

REVIEW



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Jean Tirole: Mathematician-Economist-Humanist

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ABSTRACT

Jean Tirole, the Nobel Prize winner in Economic Sciences in 2014, who in November 2018 visited the Financial University in Moscow, presents one of the most striking examples of the evolution currently experienced by some modern economists. He started his career as an economist at the time of rapid development of theories of regulation and competition policy. It was also the time of intensive development of industrial organisation (industrial economy), and especially its branch oriented to the public policy issues – economic regulation, antitrust law, and, more generally, economic governance of law in defining property rights, enforcing contracts, and providing organisational infrastructure. The progress in these areas reflected two methodological breakthroughs: the game theory and the theory of mechanism design. The widening use of game theory in industrial economics led to the migration of its achievements into other branches of microeconomics, such as behavioural economics and corporate finance. In 1978, Jean Tirole left for the USA to get a PhD in Economics at the Massachusetts Institute of Technology (MIT). He began his formation as an economist. The article tells about Jean Tirole's way from an engineer and mathematician to the world-class economist. The author has paid special attention to the traditions of the French economic science, which had a considerable impact on the main areas of scientific interests of Jean Tirole. Tirole's managerial skills allowed to build an entire scientific school around him both at the University of Toulouse and the Jean-Jaques Laffont Foundation, and in the newly formed Institute for Advanced Research.

Keywords: marginalist revolution; industrial economics; game theory; mechanism design theory; common good; public good; externalities; oligopoly theory; imperfectly competitive markets; market power

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ОБЗОР

Жан Тироль: математик-экономист-гуманист

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АННОТАЦИЯ

Жан Тироль, лауреат Нобелевской премии по экономическим наукам 2014 г., посетивший в ноябре 2018 г. Финансовый университет в Москве, является одним из самых ярких примеров эволюции, которую переживают некоторые современные экономисты. Его карьера началась в период бурного развития теорий регулирования и конкурентной политики. Это было также время интенсивного развития теории промышленной организации (индустриальной экономики), особенно ее отрасли, ориентированной на вопросы государственной политики – экономического регулирования, антимонопольного законодательства и, в более общем плане, экономического управления при определении прав собственности, принудительном исполнении договоров, обеспечении организационной инфраструктуры. Прогресс в этих областях отражал два методологических прорыва: теорию игр и теорию проектирования механизмов. Расширение использования теории игр в экономике промышленности привело к миграции ее достижений в другие отрасли микроэкономики, такие как поведенческая экономика и корпоративные финансы. В 1978 г. Жан Тироль отправился в США, чтобы получить степень доктора экономических наук в Массачусетском технологическом институте (MIT), где он начал свое становление как экономист. В статье представлен путь, проделанный Жаном Тиролем от инженера и математика до экономиста мирового класса. Особенное внимание автор уделил традициям французской экономической науки, оказавшим немалое влияние на основные сферы научных интересов Жана Тироля. Менеджерские способности Тироля позволили ему создать научную школу как в Университете Тулузы и фонде имени Жана-Жака Лаффонта, так и в новообразованном Институте перспективных исследований.

Ключевые слова: маржиналистская революция; промышленная экономика; теория игр; теория проектирования механизмов; общее благо; общественное благо; теория олигополии; несовершенные конкурентные рынки; рыночная власть

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MATHEMATICS FIRST

“Life is good for only two things: doing mathematics and teaching it.”

Siméon-Denis Poisson

At the beginning of his studies in high school, economics was not for Jean Tirole's choice. He was interested in mathematics and social sciences, in particular, in history and psychology. After preparatory studies at the Lycée Henri Poincaré in Nancy (1971–1973), he then entered the l'École Polytechnique (founded in 1794) in 1973, famous for its high level of teaching mathematics. Here, a great event has happened in his school years when he has attended his first course in economics at the age of 21. He was fascinated by the issues and liked how it combines rigorous analysis and social sciences. He started thinking about becoming an economist. However, he had to study first. From 1976 to 1978 he studied in the l'École Nationale des Ponts et Chaussées (founded in 1747 by Daniel-Charles Trudaine, now l'École des Ponts ParisTech), and received a “doctorat de troisième cycle” (an intermediate degree between a Master degree and a PhD, which has disappeared since then) in *decision mathematics* from Université Paris-Dauphine (1976–1978). Despite thinking about economics, he became a mathematician and engineer. But not for long.

In 1976 Jean Tirole joined the engineering *Corps des Ponts et Chaussées*. In 2009, the *Corps des ponts et chaussées* (in English “Corps of Bridges and Roads”) and the *Corps du génie rural, des eaux et des forêts* (in English “Corps of Rural Engineering, Waters and Forests”) merged into the current *Corps des ponts, des eaux et des forêts*. It is not just that *Corps des Ponts et Chaussées* (founded in 1716) was and stays until now the elite corps of French engineers. It is also a think-tank in the sphere of engineering and economics. Among the important former or current members of the *Corps des ponts et chaussées* are Henri Becquerel, Augustin-Louis Cauchy, Jules Dupuit, Augustin-Jean Fresnel, Louis Joseph Gay-Lussac, Charles Joseph Minard, Claude-Louis Navier, and, of course, Jean Tirole.

TRADITION AND CONTINUITY

l'École Polytechnique does not require advertising, given that among its graduates are listed mathematicians: Augustin Cauchy, Henri Poincaré, Paul Lévy, Joseph Liouville, Benoît Mandelbrot; economist Maurice Félix Charles Allais (the winner of the Nobel Memorial Prize in Economic Sciences in 1988 “for his pioneering contributions to the theory of markets and efficient utilization of resources”), Jacques

Léon Ruffé, Alfred Sauvy; physicists and chemists François Arago, Henri Becquerel, Sadi Carnot, Louis Joseph Gay-Lussac, Anne-Marie Lagrange; and also Valéry Giscard d'Estaing, André Citroën, Jean-Jacques Servan-Schreiber, and French marshals Ferdinand Foch and Joseph Joffre. This tradition of excellence was very important in Tirole's development into a scientist and a researcher.

The intellectual tradition of microeconomic inquiry can be traced back to the works of the members of the *Corps des Ponts et Chaussées*. However, when we seek in the protohistory of microeconomics, we should to remember that most of the French works of “engineer-economists” have not been translated into English. Moreover, those writings belong mainly to the engineering literature, which is not the usual place to look for the origins of economics.

Engineering degrees in the French tradition were fairly mathematics-oriented. It is not a surprise they were the first in the application of mathematics, in the analysis of economic issues. As Tirole already noted, indeed, applied economic theory offers some analogies with engineering sciences.

It was in 1999 when Robert Ekelund and Robert F. Hébert edited their book *Secret Origins of Modern Microeconomics: Dupuit and the Engineers* [1]. The main thesis of Ekelund and Hébert's book is that “Microeconomics as we now know, was developed first and foremost by engineers rather than economists, and that its origins were French rather than British” (p. xi). Further, they write “French econo-engineers, and a few kindred ‘foreigners’ who were drawn into their orbit, were not merely forerunners of neoclassical microeconomics: they were its inventors” (p. 11). Indeed, it is only in France, where it was possible to coin the term “engineer-economists”. Who was “this strange beast: the French engineer whose skills made him attack from a formal and theoretical viewpoint practical problems”, as already wrote Nikos Theodorakis. It was Arsène Jules Étienne Juvenel Dupuit (1804–1866) — an Italian-born French civil engineer self-taught in economics.

Toll questions, consumer surplus, and willingness to pay. In 1844 Dupuit published an article [2] concerning the optimum toll for a bridge (*Fig. 1*). Here, he introduced his curve of diminishing marginal utility for the first time. If somebody asks where any continuity can be found, then I'll point to Tirole's Nobel Prize Lecture “Market Failures and Public Policy” (December 8, 2014) [3], where he explains *royalty stacking*, the analogy to medieval Europe, where the river transit was hampered by a multiplicity of tolls; for instance, there were 64 tolls on the Rhine River in the 14th century. However, in the 30-s and 40-s of the 19th century, there was no



Fig. 1. Paying Toll on passing a Bridge. From a Painted Window in the Cathedral of Tournay (Fifteenth Century)

Source: URL: https://en.wikipedia.org/wiki/Toll_bridge (accessed on 04.02.2019).

welfare economics with ready answers about delivering of public goods and common goods.

What might make sense for profit-oriented private projects, can evidently be unsatisfactory for public works, where the objective is not to benefit the builder, but rather to benefit the whole community. However, the question arises on how to measure public benefits. It was what Dupuit set out to resolve using *cost-benefit analysis* developed by the father of structural analysis, Claude Louis Marie Henri Navier (1785–1836). In his article [4] published in 1830 about the evaluation of public works (roads, bridges, etc.), appealing to the cost-oriented classical economics, Navier proposed to measure the benefit to the community in terms of “costs saved” by consumers. Navier proposed a *decision rule*, meaning that projects should only be undertaken if the total community benefit exceeds total recurring costs. It means that annual cost savings to users of a road exceeded the interest on capital plus maintenance costs of the road. Dupuit made two important corrections and suggested calculating *consumer surplus* instead. However, there is no sophisticated mathematics in Deposit’s works, except that algebraic equations.

Notable that Antoine Augustin Cournot (1801–1877) was born in 1801 when *Principes d’économie politique*

by Nicolas-François Canard (1750–1833) was edited — the book mostly influenced Cournot. In the same year second French great mathematician-economist Antoine-Auguste Walras was born (1801–1866). While Antoine-Auguste Walras was coeval of Cournot, Vilfredo Federico Damaso Pareto (1848–1923) was a ten-year-old child when Cournot published his *Recherches sur les principes mathématiques de la théorie des richesses* [5].

During his study of mathematics in Paris (Sorbonne University), Cournot attended seminars at the Academie des Sciences and the salon of economist Joseph Droz. Also, he was under the intellectual influence of Pierre-Simon Laplace (1749–1827) and Joseph-Louis Lagrange (1736–1813). At that time, Jean Nicolas Pierre Hachette (1769–1834), French mathematician and a former disciple of Marquis de Condorcet, attracted his attention to the *principles of mathématique sociale*. The idea of the principle is that social sciences, like natural ones, could be dealt with by means of mathematics. It was Marie Jean Antoine Nicolas de Caritat, Marquis de Condorcet (1743–1794), the father of social mathematics, who believed that socio-economic phenomena and policies ought to be studied and dealt with by mathematical and statistical methods, the author of “Condorcet theorem” (if the individual probability of

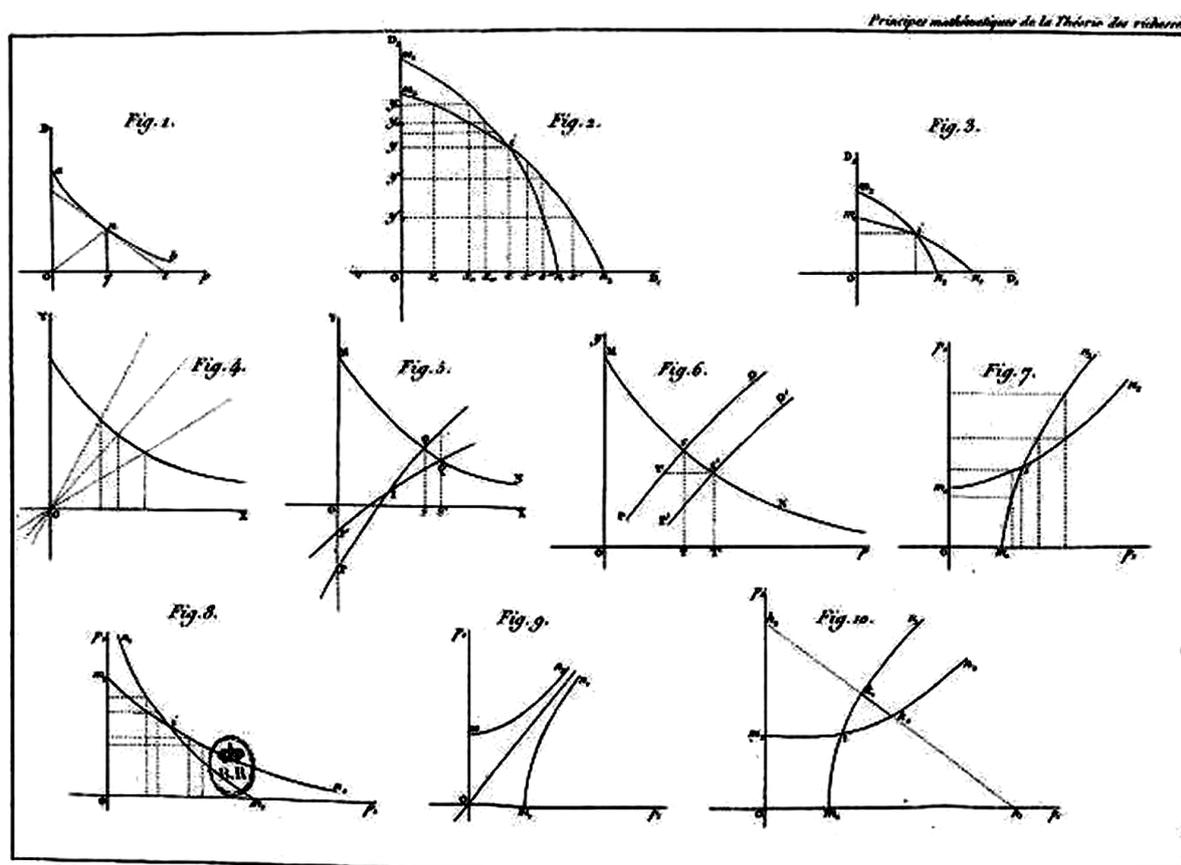


Fig. 2. Cournot graphical representation

Source: Cournot Augustin. *Recherches sur les principes mathématiques de la théorie des richesses*. Paris; 1838.

reaching a correct decision is less than a half, then the probability that a voting assembly will reach the correct decision diminishes) and the “Condorcet paradox” (if individual voter preferences are transitive, the collective outcome can exhibit intransitive preferences).

In 1829, Cournot became a Doctor of Science (mechanics and astronomy) having already licentiate in mathematics (1823). The thesis and a few of his articles draw attention of mathematician Siméon-Denis Poisson (1781–1840). In 1838, at instigation of Poisson, Cournot was called to Paris as Inspecteur Général des Études. In the same year, Cournot published his main work in economics, *Recherches sur les principes mathématiques de la théorie des richesses*, where he acknowledges Nicolas-François Canard his only predecessor. Unfortunately, his work hardly received any response because of the *French Liberal School*, who dominated the profession of the economists in France at the time with the infallibility of a self-regulating system of markets and a *radical laissez-faire* line. This is why Karl Marx would later deride them as the “vulgar” economists. Cournot was left crushed and bitter. In 1863, Cournot rewrote his *Recherches* in a more popular way, without the mathematics, but again, it was completely neglected.

Nevertheless, Cournot was the first author who presented his analysis with graphical representation (Fig. 2). Indeed, a diagram is worth a thousand words. At this time, the use of graphical methods was no better illustrated than in the works of Charles Joseph Minard (1781–1870) [6].

Achylle-Nicolas Isnard (1749–1803) was one of the first of a long string of French “engineer-economists”. Isnard was critical of the Physiocratic doctrine. In 1781, he anonymously published *Traité des richesses* (in two volumes) [7], where he tried to show arithmetically that industry, and not only agriculture, could produce a ‘*produit net*’. Secondly, he showed that the surplus accrues not to landlords as such, but to all owners of *scarce* factors of production. Isnard also addressed the determination of prices in exchange, setting the problem out with the help of mathematic equations in a multi-good scenario as a system of equations, counting equations and unknowns, determining the numeraire, etc. It was a new way of thinking about the methodology of economic analysis. Isnard’s writings were highly influential upon Léon Walras (Fig. 3).

In short, published in September 1883 in *Journal des Savants* the article *Théorie Des Richesses* by French mathematician Joseph Louis François

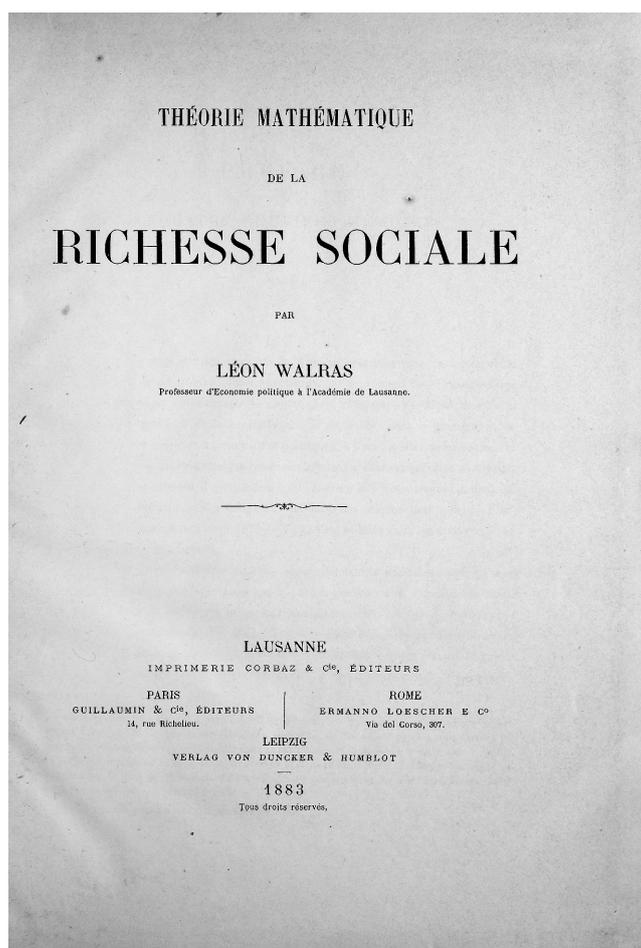


Fig. 3. Copy of Léon Walras *Théorie mathématique de la richesse sociale*, 1883

Source: https://en.wikipedia.org/wiki/File:Walras_-_Th%C3%A9orie_math%C3%A9matique_de_la_richesse_sociale,_1883_-_5834436.tif (accessed on 04.02.2019).

Bertrand (1822–1900), reviewed the work of Augustin Cournot (*Recherches sur les principes mathématiques de la théorie des richesses*, par Augustin Cournot, Paris, 1838) and of Léon Walras (*Théorie mathématique de la richesse sociale*, par Léon Walras, Lausanne, 1883). He paid special attention to Cournot’s oligopoly theory, specifically the Cournot’s competition model. Bertrand argued that the Cournot conclusion was flawed and misleading. Thus, he used prices rather than quantities as the strategic variables, showing that the equilibrium price was simply the competitive price. In 1889 Bertrand’s idea was further developed into a mathematical model by Francis Ysidro Edgeworth.

The marginalist revolution was not only the work of Swiss-French-Italian economist and mathematicians. Significant contributions were also made by Hermann Heinrich Gossen (1810–1858), William Stanley Jevons (1835–1882), Carl Menger (1840–1921), Marshall Alfred (1842–1924), John Bates Clark (1847–1938), Friedrich Freiherr von Wieser (1851–1926).

FRENCH TRACK

Glorious tradition of Dupuit, Minard, Isnard Cournot, and Walras continued in XX century François Divisia (1889–1964), René François Joseph Roy (1894–1977), Marcel Boiteux (born 1922). François Divisia was a French economist most noted for the Divisia index and the Divisia monetary aggregates index [8–10]. René Roy was seriously wounded on 14 April 1917, as a result of which he was struck blind at the early age of 23. Despite that he obtained two careers, as an engineer and a economist, lasting for 60 years. He is recognised for a major result in microeconomics now known as Roy’s identity [11]. It is a framework for analysing comparative advantage. Marcel Boiteux is most famous for his 1949 development of “peak-load pricing” and his 1956 theory of second-best pricing in public monopoly (known as “Ramsey-Boiteux” prices) [12].

Maurice Félix Charles Allais (1911–2010) was a French physicist and economist, most known for his contribution, along with John Hicks and Paul Samu-

elson, to neoclassical synthesis. Even though being titled as a doctor-engineer from the University of Paris (Faculty of Science) in 1949, after his visit to the United States in 1933 during the Great Depression, he already decided to devote himself to the economy. He is 1988 winner of the Nobel Memorial Prize in Economic Sciences “for his pioneering contributions to the theory of markets and efficient utilisation of resources”. Allais died at his home at the age of 99. He was French *par excellence* — reluctant to write in or translate his work into English. That is why many of his major contributions became known to the dominant community only when they were independently rediscovered or popularised by English-speaking economists.

Gérard Debreu (1921–2004) passed the *agrégation de mathématiques* exams at the end of 1945 and the beginning of 1946. Being under the strong influence of the lecture of Henri Paul Cartan’s lecture (1904–2008) (French mathematician who made a significant contribution to algebraic topology) he also became interested in economics, particularly in the general equilibrium theory of Léon Walras. Also, the works of French economist Maurice Allais had a strong influence on him. Working from 1946 to 1948 in the Centre National de la Recherche Scientifique he moved from mathematics to economics. In 1948, Debreu visited the United States where he visited several American universities. In 1950, he began working in the USA and became the US citizen in 1975. In 1983, he was awarded a Nobel Memorial Prize in Economic Sciences.

The marginalist revolution turned political economy from the ‘science of what is’ to the science of ‘what might be if...’ As Robert Solow already said “Today if you ask a mainstream economist a question about almost any aspect of economic life, the response will be: suppose we model that situation and see what happens. Modern mainstream economics consists of little else but examples of this process.” Unfortunately, we can observe the double change of paradigm — the transformation of political economy into economics, i.e. a branch of mathematics and, second, from the object (reality) to subject (subjective perception of reality), i.e. human behaviour or psychologisation of economic science. The emergence of the concept of marginal was related with the attempts of economists to explain the determination of price. However, this resulted in the domination of the subjective theory of value. Classical political economy disappeared forever.

WHY ECONOMICS?

Perhaps the most significant impact on the fate of Tirole had a meeting with Roger Guesnerie who he met while giving classes at the l’École Polytechnique,

at l’École des Ponts and who also was my adviser in Paris. He has specialised in the fields of general equilibrium with non-convexities, disequilibrium macroeconomics and public economics; his doctoral advisor was Jean-Jacques Laffont and the most known doctoral student was Thomas Piketty. His professional activity was also influenced by the friendship with Roland Bénabou and Bernard Caillaud (obtained a PhD at the MIT (1988) for thesis *Three Essays in Contract Theory: On the Role of Outside Parties in Contractual Relationships*”; his doctoral advisers were J. Tirole and O. Hart).

Roland Bénabou obtained his PhD in economics at the MIT in 1986, and Olivier Blanchard and Jean Tirole were his doctoral advisors. Bénabou published numerous papers jointly with Tirole. His knowledge in economics and psychology (“behavioural economics”), particularly in issues such as extrinsic incentives versus intrinsic motivation, determinants of prosocial behavior and motivated beliefs, both individual (overconfidence, wishful thinking, identity) and collective (groupthink, market manias, ideology, religion) was very helpful for Tirole’s researches.

In 1978 Jean Tirole started his PhD studies in Economics at the Massachusetts Institute of Technology (MIT), which he graduated from in 1981. At that time he was indeed a pioneer in the field of economics. During the second year, he studied four aspects — theory, public finance, econometrics, and international economics. He then started a thesis under the supervision of Eric Maskin, a 29-year-old MIT professor (2007 Nobel Prize winner).

Due to his classmate Drew Fudenberg, Tirole discovered industrial organization and regulation, the fields he was not aware of prior to his PhD studies, widely popularised by Paul Joskow (he worked at a faculty of the MIT from 1972, and from 1994 to 1998 he was the Head of the MIT Department of Economics) and Richard Lee “Dick” Schmalensee. It was also the time of rapidly evolving fields of *game theory* and *contract theory* due to the works of John Forbes Nash, John Harsanyi, and Reinhard Selten (all 1994 Nobel Prize winners for *game theory*, with a focus on non-cooperative solution concepts).

The friendship and scientific collaboration with Drew Fudenberg resulted in two books — *Dynamic Models of Oligopoly*, (by the way, it was his first book at all) and PhD-level textbook for doctoral students called *Game Theory* [see Appendix]. His first book presents a picture of economy as an ever-evolving and non-static system and stands as a document to the more detailed and realistic approach to economic modelling which Tirole did so much to foster.

In 1988 Jean Tirole presented his second book *The Theory of Industrial Organization*, the text-book for the advanced-undergraduates and graduates, supplemented with exercises indicating the level of difficulty. Here we find a novel treatment for the Bertrand-Cournot interdependent pricing problem. He concludes his book with “a game theory user’s manual”, the harbinger of his second book *Game Theory* published in 1991.

In June 1981, J. Tirole submitted his doctoral thesis *Essays in Economic Theory* to the Department of Economics (“in partial fulfilment of the requirements for the degree of Doctor of Philosophy”). In essay I “On the Efficiency of Fixed Price Equilibria” (with Eric Maskin) studied the properties of fixed-price equilibrium and related concepts were studied. In Essay II “Capital as a Commitment: Strategic Investment in Continuous Time” (with Drew Fudenberg) Tirole analysed how an early entrant in a market can exploit its head-start by strategic investment. The analysis was based on 2001 Nobel Prize winner A. Michael Spence’s (1979) paper “Investment Strategy and Growth in a New Market” (published in *Bell Journal of Economics*. 1979; 10(1):1–19). Essay III “On the Possibility of Speculation Under Rational Expectations” considered the possibility of static and dynamic speculation when traders have rational expectations.

In 1981 (after the PhD studies), he came back to France to work as a researcher at the l’École Nationale des Ponts et Chaussées (ENPC). At that time, an economics research centre (CERAS) was established where he met Roger Guesnerie and Bernard Caillaud again. In 1980 in Rio he met Jean-Jacques Marcel Laffont (1947–2004) at the Econometric Society conference. Jean-Jacques Marcel Laffont obtained his PhD (1975) at the Harvard University (his doctoral advisors were 1972 Nobel Prize winner Kenneth Arrow and Jerry R. Green). By the way, Eric Maskin who also was a student of Kenneth Arrow had already done very innovative work with Laffont. At that time, after Laffont declined calls of major American universities, he actively started establishing a school of economics in Toulouse. Not only he contributed to fundamental papers on information theory and public choice theory, but also he was the first-class organiser and manager. Unfortunately, Jean-Jacques Laffont was diagnosed with cancer in autumn 2002 and died of the disease on May 1, 2004.

It was a glorious time filled with discussions about a structural reform in such sectors as telecom, electricity, postal services and railway. J.-J. Laffont and Tirole understood that the new theories about information and industrial economics could add an important perspective on this type of reforms and their limits. First

of all, their book *A Theory of Incentives in Procurement and Regulation* where they elaborated a unified framework which deeply influenced how economists think about regulations. Next collective book *Competition in Telecommunications* analysed the regulatory reform and the competition in network industries using the state-of-the-art theoretical tools of industrial organisation, political economy, and the economics of incentives. In 1992 Tirole decided to stay in Toulouse.

Indeed, in 1982 after George Stigler was awarded the Nobel Memorial Prize in Economic Sciences “for his seminal studies of industrial structures, functioning of markets and causes and effects of public regulation”, industrial economics underwent rapid development, if not to say — a revolution. It greatly enhanced the understanding of imperfectly competitive markets and formed a foundation for a better-informed competition policy. Two methodological achievements — the *game theory* and the *theory of mechanism design*, in which J. Tirole was already an expert, stimulated the development of the *theory of optimal regulation of firms with market power*. It was also presented by Robert Aumann and Thomas Schelling who were awarded with a Nobel Memorial Prize in Economic Sciences in the field of game theory in 2005 for their analysis of conflict and cooperation and 2007 Nobel Memorial Prize winners in Economic Sciences Leonid Hurwicz, Eric Maskin, and Roger Myerson for *mechanism design theory*.

In 1981, Jean-Jacques Laffont created the Groupe de Recherche en Économie Mathématique et Quantitative (GREMAQ), a research laboratory in mathematical economics. However, the main idea of Jean-Jacques Laffont was to make the Université de Toulouse 1 Capitole (University of Toulouse 1 Capitole) one of the best European universities in the field of economic sciences. First of all, in 1990 Laffont founded the partnership-based research centre IDEI (*Institut d’Économie Industrielle*, in English Institute for Industrial Economics) located in the University of Toulouse 1 Capitole. Laffont and his friends aimed to gather in a group of leading researchers of Toulouse and wanted to use the IDEI to provide a few more resources for developing a top-level European department. Jean-Jacques Laffont was the director of the IDEI until 2002, and J. Tirole has been the IDEI’s scientific director since it was established. It is impossible to overestimate the role of Jean-Jacques Laffont in the development of the economics department in Toulouse without a strong economic tradition before him.

Nothing could memorialize Jean-Jacques Laffont better than the creation of a private foundation in 2007 — the Fondation of Jean-Jacques Laffont-Toulouse sciences économiques (Foundation Jean-Jacques Laf-

font/Toulouse School of Economics (TSE)). He was the director of the Foundation until 2009 and after that he was chairing its board and the Toulouse School of Economics (from 2007 as an independent institution and from 2011 within the University of Toulouse).

ECONOMICS – A BRANCH OF MATHEMATICS OR A SCIENCE OF A HUMAN BEING?

Were they right? Milton Friedman already said: “...economics has become increasingly an arcane branch of mathematics rather than dealing with real economic problems.” [13] Also strongly expressed by Ronald Coase: “Existing economics is a theoretical [meaning mathematical] system which floats in the air and which bears little relation to what happens in the real world.” [14]

Luis Garicano reminded of the words of Queen Elizabeth II, after she inaugurated a new building at the London School of Economics in November 2008, “She was asking me if these things are so large, how come everyone missed it?”, “Why did nobody notice?”, “No one saw this coming”. Maybe, Mark Blaug was right when he said “Modern economics is sick. Economics has increasingly become an intellectual game played for its own sake and not for its practical consequences for understanding the economic world. Economists have converted the subject into a sort of social mathematics in which analytical rigour is everything, and practical relevance is nothing” [15].

HUMANISTIC MESSAGE

Division of labour in the scientific community frequently encourages theorists to specialise in understanding the inner logic of new models. However, they usually leave the job of confronting the models with reality to more applied scientists. As a result, theoretical work sometimes seems detached from “the real world” and “relevant practice”.

At the beginning of this article, I wrote that Jean Tirole’s choice of study was not economics. Through his entire scientific life, he has been interested in other social sciences. He understands well that the major questions about human nature and society concern our understanding of behaviours and cultures. In the field of political sciences, he studied independent agencies, party organisation and electoral strategies. In the field of sociology, he is most interested in leadership and influence, cliques and collusion, stereotypes and collective reputations, real and formal authority, modes of communication. In the field of psychology, his researches concern the psychological aspects of incentives, motivated beliefs and identity. The most fruitful was a longstanding

research jointly with Roland Bénabou related to the psychological aspects [16–24].

In 2011, Jean Tirole was an inspirer, and a ‘midwife’ of the *Institute for Advanced Study* in Toulouse (IAST) in terms of the program that the French government called “Investissements d’Avenir” (Investments for the Future). As a result, they tended to select the most promising research clusters and units, the laboratories of excellence (LaBEx = laboratoires d’excellence). Today, the LaBEx IAST, the highly original scientific project successfully united political scientists, psychologists, sociologists, lawyers, anthropologists, biologists, economists and historians in a fruitful cross-disciplinary exchange. The IAST’s scientific program involves ten disciplines: anthropology, biology, economics, history, law, mathematics, philosophy, political science, psychology and sociology. It is a unified scientific project aiming to study the behaviour of human beings as evolved biological organisms who live in groups, form networks and coalitions, governed by formal institutions and informal norms, that produce and exchange scarce resources and are inspired by ideals and beliefs.

There are many fundamental questions requiring an immediate answer. For example, what motivates human behaviour? What makes humans unique? How has evolution shaped human biology and behaviour, and how do human biology and behaviour respond to cultural norms, family systems, political, economic forces and developmental experiences? What shapes preferences at individual, family, and societal levels, and what are the outcomes of those preferences? How do social groups and institutions emerge, function, and break down?

Maybe, with these and a thousand of other questions in mind Tirole decided to write his new book *Économie du bien commun*. Already in the Introduction Tirole raises questions: “Have we lost sight of the common good? If so, how might economics help us get back on track in pursuing it?” There are not only issues of distribution of public goods (decline of public services) and common goods (mainly, environmental unsustainability).

He takes the following principle as a point of departure: no matter what their place in the society is, people react to the incentives when facing them. One can think it is about *homo economicus*. It is not so. In chapter 5 Tirole strongly dissociates it from this concept. Here he discusses other dimensions of human beings — *homo psychologicus*, *Homo socialis*, *Homo incitatus*, *Homo juridicus*, *Homo Darwinus*. However, we should remember that the fiction of *homo economicus* is the hypothesis that human beings in their decisions are rational. It has a straightforward connection with

the subjective theory of value — the substratum of modern economics.

Indeed, researchers in economics have increasingly incorporated contributions from other social and human sciences to improve our understanding of the behaviour of human beings (individuals and groups). It was not surprising for a professional economist that 2002 Nobel Memorial Prize in Economic Sciences was awarded to Daniel Kahneman, an Israeli-American psychologist and economist, mainly well-known for his work on the psychology of judgment and decision-making, and behavioural economics. His empirical findings call into question the assumption of human rationality prevailing in modern economic theory. Perhaps, the economics with its manic desire to model everything mathematically is now the past, and we will witness the resurgence of the political economy. Moreover, we are now witnessing the development of new branches of economic sciences — Neuroeconomics (JEL D 87) [25, 26].

The concept “tragedy of the commons” became widely known after an article was written by the American ecologist and philosopher Garrett Hardin in 1968 [27, 28]. The term (concept and phrase) originated in an essay written in 1833 by the British economist William Forster Lloyd who analysed unregulated grazing on common land (also known as a “common”) in Great Britain and Ireland. Today, the term is used in social science and political economy to define a problem when *all* individuals have equal and open access to a shared-resource system or more widely as the “open access problem”. It is a controversy between self-interest behaviour and the *common good* of all users.

Elinor Claire “Lin” Ostrom (1933–2012) was an American political economist whose work is associated with the New Institutional Economics (Ronald Coase, Douglass North, Oliver Williamson, Daron Acemoglu and others) and the resurgence of political economy. She was blamed for having poor math skills. Elinor Ostrom was awarded the Nobel Memorial Prize in Economic Sciences in 2009 (“for her analysis of economic governance, especially the commons”) for demonstrating exactly this concept in her book *Governing the Commons* [29]. Until today she remains the first and the only woman to win the Nobel Memorial Prize in Economic Sciences. She “... has challenged the conventional wisdom that common property is poorly managed and should be either regulated by central authorities or privatised” [30].

In their article, Frank van Laerhoven and Elinor Ostrom stated: “Prior to the publication of Hardin’s article on the tragedy of the commons (1968), titles containing the words ‘the commons’, ‘common pool

resources’, or ‘common property’ were very rare in the academic literature” [31]. Jean Tirole also looks for the answers to these questions. In his articles, written in collaboration with Julien Beccherle, Josh Lerner and others, they discussed the conditions of efficient institutions against climate change because climate change is expected to dramatically deteriorate the well-being of future generations [32–39].

FINANCE MATTERS

In one of his first articles (see also [40, 41]) devoted to financial issues [42], Jean Tirole considered the interaction between productive and non-productive savings in a growing economy using an overlapping generations model (OLG) with capital accumulation and various types of rents. This provided the necessary conditions for an aggregate bubble. He also described the definition, nature, and consequences of asset bubbles where he stressed the specificity of money as an asset. Despite the fact that one of fundamental contributions of OLG models is that they justify the existence of money as a medium of exchange, Tirole concluded that the investigation of overlapping generations models should somewhat shift emphasis from the study of money to that of assets held for more speculative purposes. He also solved the task of whether we should expect to observe asset bubbles in overlapping generations economies. This is because in two kinds of models the overlapping generations and infinitely lived consumers (or overlapping generations with bequests) bubbles may exist in the former but not in the latter. He believed that bubbles are consistent with optimising behaviour and general equilibrium. Therefore, good understanding of their definition and properties may be required in various fields such as empirical studies of asset pricing, monetary theory, and welfare economics.

It was time when Tirole began close cooperation with Finnish researcher Bengt Holmström (the Nobel Memorial Prize winner in Economic Sciences in 2016) and Belgian researcher Mathias Dewatripont. Holmström specializes in the theory of contracting and incentives, especially applied to the theory of the firm, to corporate governance and liquidity problems in financial crises. Dewatripont, whose doctoral advisor was Eric Maskin, is a researcher in the theory of incentives and organisations, monetary theory, and banking. At the same time, the development of Tirole’s scientific interests were significantly impacted by the cooperation with Jean-Charles Rochet, an expert in the area of systemic risk and macro-prudential regulation of banks, sustainable finance, industrial organisation of the banking sector and dynamic contract theory and applications.

TWO CROSSING LINES

Despite the fact that Tirole began his career as an economist, with issues concerning the regulation of market competition and the theory of industrial organisation he intensively studied financial issues. In his first book [43], written jointly with Drew Fudenberg, they surveyed works on dynamic oligopoly with the main focus on the formalisation of strategic relationships. They searched for the answer to the question of how firm endogenises the firm's rivals' reactions. This endogenisation is precisely the object of the game-theoretic models and the game-theoretic explanation of "tacit collusion".

In 1988, Tirole published his first textbook [44]. The material of the book summarised lectures he had given in various forms at the undergraduate level at l'École Nationale de la Statistique et de l'Administration Economique (today L'ENSAE ParisTech), at the University of Lausanne, and as part of a basic graduate sequence in industrial organization at the MIT and at l'École des Hautes Études en Sciences Sociales, and at the advanced-topics level at the MIT. Also, Tirole used the developments from his book published in 1985 [45] and translated into English by John and Hélène Bonin.

Market economy is a money economy. The theories of regulation and competition policy, including the theory of optimal regulation of firms with market power, must take into account how *imperfectly competitive markets* act to work out a better-informed competition policy. It also needs a well-grounded theory of incentives and the contract (principal-agent) theory connecting them with the game theory and psychology (strategic behaviour, preferences, information asymmetries, tacit collusion, "moral hazard in teams" problem etc.). Intensive studies and an exhaustive review of existing literature created the favourable ground for the development of a new standard of rigour in the fields of industrial organisation and regulation [46–56].

Dealing with the issues of industrial policy and competition, Tirole does not neglect the financial aspects. After his third book was published [57], he continued his studies in the field of finance. His cooperation with Jean-Charles Rochet was very fruitful, especially concerning payments systems [58–67]. The second area of his research in finance was the regulation of the banking system [68]. Practical application of Jean Tirole's scientific research is reflected in his next book [69]. Working in this direction, Tirole summarises the results of his research in the book [70] and the well-known textbook *The Theory of Corporate Finance* [71].

In his book [70] published in 2001 Tirole wrote that the hope was that business cycles would be dampened, improved liquidity management would boost investment

and promote growth, and would permit the transfer of savings from low-return to high-return countries as well. Such transfer should raise worldwide growth and should further give a chance to the labour force of low-income countries to live better. However, capital account liberalisation that is capital mobility was followed by spectacular foreign exchange and banking crises. Tirole wrote: "This book is to some extent an attempt to go back to first principles and to identify a specific form of market failure, that will guide our thinking about crisis prevention and institutional design". He is not the only one who thinks about crisis prevention is possible.

As I have already said above, the financial crisis in 2007–2008 shocked the majority of economists. In January 2018, in volume 34 of the Oxford Review of Economic Policy titled "Rebuilding macroeconomic theory", the mainstream economics was trying to rethink its effectiveness as an objective scientific analysis of the motion laws of capitalist economies [72–85]. However, we would not know what the right policies are if we did not know what caused the crisis in the first place.

Soon after the publication of his next "financial" books [86, 87], Tirole began collaboration with young French economist Emmanuel Farhi (born 1978) from Harvard University. After the crisis, the main focus of the research was concentrated on how liquidity should be regulated, illiquidity, shadow banking, financial bubbles, the optimal prudential control of a financial institution's liquidity management, sovereign debts, and bailouts [88–94]. Dewatripont and Tirole wrote: "When liquidity requirements for banks were introduced in the wake of the 2008 financial crisis, policymakers received little academic guidance on specific questions such as the measure of the liquidity buffer, its possible decomposition into multiple tiers, and the treatment of interbank exposures, of the securitization of legacy assets, and systemic stress." [95]

INSTEAD OF THE CONCLUSION

Indeed, the scientific work and the volume of Jean Tirole's work are amazing. However, it seems to me that the mainstream economics will continue using marginalism and the general equilibrium theory, trying to incorporate 'animal spirits' or 'irrationality' into the models of modern economies. We will be witnessing no change for mainstream economics with its general equilibrium replacing real competition; marginal utility replacing the labour theory of value and the Say's law replacing crises. If economics is "a window to our world," then, given the domination of mathematics and its initial prerequisites, this window for many people will remain tightly closed. And not for the common good.

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