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HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

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APPENDIX/ANNEXURE

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- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio" Ohio State University, Nigeria.

CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

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- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

ORIGIN OF ECONOMETRICS

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ABSTRACT

Perhaps Powel Ciompa first used the term 'Econometrics' in around 1910, although the credit is given to R. Frisch for coining the term in 1926 and for establishing it as a subject in the sense in which it is known today. Available documents point out that Econometrics is originated perhaps since around 18th century. Method of least squares is developed in this century. This paper looks into the origin of Econometrics through available documents. This paper also looks into two famous conflicting claims in Econometrics between 'Hoerl-Kennard and Tychonoff over the discovery of method of ridge regression' and 'Gauss and Legendre over the discovery of the method of least squares'.

KEYWORDS

History of Econometrics, Two Famous Conflicting Claims, Bayesian Econometrics, Method of Least Squares.

PROLOGUE

Econometrics involves coming together of mathematical economics, economic statistics and statistical inferences and expresses the theories and ideas of economics in mathematical forms. It is still relatively young and has been transforming and expanding very rapidly over the past few decades. Major advances have taken place in the analysis of cross sectional data. Heterogeneity of economic relations across individuals, firms and industries is increasingly acknowledged and attempts have been made to take them into account either by integrating out their effects or by modeling the sources of heterogeneity with the existence of suitable panel data. New time series econometric techniques have been developed and employed extensively into areas of macroeconometrics and finance. Non-linear econometric techniques are applied in the analysis of cross sectional and time series observations. Application of Bayesian techniques to econometric problems has been given new impetus largely to advances in computational techniques. During early years Econometrics had been defined as the union of Economics, Statistics and Mathematics. The term econometrics has later come to have a narrower meaning than Frisch originally intended, more like the study of statistical methods for the application of economic models. Econometricians had developed a distinctive path compared to those found in Psychometrics and Sociometrics during the same period. After it, Econometrics stabilized on its current meaning as 'the use of Statistical reasoning and methods as means to establish data-based descriptions of economic phenomena and empirically based on counterparts for, and tests of, economic theories'. In the post of 1950s period econometrics understood as due to not only to strengthening of its foundations in statistical theory but also to the continuing expansion of data, its establishment in the core undergraduate teaching programme and the development of cheap desk-top computing. Together these meant that econometric work became a standard tool of policy work in governments and international agencies as well as becoming endemic, in various different forms, in the sub-fields of scientific economic research. Econometric theory has developed into a formidable body of specialist statistical theory and the increasing gap between the difficult technical and theoretical questions and the apparent ease of applications might indicate a field where applications came loose from theoretical work. This has been militated by another tool, the development of specific software packages for Econometrics, in which theoretical and technical developments can be quickly translated into modeling, measurement, and testing regimes at the level of applications. Only in the last few years has the history of econometrics become established as an accepted field of research including sessions at professional meetings. Yet, the first written history of Econometrics appeared in the 1950s, when Christ (1952) reviewed the first 20 years' econometric work of the Cowles Commission and Stigler (1954) surveyed the early econometric analyses of consumer demand.

Spatial Econometrics is the field where spatial analysis and econometrics intersect. In general, econometrics differs from other branches of statistics in focusing on theoretical models, whose parameters are estimated using regression analysis. Spatial econometrics is a refinement of this, where either the theoretical model involves interactions between different entities, or the data observations are not truly independent. Thus, models incorporating spatial autocorrelation or neighbourhood effects can be estimated using spatial econometric methods. Such models are common in regional science, real estate economics and education economics. The first general text in the field was the 1979 book by Paelinck and Klaasen.

2. EARLY DEVELOPMENT

The use of mathematics and statistics in economics is not of recent origin. In the latter part of 17th century W. Petty wrote his essays on 'Political Arithmetik'. This fledgling work, remarkable for its time, was econometric in its methodological framework, even from the modern point of view. The union of economic theory, mathematics, and statistics has been more an aspiration of the econometrician than a daily achievement. Much of what is commonly known as econometrics is mathematical economic theory that stops short of empirical work and some of what is known as econometrics is the statistical estimation of ad hoc relationships that have only a frail basis in economic theory. Gilbert and Qin (2007) discussed that W. S. Jevons (1871) was the first economist to fit a demand equation although Morgan (1990) attributes the first empirical demand function to C. Davenant (1669) at the end of 17th century. Hoover and Dowell (2001) points out that Smith (1776) discussed the history of measurement of the general price level.

Origin of Econometrics begins with discovery of method of least squares (LS). Placket (1972), Harter (1974 a, b & 1975), Stigler (1981), Singh (2010 a) and Singh (2011 b) advocated that this method was in frequent use since 18th century mainly on the ground of simplicity and ease of computation. Gauss used it for more than a decade without bothering to publish it. Gauss's letter was published in 1799 and another correction note was published in 1800. Legendre (1805) was the first to publish the method of LS. This is true that more and more qualities of LS came to light during 20th century and controversy arouse between Gauss and Legendre about who should take the credit for the publication. A number of responsible scholars wrote volumes on the method of LS prior to Gauss and Legendre. The interested reader should refer to papers by Plackett (1972), Harter (1974 a, b and 1975), Stigler (1981) and Singh (2010 a).

3. THE DEVELOPMENT ERA

At the beginning of 20th century, no generally accepted or established patterns are available to synthesize data evidence and theory. Several statistical and mathematical techniques are in vogue and new techniques and new concepts were established and then proposed. Moore (1914) observed cyclic patterns in grain yield and price data to climate conditions by observing the rainfall data. Periodograms and Fourier frequency analysis were applied and he arrived at a general explanation of business cycles. He used method of LS to estimate two regressions in his study and also used polynomial regression adding quadratic and cubic regressors. He believed that he had discovered new type of demand curves. Persons' (1919) attempt was more practical to forecast the short-run business cycle movements. He classified the forces, as he felt in his study, into four types: secular (long forces) forces, seasonal forces, cyclic forces and irregular forces. Here he used methods of moving averages and curve fitting to compute the trend. The problem of extracting causal relationships between variables from data which contained different time patterns dominated early econometric work but the questions attacked were driven by economic and policy concerns. Measurements, for example, of market demand and supply relations for agricultural goods were undertaken at the American Bureau of Agricultural Economics

during the 1920s when farmers faced falling prices in international markets and followed earlier European breakthroughs on these questions. Similarly, the problems posed by 'business cycles' were widely recognized by commerce, politicians, economists and others.

Schultz (1925) discussed orthogonal regression in estimation. Wright (1928) gave an idea about method of instrumental variables through his study on simultaneity problem between supply and demand. Frisch (1929) discussed diagonal mean regression as a solution for choosing the bivariate regression. Tinbergen (1930) studied supply curves differentiating between demand and supply curves by adding additional explanatory variables into the demand and supply equations. He also applied a time dummy to detrend price series rather than detrending prior to regression and gave a new technique which is known as indirect least squares. Bowley (1933) examined the statistical distributions of several economic time series data for the study of changes in wholesale, retail prices and household income. Hotelling (1933, 1936) invented the new methods of principal components and canonical correlation for factor analysis models on psychological data. Frisch (1934 b) advocated the method of bunch map analysis among a set of variables all subject to measurement errors. Frisch (1934 a) and Leontief (1934) debated the famous pitfalls in the early 1930s. The debate was closely related to the issue of how applied modelers should conceptualize the error terms in measurement errors or errors in equations. The issue was also related to the appropriate choice of estimation methods, where OLS was adequate or weighted least squares. A major factor that helped to unite Tinbergen and other econometricians under Frisch's structural approach was the scepticism of non-econometric economists in relation to the scientific validity the nascent econometric methods. Working (1935) examined the impact of multiple factors under 'Law of Dynamic Equilibrium' on wholesale wheat prices.

The early econometricians were already aware about the method of LS estimation. Statistical optimality criteria were also brought in during the late 1930s. Nonlinear estimators became the first choice. The research brought up a new dimension to adapt the estimation procedure to ease the computational burden of nonlinear estimators. Koopmans (1937) devised general forms of weighted regression as the best estimators for error-in-variable regression models. His derivation is based on maximum likelihood principle. Koopmans (1937) introduced the concept of specification in econometrics. Dirks (1938) proposed non-linear regression explaining the change of retail sales by the lagged change of income. Clark (1938) studied both the current and a lagged income variables in estimation in a consumption function on quarterly data. Stone and Stone (1938) discussed a variety of functional forms including log-quadratic, log-linear and additional time trend regressing aggregate consumption on income with time-series and cross-section data sets. Wold (1938) attempted for the adoption of sampling theory and probability and stochastic process concept in time series analyses in his work. The 'econometric model' formulated as an intermediary device to bridge the gap between economic theory and economic data. Concept of multicollinearity is developed and concept of measurement errors or of omitted variables from the model was established with the development of statistical tools and methods. J. Tinbergen was the most creative of econometricians of the 1930s in the development of modeling, in understanding conceptual problems and in suggesting solutions. Keynes' work put the development in the 1940s of rigorous foundations for econometrics under the 'probability approach'. Despite their difference of opinion, both Tinbergen and Keynes can be seen, in retrospect, as reshaping economic theory and policy in the aftermath of the great depression so that, in the 1950s, L. Klein could develop the post-war generation of macroeconometric models on Keynesian theories with more secure statistical foundations. Haavelmo's probability blueprint for econometrics has been interpreted as creating a 'revolution' in econometrics. Parts of Haavelmo's program were immediately elaborated at the Cowles Commission. The research was primarily concerned with developing appropriate identification conditions and estimation techniques for such econometric models. Applied econometric research revealed serious practical and methodological limitations in the Cowles approach, particularly in regard to model specification, model choice, and associated testing procedures. Theoretical studies of economic dynamics of Frisch's model pursued by Koopmans (1940) and others. They all used periodic analysis in examining the cyclic and dynamic features of estimated final equations. Keynes (1940) expressed scepticism powerfully in his critique of Tinbergen's approach to testing business cycle theories. Moreover, there was an impetus standardise econometric practice with a strong reliance on economics and to get econometrics recognized as a sub-discipline of economics. Formalization of Frisch's structural approach took place during the Second World War. The war itself brought the development of econometrics in two distinct ways. Many of the early econometricians brought together for the work and it established an economic policy environment for active work. In the beginning of the 1940s the problem was separated from estimation issues and clearly formulated statistical and mathematical terminologies. Mann and Wald (1943) provided proofs of the consistency and asymptotically normality of the maximum likelihood estimators of a linear equation system with normally disturbance terms. Formalisation of identification conditions plays an important role in formalisation of econometrics as a sub-discipline in economics. The early econometricians developed ad hoc methods to tackle the problems during the 1920s and 1930s. Haavelmo (1944) carried out a thorough foundational work related to the structural approach based on probability theory. His argument for the probability approach is based on three related components: economic time series data, sampling theory and economic theories. Stigler (1962) discussed about the significant combination of mathematical theory and statistical estimation first occurred in the work of H. L. Moore during the early part of 20th century. Moore completed econometric work on business cycles on the determination of wage rates and on the demand for certain commodities. Harter (1975) concluded that the best choices of measures of central tendency and dispersion and of methods of fitting linear (or non-linear) regression equations depend upon the error law.

The interwar period provides evidence of an increasing separation between the macroeconomic and econometric approaches to business cycle analysis. The early econometricians adopted different approaches and methods in exploring the best ways of theorizing and modeling data. Epstein (1987) observed that price control requires knowledge of industry cost curves and even demand elasticities. Pagan (1987) advocated about three econometric methodologies associated with D. Hendry, C. Sims and E. Leamer practicing by their adherents in recent years and wrote in comparative vein. He summed up that none of the methodologies claimed is to be complete in general and no methodology has managed to obtain a perfect score. Econometrics is a frontier discipline in the introduction of scientific means and methods into Economics. The purpose of its introduction was to bridge the gap between economic theory and economic data. Epstein (1987) produced a concise history of econometrics; Morgan (1996) has provided an account of early period and a report of econometric development in Britain is due to Gilbert (1989).

Morgan (1990 b) has suggested that Epstein's history suffers from omission and misinterpretations of the evidence sufficient to cast doubt both on his main historical thesis concerning the role of the Cowles Commission, and on parts of his history of structural econometrics. She mentioned three examples on the personal history of the early econometricians and took the opportunity of correcting them. The first concerns Frisch's early history, the second is implied on Haavelmo's 'Probability Approach' and the third example is related to P.G. Wright who wrote a number of trenchant criticisms of econometrics which revealed considerable mathematical intelligence. Morgan (1990 b) mentioned that the first written histories of Econometrics appeared as far back as the 1950s, when C. Christ reviewed the first 20 years' econometric work of the Cowles Commission and G. Stigler surveyed the early econometric analysis of consumer demand. Epstein's history of econometrics is related to the history of what he calls structural econometrics, by which he means the use of the simultaneous equations model. The three popular methodological approaches are the Cowles Commission approach, the probability approach and statistical methods in Econometrics. An extensive record of macro econometric model building activities from 1930s to 1980s has been prepared by Bodkin, Klein and Marwah (1991). Morgan (1996) pointed out that early econometrics applied mathematical statistics without probability theory. Econometrics, the statistical metric for economics, can be regarded as one of the main innovations which turned twentieth century economics into an engineering, or tool-based science, in which each application of economic theory requires special shaping to circumstances, whether for scientific purposes or in the policy domain (Morgan 2001). The particularities of the history of econometrics have often been linked to the nature of its tasks and aims (De Marchi and Gilbert, 1989; Heckman, 2000; Morgan, 1990; Qin, 1993).

Qin (1996) discussed that Bayesian research has largely followed mainstream econometric development as far as the major econometric ideas and methods are concerned. He summarized two observations regarding development of Bayesian econometrics describing the fact that Bayesian econometrics can produce results identical to those produced by means of classical statistic methods. The potential of the Bayesian inference in econometrics was recognized by J. Marschak as early as 1950. Raiffa and Schlaifer (1961) demonstrated Bayesian method as preposterior analysis on regression models in their book. The early 1960's pioneering Bayesian applications in econometrics include published works by W. D. Fisher (1962), Hildreth (1963) and Zellner and Tiago (1964). Fisher (1962) examined the different effects on model estimation induced by different purposes of model use and Hildreth (1963) took a more affirmative attitude. Zellner and Tiago (1964) proposed another Bayesian method for regression models with first-order autocorrelated errors. The seminal works of W. D. Fisher, Hildreth, Zellner, Rothenberg and Tiago brought to light the attraction of making Bayesian inference in Econometrics for several practical reasons. Zellner (1971) wrote the first Bayesian Econometrics textbook entitled 'An Introduction to Bayesian Inference in Econometrics'. Latter Bayesian econometricians were faced

with two major technical difficulties in devising Bayesian estimators. To overcome the difficulties research results were built on either simultaneous-equations model (SEM) or a simple/multivariate regression model. The development of Bayesian estimation methods for SEM emulated closely the strategy of full-information and limited-information estimation of the classical camp. The main research was carried out by Dreze (1968), Morales (1971), Harkema (1971), Rothenberg (1973) and Dreze and Morales (1976). Kloek and Dijk (1978) made an important breakthrough in numerical integration based on Monte Carlo integration procedures with wider range and their results freed Bayesian econometricians from the severe practical constraint of choosing priors by their analytical solvability and therefore considerably widened the scope of Bayesian application. Howson and Urbach (1989) discussed that Bayesian Econometrics can produce results identical to those produced by means of classical statistic methods is sufficient to show that there is nothing subjective in the Bayesian theory as a theory of inference: its canons of inductive reasoning are quite impartial and objective. Paelinck (2000) proved that in principle all spatial data will inevitably show up an aggregation bias in general econometric aggregation, if only one macro-aggregate is considered, just one parameter bias is present in the macro-model. Blaug (2001) summarized that there has been a virtual explosion of books on the history of econometrics, beginning with Epstein (1987), Morgan (1990) and Qin (1993) on probability approach of the 1940s and the structural estimation methods of Cowles Commission and culminating in the magnificent study of Hendry and Morgan (1995) in which all the great papers in the 20th century history of Econometrics are discussed and many of the original empirical verifications are reworked with modern techniques. The role of econometrics in Economics remains a live issue today. Macroeconomics has become ever more theoretical in the 1980s and 1990s while Econometrics has become ever more atheoretical, with many leading econometricians giving prominence to data exploration before venturing into empirical generalization. Advocacy for the Bayesian approach was recently discussed by Kennedy (2002), Hendry (2002) and Magnus (2002). Kennedy (2002) described about ten commandants of applied econometrics and they are: (i) Use of common sense and economic theory (ii) ask the right questions (iii) Know the context (iv) Inspect the data (v) do not worship complexity (vi) Look long and hard at the result (vii) Beware the cost and data mining (viii) Willing to compromise (ix) Do not confuse significance with substance and (x) Confess in the presence of sensitivity. Magnus (2002) appreciated the paper of Kennedy (2002) containing the ten commandants of applied econometrics and did not agree with almost all the points made by Kennedy. He later mentioned that Kennedy's work is only half done and he believes Kennedy will complete his task and write the sequel.

Valadkhani (2004) presented a brief literature review on macroeconometric modeling and discussed briefly about critique of macroeconometric modeling for policy analysis. It is still unique tool in relation to model selection, diagnostic tests and time series properties of the data. The criticism of some macroeconometric modeling has motivated econometricians to devise alternative methodologies proposed by Sims, Leamer and Hendry. He argued that each one of them has some shortcomings. Gilbert and Qin (2005) pointed that economists adopted a wide variety of analytical methods, some ad hoc but others reflecting advances in statistical methodology in the period prior to 2nd world war. Two major areas were business cycle analysis and demand analysis in which statistical theory was employed. During and immediately after the war, Cowles commission research sought to base econometrics autonomous probabilistic models specified in terms of underlying structural parameters. Least squares (LS) would not be normally consistent in such models and maximum likelihood estimation was to be preferred. Subsequently, however, the pendulum swung back towards methods based on LS. This was reflected ion the textbook expositions what was accepted as standard econometrics in the late sixties and early seventies. They characterized modern econometrics in terms of the emergence a widely accepted analytical framework and debated how and indeed whether econometric models can reflect the theory-generated economic structures as a major theme. Over the last quarter of the century, the paradigm became looser as econometricians moved to defining their positions relative to each other rather than, as earlier, relative to their non-econometric colleagues. The result was greater diversity in both theory and practice, but with a shared language and a common history. They discussed that key attraction of the Bayesian approach became particularly appealing to the econometricians of the 1960s for several reasons. The Bayesian principle was felt to relate easily to the problem of decision making by applied modelers who faced uncertainty in both theory and sample data at hand. The Bayesian approach appeared more natural than classical methods since the welfare outcomes are more or less satisfactory rather than correct and incorrect. The potential usage of the Bayesian method was discussed in the econometric circle as early as the mid 1950s. Serious adaption of the method of econometrics usage occurred in the 1960s, pioneered mainly by J. Dreze, T. J. Rothenberge and A. Zellner. The Bayesian econometrics became an independent approach in econometric methodology. The distinction between microeconometrics and macroeconometrics is relatively new. Few practical distinctions were drawn between the methods appropriate to the analysis of data types. Gilbert and Qin (2005) concluded that many of the advances in Econometrics took place in the statistical theory related to linear regression model with the specific problems faced on analyzing non-experimental data, often generated with error processes correlated over time and over variables. A major theme dominated over the debate through the century about how and indeed whether econometric models reflecting theory-generated economic structures. Griliches and Intriligator (2005) discussed that the development of statistical theory has played a critical role in the history of econometrics since econometric techniques are, to a large extent, based on multivariate statistics. Modern statistical theory begins with the work of Legendre and Gauss on least squares, motivated by the attempt to remove errors of observation in astronomy and geodesy.

Louca (2007, p. 25) discussed that econometrics became necessary instrument for an empirical approach, providing the flesh and bone of both pure economics to be. Its development was Ragnar Frisch's lifetime aim, the idea he had actively promoted and campaigned for ever since the early 1920's. Alkhamisi and Shukur (2007) discussed that Zellner (1962) proposed seemingly unrelated regression (SUR) model and it is considered as one of the most successful and efficient methods for estimating SUR and tests of aggregation bias. They analyzed the output from the Monte Carlo experiment along with the main dominating factors affecting the properties of the different multivariate ridge parameters for the proposed SUR ridge parameters. The simulation results support the hypothesis that the number of equations, the number of observations per equation, the correlation among explanatory variables and equations are the main factors that affect the properties of SUR ridge estimators. Srivastava and Giles (1987), Zellner (1962) and others advocated about SUR model that it has stimulated a countless theoretical and empirical results in Econometrics and other areas.

Qin (2007) in his book examined the formative period of econometric theory during 1930 to 1960. It covers the major events which led to its formulation. It focuses upon the process of how tools of mathematical statistics were selected and ideas of mathematical statistics were adapted to combine with economic motivations and enquiries. There has been a remarkable and growing interest in the history of econometrics in recent years. Gall (2007) discussed that Econometrics was perhaps born out of the probabilistic revolution in statistics in the early 1900s and the formation of Econometric Society in 1930s referring the papers by Morgan (1990 a) and Duo (1993). Qin (2007) also discussed that Econometrics took as formal subdiscipline of economics at the end of 1930s or in the beginning of 1940s. Two key developments during this period are: (i) a structural modeling procedure, which required econometrics models to be built upon a priori theoretical models and sought to confirm the theory by approximately measuring out the associated structure and (ii) a stepwise formulization of the general modeling practice. Econometrics grew rapidly in 1930s following the founding of the Econometric Society in 1930 and the publication of Econometrica in 1933. Qin (2010) examined the history of Econometrics through a particular case study – modeling the tradeoff between inflation and unemployment. He first examined the pattern of citations of the key papers grouped in three sections. Having analyzed the citation statistics, he is now backing to the issue of historical assessment making impact of modeling on the development of econometrics. Interpretations from different angles and intentions fostered diversification of research agenda. Applied economists have become increasingly willing to abandon textbook econometrics and let data speak more, although it is not yet prevailing position to forgo the general equilibrium tradition and embrace empirical models explicitly with partial and incomplete structural interpretation. Hoover (2010) described the decade 1987 to 1997 was great one for the history of Econometrics because many important works were developed by many authors such as R. Epstein, M. S. Morgan, D. Qin, D. Hendry and J. Klein. He described about the success of 2007 meeting of North American Econometric Society and highlighted about the weakness of publishing history and related papers on Econometrics in journals.

Singh (2010 b and 2011 a, b) points out that H-K (1970 a, b) introduced the generalized ridge regression estimator (GRE) and this became popular tool to prevail over the singularity. Anders (2001) and Singh (2010 b and 2011 a, b) suggested that RR is an application of Tychonoff regularization (TR), a method that has been explored in the approximation theory literature for about as long as RR has been used by Tychonoff (1943). TR is the most commonly used method of regularization of ill-posed problems in Statistics and is also a RR. Thus another controversy between H-K and Tychonoff arose here also that who should take the credit for the development of RR. Singh (2011 b) concluded that it is highly appropriate to give credit to Tychonoff 's TR due to being of more general nature

than H-K's RR and H-K expounded the finite dimensional case only of TR under statistical approach, while Tychonoff 's TR is a general case. The interested reader should refer to the papers by Singh (2010 b and 2011 a, b).

4. CONCLUDING REMARKS

Researchers in Astronomy provided new dimension to their works and latter those works evolved into the method of LS. The method of LS was in frequent use since the 18th century due to simplicity and ease of computation. More qualities of LS were developed during 20th century and controversy about the credit of invention arose between Gauss and Legendre.

History of the development of Econometrics from the mid-1950s onward ascribes a major role in the formulization of dynamic econometric modeling (Hendry 2003). Denis's accompanying paper provides a brief earlier history intellectual development. Denis' initial research had been on mathematical economics, followed by econometric theory, particularly seeking to establish the same form of rigorous inferential basis for its application to small samples that Student's famous t-distribution paper had done for statistics. Indeed, the majority of his publications related to advanced econometric theory. From the mid nineteen sixties onwards, Econometrics was established and accepted as a discipline in its own right. Advancement in computer technology and software with availability of larger and higher quality datasets eased the computational constraints.

In the post war period till 1980s, the history of Econometrics was the history of Cowles Commission Econometrics. When the limits of Cowles Commission became visible during 1970s young persons like Hendry, Leamer, Sims and others started developing alternative programmes. These new programmes originated the history of areas before and besides the Cowles programmes.

Hoover (2008) summarized that modern Econometrics can be dated from the development of structural econometrical models following the pioneering work in the 1930s of J. Tinbergen, the conceptual foundations of probabilistic Econometrics in T. Haavelmo's 1944 probability approach to Econometrics and the technical elaboration of the identification problem in the two Cowles Commission volumes. The ridge regression, generalized inverse regression, principal components regression, Bayesian methods in Econometrics, seemingly unrelated regression, partial least squares regression, distributed-lag model, method of instrumental variables and others including various softwares were developed under modern econometrics. Econometrics today is much more considered as statistics applied to economic data. This is reflected by the increase attention for history of Statistics in relation to the history of Econometrics and with a more prominent role of R. A. Fisher. Credit to coin the term 'Econometrics' is given to R. Frisch for establishing it as subject but Powel Ciompa has first used it in around 1910.

Two important controversies for the propriety claim in the history of Econometrics are between 'H-K and Tychonoff for the development of RR' and between Gauss and Legendre for the development of LS. I agree with the conclusion given by Singh (2011) that it is highly appropriate to give credit to Tychonoff 's TR for the development of RR due to being of more general in nature than H-K's RR and giving credit to Gauss and not to Legendre for the discovery of LS is not only appropriate but also legitimate because he has been extensively using the same since around 1794 onwards whereas Legendre published it in only 1805.

A variety of methods are used in econometrics to estimate models consisting of a single equation. The oldest and still the most commonly used to estimate linear regressions is the OLS method. Similarly, a variety of methods are available to estimate non-linear models. A particularly important class of non-linear models is those used to estimate relationships where the dependent variable is discrete, truncated or censored. These include logit, probit and Tobit models. Single equation methods may be applied to time-series, cross section or panel data.

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