ECONOMIC MODELLING: DEFINITION, EVALUATION AND TREND

Mario Arturo Ruiz Estrada

Doctorado en economía de la Universidad Malaya, Malasia, maestría en Economía en la Universidad de Comercio Otaru, Hokkaido, Japón, y licenciado en Economía por la Universidad de San Carlos de Guatemala.
Profesor en la Universidad Malaya en Kuala Lumpur, Malasia.
Correo electrónico: marioarturoruiz@gmail.com

Resumen

Este artículo examina los orígenes y evolución del modelado económico desde una perspectiva teorética y técnica. Esto a través de una extensa revisión y análisis de las publicaciones de la revista de modelado económico en un periodo de 28 años (1984-2012). Esto es observado en diferentes periodos de tiempo, la investigación de modelado económico recurre a diferentes asuntos nacionales e internacionales que envuelven diferente esquemas practicados en economía para facilitar la explicación de fenómenos socio-económicos y políticos complejos y dinámicos.

Palabras clave: economía, gráficas multidimensionales, modelos económicos, economía enseñanza

Abstract

This article examines the origins and evolution of economic modelling from a theoretical and technical perspective. This is done through an extensive review and analysis of publications in the journal of economic modelling (JEM) within a 28-year period (1984–2012). It was observed that at different period in time, economic modelling research focused on different national and international issues that invoked different economic practical approaches to facilitate the explanation of the complex and dynamic socio-economic and political phenomena.

Keywords: *econographicology, economic modelling, economics teaching*

Introduction

This paper makes several observations and recommendations pertaining to economic modelling. Based on a careful study of the total of 1775 research papers published in the journal of *economic modelling (JEM) Journal* between 1984 and 2012, it presents the percentages of papers published in individual categories of economic modelling identified. Second, based on an observation of the common approaches used in economic modelling papers in the past 28 years in JEM, this paper recommends multidisciplinary approach to economic modelling. It suggests the incorporation of multidisciplinary, non-economic variables in economic modeling to formulate strong policies. Third, in connection with the multidisciplinary approach, it proposes the application of the 'Omnia Mobilis' assumption (Ruiz Estrada, 2011) to economic modeling. Under this assumption ('everything is moving'), a good range of variables should be included and no relevant variables should be neglected in economic modelling.

Moreover, it is obvious that the use of more economic practical approaches could facilitate the explanation of a dynamic and complex economic and social phenomenon. The main idea behind the use of practical economic approaches is to find suitable and applicable models that can help to reduce the negative impact of any economic and social problem(s) in the society by the most efficient and realistic way. *In the 21th century the use and application of economic modelling among economists were often based on sophisticated mathematical and statistical techniques, methods and models introduced during the development of new economic models. In particular, calculus, trigonometry, geometry and statistical and forecasting methods were employed by economists in policy modeling. Consequently, the application of sophisticated mathematical and statistical techniques, methods, and models can be seen in the development of the following economic models: The Foundations of Economics Analysis (Samuelson, 1947), Monetary Theory and Fiscal policy (Hansen, 1949), Econometric Models and the Evidence of Times Series Analysis (Klein, 1956), A Contribution to the Theory of Economic Growth (Solow, 1956), Economic Policy: Principles and Design (Tinbergen, 1956), The Input–Output Economics (Leontief, 1966).*

In fact, the rapid development of economic modelling has been facilitated by high technology and sophisticated analytical instruments such as the electronic calculator and the computer. The development of analysis instruments in economics took place in two stages. The first stage involved "basic computational tools", where electronic calculators were used to compute basic mathematical expressions (e.g. long arithmetic operations, logarithm, exponents and squares).

This took place between the 1940s and 1960s. The second stage which involved "advance computational tools" began in the middle of the 1990s up to the present day. This marks the era when high speed and efficient storage-capacity computers that are installed with sophisticated software were introduced for the first time. The use of sophisticated software enables easy information management, application of difficult simulations as well as the creation of high resolution graphs. Obviously, the analysis instruments contributed substantially to the development and research in economics.

Over the years the high computational instruments backed by sophisticated software have been used to formulate large economic models which are largely beneficial for secondary data uses. Economic modelling approaches basically comprise of the descriptive economic modelling and analytical economic modelling, both of which can be categorized according to functions and database sizes. In terms of function, the two economic modeling approaches are either descriptive or analytical. The descriptive economic modelling on the one hand shows arbitrary information that is used to observe a long historical data behavior from a simple perspective. While analytical economic modelling on the other hand is used to generate time-series, cross-section modelling to show the trends and relationships between two or more variables from a dynamic perspective. The research leading to this paper shows a strong link between the introduction of new economic modelling and the development of theories, methods and techniques in statistics and mathematics. It is important to note the difference and similarity that exist between economic modelling and policy modeling (Ruiz Estrada and Yap, 2013). The main difference is based on the research focus and theoretical approaches applied to the analysis of different economic phenomena. In terms of similarity, both fields focus on the analysis of different economic phenomena to study the irrational and chaotic behaviors through time (history) and space (geographical). To study the difference and similarity that exists between economic modelling and policy modelling, the bibliographical references of two prestigious journals viz. the journal of policy modeling (Elsevier, 2012a) and the journal of economic modeling (Elsevier, 2012b) are employed.

1. Definition and Classification of Economic Modelling

"Economic modelling" can be defined as "an academic research work, that is supported by the use of different theories as well as quantitative or qualitative models and techniques, to analytically evaluate the causes and effects of any economic phenomenon that affect on society, anywhere and anytime." As an integral part of this definition, "modelling" is defined as "a theoretical or technical instrument that is formulated to solve specific problems affecting, directly or indirectly, societies across different periods of times and geographical spaces."

Economic modelling can also be classified. Based on a study of all the one thousand seven hundred seventy five (1775) papers that were published in the Economic Modelling (EM) journal from 1984 to 2012 (28 years) (see Table 1 and Figure 1), economic modelling can be classified into the following twelve (12) categories: (i) domestic and international trade economic modelling; (ii) energy, communications and transportation economic modelling; (iii) agriculture, environmental and natural resources management modelling; (iv) fiscal policy, subsidies, and government spending economic modelling; (v) institutional, regulation, planning, intervention, and negotiation modelling; (vi) labor, wages, education, unemployment and population economic modelling; (vii) monetary, finance, banking, exchange rate, and investment policy modelling; (viii) production, consumption, and inflation economic modelling; (ix) technological and R&D economic modelling; (x) welfare economics modelling; (xi) economic growth and development modelling; (xii) miscellaneous economic modelling.

Based on the same study and the same classification above, the percentages of papers in the individual categories of economic modelling were found to be as follows: (i) domestic and international trade economic modelling (25 papers = 1%); (ii) energy, communications and transportation economic modelling (40 papers = 2%); (iii) agriculture, environmental and natural resources management economic modelling (85 papers = 5%); (iv) fiscal policy, subsidies, and government spending economic modelling (260 papers = 15%); (v) institutional, regulation, planning, intervention, and negotiation economic modelling (5 papers = 0 %); (vi) labor, education, wages, unemployment and population economic modelling (90 papers = 5%); (vii) monetary, finance, banking, exchange rate, and investment economic modelling (365 papers = 21%); (viii) production, inflation, and inflation economic

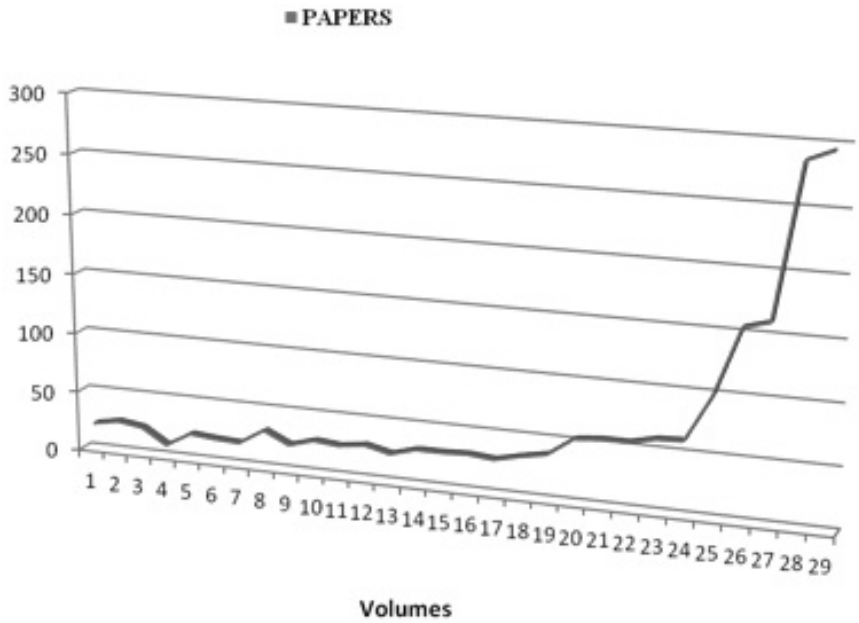
modelling (320 papers = 18%); (ix) technological and R&D economic modelling (90 papers = 5%); (x) welfare economics modelling (20 papers = 1%); (xi) economic growth and development modelling (450 papers = 25%); (xii) miscellaneous economic modelling (25 papers = 1%).

Table 1
Total Papers Output from JEM by Volume and Issues (1984-2012)

VOL	YEAR	Issues									PAPERS
		I-1	I-2	I-3	I-4	I-5	I-6	I-7	I-8	I-9	
1	1984	8	5	4	5	0	0	0	0	0	22
2	1985	12	5	1	8	0	0	0	0	0	26
3	1986	6	8	5	4	0	0	0	0	0	23
4	1987	1	1	5	3	0	0	0	0	0	10
5	1988	8	4	4	6	0	0	0	0	0	22
6	1989	5	6	1	8	0	0	0	0	0	20
7	1990	3	6	6	4	0	0	0	0	0	19
8	1991	10	5	10	7	0	0	0	0	0	32
9	1992	4	7	4	7	0	0	0	0	0	22
10	1993	8	6	8	6	0	0	0	0	0	28
11	1994	5	11	7	3	0	0	0	0	0	26
12	1995	7	8	7	7	0	0	0	0	0	29
13	1996	6	5	6	7	0	0	0	0	0	24
14	1997	7	9	6	8	0	0	0	0	0	30
15	1998	8	6	10	6	0	0	0	0	0	30
16	1999	7	8	8	8	0	0	0	0	0	31
17	2000	8	6	7	8	0	0	0	0	0	29
18	2001	8	10	8	8	0	0	0	0	0	34
19	2002	9	7	8	7	7	0	0	0	0	38
20	2003	10	9	11	10	6	7	0	0	0	53
21	2004	8	9	11	7	7	13	0	0	0	55
22	2005	11	7	10	9	10	8	0	0	0	55
23	2006	10	9	11	11	9	10	0	0	0	60
24	2007	11	10	11	9	7	13	0	0	0	61
25	2008	14	14	15	14	23	19	0	0	0	99
26	2009	28	31	21	7	36	32	0	0	0	155
27	2010	52	13	18	10	47	21	0	0	0	161
28	2011	38	40	74	66	28	40	0	0	0	286
29	2012	10	47	48	58	61	71	0	0	0	295
	Total by Issue	322	312	345	321	241	234	0	0	0	1775

Source: Journal of Economic Modelling (JEM) http://www.sciencedirect.com/science/journal/02649993

Figure 1
Total Papers Output from JEM by Volume and Issues



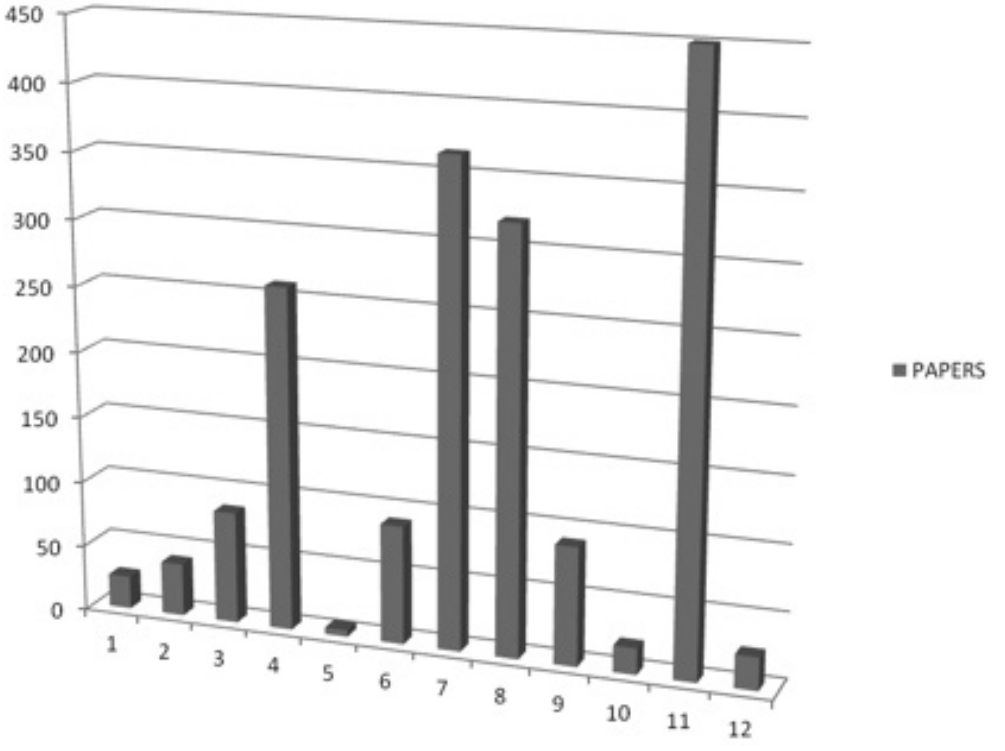
Source: Journal of Economic Modelling (JEM) http://www.sciencedirect.com/science/journal/02649993

Table 2
Classification and Distribution of JEM Papers by 12 Categories (1984-2012)

	CLASSIFICATION	PAPERS	%
1	The Domestic and International Trade Economic Modelling	20	v1%
2	Energy, Communications and Transportation Economic Modelling	30	1%
3	Agriculture. Environmental and Natural Resources Management Economic Modelling	85	5%
4	Fiscal Policy, Subsidies, and Government Spending Economic Modelling	250	17%
5	Institutional, Regulation, Planning, Intervention, and Negotiation Economic Modelling	65	0%
6	Labor, Wages, Education, Unemployment and Population Economic Modelling	70	3%
7	Monetary, Finance, Banking, Exchange Rate, and Investment Economic Modelling	365	18%
8	Production, Consumption, and Inflation Economic Modelling	320	21%
9	Technological and R&D Economic Modelling	85	5%
10	Welfare Economics Modelling	15	1%
11	Economic Growth and Development Modelling	450	27%
12	Miscellaneous Economic Modeling	20	1%
	Total	**1775**	**100%**

Source: Journal of Economic Modelling (JEM) http://www.sciencedirect.com/science/journal/02649993

Figure 2: Classification and Distribution of JEM Papers by 12 Categories (1984-2012)



Source: Journal of Economic Modelling (JEM) http://www.sciencedirect.com/science/journal/02649993

2. Multidisciplinary Approach

Among the 1775 papers published in the journal of economics modelling (JEM) journal in the past 28 years (1984-2012), the following research orientation was common: benefit/cost, probabilistic or forecasting analysis through the application of econometric methods and use of microeconomic and macroeconomic levels secondary data. Also, among these 1775 papers, and for the past 28 years, there has been an increasing dependency on econometrics models, methods and techniques. Ninety seven percent (97%) or 1722 of these papers adopted the economics research approach. Only 1% or 53 of these papers adopted a multidisciplinary approach (entailing several disciplines such as history, economics, sociology, politics, technology and social sciences et cetera).

This paper is of the view that the absence of non-economic variables can considerably increase the vulnerability of any economic modelling. Therefore, it suggests that any economic modelling should take into consideration a wide range of factors, including unforeseen factors. These factors include, among others, natural disaster trends, climate changes, terrorism, crime and violence, poverty expansion, religion and beliefs, education system, social events and phenomena, social norms and behavior, et cetera.

This paper maintains that it is necessary to incorporate these sorts of factors in economic modelling in order to formulate strong policies of minimal vulnerability possible. However, it must be assumed that all these factors maintain a constant quantitative and qualitative transformation(s) in different historical periods of the society concerned (Ruiz Estrada, 2011). Moreover, this paper makes a deep analysis about economic modelling evolution. We are taking in account a careful study of a total of 1775 papers. It presents the percentages of papers published in individual categories of economic modelling identified by Ruiz Estrada. Additionally, we are going to study the common modelling approaches used in different papers at the last twenty seven years in the journal of economic modelling (JEM) journal. At the same time, this paper recommends multidisciplinary approach to economic modelling. It suggests the incorporation of multidisciplinary, non-economic variables in economic modelling to formulate strong policies. Secondly, the evolution of the journal of economic modelling (JEM) journal is possible to observe through different volumes from year 1984 until year 2012 that the application of different research approaches into economic modelling keeps a constant quantitative transformation (volume of research output) and a qualitative transformation (content and form). Especially, these quantitative and qualitative transformations can be observed in different manuscripts in this specific journal by the application of different quantitative and qualitative methods, innovative policies and recommendations.

3. The Economic Modeling Trend

Among the 1775 papers published in the journal of economic modelling (JEM) journal in the past twenty eight years (1984-2012), the following research orientation was common: benefit/cost, probabilistic or forecasting analysis through the application of econometric methods and use of microeconomic and macroeconomic levels secondary data. Therefore, we are using forty (40) variables to evaluate all papers were published by the economic modelling (EM) journal until today. The following forty (40) variables are (1.) predicting economic modelling; (2.) monitoring economic modelling; (3.) simulation economic modelling; (4.) empirical economic modelling; (5.) theoretical economic modelling; (6.) primary data economic modelling; (7.) secondary data economic modelling; (8.) long run economic modelling; (9.) short run economic modelling; (10.) linear regression analysis; (11.) multiple regression analysis; (12.) times series data analysis; (13.) cross-sectional data analysis; (14.) panel data analysis; (15.) 2-Dimensional graphical modelling; (16.) 3-Dimensional graphical modelling; (17.) economics policy modelling approach; (18.) technological policy modelling; (19.) environment policy modelling; (20.) original theoretical framework; (21.) traditional theoretical framework; (22.) extension theoretical framework; (23.) private sector modelling; (24.) public sector modelling; (25.) macroeconomics modelling; (26.) microeconomics modelling; (27.) partial equilibrium modelling; (28.) general equilibrium modelling; (29.) dynamic economic modelling; (30.) static economic modelling; (31.) perfect competition modelling; (32.) imperfect competition modelling; (33.) national level modelling; (34.) regional level modelling; (35.) global level modelling; (36.) Keynesian modelling approach; (37.) monetary modelling approach; (38.) classic economic modelling approach; (39.) neo-classic economic modelling approach; (40.) planning economic modelling approach. (see Table 3). Based on the same study and the same classification of variables above, the percentages of papers in the individual modelling approaches in the journal of economic modelling (JEM) was found to be as follows: (1.) predicting economic modelling (1456 papers = 82%); (2.) monitoring economic modelling (142 papers = 8%); (3.) simulation economic modelling (178 papers = 10%); (4.) empirical economic modelling (1331 papers = 75%); (5.) theoretical economic modelling (444 papers = 25%); (6.) primary data economic modelling (18 papers = 1%); (7.) secondary data economic modelling (1757 papers = 99%); (8.) long run economic modelling (1686 papers = 95%); (9.) short run economic modelling (89 papers = 5%) ; (10.) linear regression analysis (89 papers = 5%); (11.) multiple regression analysis (302 papers = 17%); (12.) times series data analysis (408 papers = 23%); (13.) cross-sectional data analysis (568 papers = 32%); (14.) panel data analysis (408 papers = 23%); (15.) 2-Dimensional graphical modelling (1757 papers = 99%); (16.) 3-Dimensional graphical

modelling (18 papers = 1%); (17.) economic policy modelling (1740 papers = 98%); (18.) technological policy modelling (18 papers = 1%); (19.) environment policy modelling (18 papers = 1%); (20.) original theoretical framework (18 papers = 1%); (21.) traditional theoretical framework (1633 papers = 92%); (22.) extension theoretical framework (124 papers = 7%); (23.) private sector modelling (0 papers = 0%); (24.) public sector modelling (1775 papers = 100%); (25.) macroeconomics modelling (1740 papers = 98%); (26.) microeconomics modelling (36 papers = 2%); (27.) partial equilibrium modelling (178 papers = 10%); (28.) general equilibrium modelling (1598 papers = 90%); (29.) dynamic economic modelling (1598 papers = 90%); (30.) static economic modelling (178 papers = 10%); (31.) perfect competition modelling (89 papers = 5%); (32.) imperfect competition modelling (1686 papers = 95%); (33.) national level modelling (1633 papers = 92%); (34.) regional level modelling (53 papers = 3%); (35.) global level modelling (89 papers = 5%); (36.) Keynesian modelling approach (479 papers = 27%); (37.) monetary modelling approach (763 papers = 43%); (38.) classic economic modelling approach (178 papers = 10%); (39.) neo-classic economic modelling approach (337 papers = 19%); (40.) planning economic modelling approach (18 papers = 1%). (see Table 3). Moreover, it is possible to observe in the journal of economic modelling (JEM) journal almost all papers are focused on predicting economic modelling (82%) and empirical economic modelling (75%) according to our final results. In the case of data analysis modelling 99% of these papers are used secondary data economic modelling from different bibliographic and statistical sources. In the case of time framework in the data analysis modelling all these papers are based on the long run economic modelling (95%) and short run economic modelling (5%). Usually, the econometric approaches apply by different authors in the journal of economic modeling (JEM) journal is following by the uses of cross-sectional data analysis (32%), time series data analysis (23%) and panel data analysis (23%) respectively. In fact, the research approaches are used by the journal of economic modelling (JEM) journal all his papers are focused on economic policy modeling (98%) and in less amounts in technological policy modeling (5%) and others (1%). Another interesting result in this research paper is that 92% of the papers were published in the journal of economic modeling (JEM) journal. These papers are based on the uses of the traditional theoretical framework and only 1% of all these papers are based on an original theoretical framework. Additionally, 100% in the journal of economic modelling (JEM) journal papers are oriented to the public sector modelling. In the case of analysis under macroeconomics and microeconomics modelling levels are possible to be observed a distribution of 98% and 2% respectively. In addition, the journal of economic modelling (JEM) papers are supported by the general equilibrium economic modelling (90%), static policy economic modelling (10%) and imperfect competition modelling (95%). In the case of geographical coverage of research by the journal of economic modelling (JEM) journal papers are distributed by national level modelling (92%) and global level modelling by (5%). Moreover, the most common economic theoretical framework is used by the journal of economic modelling (JEM) journal papers is followed by Keynesian modelling approach (27%), monetary modelling approach (43%), neo-classic economic modelling approach (19%) and classic economic modelling approach (10%). Finally, in the type of graphical modelling is applied by the journal of economic modelling (JEM) journal papers are based on the common use of 2-dimensional graphical modelling (99%) and only 1% applied 3-dimensional graphical modelling (see Table 3).

Table 3
Evaluation of the EM by Economic Modeling Approach (40 Variables)

No.	Modeling Approach	Total	%
1	Predicting economic modelling	1456	82%
2	Monitoring economic modeling	142	8%
3	Simulation economic modelling	178	10%
	Total	1775	100%
4	Empirical economic modelling	1331	75%
5	Theoretical economic modelling	444	25%
	Total	1775	100%
6	Primary data economic modelling	18	1%
7	Secondary data economic modelling	1757	99%
	Total	1775	100%
8	Long run economic modelling	1686	95%
9	Short run economic modelling	89	5%
	Total	1775	100%
10	Linear regression analysis	89	5%
11	Multiple regression analysis	302	17%
12	Times series data analysis	408	23%
13	Cross-sectional data analysis	568	32%
14	Panel data analysis	408	23%
	Total	1775	100%
15	2-Dimensional graphical modelling	1757	99%
16	3-Dimensional graphical modelling	18	1%
	Total	1775	100%
17	Economics policy modelling	1740	98%
18	Technological policy modelling	18	1%
19	Environment policy modelling	18	1%
	Total	1775	100%
20	Original theoretical framework	18	1%
21	Traditional theoretical framework	1633	92%
22	Extension theoretical framework	124	7%
	Total	1775	100%
23	Private sector modelling	0	0%
24	Public sector modelling	1775	100%
25	Macroeconomics modelling	1740	98%
26	Microeconomics modelling	36	2%
	Total	1775	100%
27	Partial equilibrium modelling	178	10%
28	General equilibrium modelling	1598	90%
	Total	1775	100%

29	Dynamic economic modelling	1598	90%
30	Static economic modelling	178	10%
		1775	**100%**
31	Perfect competition modelling	89	5%
32	Imperfect competition modelling	1686	95%
	Total	**1775**	**100%**
33	National level modelling	1633	92%
34	Regional level modelling	53	3%
35	Global level modelling	89	5%
	Total	**1775**	**100%**
36	Keynesian modelling approach	479	27%
37	Monetary modelling approach	763	43%
38	Classic economic modelling approach	178	10%
39	Neo-Classic economic modelling approach	337	19%
40	Planning Economy Modelling Approach	18	1%
	Total	**1775**	**100%**

Source: Journal of Economic Modelling (JEM) http://www.sciencedirect.com/science/journal/02649993

4. The Future of Economic Modelling:

According to this paper the economic modelling can show a great future for social scientists. Hence, the economic modelling can be considered as an alternative flexible and dynamic research field that is available to adapt the uses of any research technique, method, methodology and research focus. According to our research economic modelling can be considered as a multi-discipline research approach that can facilitate the study of different socio-economic-political problems that can impact negatively on the society anywhere and anytime. However, we can say that economic modelling became an important technical-theoretical analytical tool for future academics, economists, policy makers and supranational institutions such as World Bank (WB), International Monetary Fund (IMF) and others. On another hand, the fast expansion of the economic modelling can be observed by the fast growth of his impact factor of economic modelling journal just recently got 0.701 in the year 2012 according Thomson Reuters report.

Conclusion

This paper concludes that economic modelling can open a new research field to academics, policy makers and social scientist in the study of complex and dynamic behavior of sociopolitical–economic problems that can affect our society anytime and anywhere without borders. This conclusion is drawn from the review and analysis of 1775 articles published 28 years ago (1984–2012) by the journal of economic modelling (JEM). The trend of the economic modeling is changing remarkably fast, with its origins invoked by uses of new research approaches and research focus. Finally, the economic modelling can become a powerful analytical tool that accept the adaptation of any technique, methodology, method and research approach such as economics, finances, sociology, political sciences, technology, environment, econometrics, sciences to explain deeply complex socio-political and economic problems that affect different social groups in the society at different geographical areas under different historical events.

References

Elsevier. (2012a). *Journal of Policy Modeling (JPM)*. Recuperado de http://www.sciencedirect.com/science/journal/01618938 Accessed 15.09.12

Elsevier. (2012b). Journal of *Economic Modelling (JEM)*. Recuperado de http://www.sciencedirect.com/science/journal/02649993 Accessed 15.10.12

Friedman, M. (1957). *A theory of consumption function*. United States of America: Princeton University Press., 7-19.

Hansen, H. A. (1949). *Monetary theory and Fiscal policy*. California: McGrawHill Book Co., p. 236.

Klein, L. R. (1956). *Econometric Models and the Evidence of Times Series Analysis*, *24*(2), 197–201.

Leontief, W. (1966). *The input–output economics*. New York: Oxford University Press.

Phillips, A. W. (1958). The relationship between unemployment and rate of change of money wages in the United Kingdom 1861–1957. *Economica*, *25*, 283–299.

Ruiz Estrada, M. A. (2008). Is the market in a dynamic imbalance state? *International Journal of Economics Research*, *2*(2), 239–250.

Ruiz Estrada, M. A. (2011). Policy modeling: Definition. *Classification and Evaluation Journal of Policy Modeling*, *33*(4), 1015–1029.

Ruiz Estrada, M. A. and Yap, S.F. (2013). The Origin and Evolution of Policy modeling. *Journal of Policy Modeling*, *35*(1), 170–182.

Samuelson, P. A. (1947). *Foundations of economics analysis*. Cambridge/U.S.: Harvard University Press.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, *70*(1), 65–94.

Thomson Reuters. (2011). Impact Factor Report. http://thomsonreuters.com/products services/science/science products/az/isi web of knowledge/ Accessed 25.06.12

Tinbergen, J. (1956). *Economic policy: Principles and design*. U.S.: North Holland Pub. Co., p. 276.