Econometric Theory Unveiled : Building Blocks for Effective Economic Analysis

Kaouthar Souad KOUDA
Université Batna 1, Algeria
d.kaouthar05@gmail.com
ORCID: 0009-0009-0029-8197

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Abstract

This study examines the effectiveness of econometric models in quantifying relationships between economic variables and improving forecast accuracy. By integrating economic theory, mathematics and statistics, the models analyzed reveal significant correlations between price, demand and income, validating the initial hypotheses. The results show that these models provide reliable estimates for economic decision-making, supported by statistical tests that confirm the robustness of the predictions. Despite certain limitations, such as collinearity and autocorrelation, the models used demonstrate a solid ability to anticipate economic trends. The study also proposes ways of refining these models by incorporating additional variables, thereby strengthening their relevance for economic analysis in an evolving context.

Keywords: Econometrics, Statistical Methods, Economic Forecasting, Economic Variables, Static Models

La théorie économétrique dévoilée : les éléments constitutifs d'une analyse économique efficace

Résumé

Cette étude examine l'efficacité des modèles économétriques pour quantifier les relations entre variables économiques et améliorer la précision des prévisions. En intégrant théorie économique, mathématiques et statistiques, les modèles analysés révèlent des corrélations significatives entre le prix, la demande et le revenu, validant les hypothèses de départ. Les résultats montrent que ces modèles permettent des estimations fiables pour la prise de décisions économiques, soutenues par des tests statistiques qui confirment la robustesse des prédictions. Malgré certaines limitations, telles que la colinéarité et l'autocorrélation, les modèles utilisés démontrent une capacité solide à anticiper les tendances économiques. L'étude propose également des perspectives pour affiner ces modèles en intégrant des variables additionnelles, renforçant ainsi leur pertinence pour des analyses économiques en contexte évolutif.

Mots-clés : Econométrie, Méthodes statistiques, Prévisions économiques, Variables économiques, Modèles statiques.

Introduction

The evolution of economic theories and their application, along with the use of mathematical analysis methods and tools, has led to the analysis of economic phenomena quantitatively. This is aimed at decision-making, planning, and predicting the values of economic variables, a field known as econometrics. Econometrics is considered a branch of economics, and this term was first used by early economists such as H. More, H. Schultz, and R. Stone when they established the International Association for Econometrics in 1930.

Econometrics is a specialized branch of economics that emphasizes the quantitative estimation of relationships between economic variables by integrating economic theory, mathematics, and statistics. Its main goals are to test hypotheses, estimate economic relationships, and predict future economic trends. By using economic theory to identify key problems and variables, mathematical economics to express these relationships through equations, and statistical methods to measure and accurately estimate them, econometrics has developed into a rigorous discipline since the founding of the Econometric Society in 1930. The field merges theoretical and applied approaches to economic issues, applying systematic and precise analysis akin to the natural sciences.

The purposes of econometrics include testing economic theories, supporting policy-making and decision-making by providing numerical estimates of economic variables, and forecasting future economic conditions. The econometric process involves model formulation, estimation, testing, and forecasting, following a structured methodology to ensure the accuracy and reliability of economic models. Different types of econometric models, such as verbal, geometric, algebraic, and econometric (probabilistic algebraic) models, serve various analytical functions. Additionally, econometrics distinguishes between static models, which do not account for time, and dynamic models, where time is a key factor influencing variables. Ultimately, econometrics is an essential tool in economic analysis, offering a mathematical and statistical basis for understanding and predicting economic behavior.

This research focuses on the nature of econometrics, standard variables and models, as well as presenting the methodology and stages involved in econometric analysis. It also examines correlation and simple linear regression. Based on the above, and to highlight the concept of econometrics and its key types, the following problem statement is presented: **How do econometric models contribute to improving the accuracy of economic forecasts?**

Econometric models are a vital tool in analyzing economic data and providing accurate forecasts regarding future economic variables. This research aims to explore the effectiveness

of these models through three main hypotheses. First, the first hypothesis focuses on assessing the extent to which econometric models can improve prediction accuracy compared to non-quantitative methods, while testing whether these models offer more reliable forecasts. Second, the second hypothesis examines the relationship between the strength of economic theory and the validity of econometric models, investigating whether a strong economic theory contributes to enhancing the accuracy and reliability of these models. Finally, quantitative estimation facilitates the economic analysis process, with its added value lying in providing the necessary information for economic modeling to aid in decision-making and solving economic problems. Through these hypotheses, the research aims to provide a comprehensive view of the ability of econometric models to deliver accurate and reliable insights in the field of economic analysis and policymaking.

1. Methodological

This empirical study aims to assess the validity and accuracy of econometric models based on available economic data and key variables influencing economic decision-making. It adopts a general approach using data applied to various economic sectors, with particular emphasis on global economic forecasting and policy formulation. The analysis is aimed primarily at policy-makers and economic analysts, providing quantitative estimates of economic parameters to inform their strategic choices.

2- Results

2.1 Definition of Econometrics

Econometrics is a method of economic analysis that deals with numerical estimation, or quantitative estimation, of relationships between economic variables. It relies on economic theory, mathematics, and statistics to achieve its specific goal of testing hypotheses, estimation, and subsequently predicting economic phenomena.

Econometrics initially draws upon economic theory to identify the problem under study and the key economic and social variables influencing it. It then utilizes mathematical economics to describe the existing relationships between variables in the form of symbols and equations. Lastly, it employs statistical methods to develop measurement techniques for estimating the proposed formulas, testing hypotheses, and subsequently arriving at accurate results that can be relied upon in predicting the studied problem.

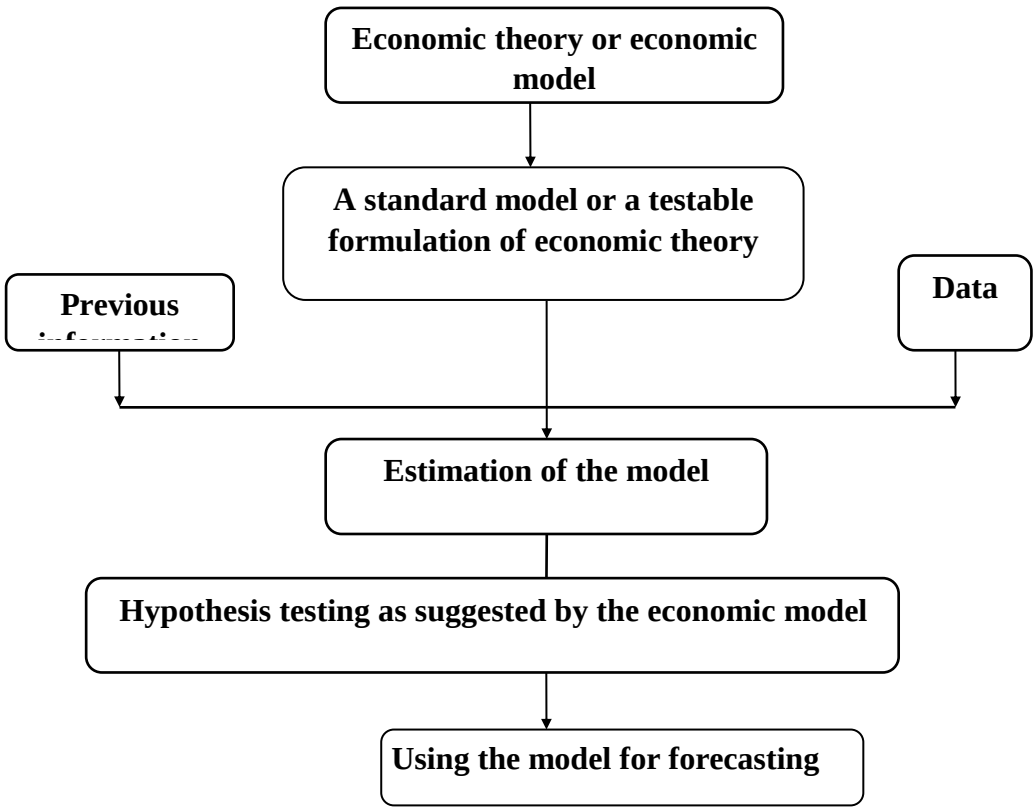
Therefore, econometrics integrates economic theory, mathematics, and statistical methods to test hypotheses about economic phenomena, “estimate coefficients of economic relationships, and predict future values of economic phenomena”. (H.A. Bakhit & S. Fathallah 2009, p.2)

Hence, econometrics can be defined as a social science in which tools of economic theory, mathematics, and statistics are used to analyze economic phenomena, and it is composed of two words: "economy," which originates from Greek, and "metrics," which means measurements.

It can also be defined as the application of mathematical and statistical methods to analyze economic data, with the aim of providing numerical content to economic theories to validate these theories. The true emergence of econometrics was with the establishment of the Econometric Society in 1930 and the publication of the Econometrica journal in 1933.

The origin of the term econometrics is attributed to Ragnar Frisch. In an editorial in the first issue of Econometrica (A.Al-Sanawi 2017, p.4) he argued that “econometrics should have as its primary goal the encouragement of studies aimed at unifying theoretical and applied quantitative approaches to economic problems and driven by constructive and “rigorous thinking similar to that which dominates the natural sciences”. (D.Hausman 2008, p. 29)

Figure 01. shows the steps to be followed in analyzing the econometrics of an economic model

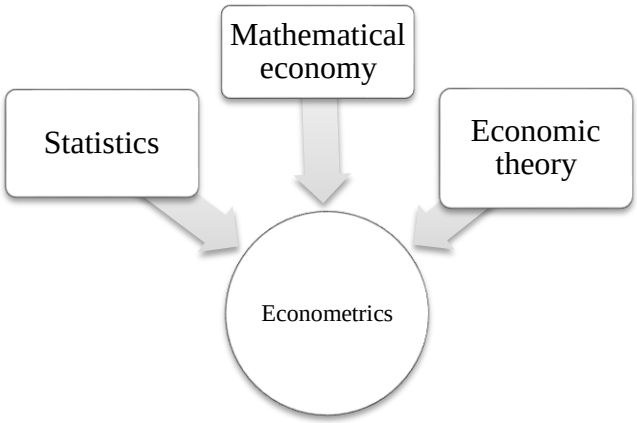


Source : N, A, AL-YOUSIF 2014, p.07

2.2. Objectives of econometrics: Econometrics has several objectives:

- Analyzing and testing different economic theories:
- An economic theory cannot be considered valid and acceptable unless it passes a numerical quantitative test that demonstrates the strength of the model and explains the strength of the relationship between economic variables.
- Policy and decision-making:
- Econometrics provides numerical values for the parameters of economic variables, such as the marginal propensity to consume, save, and invest, which helps decision makers formulate economic policies.
- Predicting future values of economic variables: The behavior of economic phenomena can be predicted by providing numerical values for the parameters of economic variables, for example, by identifying the marginal propensity to consume, the level of aggregate demand and the expected inflation rate can be predicted. (N. Mustafa 2015. pp. 7-13)

Figure 02. Relationship of econometrics to other branches of economics



Source : N. Mustafa, 2015, p.10

2.3.Econometric methodology and types of models

2.3.1. Econometric methodology

Econometrics involves measuring model coefficients to estimate and predict economic variables, requiring a specific research methodology due to the causal relationships between variables. and this methodology can be determined by the following steps (H.A. Bakhit & S. Fathallah, 2009, p. 12)

Model formulation stage: The model formulation phase is both critical and complex when constructing a model, as it entails choosing relevant variables informed by economic theory and mathematical economics. During this phase, relationships among variables such as quantity demanded (Dx), price (Px), and income (Y) are expressed through mathematical equations, for example:

$$\mathbf{Dx=B0+B1Px+B2Y}$$

According to demand theory, the coefficient B1 is expected to have a negative sign, reflecting the inverse relationship between quantity demanded and price, while B2 is anticipated to be positive, indicating the direct relationship between quantity demanded and income. At this stage, data pertaining to the model's variables is gathered.

In the estimation phase, data concerning the economic phenomenon is collected, and numerical values for the parameters B0, B1, and B2 within the demand function are estimated. These estimated parameters are subsequently assessed from economic, statistical, and measurement standpoints.

Econometrically, the values and signs of the estimated model parameters are compared with the expected values and signs of these parameters in light of economic theory.

Statistically, the total and partial deviations in the variables that make up the model are calculated and the significance of the parameters is tested through the t-test and the coefficient of determination Rˆ2.

On the standard side, the consistency and fulfillment of the hypotheses of the random variable is tested on the proposed standard model as the presence of variation implies issues such as autocorrelation, multicollinearity, and variance inhomogeneity invariance.

Testing stage: In this stage, the power and reliability of the estimated model is tested by adopting certain statistical methods to ensure the validity of the model and its ability to predict, “and it may face several issues such as heteroscedasticity, autocorrelation, linearity, and other issues, so these issues must be addressed before starting the evaluation process”. (H.A. Bakhit & S. Fathallah, 2009, p. 14)

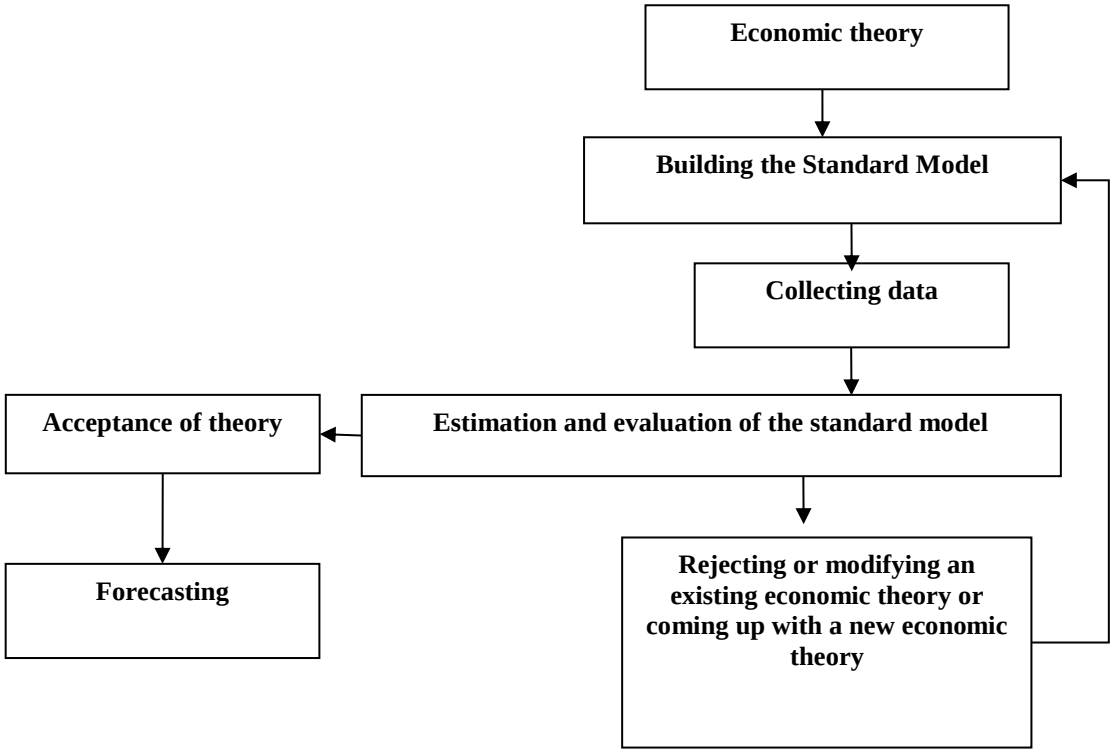
***Forecasting stage*:** In this stage, future estimates of the studied variables are prepared with the aim of:

- Predicting the future values of some variables.

- Drawing a new economic policy or rejecting an existing economic policy. (Q.M.A.H. Alloush, 2013, p. 8)

However, before using the estimated model in forecasting, the overall performance of the estimated model must be checked, and then the results obtained are applied to reality and used in the forecasting process. The research methodology in econometrics can be illustrated in the following figure: (H.A. Bakhit & S. Fathallah, 2009, p. 15)

Figure 03. Research Methodology in Econometrics



Source : H. A. Bakhit & S. Fathallah, 2009, p. 61

2.3.2. Types of Econometric Models

In general, a model can be defined as a simplified representation of a realistic phenomenon, and simplification here means summarizing the facts involved in reality in a concentrated form, which leads to the loss of part of the detailed information of lesser importance, and focus on the information and relationships of greater importance .

Models can be categorized based on various criteria, including the method of formulation. According to (M.A. Abdelkader 2005, p.45).

several types of models can be distinguished: verbal or logical models, which rely on descriptive language; engineering models, which use technical designs and structures;

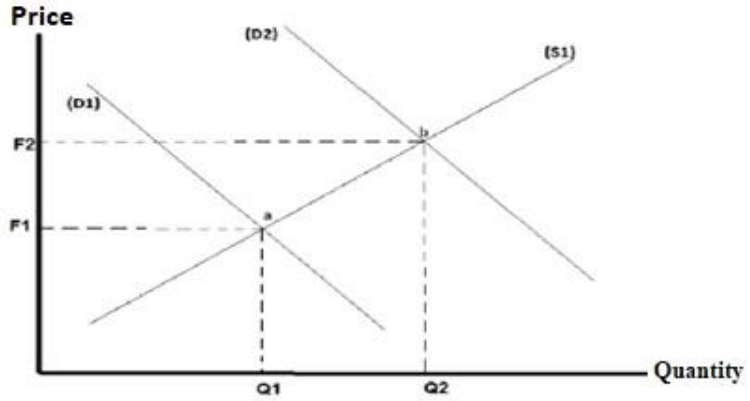
mathematical models, which employ mathematical equations and expressions; and standardized models, which follow established norms and standards. These models are summarized below:

Verbal or logical models : These models refer to the use of logic-based verbalization to explain a particular phenomenon. One of the most prominent examples in the economic literature is the idea of the "invisible hand" presented by Adam Smith in the second half of the 18th century, which became the basis for what we now know as the price model, which explained the mechanics of the market in solving the economic issue. This idea is that the individual is the most capable party to achieve his own interest, and therefore he should be left free to make his economic decisions, and thus the individual's endeavor to achieve his own interest fulfills the interest of society, as if an invisible hand is pushing him to do so.

When consumers' incomes rise, they increase their demand for preferred goods and services to maximize their benefit. This higher demand drives up prices, incentivizing producers to increase production to gain more profit. Prices stabilize when the new demand matches the new supply for each commodity. In this way, the welfare of society as a whole, both consumers and producers, increases.

Geometric models: These are those models that are expressed in the form of geometric shapes, and one of the most prominent examples is what is known as the market model or the price model, which is a geometric formulation of the invisible hand model that we referred to earlier. The following figure illustrates this model:

Figure 04. Invisible Hand Model



Source : (A. M. Abdelkader, 2005, p. 45)

Algebraic models: The algebraic model is represented by a number of mathematical equations or perhaps a single equation that includes a number of variables between which there

are relationships, and represents a certain phenomenon, and algebraic models are characterized by great flexibility due to their ability to contain any number of variables.

An example of this is the linear market model :

Demand function.....Qd=a0+a1 P

Supply function.....Qs=b0+b1 P

Equilibrium condition.....Qs=Qd

Algebraic equations are characterized by the fact that the relationships are deterministic or certain rather than probabilistic.

Econometric models: An Econometric model is a probabilistic algebraic model because it contains random variables that make the relationships between the variables probabilistic rather than certain, such as the probabilistic market model:

Supply function.....Qs=b0+b1 P+b2 R+u2

Demand function.....Qd=a0+a1P+a2Y+u1

Equilibrium condition.....Qs=Qd

The model contains dependent variables (Qd,Qs), independent variables (Y,P,R), and random variables (U1,U2)

Models are also divided in terms of their relationship to time :

- Static models: It is the one that does not depend on time and in which time does not appear as an independent variable **Y=a0+a1X**.
- Dynamic models: a model in which time plays a role in affecting some of its variables.

Yt=b0+b1Xt+b2Xt+b2Xt-1+U2

It is clear that time does not affect the first model, as income X at a given point affects consumption Y at the same point.

While the kinetic model shows that the income of the previous period Xt-1 also affects the consumption of the current period **Yt** in addition to the income of the current period **Xt** (A.M. Abdelkader, 2005, ibid, p. 47)**.**

3- Discussion

The econometric analyses in this study quantified key economic relationships, validating several theoretical hypotheses. Econometric models revealed a significant correlation between key variables, such as price, demand and income, confirming the inverse relationship between price and demand in line with classical theories. The robustness of the predictions is demonstrated, notably for consumption and production as a function of income and prices, with a fit to the data validated by the coefficient of determination (R^2), attesting to

the reliability of the models for economic forecasting. Finally, statistical tests of significance, including the t-test for coefficients, validated the relevance of the explanatory variables and confirmed the ability of the models to anticipate economic trends, while having controlled for problems of multicollinearity and autocorrelation to reinforce their robustness.

The discussion of results focuses on the interpretation of the observed econometric relationships and their comparison with previous work.

Comparison with Previous Studies: The results of this study agree with the findings of researchers such as (N. Mustafa, 2015), who emphasize the importance of econometric models for obtaining accurate economic predictions. This study confirms that dynamic models offer better predictive ability in contexts where time is an influential variable.

Original Contribution of the Study: This research demonstrates the relevance of econometric models in the development of economic policies based on reliable forecasts. By incorporating critical economic variables such as price and income, this study contributes to the methodology by showing how the use of probabilistic models can enhance the reliability of economic projections and influence economic policy decisions.

Conclusion

This study highlights the ability of econometric models to quantify key economic relationships and improve the accuracy of economic forecasts. By validating significant links between variables such as price, demand and income, this research demonstrates the effectiveness of econometric methods for accurate and reliable analyses, reinforcing their usefulness for economic policy-making. However, certain limitations remain, such as problems of collinearity and autocorrelation, which can affect the robustness of predictions. To go further, it would be relevant to incorporate additional variables or apply more sophisticated methods to further refine the models and respond to the challenges posed by changing economic contexts. These adjustments would not only help to strengthen the validity of econometric models, but also offer projections that are even better adapted to the needs of economic decision-makers in a dynamic environment.

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Kaouthar Souad KOUDA, titulaire d'un doctorat en Économie avec une spécialisation en Économie Financière. L'auteur de l'ouvrage Le financement de l'agriculture et son rôle dans l'amélioration de la compétitivité du secteur, ainsi que de plusieurs articles académiques. Il a participé à de nombreux colloques et conférences, tant au niveau national qu'international. En parallèle, occupe le poste d'inspecteur principal en chef de la concurrence et des enquêtes Èconomiques, Ses recherches et publications se concentrent principalement sur l'économie, la finance et l'économétrie. Ancien membre de « Maghtech », continue de contribuer activement au développement des connaissances dans son domaine d'expertise.

Kaouthar Souad KOUDA
Université Batna 1, Algeria
Regional Directorate of Trade
BP 25 RP Batna 05000 ALGERIA
d.kaouthar05@gmail.fr