A CONTINUING APPROACH, FROM FINANCIAL ECONOMICS TO FINANCIAL ECONOMETRICS OR THE ECONOMETRIC THINKING APPLIED TO FINANCIAL ECONOMICS

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Abstract

The main aim of this paper is to attempt a theoretical delineation of a new econoscience now known as *financial econometrics*, which is as a result of a dual approach, one originally from economics to econometrics, followed by another one, articulate, from financial economics to financial econometrics, both purely theoretical, simultaneously stressing the importance of economic and financial modelling, historically detailing the emergence and development of this new econoscience, outlining its subject and objectives, and describing some of the most commonly used methods and models, while noting the presence of increasingly sharp competition of econophysics, sociophysics and economy quantum, in the universe of modelling the processes and phenomena in classical economics and financial economics.

Keywords: economics, econometrics, financial economics, financial econometrics, economic (or economic and financial) modelling.

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The last hundred years marked the end of the initially transdisciplinary approach, apparently slow at its inception, still faster and faster after the first two or three decades, an approach, initially deemed necessary, of broadening, through scientific rigor, classical economics in econometrics, within an interstitial, pragmatic and well argumented, area combining economics, statistics and mathematics.

The term *econometrics* had two adoptive parents, Pawel Ciompa (1867-1913), Polish economist and professor, who, in 1910, first used it in a much too general sense, that of "accountancy" (or "book keeping"), and Ragnar Frisch (1895-1973), Norwegian statistician and economist, who also became the first great econometrician, one of the founders of the *Econometrics Society*, in 1930, who wrote several important studies

on the new concept, and used it since its first citation, with the modern sense of statistical and mathematical modelling of economic phenomena. Common *encyclopaedic* dictionaries define econometrics as an application of mathematical and statistical techniques to economics, in order to study problems, analyze data, and develop and test models and theories (e.g. *Encyclopedia Britannica* glosses the term as "the statistical and mathematical analysis of economic relationships, often serving as a basis for economic forecasting", capable to jointly create equations to describe phenomena, estimate the positions and formulate various economic models, or the *Columbia Encyclopedia* as "economic analysis technique, through which economic theory expresses itself in terms of mathematical relationships, subsequently validated by statistical tests", materialized in the end by trying to develop accurate economic forecasts and enabling successful planning policies).

In its attempt to comprehensively explain phenomena fluctuations, classical econometrics was originally a multidisciplinary approach, i.e. a first "unification of viewpoints relating to the theory of economics, statistics and mathematics, concerning the quantitative nature of economic relations" (Ragnar Frisch, 1933, *Editor's Note. Econometrica 1*, pp. 1-4).

The contemporary accepted senses of econometrics are increasingly diverse and inclusive, alternatively and excessively evincing now the *inductive* meaning (as investigation of economic phenomena performed by means of random or stochastic models in the 1940s and 1950s, known as the *Cowles definition*). Econometrics becomes the science that deals with the systematic presentation of methods, techniques and tools for quantitative investigation of the economic phenomena, the beneficiary of its own regularities, resulting from the analysis of its random, probabilistic and dynamic patterns.

Currently many other meanings are available, as well as other options for defining econometrics angularly (in a restricted meaning), where the focus shifts from one scientific field to another, according to the data in box below:

Angular conceptualization of contemporary econometrics - brief history

The new shades of meaning and understanding econometrics are: a) econometrics is understanding the relationship between economic variables, giving important roles to model and factors selection (the Romanian school of econometrics: O. Onicescu, M. Botez, E. Ş. Pecican, etc.); b) econometrics is measuring economic relations, defining as major objectives the verification of economic theories, evaluation and implementation of macroeconomic and microeconomic policies (Chow, G.C, Pesaran, M.H, Wootdridge, J.M.); c) econometrics consists in unifying the subject and the objectives of economic theory, statistics and mathematics, concerning the quantitative nature of economic relations (Frisch, R, Malinvaud, E., Samuelson, P. A, Koopmans, T. C., Stone, N., etc.); d) econometrics combines formulating and investigating the hypotheses useful for the decision makers (Walters, A.); e) econometrics has the subject and objectives of a kind of economics of scientific intent (Perroux, F.), etc. The main stages of the emergence and development of econometrics are: *A) protoeconometry* or the *classical phase of the precursors of econometrics* (beginning in the seventeenth century and ending with the first three decades of the nineteenth century); *B) the phase of the emergence and scientific consolidation of econometrics* (from the founding, in Cleveland, USA, of the Econometric Society, up to the full recognition of the new science, by getting the Nobel Prize in 1969); *C) the stage of modern econometrics development through continuous competition with other sciences modelling economic reality, and also multiplications of the disciplines resulting from the separation and branching out into new border sciences from econometrics: financial econometrics, panel data econometrics, Bayesian econometrics, macroeconometrics and microeconometrics*, etc. (from 1970 to the present). Ragnar Frisch is the originator of an extensive process of delimitation of econometrics in relation to other sciences, Jan Tinbergen was to generate a new understanding of macroeconomic scientific research, assigning a bivalent role to modelling, where the econometric model becomes a tool for the construction of a new reality, while also realizing and testing the theories put forward as to cyclical fluctuations in economic activity or concrete development of the business cycle (1937, 1939). The contributions made by Koopmans (1937) to statistical and mathematical regression analysis, the solutions of inferential parameters based on statistics and mathematics proposed by Hart and von Neumann (1942), the definition of the structure of an economic phenomenon analyzed in terms of probability distributions of observations, attributed to Haavelmo (1944), the famous econometric test of the diagnostic type, by identifying the limits of residual autocorrelation, the Durbin Watson test, the economic analysis of time series, both lagged and synchronous, further developed by the investment econometric studies made by Koyck (1954), Cagan (1956), Friedman (1957), Nerlove (1958), Solow (1960), Almon (1965), Jorgenson (1966), Eisner and Strotz (1963), Sargan (1964), represented the main reference points of the period of maturation of econometrics. Ragnar Frisch and Jan Tinbergen were the first econometricians who became Nobel laureates in economics in 1969 for the discovery and use of dynamic models in the analysis of economic processes.

Financial economics is a branch of economics that is associated to the idea of allocation and use of economic resources (especially money), both spatially and over time, in an environment dominated by uncertainty and risk, characterized by intensive study of monetary activities such as

macroinvestitional analyses. If economics generally, but not exclusively, deals with exchanges (bilateral transactions), in which one of the items traded remains "money" in the sense of monetary standard, which quantifies the value transfer of ownership of a product, financial economics focuses on trade as the money transactions occur in both directions of transfer (and thus even money for more money can be changed), which implies, temporally and spatially, a high level of uncertainty and risk (contracts involving temporal and spatial options, information that can reduce or possibly eliminate the uncertainty associated with future outcomes or alternative spaces, etc.).

In general, we can say that *financial economics* differs from classical or traditional economics through four major elements: a) focus on monetary activities, b) uncertainty and risk as absolutely normal and real states; c) options or alternatives; d) information and generation of databases and information systems with a decision-making role. Thus, the main questions and variables in financial economics are related to *time*, *uncertainty* (including risks), *options* (alternatives) and *information* expressed in monetary terms and used by statistical indicators. Time operates in financial economics through money, which is currently traded for more future money, with uncertainty (including risks) with which the money to be transferred into an uncertain future or in a risky alternative space, with the options or alternatives through which one side of the two trading may decide at a later date, which may affect subsequent transfers of money and, especially, through the information that provides a better understanding of the future, and can reduce or even eliminate the uncertainty associated with some future monetary value.

Financial economics, as a science and a distinct econodiscipline branching out from the broader framework of general economics, studies the relationships between financial variables such as prices, interest rates, stock value and dividends of the shares, etc., the criteria that ensures variability being three-dimensional (space, time and information). In contrast with another area generically called finance, financial economics focuses on the economy under the influence of real economic variables measured solely under the financial angle, studying the proper evaluation of a capital asset, the appropriate discount rate, the relevant cash flows, the comparison with similar capital assets, absolute or relative, the dependence on other capital assets and other events etc., delimiting financial markets and money markets instruments, describing financial and regulating institutions. Modern financial economics is characterized by a continuous concentration of the monetary activities, in which money of one type or another have real and non-zero probability to occur in domestic or foreign commercial activity, under the pressure of deeper knowledge and anticipation of a subject of general economic interest, i.e. the financial crises of recent years.

The main theories that lend originality and uniqueness to financial economics refer to the theory of arbitrage pricing (APT – *Arbitrage Pricing Theory* or *General theory of asset prices*, which belongs to Stephen Ross and appeared in 1976, a theory based on the assumption that the expected return of a financial asset can be modelled as a linear function of various macro-economic factors or market indexes), the portfolio theory (CAPM – Capital Asset Pricing Model, or *portfolio theory*, which was discovered independently by Jack Treynor (1961 and 1962), William Sharpe (1964), John Lintner (1965) and Jan Mossin (1966) and William Sharpe, Harry Markowitz and Merton Miller received the 1990 Nobel Prize in economics for that pioneering contribution to the foundation of the theory of financial economics, and reveals how exactly investors should balance the risk by investing in multiple assets or securities, complemented by the theory of the conditions under which corporate financing decisions are irrelevant for value (based on the Modigliani-Miller theorem) and grounded on the rationality of the decision-maker (in keeping with the famous Homo Economicus, and the no less famous Efficient-Market Theory, which has its roots in the work of Louis Bachelier, called The Theory of Speculation), and was developed by Eugene Fama in the 1960s as the Efficient-Market Hyphothesis, both relatively challenged by the recent global recession at the end of the first decade of the 21st century.

An *extended* definition of financial economics describes it as the analysis of public economic activities where collective decisions play a major role, and in its composition are combined the public goods theory, the economic analysis of political processes (political economics), constitutive economics, the theory of public companies, and environmental economics with fiscal policy in general. Under this generalization financial economics has practically become the third discipline of general economics, considered classical, alongside of the economic theory (microeconomics and macroeconomics) and economic policy. This new approach reveals two other key figures of financial economics, essential in the process of unification of the two Germanys (East and West Germany), like Norbert Andel and Bernd Raffelhüschen, the former specialized in the financial and fiscal aspect of macroeconomic processes, and the latter particularly interested in social and financial policies and financial economics analyses of the intergenerational type.

Financial economics is also conceptualized in a transdisciplinary manner, as the creative, theoretically and practically, intersection, respectively as an independent science, being considered different from both economics and finance. Econodiscipline of finance contains, through the investment analysis, the corporate finance and financial management, another important component of economic analysis within it, but financial economics expands

this analysis and more generally covers *optimization*, the assessment of a risk level or the minimization of the risk given for a certain level of return and profitability, the cost of capital becoming itself an opportunity cost. The difference between financial economics and finance is obviously higher than the meaning of a mere additional term of "economics": the optimum, balance, profitability, opportunity are reunited by means of deficit, imbalance, updated and refreshed stock and assets, etc., comparable cost. If economics focuses on optimization, markets and equilibrium in general, financial economics deepens monetary investigation and thus widens the horizon of knowledge through gap analysis, and opportunity cost, completing the vision of the economy with the in-depth scrutiny of urban or rural space economics, with the financial impact study of health insurance, environmental protection, etc. It can be argued that the apparent difference given by the word "financial" is still a difference of approach level, as the cash flows are here deeply analyzed and theorized.

If, whenever the statistical and mathematical methods, techniques and tools are indiscriminately used to analyze the economic processes and phenomena, the term generally recognized for such a scientific approach can be no other than that of *econometrics*, so whenever financial economics questioningly and investigation-wise meets mathematics and statistics, the result is financial econometrics. Similarly, the meeting of econometrics with financial economics or mere for finance conduces to almost the same result, which is today called financial econometrics. What is the current significance of this unusual, fresh interdisciplinary and transdisciplinary juxtaposition of *financial econometrics*? Creating a new trans- and interdisciplinary field is always an occasion for analysis and discussion, and formal definitions or reunited terminology signifying are far from, and rather unlikely to be easily understood. In a narrow definition, it can be said that financial econometrics *studies quantitative problems arising from the field of finance, especially that of financial economy*. Financial econometrics uses statistical techniques and financial theory or the theory of financial economics to address a wide range of problems in this specific**,** exclusively monetary reality (from the purely financial models of construction, estimation and simulation or inference, using financial econometric models, of assessing and forecasting volatility, of risk management, testing financial economics theory, the laws of financial economics recently formulated, of pricing of capital assets, of pricing derivatives, of optimization an allocation portfolio, of simulation of financial risk hedging systems, of tax and financial strategies, etc.).

Jianqing Fan synthetically defines financial econometrics as "an *active complex where finance, economics, statistics, probability theory and applied mathematics are continually integrated*". His major argument

is related to the fact that economic-financial activities generate many new, seemingly unsolvable, questions with conventional econometric models, and financial economics can, through the supply of useful theories, alongside of statistical and applied mathematics, which have efficient quantitative methods to solve quantitative problems in contemporary financial reality, combine their efforts, giving rise to quite sophisticated stochastic models in order to capture the basic features underlying the variables of financial economics.

The emergence and development of financial econometrics as a distinct science - brief history

The stage development of modern econometrics through permanent competition with other economic sciences modelling reality has increased, spatially and temporally, the official recognition of that science by increasing the number of Nobel Prize winners, and also *the new disciplines resulting from the separation of new border sciences from the main body of econometrics*: ***financial econometrics, panel data econometrics, Bayesian econometrics, macroeconometrics and microeconometris***. A particular concern has become short-term econometric forecast based on specific analyses and tests; Box and Jenkins (1970) marked the beginning of a completely new view in the field of testing and modelling, followed by the work of Cooper and Nelson (1972), Zellner Palm (1974), Trivedi (1975), Prothero and Wallis (1976, 1977), and many others. Other notable contributions are those of the econometric modelling undertaken by Granger and Newbold (1974) and Phillips (1986). New Nobel laureates in economics come in a growing proportion from among recognized econometricians. Lawrence Klein, professor of economics at the University of Pennsylvania, received the award in 1980 for computer modelling. Trygve Haavelmo received the award in 1989. His main contribution to econometrics was a 1944 remarkable article entitled *The Probability Approach to Econometrics* (published in *Econometrica*), which emphasizes the importance of addressing the economic phenomena through probabilistic thinking and theory. Daniel McFadden and James Heckman were awarded the prize jointly in 2000 for their work in microeconometrics. McFadden founded the econometrics laboratory at the University of California in Berkeley. Teachers and researchers Robert Engle and Clive Granger received the award in 2003 for their work on the analysis of the data series on stock markets and the evolution of exchange rates, allowing stock exchange risk assessment and defining a balance of the exchange rate of currencies and the price level. Robert Engle initiated and founded, in 1984, the ARCH method (autoregressive conditional heteroskedasticity), and Clive Granger promoted and developed *co-integration*, or the GARCH method. The *co-integration* concept was introduced in econometrics by Clive Granger in 1986, and formally developed later by the same Engle and Granger, in 1987. The work of Elliott, Timmermann and Granger (2006) provide excellent reviews of economic developments in forecasting techniques focused on econometric modelling, thus becoming fundamental modelling papers in financial econometrics, alongside of the empirical studies in books like *Econometrics of financial markets* by Campbell, Lo and MacKinlay and *Financial econometrics: problems, models and methods*, published in 1997 and 2001 at Princeton University. Just as important by

their pragmatism proved the financial econometrics books *Analysis of financial time-series* (2002), where the author, Tsay, emphasizes the methodology of techniques of time series and analysis techniques of financial data, *Statistics and Finance: an introduction* (2004) and *Introductory Econometrics for Finance* (2008), books whose authors, Ruppert, respectively Brooks, provide the new scientific discipline, called financial econometrics, with a rigorous academic structure.

If the *subject of econometrics* was initially formed by economic phenomena, subsequently it has expanded in two directions: a) addressing other phenomena beyond the economic aspects, yet with an impact on the economy and the forecast of economic phenomena, and b) by validating or invalidating of a number of components or regularities of economic theory. Confining ourselves to the conceptualizations of the Romanian school, where mathematics studies the *qualitative and quantitative relationships, as well as the structures that can be imagined between real world objects within its specific patterns*, as Caius Iacob said, and statistical science starts with the research of the variation of the data and information, according to the meaning assigned by Nicholas Georgescu-Roegen to statistical series, as *expressing a variable by comparison with the variation of another one*, while it also redefines itself as a *representative concept of information*, and, averring the words of Octav Onicescu, classical econometrics goes beyond the purely descriptive approach to economic problems "through the appeal to rigorous calculations based on numerical data, verified methods and models", as stated by Eugen Ştefan Pecican.

By econometric modelling, for the first time multivariate, like a real orchestra in which each instrument, test and method interprets its distinct score and all together succeed in creating the real model, are identified and quantified the meanings hidden in the data and information, necessary for knowledge, prediction and prompt, efficient simulation. In relation to the other disciplines branching off from the sturdy tree of econometrics, *financial econometrics distinguishes itself from them, through the fact that, although all those disciplines use econometrics and econometric modelling, it is only econometrics that gives the central role to uncertainty in its object of study, both in financial theory, and in its implementation in an empirical manner, or in an advanced modelling manner*. This remark essentially belongs to the authors of *Econometrics of financial markets*, namely Campbell, Lo and MacKinlay, who found that "without uncertainty, the problems of financial econometrics would be reduced to the exercises specific to microeconomics", and "inclusion of uncertainty is really the starting point in the self-definition of financial econometrics" as independent science with a distinct object of

study. Excessive concentration on the topic of financial uncertainty initially removed econometrics from *behavioural finance*, another econodiscipline that is maturing today, but finally approached it through common behavioural modelling focused on risks and probabilities. Note that the relations of financial econometrics with other similar sciences are dependence and interdependence. Financial economics often involves creating sophisticated models to test the variables that affect a particular decision. Generally, classical econometric models assumed that individuals or businesses or institutions taking decisions acted rationally. An econometric model could not be developed in the initial approach, from economics to econometrics through economic modelling, unless an economic theory of the reality segment under research was generated. The formal similarity of the first formal econometric models with the segment of economic reality investigated depended on the abstraction of the theory, on the mathematical operational definition of the economic categories and statistical variables, but especially on the purposes of the economic theory. Irrational behaviour is required to be increasingly taken into account in financial economics as a potential risk factor, developing both the techniques and the models of parameterizing the interdependencies modelled in the universe of financial economics. The new models of financial econometrics tend both to invalidate old financial economic theories, and to generate new financial economic theories, if they are validated in time, in space and in relation to the information available by heuristic aims or guidance on the subject studied.

Regardless of the initial or continuing approach, the economic model, and the financial economic model, respectively, represented an intermediate link between theory and reality, while also responded to immediate purposes of prediction, estimation and simulation. The continuance from econometrics to financial econometrics is materializing especially through economic and financial modelling, which secures the link of econometrics with financial economics, leading to the models of the extended family of the ARCH, GARCH, etc. type. It should also be noted that, in developing the econometric models, it was recommended, with increasing insistence, that financial and banking relations be introduced as particularly significant for the description of economic mechanisms.

Conclusions

A survey conducted by UNESCO, in the late twentieth century, managed to identify nearly 1,000 distinct scientific disciplines distinctly defined. Is the multiplication of science defined by a distinct, crisp or strict

border? What is science? What are the minimum conditions to be met by some form of knowledge to become a science? The investigation identified the following conditionalities: *theory*, its own *subject* and *model*, and secondarily, or as elements derived from the three essential elements, regularities or laws obtained by applying their own methods and instruments.

Many of the new contemporary disciplines that make up modern economic culture are border economic disciplines (econodisciplines). Nearly all subjects which have acquired a taste for measuring their specific phenomena, or have integrated in their study measuring, have gradually become "-metrics".

According to these major issues, financial econometrics can be considered a distinct science, and an econodiscipline necessary for training in modern economics. Its delimitation as a science, the description of its subject, its objectives and specific models, debating the role and potential of econometrics and financial econometrics and of the rival modelling sciences that integrate the universal thinking of physics (econophysics, sociophysics, quantum economy, etc.) represents, in the scientific research and educational processes and economic-financial as well as technical domains, and also in the social field as a whole, not only an opportunity, but an actual necessity in delimiting the normal macro- and micro- financial developments.

As a final remark, any science is fulfilled when it is also criticized. Thus, in the last decade, there have occurred the first disadvantages of financial economics, already signalled when it tended to become a practice of so-called empirical specialized tricks. This is humorously noted by mathematician, econometrician and philosopher Nassim Nicholas Taleb, author of the famous *Practical and philosophical aphorisms*, who pointed out that "*financial economy sometimes seems to be reminiscent of mediaeval medicine, the drugs and cures of which could be used to kill more patients than save them; similarly, it may jeopardize the system by creating risks, rather than reducing them*".

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