Lecture Note 10: Jevons and the English marginalists

William Stanley Jevons (1835 – 1882) is credited as one of the three founders of the neoclassical school, but otherwise he is often passed over in a hurry, which is a pity since Jevons is perhaps the most original thinker of the three. His scientific contributions spread over a wide field of themes, covering not only economics but also logic where his work was considered quite important. He even invented a mechanical logical computer. His work on marginal utility dates back to the beginning of the 1860s, and when he learned about Gossen's work, he had already laid down the basic principles of marginal utility.

The theory of exchanges as presented by Jevons differs considerably from that of Walras who assumed the existence of well-organized markets with prices taken as given by all traders. But an obvious question in this connection would be to explain where such well-organized markets came from. Actually most markets are *not* of this type, so it is quite to the point that Jevons is interested in the *emergence* of prices rather than assuming their existence. According to Jevons, a price common to all is something that occurs only in equilibrium. Out of equilibrium there may be exchanges, so balancing of supply and demand can take place also here, but this is not an equilibrium situation since other individuals exchange in different proportions

The two fundamental concepts in Jevons' theory of exchanges are:

(i) *trading bodies*, groups of individuals trading with other bodies, whereby each trading body acts as an individual (with its own utility curve)

(ii) *the law of indifference*, saying that there is only one price when a market is in equilibrium.

What happens in the market is that individuals meet and consider a mutual exchange of commodities, and following Gossen's approach, the exchange of x units of commodity A against y units of B is optimal for individual one if

$$\frac{F_1(a-x)}{G_1(y)} = \frac{y}{x},$$

where F_1 (G_1) is marginal utility of individual 1 for commodity A (B), and similarly

$$\frac{G_2(x)}{F_2(b-y)} = \frac{y}{x}$$

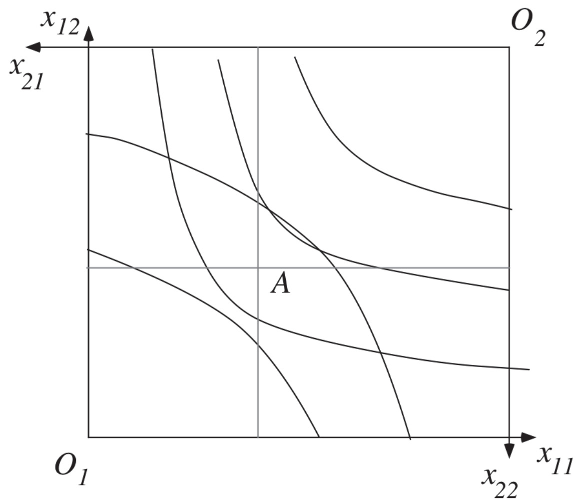
for individual 2. The quantities exchanged x and y can now be found from the two equations, this determines not only quantities but also the price, at least in this exchange. Given that many individuals exchange the two commodities, the price will be the same for all the exchanges.

Jevons' paradox is often mentioned in the literature, it states that when technological progress makes it possible to reduce the use of some input commodity, then it may happen that the overall use of this commodity may increase. It comes from an investigation of the coal industry in the 1860s, and it has acquired more attention in recent years with the concerns about energy use. The observed phenomenon may be due to elasticity of demand – when the industry uses less energy, it becomes cheaper and alternative uses may increase demand more than proportionally to the fall in prices.

Sunspot equilibria. Jevons' idea about sunspots being the cause of business cycles was a brilliant conjecture, even if it turned out to be wrong, and it shows that Jevons had a broad mind and was well oriented far beyond economics. Incidentally, the idea of economic events caused by "sunspots" (now in quotation marks) has had a revival, since the notion of a *sunspot equilibrium* was introduced by Cass and Shell (1983). The main point is that the equilibrium depends on a random variable which is completely unrelated to the fundamentals of the economy, it matters only for what individuals think. Sunspot equilibria has become an important tool for the study of business cycles in a general equilibrium framework.

In recent studies, as e.g. Peart (1991), it is pointed out that Jevons' approach was much more sophisticated than it appears from a superficial treatment of the matter. Jevons saw the main reason for business cycles in the reaction of economic decision makers on particular outside signals, which made them switch between investment with short and long maturity. Also, he conducted a competent empirical research, estimating the cycle length in agricultural prices to 10.41 years which with the knowledge available matched the sunspot periods rather well, although the data available at that time were few and unreliable.

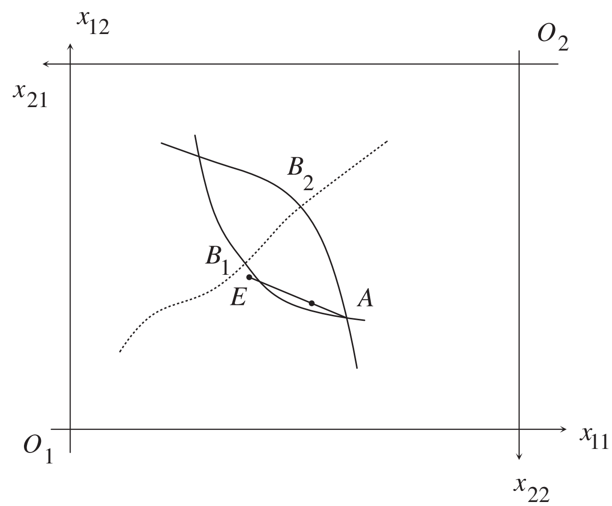
Francis Ysidro Edgeworth (1845 – 1926) can in many respects be seen as continuing the work of Jevons, investigating the situations of exchange. The *indifference curve* as we know it today was introduced by Edgeworth, and he extended the theory of utility allowing general forms of utility functions rather than the additively separable form used hitherto. The *Edgeworth box* (see below) as we now it today was however introduced not by Edgeworth but by Pareto based on a simplifying the approach used by Edgeworth himself.



The trick performed using this type of illustration is that allocation of two goods between two individuals can be illustrated in a two-dimensional plane. At the point A, the coordinates wrt. O_1 give the bundle of individual 1, and its coordinated wrt. O_2 give individual 2′ s bundle. The curve from O_1 to O_2 consisting of points where the indifference curves of the two individuals just touch each other, is the *contract curve* (not drawn in the figure), also a term introduced by Edgeworth. It shows the possible outcomes of the exchange of the two commodities between two persons. The common tangent defines relative prices of the two commodities, but there is a considerable indeterminacy with regard to this price.

This is actually the point of the Jevons-Edgeworth approach to a theory of prices and markets. Prices are not necessarily there at the beginning, they emerge through the process of trading, and only if there is enough competition there will be a unique market price. In this way, the theory may be seen as complementing that of Walras, who explains how the market works once it is there.

The approach to the Jevons-Edgeworth theory outlined here follows the revival of this field which occurred in the 1960s, and the argument was given in full details in Debreu and Scarf (1963).



In the figure above, there are two types of individuals, and the endowments are illustrated by the point A. All points on the contract curve between B_1 and B_2 can be final allocations if individuals of the same type get the same bundle. Consider now the point B_1 where individuals of type 2 are treated rather well. Could there be a trade involving both types which is better for all?

The answer is yes: Take first the point E which for type 2 may be considered as better than B_1 (above the 2-indifference curve through B_1 which is not drawn in the figure). It is worse than B_1 for type 1, but what happens if two individuals of type 1 go together and each take half of the trade from the initial point A to E? Then each of them would end in the point with no label, and it is better than B_1, and the single type 2 gets E and is also better off. Thus, when there are more people to trade with, the indeterminacy is reduced, in the limit to the Walrasian equilibrium.

Edgeworth price cycles is a phenomenon discussed by Edgeworth, where prices have an asymmetric cyclical movement, rising steeply from a base level and then slowly decreasing to the base. In recent years, it has been observed in gasoline retail markets. A recent treatment of the problem as a dynamic game between two duopolists whose current decisions depend only on present price level, is given in Maskin and Tirole (1988).

Alfred Marshall (1842 – 1924) was beyond any doubt the most influential of the marginalists, even if (or perhaps: because) his approach differed from that of other marginalists, in particular Jevons. Marshall started from the tradititon of Ricardo and Mill, and his intentions was to generalize them and reformulate their statements as systems of differential equations. Incidentally, this is why the marginalist approach was called *neo*-classical, it should be seen as a new way of using and extending the insights of the classical school.

Marshall's main work is his *Principles of Economics*, which appeared in 1890 when the new approach was already well established, and he is usually not considered as one of the founders of marginalism, though he may have used part of it in lectures already around 1870. The book was used widely and for many decades, and in this way Marshall's ideas and tools have had a considerable impact on the way we are doing economics today. Many of the wellknown economic thinkers from the first half of the 20th century have had Marshall as teacher.

A surprisingly large number of the concepts and tools used today were introduced by Marshall, the partial analysis of markets using supply-demand curves, consumer surplus and its uses, elasticity, and external effects. In each of these cases, earlier writers have described something very similar, but it is Marshall's way of formulating them that has survived until today.

Increasing returns, competitive equilibrium, and the life cycle. Here is one of Marshall's ideas which is original but did not survive to the textbooks of our days.

Increasing returns and competitive equilibrium are usually considered as incompatible, so if increasing returns prevail, there must be something preventing the firms from exploiting it. Marshall mentions limitation of markets, meaning that the individual firm faces and individual demand curve, much as it was later introduced in theories of imperfect competition. But Marshall adds another explanation, based on his *life cycle theory.* Firms may experience increasing returns to scale, but expansion of output doesn't take place immediately, rather the activities are increased over the life span of the firm. Marshall consider firms as having a life cycle, and over its life, the firms are initially successful but later they increasingly run into problems of different kind, so that they decay and eventually close down. At any moment, the industry contains many firms, young, middle-aged or old, and normally one the average behavior is observed.

Suppose that the state of the firm is indicated by what Marshall calls is *supply price* (cost plus a reasonable allowance for profits), and let p be the supply price of the industry. We let $y(x)$ denote the output of all firms in state x, assuming here that it depends only on the state x. It seems reasonable to assume that the firm will increase its output if p is greater than x, more specifically we assume that the relative change in output $D(x)$ at state x satisfies

$$\frac{D(x)}{y(x)} = p - x.$$

Let us now consider a situation where the market is in equilibrium so that industrial sales, which can be written as the sum of outputs over all firms, that is $\int y(x)\,\mathrm{d}x$ unchanged. This means that the sum (or in our formalization, integral) of all changes is 0,

$$\int D(x)\,\mathrm{d}x = \int y(x)(p - x) = 0. \tag{1}$$

Let $f(x)$ be the proportion of firms having supply pris x,

$$f(x) = \frac{y(x)}{\int y(x)\,\mathrm{d}x},$$

then we can rewrite (1) as

$$p = \int x f(x)\,\mathrm{d}x.$$

From the definition of $f(x)$ we have that $\int f(x)\,\mathrm{d}x = 1$, and we see that the industry supply price is the mean or the average of the supply prices of the individual firms. They may all differ, and each individual firm may change its x over time, but the equilibrium condition gives that for the industry as a whole there is a constant average price and constant average output.

This model of a market may have been more realistic in Marshall's time than it is today, but it illustrates the approach of Marshall who involves a time dimension even when dealing with a market in a static equilibrium. Also, the classical idea of many prices of a commodity (for the classics opposed to one value) is given a new content by involving the structure of the market.

John Bates Clark (1847 – 1938) is the first American economist who usually enters the texts on the history of economics. He was educated in Germany, with professors belonging to the historical school, and initially had an orientation toward socialism, but later changed viewpoints and became the most outspoken proponent of capitalist market systems.

The main contribution of Clark is his treatment of marginal products. In a perfectly competitive market economy, the price of production factors will correspond the the value of their respective marginal products (an easy consequence of profit maximization by the entrepreneur), and this was considered by Clark as not only a positive result but also as a normative guideline for the distribution of society's production between capital and labour, since the marginal products could be considered as a fair payment for the contribution to the total outcome in society. In his treatment of the marginal productivity theory, Clark considered marginal product as the contribution of the *last* unit, and in order to speak about the remuneration of capital, the latter should be thought of as a meaningful unit (of "abstract" capital), a problem that would surface much later in connection with the so-called Cambridge controversy in the 1950s.

Philip Henry Wicksteed (1844 – 1927) was a student of Jevons and is often considered as foremost representative of the marginalist school. His main contribution were made in the 1890s and later published in his main work, "The common sense of political economy", which appeared in 1910. Wicksteed considered some of the problems connected with the distribution of output according to marginal productivity, the main of which was that of showing that factor remunerations exhaust the product, and he pointed out the connection to Euler's theorem and constant returns to scale.

This however immediately poses another one, namely whether or not constant returns to scale was a reasonable assumption. Wicksteed himself argued that once the number of factors is fully specified, then the technology will exhibit constant returns to scale. This is true in the sense that one can always embed the given technology in a larger one, but if the marginal productivity theory shall be of any use, then the new dimensions added must be economically meaningful, which may not be the case.

References:

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