Chapter 11: Multi-Product Firms

I. Multi-Product Firms

The logic of specialization worked out in Chapters 4 and 9 implies many firms produce only a single product or a very narrow range of products—ones that can be regarded to be identical for many modeling and estimation purposes. Firms that master the production of particular goods or services can often provide them at a lower cost than those who try to be "jacks of all trades." Examples of firms that produce a single product, service, or narrow range of products and services include coffee shops, bicycle shops, plumbers, carpenters, computer programmers, and airlines. However, we also observe firms that provide a variety of services and that produce many different products.

Indeed, even the specialized types of firms listed above generally provide more than one service or sell more than one type of their product. Neither plumbing services nor cell phones are all the same, even when produced by the same plumber, sold by the same shop, or produced by the same firm. A coach seat on an airplane is not the same as a first class seat.

This chapter explains why multi-product firms exist despite the informational and training advantages of specialization.

There are several explanations for multi-product firms—many of which are grounded in ideas from the previous chapters. Diversification can reduce risks in settings in which demand or production costs are influenced by random factors. In such cases, diversification produces a steadier flow of profits than specialization can. The simplest case of diversification is a conglomerate. Conglomerates own a variety of previously independent firms that are held in a portfolio. Such conglomerates benefit from diversification and also may more efficiently allocate capital among the firms held, because of their greater "inside" knowledge of the profitability of the firms held in their portfolios. Examples of the latter include Warren Buffett's Berkshire-Hathaway Company or Richard Branson's Virgin Group, as well as corporations such as Sony and General Electric (in the past).

A second reason why a firm may produce more than one product or service is that complementarities among the products and services produced may increase the overall demand for a firm's services or products. For example, computer manufacturers often provide repair and maintenance services for their computers (but not others) because their

customers will purchase more of each when they are produced by the same firm. Such firms are likely to be better at maintaining their own products than unaffiliated repairmen are because of their greater knowledge of and experience with their own products. Customers may also benefit from reduced transaction costs when purchasing combinations of complementary services from a single seller rather than contracting with many separate firms. Negotiations with a single firm for a variety of services may take less time and effort than negotiations with a large number of single service providers.

A third possible benefit is that economies of scale may be realized by making use of specialized equipment that can be used to produce several similar products. Recall that products are various combinations of attributes. Attributes can often be varied without significant changes in equipment, personnel, or assembly lines. For example, different paint colors can be applied in the same painting facility (although not simultaneously, and often with some intermediate steps required as one changes color). In such cases, the combined demand for minor variations in very similar products may support cost-reducing specialized production facilities that would otherwise be too expensive to employ. The associated economies of scale allow prices to be reduced while increasing profits for firm owners. In such cases, smaller specialized firms have higher production costs than more diversified large firms. Examples include bicycle, automobile, aircraft, television, and cellphone manufacturing.

Similar economies from multi-product production can also be realized by companies that have greater expertise in flexible manufacturing than by other more narrowly focused firms in the same industry. Such flexible firms can produce a variety of products at a lower cost or achieve profits with less risk than less flexible producers. They may produce more types of products and be able to adjust more rapidly to fluctuations in demand among their products.

Lastly, firms may attempt to dominate a sector of the economy by producing all of the profitable variations of a general type of product. Such strategies can reduce the elasticity of consumer demand for its overall portfolio of products relative to other firms in the industry by increasing brand loyalty. In some cases, economies of scale may also allow them to sell their products at a lower price. Such multi-product firms benefit from increased profits

because of the reduced price-elasticities of the demand functions and lower production costs for their various products.[1]

The first parts of this chapter illustrate how these possibilities can be modeled and use the models developed to characterize the mix of products produced. The last parts show the limits of multi-product firms. It is the limits of multi-product firms that make multi-product firms compatible with competitive markets, i.e., markets in which many firms produce very similar products. There are cases in which natural monopolies may arise—locally or globally.

II. Risk Aversion and the Rewards of Passive Conglomerates and Holding Companies

There are several reasons why a formeteur may form a firm that is intended to own other previously stand-alone firms. The simplest rationale is diversification. For example, in an environment in which there are a large number of firms, each earning a randomly distributed rate of profit on its assets, there are advantages from diversification. Suppose that every firm's rate of profit is drawn from the same distribution, with firm j's profit in period t, $\pi_{jt} \sim f(\mu, \sigma^2, t)$. In this setting, one cannot exactly know the profit rate of firm j in year t. However, the average return can be known with much greater accuracy. If a formeteur owns a single firm or holds stock in a single firm, the observed profit rate, π, would have mean μ and variance σ^2, the distribution is in a steady state, and the effect of time, t, is zero.

A portfolio of stocks in different companies or ownership of a collection of firms across industries would have a lower variance than that associated with any single firm. Recall that the simple formula for the variance of a sample average calculated from a sample of size N is $var(\pi) = \frac{\sigma^2}{N}$, where N is the sample size, here the number of firms held in a formeteur's diversified conglomerate's portfolio of firms. The variance of the mean rate of return of diversified portfolios and conglomerates converges to zero—e.g. complete certainty—as N becomes large. Risk-averse owners benefit from diversification.

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[1] The assumption that every firm tries to maximize risk-adjusted profits is used throughout this chapter. The possibility that a firm's owners or managers may have other goals is taken up in Chapter 17. All the firms modelled in this chapter are profit maximizers. Although not realistic in all cases, this assumption is the norm in microeconomics, because it is a useful first approximation of the motivations that a typical firm's owners and managers have. It simplifies and sharpens the models developed, without significant loss of accuracy in most cases. Every firm requires profits to sustain itself in the long run.

The rate of return of a portfolio of N diverse firms in year t is essentially μ_t, the average rate of return of firms in the entire market in that year. That rate can be regarded as the risk-free rate of return on investment in the year of interest. Risk-averse investors can do no better in this environment than to own a diverse assortment of firms.

This is not to say that no conglomerate or investor occasionally earns an above-average rate of return in such settings, but it is to say that on average they do not. The same logic implies that conglomerates that hold smaller portfolios of firms tend to have rates of return with higher variation year-to-year than those with larger more diversified portfolios of firms.

Some investors with small portfolios may get lucky and earn higher than average returns while others will be unlucky and earn below average returns. The existence of multiple conglomerates is thus compatible with Marshall's characterization of competitive equilibrium, in a commercial environment in which individual firms or industries are subject to a variety of demand and cost shocks that are unknown beforehand. It is also consistent with Ricardian competitive markets in settings where each firm's share price or purchase price is the present value of expected future profits.

As long as buyer estimates of future firm net revenues are unbiased, any purchaser of a firm's shares or the entire firm will earn approximately the average rate of return on his, her, or their investments, μ_t, but the variance of that return tends to be greater than zero, $\sigma_t^2 > 0$, and hence the attraction of diversification for risk averse (passive) investors. Although the net revenues of firms may vary, the present discounted value of each firm's future profits is capitalized into its share prices and take-over cost, and so the distribution of returns for a portfolio of firms acquired at time t tends to be more narrow and stable than the net revenues of individual firms.

All this implies that large diversified conglomerates and holding companies tend to realize the average rate of return of their portfolios, μ_t, with a very low variance in their annual rates of return.[2]

[2] If company net revenues are not drawn from the same distribution of returns, or if the average estimate of returns is more biased for some firms than others, then it is possible that better than average "stock pickers" or return estimators can realize above average rates of return from their superior ability to recognize firms that are "under valued." That very few actively managed portfolios do better than diversified portfolios such as the S&P 500 index

Significant price-making ability is not required for conglomerates to exist. Indeed, the broader the diversification strategy undertaken, the less likely it is to occur.

III. Producing Goods and Services with Complementary Demands

Many firms sell more than one product because it reduces transaction costs for their customers. Consumers generally find it more convenient to shop for several products at a single store or website. This is the reason why supermarkets and department stores exist. However, large-scale retailers rarely own all the firms that provide the products for sale in their stores or hold stock in all of them. Such large-scale "retailers" provide convenience services for their customers, and could be regarded as multi-product firms, although in a different sense than the main focus of this chapter.

However, there are multi-product firms that also provide convenience services in addition to the products that they produce and sell. An extreme example is the production of left and right shoes, which are normally purchased in pairs from the same company or brand rather than purchased from separate right shoe and left shoe companies. By purchasing left and right shoes from the same company, customers are assured that they match in an aesthetic sense and that the quality of each shoe is similar. Other examples include the maintenance of consumer capital goods such as automobiles and large computer systems by firms that sell automobiles or computers. In addition to benefiting from convenience, consumers may believe that the maintenance services provided by producers are of higher quality than those provided by others. After all, the firm knows its own products inside out.

Complementarities on the demand side of the market create unique profit opportunities for firms because some of their consumers are willing to pay a premium for various combinations of products only when they are produced by a single firm.

To model this choice, we'll assume that there are two products that a firm can produce, each with its own market demand and production cost function. Customers are willing to pay a premium, V, for the complementary service. We'll refer to the products as good A and service B. The inverse demand function for goods A and B is:

$$P^A = f(Q^A, Q^B, Y, P^O) \qquad (11.1a)$$

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funds suggests that superior stock pickers are, at best, quite rare—although claims to be one of them are commonplace.

$$P^B = g(Q^{\boldsymbol{B}}, Q^A, Y, P^R + V) \quad (11.1b)$$

Note that connections between the two markets exist because of the complementarity between the product and its complementary service. $Q^{\boldsymbol{B}}$and Q^A are arguments in both inverse demand functions. We'll assume, however, that service B is purchased only if it is sold at a price less than $P^R + V$, the price of a rival service plus the additional value of service B over its rival, or its lower transaction cost, as denoted by value V. Their cost functions have the usual form:

$$C^A = c^A(Q^A, w, r) \quad (11.2a)$$

$$C^B = c^B(Q^B, w, r) \quad (11.2b)$$

In such cases, the firm's profit functions for the two potential lines of business are:

$$\pi^A = P^A Q^A - C^A = f(Q^A, Q^{\boldsymbol{B}}, Y, P^O)Q^A - c^A(Q^A, w, r) \quad (11.3a)$$

$$\pi^B = P^B Q^B - C^B = g(Q^{\boldsymbol{B}}, Q^A, Y, P^R + V)Q^B - c^B(Q^B, w, r) \quad (11.3b)$$

Maximizing profits requires taking account of the complementarity whenever each line of products can realize profits, $\pi = \pi^A + \pi^B$. The output of each of the two products can be characterized by examining the first-order conditions for maximizing overall profits:

$$\pi_{Q^A} = P^A_{Q^A} Q^A + P^A + P^B_{Q^A} Q^B - C^A_{Q^A} = 0 \quad (11.4a)$$

$$\pi_{Q^B} = P^B_{Q^B} Q^B + P^B + P^A_{Q^B} Q^A - C^B_{Q^B} = 0 \quad (11.4b)$$

Several points of interest are implied by the two first-order conditions, both of which will hold simultaneously when the firm decides to produce both products.

In the most straightforward case, where profits for each line are greater than zero, the optimal output of service B is such that its associated market price is less than $P^R + V$. In this case, the firm will produce and sell both products because both contribute to its overall profits. It is simply more profitable to be a two-product firm than a one-product firm in such cases.

Complementarities are not always necessary in such cases, although complementarity makes the production of both products more likely to be profitable than the case in which there are no complementarities. That is to say, both lines may be profitable even if $P^B_{Q^A} Q^B = 0 =$

$P^A_{Q^B} Q^A$. However, both product lines are more likely to be profitable when $P^B_{Q^A} Q^B > 0$ and $P^A_{Q^B} Q^A > 0$. Marginal revenues from each line are increased by the effects of the demand complementarities. It is also true that the larger V is, the more likely the second line is to be profitable, although it may still be profitable even when $V = 0$.

Specialized firms may have lower cost functions and be able to price the service at a lower cost than a two-product firm. The V-premium makes it possible for a firm with somewhat higher costs to compete with such specialists and obtain sales at a higher price.

There are also cases in which the firm may choose to produce only one of the products. For example, if $\pi_{Q^A} > 0$ for quantities below Q^{A*} and $\pi_{Q^B} + P^B_{Q^A} Q^B < 0$. In that case, the firm will produce good A but not good B. Such conditions are commonplace if there are a large number of one-product firms. Note that the second inequality, $\pi_{Q^B} + P^B_{Q^A} Q^B < 0$, takes account of the complementarity between the two goods. Producing service B has direct effects on profits (the first term) and indirect effects (the second term) through effects on the demand for product A.

Note also that if the second term is large enough, B will be produced even when it is directly unprofitable to do so, because of its effects on the demand for the firm's product A. The effect on sales of good B on the demand for good A can be sufficient to justify the production of service B as a "loss leader." The sum of the profits on A and loss on B is greater than the profits that would be realized by production of A alone.

A commonplace example of this is the customer service departments of many producers and merchants, which rarely make a profit themselves, but sufficiently increase the demand for their other products to be worth providing—often at a price of zero. Customer service is usually freely provided, with rationing provided by waiting time.

IV. Producing Products with Complementarities in Production

There are also cases in which producing several similar products is less costly than producing any single product—a property economists refer to as economies of scope (Baumol, Panzar, & Willig, 1982). Such products often involve variations in the attributes of a single type of product, for which the same or very similar production processes can be used. For example, several models of an automobile may be assembled on the same assembly line by changing seats, colors, user interface, wheels, and motors without significantly changing the organization of the line, personnel, or equipment. Indeed, the broader array of products

produced often yields the scale required to justify the assembly line and its specialized personnel and equipment.

The mathematics of this case are very similar to that associated with complementarities in demand. We'll again assume that just two products are involved to simplify the mathematics and narrative without significant loss of generality. We'll again refer to the products as goods A and B. The inverse demand function for goods A and B is:

$$P^A = f(Q^A, Y, P^O) \tag{11.5a}$$

$$P^B = g(Q^{\boldsymbol{B}}, Y, P^R) \tag{11.5b}$$

In this case of interest, there are no complementarities between the two market demand functions. Instead, complementarities arise through the cost functions, where additional production of good B lowers the marginal cost of good A and vice versa.

$$C^A = c^A(Q^A, Q^B, w, r) \tag{11.6a}$$

$$C^B = c^B(Q^B, Q^A, w, r) \tag{11.6b}$$

In such cases, the firm's profit functions for the two potential lines of business are:

$$\pi^A = P^A Q^A - C^A = f(Q^A, Y, P^O)Q^A - c^A(Q^A, Q^{\boldsymbol{B}}, w, r) \tag{11.7a}$$

$$\pi^B = P^B Q^B - C^B = g(Q^{\boldsymbol{B}}, Y, P^R)Q^B - c^B(Q^B, Q^A, w, r) \tag{11.7b}$$

Maximizing profits requires taking account of the complementarity if profits can be realized by both product lines, $\pi = \pi^A + \pi^B$. The output of each of the two products can again be determined by analyzing the first-order conditions for maximizing overall profits:

$$\pi_{Q^A} = P^A_{Q^A} Q^A + P^A - C^A_{Q^A} - C^B_{Q^A} = 0 \tag{11.8a}$$

$$\pi_{Q^B} = P^B_{Q^B} Q^B + P^B - C^B_{Q^B} - C^A_{Q^B} = 0 \tag{11.8b}$$

Several points of interest arise from the two first-order conditions, both of which will hold simultaneously in the cases where the firm decides to produce both products. In the most straightforward case, where profits for each line are greater than zero, the optimal output of A and B are jointly characterized by equations 11.8a and 11.8b. It is simply more profitable to be a two-product firm than a one-product firm in that case. This profitability is partially

generated by decreases in marginal cost associated with production of the other good and partly by the assumption that there is a significant market for each product.

Note that complementarities are not always necessary in such cases, although complementarity makes the production of both products more likely to be profitable than the case in which there are no complementarities. That is to say, both lines may be profitable even if $C^A_{Q^B} = 0 = C^B_{Q^A}$. However, both product lines are more likely to be profitable when $C^B_{Q^A} < 0$ and $C^A_{Q^B} < 0$. Marginal costs for each product line are decreased by the effects of the production complementarities, which implies that both products are produced at greater levels than they otherwise would be and that their profitabilities are both higher.

There are cases in which the firm may choose to produce only one of the products, because demand for one or the other of the products is too low to support its production. For example, if $\pi_{Q^A} - C^A_{Q^B} < 0$ for all output levels, the firm will produce good A but not good B, unless producing B diminishes production costs for A by more than the losses generated by producing and selling B. If there are a large number of one-product firms, it must be the case that the latter rarely happens.

Nonetheless, there are cases in which producing unprofitable versions of a product reduce overall production costs enough to be worthwhile. Commonplace examples include the "stripped down" versions of automobile models and cell phones. Selling those goods at small loss helps to justify more specialized equipment that reduces average and marginal costs for other models that can be realized only at a relatively large scale.

Again, the point is that the sum of the risk-adjusted profits from producing two or more products can be greater than that from producing a single product. It is this which accounts for the existence of multi-product firms in competitive markets.

V. Coase's Theory of the Firm and the Size of a Multi-Product Firm

All the above suggest that most firms will produce multiple products whenever diversification reduces risks, or there are complementarities among the demands or production of their products, or some combination of all three rationales.

In at least some cases, all three factors will play a role in firm decisions. Firms, for example, may invest in flexible manufacturing techniques to reduce losses from fluctuations in demand or production costs while facilitating the production of multiple products or types

of the same or similar products. Flexible manufacturing in such cases is a form of self-insurance.

The remainder of this chapter explores limitations on the number of products that a firm can profitably produce.

Without those limitations, it is not clear why a handful of firms do not produce all the products sold in the world's markets. For example, in the simplest Marshallian models, all producers have access to the same constant return to scale production methods and input costs, and face the same prices for their outputs. In such cases, there is no obvious limit to a conglomerate's size—and they may expand to the point where they jointly produce all the products sold in markets—at which point they would also profit from significant price-making ability.

Competition among rival conglomerates and among rival multi-product firms requires diseconomies of scale—and there are several explanations for these in addition to those discussed in previous chapters.

Ronald Coase (1937) suggests that, in broad terms, the size of a firm is determined by the marginal cost of managing a firm (e.g., determining tasks and allocating resources among tasks within the firm) rather than assembling products through contracts among specialists at market prices. Toward the end of his famous article on the nature of the firm, he states that:

> At the margin, the costs of organizing within the firm will be equal either to the costs of organizing in another firm or to the costs involved in leaving the transaction to be "organized" by the price mechanism. Business men will be constantly experimenting, controlling more or less, and in this way, equilibrium will be maintained. This gives the position of equilibrium for static analysis. But it is clear that the dynamic factors are also of considerable importance, and an investigation of the effect changes have on the cost of organizing within the firm and on marketing costs generally will enable one to explain why firms get larger and smaller; We thus have a theory of moving equilibrium.

Students of Coase would argue that what he has in mind is two kinds of transaction costs: those within the firm and those in dealings with persons outside the firm through contracts. Both types of transaction costs rise as the size, number, and complexity of the transactions undertaken increase. The marginal transaction costs within firms gradually rise until they reach and surpass those associated with contracting with outsiders through the price system—except in cases where natural monopolies occur.

If firms use technologies that exhibit constant returns to scale in production, then scale and the number of products sold are ultimately determined in the manner posited by Coase—by rising intra-firm transaction costs (managerial costs) that are neglected in the models developed above. Firms will grow to the point where their marginal intra-firm managerial costs equal the marginal cost of contracting with outside firms, contractors, and laborers.

The remainder of this chapter explores some of the considerations that cause marginal managerial costs to rise as conglomerates and firms increase in size—some of which have been mentioned in passing in the first part of this chapter and also in previous chapters. To do so, we'll depart from the simplified Marshallian model by assuming that problems of various kinds are commonplace within all commercial organizations, and that managerial diligence can moderate those problems, although it cannot eliminate them.

VI. Active Management of Conglomerates and their Optimal Size

Activist Conglomerate Founders as Knightian Decision Makers

The conglomerates analyzed in the beginning of this chapter were passive investors. They would buy firms but not manage them. They would simply leave in place the management of the firms purchased and assume that the firms would not significantly change their production or marketing strategies in response to changes in ownership. Such investors are analogous to those holding stock in a number of companies, except that they own the entirety of each company in their portfolios rather than some part of each (as with shareholdings).

Conglomerates that are active investors, in contrast, attempt to alter the production or marketing strategies of the firms held. They believe that the current management is not truly maximizing their firm's profits. In order for activist investments in or management of the firms making up a conglomerate to be potentially more profitable than average, some investors must be able to estimate the profits from alternative business strategies better than other investors and also better than the current managers of the subset of firms they will attempt to acquire control of.

In the former case, investors are looking for unusually profitable opportunities as well as reductions in risk from diversification. In the latter case, rather than seeking to diversify as a method of reducing risks, they are looking for opportunities to manage the companies—e.g. change the firm's investment strategies—that they acquire and thereby increase the returns from those firms over what they would otherwise have been.

Doing so requires more information and more talent on the part of investors than passive investing does. It also requires many judgments about the strategies of rival firms in the market. For an average investor, the initial model is a reasonable first approximation. For what might be termed Kirznerian investors, superior insight and/or information would allow their average returns to be higher than those of ordinary investors. For what might be termed Knightian investors, over-confidence in the possibility of larger-than-average profits would imply long-term below-average profits or greater-than-average risk than that associated with a more diverse portfolio for reasons developed below.

Conglomerates have been subjected to a good deal of empirical research. There are cases of what appears to be Kirznerian firm pickers, as with the Berkshire-Hathaway (Warren Buffett) collection of firms that remain largely independent after purchase and General Electric's successful managerial period (under Jack Welch) of a large diverse conglomerate. However, the bulk of the evidence demonstrates that conglomerates are generally worth less than the value of their constituent parts. Active management of diverse conglomerates is more difficult than expected by the leaders of such conglomerates. There are cases in which a relatively narrow range of firms are actively managed by conglomerates that realize higher than normal returns. Together these cases suggest that it is possible to acquire better information and exercise better judgment in relatively narrow subsets of industries than in broader ones. However, on average, conglomerate leaders are more likely to be Knightian entrepreneurs than Kirznerian ones.[3]

Not all conglomerates are formed by Knightian plungers or salary-maximizing empire builders. Risk-aversion can be sufficient to generate such firms—essentially the opposite of a Knightian entrepreneur. However, when a firm's management team or owners are confident that some other firm would profit from their abilities at managing firms, it is likely that such

[3] See Berger and Ofek (1995) for a general overview of the relative performance of conglomerates versus more specialized firms. See Schmid and Walter (2009) for a study of conglomerates in the financial sector. Both note stock valuation losses in actively managed diversified firms. They also note lower value losses and occasionally above-average profits in more focused conglomerates. In the latter cases, superior information and judgment are more likely to be acquired by the conglomerate's management team. The more markets one is participating in, the higher information costs tend to be, because more market conditions and production methods have to be assessed. General Electric and Berkshire Hathaway are sometimes mentioned as exceptions to the general rule.

a firm is Knightian in this sense, because there will always be unknown unknowns about what is required to improve the profitability of firms "taken over" with this in mind.

Active Conglomerate Management and their Optimal Size

Within a conglomerate, there are two general types of decision making. The first concerns which firms to acquire, which to continue holding, and which to sell (portfolio management). The second concerns decisions about the production and sales within the firms held. The latter include hiring decisions for the leadership of the firms held, allocations of capital among them, and setting production goals.

Portfolio management is required for all conglomerates. However, playing an active role in the decisionmaking processes of the firms held by conglomerate is not. To make such managerial decisions requires detailed knowledge about the internal operation of the firms held and about their respective markets. That information is normally well-beyond that required to manage a portfolio of firms or shares in firms.

To model conglomerates that engage in active management of their firms, we depart from the more or less Marshallian assumptions used in the first part of the chapter.

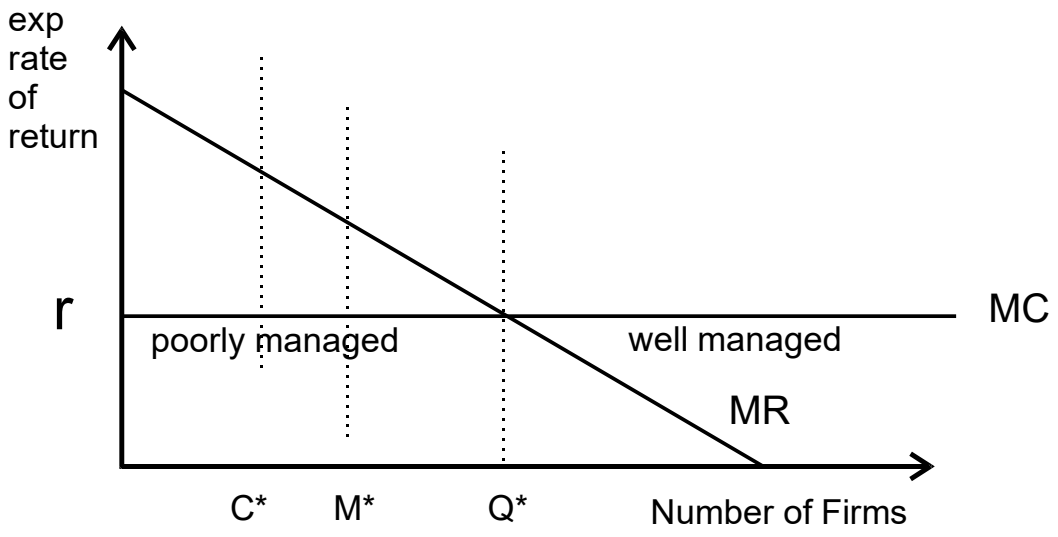
Kirznerian Formeteurs and Optimal Conglomerate Size

Suppose that every firm's average rate of profit is expected to increase with the conglomerate's managerial investments, M_j. In such cases, firm j's average rate of return in period t, is distributed as $\pi_{jt} \sim f\left(\mu_j(M_j), \sigma^2, t\right)$, with the effect of managerial effort on average profits varying among firms. If a passive investor owns a single firm or holds stock in a single firm, the observed profit rate, $\mu_j(0)$, would have mean μ_j and variance σ^2at time, t. In contrast, if an active investor holds the stock, its expected average rate of return is $\mu_j(M_j)$ when the managerial effort M_j is invested in firm *j*. In the case of a Kirznerian conglomerate, the conglomerate's management has a clear understanding of function $\mu_j(M_j)$, but in the case of a Knightian conglomerate, that function is, more or less, a guess—and thus error prone. Nonetheless, in both cases the calculus concerning which firms to purchase and how much managerial effort to invest is fundamentally similar. A firm should distribute its managerial effort among firms and purchase the ones that generate the highest rate of return if its managerial efforts are undertaken. How many firms it will purchase, N, will vary with the effect of its managerial efforts on firm returns, the overall extent of managerial effort ($M = \sum_1^N M_j$ and its cost of capital, r.

In many cases, the expected effect of managerial effort on an existing firm's average rate of return is less than or equal to zero, because the firm is already very well managed. Such firms will not be a target for purchase. In other cases, purchasing control of a firm will cost C_j and $\mu_j(M_j)C_j < rC_j \; for \; M_j > 0$, which implies that control of such firms costs more than it is expected to return in profits. These are also cases in which a subset of existing firms are not of interest to the conglomerate. Such firms may also be regarded as well managed, if not perfectly so.

If a conglomerate's line of credit at interest rate r is unlimited and its managerial ability unbounded or freely available, a conglomerate would purchase all the remaining firms. However, if managerial talent is scarce, as assumed above, then it would purchase only the firms where its managerial resources, M, generate the greatest return. This would limit it to only a subset of the existing firms that are (relatively) poorly managed—even in cases in which it has an unbounded line of credit. When lines of credit are also bounded, this rather than managerial ability may be the constraining resource. However, in either case, the firm will purchase control of only a finite subset of the firms that it may potentially acquire—namely those that are poorly managed and in which its managerial talents are expected to be most productive. Figure 11.1 illustrates these possible breakdowns among firms that a Kirznerian conglomerate has under consideration. It accurately identifies differences among firms that are missed by the average investor.

Figure 11.1 Conglomerate Size



C*, capital constrained, M* manager constrained, Q* unconstrained

The MR curve assumes that the conglomerate's managerial efforts have been optimally invested in the firms and consequent rates of return ordered from high to low. In the case in which neither managerial resources nor capital are a constraint, the conglomerate will own or control Q* firms. In the case in which managerial resources are a limiting factor the number of firms is smaller, as with M*. In the case in which capital is the constraining factor, the conglomerate may well be smaller than M* as at quantity C*—although whether C* is smaller than M* or not would depend on the managerial and capital constraints faced by the conglomerate. Note that both C* and M* are likely to be much smaller than Q* in most market settings.

Knightian Formeteurs

Knightian formeteurs of a conglomerate attempt to make the same sort of decisions as Kirznerian entrepreneurs but with far less information and insight. In effect, their decisions can be thought of as over-confident ones in which the rank order of firms is based on guesses rather than good information about possibilities for managerial improvement. Thus, rather than having a systematic ranking of possibilities for improvements, the ordering of firms is more or less a random draw from the firms under consideration. Some of the firms will be well-managed, others more or less average, and some poorly managed. Intervening in the decisions of already well-managed firms will tend to reduce their net revenues. Intervening in the others may raise or lower them according to the decisions made—again because in Knightian circumstances, there is insufficient information to truly make optimal decisions. Thus, mistakes will be commonplace—and likely more commonplace than close to optimal decisions. Some will be very profitable, but most will be less so. Knightian entrepreneurs may realize extraordinary profits or losses.

A Possible Explanation for the Negative Effects of Conglomerates on Firm Value

There are several possible explanations for the negative returns (value reducing) of most conglomerates. The simplest explanation is that most conglomerates are run by Knightian entrepreneurs and tend to base their decisions (possibly of necessity, but possibly because of not taking due diligence) on strong feelings that they can judge better than the current managers how best to deploy the resources of the firms they have acquired. In that case, most would be incorrect in their assessment, but a few would be correct and earn above normal profits through the value added by their decisions. A second possible reason is the so-called winner's curse.

In cases in which two or more conglomerates bid for the same firm, the winning bid tends to go to the firm with the most optimistic forecast of the returns from owning the firm. In most cases, this will be an outlier estimate and incorrect—thus producing losses for the winner of the bidding contest. Again, this is not always the case—well informed Kirznerian entrepreneurs also exist, and do occasionally win such bidding contests because they understand the opportunities available to the firms acquired better than their current management.

However, the evidence suggests that in most cases, rather than higher returns as implied by the model, the expected returns are overestimated, resulting in a lower rate of return on investment and lower valuation for the conglomerate as a whole.

VII. Time, Attention, Crises, and the Limits of Active Management

At the heart of the managerial decisions of a firm's leadership (formeteurs and top management) is information. If one knows everything that is relevant, and all the links between decisions of a firm's leadership and outcomes are deterministic, then one can truly optimize—which is to say make the decisions that maximize profits or otherwise systematically advance formeteur goals. Doing so requires adjusting one's "commands" to account for how others in the chain will implement them, but full information and determinism allow incentive systems that minimize such problems to be developed. This has been the underlying assumption for most of the models of the firm developed in this and other textbooks. Exceptions in this text have been decisions that involve non-deterministic processes such as those associated with risk management and innovation.

This section analyzes managerial decision making under uncertainty. There are two aspects to management: (1) constructing the internal institutions of the firm, which will be analyzed in Chapter 17, and (2) responding to changing circumstances—especially unanticipated ones. With respect to predictable changes, the standing routines of a firm can easily address such changes, because they have been designed with those in mind. For example, an employee may unexpectedly call in sick, and the routine may call for a substitute to be employed by the department in which it occurs or a temporary shift in the responsibilities of other employees in the department.

It is only surprises that are unusual that need to be addressed by a firm's leadership. Unusual shocks must first be recognized—often at lower levels in the firm's hierarchy—the relevant information transmitted to the firm's leadership, analyzed, a decision made, and instructions transmitted to the relevant managers and employees. These are the sorts of "transaction

costs" that Coase evidently had in mind in his classic paper. Creative managerial efforts (including mistakes) have to be modeled to appreciate how dealing with unpleasant surprise events (crises) constrains the size of even well-managed and designed firms.

Initially, we'll focus on a single unpleasant surprise, a single crisis. Two steps are analyzed: (1) identifying the magnitude of the crisis, and (2) determining the steps that can reduce the losses associated with the problem.

Certainty is not possible in settings where crises are possible. Nonetheless, how a senior executive allocates their time can make effective responses (expected profit maximizing ones or loss minimizing ones) more likely.

Classifying Crises

As a point of departure, suppose that there is a single top manager, possibly the company's formeteur, who makes all the adjustments to all surprise events. To simplify a bit, suppose that there are only two types of surprises, serious ones (type H) and less serious ones (type L). Suppose also that the type of a surprise cannot be easily identified.

Thus, the first step that a senior manager has to take is to invest some of his or her time, t_1, to judge whether a "crisis" is of type H or type L. The time required varies with the quality of the data, I, provided by lower management. High-quality data (high I) makes classifying the type of surprise relatively straightforward and low-quality data (low I) makes it less so. Good data makes the time spent characterizing the magnitude of the problem, t_1, more effective at reducing the probability of wrong conclusions about the importance of the surprise, $P = f(t_1, I)$. The probability of misjudging the nature of a crisis falls toward zero as both the time spent on analysis and the quality of the information increase.

Reacting to a Crisis

Next, the manager has to spend time determining the steps that can most effectively reduce the losses associated with a crisis. This also takes time, t_2. The more time invested in ameliorating a crisis, the smaller losses tend to be. Correctly classifying the crisis makes a manager's next steps more productive. We'll denote the correct identification of a serious crisis (type H) with the superscript Hr and that of a minor crisis with superscript Lr (r for right). Mistaken identifications are denoted with the letter w after H or L (w for wrong). Within the functions, an apostrophe is used to denote mistaken conclusions. A mistaken diagnosis of a major crisis (type H) implies that efforts to ameliorate the problem will be focused on the wrong profit function, Π^{Hw} rather than Π^{Lr}.

All the above characterizes a model with these features.

$$P = f(t_1, I) \tag{11.9a}$$

$$\Pi^{Hr} = \pi^{H}(H, t_2) \tag{11.9b}$$

$$\Pi^{Hw} = \pi^{L}(L', t_2) \quad \text{with} \quad \Pi^{Hw} < \Pi^{Hr} \tag{11.9c}$$

$$\Pi^{Lr} = \pi^{L}(L, t_2) \tag{11.9d}$$

$$\Pi^{Lw} = \pi^{H}(H', t_2) \quad \text{with} \quad \Pi^{Lw} < \Pi^{Lr} \tag{11.9e}$$

If the event is actually a large crisis, H, the expected profit associated with spending time investigating which case has occurred is, Π^{HE}:

$$\Pi^{HE} = P\Pi^{Hw} + (1 - P)\Pi^{Hr} \tag{11.10a}$$

If the event is actually a modest surprise, L, the expected profit, Π^{LE}, is:

$$\Pi^{LE} = P\Pi^{Lw} + (1 - P)\Pi^{Lr} > P\Pi^{Hw} + (1 - P)\Pi^{Hr} \tag{11.10b}$$

There are four possibilities. The CEO may correctly determine the type, L or H. And, there are two types of possible mistakes—mistaking a type L for a type H, the L' case, and mistaking a type H for a type L, the H' case.

Since the CEO does not initially know which type of surprise has occurred, an educated guess about the likelihood of the two types of errors is required. The two types of surprises may be regarded to be equally likely (e.g. the CEO may have diffuse priors), because he or she only deals with unusual surprises.[4]

[4] The assumption of diffuse priors simplifies the math a bit. If instead of a diffuse prior, the CEO's experience suggests that the relative frequency of type H is $\propto$ and that of type L is $(1-\propto)$, equation 11.11 would be $\Pi^{E} = f(t_1, I)[(1-\propto)\Pi^{Lw} + (\propto)\Pi^{Hw}] + (1 - f(t_1, I))[(1-\propto)\Pi^{Lr} + (\propto)\Pi^{Hr}]$. In this case, $\propto$ would be an additional explanatory variable in equations 11.14a, 11.14b, and 11.14c. Note that the time spent determining which type of surprise has occurred does not affect the CEO's priors about surprise events in general, but does affect the probability of making mistakes in this specific case.

In this case of diffuse priors, the effect on profits associated with investigating the nature of the surprise, t_1, can be characterized as:

$$\Pi^{E} = f(t_1, I)[(.5)\Pi^{Lw} + (.5)\Pi^{Hw}] + (1 - f(t_1, I))[(.5)\Pi^{Lr} + (.5)\Pi^{Hr}] \quad (11.11)$$

Or multiplying by 2 and substituting $T - t_1$ for t_2, as:

$$2\Pi^{E} = f(t_1, I)[\pi^{H}(H', T - t_1) + \pi^{L}(L', T - t_1)]$$
$$+(1 - f(t_1, I))[\pi^{L}(L, T - t_1) + \pi^{H}(H, T - t_1)] \quad (11.12)$$

Differentiating with respect to t_1 characterizes the CEO's decision about how much time to spend investigating the nature of the surprise, t_1^*, and how much to spend planning the response, $T - t_1^*$.

$$\Pi_{t_1}^{E} = f_{t_1}[\Pi^{Lw} + \Pi^{Hw}] + P[-\Pi_{t_2}^{Lw} - \Pi_{t_2}^{Hw}]$$
$$-f_{t_1}[\Pi^{Lr} + \Pi^{Hr}] + (1 - P)[-\Pi_{t_2}^{Lr} - \Pi_{t_2}^{Hr}] = 0 \quad (11.13)$$

The implicit function theorem implies that:

$$t_1^* = t(H, L, H', L', I, T) \quad (11.14a)$$
$$t_2^* = T - t_1^* \quad (11.14b)$$
$$P^* = f(t_1^*, I) \quad (11.14c)$$

The profits realized in the four cases are jointly determined by the event, H or L, whether a mistake is made or not, and the time spent planning the response, given the CEO's time allocation decision.

$$\Pi^{Hr} = \pi^{H}(H, t_2^*) \quad (11.15a)$$
$$\Pi^{Hw} = \pi^{L}(L', t_2^*) \quad \text{with} \quad \Pi^{Hw} < \Pi^{Hr} \quad (11.15b)$$
$$\Pi^{Lr} = \pi^{L}(L, t_2^*) \quad (11.15c)$$
$$\Pi^{Lw} = \pi^{H}(H', t_2^*) \quad \text{with} \quad \Pi^{Lw} < \Pi^{Lr} \quad (11.15d)$$

The profit consequences of the two types of surprises determine the marginal effects of the CEO's time allocation problem on its expected future profits. These effects, together with the information and time available for dealing with the surprise of interest, determine the

probability of mistakes and their associated lower profits for the firm. What the model does in this case is illustrate all of the factors that need to be taken into account to address crises as they emerge for a firm's various lines of products.

Reacting to Multiple Crises

For the purposes of this part of the chapter, it is variable T that is of most interest. As the amount of time available for analysis per surprise and planning per surprise diminishes, mistakes necessarily increase and the quality of the response to the surprise diminishes. The more markets and more divisions that a CEO has to keep track of, the more surprises are likely, and the more mistakes in identification, and the weaker the average responses tend to be.

The effects of increases in mistakes and reductions in the quality of the responses limit the scope of an actively managed multi-product firm. Both these effects tend to reduce a firm's profits and thereby its likelihood of survival in the long run.

This effect also partly accounts for the inverse relationship between the breadth of a multi-product firm and its valuation in the stock market. It is also consistent with Coase's hypothesis about firm size—although it stresses a particular type of transaction—namely those requiring creative interventions by a firm's senior management.

Institutions to Address the CEO's Time Constraint

The institutions of a firm can be adjusted to account for the CEO's time constraints, but these do not eliminate the fundamental problems. Most of these, in effect, transform a multi-product firm into a series of single or narrow product sub-firms, making the CEO in effect a passive investor. For example, a firm can create divisions for each of its product lines with a COO (chief operating officer) for each with broad discretion over its division policies. Such COOs resemble CEOs in all but name, and the actual CEO has less and less to manage—and thus comes to resemble the leader of a conglomerate that passively invests in a number of firms. The breadths of the divisions resemble either narrow conglomerates or single good firms with fewer markets to be informed about and fewer surprise events to assess and respond to.

VIII. Conclusions

Multi-product firms are natural consequences of efforts to reduce the variance in a firm's returns, to take advantage of complementarities among the demands for a firm's products, and to reduce unit costs by exploiting complementarities in a firm's production methods,

equipment, and personnel. Nonetheless, such firms tend to be of limited size even when they are quite large relative to many other firms because of the limitations of senior management decision making.

When the markets served are large enough to support a wide variety of firms, the usual competitive models are applicable, although some adjustments are necessary to take account of the various complementarities among markets noted in this chapter. For example, firms in such cases affect market demands through their production decisions in a manner that is less likely with only single-product firms during periods in which the attributes of the products of interest are stable.

When markets are relatively small and only a few large multi-product firms can be supported, then other models of pricing and production are necessary. In very small markets, even relatively small conglomerates may have significant monopoly power—as in the classic case of a single general store that serves an isolated small town or village. The residents of such places benefit from every trade that takes place and from the convenience of shopping locally rather than making a long journey to a town with more merchants to choose from, but they will pay somewhat higher prices for their goods and services than in somewhat larger markets.

However, many products are sold worldwide, and in those cases, markets are large enough to support the requisite number of multi-product firms for competitive conditions to be factors in each such firm's decision making.

Empirical research on conglomerates suggests that conglomerates realize lower profits, on average, than narrowly focused single or multi-product firms. This suggests that managers of large conglomerates either have a tendency for Knightian overconfidence or are as interested in size as in profitability. The latter possibility among other multi-goal objective functions that firm's owners and managers may have is taken up in chapter 17.

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