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The prize in Economic Sciences In Memory of Alfred Nobel– 1969-1998

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In conjunction with its tercentenary celebrations in 1968, Sveriges Riksbank (Bank of Sweden) instituted a new award, "The Central Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel" on the basis of an economic commitment by the bank in perpetuity. The award is given by the Royal Swedish Academy of Sciences according to the same principles as for the Nobel Prizes that have been awarded since 1901.

The procedures for selecting the laureates are also the same. Each year the Academy receives some 250 nominations, usually covering a little more than one hundred nominees. (Unsolicited suggestions from persons who have not been asked to submit nominations are not considered.) The Economics Prize Selection Committee of the Academy (with five to eight members) commissions expert studies of the most prominent candidates, sometimes by Swedish experts but usually by foreigners. The prize committee presents its award proposal to the Social Science Class of the Academy in the form of a report, with an extensive survey of the main candidates that are considered for a prize. The report motivates the proposal and includes all the solicited expert studies. Finally the entire Academy meets to take the final award decision, usually in October.

Which criteria have guided the awards so far? And what have been the main problems when selecting the laureates?

It is useful to start a discussion of these issues with a rough classification of the various types of economics prize awards given so far. It should be kept in mind, however, that all such classifications are rather arbitrary since the multidimensional nature of scientific contributions makes it difficult in avoid overlap.

I. A classification of prizes the first 30 years

General Equilibrium Theory

Obvious examples of this type of award are the prizes to Paul Samuelson (1970) for having "developed static and dynamic economic theory"; to Kenneth Arrow and John Hicks (1972) for "their pioneering contributions to general economic equilibrium theory and welfare theory"; to Gerard Debreu (1983) for “his rigorous reformulation of the theory of general equilibrium”; and to Maurice Allais (1988) “for his pioneering contributions to the theory of markets and efficient utilization of resources”. (See the table at the end of the article for an attempt to classify the awards into various fields of research.)

Contributions in this category have dealt largely 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. Often, 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 (parameters).

It is largely due to the above-mentioned theorists that general equilibrium theory has become the basic approach in theoretical economic analysis. For instance, Hicks formulated conditions for multimarket stability, and extended the applicability of the static method of analysis to several periods. 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. Hicks also presented a celebrated aggregate general

equilibrium model with four markets – commodities, labor, credit and money – the so-called IS-LM model.

Samuelson's work was not only a continuation of the contributions by Hicks; it also represented a discontinuity, i.e., a break-through, in terms of analytical sophistication. This is recognized in the prize citation, which declares that Samuelson "actively contributed to raising the level of analysis in economic science". It is hardly an exaggeration to say that he single-handedly rewrote considerable parts of central economic theory: microeconomic theory, static and dynamic, partial and general equilibrium theory, as well as welfare-economics. By extracting interesting inferences from simple mathematically formulated models, exploiting effectively the second-order conditions of maximization procedures, he derived results which still today rank among the classical theorems of economics.

Arrow's and Debreu's main contributions to general equilibrium theory were to achieve greater generality by applying more powerful mathematical methods, such as the theory of convex sets. The generality allowed them to define the concept of a good so broadly that the same theory may be used not only in static equilibrium analysis but also in analysis of the spatial distribution of production and consumption activities, intertemporal analysis and the analysis of decision-making under uncertainty. Arrow also highlighted the difficulties of deriving social welfare functions from individual preferences – Arrow´s so called "impossibility theorem".

Maurice Allais' contributions, made largely in the 1940s, have great similarities both 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 equilibrium as a process by which competition removes all "surpluses" in firms. Allais' analysis covers the case where returns to scale in production give rise to natural monopolies. His contributions thereby laid the foundation for a school of Post-War French economists who analyzed the conditions for an efficient use of resources in large public monopolies (such as Electricité de France and SNCF, the state railway system,). Allais also anticipated parts of the modern theory of economic growth.

Macroeconomics

Numerous prices has been given to macroeconomics, i.e., that branch of economic analysis that explains the behavior of the national economy as a whole in terms of a number of broad aggregates, such as private consumption, investment, exports, imports, government spending of goods and services, etc. Some of the awarded contributions in this field concern sectors ("submodels") of national economies, while others deal with an entire national economy.

An award in macroeceonomics that refer both to special sectors and to the entire national economy is the 1976 prize to Milton Friedman. The prize citation referred to his contributions to "consumption analysis, monetary history and theory." Milton Friedman's book *A Theory of the Consumption Function* in 1957 is a successful attempt to combine formal theory and its empirical application for a specific sector of the economy. His extensive empirical study of the monetary history of the United States (together with Anna Schwartz) may be regarded as an example of rather "pure" empirical research, even though the study clearly was based on a theoretical framework emphasizing a monetary interpretation of macroeconomic fluctuations.

Franco Modigliani (awarded in 1985) developed two important building blocks in macroeconomic models, namely submodels of private consumption and the financial sector. In particular, in his life-cycle theory of saving Modigliani studied the consequences for household saving of changes in demography and economic growth. Together with Merton Miller he also laid the foundation for the field "corporate finance". The Modigliani-Miller theorem states the conditions under which the value of a firm in the stock market is influenced (or not influenced) by the dividend policy of the firm, and the way the firm finances its investment, e.g., via equity capital or borrowing.

The prize to James Tobin (1981) is another example of an award for theoretical contributions concerning specific sectors of a national economy – the award being given for his analysis of "financial markets and their relation to expenditure decisions, employment, production and prices." Tobin's way of modeling interactions between financial and real sectors quickly became an integrated part of macroeconomic models for national economies, with an important role played by the relation between the market value of a capital asset

and its reproduction costs – the so-called "Tobin's q". Adding the stock of real assets – land, buildings, inventories and claims on raw materials – Tobin's portfolio model also becomes the natural analytical tool with which to analyze direct effects on product prices of changes in the supply of money.

Lawrence Klein (awarded in 1980) also made important contributions to macroeconomic research. The prize citation emphasized “the creation of econometric models and their application to the analysis of economic fluctuations and economic policies.” One of Klein's main achievements was to analyze the effects of economic policies by way of statistical model simulation. He also made important contributions in developing forecasting techniques. His analysis originally ran in the framework of Keynesian-type macrotheories, but his models tended to become more eclectic over time. They also became more and more detailed, ultimately covering more than one hundred estimated equations.

Robert Lucas, awarded in 1995, has also furthered macroeconomic model building in a fundamental way. In particular, he has emphasized the role of expectations in macroeconomic analysis. He is particularly renowned for developing the consequences of "rational expectations” among economic agents, according to which these exploit all available information and do not make *systematic* expectational mistakes. Lucas also analyzed the consequences for the macroeconomy of changes in the "economic policy regime”, i.e., the way government and central bank policies respond to changes in the economy. In particular, he has shown how conventionally statistically estimated macroeconomic behavior functions for the private sector may become unreliable after a change in the policy regime – the so-called “Lucas Critique” of traditional macroeconometric estimations. He has also suggested ways of avoiding this problem.

The shared prize to James Meade and Bertil Ohlin (1977) for their contribution to “the theory of international trade and international capital movement” is another example of a contribution concerning a specific sector of a national economy: the sector of foreign transactions. In the case of Ohlin, the award referred to his development of a theory of international and interregional trade, designed to explain both the causes and the consequences of trade –

known as the Heckscher-Ohlin model. Ohlin showed that the trade patterns of individual countries depend on their proportions of available factors of production (capital and labor), and that international trade tends to equalize the returns to these factors among countries. James Meade analyzed trade policy in a world with various market distortions, hence anticipating the theory of "second best" allocations of resources. He was also a pioneer in the field the theory of open-economy macroeconomics. Of particular importance was Meade's analysis of the relation between internal and external balance, and the relation between targets and instruments of economic policy.

While the awards to macroeconomics discussed above referred to contributions concerning short-term macroeconomic fluctuations, Robert Solow was rewarded (in 1987) for his contributions to the theory of long-term macroeconomic growth. His main contribution was to build a mathematical model (in the form of a simple differential equation) describing how the process of capital accumulation generates rising productivity. The capital intensity of production – the volume of capital per worker – is determined by the prices of capital and labor. Due to diminishing return to capital, the economy in this model will in the long run approach a situation where productivity growth is driven only by technological progress. Solow also developed a model of economic growth in which new technology was embedded in newly produced capital goods, the so-called "vintage model" of economic growth. Based on his theoretical models, Solow also pioneered in empirical research on the determinants of economic growth – so-called "growth accounting".

The shared prize to Arthur Lewis and Theodore Schultz (in 1979) also referred to economic growth, though at a less abstract level than the work by Solow. The prize citation referred to their research on "economic development with particular consideration of the problems of developing countries". The award to Lewis recognized particularly his two long-term growth models for less developed countries – emphasizing the consequences for economic growth of an elastic supply of labor, and the determinants of the terms of trade for countries that export tropical products. The award to Schultz honored his analysis of the role of investment in human capital for economic development, particularly in agriculture. Both Lewis and Schultz were concerned with

combining their theoretical reasoning with empirical data, though they used the traditional expository techniques of economic history rather than formalized statistical or econometric testing techniques. Schultz emphasized the apparent efficiency in the agricultural sector in less developed countries, considering existing constraints with respect to resources and knowledge available in these countries. Lewis instead focused on the tensions between a large and stagnant agricultural sector, with a low marginal product of labor, and a dynamic industrial ("capitalist") sector, which is sometimes in the nature of an economic enclave.

Microeconomics

A number of awards have also been given for contributions in microeconomic theory, dealing with decision-making by individual households and firms, and the allocation of resources among different uses and production sectors in the economy. One example is the prize to George Stigler (1982) for his studies of "industrial structures, functioning of markets and causes and effects of public regulation" He also analyzed how economic regulations, in fact, are conducted by politicians and public-sector administrators. He showed, for instance, that regulators often become dominated by those that are supposed to be regulated – so called "regulatory capture". In a similar vein as Friedman, Stigler represent a pronounced positivist tradition, emphasizing analytical simplicity and the importance of empirical application.

Stigler was also one of the pioneers in the field of "information economics", introducing information costs explicitly in his analysis. Other prizes have also been given to this field. James Mirrlees and William Vickrey (award in 1996) made pioneering work about the consequences of various limitations in information of individuals, including "information asymmetries" among economic agents. In particular, both studied incentive problems in connection with asymmetric information. It turns out that such information asymmetries are of great importance for the functioning of markets such as insurance and credit markets. Mirrlees did fundamental work on the consequences for taxation of asymmetric information between the government and private agents. Vickrey's clarified the properties of various types of auctions. His insights have been crucial for developing efficiently functioning

auctions of rights to broadcast, landing permits at airports, television rights as well as sales of government assets ("privatization").

Though financial economics relies on similar analytical techniques as traditional microeconomics, over time it has become a field of its own, with an enormous expansion during the last two decades. Tobin and Modigliani were mentioned above as early contributors as parts of their construction of important building blocks to macroeconomic theory. However, the field financial economics is today build mainly on foundations laid in the 1950s and 1960s by Harry Markowitz, Merton Miller and William Sharpe (jointly awarded in 1990). While Markowitz' contribution was to construct a microtheory of portfolio management of individual wealth holders, Merton and Sharpe developed equilibrium analysis in financial markets. More specifically, Sharpe developed a general theory for the pricing of financial assets. Miller made important contributions in the field of corporate finance (to begin with, partly in cooperation with Frances Modigliani). In particular, Miller clarified which factors determine share prices and capital costs of firms.

Subsequently, Robert Merton and Myron Scholes were given the prize (in 1997) for their analysis of price formation of so-called derivative instruments such as options, which are claims on underlying financial instruments including shares and foreign exchange. (The late Fisher Black was also instrumental for this achievement.) These contributions were a necessary condition for the subsequent development of today`s huge markets for various types of derivative instruments. These markets have increased the possibility for individual agents to choose adequate risk levels according to their own preference, regardless of whether they choose low or high exposure to risk.

Interdisciplinary research

Several prizes have also been awarded economists who have widened the domain of economic analysis to new areas. James Buchanan got his prize (in 1986) for his research on the boundary between economics and political science, or more specifically, "for his development of the contractual and constitutional basis for the theory of economic and political decision-making". This research made him one of the founding fathers of the "public choice"school, which analyzes the driving forces behind political decisions and

tries to endogenize political behavior in models of national economies. Rather than looking at politicians as individuals that are supposed to take care of the "general good" in society, the public choice school assumes that politicians are motivated by considerations similar to those explaining the behavior of other agents, including the strive for personal benefit and a desire for power.

Gary Becker (awarded in 1992) has instead worked on the borderline between economics and sociology, in particular in his research about the family. He has not only analyzed the "economic" behavior of families – labor supply, consumption, household production and household saving – but also behavior that has not earlier been much considered by economists, such as education, marriage, childbirth, and divorce. He has both shown how economic considerations influence choice in these areas, and analyzed "social interaction" between individuals outside the market system, reflected in the prize citation: "for having extended the domain of microeconomic analysis to a wide range of human behavior and interaction, including nonmarket behavior". Becker`s influence today extends far outside economies, in particular to the so called "rational choice" school in sociology.

Ronald Coase (awarded in 1991) has instead made important contributions on the borderline between economics, law and organization. In particular, he showed which factors determine the size of firms. He also clarified the condition under which voluntary contracts between private agents can resolve problems with "external effects" of production, an important example being pollution. These contributions are reflected in the prize citation: "for his discovery and clarification of the significance of transaction costs and property rights for the institutional structure and functioning of the economy". Coase's concept of transaction costs has become an important foundation for the theory of contracts and for the whole field "law and economics".

The prize to Herbert Simon (in1978) may also be regarded as an interdiciplinary award. The prize citation referred to his research on "the decision-making process within economic organizations." In particular, Simon challenged some basic building blocks of microeconomic theory, in particular, the maximization principle and the assumption about full ("unbounded") rationality. On the basis of both empirical evidence and psychological theory, Simon argues that decision-makers usually do not try to choose a "best"

alternative, as assumed in traditional microeconomic theory, but that they are content with a "satisfactory" outcome, i.e. they try to find acceptable solutions to acute problems. This has made Herbert Simon a main contributor in the field administrative (management) science.

Simon Kuznets (1971) has instead made empirical research on the borderline between economics and history, reflected in the prize citation "for his empirically founded interpretation of economic growth." This prize is an example of an award for inductive rather than deductive analysis. Kuznets' ambition was to make empirical generalizations from data interpreted with a minimum of formal models and without relying on complex statistical techniques. Important examples include the celebrated "Kuznets's curve" of the U-shaped relation between GDP and income inequality, as well as his findings that the long-run average propensity to consume out of income tends to be constant in time-series data, whereas it tends to be fall in cross-section data. More generally, Kuznets has exploited data for very long periods of time to extract regularities, in particular, by characterizing economic growth and the distribution of income in different nations at different times.

The prize to Robert Fogel and Douglass North (in 1993) is another award on the boundary between economics and history. The Academy cited them "for having renewed research in economic history by applying economic theory and quantitative methods in order to explain economic and institutional change". Fogel's main contributions have been to clarify the role of the railways for the development of the national economy in the United States, and the economic role of slavery. By comparing the factual development with a counterfactual benchmar, Fogel concluded that previous studies of economic growth in the United States had vastly overestimated the importance of railways. He also concluded that slavery was not abolished because of falling profitability of the slave system, but rather because of humanitarian considerations. Douglass North has shed new light on the economic development in Europe and the United States before and in connection with the industrial revolution, including the roles of sea transport and changes in the pattern of regional specialization and interregional trade. He has also been a pioneer in analyzing the role of institutions, such as property rights, for economic development, as well as the importance of different types of

transaction costs. In these fields he developed and applied the ideas initially launched by Ronald Coase.

Research on the borderline between economics and philosophy was honored with the prize to Amartya Sen (in 1998) “for his contributions to welfare economics”. Sen scrutinized the philosophical foundations of collective decisions and welfare evaluations, including problems of evaluating the distribution of income and wealth. He has also constructed influential indices to measure income distribution and poverty. Sen has also analyzed the determinants and consequences of starvation in a number of less developed countries. These empirical studies of actual famines show that reduced aggregate supply of food has not always been the most important factor for starvation catastrophes which, in some cases, have instead been caused by redistribution of income to the disadvantage of the poor.

The award to Friedrich von Hayek and Gunnar Myrdal (in 1974), too, had a strong interdisciplinary flavor. While their early contributions on business cycles and monetary phenomena in the 1930s comprised quite abstract (though non-mathematical) economic-theory structures, their works from the early 1940s instead deal with the interrelations between economic, social and political processes. Hayek is perhaps known among economists mainly for emphasizing the information and incentive content of the price system. However, he has given particular attention to the importance for individual behavior of the institutional framework for economic decisions, including the political constitution and the legal rules that define contracts and property rights. In these fields, Hayek`s work parallels the work by Buchanan and Coase. Hayek has also emphasized the importance of “spontaneous” social order by contrast to planned institutional designs.

Gunnar Myrdal has combined economic analysis with a broad sociological perspective in order to show how social, economic and political forces interact, often generating vicious or virtuous circles. In fact, Myrdal has described his methods of analysis of “mutual causation” as a generalization of Knut Wicksell’s “cumulative process” in monetary theory. The most important example is Myrdal’s study of the "Negro Problem" in the United States in his book *An American Dilemma* (1944). This work not only influenced social science research. It also played an important part in the political discussion on

segregation and integration of ethnic groups in various countries. The Supreme Court in the United States referred to Myrdal`s book when outlawing segregation. Myrdal applied a similarly approach with "mutual causation" in his subsequent work on poverty and economic development in South Asia.

New Methods of Economic Analysis

Though several of the awards discussed above to could perhaps be regarded as “method awards,” there are more clear-cut examples. One case in point is the joint prize to Ragnar Frisch and Jan Tinbergen (the very first award in 1969) for their pioneering work on econometric model building, i.e., the integration of economic theory and statistical methods. The prize citation was “for having developed and applied dynamic models for the analysis of economic processes”. While Frisch developed general methods of dynamic and econometric analysis, Tinbergen pioneered in applying such methods empirically. Tinbergen's main achievement was to make rigorous statistical tests of the realism of alternative business cycle theories. Frisch and Tinbergen were also instrumental in developing a formalized theory of the relation between instruments and targets of economic policy – a contribution paralleling Meade`s analysis of similar issues. Frisch and Tinbergen gave these theories a form that was favorable for empirical quantification and statistical testing. Frisch based his analysis partly on a system of national accounts for Norway, the so-called “oekosirk system”(income and expenditure flows), while Tinbergen pursued much of his empirical policy analysis in the context of econometric macro models for the Netherlands.

The prize to Frisch’s countryman Trygve Haavelmo (in 1989) honored further development of Frisch’s work. More precisely Trygve Haavelmo was awarded “for his clarification of the probability theory foundations of econometrics and his analysis of simultaneous economic structures”. Haavelmo showed how methodology of mathematical statistics could be applied to draw stringent conclusions about complex economic relations from a random sample of empirical observations. These methods could then be used to estimate relations derived from economic theories and to test these theories. He also showed that misleading interpretations of partial relations between economic

variables due to interdependencies can be avoided if these relations are estimated simultaneously.

Another example of an award for important methodological developments is the prize to Wassily Leontief (in1973) "for the development of the input-output method." This methodology highlights the interdependencies between different sectors of the economy in quantitative form. The analysis is also well suited to an analysis of the short-term effects of shocks in one sector on other sectors of the economic system. The candidacy of Leontief was greatly enhanced by the fact that he also pioneered in applying his method to empirical data. There is a parallel between Tinbergen`s contribution to make macroeconomic theory empirically operational and Leontief´s inter-industry analysis.

The prize to Richard Stone (in 1984) for "having made fundamental contributions to the development of systems of national accounts" similarly awarded important new methods. It is hard to think about empirical analysis in macroeconomics today without comprehensive systems of national accounts. General equilibrium theory , as formulated by Arrow and Debreu, has created a general *theoretical* system helping us grasp the idea of the interaction of billions of economic transactions in millions of different markets. Without the modern system of national accounts, however, we could not obtain an *empirical registration* of these transactions in comprehensive aggregates. The idea of national accounts harks back over several centuries, and theoretical and empirical work on national accounts flourished in the 1930s, as reflected in the works by Ragnar Frisch, Erik Lindahl, Colin Clark and Simon Kuznets. But Richard Stone was the leading architect of the modern *system* of national accounts, which married the principles of macroeconomic bookkeeping and aggregate macroeconomic models. Leontief-style input-output tables also became a useful component of this type of work.

These methodological prizes referred to advances in empirical analysis. Methodological contributions in theory have also been awarded. One example is the shared prize to Tjalling Koopmans and Leonid Kantorovich (in 1975). Kantorovich defined, as early as 1939, the concept of efficient resource use in individual enterprises, and later developed similar efficiency conditions for the economy as a whole. He also demonstrated the theoretical connection between

the allocation of resources and the price system, both at a certain point of time and in a growing economy. Koopmans' so-called activity analysis, in a similar vein, clarified the correspondence between efficiency in production and existence of a system of "accounting prices." Both showed how the theoretical possibility of decentralized decision making in a planned economy is connected with the existence of an efficient price system, including a uniform accounting price of capital on which to base investment decisions. This analysis was, in fact, closely related to the earlier discussed achievements in general equilibrium theory by Arrow and Debreu. Though both laureates have also made important contributions to the mathematical technique of linear programming, this was not what they were honored for; instead they received the prize for enriching our understanding of basic economic issues in normative allocative theory by applying new tools of analysis.

One of the most important theoretical methods development in recent decades is game theory. While John von Neumann and Oskar Morgenstern made pioneering work in this field already in the late 1940s by, the analytical breakthrough was spawned by John Harsanyi, John Nash and Reinhard Selten, who were awarded (in 1994) "for their pioneering analysis of equilibrium in the theory of non-cooperative games".

John Nash introduced the distinction between cooperative games, in which binding agreements can be made, and non-cooperative games, where binding agreements are not feasible. Nash also developed an equilibrium concept for predicting the outcome of non-cooperative games that later came to be called the Nash equilibrium. Reinhard Selten was the first to refine the Nash equilibrium concept for analyzing dynamic strategic interaction among different agents and to apply these refinements in the analyses of competition with only few sellers. These refinements made it possible to exclude a number of theoretically possible but unstable or irrelevant equilibria. John Harsanyi showed how games can be rigorously analyzed in the case of incomplete information. In this way he provided a theoretical foundation for predicting the outcome of strategic interaction between agents imperfectly informed, for instance, about the objectives of other individuals. Hence, Harsanyi gave an important impetus to further development in the field of information economics, after the pioneering work by Stigler, Vickrey and Mirrlees.

II. Problems and Difficulties

What are then the main problems and difficulties in choosing laureates in economics? It may be useful to discuss this issue in connection with four questions: (a) How should "economics" be interpreted in the context of the awards? (b) What criteria should be used when judging whether a candidate merits a prize? (c) In what order should worthy candidates be selected? (d) When and for what reason should prizes be shared?

The Scope of Economics.

The prize committee, and the Academy, has decided to give wide interpretation to the term "economic sciences," so that prizes may be awarded to scholars making important scientific contributions also in neighboring disciplines, in so far as these concern economic issues. In other words, "interdisciplinary research" has been regarded as important. Indeed, as mentioned above, several awards have been given for contributions on the borderline between economics, political science, sociology and history.

Scholars with traditional training in economics have increasingly been "trespassing" into neighboring territory by applying the methods of economic theory and econometrics to problems not previously analyzed much by economists. These various trespassing tendencies have led George Stigler (1984), as well as other economists, to talk about economics as "The Imperial Science." It is also true, however, that research in other social sciences has recently influenced research in economics.

Though the Academy, and its selection committee, has followed the same general principles as applied to the prizes in the natural sciences, i.e., to award specific contributions, the degree of "specificity" of the awards has varied considerably. Examples of prizes with high specificity are the awards to Wassily Leontief, Ragnar Frisch, Jan Tinbergen, James Mirrlees, William Vickrey, as well as the prizes to game theory and financial economics. The smallest degree of specificity is probably found in the prize citations for Paul Samuelson, Milton Friedman, Friedrich von Hayek, Gunnar Myrdal and Amartya Sen. In the case of Paul Samuelson reference was made to his contribution to "raising the level of analysis in economic science". The prize

citation to Milton Friedman mentioned his contributions to consumption analysis and to monetary history and theory as well as "his demonstration of the complexity of stabilization policy." The latter referred to Friedman's stress on how time lags, conflicts of goals , uncertainty and endogenous expectations among economic agents greatly complicates stabilization policy. In the prize citation for Gunnar Myrdal and Friedrich von Hayek the Academy mentiones both their "pioneering work in the theory of money and economic fluctuations" and "their penetrating analysis of the interdependence of economic, social and institutional phenomena." In the case of Amartya Sen, much of the contributions referred to his clarification of the philosophical foundations of economics. His empirical studies of starvation in a number of poor countries integrated political and sociological factors with more narrowly economic ones. Simon Kuznets was awarded for his lifetime contributions to the empirical analyses of economic development. Thus, the Academy has awarded not only narrowly defined specific contribution but also clusters of such contributions, including lifetime achievements if these consist of major contribution to economic science widely interpreted.

C*riteria for Awards.*

When considering what should be regarded as a "worthy" contribution, it is probably correct to say that the selection committee has looked, in particular, at the *originality* of the contribution, its scientific and practical *importance,* and its *impact* on scientific work. To provide shoulders on which other scholars can stand, and thus climb higher, has been regarded as an important contribution. To some extent, the committee has also considered the impact on society at large, including the impact on public policy.

An issue is whether the contributions by a scholar should be treated as gross or net. In other words, should the prize awarding authority make deductions for "bad" (low-quality) research? It is obvious that no such deductions have been made. Moreover, how does one deal with people who, in addition to their scholarly work, have participated in the political debate with policy recommendations which sometimes may reflect strong ideological commitments. Friedman, Hayek, Myrdal, Tinbergen, Tobin, Modigliani, and

Solow are obvious examples. In conformity with the basic idea of the prize as a scientific award, such activities have been neglected.

When deciding who should be regarded as worthy of a prize, the scrutiny of time has helped the committee considerably. Because the prize was initiated as late as 1969, time has sorted out worthy candidates, for whom the risk of "premature fame" is minimal. During the first decade of the economics prize, the committee largely had the task of working with a heavy backlog of rather obvious candidates. Indeed, some of the honored contributions were made several decades ago, even as far back as the thirties, examples being the awards to Frisch, Tinbergen, Hicks, Ohlin and Kantorovich.

Moreover, it usually takes a longer time in economics (and social sciences in general) than in the natural sciences to find out if a new contribution is *solid* or if it is just a fad. In other words, it is important to wait for scrutiny, criticism and repeated tests of the quality and relevance of a contribution. The reason is not only that economic behavior, like human behavior in general, is complex but also that it varies over time and place. This is partly because individuals learn from previous experience, which may make empirically estimated behavior patterns unstable. Thus, new results may turn out to be relevant only to a transient conjuncture of circumstances, having much less generality than was supposed at first. Another reason to be particularly careful is that relevant empirical tests usually take time to pursue, partly because such tests usually rely on non-experimental data.

When trying to define a prize-worthy contribution, the selection committee has not relied much on quantitative indicators such as the number of nominations or the frequency of citations, even though the prize-winners usually rank very high on both accounts[1] (Quandt 1976, Grubel 1979). Indeed, there are a number of exceptions of prizewinners who have received quite few nominations and who also rank quite low in citation indices, pronounced examples being Kantorovich, Stone, Haavelmo, Allais, Meade and Ohlin (though the Heckscher-Ohlin model is often referred to in the literature). There

[1] For instance, in a study by Richard Quandt (1976), based on citations in eight leading journals, Nobel Memorial Prize winners constitute 13 out of the 21 highest ranked (then living) economists in terms of citations in 1960 (with the six top economists all, by now, having been prize winners). They constitute 11 out of the 26 highest ranked in citations in 1970 (with the top five all having been awareded by now).

are also some economists who consistently rank very high on citation indices, but who have not received prizes.

The Order of Awards.

What, then, have been the main criteria for choosing the order of worthy candidates? There is an unavoidable subjectivity and arbitrariness in this choice. Two dominant criteria seem to have been: (i) to give early prizes to particularly important contributions, and (ii) to adhere to a pluralist view of economic research, by shifting over the years between candidates in different fields, using different methods of analysis, and reflecting different views of the world. There has also been (iii) a tendency to give prizes in cronological order of discovery.

Sharing of Prizes.

Another important issue is when, and how, awards should be shared. According to the rules laid down for the Nobel prizes, the prize can be shared among a maximum of three persons. A shared Nobel prize is just as honorable as a single prize, and each laureate has to be worthy of the prize alone.

For receiving a shared award, there has to be some "common denominator" of the laureates. Shared awards in economics have been given *either* when the contributions are the results of actual cooperative work, *or* when the contributors are so closely related that a sharing is important to demonstrate the connection and to be "fair" to contributors. So far, eleven prizes out of thirty have been shared, which is somewhat less frequent than in the natural sciences during the last three decades.

The prize-awarding authority has interpreted the common denominator of shared prizes in economics in different ways for different awards. For instance, the contributions of Ragnar Frisch and Jan Tinbergen were strongly linked by intellectual influence, in particular from the older laureate (Frisch) to the younger. The shared prize between John R. Hicks and Kenneth Arrow also reflected the work of two different generations working in the same field, more specifically in general equilibrium and welfare theory. In the words of the press release of the Academy, Hicks "initiated" a profound transformation of general equilibrium theory, while Arrow "provided it with fresh nourishment." The

prize in game theory was also an award to two generations of contributions, with Nash being a pioneer and Harsanyi and Selten making Nash's concepts of non-cooperative game theory more applicable.

The prize shared between Tjalling Koopmans and Leonid Kantorovich reflected instead similarity of mutually *independent* contributions in the field of normative economic theory, or more specifically a normative theory of the optimum allocation of resources. The shared prizes in the theory of information economics to Vickrey and Mirrlees were of a similar nature.

The prize-sharing between Hayek and Myrdal was, again, of a different nature. Both were pioneers in macro and monetary analysis in the thirties – the Austrian School and the Stockholm School, respectively. They both used the concepts of aggregate savings and investment to explain macroeconomic fluctuations. Both later broadened the scope of economic analysis, by emphasizing the institutional, legal, political and ideological framework of economic and social processes. The fact that they are often regarded as political "antipoles" did not bother the committee, since the prize is a purely scientific award. This is probably the shared award for which the common denominator of the laureates' achievements was the smallest.

Some shared prices have instead been awards for complementary contributions. The common denominator for the shared prize to Bertil Ohlin and James Meade was their analysis of international trade and capital movements. The contributions of Arthur Lewis and Theodore Schultz were also largely complementary. The common denominator is that their research has dealt with long-term economic development for less developed countries. Another complementary price was the shared award between Fogel and North, which was designed to honor the two most important pioneers in "new" economic history, in which modern tools of economic and statistical analysis is applied to issues in economic history.

The shared prize to Markowitz, Miller and Sharpe was also an award for complementary contributions, in this case in financial economics, though the latter two had the advantage of standing on the shoulders of Markowitz. The prize to Merton and Scholes may be regarded as a "follow up" of this prize, since they (with the late Fisher Black) developed a theory of price formation for

one specific type of important financial asset, namely "derivative financial instruments", such as options and futures. This is one of the clearest cases of a "joint" contribution in the sense that the laureates cooperated in the research that lead to their achievement.

III. Do the Prizes Reflect New Trends in Economic Analysis?

The awards that have been made so far obviously reflect some characteristic features of economic analysis during the last half-century. First of all, the awards clearly reflect the dominant role of the United States in economic research during this period. Out of 43 laureates, 28 have been United States citizens. However, although all of these had been working in the United States for a long time, it may be worth noting that four of them – Leontief, Koopmans, Debreu and Harsanyi – were born and largely trained in other countries. The only other countries that have received prizes (as defined by citizenship) are the United Kingdom (6 awards), Sweden and Norway (2 awards each), France, India, the Netherlands and the Soviet Union (one each). The only universities where faculty members have received more than a single award are Chicago (8 awards), Harvard (4 awards), Cambridge (4 awards), MIT (3 awards), Berkely (2 awards), Oslo (2 awards), Princeton (2 awards) Stanford (2 awards) and Yale (2 awards).[2]

Turning to the content of the awarded contributions, the emphasis on deductive rather than inductive methods in economic analysis shows up strongly. The increased role of mathematical formalization is also strongly reflected in the awards, important examples being the prizes to Samuelson, Hicks, Arrow, Koopmans, Kantorovich, Debreu, Allais, as well as the laureates in financial economics and game theory.

Another characteristic trend in economics during the second half of the 20th century is the growing importance of quantitative methods including systematic statistical testing or estimation, i.e., econometrics. This development is reflected notably in the awards to Frisch, Tinbergen, Leontief, Klein, Stone and Haavelmo. Indeed, the huge volume of quantitative research during the last decade, often involving large masses of data, would hardly have been possible

without the development of analytical techniques such as econometrics, input-output analysis, programming, as well as the development of powerful computers.

The awards also illustrate the important role of macroeconomics during the postwar period, (in particular, Friedman, Klein, Tobin, Modigliani, Solow and Lucas). New ways of looking at the economic system have also been recognized by the awarding authority, as reflected in the awards to economics of information, human capital and game theory as well as the role of economic institutions.

A final but difficult question: Has the selection committee viewed the award as a chance to influence the direction of new research in economics? The answer is "no" in the sense that the committee has tried to be broad and pluralistic of outlook in its decisions about awards, and to emphasize the multidimensional nature of economic research. Somewhat paradoxically, such an eclectic approach could, of course, be regarded in itself as a way to influence views about fruitful research, by recognizing research fields and methods that may not for the moment be in the focus of interest. It may also be argued that the prize-awarding authority has demonstrated that there are many different ways to advance a science like economics: rigorous deductive theorizing, whether by way of verbal or mathematical techniques; the development and application of new concepts and methods of analysis; rigorous empirical testing of existing hypotheses, as well as less formalized confrontation of various hypotheses with empirical fact; or "simply" profound observation and nonformalized innovative thinking about economic issues.

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[2] Of course, a laurete may have made his main contribution before before he came to the university where he were when being awarded.

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Year	Laureate	Field	Prize Citation
1969	**Ragnar Frisch** Oslo University **Jan Tinbergen** The Netherland School of Economics	Macroeconometrics	For having developed and applied dynamic models for the analysis of economic processes
1970	**Paul A. Samuelson** Massachusetts Institute of Technology	Partial and General Equilibrium Theory	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
1971	**Simon Kuznetz** Harvard University	Economic Growth and Economic History	For his empirically founded interpretation of economic growth which has led to new and deepened insight into the economic and social structure and process of development
1972	**John R. Hicks** Oxford University **Kenneth J. Arrow** Harvard University	General Equilibrium Theory	For their pioneering contributions to general equilibrium theory and welfare theory
1973	**Wassily Leontief** Harvard Unifersity	Input-Output Analysis	For the development of the input-output method and for its application to important economic problems

1974	**Gunnar Myrdal** University of Stockholm **Friedrich von Hayek** University of Freiburg	Macroeconomics and Institutional Economics	For their pioneering work in the theory of money and economic fluctuations and for their penetrating analysis of the interdependence of economic, social and institutional phenomena
1975	**Leonid Kantorovich** Academy of Sciences, Moscow **Tjalling C. Koopmans** Yale University	Theory of Optimum Allocation of Resources	For their contributions to the theory of optimum allocation of resources
1976	**Milton Friedman** University of Chicago	Macroeconomics	For his achievements in the fields of consumption analysis, monetary history and theory and for his demonstration of the complexity of stabilization policy
1977	**Bertil Ohlin** Stockholm School of Economics **James Meade** Cambridge University	International Economics	For their pathbreaking contribution to the theory of international trade and international capital movements
1978	**Herbert A. Simon** Carnegie-Mellon University	Administrative (Management) Science	for his pioneering research into the decision-making process within economic organizations

1979	**Theodore W. Schultz** University of Chicago **Arthur Lewis** Princeton University	Development Economics	For their pioneering research into economic development, with particular consideration of the problems of developing countries
1980	**Lawrence R. Klein** University of Pennsylvania	Macroeconometrics	For the creation of econometric models and their application to the analysis of economic fluctuations and economic policies
1981	**James Tobin** Yale University	Macroeconomics	For his analysis of financial markets and their relations to expenditure decisions, employment, production and prices
1982	**George J. Stigler** University of Chicago	Industrial Organization	For his seminal studies of industrial structure, functioning of markets and causes and effects of public regulation
1983	**Gerhard Debreu** University of Calfornia, Berkeley	General Equilibrium Theory	For having incorporated new analytical methods into economic theory and for his rigorous reformulation of the theory of general equilibrium
1984	**Richard Stone** Cambridge University	National Income Accounting	For having made fundamental contributions to the development of systems of national accounts and hence greatly improved the basis for empirical economic analysis

1985	**Franco Modigliani** Massachusetts Institute of Technology	Macroeconomics	For his pioneering analyses of saving and of financial markets
1986	**James Buchanan** George Mason University	Public Finance	For his development of the contractual and constitutional bases for the theory of economic and political decision-making
1987	**Robert M. Solow** Masshachusetts Institute of Technology	Economic Growth Theory	For his contributions to the theory of economic growth
1988	**Maurice Allais** Ecole National Surpérieure des Mines de Paris	Partial and General Equilibrium Theory	For his pioneering contributions to the theory of markets and efficient utilization of resources
1989	**Trygve Haavelmo** Oslo University	Econometrics	For his clarification of the probability theory foundation of econometrics and his analyses of simultaneous economic structures

1990	**Harry Markowitz** City University of New York **Merton Miller** University of Chicago **William Sharpe** Stanford University	Financial Economics	For their pioneering work in the theory of financial economics
1991	**Ronald Coase** University of Chicago	Theory of Institutions	For his discovery and clarification of the significance of transaction costs and property rights for the institutional structure and functioning of the economy
1992	**Gary S. Becker** University of Chicago	Microeconomics and Economic Sociology	For having extended the domain of microeconomic analysis to a wide range of human behavior and interaction, including nonmarket behavior
1993	**Robert W. Fogel** University of Chicago **Douglass C. North** Washington University, St. Louis	Economic History	For having renewed research in economic history by applying economic theory and quantitative methods in order to explain economic and institutional change

1994	**John C. Harsanyi** University of California Berkeley **John F. Nash** Princeton University **Reinhard Selten** Rheinische Friedrich-Willhelms-Univerisität, Bonn	Game Theory	For their pioneering analysis of equilibria in the theory of non-cooperative games
1995	**Robert E. Lucas, Jr.** University of Chicago	Macroeconomics	For having developed and applied the hypothesis of rational expectations, and thereby having transformed macroeconomic analysis and deepened our understanding of economic policy
1996	**James A. Mirrlees** Cambridge University **William Vickrey** Columbia University	Economics of Information	For their fundamental contributions to the economic theory of incentives under asymmetric information
1997	**Robert C. Merton** Harvard University **Myron S.Scholes** Stanford University	Financial Economics	For a new method to determine the value of derivatives
1998	**Amartya Sen** Cambridge University	Welfare Economics	For his contributions to welfare economics

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