ECONOMICS U$A

PROGRAM #2

THE FIRM: HOW CAN IT KEEP COSTS DOWN?

AUDIO PROGRAM TRANSCRIPT

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THE FIRM

(MUSIC PLAYS)

Announcer: Funding for this program was provided by Annenberg Learner.

FRANK STASIO: This program was originally recorded in 1985. Though times have changed, the basic economic principles presented here remain as relevant today as they were when this series was produced. Also, please note that individuals interviewed on this program may no longer hold the same titles they held when this program was recorded.

(MUSIC PLAYS)

FRANK STASIO: Economics U$A, one of a series of programs designed to explore twentieth-century micro and macroeconomic principles. The subject of this edition is The Firm and how it maximizes profit. Our guest is Edwin Mansfield, Professor of Economics at the University of Pennsylvania. I'm Frank Stasio.

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FRANK STASIO: December twenty-seventh, 1982: Bethlehem Steel Company announces massive production cutbacks. Ten thousand workers will lose their jobs. July 29th, 1985, General Motors says it has chosen a site for a new three and a half billion dollar manufacturing complex. Six thousand people will be hired. August 23rd, 1985. AT&T announces the last in a series of layoffs that puts nearly eleven hundred employees out of work. Changes of this scale are not the rule in American business, but less dramatic adjustments are a regular part of a firm's business activity. What determines how large a firm will grow or how many employees it will hire? How does a business decide what material to use? And when should a company buy more land or purchase new equipment? As any business executive will tell you, the answers to these questions are not easy, but we may begin to understand how a firm makes these decisions if we

accept a fundamental premise that economists believe drives business behavior. Firms want to make money, as much as possible, so, almost every decision a business makes is aimed at maximizing profit. According to Edwin Mansfield, an economics professor at the University of Pennsylvania, the rule of profit maximization is a simplified but important model for understanding business behavior.

EDWIN MANSFIELD: "It's only a first approximation, but from what we can gather, it's a very useful first approximation. Clearly, firms have to worry about risk. Uh, there are problems once you consider the possibility of uncertainty as to how even define profit maximization, but in, within the confines of the very simple model taken up in this sort of course, it's a useful first approximation."

FRANK STASIO: And what do we mean by that? Because it sounds so obvious that a firm would try to make as much money as it can.

EDWIN MANSFIELD: "Well, yes, but that sort of an objective might conflict with others. For example, it might be that certain factions within a firm are interested in their own goals rather than the profits of the firm or their own p~~r~~re~~e~~quisites. Uh, similarly, in a case where there's uncertainty, now, the firm might trade off some expected profits for less risk. I think that most firms have to, within limits, pay attention to profits; otherwise, they'd go out of business. It's clear in certain industries that particular firms have gotten rather fat and lazy, and the consequence has been that their profits have turned into losses and they've soon had to worry about the maximization of profits."

FRANK STASIO: Profit, by an accountant's definition, is the amount of a firm's revenues that exceed its costs. So, one way a firm can increase profits is to cut costs. Those costs include the land, labor, equipment, and raw materials needed to produce a firm's product. Taken together, the items and commodities used in production are called "inputs." A firm must know the characteristics of its production process to find the most profitable mix of inputs. The current state of technology imposes constraints on production. Economists have developed something called the "production function" to describe these limits.

EDWIN MANSFIELD: "Well, production function is the relationship between the amounts of various inputs that are used and the maximum output that can be produced, so that, if you have a certain amount of labor, if you have a certain amount of capital, you have a certain amount of land, that's used in a particular firm to produce a certain product. The production function tells you what's the maximum amount of that product that can be produced."

FRANK STASIO: So, I have to look at all of my uh, my capital before I can decide how much it is I want to turn out? There's a limit to what I can turn out?

EDWIN MANSFIELD: "Yes. The production function is really a summary of engineering knowledge and agricultural technology, and so on. Now, it's…it reflects what we know how to do and the firm naturally has to…to be confined in its actions and its possibilities by the limits of existing knowledge."

FRANK STASIO: For a good manager, is that a kind of intuitive process after a while, deciding what my production function is, or is a lot of attention paid to that?

EDWIN MANSFIELD: "Well, it's both, because it includes first, rather formal results in…it depends on the industry to begin with, but in many industries the production function reflects advances in science and technology that are fairly recent. If you take an industry such as aircraft, you take an industry such as electronics, now these are so-called high-tech industries where the production function is very much determined by recent and not so recent scientific and technological information. In addition, though, even in such industries, there's a great deal of craft, when you come down particularly to the manufacturing processes, there's a lot that craftsmen know that's really not written down any place, and this sort of partly intuitive, but partly also learned but not-written-down kind of knowledge, is also in the production function and can be very important."

FRANK STASIO: Economists divide inputs into two basic categories: fixed inputs, like buildings, heavy equipment and land—the amount of these inputs are not easily changed in a given period of time—and variable inputs which, on the other hand, can be increased or reduced relatively quickly. Now, these include labor, and in many cases, raw

materials. Economists and managers make the distinction between "fixed" and "variable inputs" to help determine the most profitable mix of inputs. As we've heard, it may not be profitable to add more employees if there isn't enough equipment for them to work with. Clearly, management can change the size of the workforce more quickly than it can increase plant and equipment. One of the ways firms achieve the most profitable mix of inputs is by substituting one input for another if one becomes too expensive. But because fixed inputs by definition cannot change over the short run, managers cannot always make the substitutions that they would like.

EDWIN MANSFIELD: "In general, you can substitute much better, and easier, and less expensively in the long run than in the short run. Well, take for example, you know, the great increases in the price of oil in the '70s. In the short run, it wasn't possible to substitute other fuels for oil very easily because many of the factories, many of the mechanisms that used oil now couldn't be changed very quickly. But as time went on, it was possible to shift in various ways against oil and in favor of substitutes, and this is true in other areas as well. Economics doesn't insist that there's always substitutability. In some products, chemical products, for example, you may have to use a certain amount of chemical X in order to produce chemical Y, and that doesn't violate any of the principles of economics. But in general, substitutability exists and is often underestimated."

FRANK STASIO: To maximize profits, a firm must decide on the right combination of inputs to produce the greatest output for the least cost. Now, it does not always follow that increasing one input would increase production, and it is certainly not true that simply using more of one input will maximize profits. For instance, a factory owner trying to meet rising demand might not make the greatest profit by hiring more workers.

EDWIN MANSFIELD: "As you hire more and more people, it's quite likely that diminishing marginal returns will set in, that additional people will add less and less to the product...to the amount that you produce. Now, this wouldn't occur if you could expand your plant at the same time, but given that you can't, the hundredth worker will add less to the amount that you produce than the first worker."

FRANK STASIO: Why is that? If I have more people working for me, why can't they turn out more of my product?

EDWIN MANSFIELD: "Well, because they have to work in combination with other inputs. For example, if you have a machine shop where there are ten machine tools, the first few workers can add a great deal to the amount that you produce, but when you get a hundred workers in there, the hundred and first may add very little."

FRANK STASIO: Mansfield says there are several considerations the firm must take into account before hiring additional workers.

EDWIN MANSFIELD: "One is the number of workers that are already in the firm that are participating. Another is the amount of other inputs that are used in combination with these workers. If you've got a lot of capital, then, now, this will have an effect on how much an additional worker would produce. If you've got little capital, this, too, will have an effect. If you've got lots of land, one thing will occur. If you've got little land, another thing will occur. Finally, it's dependent upon the price of the product because, so far, I've been talking just about the physical marginal product, the amount that extra worker would add to the physical amount produced. But, then, you have to multiply that physical marginal product by the price of the product in order to see how much in dollars and cents it's worth."

FRANK STASIO: To decide whether it will be profitable to add more workers or increase other inputs, the firm must be able to distinguish between an input's marginal product and its average product.

EDWIN MANSFIELD: "The marginal product is the extra amount that results from an extra hour of labor...the extra amount of product that results from an extra hour of labor. Now, this is quite different from the average product, which is the amount produced divided by the amount of labor used. To illustrate, suppose that you had a factory, which used one hundred people, and it was turning out a thousand units of the product, and the average product of labor would be a thousand units divided by the hundred dollars of

labor, or ten units of output per hour of labor. On the other hand, now, the marginal product would be the extra units of product that could be produced if you added the one hundred and first hour of labor; if you went from a hundred hours of labor to one hundred and one hours of labor."

FRANK STASIO: And how is that determined? How do I know the marginal product, for instance?

EDWIN MANSFIELD: "Well, it depends on the technology of the particular industry. It depends on the amount of capital and other inputs that are used, and it depends on the amount of labor that's being used. If you have to go back to the machine shop, before…if you have a machine shop where there are ten machine tools and you only have three workers, it may be that you can increase output a great deal by adding a fourth worker. On the other hand, if you have that same machine shop and you have twenty-four workers crowding into it, the twenty-fifth might add very little."

FRANK STASIO: Mansfield explains that the value of a marginal product is not the same as the marginal physical product itself. To find the value of the marginal product, the firm must consider the product's selling price.

EDWIN MANSFIELD: "Marginal physical product is the extra amount of output resulting from an extra unit of labor. Now, this differs from the value of the marginal product. The value of the marginal product is the marginal physical product times the price of labor. So, it's the extra amount in monetary terms. It's the extra amount in money that the firm gets as a result of increasing the amount of labor it uses by one unit. Now, I'm talking about the marginal physical product, marginal value product of labor, but it could be of capital. It could be of any other input."

FRANK STASIO: But how do firms determine the marginal product of an input? Can a manager really tell whether the next worker hired will be more or less valuable than the last?

EDWIN MANSFIELD: "In a general sort of a way, now, without question, they do. Even, for example, if you look at basketball teams when Moses Malone came to

Philadelphia, who, of course, is a star center on the Philadelphia Seventy-Sixers, the management, the owners of the team, had to figure out whether or not he was worth the very substantial price that they paid him. Now, I don't think that anyone could sit down and describe very simply or uni-dimensionally the marginal physical product of Moses Malone. But the people who owned the team had to figure out whether it was likely that he would bring in enough in the way of additional receipts so as to be worth it. They couldn't stay in business very long if they weren't able to make these judgments pretty well most of the time. There are a variety of ways that industrial engineers and others have devised to figure out how much workers produce under various circumstances, their data so far as piece rates are concerned, their time and motion studies of various kinds. So, now, the simpler the task, the easier it frequently is to determine how much a particular kind of labor adds to the total output."

FRANK STASIO: Once a firm has all the information it needs to figure out the value of the marginal product, it must use a formula to determine just how many extra workers to hire.

EDWIN MANSFIELD: "Assuming that the firm is interested in maximizing profit, the optimal number of workers to hire would be the number at which the value of the marginal product of labor equals the wage. Now, if you were to hire fewer than that number, then the value of the marginal product would exceed the wage, which would mean that you could…you could add, say, ten dollars to your receipts by hiring eight dollars worth of labor. Now, most firms, if they're aware of that, would certainly hire the additional labor. On the other hand, if you went beyond the point where the value of the marginal product equals the wage, it would be possible to increase the firm's profits by reducing the number of workers. Now all of this may be deceptively precise. No one, I think, takes seriously that firms, each and every day, now, and managers, while they brush their teeth, equate these things exactly, but over time there certainly is a movement towards this kind of an equilibrium".

FRANK STASIO: Mansfield says the same principle should be applied to all inputs if the firm is to maximize profits.

EDWIN MANSFIELD: "In the very simplest terms, now, what the firm should do is to pick a combination of inputs such that the marginal product of each input divided by its price is the same for all inputs. Now, this, you can show, will result in the production of a given amount of output at minimum cost."

FRANK STASIO: We have heard how firms may suffer diminishing returns if they try to increase their variable inputs while other inputs remain fixed. But, in the long run, firms that are able to increase all of their input proportionately may enjoy economies of scale.

EDWIN MANSFIELD: "In many industries, costs go down--average costs go down--significantly with larger scale. Just to take an…not perhaps an obvious case, but historically, a very important case. During the '20s, the…in the steel industry continuous wide strip mills were invented. The first company to introduce a continuous wide strip mill is what's now Armco. Anyway, the continuous wide strip mill reduced the average cost of producing sheets of the kind that are used in automobiles, very significantly.

Hand mills were much smaller, much more labor, you know, the costs were much higher. Now, this is an example of cases where, as you increase the amount produced, the costs go down, because, at this point, if you want to produce more in the way of sheets, you can use very efficient strip mills. I'm not saying that…that as you add more in the way of labor and capital, that necessarily you're gonna invent something. What I'm saying is that once that invention occurred, the technology was such that now, with increases in capital and labor, now unit costs went down. This was one of the results of it. The economies of scale prevailed in that area."

FRANK STASIO: Mansfield explains that the concept of economies of scale does not conflict with the idea of diminishing marginal returns.

EDWIN MANSFIELD: "The situations that are visualized are quite different. Now, when you're talking about economies of scale, you're talking about, now, what happens to unit costs as you produce more. When you talk about diminishing marginal returns,

you're saying, holding one factor or one input constant in quantity, what will be the effect on the amount produced as I increase the amount of the other factor or input?"

FRANK STASIO: Then, why would diminishing marginal returns be an issue at all for firms? Why, in the face of a growing demand, wouldn't they just increase both their capital and labor?

EDWIN MANSFIELD: "Well, in…in many cases, it takes time to increase capital, and in the long run they may well respond by adjusting the amounts of…of variety of inputs. But in the short run, you know, it's not possible in many cases to…to do more than increase or decrease the amount of certain inputs."

FRANK STASIO: It is also possible that a firm in building larger and larger factories may reach a point where the unit costs increase. The firm would then experience dis-economies of scale.

EDWIN MANSFIELD: "These are often hard to document, but there's…it certainly stands to reason that if you've got a big enough firm, a big enough plant, that there would dis-economies, that costs would go up. And there's some evidence, and, now, the reason why it's hard to document is, of course, that people don't go around building plants that are so big that the costs are high, intentionally. So you don't have so much data on it. But, at times, there have been mistakes that have been made, and they give us some idea as to where and under what circumstances these diseconomies of scale arise. It would be more sensible if you…if you thought that costs were going to go up a great deal by building a much bigger plant. Uh, to, not the bigger plant but instead build, perhaps, two smaller ones. So the…anyway, I think that, you know, anyway, there isn't much in the way of data on automobile plants that are, say, fifty times the existing size of automobile plants, for obvious reasons."

FRANK STASIO: "In most cases, the profit motive is enough to keep firms from going too large or from operating beyond the point of diminishing returns. While firms do make mistakes, the open market doesn't suffer such miscalculations lightly. Firms that

persist in their error are likely collapse. Those that adjust usually prosper.
(MUSIC PLAYS)

FRANK STASIO: Let's review some of the main points in our discussion about the firm and how it maximizes profits. Generally speaking, economists assume that the primary motive of business firms is to make the highest possible profit. This is seen as useful as a model for studying a firm, though it should be noted that there are other drives that influence a firm's behavior. Uncertainty, management perks, and conflicting executive goals may interfere with the overall desire to maximize profits. The firm's decision on how to produce a given commodity is limited by the current state of technology. Economists use the production function to show the greatest possible output that can be expected from any combination of inputs. The production function is, in effect, a summary of engineering knowledge. There are two categories of inputs--fixed and variable. Economists and managers draw a distinction between the average product of an input and an input's marginal product. Average product divides all that a firm produces by all of the inputs required for production. The marginal product is the amount of extra output gained from the last unit of input with all other inputs held the same. There is a point beyond which increases in output will shrink as more of a given input is added. This is called the point of diminishing marginal returns. It occurs when one input is increased while the rest of the inputs are held constant. To maximize profits, a firm should combine its inputs so that the marginal product of each input is proportional to price.

FRANK STASIO: You've been listening to Economics U$A, one of a series of programs on micro and macroeconomic principles. Our guest has been Edwin Mansfield, Professor of Economics at the University of Pennsylvania. Economics U$A has been produced by the Educational Film Center in Annandale, Virginia. I'm Frank Stasio.
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Announcer: Funding for this program was provided by Annenberg Learner.