Do The Countries' Monetary Policies Have Spatial Impact?

Arikan, Cengiz and Yalcin, Yeliz

Gazi University Department of Econometrics Ankara TURKEY

21 December 2017

DO THE COUNTRIES' MONETARY POLICIES HAVE SPATIAL IMPACT?

Cengiz ARIKAN[1 *]

Yeliz YALCIN[2]

ABSTRACT

Nowadays, not land border but economic cooperation and borders determine the neighborhood and closeness by globalization. No doubt, any economic event happens in any country affects other partners more and less according to economic relationship in globalization process. The desire of measuring of this interaction make occur spatial econometrics. Initially, in spatial models take into account land borders. Subsequently, studies about spatial econometric models allow economic interactions and relationships.

After the global economic crises in 2008 Central Banks have started to vary monetary policy tool to ensure economic and financial stability. It is estimated that which tool will be implemented by following the policies of the central banks in which they are closely related. The spatial effect of monetary policy can be not only geographical but also economic or social.

Different spatial models have set up to examine whether any spatial effect on monetary policy. Unlike other studies in this study not only geographic weight matrix but also economic weight matrix have been used in the spatial models. Different weight matrix models results have been compared and construed. Our preliminary findings reveal that there is a spatial effect on monetary policy between OECD, EU and G-20 countries. And also, economic weight matrix effect is more than geographic weight matrix.

Keywords: Monetary Policy, Spatial Model, Spatial Impact, Econometrics

JEL Codes: C01,C51, E52

[1] Gazi University Department of Econometrics 06510 Ankara, Turkey Phone: +90 312 449 3893 Fax: +90 312 449 3705 e-mail: C.Arikan@gtb.gov.tr

[2] Department of Econometrics Gazi University 06500 Ankara, Turkey Phone: ++90 312 216 1304 Fax: ++90 312 213 2036 e-mail: yyeliz@gazi.edu.tr URL: http://www.yyelizyalcin.googlepages.com

* Assistant Expert, Ministry of Customs and Trade. The views expressed in the paper are those of the author and do not reflect the official view of stance of the Ministry of Customs and Trade.

1. Introduction

Economic policy is a combination of fiscal and monetary policies, are the main roots of economy. Whereas fiscal policy means of income and also expenditure balance, monetary policy means achieving the targets by using different tools to get price and also financial stability. Before the oil crisis in 1970s monetary policy have played a role in supporting other policies about economy to attain sustainable growth and full employment. However, after this crisis monetary policy have got a new meaning, attaining the price stability after high inflation. Even though central banks have uses different tools after these years, the main goals have not changed radically.

Central bank's monetary policy instruments affect consumption, saving and also investment decisions not only to consumer but also producer. Furthermore this interaction mechanism effect total demand and also economic activity. Therefore, investigating central bank's monetary policy tools' efficiency on economy plays an important role to apply economic policies. Analyzing the policies gains importance and so the applied studies on this issue are increasing in the literature day by day. These applied studies have investigated the effects of monetary policy tools of central banks on economy by using different approaches. Giancinti (2003) for USA; Ziaei (2014) for Gulf Countries by applying SVAR, Gambacorta and Hofmann (2012) for 8 different countries by applying panel VAR, Gabriel and Lutz (2015) for USA; Munir and Quayyum (2014) for Nigeria by applying FAVAR, Chuku (2009) for Nigeria; Borys et all (2009) for Czech Republic; Chua (2012) for Malaysia by applying VAR, Galvao and Marcellino (2014) for USA structural break endogenous threshold VAR have investigated monetary policy effects on economy.

Nowadays in the literature central banks communication and also strategies become more of an issue for monetary policy efficiency for i.e. Blinder et all (2008) and Bilur et all (2013) (Oktar and Dalyancı (2012)). The economic decisions of countries have affected each other in the world by increasing of commercial and financial relations between countries. Even if monetary policy efficiency of countries differ from each other according to developing level, developed countries central banks monetary policy effect other countries monetary policy more or less. For example, instruments applied for monetary policy in any of FED, ECM, Bank of England or Bank of Japan effects other countries monetary policy. Effect amount changes according to relationship of the countries as well as the main countries' economic power.

In the literature there is no such an example about monetary policy, applied spatial methods. However, the related economic subjects have examined by applying the spatial econometrics. Ozdaglı and Weber (2015) have examined monetary policy impact on financial markets for US economy. Chakraborty et all (2016) have investigated benefits of financial integration for 15 different EU countries by applying spatial equilibrium models. Wu and Liu (2017) have examined the China–ASEAN bilateral trade balances by using a time-space simultaneous gravity model to get time varying spatial effects. Federal Reserve's unconventional monetary policy on employment have investigated by Luck and Zimmermann (2017).

It is expected that closer units are in tendency to together. Therefore closer units' measured economic variables approximate each other due to the spatial dependency. However, by globalization geographic position and closeness give place to economic proximity and relationship. In this study unlike other studies the monetary policy relationship of the countries will be examined in the spatial models by using different spatial weight matrices. This paper proceeds as follows: Section 2 presents methodology. In Section 3, the data set and empirical results are discussed, and conclusions are given in Section 4.

2. Methodology

Basic spatial models without time consider cross-sectional data but the model includes spatial structure. In spatial panel models consider time series besides cross sectional data. The starting point of spatial models hinge on geographic basic law by Tobler (1970), everything is related everything but closer things are more related than farther. Thanks to this law, need to measure the effects of nearby things make spatial econometrics emerged. The closeness in the spatial models can be geographic closeness as well as economic closeness and social closeness.

Spatial autocorrelation means that any data in any unit depends the same series or different series in another unit. In other words spatial autocorrelation is the analogy of data belonging to these spaces due to spatial similarity (Anselin and Bera, 1998). If there is a spatial effect but the model does not include this effect, it can lead to serious problems such as misinterpretation of coefficients, calculating wrong significance levels, use of inappropriate models, and validity of goodness of fit tests. (LeSage, 1997)

In the case of positive autocorrelation in spatial models, high value units of any variable are clustered with high value units or low value units close to low value units. In the case of negative autocorrelation, units without similar values are clustered together.

Spatial relationship existence investigating via Moran's I statistics. Spatial dependence can be shown by Moran's I statistics. Moran's I statistics shows that if there is any linear relation between any variable in a unit and neighbors mean (Ward and Gleditsch, 2008).

When a general spatial model is created by using the multiple regression model;

$$y = \rho Wy + \alpha + X\beta + WX\theta + u \qquad (1)$$
$$u = \lambda Wu + \varepsilon$$

In this model three different effects can be captured. Y is independent variable vector, X is independent variable matrix, W is represents spatial weight matrix, ρ is called spatial autoregressive coefficient, λ the spatial autocorrelation coefficient and ε is i.i.d. error term. These are;

i. Endogenous Effects: It can be captured via Wy. This term means that: any dependent variable value is effected other units' value of dependent variable
ii. Exogenous Effects: It can be captured via WX. Dependent variable in i^{th} unit is effected by independent variables in other units.
iii. Correlated (interaction) Effects: It can be captured via Wu. It shows the relationships between the neighborhood units' error terms (Elhorst, 2014).

By laying down restrictions on model (1) different forms of spatial models can be obtained (for detailed see, Elhorst 2010 and 2014).

In model (1) W is spatial weight matrix and it represents the spatial effects Spatial effect can be observed by contributing the spatial effect in model via spatial weight matrix. Spatial weight matrix show the relationship between units ant it is used to examine the effects of neighborhood. Due to the fact that the model estimation is built by weight matrix, spatial weight matrix elements are not random and is specified exogenous (Tuzcu, 2016). Spatial weight matrix can be constituted according to not only geographical position or distance between the units it can be constituted according to economic, social or any other non-psychical concept (Anselin, 1988). Spatial weight matrix is a positive matrix and also it is consider only the relationship existence or absence. The direction of the relationship is not taken into account (Corrado and Fingleton, 2012). Spatial weight matrix generally is standardized according to row total to get neighborhood mean.

3. Model and Empirical Results

In this study money supply (M2), consumer price index (CPI), reel effective exchange rate (REER) and long term interest rate (IR) variables have been collected annually from 2007 to 2016. The data have been collected for EU, OECD and G-20 members combination except Cyprus, Israel, South Africa and Saudi Arabia[3].

In our study we have applied spatial autoregressive model (SAR), spatial error model (SEM) and also ordinary least square to get the best model. The models by notations in our study is;

The SAR Model: $y = \rho W y + \alpha + X\beta + \varepsilon$ (2)

The SEM Model: $y = \alpha + X\beta + u \qquad u = \lambda W u + \varepsilon$ (3)

The OLS Model: $y = \alpha + X\beta + \varepsilon$ (4)

Where y is M2/GDP (Local currency), x is [CPI REER IR][4] . In our study we have used different kinds of spatial weight matrix, are defined below respectively.

$$W_1 = \begin{cases} 1 & if\ have\ land\ or\ maritime\ border \\ 0 & otherwise \end{cases}$$

$$W_2 = \begin{cases} 1 & if\ the\ neighboor\ is\ in\ first\ \%50\ trade\ partner^5 \\ 0 & otherwise \end{cases}$$

2007 and 2016 have been analyzed separately. First of all ordinary least square result have been analyzed, shown in table -1. The results have been compared, shown inTable-1.

[3] We have not reached all the data of Cyprus. Israel, South Africa and Saudi Arabia have not any borders (land or maritime) with other countries in the study. Therefore we had to exclude these countries.

[4] Δ percent change has been calculated for M2/GDP, CPI and REER, percent change has been calculated for IR where Δ percent change is $(X_t-X_{t-1})/X_{t-1}$ and percent change is (X_t-X_{t-1}). CPI (2010=100), REER (CPI based (2010=100)) and IR (10 year bond yield) are collected from IMF database and each countries' central bank on 10.09.2017.

[5] Trade volume has been calculated according to total of export and import from 2007 to 2016.

Table 1: OLS Estimation Results

Variable	2007		2016	
	Coefficient	p value	Coefficient	p value
Constant	0.055	0.000	0.020	0.363
CPI	-0.119	0.686	0.093	0.318
REER	0.202	0.280	-0.845	0.045
IR	-0.010	0.373	-0.124	0.000
R^2	0.045		0.478	
Adjusted R^2	-0.025		0.439	
DW	2.015		1.970	
$Sigma^2$	0.002		0.016	

According to OLS estimation results whereas the model in 2007 is not significant. The model for 2016 all of independent variables the coefficients except CPI are statistically significant.

Whether there is a spatial effect or not spatial dependence tests have been applied and the test results are shown in Table 2.

Table 2: Spatial Dependence Test Results

Weight Matrix	Test	2007		2016	
		Test statistics	p value	Test statistics	p value
W_1	Moran I	-0.009	0.795	0.247	0.012
	LM SEM	0.006	0.938	4.914	0.027
	LM SAR	0.319	0.572	5.864	0.015
W_2	Moran I	-0.032	0.966	0.203	0.003
	LM SEM	0.125	0.723	4.970	0.026
	LM SAR	6.792	0.009	140.573	0.000

According to test results there is no spatial dependence in 2007 if we use W_1. Using W_2, whereas there is no spatial dependence according to Moran I and LM_{SEM}, there is a spatial dependence according to LM_{SAR} In 2016 all the test show that there is spatial effect according to all tests and also both weight matrix. Due to the fact that there is a spatial dependence in 2016 we have estimated the spatial models for 2016, shown in Table 3.

Table 3: Spatial Model Results

Model	W	Constant	CPI	REER	IR	ρ	λ	Adj.R^2	AIC	SBC
SAR	W_1	0.001 (0.967)	0.267 (0.001)	-0.933 (0.004)	-0.109 (0.000)	0.402 (0.000)		0.575	17.251	15.864
	W_2	-0.014 (0.443)	0.075 (0.260)	-0.914 (0.002)	-0.105 (0.000)	0.823 (0.000)		0.405	17.632	16.245
SEM	W_1	0.041 (0.209)	0.181 (0.015)	-0.798 (0.011)	-0.083 (0.001)		0.501 (0.001)	0.568	17.038	15.651
	W_2	0.046 (0.344)	0.136 (0.057)	-0.786 (0.008)	-0.083 (0.001)		0.680 (0.000)	0.594	17.171	15.784
SAC	W_1	0.065 (0.001)	0.346 (0.000)	-0.432 (0.089)	0.005 (0.868)	-0.154 (0.437)	1.845 (0.000)	0.855	21.199	19.465
	W_2	-0.075 (0.000)	0.040 (0.380)	-1.030 (0.000)	-0.070 (0.000)	2.362 (0.000)	0.203 (0.495)	0.858	21.254	19.520
p values are in the parenthesis										

In SAC model for W_1 the coefficient of ρ for W_2 the coefficient of λ are statistically insignificant. Both SAR and SEM model are valid to identify the effects of independent variables on monetary aggregates. However, minimum AIC and also SBC values are in SEM model both for W_1 and W_2.

The coefficients in SEM, using W_1 and also W_2 are more significant statistically than in OLS model. Spatial interaction term λ is 0.501 in W1 model whereas λ is 0.608 in W2 model. This values are quite high and this means that these countries monetary policy effects each other' positively and strongly. This coefficient means that there is a positive sequential dependence between units. There is a spill-over effect in monetary policy and this spill-over effect is higher in W_2 model than W_1 model. In other words trade partners' monetary change effects neighbors' monetary policy more than border neighbors' monetary change. No doubt, any change in monetary policy in any country effects other countries' monetary policy and this change make spill-over effect.

4. Conclusion

Central banks use monetary policy tools to ensure financial and economic stability. By using these tools central banks economic moves effect not only consumers but also producers. Consequently, economic indicators effects according to central banks policies. And also central banks policies is effected economic indicators. Furthermore, by globalization countries' economic policies is effected each other according to closeness. This closeness can be both economic and geographically. To determine the economic and geographic closeness effects spatial models have been applied by using different spatial weight matrices, the first one is constituted according to land or maritime borders whereas the second one is created according to trade volume partners. Spatial error model for both weight matrices is the most proper one when compared the estimation results. And also there is a spill-over effect in monetary policy and this spill-over effect is higher when the countries are close to each other according to trade volume. The effect of globalization is also observed in monetary policy, too.

References

Anselin, L. (1988), "Spatial Econometrics: Methods and Models" First Edit, Dordrecht: Kluwer Academic Publishers.

Anselin, L. and Bera, A. K. (1998), "Handbook of Applied Economic Statistics", Marcel Dekker AG, Chapter 7, pages: 237-290

Bilur, A., Cihak, M. and Jansen, D.J. (2013), "Measuring the clarity of central-bank communication", VOX CEPR's Policy Portal, http://voxeu.org/article/measuring-clarity-central-bank-communication Date: 08.08.2017

Blinder A. S., Ehrmann, M., Fratzscher, M., Haan, J.D. and Jansen, D.J, (2008)"Central Bank Communication and Monetary Policy: A Survey of Theory And Evidence," Journal of Economic Literature, American Economic Association, Vol. 46(4), pages 910-45

Borys, M.M. and R. Horvath & M. Franta (2009), "The effects of monetary policy in the Czech Republic: an Empirical Study", Empirica, 36, 419-443.

Chakraborty, I., I. Goldstein, and A. MacKinlay (2016). Monetary stimulus and bank lending. Working paper.

Chuku A.C. (2009), “Measuring the Effects of Monetary Policy Innovations in Nigeria: A Structural Vector Autoregressive (SVAR) Approach”, African Journal of Accounting, Economics,Finance and Banking Research, 5(5), 112-129.

Chua, Y.S. (2012), “Assessing the Effects of Monetar Policy Shocks in Malaysia: A Factor Aughmented Vector Autoregressive Approach”, The IUP Journal of Applied Economics,11(3), 65-83.

Corrado, L. and Bernard, F., (2012), “Where is the Economics in Spatial Econometrics?”, Journal of Regional Science, 52 (2): 210-239.

Elhorst, J. Paul (2010), “Applied Spatial Econometrics: Raising the Bar”, Spatial Economic Analysis,5 (1): 9-28.

Elhorst, J. Paul (2014), “Linear Spatial Dependence Models for Cross-Section Data”, Spatial Econometrics from Cross-Sectional Data to Spatial Panels (Berlin, Heidelberg: Springer):5-37.

Gabriel, S. and Lutz, C. (2015), “The Impact of Unconventional Monetary Policy on Real Estate Markets”, SSRN Working Paper

Galvao, B.A. and M. Marcellino (2014), “The Effects of Monetary Policy Stance on the Transmission Mechanism”, Stud. Nonlinear Dyn. E., 18(3), 217-236.

Gambacorta, L. and Hofmann, B. (2012), “The Effectiveness of Unconventional Monetary Policy at the Zero Lower Band: A Cross Country Analysis”, Bank for International Settlements Working Papers, No: 384

Giacinti, D. V. (2003), “Differential Regional Effects of Monetary Policy: A Geographical SVAR Approach”, İnternational Regional Science Review,26, 3: 313-341

LeSage, J. P. (1997), “Regression Analysis of Spatial Data”, Journal of Regional Analysis and Policy, 27 (2): 83-94.

Luck, S. and Zimmermann, T. (2017), “Employment Effects of Unconventional Monetary Policy: Evidence from QE”, Federal Reserve Board, Working Paper,

Munir, K. and A. Qayyum (2014), “Measuring the effects of monetary policy in Pakistan: a Factor Aughmented Vector Autoregressive Approach”, Empirical Economics, 46, 843-864.

Oktar, S. and Dalyancı, L. (2012), “The Effect of The Monetary Policy on Economic Growth in Turkish Economy”, Marmara Universitesi IIB Dergisi, Vol. XXXII, Number:I, pages: 1-18

Ozdaglı, A.K. and Weber, M. (2016), “Monetary Policy Through Production Networks: Evidence from the Stock Market”, Federal Reserve Board, Working Paper,

Tuzcu, S.E. (2016), “Mekânsal Ekonometri ve Sosyal Bilimlerde Kullanım Alanları”, Ankara Universitesi SBF Dergisi, Vol. 71, No. 2, pages: 401-436

Ward, M. D. ve Gleditsch, K.S. (2008), Spatial Regression Models (Los Angeles: Sage Publications).

Wu, P.C. and Liu, S.Y. (2017), “Monetary Policy and the Time-Varying Spatial Effects of Bilateral Trade: Evidence from China-ASEAN-5 Countries”, Applied Spatial Analysis and Policy, Vol. 10 Issue 1, pp: 103-120