Chapter IV

ADVANCES OF THE ECONOMICS OF EQUILIBRIUM
In this chapter, we will discuss the advances in the economics of equilibrium as could be found in the contribution of six contemporary economists, namely, Kenneth J. Arrow, J.R. Hicks, Gerard Debreu, Lawrence L. Klein, Robert Solow and Paul Anthony Samuelson. All these economists believe that economic system is not 'static' or 'stationary' as it was contended by the classical economists. The economic variables viz. prices, output, investment, consumption, etc. change from one period to another. They change because of higher economic growth, increase in consumption pattern, tastes and preferences of the individuals. An economic system is said to be in dynamic equilibrium if its total stock, including both things and people, changes at a constant rate (per cent per annum), and if the rates of production and consumption of all items of the stock increase at the same rate. We may now analyse the contribution of each of these economists in the following paragraphs:

KENNETH J. ARROW

Life Sketch

Arrow was born in New York City in 1921. He received his Graduation from City College, New York in 1940. He took his Ph.D. degree in 1951. He became a Professor at Stanford University in 1953. He has served in many American Universities such as Chicago, Cambridge and Stanford. He has been appointed the President of the Econometric Society in 1956, Winner of John Bates Clark medal of the American Economic Association in 1957.

He was honoured with the Nobel Prize in Economics along with John
R. Hicks in 1972 for their pioneering work in the highly abstract field of equilibrium theory. One of the members of the Nobel Prize Committee, Professor Bertil Ohlin quoted that "the general equilibrium theory is the basis for most of the direct application of economic theory such as localisation of industrial plant, resource allocation, financial and employment theory and foreign trade, all these being used to increase the welfare of the people."

**His Works**


**His Contribution**

Arrow's theory of General Equilibrium is based on the foundation of neo-classical economic analysis. There are two notions of general equilibrium:

1) The economic system must form a system sufficiently complete to determine the values of its variables, and

2) Each relation represents a balance of force.

**Concept of Equilibrium**

According to Arrow, the concept of 'equilibrium' exists in mechanics.
long before the appearance of Smith's *Wealth of Nations* (1776). But there is no concrete evidence to prove that Smith had borrowed the concept from mechanics. Whatever may be the source from which this notion has been derived, this concept has provided the most important contribution in the economic thought, in order to understand the social processes. Smith was regarded as a creator of equilibrium theory. His 'invisible hand' is a poetic expression of the most fundamental of economic balance relations, the equalisation of rates of return, as enforced by the tendency of factors to move from low to high returns. Smith's logical gaps were filled to some extent by the classical economists like Ricardo and J.S. Mill.

However, the classical authors found that prices appeared to be determined by a system of relations not involving quantities, derived from the zero-profit condition. This is clear enough with fixed production coefficients and a single primary factor, labour, as in Smith's famous exchange of deer and beaver, and it was the great accomplishment of Malthus and Ricardo to show that land could be brought into the system.

We also find that application of partial equilibrium analysis of a single market by Cournot (1838), Jenkin (1870) and other neo-classical economists. The full credit to popularise the general equilibrium concept can be attributed to Walras (1874-1877). In Walrasian analysis, economic system consists of 1) households and 2) firms. Each household owns a set of resources, commodities, useful either in production or consumption, including different kinds of labour.
For any given set of prices, a household has an income from the sale of its resources, and with this income it can choose among all alternative bundles of consumer's goods whose cost, at the given prices, does not exceed its income.

According to Walras, the demand by an households for any consumers' good as a function of the prices of both consumers' goods and resources. An equilibrium set of prices was a set such that supply and demand were equated on each market, assuming fixed coefficients of production. It was argued that there existed an equilibrium set of prices on the ground that the equality of the number of prices to be determined with the number of equations expressing the equality of supply and demand on various markets. In this counting, Walras recognised that there were two offsetting complications - 1) only relative prices affected the behaviour of households and firms, 2) there is budgetary balance of each household between income and the value of consumption and the zero-point condition for firm.

Walras assumes a set of prices fixed abitrarily; then supply may exceed demand on some markets and fall below on others. Let us assume that in the first market, prices are adjusted to make equality between demand and supply, given all other prices. This will normally require raising the price if demand initially exceeded the supply, decreasing in the opposite case. Of course, the change in the first price will change supply and demand on all other markets. Let us repeat the process with the second and subsequent markets. At the end of the one round, the last market will be in equilibrium, but none of the
others need be, since the adjustments on subsequent markets will destroy the equilibrium on any one. However, Walras, argues the supply and demand functions for any given commodity will be affected more by the changes in its own price than by the changes in its own prices. Hence, after one round the markets should be more nearly in equilibrium than they were to begin with, and with successive rounds the supplies and demands on all markets will tend to equality. The equilibrium analysis was further developed by a number of outstanding economists like W. Stanley Jevons, Carl Menger, J.B. Clark, Wicksteed, Cassel, Neisser, etc.

According to Wald, there are two alternatives which are sufficient conditions for the uniqueness of competitive equilibrium 1) that the weak axiom of revealed preference holds the market demand functions; 2) that all commodities be gross substitutes. His theory provides further incentives for research.

Theory of Games

Von Neumann used the theory of games for the first time in his celebrated paper on 'balanced economic growth' (1937). The historical relation between game theory and economic equilibrium theory is paradoxical. In principle, game theory is a very general concept of equilibrium which should either replace the principle of competitive equilibrium or include it as a special case. In fact, while game theory has turned out to be extraordinarily stimulating to equilibrium theory, it has been through the use of mathematical tools developed in the former and used in the latter with entirely different interpretations.
In this model there is only the application of production function, demand function being excluded.

Games theory of Von Neumann in a simplified form was presented by Katutani, Shirzuo, George B. Dantzig, Albert W. Tucker, Harold W. Kuhn, Tjanlling, C. Koopmans, etc. Arrow explains that a competitive equilibrium is a designation of non-negative prices for all commodities, of a bundle for consumption for each household, and of a production bundle for each firm satisfying the following conditions:

(a) for each household, the designated bundle maximises utility among all available bundles.

(b) for each firm, the designated bundle maximises profit among all technically possible bundles.

(b) for each commodity, the total consumed by all households does not exceed the total initially available plus the net total produced by all firms.

(d) for those commodities for which total consumed is strictly less than total initially available plus total products, the prize is zero.

The following assumptions are sufficient to ensure the existence of competitive equilibrium:

1) The preference ordering of each household is continuous, admits no saturation and is convex.

2) The set of possible production bundles for each firm is convex and closed.
3) No production bundle possible to society as a whole can contain outputs but no inputs. There is at least one bundle possible for society that contains a positive net output of all commodities not possessed initially by any households.

4) The economy is irreducible.¹

There are two theorems of competitive equilibrium and allocations. They are enumerated as follows:

1) Any competitive equilibrium is necessary optimal.

2) Given any optimal allocation, there is some assignment of society’s initial assets among individuals such that the optimal allocation is a competitive equilibrium corresponding to that distribution, provided that the assumptions of the previous section which ensure the existence of equilibrium hold.

The concept of optimality can be defined without a price system or any prescribed set of markets. The optimal theorem states that there will be an identity between optima and competitive equilibrium without introducing prices into the definition of optimality.

Walras clearly explained the firm in the general equilibrium theory. He assumed fixed coefficient and passive nature of the firm. In the last quarter of the nineteenth century J.B. Clark, Wicksteed and Barone recognised the possibility of alternative production activities in the form of production function. the firm have the responsibility of minimising costs at given output levels. A number of economists were interested in analysing the theory of the firm.
These economists include Cournot (1838), Wickshell, Pareto, Robertson, Sraffa, Shove, Viner, etc..

According to Cournot firms may be either monopolists or competitors and in such circumstances profit maximisation is compatible with increasing Returns to Scale. In modern terminology, the production possibility set of typical firms displays an initial tendency towards Increasing Returns followed at higher scales by Decreasing Returns. The first part is explained by indivisibilities and the second by the decreasing ability of the entrepreneur to control the firm.

According to Arrow the set of firms is regarded as fixed. He also assumed that sometimes firms might find it most profitable to produce nothing. The production possibility sets of the firms are assumed to be convex. This assumption excludes the possibility of an initial phase of increasing returns. It is compatible with either Constant or Diminishing Returns to Scale. His model creates a category of pure profits which are distributed to the owners of the firm. But the model does not explain that the owners are necessarily the entrepreneurs or managers. Since profit maximization is assumed, conflict of interest between the organisation or its management, on the one hand, is assumed always to be resolved in favour of the owners. The model is sufficiently flexible because it includes managers as owners of the firm.

It can be concluded that in spite of the advances, some of the problems of general equilibrium are still unsolved. There is no sufficient empirical evidence
in the general equilibrium in order to prove that the system of equation had a solution at all. Secondly, there cannot be a unique profit-maximizing position for any set of prices. If there is no inputs and outputs, profit will be naturally zero. Though Arrow was unable to solve some of the problems of the general equilibrium, nevertheless, he gave a practical analysis to this type of problem. By the application of mathematical tools, Arrow discovered that the existence of multi-market equilibrium under conditions of perfect competition requires forward markets in all goods and services. That is, the markets in which we can pay today to obtain delivery tomorrow or accept today for the promise of payment tomorrow. This finding throws doubts on the practical significance of general equilibrium theory and much of Arrow's contribution was concerned to demonstrate that general equilibrium theory is still relevant to those economic with missing forward markets.

JOHN R. HICKS

Life Sketch

John R. Hicks was born in Leamington Spa, England in 1929. In 1925 he took his Graduation from Oxford University. In 1935 he became Professor at Manchester University, he retired from his Professorship in 1965 from the same institution.

Hicks and Kenneth J. Arrow were jointly winner of Nobel Prize in Economics in 1972 for their pioneering contributions to the General Equilibrium
and Welfare Theory.

**His Works**


**His Contribution**

**Exchange Equilibrium**

Hicks regards Walras as the creator of the theory of 'exchange
equilibrium' according to which solution there must be equality between the number of equations and that of unknowns. Excluding the speculative market, the theory can be explained this way: once a particular set of prices is given, it is not difficult to determine the most preferred position of any individual. This gives us the quantities he will demand of those commodities he does not possess, and the quantities he will be willing to supply in exchange for them of those commodities he does. By simple addition, we can determine the demand and supply for each commodity. If the price system is such as demands and supplies equal, the relative position will be that of the general equilibrium of exchange.

While expectations are generally precise, Hicks finds that there is always an element of uncertainty for which allowance should be made. Under conditions of perfect competition, prices can be taken as a parameter; and with the help of relevant data regarding production and the prices of the inputs, the firm can easily estimate its profit. A key concept introduced by him is the transformation of a group of commodities into a single one so long as their prices move in the same direction or change in the same proportion. In this way a number of variables are reduced to one only, thus attaining generality.

Hicks, however, fears that the introduction of monopoly conditions might have disastrous consequences for his theory. He states that "under monopoly the stability conditions become indeterminate; and the basis on which economic
laws can be constructed is, therefore, shorn away. Not only is falling average cost consistent with monopoly; falling marginal cost is consistent with monopoly too. There must indeed be something to stop the indefinite expansion of the firm, but it can just as well be stopped by the limitation of the market as by rising marginal costs, though of course, both may be in operation simultaneously.

General Equilibrium

Hicks claims that the 'general equilibrium' of production is of much wider applicability as compared to the general equilibrium of exchange. It is indeed a fairly well-developed system, and includes so much of the economic problem that many of the systems of thought employed by economists during the last century fall within it, and have to be reckoned among its simplified forms. It is applicable to long period problems such as distribution and international trade. He assumes a system which consists of two individuals 1) private individuals and 2) entrepreneurs. The demarcation is made in this way. Every individual possesses supplies of one or both of two sorts of resources - (1) factors of production which can be disposed of on the market, 2) entrepreneurial resources which cannot be disposed of in that way, but which can be used, in combination with the other sorts of factors, to produce disposable products.

A person who possesses entrepreneurial resources given a set of markets
prices for factors and products, will be in a position to determine whether the utilization of those resources in the production will yield a positive surplus. If he will do so, he becomes an entrepreneur. As entrepreneur, he will be in a position to arrange production in such a way that he will be able to maximize his surplus. At given prices, the most profitable arrangement is determined by the state of technique and by the extent of his entrepreneurial resources. Consequently, his demand for factors and supply of factors as well as his surplus is determined. This surplus now become part of his income on private account - that part of his account where his decisions become similar to those of the private individual.

The private individual unwilling to use his entrepreneurial resources, has to decide (i) how much of his supply of factors he shall dispose of, (ii) how much of the income so secured he will spend on each kind of commodity. These decisions must be made in one way by assuming a given system of prices and scale of preferences. Therefore, Hicks assumes that it is possible to determine private individual's demand for commodities and supply of factors.

The entrepreneur who possesses both entrepreneurial resources and disposable factors has to make similar decisions on his private account. At given prices, his income is derived from his surplus and supply of factors. Hence, his demand for commodities can be easily calculated since his income is determined.

The income of entrepreneur who possesses two kinds of resources -
entrepreneurial and disposable - is derived from his surplus and the supply of factors. Hicks distinguishes between four kinds of markets: (1) the markets for products, where demand comes from private account and supply comes from the business accounts of entrepreneurs; 2) markets for factors, where demand comes from firms, supply from private accounts; 3) markets for direct services, where supply and demand both come from private account; 4) markets for intermediate products which are products for one firm and factors for another. In this case both supply and demand come from the firm. In all kinds of markets, however, supply and demand are determined once the price system is given. It is of interest to note that Hicks has mentioned three drawbacks from which this system suffers. First, it pays no attention to monopoly and imperfect competition. Secondly, it abstracts from the economic activity of the state. Last but not the least, it abstracts from capital, interest, saving, investment and speculation.

**Temporary Equilibrium**

Hicks also discusses the temporary equilibrium of the whole system. Temporary equilibrium implies that current demands and supplies have been rendered equal. They consist of equations of supply and demand for goods and services of every sort, for securities and for money. We will analyse what happens when there are disturbances in some of the variables (datas) of temporary equilibrium like given tastes, resources and expectations. The theory of temporary equilibrium does not include the ultimate dynamic problems, but it is not therefore devoid of direct practical application. The prac-
tical problems which have to be considered under the heading of temporary 
equilibrium are controversial issues as the effects of savings and investment 
on the rate of interest, and the effects of general changes in money wages. 
Temporary equilibrium system is simply an extended system of multiple 
exchange. The following conditions are necessary for a system of mulitiple 
exchange to be perfectly stable. A rise in the price of any commodity must 
make the supply of that commodity exceed the demand (a) if all other prices 
are given, (b) if some other prices are adjusted so as to preserve equality 
between demand ans supply in their respective markets, (c) if all other prices 
are so adjusted. If the last of these conditions is not satisfied the system 
is not stable at all, but will break down at the slightest disturbance. If some 
of the stability conditions are not satisfied, though other conditions are, then 
the system will be imperfectly stable. It is stable in the end, so it does not 
break down.²

Trade Cycles

A Contribution to the Theory of the Trade Cycle marked Hicks' first attempt 
at equilibrium dynamics, building on the Harrod-Domar growth model and 
Samuelson's interaction of the multiplier and accelerator. Acoording to Hicks, 
there are four phases of a trade cycle viz., (1) Recovery, (2) Full Boom, 
(3) Downswing and (4) Depression. He has pointed out that "the theory of 
the multiplier and the thoery of the accelerator are the two sides of the theory 
of fluctuations, just as the theory of demand and the theory of supply are
the two sides of the theory of value." He distinguishes between two types of investment - 'induced investment' and 'autonomous investment'. Induced investment in fixed capital can generally be thought of as depending upon changes in actual output; for the output which can be produced from a given equipment is capable of some variation within the Marshallian short period. For the induced investment in working capital comes before the actual rate of output change, it occurs in response to a change in demand, and is part of the process whereby supply adjusts itself to demand. Public investment which occurs in direct response to inventions, and much of the long-range investment which is only expected to pay for itself over a long period, all of these can be regarded as autonomous investment. So far as the limits of cyclical fluctuations are concerned, the upswing is the result of the combined action of the multiplier and accelerator, the downswing is largely a product of the multiplier alone. However, there are certain limitations of his trade cycle viz., a) He assumed fixed value of multiplier in different phases of cycles and (b) He does not explain the psychological forces arising from the future uncertainty and expectations which play an important part in a dynamic capitalist economy.

In the monumental work of Hicks *Capital and Growth*, he developed well-known contrast between fix price and flex price markets and stocks and flows equilibrium concepts: when prices are constant, quantities of goods and services can be added by adding their money values; money values become volume indexes. It is called 'fix prices method'. This method has an inherent
tendency to 'go macro'; a tendency which there is now much experience to confirm. The temporal equilibrium method is generally known as 'flex-price method'. The products of manufacturing industry have a greater durability is referred to as flex price. Stock equilibrium is an equilibrium at a point of time; in accounting terms, it is an equilibrium of the balance-sheet. If a unit is in stock equilibrium at the beginning of the period, and is still in stock equilibrium at the end, it is then in flow equilibrium during the period. Flow conditions include that production should just cover consumption demand plus the required investment.

To conclude, Hicks discusses three types of equilibrium namely, exchange equilibrium, general equilibrium and temporary equilibrium. He gives credit to Walras as the creator of the Theory of Exchange Equilibrium. In his opinion general equilibrium of production is more applicable than his equilibrium of exchange. He too introduces four kinds of markets viz. markets for products, factors, direct services and intermediate products. In these markets, if the prices are given, the demand and supply is easily calculable. Hence, he can be placed reasonably in the first rank of modern theorists.

GERARD DEBREU

Life Sketch

Gerard Debreu was born in 1921 in France. He took his Graduation from the University of Paris in 1946. He became Professor of Economics
and Mathematics at the University of California, Berkeley. He was the President of the Econometric Society from 1969 to 1971, a Fellow since 1970 of the American Association of the Advancement of Science. He received honorary degrees from a number of Universities, viz. Universities of Bonn (1977) and Lausanne (1980). The Royal Swedish Academy of Sciences announced Nobel Prize for him in 1973 for his three decades of distinguished service. While announcing Nobel Prize for him, the Chairman of the five-member Nobel Committee, Asar Lindbeck commented, "we have never before awarded the Prize of contributions of such pure basic research".

**His Work**

In 1959, he published his masterpiece, *Theory of Value: An Axiomatic Analysis of Economic Equilibrium*. The book contains 102 pages with mathematical formulae, i.e. application of set theory and topology. The contribution of this book consists in a rigorous, axiomatic, and formal analysis of producer behaviour, consumer behaviour, general equilibrium, and the optimality of the market mechanism for resource allocation.

**His Contribution**

Debreu has created a model of a theoretical market place and has provided an analytical framework for some of the most tenents of classical economics. Adam Smith published his masterpiece, *Wealth of Nations* in 1776. Since then economists believed that the conflicting interests of the producers
and consumers can be easily reconciled through the price mechanism. There will be equilibrium between demand and supply. The best explanation which Smith could offer was that individual economic agents were guided by the idea of common good. In this connection, we can quote him, "They are led by an invisible hand to make nearly the same distribution of the necessaries of life which would have been made had the Earth been divided into equal portions among all its inhabitants, and thus without intending it, without knowing it, advance the interest of the society, and afford means to the implication of the species".⁵

**Equilibrium**

Debreu's chief contribution was to make invisible hand somewhat more discernible. In his classic *Theory of Value* he showed that an economy is defined by \( m \) consumers (characterised by their consumption sets and their preferences), \( n \) producers (characterised by their production sets), and the total resources. A state of the economy is specification of the action of each agent, and a state is said to be attainable if the action of each agent is possible for him and if their \((m + n)\) actions are compatible with the total resources.⁶ He called this state of the economy as a general equilibrium in which supply equals demand in every market and where there is neither shortages nor surplus of any product. Debreu and Kenneth Arrow co-authored an epoch-making paper 'Existence of an Equilibrium for a Competitive Economy' (1954), in which they provided a definitive mathematical proof of the existence
of general equilibrium, using topological methods hitherto unknown in economics. They assume that in their model the producers, distributors and consumers each attempts to maximise their own economic welfare by manipulating prices and other factors of production such as land, labour and capital. Debreu believed that in the theoretical world equilibrium can be attainable. He was confirmed to the internal logical consistency of the classical view of markets.

To attain the results, Debreu had to assume an ideal world of flexible prices and unfetted competition. He stated that an optimum is "an attainable state such that within the limitations imposed by the consumption sets, the production sets, and the total resources of the economy, one cannot satisfy better the preferences of any consumer without satisfying less well those of another". If an attainable state of an economy is an optimum, there is a price system relative to which the state is an equilibrium. "When an attainable state is not an optimum, it is possible, by suitable changes in productions and consumptions, to satisfy better the preferences of at least one consumer without satisfying less well those of any other".

According to Karl Goran Maler, a member of the Royal Academy both the World Bank and International Monetary Fund use models that are based on Debreu's work, and the economic political planning in many nations is also, to a great extent built directly on Debreu's efforts. Even the Nobel Laureates like James Tobin and George Stigler have been influenced by his contribution. His equilibrium theory is used by private forecasters and government planners
to predict such things as the impact of a tax charge on various industries.

General equilibrium theories are applicable in all branches of modern economics. If a general equilibrium model possessed a solution, one can confidently employ general equilibrium analysis. The proofs of the existence of a general equilibrium solution based on certain restrictive conditions, and these conditions may throw light on the way in which multi-markets equilibrium is actually attained in the real world. Of course, the contribution of Arrow-Debreu illuminates some aspects of real world competition. Debreu also wrote a large number of technical papers on 'existence theorems', seeking to relax the stringent assumptions required to prove the existence of general equilibrium under competitive conditions. He also addressed the quite separate question of the speed of which actual economics converge on a general equilibrium solution.

In conclusion, it may be stated that Debreu has tried to modify Adam Smith's invisible hand according to which the conflicting interests of producers and consumers are reconciled through the price mechanism. But Debreu proved this concept in a different way. In his model of topology, producers, distributors and consumers maximize their welfare by manipulating prices and other factors of production like land, labour and capital. Debreu's works include a number of major innovations with practicable application.
LAWRENCE L. KLEIN

Life Sketch

Klein was born in Omaha, Nebraska in 1920. He graduated from the University of California, Berkeley in 1942 and received his Ph.D. from the Massachusetts Institute of Technology in 1947. His Doctoral thesis 'The Keynesian Revolution' is an early study of the process whereby Keynes had moved from the arid formulas of his Treatise (1930) to the more promising line of advance in his General Theory (1936). Klein did Post-doctoral research at the University of Chicago, then joined the University of Michigan. Klein was associated with the Brookings Econometric Model Project, the largest econometric model that has ever been constructed for any economy. He was awarded the Nobel Prize in Economics in 1980 for his pioneering contribution of econometric models and their application to the analysis of economic fluctuations and economic policies. The American Economic Association award him the John Bates Clark Medal in 1959. He was President of the Econometric Society (1960), the Environmental Economics Association (1975) and the American Economic Association (1977). He is popularly known as the "Father of Econometrics".

His Works

His works include The Keynesian Revolution (1947), Economic Fluctuations in the United States, 1921-1941 (1950), Textbook of Econometrics (1953),

His Contribution

Lawrence R. Klein states that Keynes accepted the classical theory for the case of equilibrium in his Treatise, Keynes wrote that in equilibrium, i.e. when the factors of productions are fully employed, when the public is neither bullish nor bearish of securities and is maintaining in the form of savings - deposits neither more nor less than the normal proportion of its total wealth, and when the volume of savings is equal both to the cost and to the value of new investment, there is a unique relationship between the quantity of money and the price levels of consumption goods and of outputs as a whole, of such a character that if the quantity of money were double the price levels would be double also.\(^9\)

Classical economists were mainly concerned with long run equilibrium analysis whereas Keynes dealt with the problem of economy with short-run equilibrium analysis. He remarked "in the long-run we are all dead". In the same way, classical economists assumed wage flexibility in order to attain full employment. But Keynes did not believe that full employment is automatically assured; within the framework of Keynesian economics wage flexibility does not correct unemployment and leads to merely to hyper-deflation,
if carried to its logical conclusion. But in the real world one observes neither hyper-inflation nor full employment. The explanation is that wages are sticky; they are not flexible. The solution to the Keynesian system which gives a value of employment not on the supply schedule persists when wage cut do not occur. Because workers do not bid against one another, we do not experience the 'hopeless' downward spiral.

Keynes did not invent anything new but said something quite different from what his contemporary economists used to explain. Keynes' *The General theory of Employment, Interest and Money*, was based on three components, viz. 1) the propensity of consume (save), 2) marginal efficiency of capital and 3) liquidity preference. His contemporary economists had not used these three components.

According to Klein, the primary contentions of Keynesian theory as set down in his book *The Keynesian Revolution* can be summarised in a form that gives us scientific agreement in terms of reference. The Keynesian system is:

1) A theory of the determination of total income (output or employment),
2) A theoretical explanation of the possibility of under-employment equilibrium.
3) A group of doctrines in public policy about how to control the economy at desirable levels of economic activity.
4) A long-run view on the historical trend of capitalism.
General Theory

General theory deal with a static model. The world is dynamic and no static model will give a widely applicable representation of it. After the Second World War, when the Keynesian model was naively applied to the events of the period, it was usually found that there were major factors not accounted for in the simple model that had determined the course of the economy. The model needs substantial amplification for reaching the whole truth. At present, it can be classed as containing "causal empiricism". The Keynesian idea of the existence of a basic psychological law establishing a relationship between aggregate consumption and aggregate income, with slope less than unity, needs obvious extension to account for taxes, transfer payments, income distribution, lags, relative prices and possibly wealth.

Investment

Keynes paid little attention to two types of investment which play a important role in recent economic fluctuations. They are residential construction and inventory investment. Resident construction merits separate treatment in disaggregation because it is strongly influenced by its own demographic factors and may receive special form of public support. Inventory investment may follow familiar lines of stock-adjustment theories, but its adjustment parameters imply a very different lag, one that gives rise to short business cycles of less than four years' duration. Speculative variables of price-level change and interest rate change may also be peculiar to inventory
investment. These, then, are compelling reasons for some disaggregation of investment beyond that originally given by Keynes. Followers of Keynes were quick to investigate these specific type of investment, but it must be recognised that the theory needs extension to include these in a consistent and fully determined manner.\textsuperscript{11}

Keynes attributed passive role to consumption function because of the decline of marginal efficiency of capital in the long run. Marginal efficiency of capital has been defined by Keynes as "being equal to the rate of discount which would make the present value of the series of annuities given by the returns expected from the capital asset during its life just equal to its supply price.\textsuperscript{12} The pessimistic outlook for investment cannot be justified by recent events, either in the industrialised economics of the United States and Western Europe or in the newly developing countries. New discoveries will not be stopped in dynamic world. As a result of new discoveries, there will be new investment opportunities and hence it is not necessary that marginal efficiency of capital will decline in the long run.

\textbf{Liquidity Preference Theory}

The doctrine of liquidity preference theory may be defined as the preference or desire to hold money in liquid form or in cash. Keynes mention four motives which provide an incentive to liquidity viz., 1) income motive, 2) business motive, 3) precautionary motive, and 4) speculative motive. According
to Klein, this theory is not application to a complicated money market. There are three lines of development, Klein said, that need to be followed to make this theory workable:

1) More assets or debts instruments must be considered - bills, bonds, equities, cash, savings accounts, and goods.

2) More classes of holders must be considered - private households, non-financial companies, private banks, non-bank financial institutions, foreigners, central bank and public treasury, and

3) A supply theory of money must be developed.

Keynesian economics is sometimes referred to as the economics of depression situation, Keynes published his General Theory (1936) after the Great Depression of 1930's and it is wrong to assume that he was in support of either inflation or deflation. We can quote him in this regard, "Inflation is unjust and deflation is inexpedient". Klein argued that Keynesian revolution need not be discarded on the simple pretext of depression economics, rather they must receive elaboration be extended to handle more complex situations. We must realise that Keynesian economics will admit full employment or over employment as legitimate solutions to the equations as well as infinite number of underemployment solution.

It may be pointed out in conclusion, that Klein found out both the merits and demerits of the Keynesian Theory of Employment, Interest and Money.
Keynes' 'Psychological Law of Consumption Function' did not take into account taxes, transfer payments, income distribution and relative prices. In order to make the 'Liquidity Preference Theory' workable in contemporary period, it is necessary to make some addition like more assets or debts, more classes of holders and a supply theory of money. Thus besides clarifying Keynesian economics Klein also analyses equilibrium in a dynamic model.

ROBERT M. SOLOW

Life Sketch

Born in New York City (1924), Robert M. Solow obtained his Graduation in 1947, received his M.A. in 1949 and took his Ph.D. degree at Harvard University in 1951. He won the John Bates Clark Medal of the American Economic Association in 1961. He also became President of the Econometric Society in 1964 and the American Economic Association in 1979. He was awarded Nobel Prize in Economics in 1987.

His Works

His works consists of Capital Theory and the Rate of Return (1963), Growth Theory : An Exposition (1969), and Linear Programming and Economics Analysis (1958) co-author with Dorfman and Samuelson.
His Contribution

Stylized Facts

Solow states that in 1958 Nicholas Kaldor summed up six 'stylised facts' for a model:

1) Real output per man (or per man hour) grows at a more or less constant rate over fairly long periods of time. Of course, there are short-run fluctuations as well as even changes from one quarter to another,

2) The stock of real capital growing at a more or less constant rate, exceeds the rate of growth of labour input,

3) The ratio of capital to output shows no systematic trend since the rate of growth of real output and similarly the stock of capital goods remain the same,

4) The rate of profit on capital has a horizontal trend, of course, there will be occasional violent changes associated with sharp variations in effective demand,

5) The rate of growth of output per man can vary quite a lot from one country to another, and

6) Economics with a high share of profits in income tends to have a high ratio of investment to output. Solow admits that according to the third and fourth stylized facts, the share of profit in total income will be constant
in the process of economic growth. An economy growing in the lines of either three or four above rules in now-a-days termed 'steady state'. Its output, employment and capital stock grow exponentially and its capital-output ratio is constant. A steady state can be defined as that state in which output and employment be growing at some constant proportional rates and net saving and investment be a constant fraction of output. Steady state growth, constant saving rate, constant capital output ratio, accompanied by only limited fluctuations of the unemployment rate and the capacity utilisation rate, should be a rare state of affairs, except in planned economics.

The total output of an economy depends on the volume of employment, given the inherited stock of capital that is saved from the past outputs. Solow assumes that the economy's production possibilities are subject to constant returns to scale in its two homogeneous factors of production, labour and capital. The volume of employment will produce more output one year later than it would have done one year earlier. When employment is very low for a given stock of capital, the capital-output ratio is very high, perhaps infinitely high. When employment is very high for a given stock of capital, the capital-output ratio is very low. He also considers two alternative theories of saving. In the case of the first one he postulates fixed saving ratios from wage and profit income, a larger one from profits than from wages. The aggregate saving rate is thus a weighted average of the two elementary saving rates. Alternatively, the aggregate saving rate is equal to the saving rate from wages plus the extra saving from profits, which is the difference between
the two savings rates multiplied by the share of profits, the proportion of income subject to the extra saving. Now the share of profits in income is the rate of profit times the capital output ratio. It is adequate if we merely assume that profits increase (or do not decrease) with employment, given the stock of capital, so that in a free-scale economy, the rate of profit is higher (or no lower) the higher the ratio of employment to capital. Any theory of saving that deals with the saving rate and depending only on the variables of the model the capital-output ratio, the labour-capital ratio, the return on capital can be handled in the same way. If the stock of current wealth is larger, the current saving rate is lower. Employment growth will be less as compared to the growth of output and the capital stock.

In the preceding discussion, we have excluded two important factors in our model, i.e. technological progress and increasing returns to scale. Owing to the technological progress, capital and output both rise through time faster than employment. Continuous innovation could stave off the effects of diminishing returns, which otherwise bring any such process to a halt. Increasing returns to scale could do the same. The steady enlargement of the economy could offset diminishing returns and permits a continuous rise in capital and output per man. Under constant returns to scale, output has to grow at the same rate as both capital in natural units and capital in efficiency units. Progress is both labour and capital augmenting. If the economy maintains full employment with a constant fraction of output save and invested, the capital-output ratio will persistently rise and the rate of profit will persistently
fall. If the economy wishes to maintain a constant rate of profit and constant capital-output ratio, it must save and invest a persistently decreasing fraction of its output.

In a model without direct substitution, Solow describes that in a planned economy, maximisation of output is possible by fuller utilization of industrial capacity. The economy will try to employ its total working force by creating newest capacity. The economy also could increase output by shifting labour from the older to the newest capacity from a factory will lower output per man to a factory with higher output. A competitive profit-maximising economy with flexible real wages follow the same pattern. An old factory would be operated only if the real wages were less than or equal to its output per man. If the real wage exceeds its output per man, the factory will be closed down. Let us analyse the history of a single factory. When the factory is new, it earns profits which is equal to the difference between its productive capacity and its wage bill. But when the real wages increase because of technological progress and the competition of newer and more efficient factories, its wage bill rises and its profit will diminish. Eventually, the wage rises as high as the output per man in this factory and it has become the marginal no-rent factory. Sometimes a factory loses its efficiency during its life time regardless of the wage.

An economy with a capital market can be in equilibrium only if the existing supplies of money and real capital find a welcome place in the consoli-
dated balance sheet of the private economy. Solow assumes money market to be always in equilibrium, with a constant rate of inflation. Let us suppose that due to some unforeseen reason, there is a decrease in the rate of inflation. Slower inflation implies a reduction in the opportunity cost of holding money. To maintain money-market equilibrium, there must be an increase in the ratio of money supply to value of output. The normal way for this to come about is that individuals attempt to increase their own holdings of money or government debt by selling off commodities. The economy as a whole can change neither its stock of money nor its stock of capital. But the excess demands for money can deflate the price level and restore money market equilibrium by reducing the money value of capital.

Solow published a number of papers, among them, the two papers are notable. These two papers are on 'A Contribution to the Theory of Growth' and 'Technical and Aggregate Production Function'. His articles laid the basis for what was later to develop into "growth accounting". The articles established a mathematical relationship between production on the one hand and factors such as the introduction of new technology, labour and investment on the other.

It may be concluded that Solow demonstrated that only a small proportion of annual growth could be explained by an increase in labour and capital. The key factor was always technology. Solow's contribution is classified into the equilibrium economics because his output rests on dynamic analysis, i.e.
introduction of new technology in production system. Thus his contribution is indeed an advance in economics of equilibrium.

PAUL ANTHONY SAMUELSON

Life Sketch

Samuelson was born in 1915 in Gary, Indiana. He received his Doctorate degree from Harvard University at the age of twentysix. He was the President of the Econometric Society (1953) and the American Economic Association in 1961. He was the first American economist to receive the Nobel Prize (1970) in Economic for his influential and widely read works, which have raised the level of scientific analysis in economic theory.

His Works

His main works are Foundations of Economic Analysis (1947), Economics (1948), Linear Programming and Economic Activity (1958) coauthor with Robert Dorfman and Robert Solow.

His Contribution

His natural gift for economics was astonishing; most of his Foundations of Economic Analysis was written in 1937 when he was a 22-year old graduate student at Harvard. He has contributed to the field of microeconomics, macro-
economics, welfare economics, international monetary theory. He said that "turnpike theorems and osculating envelopes; non-substitutability relations in Minkowski-Ricardo-Leontief-Metzler matrices of Mosak-Hicks type; balance-budget multipliers under conditions of balanced uncertainty in locally impacted topological spaces and molar equivalences". Samuelson regards economics not as a bourgeois science but as a science essentially of the bourgeoisie. "Economics" he says, "seems to decay under a nonbourgeois society". He notes that when two men whom he admired as creative and productive scholars, the economists Oskar Lange and Michal Kalecki, returned to communist Poland and Czechoslovakia after the Second World War, neither did scientific work comparable to what each had done earlier as refugees in the capitalist West. And Samuelson is not impressed with the Soviet Economists he meets, "unless they are simply applied mathematicians, in which case they can be extremely good, as in probability theory".

Comparative Statics and Equilibrium

Samuelson made the distinction between two concepts, i.e., comparative statics and equilibrium. The former implies the investigation of changes in a system from one position of equilibrium to another without resort to the transitional process involved in the adjustment. The latter means only the values of variables determined by a set of conditions, and no normative connotation attaches to them. The general problem of comparative statics deals with how from a knowledge of the qualitative and quantitative properties
of equilibrium conditions, it is easy to deduce meaningful theorems concerning the direction and magnitude of changes in our variables which certain data change. Samuelson also state that Pareto laid basis for comparative statics. His contribution was not rich in definite theorems in this subject. Because he rarely concerned himself with the secondary inequalities relevant to maximum positions. On the few occasions when he did so, he came to grief in their statement. This concept was further developed by a number of notable economists viz. W.E. Johnson, Slutsky, Hicks and Allen, Georgescu-Roegen, Hotelling, etc. The usefulness of the notion of equilibrium conditions from which emerges our solution lies in the fact that by so doing we often gain knowledge concerning possible and necessary responses of our variables to changes in data. Without such restrictions, our theories would be meaningless. The method of comparative statics consists of the study of the responses of our equilibrium unknown to designated changes in parameters.

Samuelson also discussed that according to general method involved the equilibrium of our variables can be regarded as the solutions of an extremum (maximum or minimum) problem, it is often possible regardless of the number of variables involved to be determined unambiguously the qualitative behaviour of our solution values in respect to change of parameters. If the equilibrium of a system is determined by extremum conditions where all unknown are independently, variable, the addition of auxiliary constraints (satisfied by the equilibrium position) will leave the equilibrium unchanged.
The comparative statics show the determination of the equilibrium values of given variables (unknown) under postulated conditions (functional relationship) with various data (parameters) being specified. Sometimes it is stated that an equilibrium is stable if a displacement from equilibrium is followed by a return to equilibrium. A displacement is equivalent to an arbitrary change in the initial conditions and is possible only if some of our functional equations are momentarily relaxed or if our system is enlarged to include impressed forces or shocks.

In his contribution, Samuelson discussed about Hicks concept of equilibrium. According to Hicks, for a single market, equilibrium is stable if an increase in demand raises prices. For multiple markets, equilibrium is imperfectly stable if an increase in demand for a single good raises its price after all other prices have adjusted themselves; the equilibrium is perfectly stable if an increased demand for a good raises its price even when any subset of other prices is arbitrarily held constant.

A system is dynamical if its behaviour over time is determined by functional equations in which "variables at different point of time" are involved in an essential way. Samuelson borrowed this concept from Professor Ragnar Frisch. Comparative dynamics included (i) a change in initial conditions, (ii) a change in some force actions in the system, i.e. autonomous investments vary (iii) there may be a change in some internal parameters of the system.
Samuelson also contributed numerous papers, articles of international repute. He remarked on January 2, 1932, that he was "born as an economist".

It may be concluded that Professor Samuelson beautifully explains the concepts of 'comparative statics' and 'equilibrium'. His analyses are mainly based on equilibrium economics. He can be placed in the rank of modern theorists.

In the end of our analysis of the contribution of the six economists to the advances of the economics of equilibrium, it may be said that they all believe that in the modern world the economic system is purely dynamic. Nothing is constant. Labour, capital, techniques of production, organisation, tastes and preferences of consumers vary from one period to another and from one region to another. Hence, Economics should be studied with dynamic equilibrium concept.

While the disequilibrium economists have diverted our attention to the importance of disequilibrium in economic theory as discussed in the last chapter, the six economists cling to the importance of equilibrium analysis. Thus there is a need to strike a balance between the two opposing stands.
Notes and References


4. ————, (1965), Capital and Growth, Oxford University Press, p.78.


7. Ibid., p.90.

8. Ibid., p.91.


11. Ibid., pp.204-205.


16. Ibid., p.4.