

Firms As Knowledge Repositories

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-Abstract-

One reason firms exist is to serve as knowledge repositories. Firms compete against other firms and need profits to survive. Firms must be entrepreneurial to discover and act on profit opportunities. Knowledge required to spot profit opportunities is disbursed among economic actors and often is tacit knowledge that can only be obtained by those in close proximity. This gives rise to agglomeration economies, which can be leveraged within firms. In a competitive economy people have an incentive to keep knowledge from people in other firms, but to share it with those in their firm. One role of the firm is to act as a repository of knowledge for those within the firm's boundaries, and to lower the cost of obtaining knowledge about profit opportunities. Entrepreneurs need firms to contain and capture the profits from their innovations.

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Firms As Knowledge Repositories

The existence of the firm as an economic institution serves many purposes. Sautet (2000: 5) lists four rationales for firms: (1) They exist for technological reasons, because certain types of production processes cannot be separated; (2) They are a manifestation of a certain type of market contract, or are a nexus of contracts (Jensen and Meckling 1976; Cheung 1983); (3) They exist because sometimes it is less costly to bypass markets to allocate resources in a hierarchical manner (Coase 1937; Alchian and Demsetz 1972; Williamson 1985); and (4) They exist to concentrate capabilities of economic actors who are more efficient if they work together as a team (Penrose 1959). Another reason, explored in this analysis, is that firms act as knowledge repositories, because sharing knowledge with those within the firm's boundaries increases profits for the sharing group, whereas sharing knowledge with competing firms lowers the firm's profits.

This explanation for the existence of firms is most directly related to Sautet's fourth rationale, in that actors are more efficient if they work together and share their knowledge. Penrose (1959) emphasizes the entrepreneurial aspect of the firm's management and its ability to acquire the knowledge to effectively compete in an ever-evolving market. Firms depend on certain institutional prerequisites, especially in terms of information processing, as Harper (1988) notes. This view of the firm emphasizes the role of firms as organizations that develop productive capabilities, rather than organizations that combine factors of production. This paper builds on those insights by analyzing the entrepreneurial nature of the firm, the tacit knowledge that is required to compete successfully, and the agglomeration economies that can arise within the firm because of the existence of tacit knowledge.

Tacit knowledge, as the term is used here, means knowledge that cannot be articulated and explained to others, but that can be absorbed by people in close proximity who observe that knowledge being used. This appears consistent with Hayek's (1945: 521-522) idea that every person has "...knowledge of the particular circumstances of time and place... which use can be made only if the decisions depending on it are left to him or are made with his active

cooperation.” If the knowledge were easily communicated to others, the holder of the knowledge could communicate it and would not have to be actively involved in decisions relying on it. As Desrochers (2001) persuasively argues, although it is difficult to articulate, tacit knowledge can often be transferred to those in close proximity, when they observe that knowledge being applied.¹

When tacit knowledge exists the people who have that knowledge have an incentive to share it with those within their firms, because it increases the firm’s profits, and therefore the earning potential of those within the firm. They have an incentive to keep that knowledge from those in competing firms, because sharing that knowledge would erode the firm’s ability to profit from it. The firm is then an institution that breaks down a barrier to the transmission of tacit knowledge, because those within the firm’s boundaries benefit from sharing it with others within the firm.² They bear a cost (in terms of lost profits) if that knowledge spreads to other competing firms. In this way, the firm acts as a knowledge repository.

The Entrepreneurial Nature of Firms

The theory of the firm is based on the assumption that firms act to maximize profit, so it is worth considering this assumption first when looking into rationales for the existence of firms. In the neoclassical theory of the firm competitive firms have to maximize profit just earn a “normal” profit” and stay in business, so neoclassical competitors that do not maximize profit disappear from the economy. Monopolies in the neoclassical framework earn above-normal profit, so there is some room for slack in the static neoclassical monopoly. However, in a dynamic economy conditions are always changing, and firms with monopoly power at one point in time can lose it if competitors are able to enter their markets, or if competitors develop new products that erode the demand for the monopolist’s output. Competing firms can, over time, acquire some of a firm’s tacit knowledge through imitation, research, and reverse engineering, and more significantly, competing firms can develop new knowledge, new products, and new production processes that render the products and processes of existing firms obsolete.

The activities of those who run firms can be divided into two general categories: management and entrepreneurship (Penrose 1959: ch. 3; Boudreaux and Holcombe 1989). The managerial activities of the firm are along the lines of the neoclassical theory of the firm, where firms maximize profits by choosing the optimal quantities of inputs and by monitoring their use so that they are not used inefficiently, following Alchian and Demsetz (1972). This characterization of the firm's activities works well within an equilibrium framework, but in the more dynamic economy described by Schumpeter (1934) it fails to describe the more important entrepreneurial activities of those who run firms. As Langlois (2007) notes, a key role of the firm is to enable entrepreneurs to solve coordination problems that arise because of change and uncertainty.

In the neoclassical framework competitive firms are assumed to produce homogeneous products and work within given production functions to combine inputs into output. But the homogeneous output in neoclassical competitive markets is an assumption of the model, not a conclusion logically derived from it. In the real-world competitive economy, one of the most effective competitive strategies is to differentiate one's product by making it better than those sold by other firms, as Holcombe (2009) explains. Better, in this context, means producing more value for consumers, and profit is a signal that consumers value the innovation more than the cost of bringing it to market. Despite the neoclassical assumption of homogeneous products in competitive markets, in the real world product differentiation is a common competitive strategy. Not only is product differentiation consistent with competitive behavior, it is an essential element of competition that is necessary for a firm's survival over time.

In contrast with the neoclassical model of competition, when entrepreneurs look at their production functions, they realize that they can alter product characteristics to improve their products. They realize they can redesign their production processes to alter their production processes. They realize that they can use different inputs. Labor and capital are not homogeneous, so they can hire workers who have more human capital. Sometimes, a better strategy is to change the nature of their capital so that they can use workers with less human capital, and therefore who command a lower wage. For a trivial example, cash registers that can

scan product bar codes, and that automatically calculate the change due, have replaced cash registers from decades ago that required cashiers to key in prices and to calculate the change due themselves, lowering the human capital that is required to be a cashier. Similarly, high-level programming languages lower the human capital required to code computer programs.

Taking a neoclassical managerial approach to the firm, all of the parameters of the production function are given so the manager only chooses the optimal amounts of inputs and monitors their use to see that they are used efficiently. An entrepreneur recognizes that every parameter of the production function can be altered, as noted by Boudreaux and Holcombe (1989). The firm can change its production function, and the types of inputs and outputs in that production function. Taking an entrepreneurial view of the competitive firm, profit maximization does not mean settling for a normal profit, it means looking for better production methods and looking for ways of improving a product's characteristics to be able to make more desirable products at a lower cost.

As Holcombe (2009) explains, product differentiation is the engine of economic progress. Firms do not differentiate their products just to make them different. To do so incurs a cost, but gives the firm no competitive advantage over its rivals. Rather, firms differentiate their products to make them better than those of their rivals, so that consumers will prefer their products to those produced by other firms. Over time, products become better and production methods become more efficient. This entrepreneurial strategy of continually looking for ways to improve a firm's products, and continually looking for ways to lower a firm's costs, is the profit-maximizing competitive strategy, not looking for the optimal combination of inputs to produce a product like everyone else's. Even within a narrow neoclassical framework, if neoclassical competitive firms cannot earn above a normal profit but firms with monopoly power can, the profit-maximizing strategy is to look for ways to gain some market power.

Entrepreneurial firms will always be looking for this type of competitive advantage, which means that all firms must be entrepreneurial, or they will be left behind by those that are. If some firms are acting entrepreneurially while others are only following the neoclassical formula of

minimizing costs, those firms run by neoclassical managers will fall further and further behind entrepreneurial firms, until eventually their normal profits will turn into losses and they will be driven out of business. The fact that some firms in a competitive environment are entrepreneurial means that all firms must be, if they are to survive in an environment of inevitable economic progress.

As long as the entrepreneurial innovations firms bring to market remain with the innovating firm alone, the firm can earn profits from the innovation. If other firms are able to see and imitate the innovation, the profit from it will be competed away. If the knowledge underlying the innovation is not tacit, other firms can copy it, but if the innovation results from tacit knowledge – a manufacturing innovation that must be observed to be understood, and that is not apparent from looking at the final product, for example – then the firm can maintain control over the knowledge and continue to profit from the innovation. The entrepreneur has an incentive to have knowledge shared within the boundaries of the firm to make the firm more profitable, but has an incentive to keep knowledge from escaping the firm's boundaries to prevent the advantage the knowledge brings from being competed away.

Entrepreneurship and Knowledge

Entrepreneurship, following Kirzner (1973), means spotting and acting on unexploited profit opportunities.³ While at first it might appear that entrepreneurial opportunities are available to anyone who is alert enough to notice them, in fact it will take a considerable amount of knowledge to observe a profit opportunity in an entrepreneurial economy where many others are searching for profit opportunities. Look at all the entrepreneurial opportunities that have arisen in the electronics industry over the past several decades. Someone not intimately familiar with the industry would have no chance of spotting a profit opportunity there. The same is true of any industry. Someone not intimately familiar with the agriculture industry would have little chance of spotting a profit opportunity from reallocating crop land, using a different seed variety, and so forth, and it would take a substantial amount of technical knowledge to develop different seed

varieties. Someone not familiar with the auto repair business would have little chance of spotting a profit opportunity in opening an auto repair shop. The requisite knowledge would include not only technical knowledge about how to repair cars, but also knowledge about local markets and knowledge about business and personnel management.

Much of the required knowledge will be specific local knowledge, and tacit knowledge that would be difficult to explain to someone unfamiliar with the very specific conditions related to a specific opportunity. A human resources director at a large hospital will have a great deal of knowledge about personnel management, but probably not the right knowledge to be able to manage a group of mechanics in a local garage. The entrepreneur opening the garage will likely have obtained that knowledge from previous experience in that line of work, seeing how it was done and understanding from first-hand experience how mechanics can be kept happy and productive in their jobs.

Schumpeter (1934) made the distinction between invention and innovation. Invention means developing new techniques, products, and processes, whereas innovation means introducing them into the market. R&D produces inventions, but inventions provide no benefit to firms unless then can be transformed into innovations. If entrepreneurship entails noticing a profit opportunity, the function of R&D is to create an environment within which profit opportunities are more likely to be spotted, with the hope that someone in the firm doing the R&D can spot the opportunity first and turn it into an innovation. As a well-known example, the graphical user interface used on computers like the Apple Macintosh and those using Microsoft Windows was invented at Xerox, but Xerox never produced a profitable product using the interface they invented. The inventors were at Xerox, but Apple and Microsoft were the innovators that spotted the profit opportunity and brought profitable products to market.

Tacit Knowledge and Agglomeration Economies

All firms must be entrepreneurial, because their competitors are, and entrepreneurs are always looking for profit opportunities, so finding one is not as simple as just having one

materialize in front of the potential entrepreneur. Opportunities do not remain for long once they are produced, because entrepreneurs are trying to be alert to them.⁴ The people who have the best chance of spotting profit opportunities are those who are intimately familiar with the market in which the opportunity appears. Potential entrepreneurs must accumulate information about the potential market, and combine many bits of information to generate knowledge about whether an opportunity is likely to pay off. When one thinks about entrepreneurs, names like Bill Gates and Henry Ford often come to mind, and one often neglects to consider that most new businesses fail because the entrepreneur who started it did not have the knowledge to make it profitable, or the wisdom to see that what at first appeared to be a profit opportunity in fact could not become profitable. Holcombe (2003b) discusses how entrepreneurs collect information, combine it into knowledge, and develop the wisdom to interpret the knowledge they have gained.

Some information can be recorded and transmitted to the entrepreneur over time and at great distance. The educational system specializes in such information, which people can learn by reading, enhanced by personal instruction. Similarly, information like prices can be transmitted over long distances, and people who have interacted in specific markets over a period of time will develop a knowledge base that incorporates how prices move over time, and how they can be affected by specific events. Other information falls into the category of what Hayek (1945) refers to as specific knowledge of time and place, that is revealed to people by first-hand observation, but that is difficult to summarize and is difficult for one person to explain to another. This tacit knowledge is the product of first hand experience.

Desrochers (2001) explains the importance of geographic proximity to obtain this tacit knowledge. He relates an example of Steve Wozniak, one of the founders of Apple Computer, attending a demonstration of a color monitor hooked up to a computer. Wozniak conjectured that if he just knew about the alternative of a color rather than monochrome computer monitor, it is likely that Apple would have gone with monochrome, but actually experiencing first-hand how a color monitor could enhance the computer, the Apple II was introduced with a color monitor. It

was an entrepreneurial decision that was made based on being there and having first-hand experience, which provided Wozniak with knowledge he could not have obtained any other way.

Locational proximity generates information that can reveal many entrepreneurial opportunities. That is why agglomeration economies exist, and firms in the same industry tend to cluster. The computer industry has clusters in Silicon Valley, in Austin, and in Boston, for example, while the financial industry has centers in New York and London. When firms are in close proximity to one another they have a better chance to see and imitate – or improve on – the innovations of their competitors. Locational clusters also create concentrations of human capital. That human capital can take advantage of the same educational opportunities, which gives solidifies clusters of learning, and it allows people to gain better information about employment opportunities. Workers would find it easier to spot and move to a better job if it were located down the block, or a few miles down the road, than if it were located in a different city.

These positive spillovers related to proximity create agglomeration economies and produce concentrations of knowledge in particular industries. Because this tacit knowledge depends on geographical proximity for its transmission, firms and individuals find it advantageous to locate near others engaged in the same type of business. Doing so makes it more likely that they will be able to spot entrepreneurial opportunities when they arise, keeping them ahead of their competitors who find it more costly – or impossible – to obtain the tacit knowledge required to spot entrepreneurial opportunities as they arise. In an economy characterized by economic progress it is crucial for firms to act on entrepreneurial opportunities as they arise, because their competitors are. Firms that fail to be entrepreneurial will fail to make profits and will be driven out of business by their entrepreneurial competitors. This means they must utilize tacit knowledge that is only available to those who can observe it first-hand.

The Transmission of Knowledge Within Firms

Understanding the importance of tacit knowledge and agglomeration economies to being successful in the market, and understanding the crucial role of profits to the operation of a market

economy, firms serve the role of lowering the barriers to the transmission of tacit knowledge to those within the firm's boundaries. People within firms are able to observe each others' activities, and through observation and first-hand contact are able to assimilate the tacit knowledge possessed by their colleagues. The modern concept of mentoring, and the older concept of apprenticeship, are built on this idea of tacit knowledge. If such knowledge were easily described, it could become textbook knowledge, which could be transmitted through the educational system. Both mentoring and apprenticeship are based on the idea that some knowledge can only be transmitted by first-hand observation, because the holder of tacit knowledge cannot pass it along merely by explaining.⁵ People who work within a firm are able to observe at close hand the productive activities of their co-workers, so are able to absorb tacit knowledge from them that is not available to people outside the firm's boundaries. Seen in this way, firms are collections of workers who share knowledge for their mutual benefit, but do not share that tacit knowledge with those outside the firm's boundaries.

Firms are knowledge repositories because they are profit repositories. Firms are collections of people who are working together to produce and sell output. Everybody who works for the firm has an incentive to help the firm produce profit because even if the workers are guaranteed a contractual salary, that salary can only be paid if the firm has sufficient revenues. Taking a longer view, a more profitable firm might give its employees bonuses, or higher raises in the future, because those who run the firm will have an incentive to retain the employees who make the firm profitable. Even taking a shorter view, the jobs of employees are dependent upon their employer remaining profitable.

Employees have an incentive to share knowledge with other employees in their firm, because doing so can make the firm more profitable, and profits for the firm benefit the firm's employees. Employees of one firm have an incentive to conceal knowledge from employees of competing firms, because if competing firms use that knowledge, those firms will take business away from the firm from which the knowledge escaped. If the knowledge is easily observed and acted upon,

it may be difficult for those in the firm to keep the knowledge from escaping the firm's boundaries. With tacit knowledge, the firm's boundary can act as a barrier to its transmission.

Firms are institutions that allow individuals to benefit from sharing tacit knowledge. If tacit knowledge is shared among employees of a firm, all of the firm's employees can benefit. If tacit knowledge possessed by employees of one firm is shared with employees of a competing firm, the employees whose knowledge is shared bear a cost. One reason entrepreneurs work within the institutional structure of a firm because the firm provides a mechanism for the entrepreneur to contain and capture profits from their innovations. Firms act as knowledge repositories because there are incentives for those within the firm to accumulate and share knowledge with each other. At the same time, there are disincentives for those within the firm to share knowledge with competitors.

Knowledge Repositories and the Capabilities Theory of the Firm

Building on Penrose (1959), Richardson (1972: 895) develops a capabilities theory of the firm, where "... activities had to be undertaken by organisations with appropriate capabilities. ... Firms would find it expedient ... to concentrate on similar activities. ... [Dissimilar activities] would be the responsibility of different firms." Nelson and Winter (1982) look at firms as collections of individuals who have firm-specific intangible assets which aggregate as the firm's capabilities. Thus, Dulbecco and Garrouste (1999: 57) conclude, "The firm is then quite logically understood, not as the place where the factors of production are combined, but as the place where capabilities are built and modified." The idea that dissimilar activities are carried out by different firms is examined further in the next section, but it is also the case that similar activities are carried out by different firms, each trying to develop similar capabilities. The fact that competing firms are vying for the same customers by selling similar products makes the firm's boundary an important container of the firm's knowledge.

Why do the entrepreneurs who are building and modifying capabilities ensconce themselves in the rigid framework of the firm? The reason is that the boundary of the firm acts as a boundary

that contains the tacit knowledge of those who work within the boundary. By containing this knowledge, the boundary of the firm also contains the profits that are produced by the firm's capabilities. Entrepreneurship generates innovation which produces profit, and those within the firm have an incentive to keep any knowledge they have developed within the firm's boundaries, so that the firm can profit from it. Adelstein (2005: 59) says that all Austrian theories of the firm have the common element that they link "... the emergence of firms to the discovery of new opportunities for profit and the entrepreneur's need for the close cooperation of others to exploit them." In addition to exploiting them, they have an incentive to keep those opportunities within the firm so that the profit they generate is not competed away.

Foss (1997, 1999) emphasizes that firms are an institutional response to the need of entrepreneurs to coordinate economic activity in the face of disbursed knowledge. Firms can stimulate the entrepreneurial process of discovery, as Sautet (1999) notes. But to profit from entrepreneurial innovation, the entrepreneur also needs to maintain control of the knowledge behind it. The boundaries of the firm help the entrepreneur to retain exclusive control of that knowledge. Once that knowledge escapes the boundaries of the firm, competition dissipates the profit the knowledge produces.

Witt (1999) concludes that entrepreneurs need firms because some people want to take leadership positions to realize the profitable innovations they envision, while others prefer to be non-entrepreneurial employees, and the firm is an institution that sorts these types of people. There is more to the story, however, because everyone within the firm's boundary can benefit from the knowledge of their fellow employees, and they have an incentive to keep that knowledge within the firm to maintain the firm's profitability. Entrepreneurs need firms because without the firm's boundary, entrepreneurial profits escape as they are seized by others and competed away. So the recognition that firms are knowledge repositories is both an extension of the capabilities theory of the firm and a necessary component of the entrepreneurial theory of the firm.

Inevitably, some knowledge escapes through reverse engineering and other factors that can be observed from the outside. As Desrochers (2001) notes, even being in close proximity

outside the firm's boundaries – for example, being in the same city – can assist competitors to assimilate tacit knowledge. But firms have an incentive not only to develop capabilities through sharing of knowledge within the firm's boundaries, they also have an incentive to keep that knowledge from escaping to competitors. When it does, the profits that accrue to innovators are competed away.

Langlois and Robertson (2002: 43), in a chapter titled "A Dynamic Theory of the Boundaries of the Firm," note, "In the *long run*, the spread of knowledge should lead to a *tendency* toward the generalized spread of capabilities..." (italics in the original), recognizing that the spread of knowledge outside the firm's borders gives competitors capabilities that were once specific to the originating firm, but without noting that this spread erodes the profitability of the firm's specific knowledge. Seeing firms as knowledge repositories is an extension of the capabilities theory of the firm, and explains why entrepreneurs want the firm's boundaries to protect its stock of specialized knowledge. Firms not only develop specialized capabilities, they have an incentive to keep the knowledge that enables those capabilities proprietary.

As Lewin and Phelan (2000: 70) note, "Once a potential profit is perceived by at least one person, the question then arises as to which organizational arrangement is best suited to its appropriation or renders it vulnerable to appropriation by others." They go on to conclude (2000: 74), "Firms are formed in order to realize, and perhaps protect, the creation of value." The realization of value is the recognition of the capabilities theory of the firm. The protection of value results because firms are knowledge repositories.

The Supply Chain: Selling Knowledge

Firms may benefit from revealing knowledge they have to other firms who are not direct competitors. In many industries, from autos to computers, firms that sell final products to consumers do not build the product from the raw materials from which it is composed. Rather, they purchase components from suppliers and assemble those components. The component

suppliers, in turn, may purchase some of their components from suppliers, and so on until the supply chain reaches the raw materials from which the product is made.

If the knowledge of the supplier is not tacit knowledge, the purchaser may be able to produce the component in-house, which may explain why vertical integration occurs. But if the supplier has some tacit knowledge, the supplier can reveal that it has the knowledge to produce the component without the purchaser being able to obtain that knowledge. The supplier will reveal to potential customers that it has a stock of tacit knowledge, and will offer to sell the advantages it has as a result of that knowledge. The purchaser can see that the seller has valuable tacit knowledge, even though the purchaser is unable to obtain the knowledge. Thus, suppliers can maintain a viable business based on using its tacit knowledge.

The purchaser is in a position to benefit from this type of arrangement, especially if there are several possible suppliers. The purchaser can shop around to get the best component at the best price as potential suppliers compete among themselves. Meanwhile, the purchaser does not have to develop or maintain that knowledge base itself. For this reason the common practice of manufacturers using multiple suppliers to supply a particular component makes sense. It makes even more sense when one recognizes the dynamic nature of the economy in which entrepreneurs are always looking for ways to make better products and lower their costs. The competing suppliers will look for innovations so that they can go to their customers and offer them higher-quality components at lower prices. Competing suppliers help improve product quality and lower costs as a by-product of their entrepreneurial efforts to find profit opportunities.

If the purchaser decided to vertically integrate, and went to the expense of developing the knowledge in-house, that knowledge would become increasingly obsolete over time, and it may be less costly to purchase inputs from firms that specialize in maintaining and advancing particular types of knowledge that lie outside the firm's immediate areas of expertise. For example, in many (but not all) cases computer manufacturers buy their microprocessors from firms that specialize in making them, rather than trying to maintain current expertise in-house. To benefit from bringing suppliers' activities in house through vertical integration, the purchaser

would not only have to match the suppliers' current level of knowledge and expertise, but also would have to be committed to continually adding to its stock of knowledge to keep up with the market's innovation. Often, a better strategy is to rely on outside suppliers who have specialized knowledge in their areas.

Of course, there are good reasons for firms to vertically integrate. Langlois and Robertson (1995: ch. 7) offer a thorough discussion of vertical integration, and Coase's (1937) well-known transaction cost explanation of the firm's boundaries also explains why firms may vertically integrate rather than rely on market transactions. The literature has addressed reasons for vertically integrating and bringing processes in-house. The arguments given in this section suggest that vertical integration may be desirable if it is built on proprietary knowledge the firm wants to keep in-house, but will work against the firm when other firms in the supply chain have proprietary information the firm in question does not, or even when all firms are in an equal informational footing. In a dynamic economy, there are advantages to being able to choose among suppliers.

Consider two companies producing consumer goods, one that produces its components in-house and the other that buys them from suppliers. The one that produces its components in-house does not have the advantage of competition among component suppliers that provide the incentive to improve the quality of the product and lower cost. Vertical integration takes away that advantage. Over time, it may be that the most advantageous component suppliers will change, so the firm buying components on the market has the flexibility to shift from one supplier to another to take advantage of any innovations in all firms. The firm that is not vertically integrated can take advantage of competing knowledge repositories, all of whom depend upon continuing innovation to maintain their profitability. The vertically integrated firm must count on its own divisions being able to match or exceed all competitors. The supply chain is selling the advantages of the knowledge it possesses, and has an incentive to continue innovating and adding to its stock of knowledge.

Information Diseconomies

Larger firms may be able to take advantage of scale economies to give themselves a competitive advantage. However, there are diseconomies of scale that arise in knowledge repositories because individuals within firms can view fellow employees as competitors, which can inhibit the sharing of knowledge.

One reason the management of a large firm is a challenge is that it may be difficult to assign profits (and losses) to particular elements of the firm. In the aggregate, the firm incurs costs and collects revenues, with profit being the excess of revenues over costs. However, in a large firm it may be difficult to determine which components of the firm are producing the profits and whether some components are generating losses. Some components – the overall costs of managing the firm are an example – may be difficult or impossible to assign to particular revenue streams. One way this is sometimes handled is to divide the firm into divisions or profit centers and do separate accounting of profits and losses in each division or profit center.

A problem that arises with this type of organization is that the divisions can view themselves as competing with each other, so those with knowledge in one division may be reluctant to share their knowledge with those in competing divisions. Thus, the internal organization of the firm can erect the very knowledge barrier that the existence of the firm (as a knowledge repository) is designed to overcome. As Pongracic (2009) notes, the profitability of large-scale firms requires that intra-firm institutional structures be developed to align the interests of the firm's owners and workers, and provide incentives for employees to contribute toward the firm's profits. Such structures are difficult to design, which places a limit on the size of the firm.

Large firms will have many employees who undertake the same functions, and they too may view each other as competitors. For example, consider a firm with many people in its sales force. More sales improve the profitability of the firm, so in this sense each salesperson benefits from increased sales. However, it is not uncommon for the sales of individual salespeople to be compared with each other. People who are sell more will earn more, and may be in line for promotion to sales manager. (Of course, large firms have competing sales managers too.)

Salespeople whose sales are low by comparison may lose their jobs. Thus, people within the firm can come to view others working for the same firm as competitors, which will inhibit their sharing of knowledge. Salespeople with good techniques, or who come up with good lines to attract customers, will keep them to themselves rather than share them. Again, the internal organization of the firm can erect a knowledge barrier that the existence of the firm is designed to overcome.

The same is true in manufacturing. A large firm with several plants that produce the same, or similar, components, can compare those plants with each other to gauge their efficiency. But if rewards go to the people at the more productive plants that can provide a disincentive for sharing knowledge among the plants. Again, the function of the firm as a knowledge repository can be compromised.

Good management of the Alchian and Demsetz (1972) type means overcoming these barriers, making all employees believe that they are working on the same team, not that they are competitors, and keeping them from shirking, where shirking includes not sharing productive information with fellow employees. But there is a limit to how successful this can be as the firm grows. If the firm has one salesperson, that person has no disincentives toward sharing any available information with others in the firm (such as, for example, informing management about product characteristics customers say they desire). As the sales force increases, it will become more difficult for managers to create a team spirit among the employees. Thus, information diseconomies can create the same barriers within firms that exist between firms, which is a factor that limits the size of firms.

Eventually, it becomes more efficient to have smaller units to reduce these knowledge barriers. Smaller units can be produced by having firms divest themselves of divisions, which is a common occurrence, but can also occur when smaller more nimble competitors take market share from larger firms with less flexible management structures.

Division of Knowledge and Knowledge Repositories

One way to view firms is as specialists in the division of knowledge, to use Hayek's (1937) phrase. Some firms specialize in one type of knowledge while others specialize in other types. Consider, for example, the manufacture of a computer, where one firm produces the microprocessor, another produces the hard disk drive, and so forth. Each firm specializes in knowledge that the others do not possess, nor do they need to possess, because the market coordinates the knowledge of the various firms to produce and bring to market the final product. Indeed, as Lewin (1999: 130-132) and Lachmann (1956: 79-84) note, there is a similar division of capital, which can occur within or among firms, in which capital becomes increasingly specialized, enhancing productivity and generating increasing returns.

Taking this approach to the analysis of firms suggests a natural division that creates firms within a market. Firms specialize in a particular type of knowledge, which lies within the firm's boundaries, and engages in market transactions to take advantage of the different types of knowledge held by others. Such an approach is consistent both with Coase's (1937) view of the division between firms and market transactions based on transaction costs and with Richardson's (1972) capabilities view of the firm. Knowledge outside the boundaries of the firm is more economically acquired by purchasing it from others who specialize in that knowledge, rather than developing it in-house. This approach illuminates the way in which firms cooperate with each other and coordinate their activities to bring goods and services to market. The firms within a supply chain are complements, not substitutes.

This division of knowledge approach to understanding firms does not explain why there are many firms that serve the same function. One may conjecture that there may be limits to managerial efficiency that would limit the size of firms, but viewing firms as knowledge repositories offers another reason. Firms organize so that owners and employees with specialized knowledge can pool that knowledge for their mutual benefit, reaping the profit from it, and exclude others who are outside the firm from that profit. The firm is an institution that enables entrepreneurs to capture and contain the profits from their innovations. Sharing knowledge within the firm provides a mutual benefit; allowing knowledge to escape outside the

firm's boundaries reduces the firm's competitive advantage and places outsiders on a more equal footing. The role of profits and losses within the market gives people within the firm's boundaries an incentive to share knowledge among themselves, and to keep that knowledge from others not part of the firm.

This manifests itself in trade secrets, and non-compete agreements which specify that if employees leave a firm they are not allowed to take proprietary information with them, nor work for competing firms. Under the contemporary legal structure it also manifests itself in patents. While patented information does become public, the patent holder has a monopoly right to it, which also enables the patent holder to lease the patent or trade it for information held by other firms.

An overlooked reason for the existence of firms is that they act as knowledge repositories. A single entrepreneur may spot a profit opportunity, and believe that organizing a firm around that profit opportunity will enable the entrepreneur to sell the firm's output for more than the cost of the inputs, yielding a profit. If the entrepreneur's knowledge were easily observable, and if the entrepreneur's activities were easy to duplicate, that knowledge would be a common pool resource that would rapidly erode the entrepreneur's profit, rendering the establishment of a firm pointless. There is always risk in an entrepreneurial venture, because the entrepreneur is attempting to take advantage of a profit opportunity others have not exploited. Thus, there is no way to know from experience whether the entrepreneur's venture will succeed.

The entrepreneur will take a risk only if there is the potential for a return in the form of entrepreneurial profit. For this to happen the entrepreneur must possess knowledge that will be difficult for others to appropriate. Were it not the case, imitators would enter the entrepreneur's market as soon as profits appeared, eliminating the profit opportunity. The entrepreneur would suffer losses if the profit opportunity were only an illusion, but would gain no profit (because it would immediately be competed away) if the profit opportunity were real. There would be no payoff from taking the risk of entrepreneurial action.

For entrepreneurship to pay off, the entrepreneur must have knowledge that remains within the knowledge repository of the firm, so cannot be imitated by competitors. Often, this can come solely from the entrepreneur's first-mover advantage. The entrepreneur can start a successful business, and as other businesses try to imitate the entrepreneur's success, the entrepreneur has acquired additional knowledge that allows the entrepreneur to innovate and stay ahead of rivals. The entrepreneur may also believe the firm has engineering, design, or marketing talent that will enable the firm to maintain a lead over its rivals. This is an essential component of the capabilities theory of the firm. A good example at the beginning of the 21st century is Apple Computer, which as come out with a series of innovative goods and services (iMac, iPod, iTunes, iPhone, iPad) that have kept rivals trying to catch up. Before they can imitate one innovation, another appears on the market.

Entrepreneurs run the risk that those inside the firm's boundaries may leave, taking the knowledge they have acquired with them, and start competing firms. While this can happen, employees who leave will lose the synergy produced by the continually-developing tacit knowledge of their former colleagues. Unless they develop a substantial amount of tacit knowledge themselves, employees benefit from staying within the boundaries of their current firm. Departing employees may be on a relatively equal footing with their former employer when they leave, but unless their new firms can become knowledge repositories that rival their former firms, they will be unable to keep up in their markets. An example is former IBM engineer Gene Amdahl, who left IBM in 1970, when IBM mainframe computers dominated the market, to start a rival company manufacturing mainframe computers. Amdahl's first mainframe computer was sold in 1975. Amdahl's computer company did enjoy some success, but was bought by Fujitsu in 1997. IBM continues to be a dominant force in the computer industry in the twenty-first century, while Fujitsu is not among the major players in that industry.

One reason for forming a firm is to concentrate that knowledge into a knowledge repository so that the profits from the knowledge can be shared among the firm's owners, managers, and employees. The firm's boundary serves as a knowledge boundary. The firm's knowledge stays

within that boundary to maintain the firm's profitability, and to prevent that knowledge from becoming a common pool, which would eliminate its profit potential. Firms are established to allow those within the firm to take advantage of the firm's knowledge repository, and to prevent those outside the firm from doing so.

Knowledge and Progress

In a static, evenly rotating economy, the knowledge repositories of firms would lead to inefficiency, because knowledge hoarded by one firm would be unavailable to others that could make good use of it. The evenly rotating economy would be better served if all firms had access to all information. In a dynamic economy characterized by Schumpeterian creative destruction, firms have an incentive to develop proprietary information that gives them a competitive advantage over their rivals. As Holcombe (2009) notes, firms have an incentive to look for ways to improve their products and production processes to differentiate themselves from their rivals, gain a competitive advantage, and reap profits from doing so. Penrose (1959: 115) observes that corporate research "... enables at least the large firms to turn aside the process of 'creative destruction' and to thrive on the novelty that might otherwise have destroyed them." But this holds true only if firms can make proprietary use of the discoveries of their research.

If firms were not able to erect barriers to prevent knowledge they developed from flowing to their competitors, knowledge would become a common pool resource. All firms would be looking to take knowledge from that common pool, but there would be little incentive for people to contribute knowledge to the common pool. If it were available to everyone, the knowledge would be a public good, and those developing the knowledge would incur the expense of doing so, while sharing the benefit of the knowledge with everyone else. Thus, economic progress depends on firms being knowledge repositories, so that those who go to the expense of developing knowledge are able to profit from doing so.

Knowledge is often tacit; that is, it belongs to specific individuals who have acquired it by experience, and who may not be able to communicate that knowledge to others even if they try.

Even ordinary tasks like riding a bicycle or hitting a baseball can only be learned through experience. One can explain to someone how to ride a bicycle, but no explanation is sufficient. The same is true of manufacturing operations, crafts, and management functions. Thus, even when competing firms “see” what their competitors are doing, by observing their production processes or seeing their products, the firm is still likely to hold some information in its repository that cannot easily be appropriated by its competitors.

Over time, competitors can see, imitate, and eventually acquire the knowledge the entrepreneurial firms they compete with have generated. That is why firms must continually be entrepreneurial to have continued success. By the time competitors have obtained the knowledge of their entrepreneurial competitors, entrepreneurial firms will have built on their previous knowledge to keep their lead, as the example of Apple Computer in the previous section illustrated. Other firms see and imitate (and sometimes even improve on) the features of new products, but by the time they do, the more entrepreneurial firms have built on those advances to offer even more improvements.

Because the profits from innovation and knowledge stay within the boundaries of the firm, firms have the incentive to develop new knowledge and bring new innovations to market, because those within the firm’s boundaries profit from the development of that knowledge. Thus, the firm, as a knowledge repository, is an important economic institution that generates economic progress.

Conclusion

Foss (1997: 175) says that the theory of the firm addresses three issues: why firms exist, the boundaries of the firm, and the firm’s internal organization. This paper does not address the firm’s internal organization, but does add to the other two issues. One reason firms exist is to act as a knowledge repository, because the firm is a profit repository. The firm’s boundary serves the dual function of providing an incentive to share tacit knowledge within the firm, for the benefit of its owners and employees, and preventing that knowledge from spreading to competitors,

which would result in its value being dissipated. One reason to establish a firm is to share the benefits that come from combining the tacit knowledge of its employees. Entrepreneurs create firms to contain and capture the profits from their innovations.

Many other theories have been proposed for the existence of firms, and this analysis is not intended to replace them. The institution of the firm may serve many purposes. However, previous theories have not recognized the importance of the firm's boundary as a mechanism to prevent tacit knowledge from escaping to others outside the firm. In a dynamic and entrepreneurial economy firms can only survive by improving their products and production methods, and some of the knowledge that can produce this type of innovation is tacit knowledge. Within the firm there is an incentive to share this tacit knowledge, whereas those within one firm have an incentive to keep this tacit knowledge from those in competing firms.

The existence of tacit knowledge in an entrepreneurial economy also helps explain why firms utilize supply chains of other firms to produce components for their production. Suppliers can reveal that they have tacit knowledge without actually sharing that knowledge, and firms will want to buy the benefits of this tacit knowledge. Also, in an entrepreneurial economy firms can utilize competing suppliers, and suppliers competing with each other have an incentive to innovate in order to retain and build their firms. Firms using competing suppliers can choose more innovative suppliers over those that are less innovative, whereas if components are supplied in-house the firm is locked into its vertically-integrated supply chain.

As firms become larger, either by enlarging their product lines or by employing many people to perform similar functions, the informational advantages of the firm's organizational form can be eroded. Not only is it more difficult to attribute the firm's profits and losses to particular components – which has been well-recognized in the literature – barriers are created to the sharing of tacit knowledge because those with tacit knowledge can come to view other components of the firm as competitors, taking away the incentive to share and erecting the same knowledge barriers that exist between firms. This can place a natural limit on firm size.

Depicting firms as information repositories adds substantially to an understanding of the reason that production processes are organized into firms, and why there are informational limits that constrain the size of firms. The literature has noted that agglomeration economies explain the existence of concentrations of economic activity, and explain why industries tend to concentrate geographically. The institutional structure of the firm reduces some of the barriers that inhibit agglomeration economies by creating an environment within which people have an incentive to make their knowledge available to others in the firm. Thus, the firm can be viewed as a manifestation of knowledge-based agglomeration economies.

Footnotes

¹ The purpose of this paragraph is not to argue that Hayek had this transmission mechanism for knowledge in mind, but rather to clarify that in the present paper tacit knowledge is knowledge that is not easily articulated, but that can be absorbed when others observe it being used. Hayek was considering a different issue, which was the way knowledge is transmitted through the price system. Hayek (1945: 526) says, “We must look at the price system as such a mechanism for communicating information if we want to understand its real function...” but he was not arguing that the price system is the only method for communicating information, or that it is the best mechanism in every instance.

² This argument applies to other types of knowledge as well, such as Knowledge the firm holds as trade secrets. However, if the trade secret is easily explained, firms might share the knowledge with others and protect it with a nondisclosure agreement. If the knowledge is tacit, there would be more reason to place those with whom it was to be shared within the firm’s boundaries, so that the knowledge could be transmitted more easily to them. Meanwhile, the boundary of the firm prevents tacit knowledge from being passed on to others outside the firm, who are not in such close proximity.

³ Kirzner (1973) defines the entrepreneurial act as noticing a profit opportunity, and acting on it goes beyond the basic entrepreneurial act because it uses other factors of production, so the concept of entrepreneurship here is in the spirit of Kirzner, but goes beyond his definition. The reasoning is that the profit only comes after the opportunity is acted upon.

⁴ Holcombe (2003a) discusses the origins of entrepreneurial opportunities and the reasons they are exploited almost as soon as they appear.

⁵ Recognizing the importance of observation to the transmission of tacit knowledge, one educational innovation is the case study, which is especially popular in business schools. The idea of a case study is to try to approximate observation (after the fact) of successful business activity, almost as if the students were witnesses to the process. Some evidence that the case

study is not a perfect substitute for mentoring and first-hand observation is that firms still place value on the mentoring process.

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