Zagreb International Review of Economics & Business, Vol. 7, No. 2, pp. 27-42, 2004

ISSN 1331-5609; UDC: 33+65

A VAR Analysis of Monetary Transmission Mechanism in the European Union

Ivan Lovrinović*

Manuel Benazić**

Abstract: The paper studies the functioning of the monetary transmission mechanism in the EU. It analyses the influence of an increase in short-term interest rate on real and monetary variable e.g. industrial production of the EU members, retail prices, monetary mass and real exchange rate. Frequently used econometric technique of VAR has been used to analyse the monetary transmission mechanism.

Key words: monetary transmission mechanism, interest rate, VAR, decomposition of variance, impulse response

JEL Classification: E42, F3

Introduction

The primary object of this paper is to analyse the monetary transmission mechanism in the EU. It analyses the impact of interest rate on real and monetary macroeconomic variables. It also looks upon the influence of restrictive monetary policy of the European Central Bank (ECB), which controls any unitary increase in short-term interest rate. The basic presupposition is that a unit increase in interest rate will bring about a reduction in industrial production of the EU members, fall in retail prices, reduction of monetary aggregates, and appreciation of real exchange rate. Two models of monetary policy are presented here. In the second, as against the first model, monetary aggregates have been included as endogenous variable. In both the models we expect similar response of variables to unitary increase in short-term interest rate. In our study, we shall apply VAR model without restrictions. The VAR method considered as highly appropriate, and is frequently used by many, for it does

* Ivan Lovrinović is Associate Professor at the Graduate School of Economics and Business, University of Zagreb, Croatia.

** Manuel Benazić is at the Istarska kreditna banka, Umag, Croatia.

not require complete specification of structure of the economy (Erjavec, Cota, Bahovec, 1999). It requires investigation of all the characteristics of variable i.e. stationarity and integration of time series. We shall also examine here mutual effects of variables in short and long run. Graphic method will be used to show the impulse response of variables to restrictive monetary policy. We are of the opinion that such analysis could provide a lead to the European monetary authority in defining the future directions of conduct of the monetary policy in EU.

Transmission Mechanism of Monetary Policy

Monetary transmission mechanism can be defined as the manner influence of monetary policy on entire economic activity. In modern financial systems we find following three channels of monetary policy. These are:

- Rate of interest
- Asset prices
- Exchange rate

Rate of interest directly affects the costs of credit and the flow of money on the market that are of great importance. Low interest rate implies higher current value of capital and durables compared to their future prices thereby stimulating production and consumption. Increase in interest rate on the interbank market under conditions of high concentration of credit to firm sector leads to a reduction in production and final consumption of the sector. Therefore, change in interest rate directly affects on company balance sheets, as it raises the costs of meeting credit liabilities and affects the extension of repayment of the principal.

Asset prices – of shares and bonds, capital and other long-term assets – is another channel of transmission. Increase in interest rate causes reduction in share prices and long term assets. This brings down the value of economic subjects and their incomes. Ultimately it leads to a reduction in industrial production and other macroeconomic aggregates.

Functioning of transmission mechanism through exchange rate is directly reflected on the foreign exchange market. Namely, a reduction in monetary aggregates through interest rate leads to increased demand for financial assets and thus appreciation of exchange rate. It further increases demand for imports and reduction in domestic demand.

Our analysis basically concentrates on the first channel of transmission mechanism i.e. interest rate, since earlier analyses have proved it to be the dominant. Namely, interest rate affects on the fluctuation of prices of financial assets and exchange rate. Interest rate channel is characterised as response to industrial production, retail prices, and real exchange rate on changes in short term interest rate.

Changes in interest rate by the Central Bank affects on a series of variables and mechanisms in the economy, primarily on economic activity and price level. However, there is no consensus on all the aspects of functioning of transmission mechanism of monetary policy. It is known that in the long run, after all the adaptation that the transmission mechanism causes, change in the quantity of money leads to increase in prices and does not lead to increased production and employment. Popularly mentioned general approach of 'the long-run neutrality' of money underlies all economic theories. In the long run real income and level of employment are determined by factors like technology, demographic trends, institutional changes, tax system, consumer preference etc.

Such a view is based on the known thesis propounded by Milton Friedman that inflation is exclusively a monetary phenomenon. In monetary theory, it is well known that changes in interest rate, i.e. in supply of money in the short run can be stimulative for real trends. Economists agree that the low levels of inflation (the so-called creeping inflation) unto 3 per cent is desirable as it positively affects on economic activity through increased demand. The success of monetary policy and its transmission mechanism is reflected in the very fact that acceptable price level and increase in economic activity are attained simultaneously.

Transmission mechanism is tuned according to the key goal of monetary policy as determined by the Central Bank. In the EU it is the perseverance of stability of prices and in case of the US Federal Reserve it is to maintain a high rate of employment. In both the cases the initial impulses of transmission mechanism stems from base (official) rate. In fact, meeting both the goals is very difficult, as the two are conflicting. Their co-existence is possible only over short periods of time.

Various empirical studies of transmission mechanism of monetary policy have only partially explained this complex process. This particularly is valid in case of the ECB — European Central Bank, which as against the US Federal Reserve lacks historical experience. The level of homogeneity of individual transmission mechanisms in member countries of EU is different and so is the degree of development of financial markets. Peersman (2000) drew same conclusion in his analysis of the monetary transmission channels in the member countries of the EU. He used interest rate, asset price, and credit channels. Many institutional changes including the introduction of Euro have changed the relationships among various economic variables. On the other hand space of European union is at times exposed to various external shocks of which the important ones are the fluctuation dollar/Euro rate, federal fund rate, and lately the oil prices. Furthermore, a series of financial innovations related to the financial instruments, techniques and mechanisms also affect upon the changes in channels of transmission mechanism.

Before creation of the EU, the current members of the Union and their central banks ran their own independent monetary policies. They knew the implications on macroeconomic aggregates also. The introduction of Euro as a new common currency has had different impacts on monetary policy of member countries. Therefore, understanding the monetary transmission mechanism in the Union is of primary significance for the European monetary authority (ECB) and it needs to lead a new and efficient monetary policy in the newly created surroundings.

Methodology

VAR (Vector Autoregression) technique has been widely used to study the monetary transmission mechanism. Sims (1980); Leeper, Sims and Zha (1998); Christian, Einchebauma and Evans (1999) have used it for studying the mechanism in the US. In the EU context, to arrive at their 'benchmark' model, Peersman and Smets (2001) have also used the VAR method.

In our approach we shall use the unrestricted VAR method as it envelops most of the characteristics of the data (Babić, 2000). This would imply that we ignore the limitations and tendencies that currently prevail among macroeconomic aggregates in the EU. The period of our observation is 1992-2003.

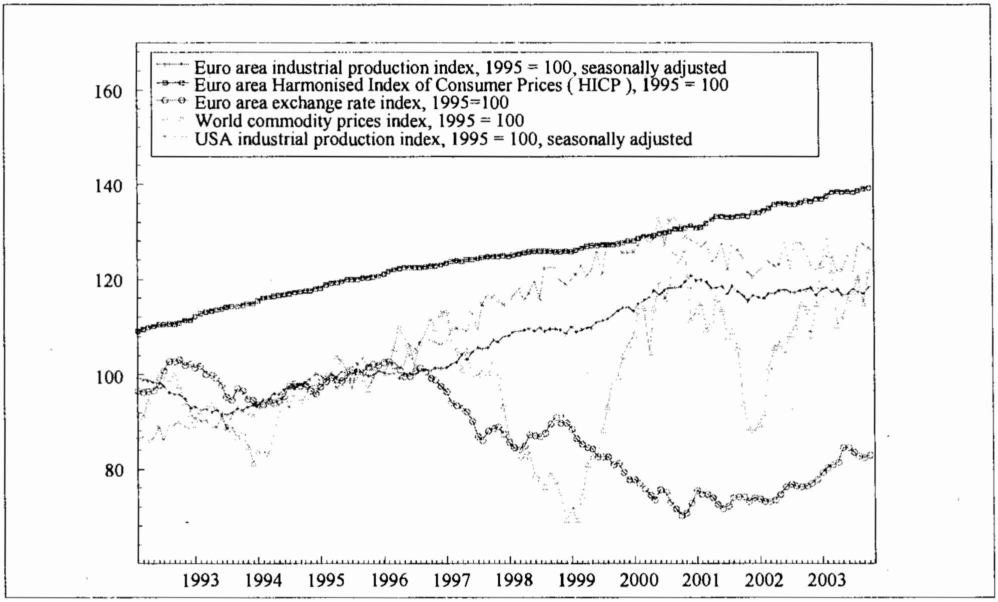
Our model includes endogenous (that operate within the EU) and exogenous (operating outside EU) variables. Endogenous variables in the model are the variables of economic activity such as industrial production within the EU, index of retail prices (HICP) as a measure of inflation, short term nominal interest rate of 3-month Euribor, and the real exchange rate. Exogenous variables in the model are world commodity prices, index of industrial production in the US, short term (3 months) interest rate on treasury bills on the US money market.

Seasonally adjusting has been done for all data series so as to eliminate the seasonal factor in the variables. All values, except the rate of interest, are shown as indices (1995=100). For reasons of stability of variance, in-transformation has been carried out. By using standard Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). Order of VAR=2 is used to provide the best results.

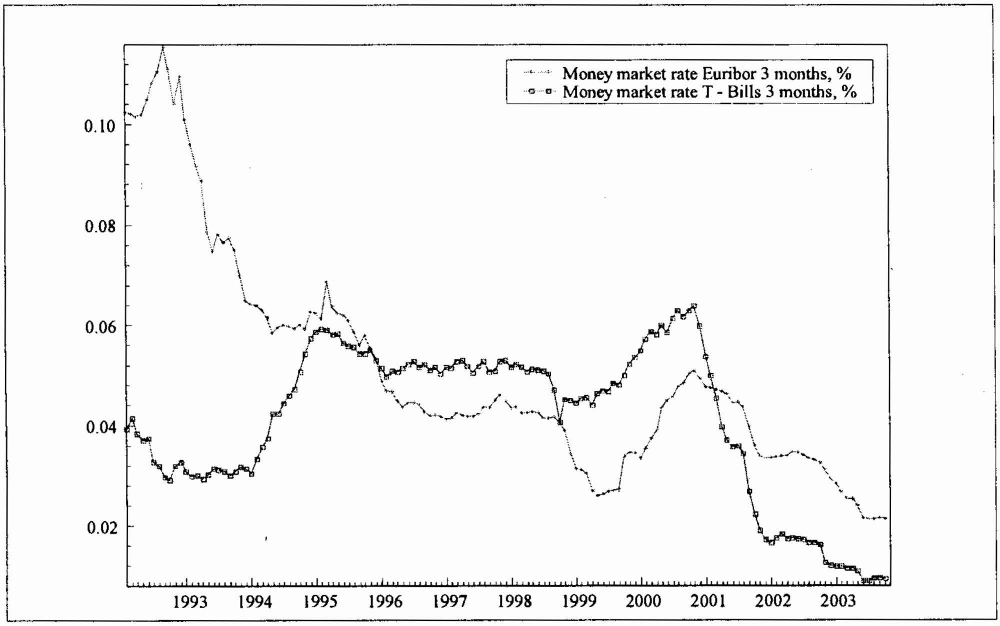
Graphic and Statistical Characteristics of Series

In the following graphs, we see the movements of each variable of the model and their statistical characteristics.

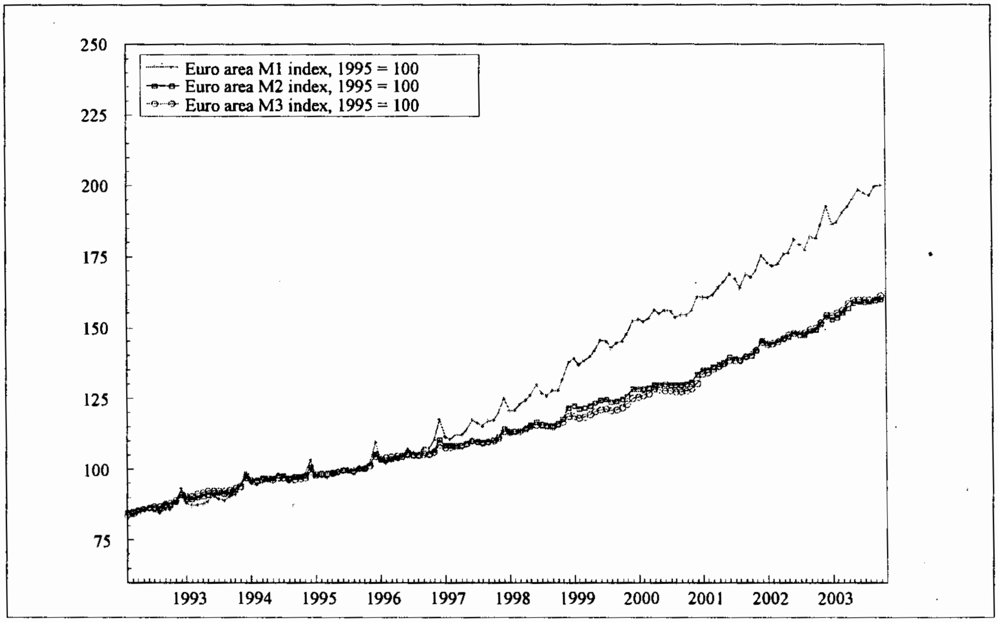
Graph 1.: Indices of EU Industrial Production, Retail Prices and Real Exchange Rate



Graph 2.: 3-Month Interest Rate Euribor and US T-Bills



Graph 3.: Monetary Aggregates: M1, M2, and M3



From the above graphs we can see that the indices of industrial production of EU and US, indices of retail prices (HICP), and the indices of monetary aggregates M1, M2, M3 had a rising trend. Indices of real exchange rate, and interest rate had a falling trend. World commodity price indices have shown a rising tendency. The changes in the commodity prices can be greatly attributed to a rise in price of oil. All this can be seen from the statistical table showing the characteristics of data.

Table 1.: Statistical Characteristics of the Series

Variable	Description	Sample period	Maximum	Minimum	Mean	Standard Deviation	Coefficient of Variation
INDPROEU	Euro area industrial production index, 95=100, SA	02.1992. – 07.2003.	120.6909	91.6313	106.5024	9.0753	0.085212
HICP	Harmonised Index of Consumer Prices, 95=100, SA	02.1992. – 07.2003.	138.5048	109.0440	124.3264	7.9621	0.064042
EURIBOR	Money market interest rate Euribor 3 months, in %, SA	02.1992. – 07.2003.	11.1993	2.1077	5.1550	2.2265	0.43191

REER	Euro area exchange rate index, 95=100, SA	02.1992. – 07.2003.	103.0354	70.0193	88.4778	10.4104	0.11766
COMMODITY	World commodity prices index, 95=100, SA	02.1992. – 07.2003.	128.8817	69.9477	99.2714	12.5770	0.12669
INDPROUSA	USA industrial production index, 95=100, SA	02.1992. – 07.2003.	133.0330	85.9895	110.9209	14.4921	0.13065
TBILLS	Money market interest rate T-Bills 3 months, in %, SA	02.1992. – 07.2003.	6.3595	0.82502	4.1735	1.4790	0.35438

Source: International Financial Statistics, ECB

'Benchmark' VAR Model

As stated earlier the model designed by Peersman and Smets (2001) defining the monetary transition in the EU has the following form:

$$Y_t = A(L)Y_{t-1} + B(L)X_t + u$$

Where Y_t, is vector of endogenous variables, X_t, is vector of exogenous variables, and u_t, is the vector of residuals.

Vector of endogenous variables consists of indices of industrial production of the EU (LOGINDPROEU), retail prices (LOGHICP), short term interest rate on the money market (EURIBOR), and real exchange rate (LOGREER). Vector of exogenous variables includes the index of world commodity prices (LOGCOMMODITY), US industrial production (LOGINDPROUSA), and the US short-term interest rate (TBILLS). Other variables are also included for the sake of control of changes in world demand and inflation. In the first place are real economic activities and the following positions are attributed to monetary variables. This means that any monetary shock will not have simultaneous impact on industrial production and retail prices, but will have an affect on the exchange rate. While in the Peersman and Smets research GDP of EU is taken on a quarterly basis, in our analysis EU industrial production has been taken on a monthly basis. Both the approaches show practically similar impulse responses. The fact is that the industrial production still does constitute the major part of GDP in the EU. This is the proof the robustness of the model.

Along with the 'benchmark' model, we shall also test another model using the variables of monetary aggregates.

As stated earlier, in our investigation we analyse the effects of unitary increase in short term interest rate as an instrument of economic policy. Typically, the central bank increases the rate of interest when it wants to pacify the booming business cycle (during economic expansion), and reduces the interest rate when it wants to stimulate the cycle (during recession).

Stationarity and Integration

Before defining VAR model we analyse the characteristics of the data of the series, i.e. analyse stationarity and integration of the series. Namely, the results achieved through analysis of non-stationary time series could lead to misleading results and create wrong suppositions in the model. Economic time series are, in principle, are non-stationary. Thus these need to be transformed through differencing d-times so as to achieve the stationarity. Such series are called integrated of the order d and marked as X~I (d). We use here the augmented Dickey-Fuller test (ADF test). Following table shows the stationarity tests of the variables in the model with constant and without trend, and in other model with constant and trend. Comparing the test and critical values has done testing. If the absolute value of the test value is greater than the absolute value of critical value, we have concluded that the variable is stationary (Dickey and Fuller, 1979). The choice of ADF test is based on the maximising the AIC.

Table 2.: Test Values for ADF Test

Variable	Levels / First differences	ADF test statistic		Conclusion
		Intercept, not a trend	Intercept, linear trend	
LOGINDPROEU	Levels	- 1.5436	- 2.3646	Non - stationary
	First differences	- 5.3570	- 4.6915	Stationary
LOGHICP	Levels	- 1.8055	- 3.0599	Non - stationary
	First differences	- 6.5913	- 6.0285	Stationary
EURIBOR	Levels	- 3.7567	- 4.4547	Stationary
	First differences	- 3.2307	- 3.6003	Stationary
LOGREER	Levels	- 1.3429	- 0.72395	Non - stationary
	First differences	- 7.2539	- 7.3345	Stationary
LOGCOMMODITY	Levels	- 2.0586	- 2.3837	Non - stationary
	First differences	- 5.0905	- 5.0749	Stationary
LOGINDPROUSA	Levels	- 2.0995	- 0.12091	Non - stationary
	First differences	- 5.5030	- 6.7749	Stationary
TBILLS	Levels	- 0.73156	- 1.3066	Non - stationary
	First differences	- 4.1672	- 4.6171	Stationary

a) 95% critical value for the ADF statistic (intercept, not a trend) = - 2.88
b) 95% critical value for the ADF statistic (intercept, linear trend) = -3.45

From these tests of stationarity it can be concluded that the series are integrated of the order 1, i.e. I (1), implying that it can be concluded that the observed series are non-stationary, and their first differences stationary.

Along the ADF test, using the empirical autocorrelation function (ACF) can also check the stationarity of time series. If the stochastic process were stationary, its autocorrelation function would lean towards zero ifs the gap among the members of the process increases. Testing of empirical autocorrelation function shows (through Ljung-Box test) that the differenced time series are stationary as shown by the ADF test (not shown here).

Granger Causality

Test relates to fact if one variable (including time lag) causes in the model another variable or a block of variables. We examine the p – value with ÷2 test with n degree of freedom. If the p – value is < 0.05, we can talk about Granger causality within the observed period (Granger, 1969). We shall be testing causality based on the values of non-differenced series (constant and trend included) and in first differences (only constant included). In this investigation we investigate if the variable of short-term interest rate causes the block of other variables i.e. industrial production, retail prices, and exchange rate, and the same causes other variables individually. We shall also test if these mentioned variables cause block of other variables. Test is performed with lags of 2,4,6,8, and 10. But here we shall show the results of 2 lags. Variables world commodity price index, industrial production in US, interest on T-bills, constant and trend are exogenous variables.

Table 3.: Block Granger Causality Test (undiferenced series)

Lags = 2	Test	Conclusion
LOGINDPROEU cause LOGHICP, EURIBOR and LOGREER	CHSQ (6) = 29.4247 [0.000]	Cause
LOGHICP cause LOGINDPROEU, EURIBOR and LOGREER	CHSQ (6) = 9.7427 [0.136]	Does not cause
EURIBOR cause LOGINDPROEU, LOGHICP and LOGREER	CHSQ (6) = 17.8127 [0.007]	Cause
LOGREER cause LOGINDPROEU, LOGHICP and EURIBOR	CHSQ (6) = 26.5107 [0.000]	Cause

We see in the test that all the variables except retail prices cause block of other variables. In case of tests with larger lags (not shown here) show that block of Granger causality among variables does not exist. We must also mention the delicate character of interpretation of the obtained results. Namely, because of large number of variables and relatively small time series the problem of small number of data used in causality analysis arises. Therefore, obtained results with larger number of lags must be carefully interpreted. Accordingly, We shall repeat the procedure on the first differenced series that are stationary.

Table 4.: Block Granger Causality Test (first differences)

Lags = 2	Test	Conclusion
dLOGINDPROEU cause dLOGHICP, dEURIBOR and dLOGREER	CHSQ (6) = 6.8902 [0.331]	Does not cause
dLOGHICP cause dLOGINDPROEU, dEURIBOR and dLOGREER	CHSQ (6) = 1.6699 [0.947]	Does not cause
dEURIBOR cause dLOGINDPROEU, dLOGHICP and dLOGREER	CHSQ (6) = 9.9927 [0.125]	Does not cause
dLOGREER cause dLOGINDPROEU, dLOGHICP and dEURIBOR	CHSQ (6) = 6.6630 [0.353]	Does not cause

If we look at causality in first differences, results of our test differ from the results in no-differenced series. In tests with smaller number of lags Granger causality block does not exist. Only the test with larger number of lags result in causality in variables. Therefore, evident is the causality in between industrial production and block of other variables, short-term interest rate and block of other variables, and in between real exchange rate and block of other variables.

We can conclude that industrial production and real exchange rate cause block of other variables with non-differenced series (long run) and in first difference (short-run) series. Retail prices do not cause block of other variables neither with non-differenced series nor in the first difference. Short-term interest rate cause a block of other variables with non-difference series, and not in the first differenced.

Now apply Granger causality test individually in between the variables. We shall see if the short-term interest rate cause other variables individually. As earlier, we shall test with non-difference series and first difference with lag of 2, 4, 6, 8, and 10. But we shall show the results with 2 differences.

Table 5.: Individual Granger causality test (non-differenced series)

Lags = 2	Test	Conclusion
EURIBOR cause LOGINDPROEU	CHSQ (2) = 7.6750 [0.022]	Cause
EURIBOR cause LOGHICP	CHSQ (2) = 1.2836 [0.526]	Does not cause
EURIBOR cause LOGREER	CHSQ (2) = 4.0990 [0.129]	Does not cause

From the test we can see that short term interest rate on the money market causes industrial production. But the same does not cause individually other variables. The results are the same in case of larger lags. The procedure is repeated in case of first difference of series that are stationary.

Table 6.: Individual Granger Causality Test (first differences)

Lags = 2TestConclusionDEURIBOR cause dLOGINDPROEU	CHSQ (2) = 5.8542 [0.054]	Cause
dEURIBOR cause dLOGHICP	CHSQ (2) = 0.11718 [0.943]	Does not cause
dEURIBOR cause dLOGREER	CHSQ (2) = 2.3345 [0.311]	Does not cause

From the above tests we can observe that first differences of the short-term interest rate the money market cause industrial production. But the same does not cause individually other variables. Results are similar in case of larger lags. We also observe similarity with the tests on non-differenced series.

From the above mentioned results we conclude that in the long-run all variables except the retail prices cause the block of other variables, whereas short-term interest rate on the money market individually affect the industrial production and on other variables it does not. In the short-run, in case of lower number of lags, causality among variables does not exist, but in case of larger number of lags it exists in all the variables except the retail prices. Further, short run interest rate on the money market singly affects the industrial production and not the others. This shows the functioning of monetary transmission mechanism in the EU over the long and short run.

Decomposition of Variance

On the basis of earlier carried out Granger causality test of variables within analysed period can not analyse dynamic interdependence of among the variables. Therefore, we need to decompose the variance. With the help of this technique it is possible to explain the significance of variability of other variables in the model. Here, we shall follow the decomposition from the time perspective (prediction horizon) in 10, 20, 30, 40, and 50 months. We must warn again the delicate nature of interpretation of obtained results for larger time series. Namely, because of the large number of variables and relatively short time series there comes up the problem of the size of data that is processed.

Decomposition of variance precedes the orthogonalsation (Cholesky) of innovation process that requires causal arrangement of variables. If a co-linearity exists in the model then a different arrangement will lead to different results. In our analysis the decomposition of variance is done for all variables of the model by changing the order. In the first place are the real variables, and then the monetary. In the second instance the order of the same has been changed and decomposition done again. Out of brevity, decomposition of variance in inverse order (which has done by the authors in detailed research) will not be shown here.

Table 7.: Decomposition of Variance (Variables' order in VAR (2) model: LOGINDPROEU, LOGHICP, EURIBOR, LOGREER and exogenous variables LOGCOMMODITY, LOGINDPROUSA, TBILLS)

Orthogonalised forecast error variance decomposition for variable LOGINDPROEU				
Horizon (months)	LOGINDPROEU	LOGHICP	EURIBOR	LOGREER
10	0.65882	0.01114	0.08170	0.24834
20	0.52204	0.07612	0.08718	0.31467
30	0.50061	0.10814	0.08350	0.30774
40	0.49528	0.11470	0.08270	0.30732
50	0.49245	0.11723	0.08251	0.30781
Orthogonalised forecast error variance decomposition for variable LOGHICP				
Horizon (months)	LOGINDPROEU	LOGHICP	EURIBOR	LOGREER
10	0.08279	0.89643	0.01358	0.00721
20	0.08707	0.84514	0.02782	0.03996
30	0.08403	0.83761	0.02885	0.04951
40	0.08350	0.83672	0.02870	0.05108
50	0.08339	0.83599	0.02871	0.05190
Orthogonalised forecast error variance decomposition for variable EURIBOR				
Horizon (months)	LOGINDPROEU	LOGHICP	EURIBOR	LOGREER
10	0.21995	0.06029	0.47046	0.24930
20	0.15608	0.14871	0.30174	0.39347
30	0.13342	0.21371	0.26033	0.39254
40	0.12863	0.23560	0.24845	0.38732
50	0.12697	0.24223	0.24443	0.38637
Orthogonalised forecast error variance decomposition for variable LOGREER				
Horizon (months)	LOGINDPROEU	LOGHICP	EURIBOR	LOGREER
10	0.02981	0.10807	0.02595	0.83616
20	0.02830	0.22310	0.02156	0.72705
30	0.03266	0.24966	0.02119	0.69648
40	0.03248	0.25916	0.02187	0.68650
50	0.03227	0.26361	0.02188	0.68224

From the obtained results shown above, it is evident that gross part of variation of industrial production is explained by industrial production itself. This is around 50 per cent. If enlarged are the prediction horizons, other variables will have less impact on industrial production. Change of real exchange rate explains the variations in industrial production by 30 per cent. The broadening of prediction framework the significance also increases. Changes in the retail prices, and the short term interest rate explains the changes in industrial production by only 10-20 per cent depending upon the prediction horizon. Increase in prediction horizon of significance of retail prices in explaining the changes in industrial production is higher, and in case of exchange rate it is basically same.

It must be noted that an inverse order of variable in the model does not change the results very much.

From the results it is evident that a large part of variations in retail price is explained by the changes in the same. This is approximately around 85 per cent depending upon the prediction horizon. The percentage shrinks as the prediction horizon is enlarged. It also means that an increase in prediction horizon of other variables will influence the retail prices much less. Change in industrial production explains variability of industrial production by 8 per cent. This percentage increases if the prediction horizon is expanded. Change in exchange rate and short-term interest rate explains the variability of retail prices by only 1-5 per cent depending upon the prediction horizon.

Change of the order of variables in the model leads to a change in the results i.e. it influences upon the variability of rate of exchange.

Impulse Responses

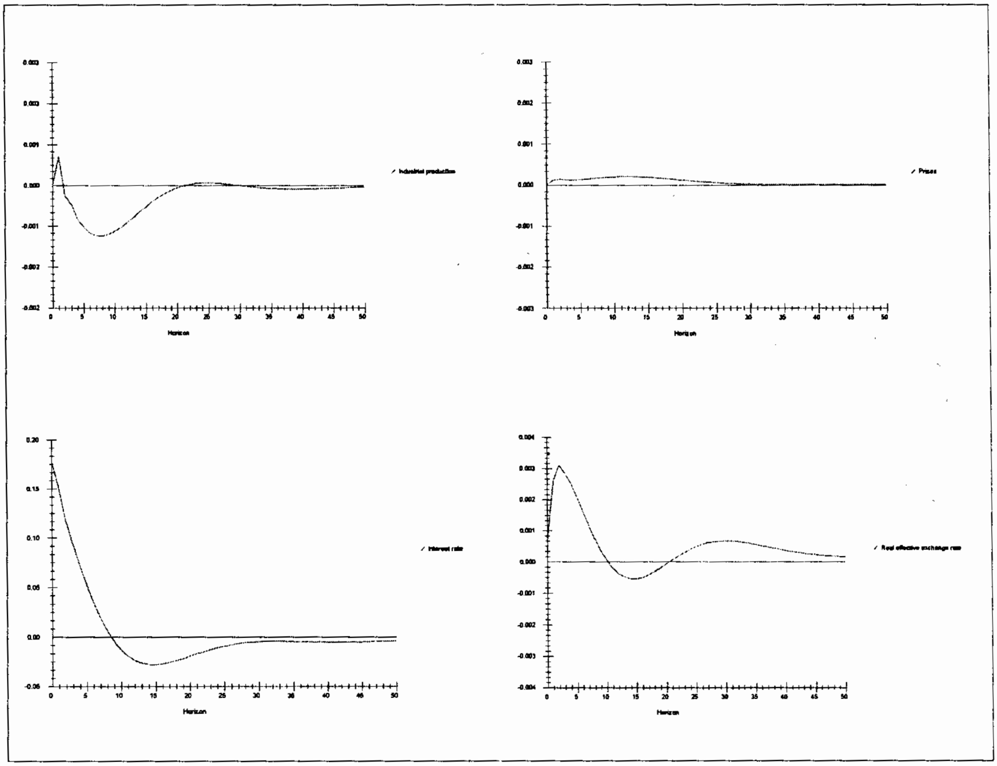
Through VAR model we can also observe the impulse responses of the variables. In this study we analyse the effects of change in short-term interest rate on the remaining variables, i.e. on monetary transmission mechanism (Sims, 1980). We shall follow the impact of short-term interest rate upon industrial production, retail prices, real rate of exchange, and monetary aggregates M1, M2, M3 as well.

From the graphs of impulse response we can see that any unit increase in the short-term interest rate EURIBOR will result in an increase in industrial production of the EU. Later it will come to decline. After 20 months from the origin of shock industrial production will come back to its equilibrium position.

An increase in short-term interest rate will bring about an increase in retail prices. This is the so-called price-puzzle problem. The influence of interest rate on the prices is nominal, almost negligible, but it is lasting compared to the influence of interest rate on industrial production. The prices get back to the equilibrium position only after 30 months after the shock. In theory the increase in interest rate should lead to fall in prices since the economic subjects will have a motive to hold money. In our model, although it does not happen, but we can say that the impact is negligible.

Further, an increase in interest rate will lead to appreciation of real exchange rate. Impact of interest rate is very strong but momentary. The influence of interest rate upon exchange rate ceases after 50 months when it returns to its equilibrium position.

Graph 4.: Impulse Responses for Industrial Production, Retail Prices, Short-Term Interest Rate, and Exchange Rate on Unit Shock of Short-Term Interest Euribor (model without monetary aggregates)

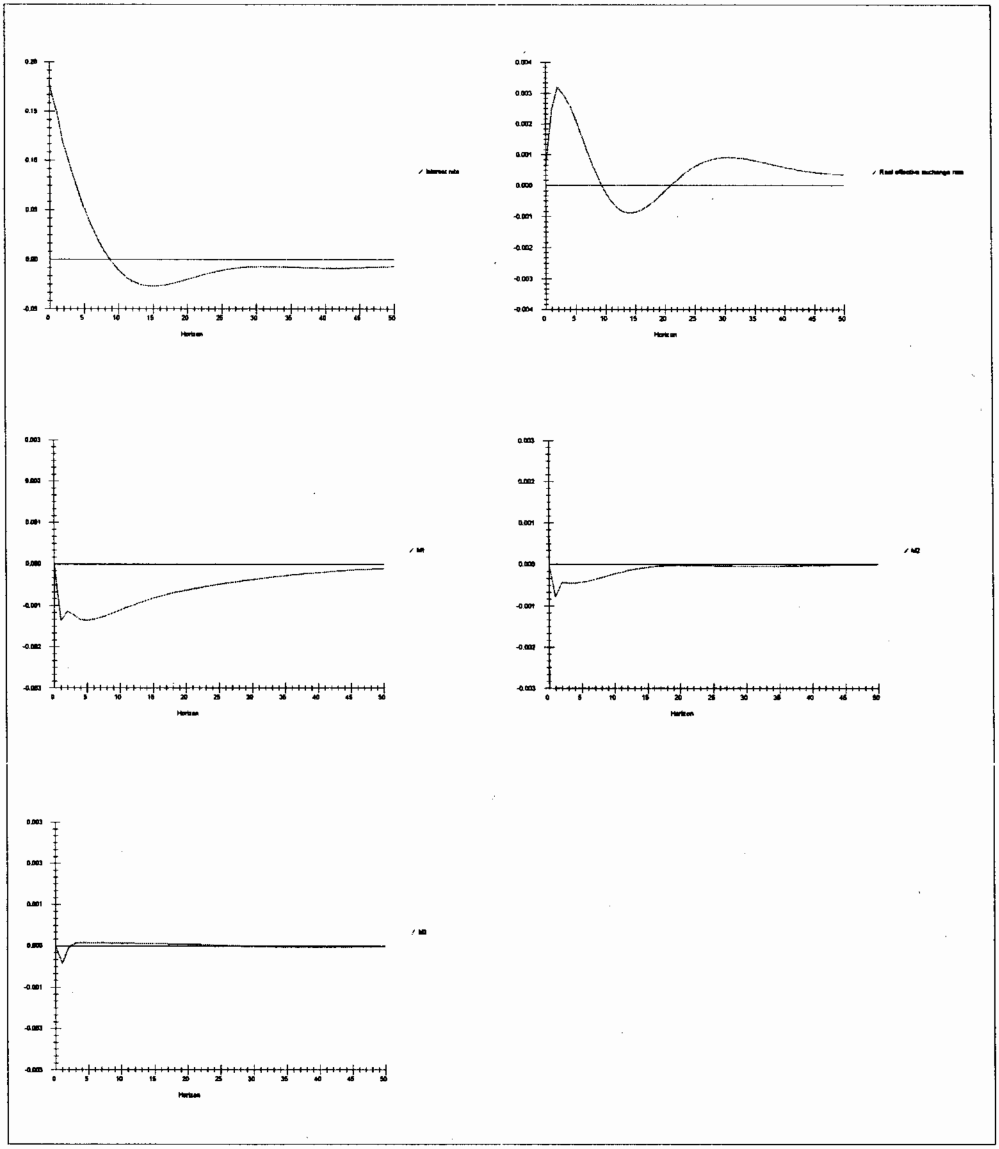


All impulse responses of variables to the shocks meet our expectations. In our extended model of monetary aggregates we expect similar responses as in the model without the monetary supply.

From the graphic presentations (Graph 5), we can see that the impulse response in the extended model are similar to the previous responses. Evidently, a unit increase in the short-term interest rate leads to a reduction in industrial production, and a negligible retail price increase and appreciation of exchange rate.

Unitary increase in the short-run interest rate leads to a decrease in M1. M1 immediately starts shrinking and return to equilibrium level after 50 months. The impact of interest rate on M2 is identical; it evaporates after 15 months after the shock. In case of M3 the influence of interest rate is somewhat different. After an initial decline in M3 it starts increasing and comes back to the equilibrium rate after 25 months. The impact of interest rate is much less on M3 than on M1 and M2.

Graph 5.: Impulse Responses for Industrial Production, Retail Prices, Short-Term Interest Rate and Exchange Rate And Monetary Aggregates on Unit Shock of Short-Term Interest Euribor (model with monetary aggregates)



Conclusion

In this study we have tried to analyse the monetary transmission mechanism in the European Union. The analysis is based on aggregated historical data of the EU. We have basically concentrated on the first channel of monetary transmission i.e. the rate of interest. It has been characterised as a response of industrial production, retail prices, real exchange rate, and the supply of money on the increase of short-term interest rate (i.e. restrictive monetary policy). The presupposition in our study was that an increase in short-term interest rate would lead to reduction of industrial production, increase in retail prices, appreciation in real exchange rate and reduction in monetary mass. Granger tests of causality have shown that the interest rate influences only the industrial production and not the other variables. VAR has been as used as a tool of analysis.

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