

# Jan Tinbergen (1903-1994)

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## Abstract

Jan Tinbergen was the first Nobel Laureate in Economics in 1969. This paper presents a brief survey of his many contributions to economics, in particular to macro-econometric modelling, business cycle analysis, economic policy making, development economics, income distribution, international economic integration and the optimal regime. It further emphasizes his desire to contribute to the solution of urgent socio-economic problems and his passion for a more humane world.

## **Jan Tinbergen (1903-1994)**

### *Overview*

Jan Tinbergen was born in The Hague, The Netherlands, on April 12, 1903 as the first of five children in an intellectually stimulating family with a love of foreign languages. Eventually two of the children would win a Nobel Prize: Jan in Economics (in 1969) and Niko, an ethologist, in Physiology or Medicine (in 1973). Jan Tinbergen enrolled as a student of mathematical physics at Leiden University in 1921 where he obtained his doctorate in 1929. By that time he had already decided to switch to economics. From 1926 to 1928 Tinbergen worked as a conscientious objector, first in a convict prison and later, and of greater import to his subsequent career, at the Central Bureau of Statistics. He continued to work there until 1945. In 1933 he became extraordinary professor of statistics, mathematical economics and econometrics at the Netherlands School of Economics in Rotterdam. As a result of his quantitative approach to the study of economic dynamics, he was invited to the League of Nations in Geneva during the period 1936-1938 in order to carry out statistical tests of business cycles theories. In 1945, at the end of World War II, Tinbergen was appointed as the first director of the Central Planning Bureau, The Hague. He held this position until 1956 when he became full professor of mathematical economics and development planning at the Netherlands School of Economics, later Erasmus University Rotterdam. Throughout the 1960s and a part of the 1970s he acted as advisor to various international organizations and to governments of a considerable number of less developed countries. He was elected chairman of the United Nations Committee on Development Planning in 1965 and held this position until 1972. In 1969 he was awarded, together with Ragnar Firsch, the first Nobel Prize in Economics. After his retirement as full professor in 1973 he held the Cleveringa Chair in Leiden for two years. He continued to be involved in various research projects at old age. Jan Tinbergen died on June 9, 1994.

### *Personal motivation*

Already at an early age Tinbergen was profoundly impressed by the horrors of the Great War – subsequently numbered as World War I – partly because of the vicissitudes of the Austrian refugee children his parents had lodged. Later, in Leiden as a student, when he was invited by his mailman to join him on his rounds, he was appalled by the conditions of poverty in which the local population lived. Wishing to contribute to the combat against such social evils, he decided to become an economist. This decision was characteristic of Tinbergen and his attitude towards economic science in his later life: his scientific contributions would always be inspired by the desire to tackle the social problems he observed. Paul Ehrenfest, professor of theoretical physics and Tinbergen's mentor in Leiden, was not unsympathetic towards the switch from physics to economics. Having made important contributions to statistical mechanics together with his wife Tatyana Afanasyeva, he called Tinbergen's attention to the possibilities that a mathematical representation of

economic problems would offer. The dissertation on minimum problems in physics and economics that Tinbergen defended in 1929 bridged the two disciplines.

#### *Econometric modelling and business cycle research*

In 1969 Tinbergen was awarded, together with R.Frisch, the first Nobel Prize in Economics “for having developed and applied dynamic models for the analysis of economic processes” as the Nobel Prize committee described it.

The desire to combat the socio-economic consequences of the great depression of the 1930s was Tinbergen’s most important motivation for studying business cycles. In his inaugural address as extraordinary professor in 1933 he summarized his project as “statistics and mathematics in the service of business cycle research”. His approach contrasted with studies of business cycle research that had been taken up before then<sup>1</sup>. After a nineteenth century undertaking by Juglar (1862) ascribing the recurrent business crises in Europe and North-America to credit crises and Jevons’ (1884) study pointing at agricultural production cycles connected with sunspot numbers, several research projects in the early twentieth century were devoted to the construction of so-called ‘business cycle barometers’. The purpose was to measure economic fluctuations through a particular index (or set of indices) with the aim of giving warning signals for turning points that would lead to a depression. An example was the Harvard Index of Business Conditions, informally known as the Harvard Barometer, constructed by a team led by Persons (1919, 1927). Another well known descriptive approach to the business cycle during this period had been initiated by Mitchell (1913). His work was followed by Yule (1927) and Slutsky (1927) who suggested that the cumulative effect of random shocks could be the cause of cyclical patterns in economic variables. Frisch (1933), co-recipient of the 1969 Nobel Prize, applied these ideas introducing econometric models in which impulse propagation mechanisms led to business cycles.

However useful it could be as a starting point, Tinbergen criticized descriptive analysis as being too vague for use in policy preparation and started a quantitatively oriented research programme to explore possible economic causes for the periodic up- and downswings in economic activity. In an earlier theoretical study Aftalion (1927) had argued that lags in an economic model could generate cyclical variation in economic activity. Following up on this argument, Tinbergen specified a first simple case using a system of difference equations to express lagged responses of supply to prices changes in a market for a single good. He noted that the systematic fluctuations that could arise in such a system had been observed in an empirical study of the pork market by the German economist Hanau (1928), a phenomenon that became known as the ‘cobweb model’<sup>2</sup>.

Tinbergen subsequently generalized the specification of dynamic equations with lagged adjustment processes to macro-economic settings arguing that fluctuations in components of national product, such as investment and consumption expenditures, would lead to business cycle fluctuations in general economic activity. In 1936 he published the first applied macro-econometric model (for the Netherlands). It was a dynamic model, consisting of 22 equations in 31 variables. Employing what we now see as basic statistical techniques like correlation and regression analysis, it was meant to be used for the analysis of the particularly pressing unemployment problem. The specification of the equations of this model was very much inspired by

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<sup>1</sup> For more details, see *e.g.* Morgan (1990).

<sup>2</sup> Tinbergen (1979) presents additional relevant literature.

the work of Keynes. This modelling exercise resulted in a strong policy recommendation in favour of a devaluation of the Dutch guilder to tackle unemployment. But its importance for the economics profession was far more profound: for the first time the economic-policy debate had been based on empirically tested, quantitative economic analysis and not on rather informally stated economic theory, the so-called verbal approach. Thus, according to Solow (2004), Tinbergen's work during this period "was a major force in the transformation of economics from a discursive discipline into a model-building discipline."

In 1936 Haberler had published a survey of theories on business cycles for the League of Nations. As a follow-up, and in reaction to the dynamic model for the Netherlands Tinbergen had published in that year, the same institution invited him to examine statistically which factors could be considered to contribute most to macro-economic fluctuations. This project resulted in his two-volume book *Statistical Testing of Business Cycles Theories* (1939). The first volume contained a description of the methodology applied, while the second volume presented a dynamic macro-econometric model for the United States with the aim of studying business cycles in that country after World War I. This model was not only considerably larger than the one for The Netherlands. As imports and exports were much less important for the United States, it also allowed a relatively undisturbed view of internal dynamic mechanisms. Subsequently, the US model was much refined and enlarged by Klein (1950) and Duesenberry *et al.* (1965). Tinbergen presented his views on the dynamics of business cycles and on objectives and instruments of business-cycle policy for a wider audience in Tinbergen (1943) and Tinbergen and Polak (1950).

#### *Discussion with Keynes*

Tinbergen's modelling approach was to a large extent inspired by Keynes' publications. But Keynes' sceptical evaluation of Tinbergen's work in the *Economic Journal* of 1939 was remarkable also for other reasons. Keynes labelled Tinbergen's method of estimating the parameters of an econometric model and computing quantitative policy scenarios as 'statistical alchemy' arguing that this approach "... is a means of giving quantitative precision to what, in qualitative terms, we know already as the result of a complete theoretical analysis." Their widely diverging views on the relevance of quantitative economic analysis were clearly illustrated also by Keynes' reaction to Tinbergen's estimate of the price elasticity of demand for exports. When, in 1919, Keynes had strongly criticized the excessive war indemnity payments enforced upon Germany after World War I, his argument had depended critically on the value of this elasticity. Tinbergen empirically found this value to be minus 2, precisely the value that Keynes had assumed *a priori* in his study. When informed about this Keynes replied: "*How nice that you found the correct figure.*"

#### *Theory and Practice of Economic Policy*

In 1945 Tinbergen was appointed as director of the newly established Central Planning Bureau, an institution occupied with forecasting the effects of economic policy and advising the government on related matters (tasks which are more adequately captured by its present-day English name: Netherlands Bureau for Economic Policy Analysis). In the aftermath of World War II work at the CPB concentrated on the nation's pressing macro-economic problems: a depleted capital stock, severe inflationary pressure, low levels of employment and an extreme shortage of foreign exchange. It led to the writing of several monographs on the theory of economic policy models (1952 and 1956). Building on earlier work by Frisch

distinguishing between various types of variables in relation to their role in policy models, Tinbergen demonstrated the connection between the analytical, or explanatory version and the policy, or normative version of economic models. In the analytical version, the policy targets were explained by other endogenous variables and by exogenous variables, among which the policy instruments. In the policy version the position of targets and instruments would be reversed (targets becoming exogenous and instruments endogenous variables) such that, in a well-behaved linear system, their numbers must be equal for a solution to be obtainable.

#### *Development economics*

In reaction to his experiences during a trip to India in 1951 Tinbergen left the Central Planning Bureau in 1955 and moved to the field of development economics, more specifically: the planning of socio-economic development of low-income countries. Much earlier he had published a mathematical-statistical study of the theory of long-term economic growth, but this had still related to industrialized countries (1942). In the model technological progress had explicitly been included and the statistical tests (using data for England, France, Germany and the United States from the decades before World War I) already suggested that capital and labour growth could explain only a relatively small portion of the growth of production.

Characteristically, Tinbergen applied a quantitative, systematic policy approach to the development problem. This approach, which became known as 'planning-in-stages', distinguished a macro, middle and micro-stage, dealing with policy problems of private and public decision-makers at the national, sectoral and project level, respectively (1967). In view of the difficult transportation conditions and the scarcity of skilled labour in developing countries he subsequently added spatial and educational dimensions to the backbone of the planning-in-stages approach. He greatly simplified the calculation procedure for project evaluation by devising the semi-input-output method. This method was based on the notion that only the indirect effects emanating from sectors producing non-tradable (national) goods need to be incorporated. In a time when computer capacity was still very limited, such a simplification was most useful. However, consistency between the micro stage and the other two levels was achieved only with the advent of computable general equilibrium models.

Tinbergen acted as advisor on matters related to economic development to the governments of Egypt, Turkey, Venezuela, Surinam, Indonesia and Pakistan and he wrote studies for international organizations as UNESCO and the OECD. As Chairman of the UN Committee on Development Planning from 1965 to 1972 he was involved among others with the preparation of the UN Second Development Decade (1971-1980).

#### *Income distribution*

Tinbergen revisited the field of income distribution after his retirement as full professor (1972 and 1975). His approach, then as much as before, was inspired to a considerable extent by the positional-exchange criterion that had emerged from discussions in his student days with Paul Ehrenfest. According to this criterion a distribution of welfare could be considered fair when no one would wish to take another person's position. It was, for example, expressed in the individual welfare function Tinbergen proposed which depended negatively on the difference (positive or negative) between the level of schooling required for a job and the actual schooling obtained by the person on this job. The notion that an income distribution is the

outcome of a confrontation of demand and supply factors was another characteristic element of his approach. Thus, the development of a country's income distribution would be governed to a large extent by the process of technological innovation (a demand factor) and the rise of educational attainment levels (a supply factor). On the basis of material from the United States and The Netherlands from 1900 onwards he found that this 'race' was mostly won by the rise in education which resulted in more equitable distributions.

In his contributions to the field of income distribution – which concentrated on the remuneration of labour categories – he aimed to examine the effect of some unorthodox propositions. One such proposition was to consider the applicability of a capability tax which, as a lump sum tax, would be preferable to the familiar income tax<sup>3</sup>. Further, and true to his conviction that scientific progress and practical applications depended on quantitative tests of hypotheses, he treated welfare as measurable on the assumption that further progress in this area would be feasible. Assuming that workers move freely from one job to another so utility would be equalized, he derived an empirical relation expressing the connection between wage income on the one hand and attained schooling and the difference between attained and required schooling on the other. He then used this relation to compute an optimal or just distribution of income, tentatively relating to the situation in The Netherlands in the early 1960s. It would require very considerable shifts in income as compared with the actual situation.

#### *International Economic Integration*

Tinbergen's earliest work on international economic relations was still connected with national policy-making. Thus, his estimates of price elasticities of trade packages were meant to examine the effectiveness of a devaluation policy, where he emphasized the need to use long-term rather than short-term elasticities. His gravitation model (1962) was a Newtonian approach to the explanation of bilateral trade flows which appeared to depend positively on the GNPs of the trade partners and negatively on the shipping distance separating them. It could be used to identify among others the magnitude of potential trade lost to higher-than-average trade barriers which impeded the efficient international division of labour he advocated in a number of studies written in the 1960s. Tinbergen (1954) applauded the international economic integration movement as it could remove trade barriers (which he dubbed negative economic integration) and could even result in new institutions for co-ordinated and centralized policy-making (positive economic integration). But he attached particular importance to the fact that economic integration would effectively reduce the probability of armed conflicts. From historical processes in Europe he derived a 'velocity of integration' which he hoped would remain positive until full integration at the regional and indeed the world level would be achieved (1991).

#### *The Optimal Regime*

His life-long concern for (inter)national policy making and, in that context, his special concern for the underdog resulted in a number of publications on the optimal economic order. In a deviation from his usual approach, Tinbergen emphasized in his Nobel Prize acceptance speech (1970) that the problem here consisted not of establishing the right mix of values of economic variables, but of finding the proper

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<sup>3</sup> Remarkably, this proposal ran counter to his finding that tax changes have a very slight impact on primary incomes such that tax shifting would hardly be a problem.

set of institutions regarding the size and content of the public sector, the extent and content of (de)centralization of socio-economic decision making and therefore also of market regulation. The goal would be achieved with the realization of an optimal combination of efficiency and equity. He argued against rigidities, privileges, monopolies and insider-determined remunerations that bore no relation to marginal productivities, but he also rejected excessively generous social security systems that invited rent seeking.

In Tinbergen's view the interests of developing countries deserved separate attention in discussions on the optimal economic order. No country would accept within its borders an income inequality between groups of rich and poor citizens as could be found between rich and poor countries in the world. Not only must obstacles to exports from developing countries be removed. It would also be necessary to support these countries' development efforts by providing technical and financial aid. Tinbergen urged to replace the arbitrary UN target for international aid of 0.7 percent of GNP of rich countries by the volume of aid that would be required for a harmonization of incomes within a predetermined number of years. He coordinated a study for the Club of Rome (1977) offering views on the international order, development aid, food production, the international division of labour, energy sources and raw materials, technological development, the environment and the arms race, among others.

With the help of the theory of the optimal regime Tinbergen further sought to rid the confrontation of the communist East and the capitalist West of the dogmatic character that dominated world politics before the fall of Communism in 1989. Horrified by the prospect of nuclear warfare he devoted a large part of his later years to a plea for a rational debate on the pros and cons of both systems and for a stronger role of a reformed United Nations taking decisions that would incorporate international external effects (1990).

### *In conclusion*

Tinbergen's contribution to the economics discipline lies in the pioneering work he did in a number of different economic fields. He would not consider himself an expert even in these areas, would gladly admit that others who had come in after him had meanwhile gained a better understanding and he would move on to another area where another pressing social problem needed to be addressed. In his own words: "*Solving the most urgent problems first*" is what moved him most in his intellectual agenda.

He had little patience for studies lacking use for practical problems and was not much impressed by scientific elegance for its own sake. His work discipline, punctuality and efficiency were exemplary. For an appointment students and assistants he supervised would get seven minutes on the watch he would keep nearby. Still, Tinbergen also gave innumerable lectures for organizations and social action groups even of humble status.

His intense desire for a more humane world led him to put great trust in the benevolence and effectiveness of governments and international organizations, realizing that policies to overcome social problems would nearly always require the participation of public institutions. The latter's serious shortcomings in terms of management and governance were just another problem to be solved. He nursed a strong hope that people would behave more sensibly over time and learn to avoid the terrible conflicts that had caused so much suffering and devastation in the twentieth century. It was for all these characteristics that Samuelson (2004) described Tinbergen

as ‘a humanist saint’. Naturally, during his long life Tinbergen was often deeply disappointed. Still, his optimism never left him, if only, as he said at an advanced age: “I cannot afford to be pessimistic”.

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