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# The contribution of several Nobel Laureates in the development of the Theory of general economic equilibrium

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*Nobel Laureates with their contributions to the development of the theory of general equilibrium have enabled this theory to be one of the most important for theoretical and practical analysis of the overall economy and the efficient use of economic resources.*

*Results of the research showing that contributions of Nobel Laureates in the economy belong to two main frameworks of development of the general equilibrium theory: one was the mathematical model of general equilibrium developed by John R. Hicks (1939), Kenneth J. Arrow (1951) and Gerard Debreu (1954) and second frames of general equilibrium belongs to Paul A. Samuelson (1958).*

*To highlight the contributions of these Nobel laureates in the development of the theory of general equilibrium have been selected and are presented in the paper some views, estimates and assumptions that have contributed not only in solving concrete problems, but also to the development of economic science in general.*

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*Their works represent a synthesis of theoretical and practical aspects of treatment of general equilibrium which are the starting point for further research in this field.*

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### **Introduction**

The development of the Theory of general economic equilibrium, had as its starting point the publication of french economist Leon Walras (1834-1914), but in the Walras's publications were included some views of Adam Smith (1776).

According to Adam Smith's explanation, the economic agents which are as individuals, firms, and government, with their own independent decisions do not create chaos, but they have affect in achieving a social optimum. Attempts to answer this question have encouraged the study of a variety of problems that need to solve every economic system like: the problem of efficient use of economic resources, decentralization of decision-making, the creation of incentives for decision-makers and the treatment of information (Pano and Angjeli, Prize Lectures (2) 2004, Debreu 1983).

Walras in his publication "Elements of Pure Economics" (1874) explained that all prices and quantities are determined simultaneously with the mutual interaction of one another. This publication provides a series of models that contain many aspects of the real economy (goods, production, growth, wages).

Walras created a system of simultaneous equations, presenting the consumer demand for goods, producers supply of goods and conditions of equilibrium when the supply is equals to demand in every market. Assuming that each customer is behaving in a way that maximizes their utility, every manufacturer attempt to maximize

profit and full competition prevails in the sense that the producers and consumers depend on the price that is independent by their personal choice. However, Walras did not give arguments to show that the equations that are given have solutions.

Later on with the development of more sophisticated mathematical techniques in XX century, Arrow and Debreu have shown that Walras was correct in his conclusion (even if not in his argument), while customer preferences were convex.

However, Walras created an important research program which was continued by many other economists, some of whom are rewarded with the Nobel Prize for their contribution to the development of the theory of general equilibrium. The contributions of these Nobel laureates enabled the theory of general equilibrium to be one of the most important for theoretical and practical analysis of the overall economy and the efficient use of the economic resources.

The contribution of several Nobel Laureates in the development of the general equilibrium theory

Issues covered by the Nobel laureates in economic sciences are different, like their views differ for the same area. Their contributions enable us to become acquainted with the controversy developed in the field of development of the economic science and the concrete problems that concerned the world economy.

It is not easy to make classification of the contributions of Nobel Prize laureates, because many of them have contributed to more than one field or scientific problem. However, specialized researchers think that the most important contributions of economists in the fields of economics, who were honored with the Nobel Prize belong to these main areas:

- ✓ General Equilibrium Theory
- ✓ Macroeconomics
- ✓ Microeconomics
- ✓ Interdisciplinary Research,

✓ New methods of Economic Analysis

According to the results of research, Nobel laureates who have contributed in the development of economic science are presented in the following table.

**Table 1.**  
**Classification of the Nobel laureates who have contributed in the development of economic science (1969-2005)**

<b>General Equilibrium Theory</b>	<b>Macroeconomics</b>	<b>Microeconomics</b>	<b>Interdisciplinary Research</b>	<b>New Methods of Economic Analysis</b>
<b>Samuelson, 1970</b> <b>Hicks, 1972</b> <b>Arrow, 1972</b> <b>Debreu, 1983</b> <b>Allias, 1988</b>	Friedman, 1976 Meade, 1977 Ohlin, 1977 Lewis, 1979 Schultz, 1979 Klein, 1980 Tobin, 1981 Modiglian, 1985 Solow, 1987 Lucas, 1995 Mundel, 1999 Kydland, 2004 Prescott, 2004	Stigler, 1982 Markowitz, 1990 Miller, 1990 Sharpe, 1990 Mirrleee, 1996 Vickrey, 1996 Merton, 1997 Scholes, 1997 Stiglitz, 2001 Spence, 2001 Akerlof, 2001	<u><b>Economics with political science</b></u> Buchanan, 1986  <u><b>Economics and sociology</b></u> Becker, 1992  <u><b>Economics, Law and organization</b></u> Simon, 1978 Coase, 1991  <u><b>Economics and history</b></u> Kuznets, 1971	<u><b>Econometrics</b></u> Tinbergen, 1969 Frisch, 1969 Haavelmo, 1989 Heckman, 2000 Mc Fadden, 2000 Eangle, 2003 Granger, 2003  <u><b>Theory of optimal allocation of resources</b></u> Leontief, 1973 Kantorovich,

			Fogel, 1993 North, 1993 <u><b>Economics and philosophy</b></u> Hayek, 1974 Myrdal, 1974 Sen, 1988  <u><b>Economics and psychology</b></u> Kahneman, 2002 Smith, 2002	1975 Koopmans, 1975 Stone, 1984  <u><b>Game theory</b></u> Harsanyi, 1994 Nash, 1994 Selten, 1994 Aumann, 2005 Schelling, 2005
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So, several Nobel Laureates that have contributed in the development of the General Equilibrium Theory are as follows:

**Paul A. Samuelson** was the first American economist who won the Nobel Prize (1970) "for the scientific work through which he has developed static and dynamic economic theory and actively contributed to raising the level of analysis in economic science";

**John R. Hicks** dhe **Keneth J. Arrow** (1972)"for their pioneering contributions to general economic equilibrium theory and welfare theory";

**Gerard Debreu** (1983) "for having incorporated new analytical methods into economic theory and for his rigorous reformulation of the theory of general equilibrium";

**Maurice Allais** (1988) “for his pioneering contributions to the theory of markets and efficient utilization of resources” (The Sveriges Riksbank 2016, Mustafa 1997).

The contributions of Nobelists, as previously mentioned, cover two frameworks of the general equilibrium theory: one was the mathematical model of general equilibrium developed by John R. Hicks (1939), Kenneth J. Arrow (1951), Gerard Debreu (1954) and McKenzie (1954) and second frames of general equilibrium belongs to Paul A. Samuelson (1958) that seems more suited to the study of monetary issues (Lucas 1995, Dymond 2015).

The contributions of the Nobel laureates in the development of the general equilibrium theory have dealt with the analytical structures of theoretical economic models, often highlighting the formal similarity of these structures, and clarifying the conditions for consistency, equilibrium, stability and efficiency of the economic system. These contributions also have included important comparative static experiments, i.e., analyses of how equilibrium positions change in response to changes in various exogenous factors (Lindbeck 1999, Levinovitz and Ringertz 2001, Pano and Angjeli 2003).

### **John R. Hicks**

Hicks have been a key figure of the economic science in the twentieth century. Regarding his contribution, Nobel laureate Paul Samuelson (2001) wrote that “Hicks was one of the last of an almost extinct species of scholars: a generalist who covered microeconomics and macroeconomics, mathematical economics and literary economics, pure theory and policy applications” (Puttaswamaiah 2001).

The first Hicks’s contribution to the economic theory was “*Classics*” article ([1937] 1967) where he reduces and simplifies the central theoretical message of Keynes’s General Theory to a short set of simultaneous equations and a single graph that became the cornerstone of macroeconomics (De Vroey 2004). Through the IS-LM graph is enabled to more easily understand the arguments of

Keynes given in his *General Theory of Employment, Interest and Money* (1936) like how an economy could be in equilibrium with less than full employment.

Hicks has used this model to investigate assumptions regarding investments, savings and also supply and demand for money (Xhelili 2007). This has become an alternative framework widely accepted from the analysis of Keynesian standards.

Another important contribution of the Hicks to the theory of general equilibrium is his book *Value and Capital* (1939; second edition 1946), which spearheaded the revival of Walrus's theory, and where, he introduced the temporary equilibrium framework (De Vroey 2004).

Hicks noted that there were shortcomings in the Walras's treatment of general equilibrium and defined the ways of overcoming them, taking into account the "laws of change" of a general equilibrium system. For this, Hicks first does the analyzes of the conditions for multimarket stability known as a "*Hickian Stability*". These conditions of general equilibrium (which mathematically formulated with a whole system of equations with the quantities and prices of goods of different markets) based on the law of supply and demand shows that stability in a market depends on the conditions of other markets.

In addition, Hicks in his later publication from the static equilibrium analysis moved to the study of economic dynamics, linking the equilibrium with the problem of economic growth. He makes differentiations between the concept of *temporary equilibrium* from *the long-term equilibrium* and gives an idea of the impact of current market conditions in future situations, through the concept of expectations of economic agents participating in the economic activity.

He also initiated rigorous dynamic analysis of capital accumulation. Because it was deeply anchored in microeconomic theories of the behavior of individual consumers and firms, the models developed by Hicks offered far better ways to study the consequences of changes in

various parameters than did earlier general equilibrium models such as Léon Walras' general equilibrium system of equations.

### **Paul A. Samuelson**

Paul Samuelson has contributed in many areas of the economic theory. On the occasion of receiving the Nobel Prize, Samuelson has noted that "actively contributed to raising the level of analysis in economic science" which means that Samuelson's publications were not only a continuation of the Hicks, but he has in fact rewritten considerable parts of economic theory: microeconomic theory, static and dynamic, partial and general equilibrium theory, as well as welfare-economics. (Lindbeck 1999, Levinovitz and Ringertz 2001).

His *Foundations of Economic Analysis* (1947) provides the basic theme of his work, with the universal nature of consumer behavior. Samuelson studied different fields such as incorporation of the theory of international trade into that of general economic equilibrium, welfare economics, dynamics and stability of economic systems, the analysis of public goods, capital theory, and public expenditure. (Duignan 2013).

Samuelson is known for analyzing the multiplier and accelerator effects (The multiplier-accelerator model) in the macroeconomic field and the analysis of consumer Revealed preference theory in microeconomics. While Keynes have explained the growth of national income and employment through multiplier effect of investment (mainly public investment), supporters of the accelerator effect showed how changes in the level of current income will have an accelerated impact on the level of investment.

The possibility of combining the multiplier effect and the accelerator in a unique model of economic growth and employment, Samuelson explains very simply in the textbook called "Economics", by the graphic angle 45 degrees. The combination in a single multiplier model (investment) and accelerator (consumption) is one of the greatest merits of Samuelson.



Problems of equilibrium and stability, Samuelson studied closely related with the analysis of the economic dynamics, as in each market, as well as on the overall economy. For all these problems was clearly based on the laws of supply and demand. Regarding his contributions in the study of general equilibrium conditions the more important are considered *Non-substitution theorem* and *factor-price equalization*.

With this theorem he showed under what conditions international trade results in an equalization of the factor rewards between countries engaged in international trade. Here Samuelson followed up a line of research started by Eli Heckscher and Bertil Ohlin (A. Lindbeck 1992) For small countries, non-substitution theorems, like factor price equalization theorems, are of great practical usefulness because they simplify general equilibrium comparative statics. The simplifications made possible by a non-substitution theorem are as useful as those that would follow from a factor price equalization theorem (Bergstrom 1996).

Samuelson's model in which he takes the example of the economy, in which money plays a crucial role in the economic life, is also used by the Nobel laureate Robert Lucas (1972) in his publications. The model is very simple and flexible and can be used to illustrate many issues (Lucas 1995).

### **Kenneth J. Arrow and Gerard Debreu**

Arrow's and Debreu's main contributions to general equilibrium theory were to achieve greater generality by applying more powerful mathematical methods. The generality allowed them to define the concept of a good so broadly that the same theory can be used in static equilibrium analysis and also in analysis of the spatial distribution of production and consumption activities, intertemporal analysis and the analysis of decision-making under uncertainty (Lindbeck 1999).

The contributions of these two Nobel laureates to general equilibrium theory can be found in the mathematical model presented in the paper "*Existence of Equilibrium for a Competitive Economy*" (Arrow and Debreu

1954), in literature known as "*Arrow-Debreu model of general equilibrium*". In this model it is difficult to divide the contributions of economic mathematics by those of economic science for equilibrium.

According to them, the balance of supply and demand is never a perfect thing. In the history of the capitalist system have been such cases which were characterized by an excess supply of labor as was the case of the crisis of the 30's years.

Balancing supply and demand can be considered as equilibrium in the sense in which this term is commonly used in science and mathematics. The adjective "general" means that we do not have rights to talk about the equilibrium of any particular goods, because the supply and demand of each market separately depends on the prices of other goods, so the equilibrium of the economy in general, cannot be decomposed into separate equilibriums of individual goods (Pano 2002, Lindbeck 1999).

Arrow also highlighted the difficulties of deriving social welfare functions from individual preferences – Arrow's so called "impossibility theorem", also known by the name "Arrow's theorem". This theorem has to do with the problem of the role of the state in a market economy by introducing two extremes: increasing the role of the state in the economy or minimizing the role of the state in the market economy, even though Arrow did not support either of these two extremes.

### **Maurice Allias**

Maurice's contribution to the fundamental Economic Science has to do with the research to find a solution to the fundamental problem of any economy, namely for the greatest feasible economic efficiency while ensuring a distribution of income that would be generally acceptable (Allias 1988).

Maurice Allias has contributed to the field of General Equilibrium Theory and in the investment of optimal resources. Since 1943 in his publications came up with the formulation of *Intertemporal general*

*equilibrium*, by defining clear terms of the relationship between capital goods and land.

Allais further developing Walras, argues that the state of the overall economic equilibrium is a condition in which there can be no surplus, while the movement of the entire system run by forces in search of such a surplus.

Maurice Allais' contributions have great similarities with Paul Samuelson's contemporaneous work and Arrow's and Debreu's later contributions. A special feature of Allais' work is that he describes the economy's path to general equilibrium as a process by which competition removes all "surpluses" in firms (The Sveriges Riksbank 1988).

Allais' analysis also covers the case where returns to scale in production give rise to natural monopolies and his contributions laid the foundation for school of Post-War French economists who analyzed the conditions for an efficient use of resources in large public monopolies. Allais also anticipated parts of the modern theory of economic growth (The Sveriges Riksbank 1988).

### **Conclusion**

Many Nobel laureates have contributed to the economy of general equilibrium theory among which stand out the contributions of Paul A. Samuelson, John R. Hicks, Kenneth J. Arrow, Gerard Debreu and Maurice Allais.

The contributions of the Nobel laureates in the development of the general equilibrium theory have dealt with the analytical structures of theoretical economic models, clarifying the conditions for consistency, equilibrium, stability and efficiency of the economic system, and analyses of how equilibrium positions change in response to changes in various exogenous parameters.

Their opinions, views, proposals and suggestions not only contributed to the solution of concrete problems, but also to the development of economic science in general. So, their theoretical and practical contributions are always starting point for further research in this field. Recognition of their views and contributions also allows us to become acquainted with the controversy developed in the field of development of economic science and the concrete problems of concern to the global economy in different periods of time.

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