The Role of Interest Rates and Credits in Explaining Output Variations: Empirical Evidence from Turkey and the Euro Area

RESEARCH PAPER

Oguzhan Ozcelebi*

Abstract

This study aims to analyze the effects of monetary policy on real economic activity in the cases of Turkey and the euro area by investigating the role of financial intermediaries. Structural vector error correction (SVEC) models are used to examine the effects of short-term interest rates and credit activity on output. Empirical results reveal that short-term interest rates and credits may affect Turkey's output in the short run, whereas changes in short-term interest rate and credit volume do not have a significant long-term impact on real economic activity either in Turkey or the euro area.

Keywords: interest rates, credits, real economic activity, SVEC model, Turkey, the euro area

JEL classification: C32, E50

* *Oguzhan Ozcelebi, Assistant Professor, Faculty of Economics, Istanbul University, Turkey, e-mail: ogozc@istanbul.edu.tr.*

1 Introduction

In the process of Turkey's accession to the EU and the consequent effort to harmonize its policy structures with the EU, the Central Bank of the Republic of Turkey (CBRT) implemented a new economic stabilization and structural change program in 2002.[1] Thus, the year 2002 was marked by the adoption of an inflation targeting regime. Since then, price stability has been proclaimed as the primary objective of the central bank while short-term interest rates are used as the main policy tool.

Although the year 2002 was characterized by hyperinflation in Turkey, inflation tended to decrease and in the period 2002-2011, monetary policy was generally perceived as successful both in Turkey and the euro area. However, in 2011, producer prices inflation reached 13 percent in Turkey and 5 percent in the euro area. Table 1 indicates that this period also coincided with the rise in GDP (except 2009) and strong upward trend in share prices.

This process led to acceleration in credit activity, low risk premiums, abundant liquidity and speculative bubbles in the financial markets. However, the 2008 financial crisis arising from the collapse of the US subprime market spread to the rest of the financial sectors as well as to other countries due to tight connections within the financial system and strongly integrated supply chains in global product markets. Consequently, credit restraints and sagging confidence hindered the real economic activity. Table 1 indicates that in 2009 GDP growth of the euro area decreased by 4.3 percent while real economic activity decreased by 4.8 percent in Turkey. As a result, financial rescue policies in the EU have focused on restoring liquidity and capital of banks and the provision of guarantees. In addition, "central banks cut policy interest rates and gave financial institutions access to lender-of-last-resort facilities, whereas governments provided liquidity facilities to financial institutions in distress, along with state guarantees on their liabilities, followed by capital injections" (Directorate-General for Economic and Financial Affairs of the European Commission, 2009: 2).

[1] *For details on the policy framework of the CBRT see Republic of Turkey Pre-Accession Economic Programme (2002: 1-96).*

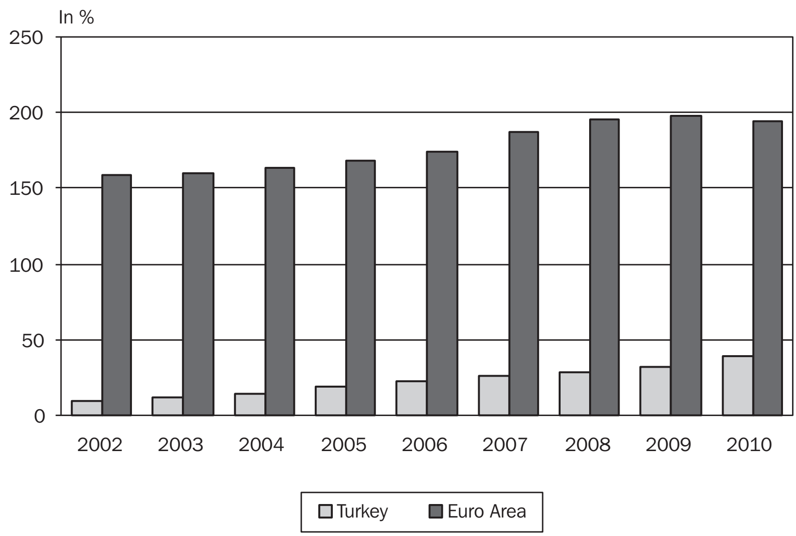
Table 1 **Main Macroeconomic and Financial Indicators: Turkey and the Euro Area**

	GDP growth (in %)		Producer price inflation (in %)		Overnight interbank rate (in %)		Share prices (% change)		Credit extension by financial intermediaries (% change)	
Years	**Turkey**	**Euro area**	**Turkey**	**Euro area**	**Turkey**	**Euro area**	**Turkey**	**Euro area**	**Turkey**	**Euro area**
2002	6.1	0.9	48.3	0.1	44.0	3.0	8.6	-22.5	1.5	4.6
2003	5.2	0.7	23.8	0.8	26.0	2.0	11.3	-18.1	51.8	3.1
2004	9.3	2.2	11.0	2.7	18.6	2.0	62.0	17.8	54.1	13.5
2005	8.4	1.7	9.6	3.2	13.5	2.2	47.5	16.9	51.7	28.4
2006	6.8	3.2	9.3	3.5	17.5	3.5	35.7	21.7	40.6	19.9
2007	4.6	2.9	5.5	3.0	15.9	3.8	21.1	16.5	27.5	13.2
2008	0.6	0.3	11.7	4.8	15.6	2.4	-22.0	-24.6	23.2	-2.6
2009	-4.8	-4.3	-0.5	-5.4	6.5	0.3	-0.3	-25.3	10.7	-15.9
2010	9.1	1.9	6.0	3.4	1.6	0.5	58.6	13.4	44.7	5.0
2011	8.4	1.4	13.3	5.5	5.0	0.6	2.1	-3.3	32.3	0.5

Sources: Central Bank of the Republic of Turkey (CBRT) and European Central Bank (ECB).

As shown in Figure 1, the share of credits in GDP in the euro area was approximately 150 percent in 2002 and 2010. That implies that banks' balance sheets are still vulnerable to higher credit default risk in the euro area. On the other hand, credit risk is also present in Turkey where the share of credits in GDP gradually increased in the 2002-2010 period.

Figure 1 **Credits as a Share of GDP**[2]



Sources: CBRT and ECB.

Credit volume is an important macroeconomic variable that affects real economic activity but is also dependent on real economic activity. Expenditures financed by credit growth may lead to an increase in output, whereas output growth may also influence the demand for credits. In addition, monetary policy changes cause financial intermediaries to adjust the volume of loans with central banks responding to such changes. This study investigates the impact of short-term interest rates and volume of credits on real economic activity in the case of Turkey and the euro

[2] *Credits exclude credits by the central bank.*

area[3] by using the structural vector error correction (SVEC) framework that considers the interactions between variables. Within this context, a comparative analysis between advanced economies like the euro area and a fast-growing emerging economy like Turkey is undertaken in order to point out some issues for policy-makers.

The rest of the paper is organized as follows. Section 2 reviews the theoretical background of the study. In Section 3, the empirical methodology is presented while empirical findings are discussed in Section 4. Finally, Section 5 concludes and stresses issues for further research.

2 Literature Review

Before the 2008 financial crisis there was a general consensus among both the academic community and policy-makers about conducting monetary policy based on neoclassical synthesis. Within that context, financial conditions were regarded as critically important for maintaining macroeconomic stability since financial frictions can have negative effects on macroeconomic variables as supported by empirical studies (Mishkin, 1978; 1991; 1996; Bernanke, 1983; Calomiris, 1993). This has prompted a large literature on the role of financial frictions in business cycle fluctuations.[4] Nonetheless, "the general equilibrium modeling frameworks in central banks did not incorporate financial frictions as a major source of business cycle fluctuations; thus monetary and financial stability policies were conducted separately" (Mishkin, 2011: 18). As a result of the 2008 financial crisis, the importance of coordination of monetary and financial stability polices has been recognized. Therefore, the role of financial conditions in economic activity is critically considered when central banks construct macroeconomic models for analyzing monetary policy. On the

[3] *The euro area comprises of 17 countries: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia and Spain.*

[4] *See, for example, Kashyap and Stein (1993), Bernanke and Gertler (2000; 2001), Bernanke, Gertler and Gilchrist (1998), Christiano, Motto and Rostagno (2010), Alvarez-Parra, Marques and Toledo (2011), Khan and Thomas (2011), Quadrini (2011), Fernández and Gulan (2012) and Yao (2012).*

other hand, the monetary policy transmission mechanism works through various channels and thus it influences different macroeconomic variables as stated by Loayza and Schmidt-Hebbel (2002). Accordingly, in order to determine the changes in monetary policy, the transmission mechanism of monetary policy should be identified.

For the success of monetary policy implementation, it is important to determine the effects of monetary policy stance on the financial sector. Bernanke and Blinder (1992), Gilchrist and Zakrajšek (1995), Kashyap and Stein (2000) and Peersman and Smets (2003) show that banks react to monetary policy stance, while Driscoll (2004) concludes that although monetary shocks have a significant effect on loan supply in the US, loan supply has no significant effect on real economic activity. The significance of the bank-lending channel is related here to the change in deposits and therefore the stability of money demand plays a major role. Hayo (1999), Coenen and Vega (2001), Funke (2001), Brand and Cassola (2004), Beyer (2009), Narayan, Narayan and Mishra (2009), Belke and Czudaj (2010) and Hossain (2012) confirm that demand for money is stable, whereas there are studies in the literature stressing the instability of money demand (Cogley, 1993; Lütkepohl, 1993; Gerlach and Svensson, 2003; Carstensen, 2006; Nautz and Rondorf, 2010). The instability of money demand may arise from the omission of important variables in money demand equations as stated by Nautz and Rondorf (2010). Within this context, Dreger and Wolters (2010) suggest that financial variables should be incorporated into money demand equations.

Financial stability is a major factor affecting business cycle dynamics and macroeconomic equilibrium, and consequently a growing literature has incorporated the financial sector into a general equilibrium framework.[5] Accordingly, the behavior of financial intermediaries and the relationship between borrowers and lenders in affecting credit quantity should be considered. Within this context, the first generation of bank lending

[5] *See, for example, Chen (2001), Aikman and Paustian (2006), Christensen and Dib (2006), Goodfriend and McCallum (2007), Teranishi (2008), Gertler and Kiyotaki (2009), Gerali et al. (2010), Pariès, Sørensen and Palenzuela (2010), Gertler and Karadi (2011), Quint and Rabanal (2011) and Brzoza-Brzezina and Kolasa (2012).*

models in the literature depends on the asymmetric information between borrowers and lenders. Stiglitz and Weiss (1981) assume that the interest rate charged by a bank may affect the riskiness of a pool of loans by either adverse selection or moral hazard since borrowers have different probability of repayment, thus they stress that a loan market may be characterized by credit rationing. In contrast to Stiglitz and Weiss (1981), Rothschild and Stiglitz (1976), Bester (1985a), Milde and Riley (1988) and Grinblatt and Hwang (1989) suggest that instead of credit rationing, an instrument to screen loan applicants should be used. Wette (1983) and Bester (1985b) reveal that safe borrowers would be more willing to undertake secured borrowing rather than risky ones; therefore collateral can be used as a sorting device. On the other hand, Leland and Pyle (1977), Stiglitz (1982) and Brennan and Kraus (1987) show that using collateral as a sorting device may not always be sufficient to eliminate credit rationing and suggest that co-investment requirement and capital structure could be used to screen applicants.

To identify the effects of financial conditions on the monetary policy implementation, all possible factors which are likely to lead to changes in financial variables should be detected. Within this context, Bernanke, Gertler and Gilchrist (1998) do not provide any support to the broad credit channel since they find that corporate spreads over risk-free government rates increase sharply in response to a contractionary monetary shock. Corporate spreads may fluctuate even in the absence of credit frictions, simply because of the changes of corporate risk or the market price. Similarly, Cooper, Hillman and Lynch (2001) reveal that evidence for broad credit channel from corporate bond spread indices is not clear and that individual spreads are a non-linear function of individual debt-to-equity ratios. On the other hand, investment is highly dependent on the value of the collateral, which can affect monetary policy implementation as concluded by Kiyotaki and Moore (1997). Accordingly, the significance of credit constraints on investment should be analyzed since there has been a growing literature on credit constraints revealing the failure of the standard Q-model of investment. Fazzari et al. (1988) imply that constrained firms are more sensitive to cash flow than unconstrained firms, whereas Devereux and Schiantarelli (1989) reveal that large firms are more sensitive to cash flow than small ones. Since both small and large companies may face financial constraints, neoclassical models of investment perform poorly. However, according to many empirical findings (Cummins and Hassett, 1992; Cummins, Hassett and Hubbard, 1994; Caballero, Engel and Haltiwanger, 1995; Abel and Eberly, 1996; Barnett and Sakellaris, 1998; Petrakos, Arvanitidis and Pavleas, 2007) neoclassical fundamentals are important determinants of investment.

3 Empirical Methodology

Short- and long-run restrictions derived from economic theory are imposed within the SVEC modeling framework thereby allowing for the relation between monetary policy and real economic activity in Turkey and the euro area to be investigated. Within this framework, empirical analysis should indicate the possible effects of a 3-month interbank rate[6] and real volume of credits induced by financial intermediaries on industrial production[7] via impulse response function and forecast error variance decomposition using two SVEC models.[8] Analysis is undertaken for the period from January 2002, when the Central Bank of the Republic of Turkey began to implement anti-inflationary policy, in line with the country's full EU membership target, to December 2011. Data is on monthly basis and the following variables are used: the log of the industrial production for Turkey and the euro area,[9] ind_t^{tr} and ind_t^{eur}, the log of the volume of credits by financial sectors in Turkey and the euro area deflated by GDP deflator (seasonally adjusted),[10] cre_t^{tr} and cre_t^{eur} and 3-month interbank rates for Turkey and

[6] *According to OECD, short-term rates are usually either the 3-month interbank offer rate attaching to loans given and taken amongst banks for any excess or shortage of liquidity over several months or the rate associated with treasury bills, certificates of deposit or comparable instruments, each of three-month maturity.*

[7] *Besides industrial production, retail sales and construction can be regarded as output indicators. Monthly retail sales and construction series are not available for the analyzed period.*

[8] *For conducting the empirical analysis, JMulTi software version 4.23 is used.*

[9] *Industrial production series are obtained from OECD's database, expressed as indices and seasonally adjusted with base year 2005 = 100.*

[10] *Volume of credits by the financial sector series are extracted from the CBRT and ECB database. The volume of credits series of Turkey are deflated by OECD's GDP deflator (2005 = 100). The volume of credits series of the euro area are deflated using the GDP deflator of ECB.*

the euro area,[11] i_t^{tr} and i_t^{eur}. All series are in levels and derived from CBRT, ECB and OECD databases.

3.1 Unit Root Tests

Stationarity of the variables included in the analysis needs to be tested in order to specify the appropriate econometric model. Thus, we employ augmented Dickey-Fuller (ADF) and KPSS tests. Critical values for the tests depend on the deterministic terms which have to be included; thus the Pantula principle (Pantula, 1989) is followed.[12]

Table 2 **Augmented Dickey-Fuller and KPSS Tests**

Variables	ADF test statistic	KPSS test statistic	Number of lagged differences
ind_t^{tr} (c, t)	-2.25	0.65	1
$\Delta\ ind_t^{tr}$ (c)	-20.00	0.01	0
cre_t^{tr} (c, t)	-1.93	0.34	6
$\Delta\ cre_t^{tr}$ (c)	-2.73	0.18	5
i_t^{tr} (c, t)	-2.37	0.68	1
$\Delta\ i_t^{tr}$ (c)	-5.24	0.01	0
ind_t^{eur} (c, t)	-2.39	0.14	10
$\Delta\ ind_t^{eur}$ (c)	-7.38	0.08	10
cre_t^{eur} (c, t)	0.18	0.51	3
$\Delta\ cre_t^{eur}$ (c)	-4.50	0.27	2
i_t^{eur} (c, t)	-2.33	0.24	6
$\Delta\ i_t^{eur}$ (c)	-2.67	0.01	0

Notes: 10 percent critical values for the ADF test with constant and trend (c, t) and constant (c) term are -3.13 and -2.57, respectively. Critical values for the ADF test are from Davidson and MacKinnon (1993). 10 percent critical values for the KPSS test with constant and trend and constant terms are 0.11 and 0.34, respectively. Critical values for the KPSS test are from Kwiatkowski et al. (1992).

[11] *3-month interbank rates are obtained from the OECD database. Monthly figures shown are calculated as the average of weighted or unweighted arithmetic rates relating to all days or specified days in the month or they refer to a day at or near the month's end. In this study, interest rate series included in the empirical exercise are expressed in percents.*

[12] *According to the Pantula principle, if a linear trend term is needed in the test for s_t, then only a constant term should be used in the test for Δs. Similarly, if just a constant is necessary in the test for s_t, the test for Δs is to be carried out with no deterministic term (Lütkepohl, 2007a: 55).*

All series used in the empirical analysis have a nonzero mean and a linear trend; thus unit root tests are implemented with constant and trend terms. The lag order used in the ADF test is selected by the Akaike information criteria (AIC). As shown in Table 2, the results of the KPSS test are in line with results obtained for the ADF test. Accordingly, at the 10 percent significance level, all series in levels are non-stationary, whereas all series are stationary in first differences. Since all series are regarded as integrated of order 1, the possibility of cointegration relationship among the series is explored.

3.2 Cointegration Test

To determine whether or not the linear combination of these variables in the empirical exercise is $I(0)$, several tests are carried out. Among them, the most widely used is the Johansen cointegration test. The Johansen cointegration test is based on estimation of the model:

$$y_t = \mu_t + x_t \,, \tag{1}$$

where y_t is a K-dimensional vector of observable variables. $\mu_t = \mu_0 + \mu_1 t$ is the deterministic part with a linear trend term and x_t is a stochastic process that has vector autoregression (VAR) representation. If $y_t = 0$, there is just a constant mean and no deterministic trend term. In that case, $y_t - \mu_0 = x_t$, and thus y_t has the following vector error correction (VEC) form (Lütkepohl, 2007b: 112):

$$\Delta y_t = \Pi(y_{t-1} - \mu_0) + \sum_{j=1}^{p=1} \Delta y_{t-j} + u_t \,. \tag{2}$$

The rank of Π is the cointegrating rank of x_t and hence of y_t. Thus, the pair of hypotheses below is tested to specify the appropriate type of the model:

$$\mathrm{H}_0(r_0)\!:\!\mathrm{rk}(\Pi) = r_0 \text{ versus } \mathrm{H}_1(r_0)\!:\!\mathrm{rk}(\Pi) > r_0, \quad r_0 = 0, \dots, K-1 \,. \tag{3}$$

Table 3 **Johansen Cointegration Test**					
Series: $indtr_t, cretr_t, itr_t$ **No. of included lags (levels): 5**			**Series:** $indeur_t, creeur_t, ieur_t$ **No. of included lags (levels): 10**		
Null hypothesis	**Test value**	**Critical value (90%)**	**Null hypothesis**	**Test value**	**Critical value (90%)**
r=0	49.30	39.73	r=0	52.44	39.73
r=1	16.13	23.32	r=1	11.56	23.32
r=2	4.23	10.68	r=2	3.56	10.68

Note: Optimal lag lengths of the two models are determined by the Akaike information criterion (AIC), Hannan-Quinn criterion (HQ) and Schwarz criterion (SC).

According to Table 3, there exists one cointegrating relation both among the variables in the vector $y_t = (indtr_t, cretr_t, itr_t)'$ and the variables in the vector $y_t = (indeur_t, creeur_t, ieur_t)'$. Thus, two VEC models can be estimated for analyzing the consequences of changes in the 3-month interbank rate and real volume of credits on industrial production for both the separate cases of Turkey and the euro area.

3.3 SVEC Model

To examine the contemporaneous and long-run shocks in an impulse response analysis, the SVEC model can be used. Within this framework, restrictions on the matrix of long-run effects of shocks and the matrix of contemporaneous effects of the shocks are imposed. SVEC model is expressed as:

$$A\Delta y_t = \Pi^* y_{t-1} + \Gamma_1^* \Delta y_{t-1} + \ldots + \Gamma_{p-1}^* \Delta y_{t-p+1} + C^* D_t + B^* z_t + v_t, \quad (4)$$

where $y_t = (y_{1t}, \ldots, y_{Kt})'$ is a $(K \times 1)$ vector of endogenous variables. z_t is a vector of exogenous or unmodeled stochastic variables. D_t includes all deterministic terms. The Π^*, $\Gamma_j^* (j = 1, \ldots, p-1)$, C^* and B^* are structural form parameter matrices and v_t is a $(K \times 1)$ structural form error that is a zero mean white noise process with time-invariant covariance matrix Σ_v. Finally, the invertible $(K \times K)$ matrix A allows modeling instantaneous relations among the variables in y_t. If the error variables are viewed as the actual exogenous variables, SVEC model is expressed as below (Breitung, Brüggemann and Lütkepohl, 2007: 161-162):

$$A\Delta y_t = \Pi^* y_{t-1} + \Gamma_1^* \Delta y_{t-1} + \ldots + \Gamma_{p-1}^* \Delta y_{t-p+1} + B\varepsilon_t \,. \quad (5)$$

From Johansen's version of Granger's representation theorem (see Johansen, 1995), it is known that if y_t is generated by a reduced form VEC model: $\Delta y_t = \alpha\beta' y_{t-1} + \Gamma_1 \Delta y_{t-1} + \ldots + \Gamma_{p-1} \Delta y_{t-p+1} + u_t$, it has the following MA representation (Breitung, Brüggemann and Lütkepohl, 2007: 166-168):

$$y_t = \Xi \sum_{i=1}^{t} u_i + \Xi^*(L) u_t + y_0^*, \quad (6)$$

where $\Xi = \beta_\perp (\alpha'_\perp (I_K - \Sigma_{i=1}^{p-1} \Gamma_i) \beta_\perp)^{-1} \alpha'_\perp$, $\Xi^*(L) = \Sigma_{j=0}^{\infty} \Xi_j^* L^j$ is an infinite-order polynomial in the lag operator with coefficient matrices Ξ_j^* that go to zero as $j \to \infty$. The term y_0^* contains all initial values. Ξ has rank $K - r$ if the cointegrating rank of the system is *r*. Ξ represents the long-run effects of forecast error impulse responses and the matrices Ξ_j^* contain transitory effects. If u_t is replaced by $A^{-1}B\varepsilon_t$, the orthogonalized short-run impulse responses may be obtained as $\Xi_j^* A^{-1} B$ in a way analogous to the stationary VAR case. Furthermore, the long-run effects of ε shocks are given by $\Xi A^{-1} B$. This matrix has rank $K - r$ since $\text{rk}(\Xi) = K - r$ and A and B are nonsingular. Accordingly, the matrix $r = 1$ can have at most *r* columns of zero and there can be at most *r* shocks with transitory effects and at least $k^* = K - r$ shocks have permanent effects. Given the reduced rank of the matrix, each column of zeros stands for only k^* independent restrictions. Thus, the corresponding zeros represent $k^* r$ independent restrictions if there are *r* transitory shocks. For identifying the permanent shocks, $k^*(k^* - 1)/2$ additional restrictions are imposed, whereas $r(r-1)/2$ additional contemporaneous restrictions are needed for identifying the transitory shocks. Consequently, enough restrictions are imposed for identifying B assuming that $A = I_K$ (Breitung, Brüggemann and Lütkepohl, 2007: 166-167).

Besides impulse response analysis, forecast error variance decompositions (FEVDs) are used as a tool for examining the dynamics of VAR type of models. They give the proportion of the movements in the dependent variables that are due to their own shocks versus shocks to the other variables. Thereby, it is shown how much of the *h*-step-ahead forecast error variance of a given variable is explained by exogenous shocks to the other variables (Brooks, 2008: 299-300). The *h*-step forecast error from a VAR model is $y_{T+h} - y_{T+h|T} = u_{T+h} + \Phi_1 u_{T+h-1} + ... + \Phi_{h-1} u_{T+1}$. When this error in terms of the structural innovations is expressed as $\varepsilon_t = (\varepsilon_{1t}, ..., \varepsilon_{Kt})' = \mathrm{B}^{-1}\mathrm{A}u_t$, $y_{T+h} - y_{T+h|T} = \Psi_0 \varepsilon_{T+h} + \Psi_1 \varepsilon_{T+h-1} + ... + \Psi_{h-1}\varepsilon_{T+1}$ is given where $\Psi_j = \Phi_j \mathrm{A}^{-1}\mathrm{B}$ (Breitung, Brüggemann and Lütkepohl, 2007: 180).

3.4 Identification of the SVEC Model

In the empirical analysis, two SVEC models based on VEC framework are employed to explain the relationship between short-term interest rates, credits and output for both Turkey and the euro area. Within this context, the vectors of time series variables are $y_t = (indtr_t, cretr_t, itr_t)'$ and $y_t = (indeur_t, creeur_t, ieur_t)'$, whereas the vectors of structural shocks are given by $\varepsilon_t = (\varepsilon_t^{indtr}, \varepsilon_t^{cretr}, \varepsilon_t^{itr})'$ and $\varepsilon_t = (\varepsilon_t^{indeur}, \varepsilon_t^{creeur}, \varepsilon_t^{ieur})'$. Assuming $\mathrm{A} = I_K$, we need $\frac{1}{2}K(K-1) = 3$ linearly independent restrictions to just-identify the parameters in B. There are $k^* = K - r = 2$ shocks with permanent effects in each of the two SVEC models. On the other hand, the $r = 1$ shock merely has transitory effects. Accordingly, it is assumed that nominal shocks attributed to the shocks to the 3-month interbank rate have no long-run effect on other variables included in the SVEC model and three zero restrictions in the last column of the identified long-run impact matrix $\Xi\mathrm{B}$ are imposed. In addition, owing to the reduced rank of $\Xi\mathrm{B}$, this imposes $k^* r = 2$ independent restrictions. For identifying the $k^* = 2$ permanent shocks, $k^*(k^* - 1)/2 = 1$ additional restriction is necessary. Thus, we assume that industrial production is only driven by its own shocks or namely the supply shocks; $(\Xi\mathrm{B})_{12} = 0$. More precisely, monetary variables have no effect on the direction of real economic activity in the long run. Consequently, restrictions imposed on matrix B and the long-run impact matrix $\Xi\mathrm{B}$ are expressed as follows:

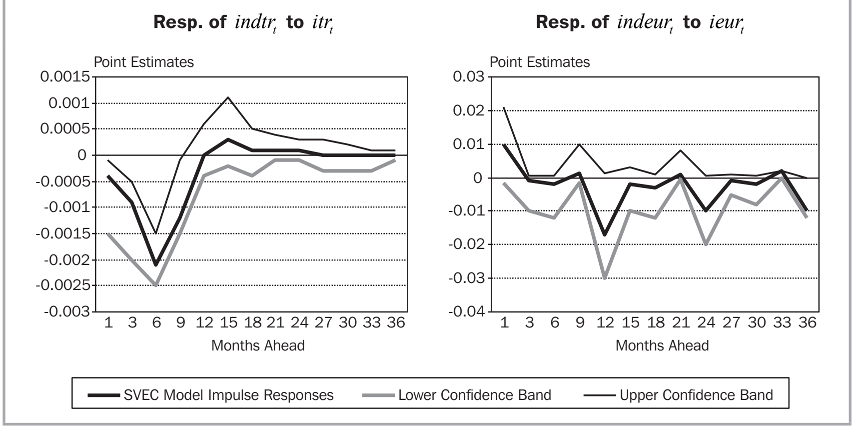
$$B = \begin{pmatrix} * & * & * \\ * & * & * \\ * & * & * \end{pmatrix}, \Xi B = \begin{pmatrix} * & 0 & 0 \\ * & * & 0 \\ * & * & 0 \end{pmatrix}. \tag{7}$$

4 Empirical Results

In this study, two 3-variable SVEC models are estimated depending on VEC model framework with constant and trend terms. Optimal lag lengths of the two SVEC models are determined by the AIC, HQ and SC. For the model with the time series vector $y_t = (indtr_t, cretr_t, itr_t)'$, a lag length of 5 is imposed by the AIC, HQ and SC, whereas the same criteria suggested a lag length of 10 for the model with the time series vector $y_t = (indeur_t, creeur_t, ieur_t)'$. Within this framework, SVEC model impulse response functions are estimated to show how industrial production reacts to the shocks to 3-month interbank rate and real volume of credits for the next 36 months considering the dynamic behavior of the system.[13] In the impulse response analysis, confidence intervals are implemented to reflect the estimation variability of estimated impulse responses; thus 90 percent Hall's percentage intervals are used based on 100 bootstrap replications. Forecast error variance decomposition analysis is also carried out to expose the degree of importance of the 3-month interbank rate and real volume of credits for the variations in industrial production in the following 36 months for both cases.

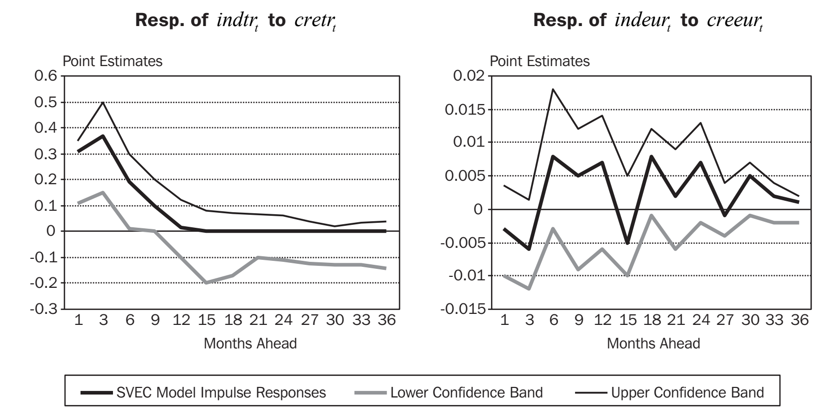
[13] *JMulTi software version 4.23 provides orthogonalized shocks for the impulse response analysis of SVEC models. The expected response of $y_{i,t+s}$ to a unit change in y_{it} is not traced (y_{it} is the i^{th} element of vector y_t in VAR-type of model and $s = 1, 2...$) since forecast error impulse responses cannot be computed. See, for example, Breitung, Brüggemann and Lütkepohl (2007) and JMulTi User Guide. Therefore, cumulative effects (for instance, sustained effects of reducing interest rates, say 25 basis points a month, or increasing credits a million a month on industrial production) cannot be measured exactly.*

Figure 2 **Impulse Response to an Interest Rate Shock**



Short-term interest rates can be used as indicator variables to explain the variations in real economic activity as pointed out by Bernanke and Blinder (1992) and Estrella and Mishkin (1998). Impulse response analysis shows that after a positive shock to itr_t, $indtr_t$ decreases for the first nine months and this impact in Turkey is statistically significant. After nine months, the shock becomes statistically insignificant. Thereby, it is revealed that the expected negative effect of the rise in short-term interest rates on the real economic activity of Turkey is not long-lived, with the effect remaining up to three quarters. This finding is in line with the outcome of the study by Levin, Natalucci and Piger (2004), investigating the relationship between monetary policy shocks and output. Accordingly, it is implied that although CBRT may influence the output by changing its policy rates in the short run, economic growth is not influenced by the CBRT's monetary policy decisions in the long run. On the other hand, the response of $indeur_t$ to a positive shock to $ieur_t$ is not statistically significant either in the short or long run. Therefore, impulse response analysis results emphasize that short-term interest rates do not have significant effects on economic growth in the long run as implied by Plosser and Rouwenhorst (1994), Stock and Watson (2001) and Aksoy and Leon-Ledesma (2005). On the other hand, dynamics of money markets and economic policy implementations affecting short-term interest rates are important factors for maintaining financial stability; therefore they should be taken into consideration by the CBRT and ECB.

Figure 3 **Impulse Response to a Credit Shock**



Besides short-term interest rates, total volume of credits can be used as an operating target of monetary policy implementation for achieving the objectives of monetary policy. Thus, the effects of credit supply on real economic activity are critically important as stated by McCallum (1991), Galbraith (1996), Balke (2000) and Atanasova (2003). According to the impulse response exercise, it can be seen that a positive shock in $cretr_t$ has a significant short-run impact on $indtr_t$ (between the first and ninth month). However, the significance of the shock in $cretr_t$ on $indtr_t$ disappears after nine months. Thereby, it is implied that increases in the total volume of credits may influence Turkey's output in the short run, consistent with the Lucas aggregate supply function framework proposed in Lucas (1972). On the other hand, a positive shock in $creeur_t$ does not have a statistically significant impact on $indeur_t$ either in the short or long run, as shown in Figure 3. This finding reveals that determinants of the changes in credit volume do not have effects on the long-run economic growth in the euro area in contrast to Ehrmann et al. (2003) and Cappiello et al. (2010). Impulse response results imply the possibility of long-term monetary neutrality for both Turkey and the euro area as concluded by

Boschen and Mills (1995), Bae and Ratti (2000), Chen (2007) and Coe (2010). Nevertheless, factors that may influence real volume of credits should be analyzed seriously when the possible effects of total volume of credits on inflation are concerned.

Table 4 **FEVDs of the Industrial Productions**

	FEVD of $indtr_t$			FEVD of $indeur_t$		
Forecast horizon h	$indtr_t$	$cretr_t$	itr_t	$indeur_t$	$creeur_t$	$ieur_t$
1	0.87	0.05	0.08	0.13	0.07	0.80
3	0.87	0.05	0.08	0.13	0.07	0.80
6	0.88	0.05	0.07	0.21	0.07	0.72
12	0.90	0.05	0.05	0.38	0.07	0.55
18	0.92	0.04	0.04	0.38	0.07	0.55
24	0.92	0.04	0.04	0.40	0.07	0.53
30	0.92	0.04	0.04	0.44	0.06	0.50
36	0.92	0.04	0.04	0.49	0.06	0.45

Table 4 shows that $indtr_t$ has the highest explanatory power over the variation of itself which accounts for nearly 90 percent of the 36-step forecast error variance of itself. Accordingly, FEVD results imply that Turkey's output is mainly driven by supply shocks and that other macroeconomic variables which can be attributable to monetary policy cannot be regarded as the major determinants of the variations in economic activity, consistent with the finding of Aguirre and Schmidt-Hebbel (2005). Within this context, factors causing supply shocks in Turkey such as resource prices and production technology should be investigated closely. Thereby, the development policy of Turkey can be conducted both on the micro and macro basis. Similarly, sources of supply shocks are also important for the euro area since $indeur_t$ accounts for nearly 50 percent of the 36-step forecast error variance of itself. On the other hand, FEVDs indicate that itr_t and $cretr_t$ explain 5-10 percent of the variation in $indtr_t$, whereas $ieur_t$ and $creeur_t$ account for nearly 50 percent of the 36-step forecast error variance of $indeur_t$. According to these findings, changes in the 3-month interbank rate cannot be regarded as major factors affecting the output in Turkey. However, money market rates may cause fluctuations in the euro area's output. Thus, money market rates should seriously be considered when investigating the business cycles in the euro area since $ieur_t$ explains 45 percent of the variation in $indeur_t$. Furthermore, although $cretr_t$ and $creeur_t$ account for nearly 5 percent of the variation in $indtr_t$ and $indeur_t$, well-functioning financial institutions may promote economic growth, as stated by Greenwood and Jovanovic (1990), Allen and Gale (1995), De Gregorio (1996), Demetriades and Hussein (1996), Levine (1997), Levine and Zervos (1998), Benhabib and Spiegel (2000) and Christopoulos and Tsionas (2004). Therefore, monetary and financial variables should be taken into consideration when analyzing the fluctuations in economic activity as Berkelmans (2005) and Ridhwan et al. (2010) concluded. Within this context, changes in the monetary policy stances of CBRT and ECB and the behavior of financial intermediaries in Turkey and the euro area can be considered important in exploring the dynamics of output variations both in Turkey and the euro area.

5 Conclusion

Impulse response functions indicate that, as a result of a positive shock to Turkey's 3-month interbank rate, industrial production decreases for up to the following nine months. After nine months, the shock becomes statistically insignificant. According to impulse response analysis, shocks to the 3-month interbank rate do not affect industrial production significantly in the euro area either in the short or in the long run. It may, therefore, be concluded that short-term interest rates do not have an effect on long-term economic growth in Turkey or the euro area. On the other hand, the results of forecast error variance decomposition indicate that short-term interest rates can be considered an important factor in explaining the fluctuations in economic activity in both Turkey and the euro area.

Impulse response analysis has also revealed that, similar to short-term interest rates, real credit volume may influence output in the short run in Turkey, whereas it does not influence economic growth in the long run in Turkey or the euro area. This finding confirms the assumption that monetary variables have no long-run effect on the real economic activity.

Therefore, CBRT and ECB may not promote economic growth and sustain economic development by implementing expansionary monetary policy. Besides, expansionary monetary policy may be inflationary as empirical results imply long-run monetary neutrality for both Turkey and the euro area. On the other hand, when the consequences of the 2008 financial turmoil are considered, macroeconomic policies in the future should incorporate the role of financial conditions. Particularly changes in total volume of credits by financial intermediaries should be closely monitored. In order to overcome the effects of the financial crisis and maintain macroeconomic stability, monetary and fiscal policy authorities both in Turkey and the euro area should provide support to their economies and their financial sectors without compromising their objectives in the long term. Within this context, regulation and supervision of financial markets is critically important.

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