Monetary Transmission Mechanism and Firm Performance in Turkey: Empirical Evidence from VAR-type of Models

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ABSTRACT

In this study, factors affecting the firm performance in Turkey are analyzed within the context of monetary transmission mechanism (MTM) providing evidence from the manufacturing sector. Impulse response estimates of Vector Autoregression (VAR) and Bayesian Vector Autoregression (BVAR) models reveal that GDP growth is a promising factor for the manufacturing sector, whereas inflationary shocks do not promote the sector since macroeconomic expectations are affected negatively. On the other hand, empirical exercise stresses that rises in interest rates lead to an increase in the manufacturing sector revenue through wealth effect, they also decrease the availability of bank loans which in turn hinder the growth of the sector.

*JEL Classificat*ions*:   C30, C50, E20, E31, E32, E43, E51*

Keywords: real economic activity; inflation; interest rates; credits; monetary transmission mechanism; firm performance; VAR model; BVAR model

I.   INTRODUCTION

The Vector Autoregression (VAR) model is an extension of the univariate autoregressive (AR) model to dynamic multivariate time series and it captures the linear interdependencies among multiple time series. Within this framework, VAR model has proven to be useful for examining the dynamic behavior of macroeconomic time series and macroeconomic forecasting. In VAR models, assumptions about the causal structure of the data under investigation are imposed avoiding the complete specification of a structural model of the economy, thereby impacts of unexpected shocks to specified variables on the variables in the model are measured via impulse response functions and forecast error variance decompositions. Therefore, VAR models were widely been used in the analysis of monetary transmission mechanism (MTM) (as, for example, Bagliano and Favero, 1998; Christiano, Eichenbaum and Evans, 1999; Mojon and Peersman, 2001; Peersman and Smets, 2001; Rebucci and Ciccarelli, 2002). At this point, it is critically important to distinguish the policy actions which are an endogenous response to the current developments in economy from exogenous policy actions as noted by Bagliano and Favero (1998).

Bayesian Vector Autoregressive (BVAR) models also analyze the dynamic impact among variables for the following periods. Besides, Bayesian VAR models reduce the tendency of unrestricted VAR models to be over-parameterized by placing prior distributions over the parameters of unrestricted VAR models as stated by Banbura, Giannone and Reichlin (2010). Thus, BVAR system is a useful econometric tool for macroeconomic analysis and forecasting (as, for example, Bhuiyan, 2008; Biswas, Singh and Sinha, 2010; Carriero, Kapetanios and Marcellino, 2010; Giannone et.al, 2010; Utlaut and van Roye, 2010; Bloor and Matheson, 2011; Carare and Popescu, 2011). Similarly, there have been studies in the literature analyzing the MTM via BVAR models with different size and specifications (as, for example, Sims and Zha, 1998; Banbura, Giannone and Riechlin, 2010; Giannone, Lenza and Reichlin, 2012). At this point, the success of BVAR model is related to the matching the dimension of the typical structural macroeconomic model as implied by Banbura, Giannone and Reichlin (2010).

For the identification of the MTM, several empirical studies in the literature have given emphasis to the role of the money markets and particularly the bank reserves market (as, for example, Bernanke and Mihov, 1995; Christiano, Eichenbaum and Evans, 1996a; Kashyap and Stein, 2000; Freixas and Jorge, 2008). Within this context, the financial market price view stresses the impact of monetary policy on the rates of return on financial assets which in turn influence spending decisions by firms and households. Besides the wealth effect, financial asset values may play an important role in the broad credit channel since they determine the value of the collateral that firms and consumers may present when obtaining a loan as stated by Kuttner and Mosser (2002). According to the narrow credit or bank lending channel, changes in monetary policy affects the aggregate volume of bank reserves which in turn determine the availability of bank loans. Bernanke and Gertler (1995) expose that there is a significant relationship between credit channels and monetary policy shocks, there are also studies in the literature such as Romer and Romer (1990) and Ramey (1993) pointing out that credit channels play an insignificant role in monetary policy transmission. At this point, for verifying the consistency of credit channels, it should be considered that banks may

react heterogeneously to the changes in monetary policy stance. Thus, the degree and speed of pass-through of market rates to bank interest rates may differ across banking products as noted by Sorensen and Werner (2006). Several studies in the literature (as, for example, Angbazo, 1997; Mojon, 2000; Saunders and Schumacher, 2000; Maudos and de Guevera, 2004; Sander and Kleimeier, 2004) have given emphasis on the examination of factors leading to pass-through heterogeneity. The relationship between credit channels and monetary policy shocks is critically important for analyzing the consequences of changes in monetary stance on spending behavior which in turn may determine firm performance.

In this study, factors affecting firm performance are studied on the basis of MTM using both VAR and BVAR models via impulse response functions (IRFs) providing evidence from the manufacturing sector of Turkey. For explaining the dynamics of manufacturing sector performance in Turkey, it is critically important to determine the ordering of the variables in VAR model since VAR model impulse response estimates and therefore the robustness of VAR model outcome may change depending to the ordering of variables. Following the theoretical methodology of Christiano, Eichenbaum and Evans (1996b), it is assumed that monetary authority considers the contemporaneous state of real economic activity as well as the price level before deciding the monetary policy action which in turn influences credit volume and firm performance. In the empirical analysis of the quarterly data from 1990Q1 to 2011Q3, the VAR model includes the following variables: the log of real gross domestic product (GDP), consumer's price inflation (INF), inter-bank call money interest rate (RATE), the log of the volume of credits induced by deposit banks (CRE) and the log of the revenue index of manufacturing sector (RIN). Accordingly, when the inter-bank call money interest rate is regarded as the Central Bank of the Republic of Turkey (CBRT)'s monetary policy instrument, the ordering of variables in the time series vector that bases the VAR estimation can be specified as (GDP, INF, RATE, CRE, RIN). INF and RATE are extracted from the OECD database, whereas GDP, CRE, and RIN series are sourced from the CBRT. Estimations are carried in E-VIEWS 7.1.

II.   EMPIRICIAL METHODOLOGY

A.   Data

Before the estimation of an econometric model, stationary among variables is to be tested for the appropriate econometric model specification. Thus, the Augmented Dickey-Fuller (ADF) test as expressed basing on the estimation of the model (1) is applied in this study.

$$\Delta y_t = \varpi y_{t-1} + \sum_{j=1}^{p-1} \alpha_j^* \Delta y_{t-1} + \eta tr + \mu + u_t \qquad (1)$$

In the regression model (1), Δy denotes the first-differenced series $y_t - y_{t-1}$, p is the number of lagged differences, intercept and trend terms are denoted by μ and tr

respectively and η is the coefficient of tr. The pair of hypothesis $H_0 : \varpi = 0$ versus $H_1 : \varpi < 0$ is tested based on the t-statistic of the coefficient ϖ from OLS estimation. Critical values of the test depend on the deterministic terms (μ and tr) which have to be included, thus the Pantula principle proposed by (Pantula, 1989) is followed in this study. Accordingly, if a linear trend term is needed in the test for y_t, then only a constant term should be used; if just a constant is necessary in the test for y_t, the test is to be carried with no deterministic terms (Lütkepohl, 2007: p.55).

As shown in Table 1, GDP, CRE and RIN series have a nonzero mean and a linear trend, thus ADF test is applied to these series with constant and trend terms, whereas ADF tests of INF and RATE series are implemented with only constant terms. According to the ADF test results, all series are stationary in first-differences at the 5% significance level.

Table 1
Augmented Dickey-Fuller test results

Variables	Augmented Dickey-Fuller Test Statistic	Deterministic Terms	Number of Lagged Differences
GDP	-2.01	Constant, trend	1
ΔGDP	-7.74	Constant	0
INF	-0.35	Constant	4
ΔINF	-7.16	None	3
RATE	-2.50	Constant	2
ΔRATE	-9.02	None	2
CRE	-1.05	Constant, trend	0
ΔCRE	-8.32	Constant	0
RIN	0.80	Constant, trend	0
ΔRIN	-2.77	Constant	1

Notes: 10% critical values with constant and trend constant and no deterministic terms are -3,41, -2,86 and -1,94 respectively. Critical values are from Davidson and McKinnon (1993), Table 20.1, p. 708. The number of lagged differences in the regressions is determined by the Schwarz Criteria (SC).

B.   VAR Model

The point of departure is a K-dimensional stable VAR(*p*) process;

$$y_t = \alpha_0 + \sum_{j=1}^{p} A_j y_{t-j} + \varepsilon_t \qquad (2)$$

where y_t is an M×1 vector of time series variables. α_0 is an M×1 vector of intercepts, whereas A_j is an M×M matrix of coefficients. Finally, ε_t is an M×1 vector of errors and it is M-dimensional unobservable zero-mean white noise or innovation process that is E(ε_t)=0 and has covariance matrix $E(\varepsilon_t \varepsilon_t^{'}) = \Sigma_\varepsilon$ (Lütkepohl, 2005: p.13).

C.   BVAR Model

The VAR process in (1) can be written in matrix form in terms of the matric-variate Normal distribution, if Y is defined to be T×M matrix which stacks the T observations on each dependent variable in columns next to one another. In that case, ε and E denote stackings of the errors in a manner conformable to y and Y, respectively. Define $x_t = (1, y_{t-1},...,y_{t-p})$ and

$$X = \begin{bmatrix} x_1 \\ x_2 \\ . \\ . \\ . \\ x_T \end{bmatrix} \qquad (3)$$

where X is a T×K matrix, if K=1+Mp is led to be the number of coefficients in each equation of the VAR. Finally, if $A = (\alpha_0 A_1 . A_p)'$ α=vec(A) is defined which is a KM×1 vector which stacks all the VAR coefficients (and the intercepts) into a vector. Accordingly, the VAR model can be specified as below (Koop and Korobilis, 2009: p.4):

$$Y = XA + E \qquad (4)$$

Impulse responses and forecasts may be imprecisely estimated particularly in large VAR models without prior information. Accordingly, the Minnesota priors proposed by (Doan, Litterman and Sims, 1984; Litterman, 1986) are used. They are based on an approximation which leads to great simplifications in prior elicitation and computation. This involves replacing Σ with an estimate $\hat{\Sigma}$. If the original Minnesota prior is simplified even further by assuming Σ to be a diagonal matrix, then each equation of the VAR can be estimated one at a time and $\hat{\sigma}_{ii} = S_i^2$ (where S_i^2 is the standard OLS estimate of the error variance in the ith equation and $\hat{\sigma}_{ii}$ is the ii^{th} element of $\hat{\Sigma}$) can be set. When Σ is replaced by an estimate, the Minnesota prior assumes;

$$\alpha \in N(\underline{\alpha}_{Min}, \underline{V}_{Min}) \qquad (5)$$

The Minnesota prior assumes the prior covariance matrix, $\underline{V}_{Min}$, to be diagonal. If $\underline{V}_i$ denote the block of $\underline{V}_{Min}$ associated with the K coefficients in equation I and

$\underline{V}_{i,jj}$, then a common implementation of the Minnesota prior would set: $\dfrac{\underline{\alpha}_1}{r^2}$ for

coefficients on own lag r for r = 1,…p, $\dfrac{\underline{\alpha}_1 \sigma_{ii}}{r^2 \sigma_{jj}}$ for coefficients on lag r of variable j ≠ i

for r = 1,…p, $\underline{\alpha}_3 \sigma_{ii}$ for coefficients on exogenous variables. The exact choice of values for $\underline{\alpha}_1$, $\underline{\alpha}_2$ and $\underline{\alpha}_3$ depends on the researcher who may carry the empirical application with different values for them (Koop and Korobilis, 2009: pp.5-6).

III.   EMPIRICAL RESULTS

In this study, VAR-type of models are employed for analyzing the relationship between macroeconomic variables and firm performance considering the MTM in Turkey. Firstly, VAR(9) model with intercept terms suggested by the Schwarz Criteria (SC) is adopted. Since all variables stationary at first-differences, the time series vector is specified as (ΔGDP, ΔINF, ΔRATE, ΔCRE, ΔRIN)′. Following the same framework, BVAR(9) is also estimated in first differences. For identification of the BVAR model[1], the prior mean for the coefficient on the first own lag and relative cross variable length are set to 0,9 and 0,1 respectively, reflecting a prior belief that variables in the model exhibit a fair degree of persistence, but not unit root behavior as suggested by Koop and Korobilis (2009). On the other hand, scale on the intercepts is set to 100. Within this context, impulse-response functions are estimated to show the response of ΔRIN to a positive shock in ΔGDP, ΔINF, ΔRATE and ΔCRE in the following 18 quarters for each two models. Thereby, it is aimed to make inferences about the macro dynamics of the manufacturing sector's performance in Turkey considering the MTM.

Figure 1 indicates that a positive shock in ΔGDP lead to an increase in ΔRIN from the 1st quarter, whereas BVAR model's impulse responses show that positive effects on manufacturing sector become persistent from the 4th quarter as result of a positive shock in ΔGDP. Thereby, it is implied that development of economy is a promoting factor for Turkey's manufacturing sector.

On the other hand, no prominent effect on ΔRIN is detected for the next 18 quarters following to a positive shock in ΔINF for both models. Thereby, it is exposed that expansionary macroeconomic policies leading to inflationary pressures do not influence Turkey's manufacturing sector positively. Within this context, it is critically important for the CBRT to achieve and maintain price stability.

As a result of a positive shock in ΔRATE; VAR model's impulse responses show that ΔRIN increases except between the next 4-8 quarters, whereas according to BVAR model's impulse responses, ΔRIN only decreases in the next 3rd quarter. Thereby, it is indicated that the manufacturing sector revenue tend to increase related to a rise in the call money market rate and this finding provides empirical evidence for the consistency of wealth effect in Turkey. Accordingly, it is revealed that for analyzing the spending decisions by firms and households in Turkey which in turn influence the manufacturing sector performance, factors leading to changes in interest rates are critically important.
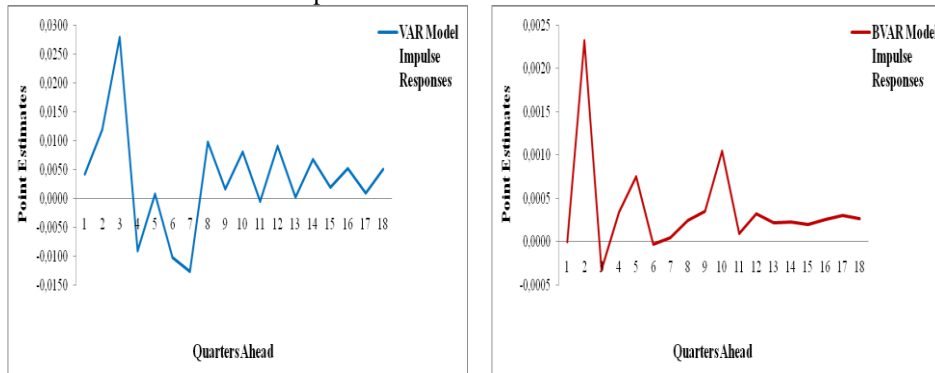
Figure 1
Response of ΔRIN to a ΔGDP shock
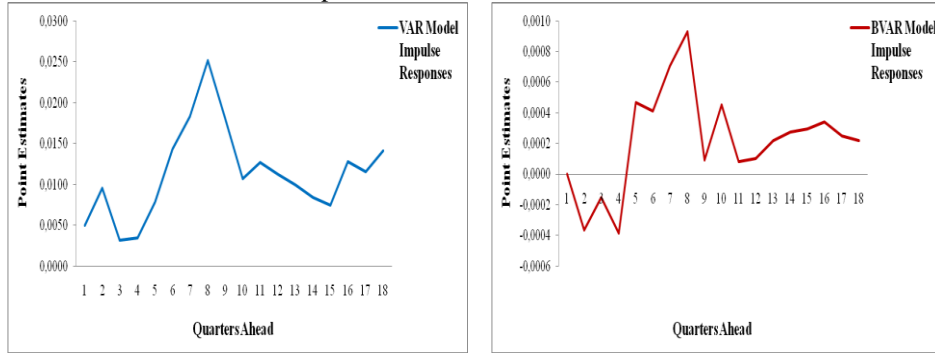
Figure 2
Response of ΔRIN to a ΔINF shock
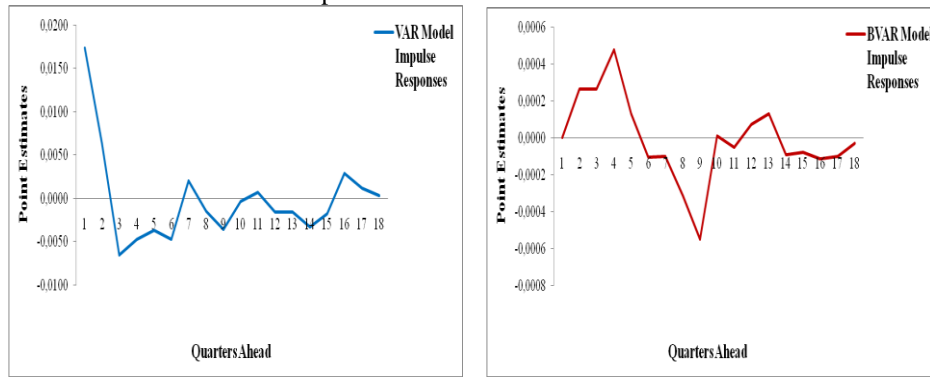
Figure 3
Response of ΔRIN to a ΔRATE shock
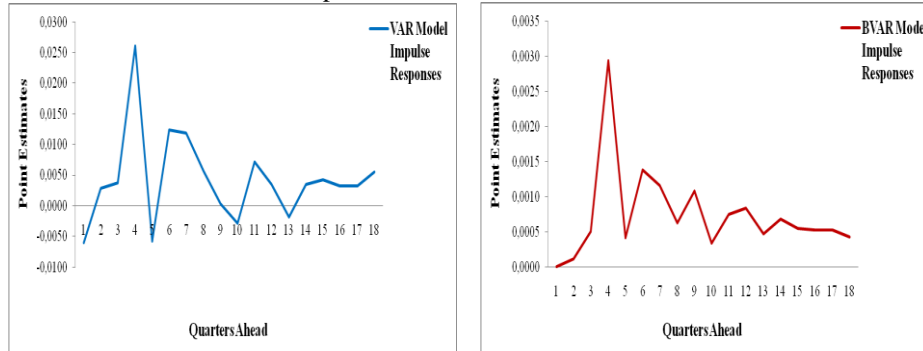
Figure 4
Response of ΔRIN to a ΔCRE shock

Figure 4 reveal that increases in the total volume of credits lead to a jump in the manufacturing sector activity. As a result of an extension in the volume of credits induced by deposit banks, domestic demand for the manufacturing sector grows which is also a promising factor for the investments in manufacturing sector. Within this context, it is implied that stability and growth of Turkish banking sector should be sustained for the manufacturing sector development. Thus, CBRT should consider the activities of financial intermediaries when conducting its monetary policy.

IV.   CONCLUSION

In this study, determinants of manufacturing sector performance are studied on the basis of the MTM mechanism in Turkey by employing VAR-type of models. Within this context, VAR and BVAR models are estimated, whereupon effects of GDP, inflation, interest rates, credits on the revenue of the firms in manufacturing sector are detected via IRFs.

VAR and BVAR model impulse responses expose the fact that GDP growth lead to an improvement in the performance of manufacturing sector in Turkey. Within this context, economic growth should be sustained, besides external competitiveness in the manufacturing sector should be gained. IRFs also emphasize that rising inflation does not promote the manufacturing sector since macroeconomic expectations are affected negatively. Accordingly, macroeconomic stability should be maintained by the optimal coordination of monetary and fiscal policies. Then, interactions between monetary and fiscal policy should be determined in open economy framework.

Interest rates play a major in explaining the manufacturing sector performance via various channels. According to the empirical exercise, rises in interest rates lead to wealth effect. Expenditures by firms and households in Turkey increase which in turn influence the sector's performance positively. On the other hand, rises in interest rates may decrease the aggregate volume of bank reserves and therefore the availability of bank loans. IRFs expose that increases in the total volume of credits lead to the growth of manufacturing sector. Accordingly, it is implied that interest rates should be kept low for increasing the availability of bank loans in Turkey.

ENDNOTE

1. E-VIEWS 7.1 does not prove significance levels for the Impulse response estimates of BVAR models.

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