University of Zurich[UZH]

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Unit 1:

– Produktionsfunktion

Quellen:

- **Chapter 10 – Production**
  Frank, Robert H, & Cartwright, Edward. (2016). *Microeconomics and Behaviour (2nd European ed.)*. London: McGraw-Hill Education.

CHAPTER

10

PRODUCTION

Actor and comedian Woody Allen tells the story of the man who complains to his analyst that his brother thinks he's a chicken. 'Why don't you tell him he's *not* a chicken?' asks the analyst, to which the man responds, 'I can't, I need the eggs.'

Many people think of production as a highly structured, often mechanical process whereby raw materials are transformed into finished goods. And without doubt, a great deal of production—like a mason's laying bricks for the walls of a house—is of roughly this sort. Economists emphasize, however, that production is also a much more general concept, encompassing many activities not ordinarily thought of as such. We define it as *any activity that creates present or future utility.*

Thus, the simple act of telling a joke constitutes production. Once a joke is told, it leaves no more tangible trace than a pleasant memory. But under the economic definition of production, Woody Allen is as much a production worker as the welder putting together a container ship at the Odense Steel Shipyard. The person who wins Olympic gold is also engaged in production; so is the doctor who gives a child a tetanus vaccination; the lawyer who draws up a will; the people who collect the rubbish on Wednesday mornings; the postal worker who delivers a tax return to the government; and even the economists who write about production.

A Production Worker

CHAPTER PREVIEW

In our discussions of consumer choice during the preceding chapters, an existing menu of goods and services was taken for granted. But where do these goods and services come from? In this chapter we will see that their production involves a decision process very similar to the one we examined in earlier chapters. Whereas our focus in earlier chapters was on the economic decisions that underlie the demand side of the market relationship, our focus in the next five chapters is on the economic decisions that underlie the supply side.

In this chapter we describe the production possibilities available to us for a given state of technology and resource endowments. We want to know how output varies with the application of productive inputs in both the short run and the long run. Answers to these questions will set the stage for our efforts in the next chapter to describe how firms choose among technically feasible alternative methods of producing a given level of output.

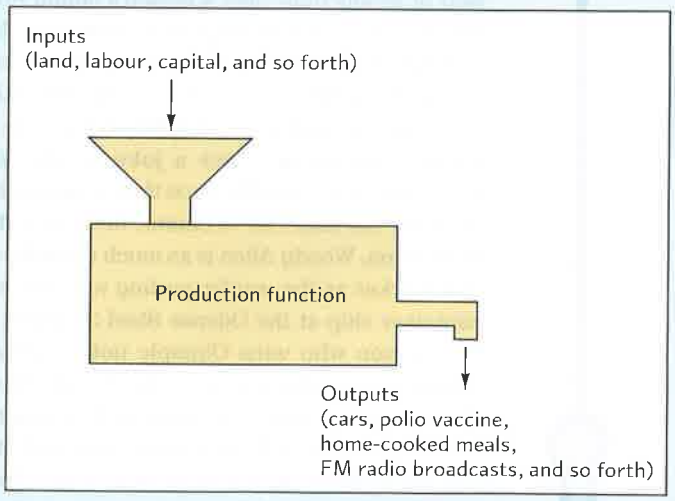
THE INPUT–OUTPUT RELATIONSHIP, OR PRODUCTION FUNCTION

There are several ways to define production. One definition, mentioned above, is that it is any activity that creates present or future utility. Production may be equivalently described as a process that transforms inputs (factors of production) into outputs. (The two descriptions are equivalent because output is something that creates present or future utility.) Among the inputs into production, economists have traditionally included land, labour, capital and the more elusive category called entrepreneurship.[1] To this list, it has become increasingly common to add such factors as knowledge or technology, organization and energy.

production function the relationship that describes how inputs like capital and labour are transformed into output.

A **production function** is the relationship by which inputs are combined to produce output. Schematically, it may be represented as the box in Figure 10.1. Inputs are fed into it, and output is discharged from it. Consider, by way of illustration, the BMW plant in Munich. Inputs are the land the plant is built on, the workers, machines, computers, raw materials, engine parts, and so on. The

FIGURE 10.1
The Production Function
The production function transforms inputs like land, labour, capital and entrepreneurship into output. The box in the diagram embodies the existing state of technological knowledge. Because knowledge has been accumulating over time, we get more output from a given combination of inputs today than we would have obtained in the past.



[1]'Entrepreneurship' is defined as 'the process of organizing, managing, and assuming responsibility for a business enterprise' (*Random House College Dictionary*). An entrepreneur is thus, by definition, a risk-taker.

output is BMW cars ready for the customer to drive away. Or consider your local restaurant. Here the inputs are the raw food, chefs, waiting staff, plates, cutlery, and so on. The output is good quality food.

It is sometimes useful to think of the production function as akin to a cooking recipe. It lists the ingredients and tells you, say, how many pancakes you will get if you manipulate the ingredients in a certain way. It is important to recognise, though, that a production function is more than a simple recipe. There are, for instance, many alternative ways that BMW could produce, say, the BMW M4 coupe. The paint could be applied by a labourer or a robot, the plant could be in China or Munich, the engine parts could be sourced from a supplier or built in-house. The production function should capture all of these possibilities.

Note that the production function box implicitly embodies the existing state of technology, which has been improving steadily over time. Thus, a given combination of productive inputs will yield a larger number of cars with today's technology than with the technology of 1970.

Yet another way of describing the production function is to cast it in the form of a mathematical equation. Consider a production process that employs two inputs, capital (K) and labour (L), to produce meals (Q). The relationship between K, L and Q may be expressed as

$$Q = F(K, L) \tag{10.1}$$

where F is a mathematical function that summarizes the process depicted in Figure 10.1. It is no more than a simple rule that tells how much Q we get when we employ specific quantities of K and L. By way of illustration, suppose the production function for meals is given by $F(K, L) = 2KL$, where K is measured in equipment-hours per week, L is measured in person-hours per week, and output is measured in meals per week. For example, 2 equipment-hr/wk combined with 3 person-hr/wk would yield 2(2)(3) = 12 meals/wk with this particular production function. The relationship between K, L and weekly output of meals for the production function $Q = 2KL$ is summarized in Table 10.1.

TABLE 10.1
The Production Function $Q = 2KL$

		Labour (person-hours/wk)				
		1	2	3	4	5
Capital (equipment-hours/wk)	1	2	4	6	8	10
	2	4	8	12	16	20
	3	6	12	18	24	30
	4	8	16	24	32	40
	5	10	20	30	40	50

The entries in the table represent output, measured in meals per week, and are calculated using the formula $Q = 2KL$.

ECONOMIC NATURALIST 10.1

Why do housewives (and husbands) not get paid?

Consider Alice, a housewife who, on a typical Tuesday, cleans the bedrooms, washes the linen, looks after her two-year-old son and cooks dinner for her family. According to the economists' definition, all of these activities are production. That they happen within the household is simply irrelevant. Alice, though, does not get paid.

Alice could employ people to do these tasks for her. She could hire a cleaner, send her son to kindergarten and take the family out for dinner in a restaurant. This would free up time to get a

salaried job, but would also cost money. And the salary she earns may not be enough to compensate. Indeed, many families find that the costs of childcare exceed the wage they can earn on the job market.

Seen in this light Alice 'earns' money for her family even though she does not get a pay cheque at the end of the month. In particular, there is a significant opportunity cost of her not doing the housework. It is important to recognize this opportunity cost.

Note, however, that national accounts do not take account of household production. If Alice pays someone to, say, look after her child then it counts in the GDP statistics. If she looks after the child at home then it does not count. This creates a non-negligible bias in the statistics. Household production, for example, has decreased considerably over the last 100 years. We use childcare more, eat out at restaurants more, hire domestic cleaners, and so forth. This means that estimates of GDP growth over the last 100 years are biased upwards. ■

Intermediate Products

Capital (as embodied, for example, in the form of stoves and frying pans) and labour (as embodied in the services of a chef) are clearly by themselves insufficient to produce meals. Raw foodstuffs are also necessary. The production process described by Equation 10.1 is one that transforms raw foodstuffs into the finished product we call meals. In this process, foodstuffs are *intermediate products,* which many economists treat as inputs like any others. For the sake of simplicity, we will ignore intermediate products in the examples we discuss in this chapter. But this feature could be built into all these examples without changing any of our essential conclusions.

SHORT RUN AND LONG RUN

The production function tells us how output will vary if some or all of the inputs are varied. In practice, there are many production processes in which the quantities of at least some inputs cannot be altered quickly. The FM radio broadcast of classical music is one such process. To carry it out, complex electronic equipment is needed, and also a music library and a large transmission tower. Music files can be purchased in a matter of minutes. But it may take weeks to acquire the needed equipment to launch a new station, and months or even years to purchase a suitable location and construct a new transmission tower.

long run the shortest period of time required to alter the amounts of all inputs used in a production process.

short run the longest period of time during which at least one of the inputs used in a production process cannot be varied.

variable input an input that can be varied in the short run.

fixed input an input that cannot vary in the short run.

The **long run** for a particular production process is defined as the shortest period of time required to alter the amounts of *every* input. The **short run**, by contrast, is defined as that period during which one or more inputs cannot be varied. Clearly this distinction is somewhat arbitrary. There may be some inputs that can be varied in a matter of minutes, some a matter of weeks, and others a matter of years or decades. Where we draw the line between the long and short run is, therefore, often a matter of judgement. We shall see, though, in this and subsequent chapters that the distinction is a very useful one.

An input whose quantity can be altered in the short run is called a **variable input**. One whose quantity cannot be altered—except perhaps at prohibitive cost—within a given time period is called a **fixed input**. In the long run, all inputs are variable inputs, by definition. In the classical music broadcast example, music files are variable inputs in the short run, but the broadcast tower is a fixed input. If sufficient time elapses, however, even it becomes a variable input.

Note that the long run is determined by the ease with which inputs can be varied and so should not be equated to a period of calendar time. In some production activities, like those of a window cleaner, the long run could be a matter of weeks. In other production activities, like that of a ship builder, the long run could be years or decades. The period of time it takes to vary inputs can also change with technological progress, as the following Economic Naturalist illustrates.