Lecture 8

The emerging scientization of economics

Different interpretations of the 'history of economics'.

- History of the emergence of economic ideas in interaction with philosophy and other disciplines (science)
- History of methodology (e.g. mathematization) and individual theories (e.g. general equilibrium from Smith to Debreu)
- History of interaction between theory and policy
- History of fundamental ideas: self-interest - market - state
- History of institutional developments: from ideas to disciplinary field, the role of universities, internationalization, journals, associations
- Driving forces in the progress of economics: Intellectuel challenge, Policy, Scientific ideals

Signs of scientization of economics

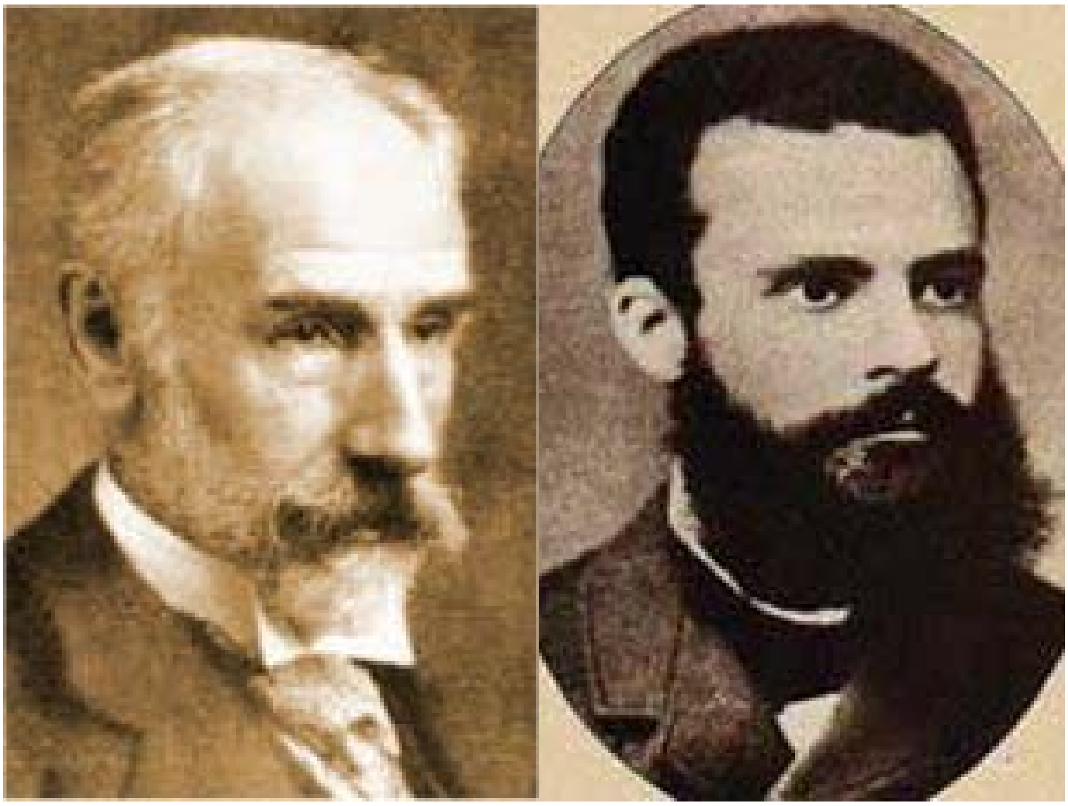
- Internationalization
- Empirical methods, testing of theory
- The statisticians enter – the birth of econometrics
- National accounting

Two well known names from the microeconomics book:

Francis Y. Edgeworth (1845-1926)

and

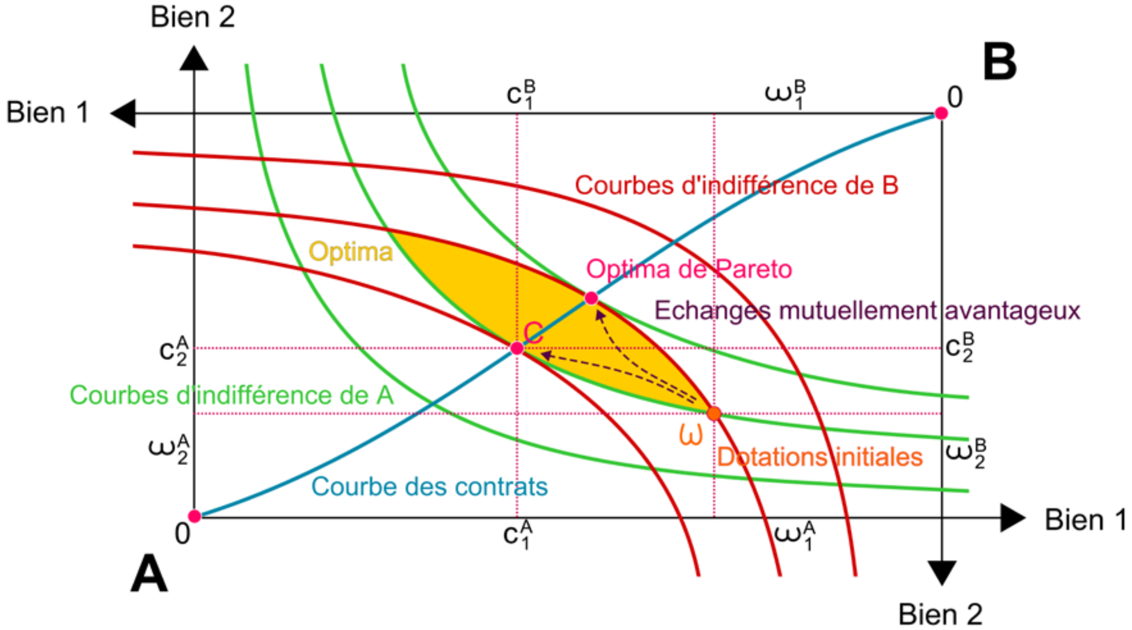
Vilfredo Pareto (1848-1923)



All economics students know about the *Edgeworth box* and the *Pareto optimum*. Paradoxically, it was Pareto who originated the analytic tool known as the Edgeworth bok and, indeed, Edgeworth who originated the idea of Pareto optimum. This tells us nothing about Edgeworth and Pareto, however, only that they were contemporaries and that those who labeled these valuable discoveries were not sufficiently well informed.

Edgeworth and Pareto (as also Wicksell) were brilliant links between the first generation neoclassical and modern economics. Both were concerned above all with the utility function and its uses in economics.

Francis Ysidro Edgeworth 1845-1926



Edgeworth was Irish and studied ancient and modern languages in Dublin and Oxford. His interest shifted, and he acquired an impressively deep insight in mathematics and economics largely on his own. After an impressively creative period from the late 1870s through the 1880s he became Professor of political economy at Oxford 1891. Edgeworth was editor of *Economic Journal* since its foundation in 1891 and until his death (jointly with J.M. Keynes from 1911).

1877 *News and Old Methods of Ethics: or 'Physical Ethics' and 'Methods of Ethics'*, Oxford
1881 *Mathematical Psychics: An Essay on the Application of Mathematics to the Moral Sciences*, London
1887 *Metretike, or the Method of Measuring Probability*, London

The 1877 book indicates Edgeworth's deep involvement in philosophical issues, particularly ethics. He is in economics mainly known for *Mathematical Psychics* and also for a number of articles. The 1887 book reflected his great knowledge of statistical methods.

Edgeworth was the leading economist in Britain next to Marshall. His innovative brilliance made him influential long after Marshall was virtually forgotten. For both Marshall and Edgeworth the interest in economic issues seems to have arisen from ethical studies but the contrast is notable:

- Despite Edgeworth's lack of formal training in mathematics (unlike Marshall) his approach to economics was highly mathematical with original uses of techniques. As summarized by Pigou: "Edgeworth, the tool-maker, gloried in his tools … Marshall, on the other hand, had what almost amounted to an obsession for hiding his tools away."

- Marshall preferred biological analogies while Edgeworth generally used mechanical analogies, made comparisons with scientific laws, relied on abstractions as in the physical sciences, and liked to conclude in terms of theorems.
- Edgeworth defended the deductive method while Marshall sympathized with the 'Historical School'.

Edgeworth's philosophical background was mainly utilitarianism but in an eclectic way. He distinguished 'impure utilitarianism' (i.e. like 'short term' egoism) from 'pure utilitarianism' (i.e. concerned with the welfare of society), believing that ultimately individuals would evolve to become 'pure utilitarians'. Edgeworth applied utilitarianism as the appropriate principle of distributive justice through a contractarian approach. He also argued for maximum utility as the single principle in social sciences, suggesting *mécanique sociale* as an analogy to Laplace's famous *Mécanique Céleste*.

Mathematical Psychics promoted the use of mathematics in economics. Edgeworth used Lagrange multipliers and even calculus of variations, techniques few economists were familiar with. The book was difficult to read, because of both content and style. It was in this book that Edgeworth introduced the generalized utility function, U(x, y, z, ...), and drew the first *indifference curves*. Utility curves entered in almost everything Edgeworth did in economics. He was the first to apply formal mathematical techniques to individual decision making in economics. Edgeworth's also drew on psychology in his utility reasoning.

Exchange and contract

Jevons had studied the equlbrium when all agents took prices as given, Edgeworth was concerned with understanding how an equilibrium could be reached among few or many agents through contracting. Such contracting led generally to multiple possible outcomes. Edgeworth's achievement was to show the conditions under which competition between buyers and sellers, through a barter process, lead to the same point as when all agents act as price takers.

Edgeworth began his analysis of this problem by taking Jevons case of two individuals exchanging fixed quantities of two goods, the first individual holds all of the initial stocks of the first good, and the second individual holds all the stocks of the second good. He then immediately defined the contract curve and indifference curves: “It is required to find a point (*x*, *y*) such that, in whatever direction we take an infinitely small step, [U_A] and [U_B] do not increase together, but that, while one increases, the other decreases.” The locus of such points “it is here proposed to call the contract-curve.” He alternatively maximized one person's utility subject to the other person's utility remaining constant.

The problem of indeterminacy

The indifference curves and the contract curve specified a range of ‘efficient exchanges’. The range of efficient contracts meant that the rate of exchange was ‘indeterminate’, to be determined in practice by bargaining strength. Edgeworth argued that this analysis could be applied widely, e.g. to the case of trade unions and employers’ associations. The indeterminacy could be resolved by either competition or arbitration.

Competition and the number of traders

After the analysis of barter between two traders Edgeworth studied how further traders would affect indeterminacy. This led to complicated reasoning, Edgeworth mobilized enormous ingenuity in study of coalitions and recontracting among many traders, simplifying by assuming that traders were exact replicas of the initial pair, with same tastes and endowments. This enabled the Edgeworth box to be used as in the case with only two traders.

Edgeworth’s replication method implied that all individuals would end up at a common point on the contract curve. Edgeworth thus showed that a recontracting competitive process among many agents led to a unique solution. Edgeworth’s reasoning anticipated and indeed inspired important developments that followed in the wake of general equilibrium and game theory much later in the 20th century.

The outcome was that the final settlement looked like a price-taking equilibrium. The argument of more traders and a shrinking contract curve is referred to as the *Edgeworth’s limit theorem*. The analysis also originated the result that a price-taking equilibrium is Pareto efficient.

The utilitarian calculus

After showing how indeterminacy can be removed by increasing the number of agents, Edgeworth turned to consider the role of arbitration in resolving the conflict between traders. Naturally, it would be based on a utilitarian principle, but the new context of indeterminacy led to a deeper justification of utilitarianism as a principle of justice.

Edgeworth argument involved two steps. It was a necessary condition of a principle of arbitration that it should place the parties somewhere on the contract curve. Edgeworth further argued that the contractors, faced with uncertainty about their prospects, would choose to accept an arrangement along utilitarian lines, "subject to the condition that neither should lose by the contract", as Edgweworth explicitly stated. In the use of equal a priori probabilities he saw a crucial link between 'impure' and 'pure' utilitarianism.

Edgeworth's argument was perhaps somewhat incomplete and it was neglected until restatements along similar lines were made by John Harsanyi and William Vickrey in the 1950s. The maximization of expected utility, with each equally likely, was shown to lead to the use of a social welfare function maximizing the sum of individual utilities, an approach now denoted as 'contractarian neo-utilitarianism'.

In discussing the utilitarian solution as a principle of arbitration in indeterminate contract, Edgeworth did not clearly indicate in 1881 that the utilitarian solution of maximum total utility could specify a position which makes one of the parties worse off than in the no-trade situation. This was nevertheless later made explicit when, after proposing arbitration along utilitarian lines, he added. This possibility of course depends largely on the initial endowments of the individuals.

Oligopoly

Edgeworth also analysed oligopoly by reconsidering and criticizing Cournot's work. Cournot's solution of the case of two duopolists, each owning a spring of mineral water, with a competetive demand side, was not accepted by Edgeworth. He found that the equilibrium would be indeterminate, not accepting the Cournot solution. We do not pursue this further, just nota that this was another casde that Edgeworth posed problems to be fully resolved later.

Edgeworth also discussed a case of complementary demand within the context of 'bilateral monopoly', the two goods were demanded in fixed proportions for use in the production of a further article. In his analysis he explicitly dealt with what would later be called conjectural variations, i.e. expectations of how the other monopolist would react. Early game theoretic thinking, we may call it.

The theory of taxation

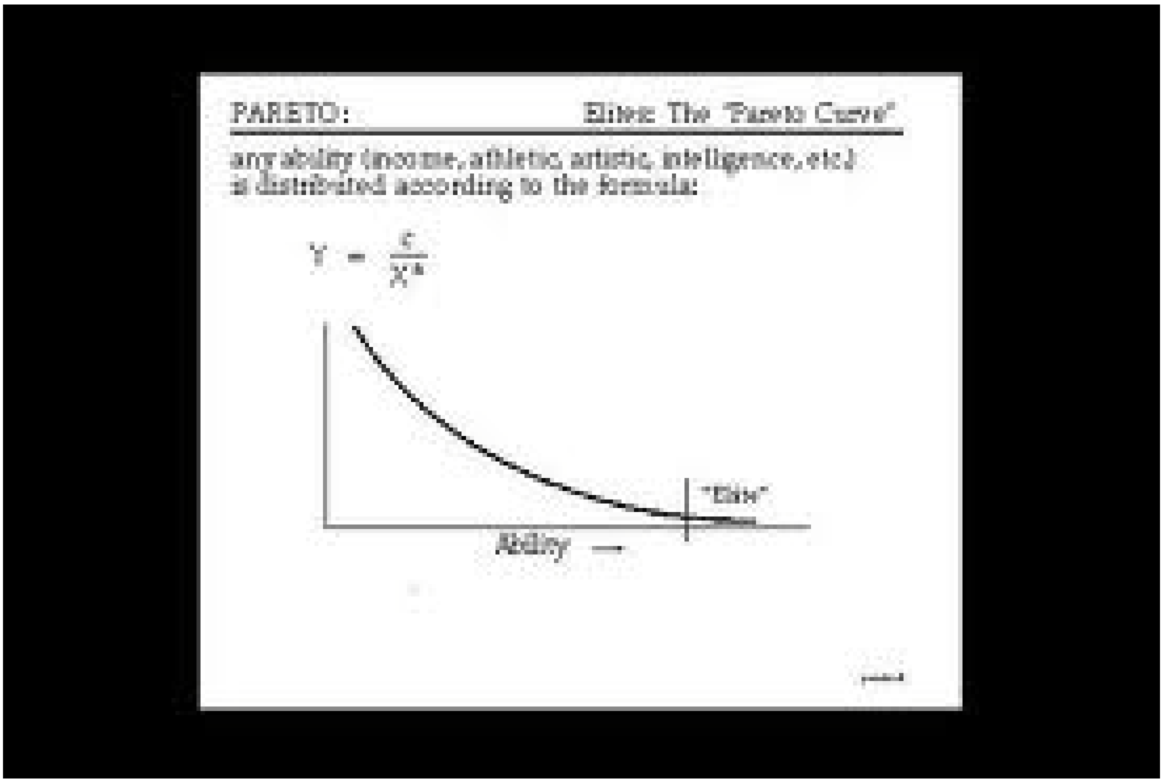
Edgeworth's attitude to taxation was similar to that of the major classical economists (and unlike Wicksell), in rejecting a benefit approach on the argument that taxation is not an economic bargain governed by competition, it is about determining the distribution of taxes for common purposes. His discussion of ‘sacrifice’ theories of the tax burden led to his qualified support for progressive taxation. Edgeworth argued along neo-contractarian lines that a utilitarian arrangement would be accepted by individuals uncertain of their own prospects and taking an equal a priori view of the probabilities. His approach can be seen as a crucial stage towards a ‘welfare economics’ view of public finance. He also argued a ‘negative income tax’ in a society sith very skewed distribution.

Edgeworth discussed a variety of special cases of tax incidence, within the standard partial equilibrium. While standard analysis suggests that the price of the taxed good will increase, Edgeworth showed - like a puzzle - that when interrelationships among commodities were present, there could be cases where the price of the taxed good will fall. Edgeworth’s puzzle was taken up in a famous paper by Hotelling in 1932.

International trade

Edgeworth also applied his general theory of exchange to international trade. Thus the gains from trade were just like the gains from exchange in simple barter. In the trade application Edgeworth used community indifference curves without clearly specifying how aggregation might be carried out. He said only that ‘by combining properly the utility curves for all the individuals, we obtain what may be called a collective utility curve’. Edgeworth analysis of trade was wide-ranging and also discussed ‘optimal tariff’.

Vilfredo Pareto 1848-1923



Pareto studied mathematics and earned a doctorate in engineering. He was introduced to Walras in 1891 and in 1893 succeeded Walras as professor at Lausanne. By that time he had written some articles but no major work in economics. His broad scientific interests and orientation made him also a philosopher and sociologist. His main works were:

1896-97 *Cours d'économie Politique*, two vols., Lausanne
1906/1909 *Manuale d'economia Politica*, Milano/Paris
1911 'Economie mathématique', in *L'Encyclopédie des Sciences Mathématiques*
1916 Trattato di Sociologia Generale, four vols., Firenze

Pareto's name is associated with general equilibrium, welfare economics and ordinal utility. He was a forerunner of the axiomatic approach culminating with the Arrow–Debreu model. The impact of Pareto's work was not immediate and to begin with confined to Italy and France. Pareto's role can be stated as being a link from the contributions of Walras to the full axiomatic formulation of the Arrow–Debreu model, but that is a too narrow view.

Pareto was preoccupied by the idea of the economy as a complete system and by the interaction between the various parts of the economy, in line with Walras' thinking and far from the partial equilibrium analysis of Marshall. Pareto wanted rigorous but parsimonious models of individual economic behaviour and from such models derive a model of the economy as a whole.

Pareto's background as engineer and mathematician was helpful towards a formal approach to economics. In the later sociological phase of his career he sought to include in his analysis also the idea that people could make "irrational choices". He thus anticipated the modern 'cognitive' approach to economics by a century. His overall aim was to broaden the analysis towards a system of laws capable of describing the behaviour of society as a whole.

Cours d'économie Politique presented theory in a more precise and refined way than Walras, emphasizing the interdependence of economic phenomena and the idea of general equilibrium. But in this book there was nothing really completely original, instead political philosophy and policy arguments, such as free trade, and empirical material filled the pages but did not add much value.

Manuale d'economia Politica is important for us mainly for the long Mathematical Appendix, which comprises Pareto's contribution to the theory of general equilibrium. It is there we find the discussion of 'Pareto optimality' which in the book is denoted 'the maximum of society's ophelimity'. The appendix with its formal analysis makes up well over 100 pages but makes up less than a quarter of the book, which in a way marks a watershed between Pareto's involvement in economics and his move into sociology. It displays the coexistence of philosophical reflection, empirical observations and rigorous analysis in Pareto's work and gives an insight into the more general scientific views of Pareto, which we leave aside here.

Ordinal utility, measurable utility and the integrability problem

One of Pareto's major contributions was to establish that an ordinal notion of utility is sufficient for the construction of equilibrium theory. This does not imply that Pareto necessarily rejected the idea of 'measurable utility'. Pareto explicitly contrasted his analysis of 'indifference curves', constructed without reference to a utility function, to that of Edgeworth who started with 'ophelimity' or 'utility' and obtained expressions for the indifference curves.

Thus Pareto arrived at conditions for economic equilibrium using preferences alone and thus led the way for modern economic theory. But he did not abandon his interest in the nature of utility and its measurement, and as a result of this dual preoccupation he adopted the term 'ophelimity' or 'ofelimità' in Italian, meaning satisfaction.

General equilibrium

Few have studied general equilibrium theory without learning about the *Edgeworth box*. Despite the name, this graphical representation first appeared in Pareto's *Manuel*, where it was used to motivate the attempted proofs of the welfare theorems in the general case. Pareto provided the standard equilibrium conditions for the consumer side of economy, with the marginal rate of substitution equal to the price ratio. (In Arrow and Debreu's later work the use of calculus is eliminated, the analysis relies on convex sets and separating hyperplanes.)

Pareto made an effort also to discuss 'monopolistic competition' in the general equilibrium analysis, namely that some agents can influence prices. This received little attention until the issue resurfaced much later, first with an article by Negishi from 1961. Pareto was in fact dealing with a problem which has still not been really satisfactorily treated.

Pareto did not make a clear distinction between the question of existence and the question of stability. He regarded equilibrium as the terminating point of a process and gave some arguments suggesting that equilibria would be stable. Thus Pareto recognized explicitly that stability is a property of a particular process.

Pareto did not really try to show the existence of equilibrium beyond counting equations and unknowns as Walras had done. He just assumed from such a simple argument the existence of a solution. (This was perhaps just as well as we now know that proving the existence of equilibrium requires fixed point theorems that had not yet been discovered.) Pareto was however aware of the possibility of multiple equilibria.

Pareto optimality

Of all Pareto's contributions it is 'Pareto optimality' that has made the greatest impact. Yet, it was not Pareto who first gave a definition of this concept, as Edgeworth in 1881 had defined a situation in which the utility of each individual is maximized given the utilities of all others. Although this definition was given in the context of an exchange economy, its extension to more general cases was obvious. It was the use that Pareto made of this idea which makes his contribution important. Thus, although he had read Edgeworth, his definition, which also included production, was an integral part of his own work.

Pareto had the insight that this notion of efficiency was independent of all institutional arrangements and distributional considerations. Pareto went on to establish the first theorem of welfare economics, i.e. a competitive equilibrium is a Pareto optimum and a tentative version of the second theorem, that any Pareto optimum can be obtained as a competitive equilibrium from an appropriate distribution of initial resources. (Both results were somewhat incomplete and incorrect as a result of confusion in Pareto’s treatment of production.

Pareto's ideas on the nature of efficiency evolved over time and in the *Trattato* he showed that the maximization of a social welfare function W as an increasing function of individual utility functions U_i

$$W = F(U_1, U_2, \ldots, U_m)$$

whether the U_i were defined over the consumption of all individuals or just restricted to individual consumption, gave an optimum. The idea of including the consumption of other individuals in the utility functions extended the scope of economic analysis and were thought of as more sociological considerations.

Economics and physics: Pareto's view

Pareto shared with contemporaries such as Edgeworth, Jevons and Fisher a conviction that there was an analogy between economic systems and those of classical mechanics. Edgeworth’s ‘mécanique sociale’ is mentioned above, Jevons argued that economics resembled physics in that ‘the equations employed do not differ in general character from those which are really treated in many branches of physical science’.

The validity and consequences of such assertions have been examined recently by Mirowski and others who have concluded that the analogy between physics and economics has been unfortunate and could have been avoided had the source of inspiration ben found elsewhere, e.g. in biology, as with Marshall. In *Cours d’économie Politique* there is a table of analogies between economics and physics. Pareto seemed, however, well aware of the dangers of taking the analogy too far. He had a cautious attitude in using equations from physics, but maintained his declared goal of modelling the whole social system rigorously.

Economics and its relationship with the other social sciences

Pareto's vision of the nature of the social sciences was set out in *Trattato*. His defence of positivism embraced Auguste Comte (1830) and wanted a ‘positive theory of economic policy’. He argued that laws or relations deduced from specific assumptions should be tested empirically against ‘observed statistical laws’. Unlike J.S. Mill who asserted that to verify hypotheses was not the business of science, a position similar to that of Friedman (1953), Pareto argued that assumptions should be examined to see how reasonable they were. Pareto insisted on what he called the ‘experimental method’ as the only appropriate method appropriate for the social sciences and would not accept theoretical work which could not be empirically tested.

In economics he – on the one hand – seemed to share Marshall's opinion that economic theory should be aimed at examining ‘man as he is’ rather than become an abstract intellectual exercise. On other hand, he condemned attempts to apply too readily economic theory to real problems, arguing argued that economic considerations could not be isolated from more general sociological concerns, to do so would lead to misleading and erroneous conclusions.

Finally, while Pareto was with Max Weber among the first to expound the principles of ‘positive social science’, his view of the status of economics was ambiguous. He believed fundamentally that there should be a universal scientific approach to social science. Over time it seemed that he became progressively more convinced of the importance of the non-economic factors in explaining the evolution of society. (Pareto's sociology was introduced to the United States and had considerable influence, especially on Harvard sociologist Talcott Parsons who developed a systems approach to society and economics).

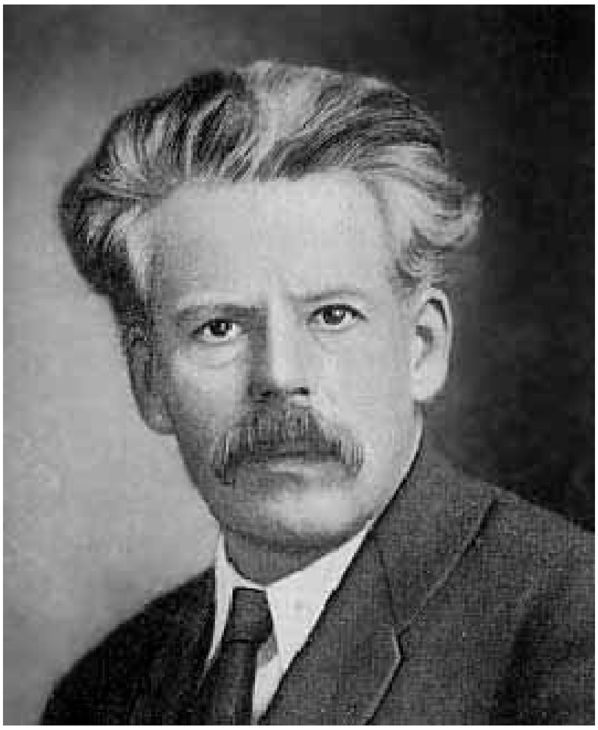
Pareto's law

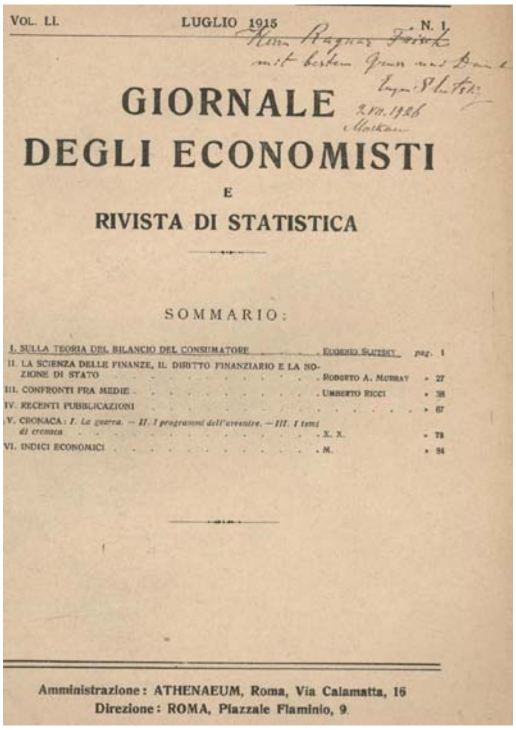
This is a ‘law’ governing the distribution of personal income. The formula proposed by Pareto was $N(x) = Ax^{-a}$, where $N(x)$ is the number of people with an income greater than or equal to x. ‘Pareto's law’ is known to fit well for the upper tail of the income distribution.

The *Pareto principle*

In 1906, Pareto made the observation that twenty percent of the population owned eighty percent of the property in Italy. This was much later generalised by Joseph Juran and called the *Pareto principle*.

The key contributors to the modern theory of demand: Eugen E. Slutsky and John Hicks





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GIORNALE
DEGLI ECONOMISTI
E
RIVISTA DI STATISTICA

SOMMARIO:

Amministrazione: ATHENAEUM, Roma, Via Calamatta, 16
Direzione: ROMA, Piazzale Flaminio, 9.

Evgeny E. Slutsky (1880-1948)

Slutsky studied physics and mathematics at Kiev University, was expelled in 1905 for taking part in student revolts, went abroad to study engineering in Munich and finally graduated in law in 1911 at Kiev University. He became professor in Kiev and moved in 1926 moved to Moscow to work at the Conjuncture Institute. In 1934 he moved to Moscow and became member of the Mathematical Institute of the Academy of Sciences.

1915 Sulla teoria del bilancio del consumatore [On the theory of the budget of the consumer], *Giornale degli Economisti e Rivista di Statistica*

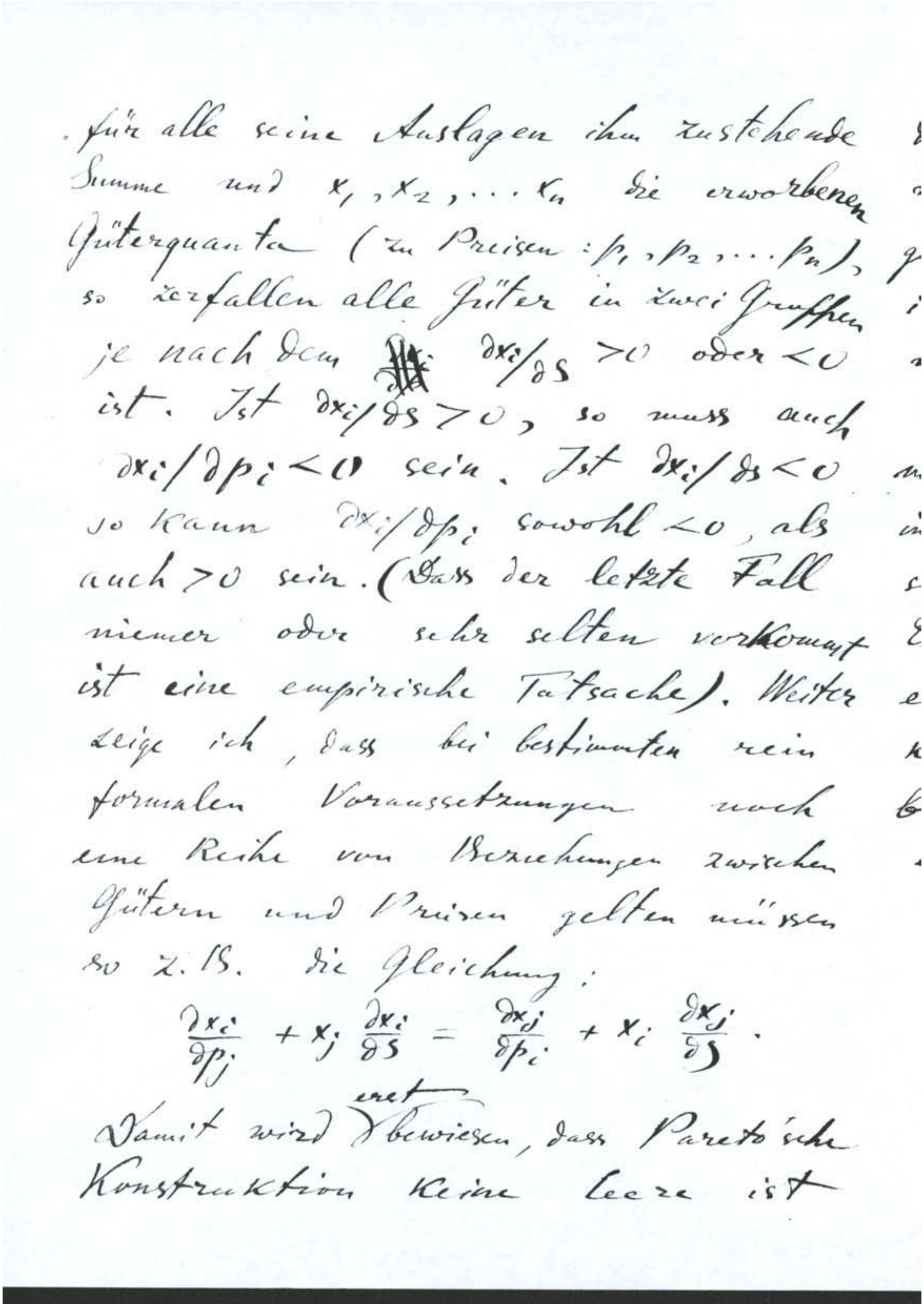
1927/1937 The summation of random causes as the source of cyclic processes (in Russian), *Problems of Economic Conditions*, Revised English version in *Econometrica*

Slutsky was a mathematician, statistician and economist, known in economics mainly for the 1915 article, which was unnoticed until the mid-1930s but influenced the further development of consumer theory. Building on earlier work by Pareto, Slutsky showed that the effect of a price change on the quantity demanded can be divided into two effects, which we are familiar with as the Slutsky equation.

The theoretical context of Slutsky's paper is as follows. Mathematical economists of that period tried to pursue the analysis of demand along the lines of the Paretian theory of the equilibrium of the individual consumer.

Slutsky's article was driven by the idea of testing and measuring economic relatons empirically; this also can be traced to Pareto's methodological principles. In that regard the most important result of Slutsky's paper is not the Slutsky equation but the symmetry of the compemnsated (Slutsky) derivative, as this was most general empirical restricton on individual demand functions. In Slutsky's view the symmetry condition is a qunatitative, measurable relationship.

On the other hand Slutsky comes to the conclusion that the determination of the second derivatives of the utility function on the basis of data is a wasted effort. This had tremendous importnce for the relation between psychology and economics. After proving the complete properties of the demand curves Slutsky showed that the 'own' substitution effect is always negative and the cross substitution effect symmetric. He also redefined the meaning of complementary and competing goods.


für alle seine Auslagen ihm zustehende Summe und $x_1, x_2, \ldots x_n$ die erworbenen Güterquanta (zu Preisen: $p_1, p_2 \ldots p_n$), so zerfallen alle Güter in zwei Gruppen je nach dem $\partial x_i/\partial s > 0$ oder < 0 ist. Ist $\partial x_i/\partial s > 0$, so muss auch $\partial x_i/\partial p_i < 0$ sein. Ist $\partial x_i/\partial s < 0$ so kann $\partial x_i/\partial p_i$ sowohl < 0, als auch > 0 sein. (Dass der letzte Fall niemer oder sehr selten vorkommt ist eine empirische Tatsache). Weiter zeige ich, dass bei bestimmten rein formalen Voraussetzungen noch eine Reihe von Beziehungen zwischen Gütern und Preisen gelten müssen so z.B. die Gleichung:

$$\frac{\partial x_i}{\partial p_j} + x_j \frac{\partial x_i}{\partial s} = \frac{\partial x_j}{\partial p_i} + x_i \frac{\partial x_j}{\partial s}.$$

Damit wird erst bewiesen, dass Pareto'sche Konstruktion keine leere ist

Slutsky also worked on the theory of stochastic processes and in his 1927 paper he proved that the summation of random causes may be the source of cyclic processes. A corollary is the famous *Slutsky-Yule effect* (independently discovered by Yule) that if a moving average of a random series is taken (for example to determine trend), this may generate an oscillatory movement in the series where none existed in the original data, a result that Ragnar Frisch took a great interest in. Most of Slutsky's colleagues at the Conjuncture Institute were executed on Stalin's orders. Slutsky survived and spent the last years of his life preparing mathematical tables.

Vincent Barnett, an expert on Soviet economists, states:

> "A good case can be made for the notion that Slutsky is the most famous of all Russian economists, even more than N.D. Kondratiev. L.V. Kantorovich or M. Tugan-Baranovsky. There are eponymous concepts such as the Slutsky equation, the Slutsky diamond, the Slutsky matrix, and the Slutsky-Yule effect, and a journals-literature search conducted on his name for the years 1980-1995 yielded seventy-nine articles directly using some aspect of Slutsky's work... Moreover, many microeconomics textbooks contain prominent mention of Slutsky's contribution to the theory of consumer behavior, most notably the Slutsky equation, christened by Hicks the 'Fundamental Equation of Value Theory'. Slutsky's work is thus an integral part of contemporary mainstream economics and econometrics, a claim that cannot really be made by any other Soviet economist, perhaps even by any other Russian economist."

John R. Hicks (1904-1989)

Hicks studied mathematics at Oxford before he took up economics, taught at LSE, became Professor at Manchester in 1935 and later at in Oxford. Hicks' work is too great to be included here, we mention only some work related to what has been discussed earlier.

1932 *The Theory of Wages*, London
1934 A Reconsideration of the Theory of Value, *Economica* (with R.G.D. Allen)
1937 *Théorie mathématique de la valeur en régime de libre concurrence*, Paris
1937 Mr Keynes and the Classics: A Suggested Interpretation, *Econometrica*
1939 The Foundations of Welfare Economics, *Economic Journal*
1939 *Value and Capital*, Oxford: Clarendon.
1941 The Rehabilitation of Consumers' Surplus, *Review of Economic Studies*.
1956 *A Revision of Demand Theory*, Oxford

Hicks may have been close to being in the last generation of economists who could take up almost any theoretical problem. His powerful and original mind first made itself felt in what is now called microeconomics and in welfare economics. Hicks' best-known work, *Value and Capital* (1939), goes beyond microeconomics to offer an economic dynamics and discussion of monetary theory which reaches into the new macroeconomics.

Hicks's paper with R.G.D. Allen, 'A Reconsideration of the Theory of Value' (1934) was written just prior to the discovery of Slutsky's 1915 paper on income and substitution effects in demand. Hicks and Allen had obtained independently of Slutsky, a decomposition of the elasticity of demand for a good into term involving the income elasticity of demand and an ‘elasticity of complementarity’. Hicks discussed the relation to Slutsky’s work in his 1937 book. It is somewhat unclear both why Slutsky’s paper was not “dicovered” earlier and also how it suddenly became known to Hicks & Allen, to Henry Schultz (with Milton Friedman as assistent) and others almost simultaneously in 1935.

More on Hicks

Value and Capital is a work very rich in ideas and a short account cannot do it justice. It showed that the basic results of consumer theory could be obtained from ordinal utility; it expounded what became known as the ‘Hicksian substitution effect’, obtained by varying income as relative prices changed so as to maintain an index of utility constant; it popularized among English speaking economists the notion of general equilibrium. Hicks (unlike Arrow) did not take the existence argument beyond equation and variable counting.

Later followed work on the trade cycle, *A Contribution to the Theory of the Trade Cycle* (1950); on growth, *Capital and Growth* (1965); and an unusual approach to capital theory, *Capital and Time: A Neo-Austrian Theory* (1973). More non-conventional is *A Theory of Economic History* (1969), proposing a grand theory of economic history, and *Causality in Economics* (1979), venturing into ground normally reserved for philosophers and statisticians. Hicks has been an economist of outstanding breadth and erudition.

In making the 1972 Nobel Prize award to Hicks jointly with Arrow the Committee mentioned ‘general equilibrium and welfare economics’. The reference in Hicks's case was clearly to *Value and Capital*, and to the various papers which established the Kaldor–Hicks criterion in welfare economics.

Welfare economics

Hicks was one of the pioneers of the ‘new welfare economics’, an approach which originated in a paper by Kaldor in 1939. The problem at issue is inescapable and fundamental to the justification of the recommendations of economists. By the time the debate arose, cardinal utility was no longer generally accepted and the need was felt to differentiate between ‘scientific’ propositions and ‘value judgements’. The notion of a ‘Pareto improvement’ – a change that would make no individual worse off , and at least one better off – was familiar but was seen to be limited as a basis for recommendations, as nearly all actual changes made at least one person or group worse off. In

Robbins' telling example, economists could not state scientifically that the abolition of the Corn Laws was a good thing because this reform made landlords worse off.

Hicks's suggested solution to the difficulty was the same as that proposed by Kaldor – a compensation test. A reform should be counted an improvement if the gainers could afford to compensate the losers and still be better off. In 'The Foundations of Welfare Economics' (*Economic Journal*, 1939), Hicks discussed the question of whether compensation must be paid for the improvement to count without a sense of how crucial this question was to prove to be.

Perhaps the most interesting thing to notice about Hicks's long involvement with the foundations of welfare economics is that he seems never to have accepted that value judgements are an inescapable element in welfare evaluations and that judgements shoudl be made explicit. Hence the design of policy by the means of the maximization of an explicit social welfare function – the welfare weights of cost-benefit analysis – never engaged Hicks.

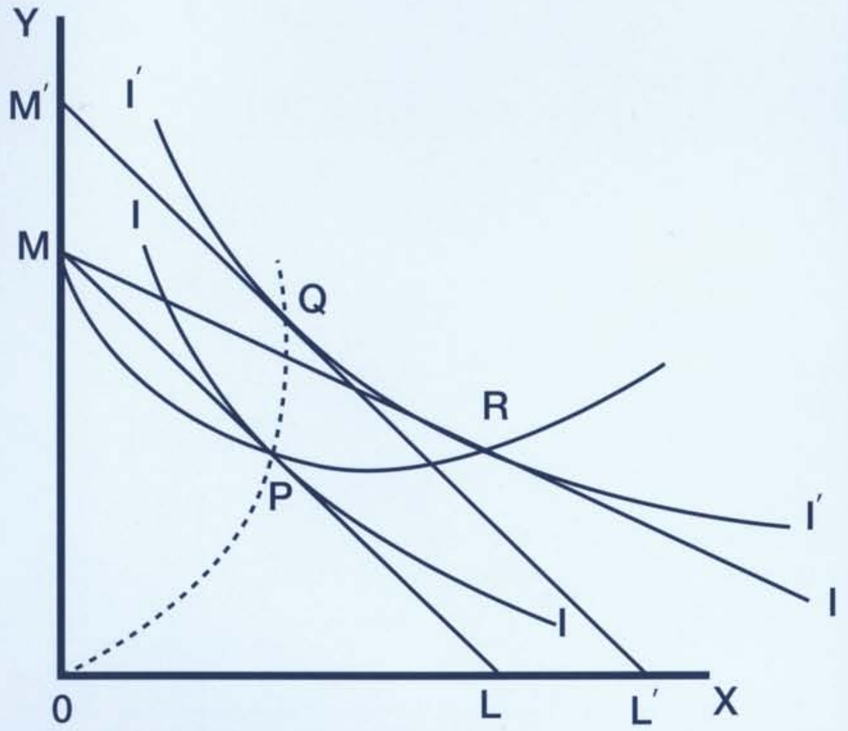
General Theory and IS-LM

Hicks response to the *General Theory* is 'Mr Keynes and the "Classics"' (1937) that gave an easily accessible account of the essentials of Keynes' argument. The paper has been widely criticized for misrepresenting what the *General Theory* is about. Hicks reproduced, however, rather faithfully Keynes's various specifications, but by working with a two-sector model produced a framework which resulted in a simple diagram – the IS–LM diagram.

The beauty of this elegant and lucid way of expounding Keynes's model is that it brings out clearly the vital role played in the model by aggregation assumptions which have the effect that the model decomposes, so that parts of it can be dealt with in partial isolation from the complete system. The simple specifications of the determinants of investment and the consumption function produce this result. The role played by income and working in terms of nominal values – which are equivalent to wage units, as the nominal wage has been taken as given – are all brought out clearly.

The IS–LM model made the *General Theory* intelligible to a whole generation, not because it left out the subtleties, it was never intended to substitute for the text, but because it perfectly captured the part of Keynes's message which is most amenable to formalization.

Income and Substitution Effects



John Hicks (1904 – 1989) and Roy Allen (1906 – 1983)

Hicks and Allen showed that the effect of a price change on the quantity demanded by an individual buyer could be decomposed into two components – the income effect and the substitution effect. Thus, a fall in the price of a commodity affects the demand for it in two different ways; one is the increase in the individual's real income, given a fixed relative price of the good, and the second is the fall in its relative price, given a fixed real income (utility). Their diagram illustrated this decomposition for the case of a consumer buying quantities of two commodities. This decomposition carries over to a more general model in which an individual maximises his/her welfare, given the prices of n goods and a fixed monetary income, and it applies to cross-price effects as well as to own price effects. It gives insights into the causes of the quantities demanded when prices change. It has been applied to markets for goods, labour services, assets and other commodities.

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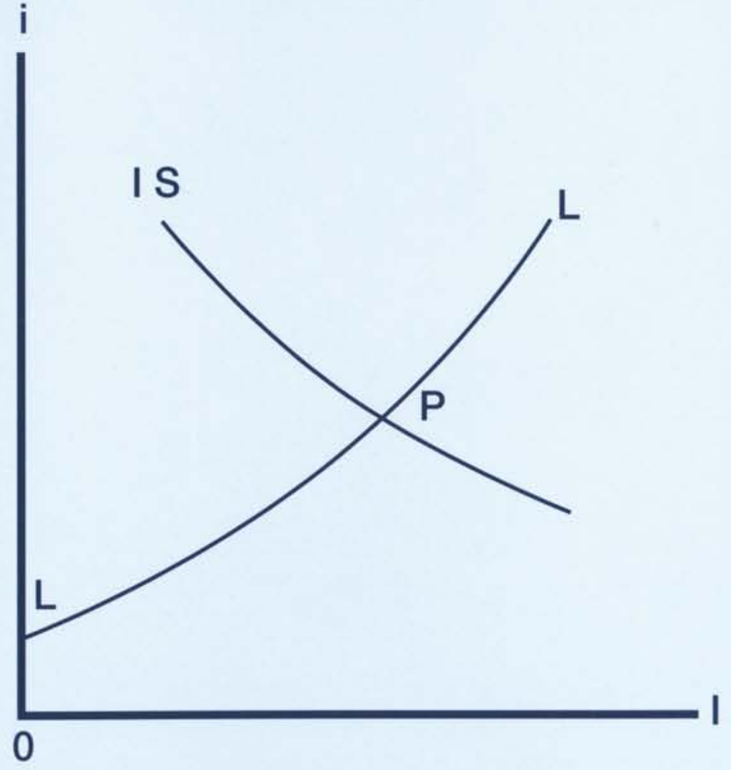
The IS/LM Diagram



John Hicks (1904 – 1989)

The IS-LM diagram is one of the most popular tools of undergraduate macroeconomics. Hicks (1937, p. 156) described his invention as a "little apparatus". One curve (IS) shows those combinations of the interest rate and level of income (output) consistent with equilibrium in the market for commodities. The other curve (labelled LL by Hicks but more often labelled LM) shows those combinations of the interest rate and level of income (output) consistent with equilibrium in the market for money (bonds). The intersection of the two curves at P shows the (unique) values of the interest rate and level of income (output) consistent with 'general equilibrium'. IS-LM analysis has a number of roles. It can be used to summarise the key ideas to be found in Keynes's *General Theory* (seen in a 'general equilibrium' or 'simultaneous equations' framework) and to clarify the key differences between Keynes and his predecessors. It also offers a device suitable for neat 'back-of-the-envelope' expositions of the short-run consequences of changes in fiscal and monetary policy. While Hicks himself was later to become "dissatisfied with it" (1980, p. 139), it remains a popular tool for undergraduate instruction where it is usually combined with a neoclassical model of the labour market and with a Mundell-Fleming model of a small open economy.

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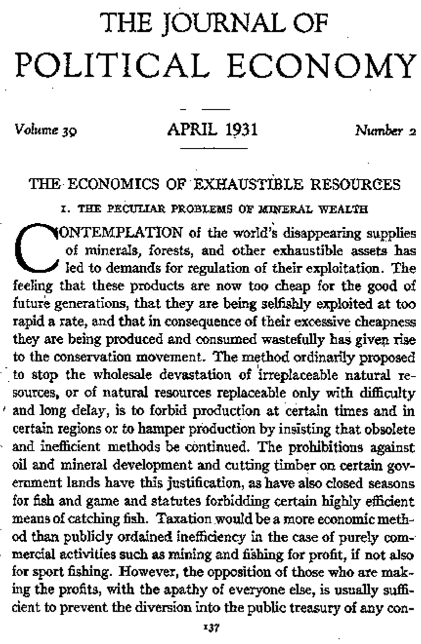
Three eminent outsiders: Harold Hotelling (1895-1973) and Frank Plumpton Ramsey (1903-1930), John von Neumann



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THE ECONOMICS OF EXHAUSTIBLE RESOURCES

I. THE PECULIAR PROBLEMS OF MINERAL WEALTH

CONTEMPLATION of the world's disappearing supplies of minerals, forests, and other exhaustible assets has led to demands for regulation of their exploitation. The feeling that these products are now too cheap for the good of future generations, that they are being selfishly exploited at too rapid a rate, and that in consequence of their excessive cheapness they are being produced and consumed wastefully has given rise to the conservation movement. The method ordinarily proposed to stop the wholesale devastation of irreplaceable natural resources, or of natural resources replaceable only with difficulty and long delay, is to forbid production at certain times and in certain regions or to hamper production by insisting that obsolete and inefficient methods be continued. The prohibitions against oil and mineral development and cutting timber on certain government lands have this justification, as have also closed seasons for fish and game and statutes forbidding certain highly efficient means of catching fish. Taxation would be a more economic method than publicly ordained inefficiency in the case of purely commercial activities such as mining and fishing for profit, if not also for sport fishing. However, the opposition of those who are making the profits, with the apathy of everyone else, is usually sufficient to prevent the diversion into the public treasury of any con-

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Harold Hotelling (1895-1973)

Hotelling was the leading statistician in USA, very famous in his field. Known as having influenced as teacher the career of e.g. Kenneth Arrow, Abraham Wald, and Theodore Anderson and for some gems on economic problems.

Hotelling's Rule (1931), Law (1929), and Lemma (1932).

1929 Stability in Competition, *Economic Journal*
1931 The Economics of Exhaustible Resources, *Journal of Political Economy*
1932 Edgeworth's taxation paradox and the nature of demand and supply functions, *Journal of Political Economy*
1935 Demand function with limited budgets, *Econometrica*
1938 The General Welfare in Relation to Problems of Taxation and of Railway and Utility Rates, *Econometrica*

Hotelling's law is that in many markets it is rational for producers to make their products as similar as possible. Suppose that there are two competing shops on a street. Hotelling's law predicts that the two shops will be next to each other at the halfway point.

Hotelling's rule states that the equilibrium net price path for an extracted non-renewable resource, such as oil, has constant growth rate (equal to the discount rate).

Hotelling's lemma is not on the level of the Law and Rule. It states that the supply function of a firm, $x(p)$, can be derived from the profit function, written as function of prices, $\pi(p)$, as $x(p) = d\pi(p)/dp$. This result falls under 'envelope theory'.

Hotelling's 1935 and 1938 papers are influential papers on the problems of maximization of non-convex sets and on marginal cost pricing in railways and public utilities.

Frank Plumpton Ramsey (1903-1930)

Ramsey was a Cambridge mathematician, famous for 'Ramsey Theory'. Also know for having translated Wittgenstein's Tractatus Logico Philosophicus when he was only. Made an impact in economics through three papers:

1926 Truth and probability, published post-mortem in 1931.
1927 A contribution to the theory of taxation, *Economic Journal*
1928 A mathematical theory of saving, *Economic Journal*

Ramsey pricing applies when a monopolist, say a utility company, aims at maximizing consumer surplus while ensuring that costs are covered. The answer is for prices to have a mark-up over marginal cost inversely proportional to the price elasticity of demand.

The Ramsey model founded optimal growth theory, posing is a question of optimal saving rate, using intertemporal maximization.

Ramsey's **Truth and probability** is on subjective probability approach. It criticized Keynes' work and formulated a more attractive foundation for subjective probabilities, inferrable by observing an individuals action, e.g. by finding the odds the individual would accept in betting on outcomes. The work was unknown until von Neumann and Morgenstern drew attention to it in *Theory of Games and Economic Behaviour* (1944).

John von Neumann 1903-1957

1928 Zur Theorie der Gesellschaftsspiele, *Mathematische Annalen*
1937 Über ein ökonomisches Gleichungssystem und eine Verallgemeinerung des Brouwerschen Fixpunktsatzes, *Ergebnisse eines mathematische Kolloquiums* 8, ed. Karl Menger (trans. as 'A model of general equilibrium', *Review of Economic Studies* 1945–6)
1944 *Theory of Games and Economic Behavior* (with Oscar Morgenstern)

Although von Neumann has only three publications that can directly be called contributions to economics, namely, his 1928 paper on the theory of games, his 1937 paper on the expanding economy model and his 1944 treatise (with Morgenstern) on the theory of games, they exerted enormous influence. The small *number* of contributions is deceptive because each one consists of several different topics, each being important.

The expanding economy model, von Neumann (1937) consisted of two parts: the first input–output equilibrium model that permits expansion; and second the fixed point theorem. The linear input–output model is a precursor of the Leontief model, of linear programming as developed by Kantorovich and Dantzig, and of Koopman's activity analysis. This paper (together with one by A. Wald 1935) raised the level of mathematical sophistication used in economics enormously.

The theory of games, von Neumann (1928) and von Neumann and Morgenstern (1944), was an enormous contribution consisting of several different parts: (1) the axiomatic theory of utility; (2) the careful treatment of the extensive form of games; (3) the minimax theorem; (4) the concept of a solution to a constant-sum n-person game; (5) the foundations of non-zero-sum games; (6) market games. Each of these topics could have been broken into a series of papers, had von Neumann taken the time to do so.

Von Neumann's indirect contributions, such as the theory of duality in linear programming, computational methods for matrix games and linear programming, combinatorial solution methods for the assignment problem, the logical design of electronic computers, contributions to statistical theory, etc. are equally, important to the future of economics. Each of his contributions, direct or indirect, was monumental and decisive. We should be grateful that he was able to do so much in his short life. His influence will persist for decades and even centuries in economics.