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Policy modeling: Definition, classification and evaluation

Mario Arturo Ruiz Estrada *

Faculty of Economics and Administration (FEA) and Institute of China Studies (ICS), University of Malaya, 50603 Kuala Lumpur, Malaysia

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Abstract

This paper introduces a definition, a way of classifying and a method of evaluating policy modeling. An analytical tool called "Policy Modeling Consistency (PMC-Index)" has been developed for the purposes of evaluating policy modeling. The PMC-Index enables policy-makers and researchers to identify the level of consistency as well as the strengths and weaknesses within any policy modeling. The implementation of the PMC-Index involves the following four basic steps: (i) the use of multi-input-output table; (ii) classification of variables and identification of parameters; (iii) measurement of the PMC-Index; (iv) construction of the PMC-Surface. Through the PMC-Index, this paper promotes multidisciplinary approach to policy modeling. It suggests that various possible effects of any economic policy can be shown using a multi-dimensional graphical means.

JEL classification: E65

Keywords: Econographicology; Policy modeling; Economics teaching; Multi-dimensional graphs and multi-dimensional geometry

1. Introduction

This paper makes several observations and recommendations pertaining to policy modeling. First, it introduces a definition of policy modeling together with a way to classify policy modeling.

* Tel.: +60 126850293.
E-mail address: marioruiz@um.edu.my
URL: http://www.econonographication.com.

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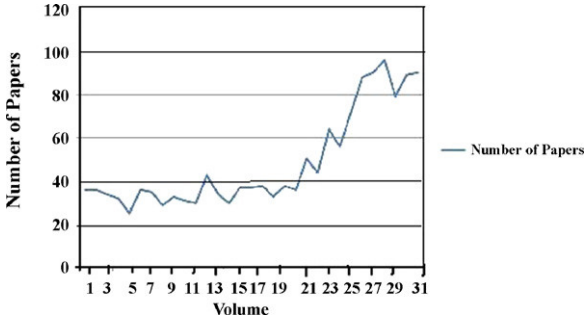

Fig. 1. Papers published in JPM from 1979 until 2009.
Source: Journal of Policy Modeling (JPM) – Elsevier group.

Based on a careful study of the total of 1501 research papers published in the Journal of Policy Modeling (JPM) between 1979 and 2009, it presents the percentages of papers published in individual categories of policy modeling identified. Second, based on an observation of the common approaches used in policy modeling papers in the past 30 years in JPM, this paper recommends multidisciplinary approach to policy modeling. It suggests the incorporation of multidisciplinary, non-economic variables in policy modeling to formulate strong policies. Third, in connection with the multidisciplinary approach, it proposes the application of the 'Omnia Mobilis' assumption (Ruiz Estrada, Yap, & Nagaraj, 2008) to policy modeling. Under this assumption ('everything is moving'), a good range of variables should be included and no relevant variables should be neglected in policy modeling.

As its fourth and main contribution, this paper introduces the idea of evaluating policy modeling. It introduces the purpose-built Policy Modeling Consistency Index (PMC-Index) to evaluate the level of consistency of any policy modeling. Through its PMC-Surface, this index can further be used to identify the strengths and weaknesses within any policy modeling. There are four basic steps in the implementation of the PMC-Index. These four steps are: (i) the use of multi-input-output table; (ii) classification of variables and identification of parameters; (iii) measurement of PMC-Index; (iv) construction of the PMC-Surface.

2. Definition and classification of policy modeling

"Policy modeling" can be defined as "an academic or empirical research work, that is supported by the use of different theories as well as quantitative or qualitative models and techniques, to analytically evaluate the past (causes) and future (effects) of any policy on society, anywhere and anytime." As an integral part of this definition, "policy" 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."

Policy modeling can also be classified. Based on a study of all the one thousand five hundred and one (1501) papers that were published in the Journal of Policy Modeling (JPM) from 1979 to 2009 (30 years) (see Table 1 and Fig. 1), policy modeling can be classified into the following twelve (12) categories: (i) domestic and international trade policy modeling; (ii) energy, communications, infrastructure and transportation policy modeling; (iii) environmental and natural resources management policy modeling; (iv) fiscal and government spending policy modeling; (v) institutional, regulation and negotiation policy modeling; (vi) labor, employment and population

Table 1
Total of papers published by JPM from 1979 to 2009.

Year (vol)	11	12	13	14	15	16	17	18	19	Top
1979 (1)	12	14	10	0	0	0	0	0	0	36
1980 (2)	12	14	10	0	0	0	0	0	0	36
1981 (3)	11	11	12	0	0	0	0	0	0	34
1982 (4)	10	11	11	0	0	0	0	0	0	32
1983 (5)	8	8	9	0	0	0	0	0	0	25
1984 (6)	9	11	6	10	0	0	0	0	0	36
1985 (7)	9	8	7	11	0	0	0	0	0	35
1986 (8)	7	7	7	8	0	0	0	0	0	29
1987 (9)	9	6	6	12	0	0	0	0	0	33
1988 (10)	8	7	8	8	0	0	0	0	0	31
1989 (11)	7	5	8	10	0	0	0	0	0	30
1990 (12)	8	7	20	8	0	0	0	0	0	43
1991 (13)	8	9	9	8	0	0	0	0	0	34
1992 (14)	6	8	7	9	0	0	0	0	0	30
1993 (15)	11	7	5	7	7	0	0	0	0	37
1994 (16)	10	4	4	7	6	6	0	0	0	37
1995 (17)	11	6	4	7	6	6	0	0	0	38
1996 (18)	7	4	5	4	7	6	0	0	0	33
1997 (19)	9	4	6	6	7	6	0	0	0	38
1998 (20)	5	7	5	5	7	7	0	0	0	36
1999 (21)	8	6	7	8	9	6	6	0	0	50
2000 (22)	6	5	5	3	12	6	7	0	0	44
2001 (23)	6	6	9	9	9	10	8	7	0	64
2002 (24)	7	9	6	7	10	5	8	4	0	56
2003 (25)	13	12	10	10	7	8	6	6	0	72
2004 (26)	18	11	8	7	12	9	10	13	0	88
2005 (27)	9	9	10	9	11	11	12	11	8	90
2006 (28)	9	13	11	15	8	11	11	10	8	96
2007 (29)	10	14	13	15	12	15	0	0	0	79
2008 (30)	16	19	11	14	15	14	0	0	0	89
2009 (31)	11	19	16	14	12	18	0	0	0	90
Total										1501

Source: Elsevier (2010) Journal of Policy Modeling (JPM) – Elsevier Group Topic Economics.

policy modeling; (vii) monetary, banking and investment policy modeling; (viii) production and consumption policy modeling; (ix) technological and R&D policy modeling; (x) welfare and social policy modeling; (xi) economic growth and development policy modeling; (xii) miscellaneous policy modeling.

Based on the same study and the same classification above, the percentages of papers in the individual categories of policy modeling were found to be as follows: (i) domestic and international trade policy modeling (220 papers = 15%); (ii) energy, communications, infrastructure and transportation policy modeling (80 papers = 5%); (iii) environmental and natural resources management policy modeling (70 papers = 5%); (iv) fiscal and government spending policy modeling (80 papers = 5%); (v) institutional, regulation and negotiation policy modeling (55 papers = 4%); (vi) labor, employment and population policy modeling (70 papers = 5%); (vii) monetary, banking and investment policy modeling (410 papers = 27%); (viii) production and consumption policy modeling (165 papers = 11%); (ix) technological and R&D policy modeling (35 papers = 2%); (x) welfare and social policy modeling (56 papers = 4%); (xi) economic growth and development

Table 2
JPM papers distribution by 12 categories (1979–2009).

	Papers	%
1. Domestic and international trade policy modeling	220	15%
2. Energy, communications, infrastructure and transportation policy modeling	80	5%
3. Environmental and natural resources management policy modeling	70	5%
4. Fiscal and government spending policy modeling	80	5%
5. Institutional, regulation and negotiation policy modeling	55	4%
6. Labor, employment and population policy modeling	70	5%
7. Monetary, banking and investment policy modeling	410	27%
8. Production and consumption policy modeling	165	11%
9. Technological and R&D policy modeling	35	2%
10. Welfare and social policy modeling	56	4%
11. Economic growth and development policy modeling	150	10%
12. Miscellaneous policy modeling	110	7%
	1501	100%

Source: Journal of Policy Modeling (JPM) – Elsevier Group.
Notes: Miscellaneous Geological Partial Equilibrium Analysis and Macroeconomic Analysis and New Topic in Economics.

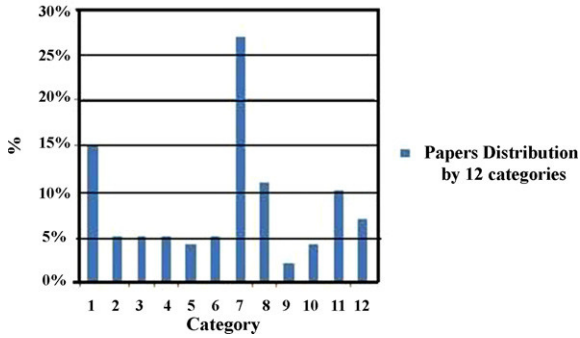

Fig. 2. JPM papers distributed by 12 categories (1979–2009).
Source: Journal of Policy Modeling (JPM) – Elsevier group.

policy modeling (150 papers = 10%); (xii) miscellaneous policy modeling (110 papers = 7%) (see Table 2 and Fig. 2).

3. Proposed approach to policy modeling

3.1. Multidisciplinary approach

Among the 1501 papers published in JPM in the past 30 years (1979–2009), 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 1501 papers, and for the past 30 years, there has been an increasing dependency of policy modeling on econometrics models, methods and techniques. Ninety seven percent (97%) or 1456 of these papers adopted the economics research approach in policy modeling. Only 3% or 45 of these papers adopted the institutional approach or multidisciplinary

approach (entailing several disciplines such as history, economics, sociology, politics, technology and social sciences et cetera) in policy modeling.

This paper is of the view that the absence of non-economic variables can considerably increase the vulnerability of any policy. Therefore, it suggests that any policy modeling 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 policy modeling 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.

3.2. 'Omnia Mobilis' assumption

The Ceteris Paribus assumption was commonly applied to policy modeling in earlier publications in JPM. This paper suggests that it is not necessary to apply the Ceteris Paribus assumption to policy modeling. The argument is that no relevant variable should be neglected or considered less important to be accounted for in policy modeling. For this reason, this paper proposes a new assumption for policy modeling: the 'Omnia Mobilis' assumption (everything is moving) advanced by Ruiz Estrada et al. (2008). The objective of applying the Omnia Mobilis assumption is to include a wide range of variables and not neglect any relevant variable in policy modeling.

4. The Policy Modeling Consistency Index (PMC-Index)

With the Omnia Mobilis assumption, this paper proposes the "Policy Modeling Consistency Index (PMC-Index) as a tool to evaluate policy modeling. This purpose-built index performs the following functions: (i) to evaluate the consistency level of any policy modeling; (ii) to identify the strengths and weaknesses of any policy modeling.

The construction of the PMC-Index involves the use of fifty (50) sub-variables distributed in ten (10) main-variables. These 10 main-variables are: (X_1) types of research; (X_2) research orientation; (X_3) data sources; (X_4) econometrics methods applied; (X_5) areas of research; (X_6) research theoretical framework; (X_7) policy modeling by sectors; (X_8) economics frameworks; (X_9) geographical analysis; (X_{10}) paper citation.

There are four basic steps in the implementation of the PMC-Index. These steps are: (i) the use of multi-input-output table; (ii) classification of variables and identification of parameters; (iii) measurement of the PMC-Index; (iv) construction of the PMC-Surface. The PMC-Surface is used to show the strengths and weaknesses in any policy modeling from a multi-dimensional perspective. The mega-surface coordinate space (see Fig. 3) (Ruiz Estrada, 2007) is used in the construction of the PMC-Surface.

4.1. Steps to implement PMC-Index

4.1.1. The use of multi-input-output table

The multi-input-output table (see Table 3) is an alternative database analysis framework that permits storage of a large amount of data to measure any single variable. This single variable can show the evolution of any policy from a general perspective. In the construction of the PMC-Index, the multi-input-output table functions as the basic analytical framework to measure the

Table 3
Multi-input-output table.

P	$X1$							$X2$						$X3$					
	$X1{:}1$	$X1{:}2$	$X1{:}3$	$X1{:}4$	$X1{:}5$	$X1{:}6$	$X1{:}7$	$X2{:}1$	$X2{:}2$	$X2{:}3$	$X2{:}4$	$X2{:}5$	$X2{:}6$	$X3{:}1$	$X3{:}2$	$X3{:}3$	$X3{:}4$	$X3{:}5$	$X3{:}6$
P	$X4$						$X5$									$X6$			
	$X4{:}1$	$X4{:}2$	$X4{:}3$	$X4{:}4$	$X4{:}5$	$X4{:}6$	$X5{:}7$	$X5{:}1$	$X5{:}2$	$X5{:}3$	$X5{:}4$	$X5{:}5$	$X5{:}6$	$X5{:}7$	$X5{:}8$	$X6{:}1$	$X6{:}2$	$X6{:}3$	
P	$X7$			$X8$										$X9$				$X10$	
	$X7{:}1$	$X7{:}2$	$X7{:}3$	$X8{:}1$	$X8{:}2$	$X8{:}3$	$X8{:}4$	$X8{:}5$	$X8{:}6$	$X8{:}7$	$X8{:}8$	$X9{:}1$	$X9{:}2$	$X9{:}3$	$X10$				

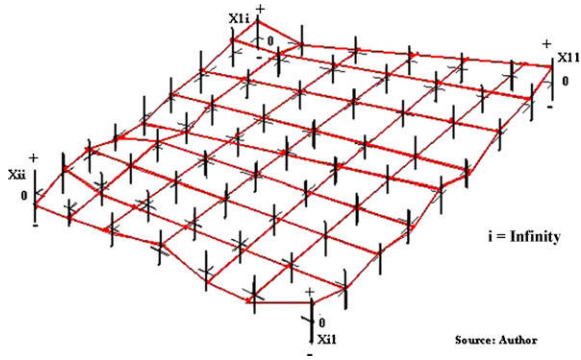

Fig. 3. The mega-surface coordinate space.

"*m*" number of main-variables. Each main-variable is formed by "*n*" number of sub-variables. The number of sub-variables in each main-variable is unlimited. As such, the multi-input-output table concept does not include any notion of ranking of variables according to importance. All sub-variables are given the same importance (weight) because we are interested to measure a single value, which is the PMC-Index in this case. In order to give the same weight to all sub-variables, it is necessary to use the binary system. The binary system (0,1) helps to maintain a balance among all variables.

4.1.2. Classification of variables and identification of parameters

The construction of the PMC-Index involves 10 main-variables and 50 sub-variables. The 10 main-variables are: (X_1) type of research; (X_2) research orientation; (X_3) data sources; (X_4) econometrics methods applied; (X_5) areas of research; (X_6) research theoretical framework; (X_7) policy modeling by sectors; (X_8) economics frameworks; (X_9) geographical analysis; (X_{10}) paper citation.

(I) The first main-variable (X_1) ('types of research') is formed by seven sub-variables: ($X_{1:1}$) predicting; ($X_{1:2}$) monitoring; ($X_{1:3}$) proposal; ($X_{1:4}$) descriptive; ($X_{1:5}$) diagnostic; ($X_{1:6}$) simulation; ($X_{1:7}$) experimental. (II) The second main-variable (X_2) ('research orientation') is formed by six sub-variables: ($X_{2:1}$) empirical; ($X_{2:2}$) theoretical; ($X_{2:3}$) technical; ($X_{2:4}$) historical; ($X_{2:5}$) quantitative; ($X_{2:6}$) qualitative. (III) The third main-variable (X_3) ('data sources') consists of six sub-variables: ($X_{3:1}$) primary data; ($X_{3:2}$) secondary data; ($X_{3:3}$) mix data; ($X_{3:4}$) long term; ($X_{3:5}$) medium term; ($X_{3:6}$) short term. (IV) The fourth main-variable (X_4) ('econometric methods applied on policy modeling') is made up of ($X_{4:1}$) linear regression analysis; ($X_{4:2}$) multiple regression analysis; ($X_{4:3}$) times series data; ($X_{4:4}$) cross-sectional data; ($X_{4:5}$) panel data; multi-dimensional panel data ($X_{4:6}$). (V) The fifth main-variable (X_5) ('area of research') comprises eight sub-variables: ($X_{5:1}$) economics; ($X_{5:2}$) social; ($X_{5:3}$) technological; ($X_{5:4}$) political; ($X_{5:5}$) environment; ($X_{5:6}$) institutional; ($X_{5:7}$) sciences; ($X_{5:8}$) multi-disciplinary. (VI) The sixth main-variable (X_6) ('research theoretical framework') comprises three sub-variables: ($X_{6:1}$) original theoretical framework; ($X_{6:2}$) traditional theoretical framework; ($X_{6:3}$) extension theoretical framework. (VII) The seventh main-variable (X_7) ('policy modeling by sectors') is made up of three sub-variables: ($X_{7:1}$) private sector; ($X_{7:2}$) public sector; ($X_{7:3}$) public/private sector. (VIII) The eighth main-variable (X_8) ('economics frameworks applied on policy modeling') comprises the following eight sub-variables: ($X_{8:1}$) macroeconomics analysis; ($X_{8:2}$) microeconomics analysis; ($X_{8:3}$) partial equilibrium; ($X_{8:4}$) general equilibrium; ($X_{8:5}$) dynamic modeling; ($X_{8:6}$) static model-

ing; ($X_{8:7}$) perfect competition; ($X_{8:8}$) imperfect competition. (IX) The ninth main-variable (X_9) ('geographical analysis') is affected by three sub-variables: ($X_{9:1}$) national level; ($X_{9:2}$) regional level; ($X_{9:3}$) global level. (X) The tenth main-variable (X_{10}) is 'paper citation'. It is without any sub-variable (see Table 4).

Besides variables and sub-variables, two (2) parameters are used in the construction of the PMC-Index. These parameters are: (i) if the sub-variable can fit into the policy modeling, then this sub-variable is denoted by "1"; (ii) if the sub-variable cannot fit into the policy modeling, then this sub-variable is denoted by "0". Each parameter uses the binary digit "0" or "1". The binary system is applied to every sub-variable because all sub-variables have the same level of importance and exert the same level of influence in the multi-input-output table.

4.1.3. Measurement of PMC-Index

The measurement of the PMC-Index involves four steps. (i) The first step is to put the 10 main-variables and 50 sub-variables into the multi-input-output table (see Table 3). (ii) The second step is to evaluate sub-variable by sub-variable according to the parameters mentioned above (see Expressions (1) and (2)). (iii) The third step is to calculate the value of each main-variable. This value is the sum of all sub-variables (of the particular main-variable) divided by the total number of sub-variables (see Expression (3)). The last step is the actual measurement of the PMC-Index. The PMC-Index is equal to the sum of all main-variables (see Expression (4)):

$$X \sim N[0, 1] \tag{1}$$

$$X = \{XR : [0v1]\} \tag{2}$$

$$Xt\left(\sum_{j=1}^{n}\frac{Xt_j}{T(Xtj)}\right) \quad t = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, \ldots, \infty \tag{3}$$

i = main variable; j = sub-variable; t = total variables in analysis:

$$\mathrm{PMC} = \begin{pmatrix} \overset{7}{} & \overset{6}{} & \overset{6}{} \\ X_1\left(\sum_{i=1}\frac{X_1 i}{7}\right) + & X_2\left(\sum_{J=1}\frac{X_2 j}{6}\right) + & X_3\left(\sum_{k=1}\frac{X_3 k}{6}\right) + \\ \overset{6}{} & \overset{8}{} & \overset{3}{} \\ X_4\left(\sum_{l=1}\frac{X_4 l}{6}\right) + & X_5\left(\sum_{m=1}\frac{X_5 m}{8}\right) + & X_6\left(\sum_{n=1}\frac{X_6 n}{3}\right) + \\ \overset{3}{} & \overset{8}{} & \overset{3}{} \\ X_7\left(\sum_{o=1}\frac{X_7 o}{3}\right) + & X_8\left(\sum_{p=1}\frac{X_8 p}{8}\right) + & X_9\left(\sum_{r=1}\frac{X_9 r}{3}\right) + X_{10} \end{pmatrix} \tag{4}$$

4.1.4. Evaluation of consistency of policy modeling

The PMC-Index can be used to evaluate the level of consistency of any policy modeling. The PMC-Index is classified according to one of these four levels of research consistency: 'perfect

Table 4
Application of binary system in the multi-input-output table.

P	*X*1							*X*2						*X*3					
V	*X*1:1	*X*1:2	*X*1:3	*X*1:4	*X*1:5	*X*1:6	*X*1:7	*X*2:1	*X*2:2	*X*2:3	*X*2:4	*X*2:5	*X*2:6	*X*3:1	*X*3:2	*X*3:3	*X*3:4	*X*3:5	*X*3:6
*P*1	0	1	1	1	1	1	1	0	1	1	1	1	1	0	1	0	0	1	1
*P*2	0	1	1	1	1	1	1	0	1	1	0	1	1	0	1	0	0	1	1
*P*3	0	1	1	1	1	1	1	0	1	1	0	1	1	0	0	0	0	0	0

P	*X*4						*X*5								*X*6			*X*7		
V	*X*4:1	*X*4:2	*X*4:3	*X*4:4	*X*4:5	*X*4:6	*X*5:1	*X*5:2	*X*5:3	*X*5:4	*X*5:5	*X*5:6	*X*5:7	*X*5:8	*X*6:1	*X*6:2	*X*6:3	*X*7:1	*X*7:2	*X*7:3
*P*1	1	1	1	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
*P*2	1	1	1	0	0	1	1	0	1	0	0	0	0	0	1	1	1	0	0	0
*P*3	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1	0

P	*X*8								*X*9			*X*10
V	*X*8:1	*X*8:2	*X*8:3	*X*8:4	*X*8:5	*X*8:6	*X*8:7	*X*8:8	*X*9:1	*X*9:2	*X*9:3	*X*10
*P*1	1	0	1	1	1	0	0	1	1	1	1	0
*P*2	1	0	1	1	1	0	0	1	1	1	1	1
*P*3	1	0	1	1	1	0	0	1	0	0	0	0

Table 4
(*Continued*).

Variables		
(*X*1) Type of research	(*X*3:6) Short term	**(*X*7) Policy modeling by sectors**
(*X*1:1) Predicting	**(*X*4) Applied Econometrics methods**	(*X*7:1) Private sector
(*X*1:2) Monitoring	(*X*4:1) Linear regression analysis	(*X*7:2) Public sector
(*X*1:3) Proposal	(*X*4:2) Multiple regression analysis	(*X*7:3) Public/private sector
(*X*1:4) Descriptive	(*X*4:3) Times series data	**(*X*8) Economics framework**
(*X*1:5) Diagnostic	(*X*4:4) Cross-sectional data	(*X*8:1) Macroeconomics analysis
(*X*1:6) Simulation	(*X*4:5) Panel data	(*X*8:2) Microeconomics analysis
(*X*1:7) Experimental	(*X*4:6) Multidimensional panel data	(*X*8:3) partial equilibrium
(*X*2) Research orientation	**(*X*5) Area of research**	(*X*8:4) General equilibrium
(*X*2:1) Empirical	(*X*5:1) Economics	(*X*8:5) Dynamic modeling
(*X*2:2) Theoretical	(*X*5:2) Social	(*X*8:6) Static modeling
(*X*2:3) Technical	(*X*5:3) Technological	(*X*8:7) Perfect competition
(*X*2:4) Historical	(*X*5:4) Political	(*X*8:8) Imperfect completion
(*X*2:5) Quantitative	(*X*5:5) Environment	**(*X*9) Geographical analysis**
(*X*2:6) Qualitative	(*X*5:6) Institutional	(*X*9:1) National level
(*X*3) Date source	(*X*5:7) Sciences	(*X*9:2) Regional level
(*X*3:1) Primary data	(*X*5:8) Multi-disciplinary	(*X*9:3) Global level
(*X*3:2) secondary data	**(*X*6) Research theoretical framework**	**(*X*10) Paper citation**
(*X*3:3) Mix data	(*X*6:1) original theoretical framework	
(*X*3:4) Long term	(*X*6:2) Traditional theoretical framework	
(*X*3:5) Medium term	(*X*6:3) Extension of theoretical framework	

Table 5
The PMC-Index measure.

	Paper-1	Paper-2	Paper-3
($X1$) Type of research	0.86	0.43	0.43
($X2$) Research orientation	0.83	0.67	0.67
($X3$) Data sources	0.50	0.50	0.00
($X4$) Econometrics methods applied	0.83	0.67	0.33
($X5$) Area of research	0.62	0.25	0.12
($X6$) Research theoretical framework	1.00	1.00	1.00
($X7$) Policy modeling by sectors	1.00	0.67	0.00
($X8$) Economics framework	0.62	0.62	0.50
($X9$) Geographical analysis	1.00	1.00	0.00
($X10$) Paper citation	0.00	1.00	1.00
Total (PMC-Index)	7	7	4

Results	PMC-Index	Level
Paper 1	7	Good consistency
Paper 2	7	Good consistency
Paper 3	4	Low consistency

consistency'; 'good consistency'; 'acceptable consistency'; 'low consistency'. If the PMC-Index is between 10 and 9 points, then the research is of 'perfect consistency'. If the PMC-Index is between 8.99 and 7 points, then there is 'good consistency' in the research. A PMC-Index that is between 6.99 and 5 points shows 'acceptable consistency' in the research. If the PMC-Index is between 4.99 and 0 points, then we are referring to a 'low consistency' research.

4.1.5. Construction of policy modeling consistency surface (PMC-Surface)

The full implementation of the PMC-Index requires one fourth step, that is, the construction of the PMC-Surface. The purpose of constructing the PMC-Surface is to graphically represent all results in the PMC-Matrix. The PMC-Surface shows the strengths and weaknesses within any policy modeling on a multi-dimensional coordinate space (see Fig. 4).

The construction of the PMC-Surface is based on the PMC-Matrix results (see Expression (5)). The PMC-Matrix is a three by three matrix that contains the individual results of all nine main-variables (taken from Table 5). The idea here is to use the results of strictly nine main-variables in the PMC-Matrix to build a symmetric surface. When the PMC-Matrix keeps the number of rows strictly the same as the number of columns, then the PMC-Surface can always show a perfect symmetric view:

$$\text{PMC-Surface} = \begin{pmatrix} X_1 & X_4 & X_7 \\ X_2 & X_5 & X_8 \\ X_3 & X_6 & X_9 \end{pmatrix} \tag{5}$$

4.1.6. Evaluation of strengths and weaknesses of main-variables in policy modeling

The result of each main-variable in the PMC-Matrix is evaluated according to five levels of performance. If the result of the main-variable is between 1 and 0.90, then this main-variable is of 'excellent performance'. If the result is between 0.89 and 0.70, then the main variable is of 'good performance'. If the main-variable has a result between 0.69 and 0.50, then this main-variable is of 'acceptable performance'. If the main-variable shows a result between 0.49 and 0.30, then this

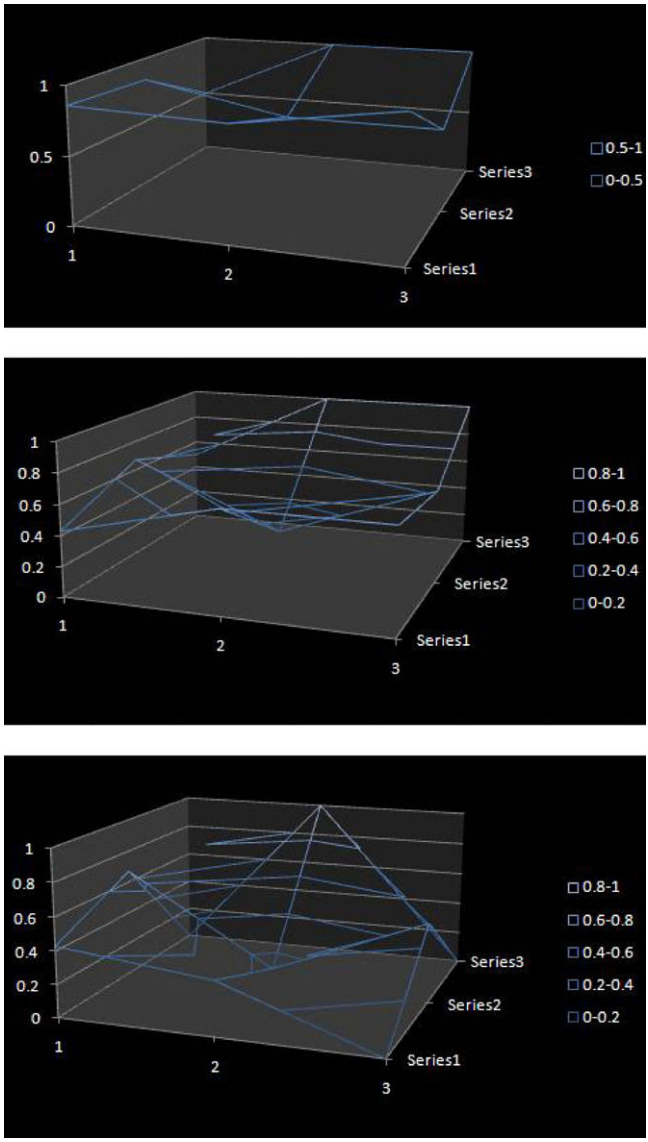

Fig. 4. PMC-Surface.

main-variable has 'non-satisfactory performance'. If the main-variable has a result between 0.29 and 0, then its performance is 'poor performance'.

5. Application of PMC-Index and PMC-Surface: an example

For demonstration purposes in this paper, the PMC-Index and PMC-Surface were applied to 3 different cases of policy modeling that were featured in three JPM papers respectively. The first is the paper entitled 'the Korea unification: how painful and costly' (Paper-1) authored by Ruiz

Table 6
PMC-Surface data.

$$\text{Paper-1} = \begin{pmatrix} 0.86 & 0.83 & 1.00 \\ 0.83 & 0.62 & 0.62 \\ 0.50 & 1.00 & 1.00 \end{pmatrix}$$

$$\text{Paper-2} = \begin{pmatrix} 0.43 & 0.67 & 0.67 \\ 0.67 & 0.25 & 0.62 \\ 0.50 & 1.00 & 1.00 \end{pmatrix}$$

$$\text{Paper-3} = \begin{pmatrix} 0.43 & 0.33 & 0.00 \\ 0.67 & 0.12 & 0.50 \\ 0.00 & 1.00 & 0.00 \end{pmatrix}$$

Estrada and Park (2008). The second paper is 'the openness growth monitoring model' (Paper-2) authored by Ruiz Estrada and Yap (2006). The third paper is 'the trade liberalization monitoring model' (Paper-3) by Ruiz Estrada (2004).

Paper-1 and Paper-2 each has a PMC-Index of 7 points (good consistency). The PMC-Index of Paper-3 is 4 points (low consistency) (see Table 5). In the case of Paper-3, the 'low consistency' result originates from the following four weak main-variables: main-variable X_3 (0 = poor performance); main-variable X_5 (0.12 = poor performance); main-variable X_7 (0 = poor performance) and main-variable X_9 (0 = poor performance) (see Table 6).

The poor performance of the above four main-variables in Paper-3 can be seen on the PMC-Surface (see Fig. 4). Here the PMC-Surface shows the weaknesses within a specific case of policy modeling through a multi-dimensional graphical representation.

Now that we have found the four weaknesses within the policy modeling featured in Paper-3, we can make a series of recommendations. The first recommendation is for Paper-3 to use secondary data in its specific model to improve the main-variable (X_1). As the second recommendation, Paper-3 should include non-economic variables in its model to improve the main-variable (X_5). Thirdly, Paper 3 should identify the sector that is relevant to improve the main-variable (X_7) in the model. Finally, the recommendation is for Paper-3 to improve the main-variable (X_9) by applying its model to different regions and countries (see Table 6 and Fig. 4).

6. Concluding remarks

By introducing a definition of policy modeling, a way of classifying as well as a method of evaluating policy modeling, this paper is a point of departure for the development of a theoretical framework of policy modeling. In effect, the definition, classification and method of evaluation introduced in this paper can be part of a policy modeling theoretical framework. They are useful as terms of reference for policy modeling and generally, for any research pertaining to economic policies. As an instrument to evaluate the strengths and weaknesses within any policy modeling, the PMC-Index can serve to improve the quality of future research in policy modeling. Other recommendations in this paper - specifically 'multidisciplinary approach to policy modeling', 'use of multi-dimensional coordinate space in policy modeling' and 'Omnia Mobilis assumption in policy modeling' – are beneficial to expanding the horizon of research in policy modeling.

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