J. Basic. Appl. Sci. Res., 2(8)7752-7758, 2012
© 2012, TextRoad Publication

ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

AFuzzy Logic Approachto Modeling theUncertaintyof Government ConsumptionExpenditure

GhodratollahEmamverdi[1] (Ph.D), Maryam ShahabiTabari[2]

[1]Assistant Professor of Economics, Islamic Azad University, Central Tehran Branch, Tehran, Iran
[2]M.A Student of Planning Economic Systems, Islamic Azad University, Central Tehran Branch, Tehran, Iran

ABSTRACT

In this paper we propose measuring the uncertainty rate of government consumption expenditure in Iran during 1992-2007 on the basis of fuzzy sets theory and logic. We select two input variables of the government consumption expenditure ratio and economic growth in order to create annual time series for the uncertainty of government consumption expenditure. The obtained results indicate that the uncertainty of government consumption expenditure has different fluctuations during the years under consideration. These fluctuations arise from economic-politic issues inside and outside the country. And by studying uncertainty graphs of consumption expenditure ratio and economic growth, we conclude that the uncertainty of government consumption expenditure may cause an increase in economic growth.

KEYWORDS: The uncertainty of government consumption expenditure, fuzzy sets, fuzzy logic, economic growth, government consumption expenditure ratio.

1. INTRODUCTION

Generally, the uncertainty emerges after wars and invasions, economic and politic crises and can play an important role in conducting business cycles (Bloom, 2009).The most important features are that different probable results will be considered. Consequently, available mechanisms in the market or available politic levers may lose their efficiency in the economies under uncertain conditions [5]. A stable macroeconomics requires basic changes in government financial structure in order to react against domestic and foreign shocks. [6].So the importance of measuring uncertainty rate makes the economist apply different methods and compare the results. Fuzzy logic facilitates common sense reasoning with imprecise and vague propositions dealing with natural language and serves as a basis for decision analysis and control actions [11].In the last years, different methods had been applied for measuring the uncertainty but each had its own particular shortcomings [15]. A research program whose objective is to study uncertainty and uncertainty-based information in all their manifestations was introduced in the early 1990's under the name "generalized information theory" (GIT). This research program, motivated primarily by some fundamental methodological issues emerging from the study of complex systems, is based on a two-dimensional expansion of classical, probability-based information theory [13].In thepost-Keynesian approach, uncertainty is understood as 'radical uncertainty' and cannot be formalized by the classical probability theory. There are a great debate in how formalize the notion of uncertainty, as conceived by Keynes in his Treatise on Probability and General Theory.

Government consumption expenditure is fundamental for economic activities and lots of changes in this field may cause uncertainty (especially in private sector) [4]. In this paper we address this need by illustrating how the tools of fuzzy sets and logic can be used to measure the uncertainty of government consumption expenditure.

We will follow these two hypotheses during the study:

Hypotheses:

1. Relatively high changes in government consumption expenditure andcosts cause some uncertainty. In the other words, there's accompaniment between uncertainty of government expenditure and the role of consumption expenditure.
2. The uncertainty of government consumption expenditure causes decreasing economic growth.

***Corresponding Author:** GhodratollahEmamverdi Assistant Professor of Economics , Islamic Azad university, Central Tehran branch. ghemamverdi@gmail.com

We willproceed introducing fuzzy logic and the method of estimating government consumption expenditure by using sets theory and fuzzy logic in the second part of this paper. The third part of the paper includes empirical findings of the uncertainty of government consumption expenditure in Iran and finally, main results of discussion have been described in the fourth part.

2. Definitions of Fuzzy Logic and General Research Method

Fuzzy sets theory and logic were firstly introduced by Dr. LotfiAsgarZadeh, Iranian mathematician of America Berkley University in 1965. This theory has had lots of applications in different sciences. More specifically, the use of fuzzy set theory in *econometrics* is virtually unknown.To our knowledge the only other such contributions are those of Shepherd and Shi [1998] and Lindstrom [1998]. The former authors use fuzzy sets in a regression context to model non-linearity's, while Lindstrom uses fuzzy analysis to "predict" fixed investment behavior on the basis of interest rate levels and changes[9].Our own analysis here follows his methodology quite closely.

Fuzzy logic systems use fuzzy sets. While a traditional crisp set only allows its members' membership function to take values of one or zero (either belongs to the set or not, respectively), members of a fuzzy set can have a membership function in the interval [0, 1]. As a result, a member can belong to a fuzzy set with a certain degree of membership between zero and one[19]. The closeness of membership degree towards to 1 is indicative of more dependency to the sets and towards to 0 less dependency (Zimmermann, 1991, 12). Membership function of a mappingis from real numbers to (0,1) sets which can be definedwith the following formula:

$F: R \rightarrow [0, 1]$

$\{(x, A(x)) \mid x \in X\}$

In this function, A(x) is x membership degree. If A(x)=1, x is completely A member and if A(x)=0, x is not A member at all.

In fuzzy logic some phrases are defined as follows:

LV: Linguistic variable =(x, T(x), U, G, F)

Linguistic variables represent crisp information in a form and precision appropriate for the problem[10].

X: variable name (concept)؛ T(x): linguistic terms sets ؛ U: universal set ؛G: govern and F: fuzzy set

For example, if we assume that our variable is "consumption", its linguistic terms set are:

T (consumption) = {very low, low, normal, high, very high}

In fuzzy sets, regularinductive rules are notall true especially inclusion law and exclusion law will be violated. i.e., in A fuzzy sets and A complement (namelyA'):

$A \cap A' \neq \emptyset$ ؛ $A \cup A' \neq M$ [1]

Also, against traditional sets theory, we use MIN operator instead of intersection of two sets and MAX operator instead of their union. A minus of that set can be replaced for complement law [17].

The purpose of the present paper is to quantify and measure the uncertainty of government consumption expenditure in Iran during 1992-2007. Therefore, common regression analyses haven't been used. We only use causal variables (the government consumption expenditure ratio and economic growth) for simplicity. Main part of government expenditure in Iran's economy is arisen from oil incomes. So, for avoiding the problem we use GDP without the oil. The requisite of above fuzzy analysis is making a fuzzy set and using two related indices. This set is along with the quantities of two variables of I_1 and I_2 (economic growth and government consumption expenditure ratio, respectively) and for creating that, moving average will be firstly calculated with 6 years lag in I_1 and I_2 series[2].We start from the year of 1987 because we want to calculate the degree of uncertainty of government consumption expenditure for 1992-2007.((Normal))quantities will be obtained for each series in each year. After determining normal quantities of two I_1 and I_2, quantitative support level will be estimated by calculating one and two sample standard deviations around moving average (normal quantity). The number of standard deviations can be considered 3, 4, etc.

[1]M is the universal set and Ø, the nullset

[2]for removing the effect of business cycles from the data, moving average can be used

3. Extracting the Uncertainty of Government Consumption Expenditure

It should be mentioned that the selection of two variables and specifying the limits of fuzzy sets are subjective. But we expect positive accompaniment between causal variables and uncertainty rate of government expenditure. It means in fuzzy language (if economic growth and the government consumption expenditure ratio are high, we expect that the rate of uncertainty of government consumption expenditure should be high.

.Accordingly, we will have for the year of 2005:

Very low LowNormal High Extremely HighVLL N H EX

-2SD -1SD Mean +1SD+2SD

I_1: 0/00977 0/03836 0/06695 0/09554 0/12413I_2: 0/085580/11183 0/138090/164340/19059

Standard deviation of economic growth and the government consumption expenditure ratio will be 0.02859 and 0.02625 respectively.

Therefore, by above calculations in each year, we will have two 5 member sets and in total a 16x10 matrix (16 is the number of years of 1992-2007 underconsideration). Each of the above points is called break-points.

Then, we convert the data of above table for fuzzy calculations to quantitative and standard form. For example, real quantity of I_1 index is equal to 0.07804 which has a place between normal and high category according to the above table.

As it will be seen 0.07804 is accompanied by two levels and this is the concept of multi-value of fuzzy logic. Fuzzy logic is an extension of the many-valued logic in the sense of incorporating fuzzy sets and fuzzy relations as tools into the system of many-valued logic[12].Being normal and high of this quantity depend on the situation of that ratio to break-points. Fuzzy logic of support level will be propounded by membership functions. Membership function formula which used here is as follows:

$\mu_{xi} = \frac{|xj-x|}{SDx}$(1)

Where,

X: is real quantity of observation؛ X_i: is quantity close to real ؛X_j: is other support level

For instance, in above relation, x_i is 0.06695 and $x_j$is equal to 0.09554 and then, we have:

$\mu_{0.06695} = \frac{|0.09554-0.07804|}{0.02859} = 0.6118$(2)

$\mu_{0.09554} = \frac{|0.06695-0.07804|}{0.02859} = 0.3882$(3)

By above relation, the measurements will be conversely related to the interval.

VL	L	N	H	EX
0	0	0	0.6118	0.3882

Fuzzy membership functionrelates the observations to two quantity levelswhich the sum of its measurements is equal to 1.

1 and 0 quantities with each special level show complete membership andnon membership, respectively. Decision making rules show the combination of special support levels of I_1 and I_2 indexes for reaching to support level of uncertainty of government expenditure. These rules are optional and subjective. Basic rules (1,7,13, 19 and 25) can be directly related and then Lindstrom(1987) method is symmetrically used for relating other data. For 5 conditions and two indexes, totally 5^2=25 will be created which areillustrated in table 1[3].

Table 1is explained by using simple decision making criterion (IF-THEN). For example, in the year of 2005 economic growth is related to high and extremely high. So, by using the rule 6 it can be said that the uncertainty of government expenditure is extremely high in this year.

The column of support degree in table 1 shows quantification degree of the uncertainty which this quantity is equal to 1, according to the rule 6 and therefore, the uncertainty has allocated extremely high degree to itself in this year.

The last stage is the analysis of extracting numeral series for the uncertainty of government expenditure. This will be done by relating optional quantities of 0, 0.25, 0.5, 0.75 and 1 to very small, small, medium, big and very big levels.

[3]Table 1 is presented in appendix 1.

There are two support levels for each observation of I_1 and I_2 series. Therefore, maximum 4 decision making rules (2x2) will be implemented for uncertainty quantity of government consumption expenditure.
Max and Min fuzzy operators will be used instead of AND and OR operators in regular sets. In the year of 2005, relative quantities for 4 different levels are as follows:
(Normal) N (High) H
I_1 :0.61180.3882
(Low) L (Normal) N
I_2 :0.28570.7143
So, four conditions will be created which table 2 indicates them:

Table 2, relative quantities for different levels of measurements:

I_1/I_2	Rule	Uncertainty expenditure level	Uncertainty expenditure association
1-N/L	18	0.228588653	
2-N/N	13	0.611771939	
3-H/L	17	0.285735816	drop
4-H/N	12	0.310582449	

In above calculations, I_1 and $I_2$are economic growth and government expenditure ratio respectively , fuzzy decision making rules based on the state of I_1 and I_2 indexes are shown in the second column , third column summarizes the multiplication of association degree and MIN (I_1, I_2)[4] and finally MAX of quantities are presented for each level in the last column.
In these calculations, two A levels are with 0.6117 and 0.2857 quantities which in the end 0.6117 quantity is acceptable with MAX operator[5]. Finally, optional quantity of 0.25 for S level, 0.5 quantityfor A level and finally 0.75 quantity for B has been related in this year:

Table 3, attaching the values to their weights and levels:

weight	value	level
0.25	0.228588653	**S**
0.5	0.611771939	**A**
0.75	0.310582449	**B**

And finally, following formula will be used for calculating the uncertainty rate of government consumption expenditure in the year of 2005:

$$\frac{(0.2286 \times 0.25)+(0.61178\times 0.5)+(0.3106\times 0.75)}{0.2286+0.61178+0.3106} \sim 0..52 \quad (4)$$

As we can seein formula (4) the uncertainty rate of government expenditure shows 0.52 for the year of 2005. The government consumption expenditure ratio is almoststable and uncertainty rate is also normal.

All calculations for the years (1992-2007) under consideration have been algorithmically carried out by using EXCEL software package. The results of these calculations in graph 1[6] show that in the year of 1996 and 2002 the uncertainty rate of government expenditureis extremely high and this rate is low in the year of 1993-1995 and also 1999.

4. RESULTS AND DISCUSSION

As it has been illustrated in graph 1, the uncertainty of government consumption expenditureshows different fluctuations during our period under consideration. These fluctuations are arisen from economic politic issues inside and outside the country. According to the graph, the uncertainty rate of government expenditure has allocated the maximum and the minimum in the year of 2002 and 1995, respectively. The

[4] It shows that a level of small (s) is associated for uncertainty of government expenditure with the degree of 0.8, multiplying this degree by MIN of I1(normal) or I2(low) equal here to 0.22858.
[5]the OR operator applied here chooses the larger value of 0.61177(and so we drop the 0.28573).
[6] Graphs 1 ,2, 3 &4 are illustrated in appendix 2.

minimum uncertainty rate of government consumption expenditure in the year of 1995 and its sudden increase in the year of 1996 can be due to the inflation of 49.5% in the year of 1995 which this issue has been shown by sudden gap and increase of its uncertainty in the year of 1996 due to the expected and dynamic nature of inflation. The highness of the uncertainty rate of government consumptionexpenditure in the year of 1996 can be due to considerable recession of Iran's stock exchange in this year and the fluctuations of exchange rate and other politic issues in addition to cost increase. Then, we cansay that reducing investment attraction is another effective important factor on the uncertainty of government consumption expenditure. So, the government is determined to revise adjustment economic policy in order to accelerate its inflation outcome which this issue shows itself by reducing the uncertainty of government consumption expenditure in the years after 1996. According to the studies, it can be realized that in the year of 2002 with the single rate condition, there was stability in the government consumption expenditure ratio which shows considerable drop of its uncertainty in the years after the aforementioned year.By comparing the graph 1 and 2, the uncertainty of government consumption expenditure in Iran is led to increasing on economic growth (during 1992-2007). Therefore, second research hypothesis is rejected. But we have no comment regardingthe comparison graph 3 and 4. So, first hypothesis is not easily accepted or rejected.

5. Conclusion

Measuring the uncertainty rate of a variable is one of the fundamental problems in empirical studies.The size of the uncertainty in economics is unobservable, but it is important for policy-makers to have reliable measures of its magnitude, trend,and cyclical characteristics. Fuzzy framework can help experts to formalize the uncertainty in a mathematical and computational approach.

In this paperwe proposed measuring uncertainty rate of government consumption expenditure during 1992-2007by using fuzzy sets theory and logic,.The obtained results indicated that the uncertainty of government consumption expenditureshows different fluctuations during the years under considerationwhich arise from different issues.Lack of the stabilization policy in government structure and increasing in government consumption expenditure cause uncertainty.This issue is led to raise economic growth in some sectors especially in the developing countries such as Iran which consumption expenditure includes the most part of expenditure ratio. Although it shows an increase in short-term period but later the trend might change in negative way [14].

Since the purpose of this paper is not analyzing the relation between variables but turning qualitative data into quantitative ones, we suggest considering more years and variables such as private investment in this case in order to explain other aspects of this field. Also the comparison between other methods can be used by other researchers.

Although this illustration takes the form of a rather limited, but very innovative and promising, application with Iran data.Ultimately this same type of analysis can be used to measure other unobservable, economic variables.

REFERENCES

[1]AgheliLotfali, SadeghiHossein,2001, The Process of EnvironmentalDestruction in Iran with a Fuzzy Logic Approach, Agricultural economy and development, 36, pp:151-171.

[2]ShakibayiAlireza, SadeghiHossein, Spring and summer 2003,Moddeling Underground Economy with Fuzzy Logic Method, economic research journal,62, pp.175-194.

[3]AminiFaskhoodi Abbas, 2005,Applying Fuzzy Logic Deduction in Planning and Territorial Development Studies, Science and development journal, 17, pp: 40-61.

[4]Souri Ali and et al, 2011, Uncertainty of Government Study and Economic Growth,Economic science bulletin, 11, pp: 108-124.

[5]AbbasianEzatollah and et al, 2005, ASurvey in Taxes Uncertainty on Employment Sector in Iran Economy, Economic research journal, 75, pp.171-196.

[6]KhaliliAraghi Mansour, RamezanpourEsmaeel, Spring and summer 2001, The Importance of Stable environment of Macroeconomics, Economic researchjournal, 58, pp.1-28.

[7]Central bank of Iran, Economic account, Iran national account, the years 1986-2007.

[8]Darby Julia and et al, July 2000 political uncertainty, Republic Expenditure and Growth, Working paper 310.

[9]Robert Draeseke , David E. A. Giles, July 1999, A fuzzy Logic Approach to Modeling the Underground, Economy Department of Economics, University of Victoria, Canada, Working paper 9909.

[10] Bank, Walter, Ontario Waterloo, 2008, LinguisticVariable: Clear Thinking with Fuzzy Logic,.IEEE Toronto Section.

[11]Bojadziev, G, Bojadziev,M, 2007, FuzzyLogic for Business, Finance&Management, Singapore, World Scientific.

[12] Khcherem, Fatma, Bouri, Abdelfettah, 2009, Fuzzy logic & investment strategy, Global economy and financial journal, Vol.2, No.2,pp: 22-37.

[13] Klir, G, 2006, Systemic of Emergence: Research and Development, part1, pp: 3-28

[14]Shafei,Afsaneh et al, The Test of the Effect of Financial Policy on Economic Growth, 2006, Economic research letter, No 23, pp: 81-112

[15] Pemberton, James,Modeling and measuring income uncertainty in life cycle models,Economic Modeling, Volume 14, Issue 1, January 1997, pp: 81–98

[16]Bronson William H., 2004, Macroeconomic Theory and Policy, ShakeriAbass, Tehran, Ney publication, 1994, pp: 31-53.

[17]Azar, Adel, FarajiHojjat, 2008, Fuzzy Management Science, Tehran, KetabeMehrabanpublication,pp: 26-60.

[18] Chen, C., Flintsch, G.W., & Al-Qadi, I.L., Fuzzy Logic-Based Life-Cycle Costs Analysis Model for Pavement and Asset Management, 6th International Conference on Managing Pavements, 2004.

[19]Li,Y.F et al,Modeling for Environmental-Economic Management Systems under Uncertainty,International Society for Environmental Information Sciences 2010 Annual Conference (ISEIS), Elsevier, pp:192-198

Appendices

APPENDIX 1:

The rules of fuzzy decision making:

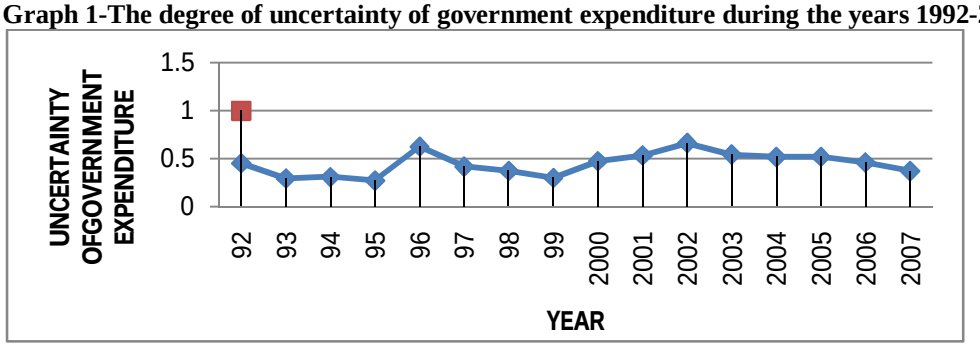
Rule	Government Expenditure Ratio	Economic Growth	Uncertainty of Expenditure	Quantative degree of Uncertainty Expenditure
1	E	E	VB	1
2	E	H	VB	0.8
3	E	N	S	1
4	E	L	S	0.8
5	E	VL	A	0.8
6	H	E	VB	1
7	H	H	B	1
8	H	N	B	0.8
9	H	L	A	1
10	H	VL	S	1
11	N	E	B	1
12	N	H	B	0.8
13	N	N	A	1
14	N	L	S	0.8
15	N	VL	S	1
16	L	E	B	1
17	L	H	A	1
18	L	N	S	0.8

19	L	L	S	1
20	L	VL	VS	1
21	VL	E	A	0.8
22	VL	H	S	0.8
23	VL	N	S	1
24	VL	L	VS	0.8
25	VL	VL	VS	1

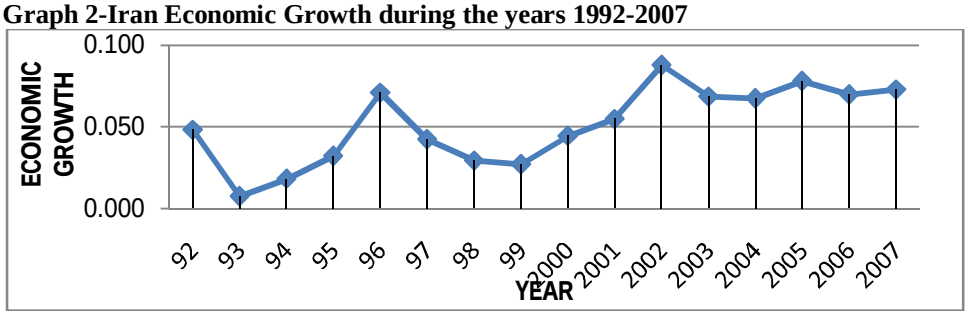
Source :calculations based on Mamdani Methods(Mamdani& Gaines,1981)
VL=LVery low=NLow=HNormal= EHigh= Extremely High
VS=SVery Small=ASmall=BAverage=VBBig=Very Big

APPENDIX 2:

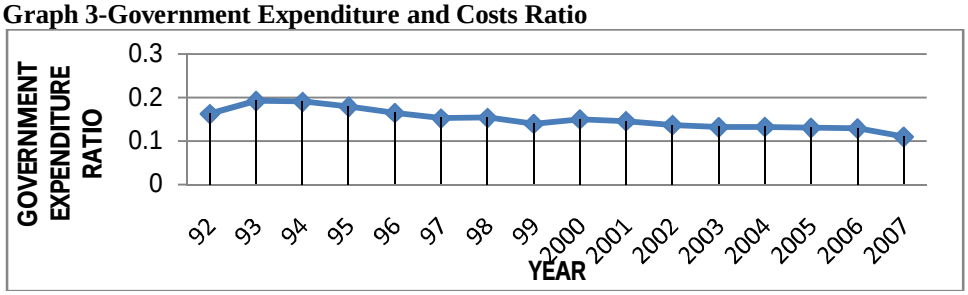
Graph 1-The degree of uncertainty of government expenditure during the years 1992-2007



Graph 2-Iran Economic Growth during the years 1992-2007



Graph 3-Government Expenditure and Costs Ratio



Graph 4-Government Expenditure and Costs