoming, 2015

Atalay, Elghin, Hortacsu, Ali, and Chad Syverson, "Vertical Integration and Input Flows", *American Economic Review,* 104, no. 4, April, pp. 1120-48, 2014.

Bain & Co, http://www.masteringthemerger.com/masteringthemerger/case_example_newell.asp, accessed 7/22/2013.

Bajari, Patrick, and Steven Tadelis, "Incentives versus Transaction Costs: A theory of Procurement Contracts", *RAND Journal of Economics,* 32, no. 3, pp. 387-407, 2001.

Barney, Jay B., "Firm Resources and Sustained Competitive Advantage, *Journal of Management,* 17, no. 1, March, pp. 99-120, 1991.

Bartling, Bjoern, Ernst Fehr, and Klaus M. Schmidt, "Use and Abuse of Authority: A Behavioral Foundation of the Employment Relation", *Journal of the European Economic Association,* 11, no. 4, August, pp. 711-42, 2013.

Becker, Gary S., and Kevin M. Murphy, "The Division of Labor, Coordination Costs, and Knowledge", *Quarterly Journal of Economics,* 107, no. 4, November, pp. 1137-60, 1992.

Coase, Ronald H., "The Nature of the Firm", *Economica,* n. s. 4, November, pp. 386-405, 1937.

Garicano, Luis, "Hierarchies and the Organization of Knowledge in Production", *Journal of Political Economy,* 108, no. 5, October, pp. 874-904, 2000.

Gibbons, Robert, Richard Holden, and Michael Powell, "Organization and Information: Firms' Governance Choices in Rational-Expectations Equilibrium", *Quarterly Journal of Economics,* 127, no. 4, December, pp. 1813-41, 2012.

Grossman, Sanford, and Oliver D. Hart, "The Costs and Benefits of Ownership", *Journal of Political Economy,* 94, August, pp. 691-719, 1986.

Hortacsu, Ali, and Chad Syverson, "Cementing Relationships: Vertical Integration, Foreclosure, Productivity, and Prices", *Journal of Political Economy,* 115, no. 2, April, pp. 250-300, 2007.

Legros, Patrick, and Andrew F. Newman, "A Price Theory of Vertical and Lateral Integration", *Quarterly Journal of Economics,* 138, no. 2, May, pp. 725-70, 2013.

Maciejovsky, Boris and Birger Wernerfelt, "Costs of Implementation: Bargaining Costs versus Allocative Efficiency", *Journal of Economic Behavior and Organization,* 77, no. 3, March, pp. 318-25, 2011.

Maskin Eric, and Jean Tirole, "Unforeseen Contingencies and Incomplete Contracts", *Review of Economic Studies,* 66, no. 1, pp. 83-114, 1999.

Matouschek, Niko, "Ex Post Inefficiencies in a Property Rights Theory of the Firm", *Journal of Law, Economics, and Organization,* 20, no. 1, pp. 125-47, 2004.

Milwaukee Journal Sentinel, "DaimlerChrysler may Divest Unit", p. 39, April 5, 1999.

Montgomery, Cynthia A., and Sam Hariharan, "Diversified Expansion by Large Established 1959. Firms", *Journal of Economic Behavior and Organization,* 15, no. 1, pp. 71-89, 1991.

Montgomery, Cynthia A., and Birger Wernerfelt, "Diversification, Ricardian Rents, and Tobin's *q*", RAND *Journal of Economics,* 19, no. 4, Winter, pp. 623-32, 1988.

Myerson, Roger B., and Mark A. Satterthwaite, "Efficient Equilibria for Bilateral Trading", *Journal of Economic Theory,* 29, no. 2, pp. 265-81, 1983.

Novak, Sharon, and Birger Wernerfelt, "On the Grouping of Services into Firms: Make-or-Buy with Interdependent Parts", *Journal of Economics and Management Strategy,* 21, no. 1, pp. 53-77, 2012.

Penrose, Edith, *The Theory of the Growth of the Firm*, New York, NY: John Wiley and Sons, 1959.

Rosen, Sherwin, "Short-Run Employment Variation on Class-I Railroads in the US, 1947 - 1963", *Econometrica,* 36, no. 3, July-October, pp. 511 – 29, 1968.

Rosen, Sherwin, "Substitution and the Division of Labor", *Economica*, 45, no. 179, August, pp. 235-50, 1978.

Rosen, Sherwin, "Specialization and Human Capital", *Journal of Labor Economics,* 1, no. 1, pp. 43-49, 1983.

Simester, Duncan I., and Birger Wernerfelt, "Determinants of asset Ownership: A Study of the Carpentry Trade", *Review of Economics and Statistics* 87, no. 1, February, pp. 50-58, 2005.

Simon, Herbert A., "A Formal Theory of the Employment Relationship", *Econometrica*, 19, July, pp. 293-305, 1951.

Smith, Adam, *The Wealth of Nations*, New York, NY: Modern Library, 1965.

Spulber, Daniel F., *The Theory of the Firm: Microeconomics with Endogenous Entrepreneurs, Firms, Markets, and Organizations,* New York, NY: Cambridge University Press, 2009.

Stigler, George J., "The Division of Labor is Limited by the Extent of the Market", *Journal of Political Economy*, 59, no. 3, June, pp. 185-93, 1951.

Stigler, George J., "Production and Distribution in the Short Run", *Journal of Political Economy,* 47, no. 3, June, pp. 305-27 , 1939.

Tullock, Gordon,"The Welfare Costs of Tariffs, Monopolies, and Theft," *Western Economic Journal*, 5, no. 3, June, pp. 224 – 32, 1967.

Wernerfelt, Birger,"The Comparative Advantages of Firms, Markets, and Contracts: A Unified Theory", *Economica*, 82, forthcoming, 2015.

Wernerfelt, Birger, "On the Nature and Scope of the Firm: An Adjustment-Cost Theory", *Journal of Business*, 70, no. 4, October, pp. 489-514, 1997.

Wernerfelt, Birger, "A Resource–Based View of the Firm", *Strategic Management Journal,* 5, no. 2, April – June, pp. 171-80, 1984.

Wernerfelt, Birger, and Cynthia A. Montgomery, "Tobin's *q* and the Importance of Focus in Firm performance", *American Economic Review,* 78, no. 1, March, pp. 246 – 50, 1988.

Williamson, Oliver E. *The Economic Institutions of Capitalism,* New York, NY: The Free Press, 1985.