ENERGY ECONOMICS

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CHAPTER 0

ECONOMICS REFRESHER

1. Introduction

'Economics' studies how scarce resources can best be used to satisfy different and ample needs. As on the one hand resources are limited, but on the other hand the needs of economic agents are superfluous, choices have to be made. This dilemma of choice in economics can be captured in 4 basic questions:

- What can be produced and in what quantity?
- How are goods and services produced?
- Who are the goods and services produced for?
- Who takes the economic decisions, and what process leads to these decisions?

The answers to these questions are largely given by the process of a market economy. In the next section we discuss the building blocks of this market economy, more specifically for the electricity market.

The objective of this chapter is to elaborate on the basic concepts that are used in the rest of the book to discuss the energy market. The basic principles of the functioning of a market are explained by using a 'partial equilibrium analysis' (i.e., study one market and keep all the others constant). By the end of this chapter, the reader should be able to understand and use the following important concepts:

- Individual demand, aggregate demand, willingness to pay (WTP)
- Supply of one firm, aggregate supply in industry
- Efficient allocation of a quantity over a set of consumers
- Efficient production of a quantity by a set of producers
- Producer and consumer surplus
- Perfect competition market equilibrium
- Imperfect competition
- External effects
- Public goods

2. The market

Private decisions are at the basis of the functioning of the market. These decisions follow from the belief that they will lead to an advantage for the decision-maker. If someone buys a can of cola, this only happens because that person believes the cola is worth its price. The seller of the cola only sells the can because he knows that it will result in some kind of profit for him. Since the transactions take place on a voluntary basis, all parties involved will find their advantage (or at least no disadvantage) in the deals. It is this search for interesting transactions that leads to an equilibrium in the market. In this equilibrium an ***equilibrium price*** occurs, which is the price where demand for a certain good or service equals the supply for that good or service.

2.1 Individual demand

The quantity of electricity that a consumer wishes to use depends on many factors, such as the price of electricity, the price of other energy sources (gas, coal...), the consumer's preferences, his budget, the season, the moment of the day... Bringing all these factors into our analysis would result in a very complex case. So in a first step, only the relation between the price of electricity and the quantity demanded is considered, while the value of all other factors is assumed to be a given. A possible graphical representation of this relationship, the demand function, is shown in Figure 0.1. Throughout the course, we will occasionally use linear demand functions. In section 3 we illustrate where these linear demand functions originate from.

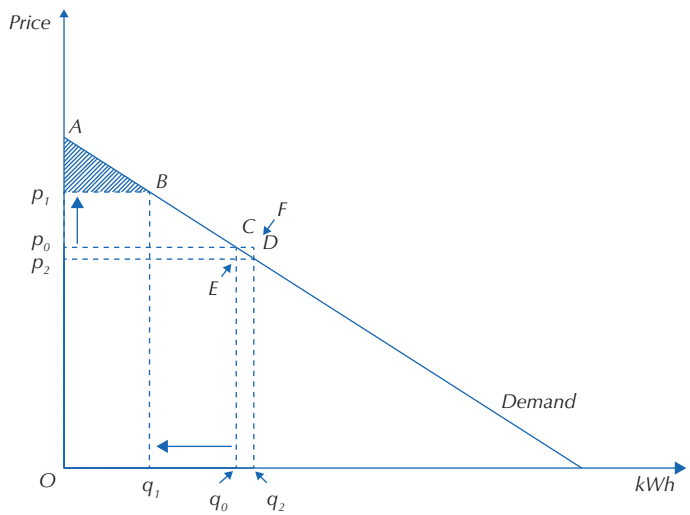

FIGURE 0.1. Individual demand.

The demand function is expressed as $D(q)$, with $D'(q) < 0$. In general the relation between the quantity demanded and the price is negative. If the price of 1 *kWh* of electricity is p_1 then demand will be q_1 *kWh*. If the price would decrease to p_0, demand will increase to q_0 *kWh*. In the same sense, the demand curve also gives us the maximum price the consumer wants to pay for a certain unit of electricity (in *kWh*). This price is an indication of the value the consumer attaches to this *kWh*, and is therefore also called the 'willingness to pay' (WTP). So for the $q_0{}^{th}$ *kWh*, the consumer is willing to pay a price p_0.

The benefits the consumer receives from buying electricity are shown in Figure 0.1 as well. If the market price for a *kWh* is p_1, a quantity of q_1 is consumed. We can see that the consumer is willing to pay more than p_1 for each of these *kWh* (except for the last unit, for which the consumer wants to pay exactly p_1). The value attributed by the consumer to these quantities is higher, so the consumer retrieves a surplus from this transaction, the ***consumer surplus***. For the first *kWh* the advantage equals A–p_1. This advantage can be calculated similarly for all the units, so that the total consumer advantage of consuming q_1 at a price p_1 sums up to the surface of the triangle p_1AB.

2.2 Aggregate demand

Market demand for electricity results from summing the demand for electricity over all consumers, for each price level. This is shown in Figure 0.2. Demand from consumer *a* and demand from consumer *b* (horizontally) sums op to demand *a* + *b*.

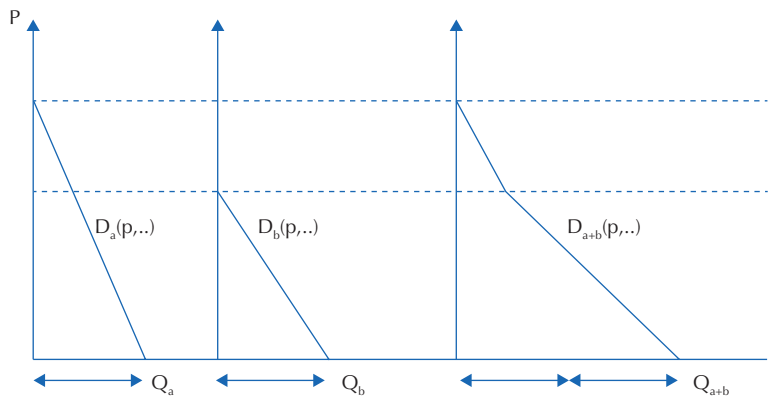

FIGURE 0.2. Aggregate demand.

2.3 Optimal allocation of demand

From a demand side point of view, the optimal allocation of a good is such that the marginal willingness to pay is equal for all consumers. If a total quantity Z is offered, then the allocation of Z among consumer a and b is such that the total 'value' for consumers is maximized, which is shown in Figure 0.3. In this way, those who need it most also get it, or those who would be prepared to pay the highest price get it.

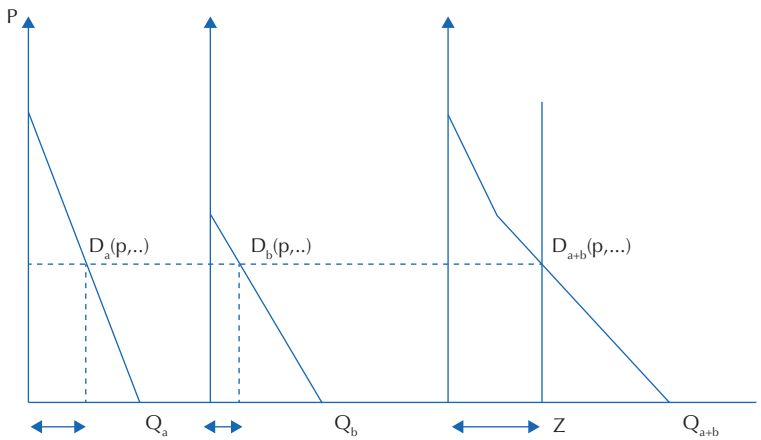

FIGURE 0.3. Optimal allocation among consumers.

2.4 Individual supply function

The second party involved in a market transaction is the seller or the supplier of a good or service. Again, supply of electricity is defined by many different factors, such as the price of primary energy sources (coal, oil, gas, nuclear), available technologies etc. And again it is standard practice to focus on the relation between the price of the good or service and the quantity that is offered on the market at that price, keeping all other factors constant.

In the typical case there is a positive relation between the price and the quantity offered. Figure 0.4 illustrates such a relation for the supply of electricity. For example, at a price of p_0 a quantity of q_0 is supplied, while at a higher price p_1 supply also increases, to q_1. We can also read on the graph at which minimum price a producer is willing to supply a certain quantity on the market. This price should be high enough to cover the additional costs of producing this additional unit or *kWh*. This cost is also called the ***marginal cost*** of production. When a supplier or producer receives a