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Marginalist (or Neoclassical) Economics

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Abstract

Marginalist economics is foremost an application of differential calculus to major problems of rational economic choice. Some clear marginalist ideas were put forward since the early decades of the nineteenth century. A first proper wave of marginalism occurred in 1871–77; it focused mainly on marginal utility as a measure of scarcity and formalized a theory of exchange characterized by proportionality between prices and marginal utilities; the marginalist principles referred to production were at that time still rather tentative and incomplete. Further studies at the turn of the nineteenth century both improved the analytical description of utility and provided a marginal productivity theory of the demand for factor services: a ‘supply and demand’ theory of prices and distribution was then built on marginalist principles. A third wave (1934–39) brought the analytical structure of marginalism to the present state. In more recent times it became a terminological convention to describe marginalist economics as ‘neoclassical’.

Introduction

The origin of marginalist economics is traditionally traced back to three books, written independently of one another and almost simultaneously by authors belonging to three distinct linguistic and cultural areas: Stanley Jevons’s *Theory of Political Economy* (1871), Carl Menger’s *Grundsätze der Volkswirtschaftslehre* (1871) and Léon Walras’s *Éléments d’économie politique pure* (1874–77). This sudden flourishing of innovative ideas was rooted in common motivations and a shared strong, pervasive principle. In a nutshell, the leading motivation was to gain a better knowledge of the role of demand in the determination of commodity and factor prices; the shared principle was that demand is grounded on rational choice and the test of rationality requires one to consider the potential effects of *small variations* at the ‘margin’ of choice. Not that these aims and method were completely new. Some fundamental ingredients of a marginalist theory of demand were in fact introduced some twenty years earlier in a book by Gossen (1854), which initially passed unnoticed; he referred to an even earlier contribution, by Rau (1833). The contribution of von Thünen (1826) is credited with priority in the application of marginalist principles to production and the demand for factor services.

The arguments of Jevons, Menger and Walras were presented in the most diverse styles (inspired to mathematical logic, discursive, as a system of equations, respectively), they differed widely on specific topics, and were by no means conclusive on the potentialities of the new approach. They stimulated therefore a series of studies, including Edgeworth (1881),

Böhm-Bawerk (1888), Marshall (1890), Wicksell (1893), Wicksteed (1894), Clark (1899), Pareto (1906), which refined, coordinated, to some extent amended, and further developed their main ideas, so that a new economic theory based on marginalist principles took shape by the turn of the century. A third wave of studies, in the 1930s, should also be mentioned. It was aimed at further improving the mathematical structure of marginalist economics, and eventually led to the current textbook understanding of the marginalist method, as referred to an individual agent. The most representative works are Hicks and Allen (1934 a and b) and Hicks (1939). A masterly account of the ‘state of the art’ after that wave is Samuelson (1947).

The origin of marginalism and the works of Jevons, Menger and Walras

The classical theory of value of Smith and Ricardo emphasized the long-period proportionality between commodity prices and costs of production: under free mobility of labour and capital and apart from occasional and temporary deviations, prices would be such that the wages (largely determined by demographic factors) and the rate of profits on capital were the same in the various industries. The proportions among such ‘natural’ prices were found to depend on *how* production of the various commodities was realized, which in turn was synthesized by the amounts of labour per unit of output. Only the ‘natural’ prices can permanently bring to the market the required amounts, which in the long period were determined by the demand stimulated by the ‘natural’ prices themselves (‘effectual demand’ in Smith’s terminology).

The new approach consisted of an inquiry into the reasons *why* commodities are produced and consumed. The costs of production, albeit being important *proximate* determinants, were not considered to be the *ultimate* ones. Deeper determinants were found in utility, that quality of things which ‘expresses their relations to the pains and pleasures of mankind’ (Jevons, 1970, p. 105). The starting point was Smith’s so-called ‘paradox of value’, according to which some indispensable things, like water, have no economic value. The key to a solution, reached by means of an accurate description of the causal connections between the goods and the satisfaction of wants, typical of Gossen and Menger, was a neat understanding that what matters for (exchange) value is not total utility, but the loss of utility if one unit is withdrawn at the margin of the actual consumption level. This led to the concept of scarcity and, of course, of ‘marginal utility’. ‘*Rareté*’ (in Walras’s terminology) or ‘the final degree of utility’ (in Jevons’s) was taken to be the ultimate source of value of all commodities which are exchanged in the market, whether or not be they reproducible. In the latter case, raw materials and other instrumental commodities derived their value from the marginal utility of the consumption good, as forcefully stressed by Menger.

Since marginal utility was in fact a measure of scarcity, authors in the marginalist tradition insisted on the fact that it was by no means a fixed magnitude, but depended on the available amount of that thing – and diminished as the amount increased (the so-called ‘first Gossen’s law’).

The distinction between total and marginal utility, important as it is, would not have led marginalist authors to a theory of demand without a further step: they considered utility as subject, in principle, to mathematical calculus and foremost they assumed that ‘a perfectly wise being’ (Jevons, 1970, p. 116) *makes* this calculus in order to obtain from its subjective circumstances and from market conditions the maximum possible advantage. A detailed attention to the ‘atomistic’, individual, behaviour (later to be called ‘methodological individualism’) and utility maximization were the foundations on which the marginalist theory of demand was built.

The case with only one commodity capable of different uses readily illustrates this point. Let the amount of a certain commodity be x and the two uses be labelled 1 and 2. Hence $x^1 + x^2 = x$. Now assume that a certain person positively distributes the commodity in both uses and that

their marginal utilities (MU) differ with, say, $MU^1 > MU^2$. It is clearly advantageous to redistribute x in favour of use 1. By the ‘law’ of diminishing marginal utility, MU^2 increases and MU^1 falls. The above inequality might of course still hold even when use 2 is completely discarded and in this case utility is maximized for $x^1 = x$. Otherwise, there will exist a distribution x^1, x^2 such that $MU^1 = MU^2$. The extension to two commodities is straightforward. Now let x^1, x^2 be the amounts of two *different* commodities, which can be *traded* at prices p^1, p^2 . Assume that initially $MU^1 > (p^1/p^2)MU^2$, where p^1/p^2 is the rate of exchange in the market (units of commodity 2 that exchange for one unit of commodity 1). It is clearly advantageous to give away some commodity 2 in exchange for commodity 1 until either $x^2 = 0$ or $MU^1/MU^2 = p^1/p^2$ (also known as ‘second Gossen’s law’). The latter equality should be referred to *all persons* in the market: they select consumption levels such that the ratio (MU^1/MU^2) becomes uniform and equal to the ratio (p^1/p^2). Such a proportionality between marginal utilities and prices was considered by Jevons ‘the keystone of the whole theory of exchange and of the principal problems of economics’ and led him to the famous bold statement that ‘*value depends entirely upon utility*’ (Jevons, 1970, pp. 139 and 77, respectively). As later reflection showed, such a statement should not be taken too literally, even adopting the marginalist point of view, but represents well the swing in emphasis from classical to marginalist theories of value.

It should be stressed that utility maximization has nothing to do with having decent living standards: it only concerns the need to economize, to get the most out of given circumstances, however large or strict these might be. Such a point of view is in sharp contrast with classical political economy, which stressed the aspects of change in the economic condition of a country and the different social classes within it. Marginal utility theory was therefore an eminently static theory, which put the logic of exchange and market interactions at the centre of the scene. In fact, we can find both in Walras and Jevons a self-contained theory of *pure* exchange. People in the economy are assumed to possess certain amounts of commodities, however obtained, and to be free to exchange them, each person aiming at improving his condition to the highest possible degree. Their interactions in the marketplace determine the rates of exchange and the exchanged quantities.

Pure exchange can no doubt be considered as a metaphor of a more fundamental exchange that embraces all the activities of a real economy: for the members of society are the owners of resources (labour, capital, land) whose services are *ultimately* sold in exchange for commodities to be consumed. Production was, so to speak, ‘in between’, an activity that was instrumental to a wider and more fundamental exchange. Toil was seen as a sacrifice in view of obtaining commodities for consumption no less than would be ‘giving away’ some endowment of other commodities. However, pure exchange was also and mainly a first step, preliminary to more realistic developments in which production, the use of factor services and the determination of their prices received specific attention.

The main problems to be solved were how production was stimulated and how the demand for factor services was determined. In fewer words, marginalism had to deal with the relation of prices to costs, which was so central in classical political economy.

Von Tünen published as early as 1826 a treatise on an optimal organization of agricultural production, in which variable proportions of factor services and an early concept of marginal productivity featured prominently. Many years later, the contributions of Jevons, Menger and Walras in this field differed from each another more than those concerning commodity demand and were generally less developed than them. Many problems were to be better clarified and eventually solved, though relatively slowly, by further contributions.

In the first edition of his book, Walras argued for an equality between prices and unit costs of production *under the special assumption* that the amounts of the various productive

services and the product were always in constant proportions, as if production was subject to a chemical law of definite proportions. The demand for factor services was therefore mechanically determined by the amount produced and the cost of production was in a fixed proportion to it: in this case the equality between unit cost and price was the simple condition for stimulating production under competitive conditions (in his system of equations, of course, this equality was consistent with the proportionality between prices and marginal utilities).

But this was not the main route followed by marginalism. Menger formulated the principle that all resources can be combined in variable proportions, so that the demand for factor services can be studied, in principle, in a way not too dissimilar from commodity demand, but did not engage in any formal analysis.

Jevons went somewhat further in the extension of the method of small variations to the problems of production. His starting point was the Ricardian theory of extensive and intensive margins of land cultivation. It should be recalled that, according to classical political economy, increased agricultural production, necessitated by population increase, is met by extending the cultivation to less and less fertile land and/or by cultivating the same land more intensively; in both cases, the additional product obtained by a given additional amount of labour (and capital) was to become smaller and smaller. The analogy with diminishing marginal utility of a commodity was evident, and Jevons found it natural to adopt the twin concept of a 'degree of productiveness' (marginal productivity, in later terminology) of labour. The fundamental idea was indeed simple and intuitive: marginal productivity of labour is the loss of output incurred by a firm if a unit of labour withdraws; in order to avoid this, it is profitable to offer a real wage, in terms of the output, up to that value; in a competitive market, a wage *exactly* equal to marginal productivity will be offered. He extended this argument to the rate of interest on capital. Here marginal productivity was taken to consist in the reaction of the product to a *lengthening* of a production process. His attempt was still rather primitive, but far more original than his rational reconstruction of the Ricardian theory, and anticipated Böhm-Bawerk's 'period of production'. Jevons's formulation of the equality between the marginal productivity of a factor service and its price was defective on two major grounds: i) rent was still conceptualized as a residual; ii) the two marginal-productivity arguments relating to wages and interest were uncoordinated. Later literature will provide the necessary amendments and clarifications, as we shall see in the next section.

Before we move to further marginalist studies, it is proper to conclude this section stressing some methodological aspects that are common to both early and mature marginalism. One concerns the need to consider *infinitely* small variations. Small but finite variations would introduce an element of arbitrariness and imprecision, for neither a marginal utility nor a marginal productivity can be generally assumed to be constant within any given interval of variation, and the value obtained would depend on the arbitrary choice of the interval itself. Consequently, since the first generation, marginalism insisted on definitions as *limiting values* of ratios calculated for *infinitesimal changes*. A marginal utility or a marginal productivity are thus referred to a *point*, with no need to effectively deviate from it. This adoption of *differential calculus* as a method of economic analysis will remain a characteristic feature of marginalist economics (even though it is true that Cournot had previously adopted it in narrower economic contexts). The obvious implicit assumption is that all goods and services are *infinitely* divisible. A second and wider aspect concerns the abstract character of the economic theory introduced by Jevons, Menger and Walras. The strong links of political economy with social philosophy, history and social reform that characterized the British classical political economy, as well as some national traditions in continental Europe, became weaker and the links with mathematics and statistics became stronger. Of course, this did not prevent later authors who can be inscribed in the marginalist tradition, like Marshall, from

addressing, by other means, the issues of social progress; but marginalism remained typically focused on individual and social *rationality* as such, quite independently of ethical or political or historical evaluations.

Refining the notion of utility

For the marginalists of the first generation, a marginal utility curve incorporated the relation between a commodity and human wants; total utility was a *derived* concept and corresponded geometrically to the area beneath the curve (the integral, in mathematical terms). In that context, therefore, they referred utility to individual commodities. But when they discussed maximum utility, they had to consider actions (exchange, for example) that involved several commodities *at once*, thus necessitating a calculus of the addition and subtraction of utilities from the different commodities. Gradually, it became more natural to consider utility, right from the beginning, as a property of consumption *bundle*, rather than individual consumption goods. An important step in this direction was made by Edgeworth (1881). Addressing the question of a mutually advantageous exchange, he adopted the key notion of an *indifference curve* – that is, the set of alternative *combinations* of two objects (say, two commodities) that give the same overall utility – and the position of this curve was a reference for evaluating how advantageous were other possible combinations. This was an early description of utility levels in relation to consumption bundles (say, $f(x^1, x^2)$) and Edgeworth very explicitly used first and second order *partial derivatives* in his own hedonical calculus. Utility of a consumption basket, rather than marginal utility of individual goods, thus became the ‘primary’ concept.

A second and closely related line of evolution concerned the *measure* of utility. Jevons insisted that the important requisite of his theory was the ability to ‘estimate the equality or inequality of feelings’ (Jevons, 1971, pp. 83–4), rather than to measure utility in a certain standard. He was sceptical about the possibility to conceive ‘of a unit of pleasure or pain’, and even suggested that ‘we do not need the units’ (Jevons, 1971, p. 84). Nonetheless, he and the other marginalist authors for many decades put forward their arguments as if such a (subjective) standard existed. It was not until Pareto’s treatise (1906) that it was clarified that an indifference curve by no means required a prior knowledge of a utility level. Pareto inverted, so to speak, Edgeworth’s problem: rather than deriving the indifference curves from a prior knowledge of a utility function, he did it the other way round – his ‘primary’ concept was a series of indifference curves (later to be called ‘preference ordering’) and from them an analytical description of utility (*ofelimità*, in his terminology) was derived. What mattered now was the *index* of the indifference curves, a higher index corresponding to a higher utility. Pareto’s description of utility was therefore in terms of an equation like $f(x^1, x^2, I) = 0$, where I is an indifference-curve index. He (correctly) remarked that a surface having I as ordinate was *not* univocally determined: in so doing he discovered what came to be known as ‘ordinal utility’: a result that first-generation marginalists would perhaps have much appreciated!

The making of a marginal productivity theory

A proper marginalist theory of production and distribution took shape towards the turn of the nineteenth century, with the fourth edition of Walras’s *Éléments*, in 1900, and the contributions of Böhm-Bawerk (1889), Wicksell (1893), Wicksteed (1894), Clark (1899), just to mention some representative works.

A formulation of the Ricardian theory of intensive rent in terms of differential calculus was a useful but by no means an innovative step. Three main developments were central to the

logic of marginalism. One consisted in referring marginal productivity to *all* factor services alike, thus abandoning the residual nature of rent. By the end of the nineteenth century the amount produced was expressed as a continuous, smooth function of the amounts of the factor services, whose partial derivatives were the marginal productivities.

A second related development consisted of a great emphasis on *variable proportions* among factor services: such proportions were subject to rational choice by entrepreneurs, in just the same way as the amounts of consumption were for households. In the main it was assumed that output was proportional to factor services (constant returns to scale, in modern terminology), but the same output can be obtained combining factor services in different proportions; in other words, they can be substituted for one another according to economic convenience. Variable proportions, therefore, supported a theory of demand for factor services. Under these assumptions, Walras could argue that a) free competition brings the cost of production per unit of output down to a minimum; b) in equilibrium, such a cost and the selling price are equal; c) the prices of the services are proportional to their marginal productivities (see Walras, 1969, p. 385).

The third development consisted of asking whether, when all factor services are paid their marginal productivities, the product covers all payments to factors and is covered by it. Only then could marginal productivity be claimed to be a principle of income *distribution*. To elaborate on this question was the great achievement of Wicksteed (1894). He proved that, under constant returns to scale, it does. As later authors remarked, such a property is just an application of a theorem of differential calculus (Euler's theorem): if $Q(x_1, x_2, \dots, x_n)$ is the production function, homogeneous of degree one, then $Q = \frac{\partial Q}{\partial x_1} x_1 + \frac{\partial Q}{\partial x_2} x_2 + \dots + \frac{\partial Q}{\partial x_n} x_n$. Substituting each partial derivative for the corresponding factor service price, gives the required property. Wicksell (1901) acutely observed that the above equation holds also 'at the point of transition from "increasing" to "diminishing returns" (relatively to the scale of production)' (Wicksell 1934 [1901]: 129). It is to be noted that Walras and Wicksteed considered an *indefinite* number of factor services and Wicksteed, in particular, strongly rejected the classical tripartite division.

Clark applied the above property (which he generically derived from the tendency to zero net profits under pure competition) to wages, interest and rent and his contribution is strongly characterized by the alleged ethical implications that he drew from the equality between each factor price and its marginal productivity, which were clearly apologetic for capitalism. Clark's theory had been considered for some time *the* marginal productivity theory, elaborated as it was with 'appropriate detail, emphasis and lucidity' (Stigler 1941, p. 297); nonetheless, it can hardly be denied that 'his chief task (...) was that of popularization' (*ibidem*).

Böhm-Bawerk (1889) and Wicksell (1893) studied in much greater detail the difficult question of fitting 'free' capital (rather than individual capital goods) in marginal productivity theory. They aimed at tracing back the different capital goods to a common origin, by elaborating on the time dimension of capital (as Jevons did). No conclusive analytical results concerning a proper scalar measure of 'capital' emerged, however, neither in terms of time nor in terms of any other magnitude. The conception of a given capital stock remained what Wicksell later qualified as a 'theoretical anomaly' (Wicksell 1934 [1901]: 149). The notion of a marginal productivity of capital had long been debated in the history of economic thought, even in relatively recent times (especially in the 1960 and 1970s), and no crystal-clear definition had ever been provided, except for special cases.

The theory of marginal productivity completed the overall picture of the economy, in terms of supply and demand. In Walras's words:

[the theory of marginal productivity] shows the underlying motive of the demand for services and the offer of products by entrepreneurs, just as *the theory of final utility* shows the underlying motive of the demand for products and offer of services by land-owners, workers and capitalists. (Walras 1969, p. 385; emphasis in original)

Marshall's marginalism

Alfred Marshall's position in the history of marginalism must be singled out. For he undertook a wide reconstruction of the whole body of economic theory in the light of marginalism and greatly contributed to its success as a new conventional wisdom in the decades across the turn of the nineteenth century. However, he was a marginalist *sui generis*. His theoretical work was aimed at practical, more than abstract, knowledge and he re-laborated on marginalist ideas having a particular concern for, and indeed a wide knowledge of, the economic and social problems of his age. Moreover, he was perhaps more interested in evolution and change than in the static problems of exchange. His ideal economic theory could be easily explained to open-minded businessmen or educated workers or parliamentary committees and was not developed for the sake of pure knowledge. The speculations on the ultimate sources of value had therefore a limited interest for him, like a representation of the entire economy in terms of a system of equations (although Marshall was a trained mathematician). His typical approach, weighing one argument against the other and appreciating the complexity of human and social facts, led him to seek a harmonization between marginalism and the classical tradition, as formulated by J. S. Mill. Marshall borrowed from marginalism the analytical kernel of optimization by households and firms but added many more practical details. His theory of supply, in particular, was rich in novel details: he built quite a lot on the distinction between the short run and the long; he developed in his own way the doctrine of diminishing returns and increasing marginal cost; he introduced a subtle distinction between internal and external economies of scale in manufacture; and so on. Concerning his theory of demand, the mere concept of diminishing marginal utility provided no sufficient ground for an analysis of market reactions to a change in prices: hence his analysis of the elasticity of demand and its determinants. More generally, a qualitative relation among economic variables was not sufficient for Marshall and even less was it sufficient to prove that all variables were interdependent: he insisted on the necessity of evaluating the relative strengths of such connections case by case, market by market. This attitude is mirrored by his insistence on equilibrium in individual markets. Marshall's *partial equilibrium* logic, his analysis of supply and demand in individual markets, mixed up practical and theoretical knowledge of the factors that determine prices and quantities exchanged. In his formulation of market equilibrium, the contrast between the classical theory of prices, based on costs of production, and the marginal utility theory is settled in an all-embracing synthesis: *both* factors cooperate in price determination, like the two blades of a pair of scissors. Their relative importance, however, differed according to whether one considers long-run or short-run equilibria. Costs are relatively more 'important' in the former case. The relative importance was expressed by the relative elasticities of supply and demand in the neighbourhood of equilibrium.

A final wave of marginalism

The domain of Marshallian economics was eventually challenged in the 1920s and 1930s: his peculiar mix of practical and theoretical, historical and stationary analysis, no longer fitted the quest for rigour and precision of that age. This eclipse saw also a new wave of marginalism,

aimed at further improving its logical structure and extending its results. Pareto's ordinal utility provided an excellent starting point. On that basis, Hicks and Allen (1934 a and b), Hotelling (1935) and Schultz (1938) formally analysed the conditions for the existence and the properties of single-valued *functions* of multi-commodity demand, in which the dependent variables were the amounts of commodities demanded and the independent variables were the individual's income and the prices of all goods. The precise logic of downward (or upward) sloping demand *curves* in relation to price, the relationships of substitutability or complementarity among commodities, the effect of income changes on the optimal consumption bundle were then studied, as if in a laboratory experiment, assuming, in turn, all independent variables *but one* as constant. In short, all the fundamental elements of the axiomatic theory of individual demand which can be found in current microeconomics textbooks had been put forward in the 1930s. Likewise, a clear concept of a smooth multi-input production function led Allen (1938), Mosak (1938) and Hicks (1939) to lay the foundations of the current, textbook theory of input demand and output supply by the individual competitive firm. Once again, the main progress relative to the state of the art at the end of the nineteenth century consisted of a formal derivation of a series of *functions*, namely i) a series of (conditional) input demand functions in which the independent variables were the input prices and the output level; ii) a minimum-cost function in relation to the same variables; and finally iii) the determination of the profit-maximizing output in relation to the prices of the output and the inputs. The common ground with earlier contributions consisted of the central role of differential calculus and the focus on the marginal conditions in the neighbourhood of equilibrium. By contrast, almost nothing was made of the old tripartite division of factor services.

Marginalist economics as 'neoclassical'

Since the early 1900s the Marshallian synthesis was widely referred to as 'neoclassical', due to the presence of aspects of continuity with the classical tradition, especially with reference to long-run equilibrium, as we have seen. But, as it happened, the term 'neoclassical' also embraced marginalist theory in general, including all generations of marginalists; after World War II this became an accepted convention. It should be stressed, however, that the terminological convention did not correspond to any agreement concerning the precise relationship between marginalism and classical political economy: it should by no means be taken for granted that the application of differential calculus to the analysis of choice and market equilibrium simply determined an improvement on previous theories, rather than a completely different theory. This issue is, to say the least, highly controversial. While early marginalism insisted on the novelty of the utility-based approach, in the course of time many authors in the marginalist tradition came to stress the aspects of continuity and progress, mainly by downplaying the rigour and particularities of the classical tradition; non-marginalist authors, by contrast, and particularly those inspired by a path-breaking contribution by Sraffa (1960), stressed all the interesting aspects of the economics of Smith and Ricardo that were independent of the transformations of marginalism.

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