AN EMPIRICAL ANALYSIS OF OUTPUT-CREDIT RELATIONSHIP IN TURKEY

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ABSTRACT

With the latest global financial crisis, the debate about the role of credit in affecting output has intensified. In this respect, it has become necessary to investigate output-credit relationship for Turkey. In this paper, we aim to analyze the empirical relationship between output and credit by employing different econometric techniques. First, we employed cross correlation, regression and VAR analysis. Following this, we used Bounds test approach in order to investigate cointegration relationship between output and credit. Then, ARDL approach is employed with the purpose of investigating the long and short- term static relationship between output and credit. The results show that output leads credit in Turkey. Credit responds significantly to an output shock, but not vice versa. According to Bounds Test results, we have found a significant long run cointegration relationship between output and credit. ARDL model results show that credit coefficients are not significant but error correction mechanism works.

Keywords: *Credit, VAR analysis, Bounds test*

Jel Classification: *E32, E51*

TÜRKİYE'DE MİLLİ GELİR-KREDİ İLİŞKİSİNİN AMPİRİK ANALİZİ

ÖZ

Son küresel finansal krizle birlikte, kredilerin milli gelir üzerindeki etkisine ilişkin tartışmalar hızlanmıştır. Bu çerçevede, Türkiye'de milli gelir-kredi ilişkisini inceleme gereği ortaya çıkmıştır. Bu çalışmada, milli gelir ve kredi arasındaki ampirik ilişkinin farklı ekonometrik yöntemler kullanılarak incelenmesi amaçlanmaktadır. Öncelikle, çapraz korelasyon, regresyon ve VAR analizi yapılmıştır. Ardından, Bounds testi yaklaşımıyla milli gelir ve krediler arasındaki eşbütünleşme ilişkisi incelenmiştir. Daha sonra, milli gelir ve krediler arasındaki kısa ve uzun dönemli ilişkinin statik olarak incelenmesi amacıyla ARDL yaklaşımı kullanılmıştır. Sonuçlar Türkiye'de milli gelirin kredileri öncülediğini ortaya koymuştur. Krediler milli gelir şokuna anlamlı bir biçimde tepki gösterirken tersi durum geçerli değildir. Bounds testi sonuçlarına göre, milli gelir ve krediler arasında uzun dönemli eşbütünleşme ilişkisi bulunmuştur. ARDL modeli sonuçları kredi katsayılarının anlamlı olmadığını, fakat hata düzeltme mekanizmasının işlediği göstermektedir.

Anahtar Kelimeler: *Krediler, VAR Analizi, Bounds testi*

Jel Sınıflandırması: *E32, E51*

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1. INTRODUCTION

The global financial crisis of 2008–09 that originated in U.S. credit markets rapidly spread across borders and led to recessions in almost all advanced economies. The global reach and depth of the crisis, which are without precedent in the post-World War II period, have renewed interest in the linkages between the real economy and credit markets, and have triggered an intensive debate about the importance of shocks originating in financial markets for business cycles.

The recent global financial crisis has intensified the debate about the role of credit as a means of explaining output fluctuations. Therefore, monitoring credit aggregates has become increasingly relevant for policymakers. Credit aggregates might be used as a policy variable if they contain any useful information for understanding the evolution of key macroeconomic variables such as output and employment. In this respect, it is crucial to understand the role of credit in affecting business cycles.

Credit-output relationship in Turkey has become much more important in the last couple of years for several reasons. First, credit-to-GDP ratio increased from 13 percent in 2002 to 52 percent in 2012. Second, with the emphasis of Central Bank of the Republic of Turkey (CBRT) on financial stability in the last years, the importance of credit as a policy variable has increased. Credit growth has become one important policy variable that is monitored closely. Third, implicit credit growth target of CBRT has intensified the debate of whether 15 percent credit growth is enough to reach output growth target. To that extent, understanding the relationship between output and credit is of vital importance for policymakers.

This paper aims to examine the role of credit in explaining business cycles in Turkey during the last decade. In order to do this, we employ four econometric models in order to explore the relationship between economic growth and credit growth. First, we used cross correlation and regression analysis to investigate the relationship between variables. Second, we employed Vector Autoregression (VAR) analysis to explore the effect of a credit shock to output. Third, we investigated cointegration relationship between variables by employing Bound test approach proposed by Pesaran at all. (2001). Finally, autoregressive distributed lag (ARDL) approach is used to examine the long and short- term static relationship between credit and economic growth.

The paper is divided into 5 sections. Section 2 contains a brief literature review that further motivates the renovated interest in analyzing the empirical relationship between credit and output. Section 3 presents some stylized facts and describes the data used in the empirical model. Section 4 describes the empirical analysis used in the paper and presents the results. Finally, section 5 presents the main conclusions.

2. LITERATURE SURVEY

The importance of financial institutions in generating growth within the economy has been widely discussed in the literature. Early economists such as Schumpeter identified banks' role in facilitating technological innovation through their intermediary role. He believed that efficient allocation of savings through identification and funding of entrepreneurs with the best chances of successfully implementing innovative products and production processes are tools to achieve this objective (Schumpeter, 1934). The Austrian view of business cycles with its roots in the work of Hayek (1929) emphasizes the role of credit creation in affecting business cycles. A credit expansion by reducing interest rates would increase investment relative to savings. The rising consumer prices as a result of increased consumption, indicates that consumer goods are more profitable than producer goods, thus forcing producers to reassess investment plans. That situation would eventually cause recession.

The literature on the relationship between output and credit is wide and varied. There are many studies trying to explain the relation using different methods. However, still there is little consensus about the nature and strength of the relationship. Most of the literature has focused on the role of credit to explain output fluctuations and predict financial crisis. With the latest global financial crisis, there has an increasing interest about the relationship between credit and output. In this respect, number of studies in this field has increased in the years after the crisis.

Perri and Quadrini (2011) find that the latest crisis and its global effect can be explained by credit market shocks in a Dynamic Stochastic General Equilibrium (DSGE) model. Their model suggests that recessions are more severe if they happen after a prolonged period of credit expansion.

Helbing et al. (2011) study the role of credit market shocks in driving global business cycles. Using a series of VAR models, they found out that credit market shocks have been influential in driving global activity during the latest global recession. Credit shocks originating in the United States also have a significant impact on the evolution of world growth during global recessions.

Zhu (2011) examines the credit-output link by using time and frequency domain methods. He reveals that the relationship between two variables is weak in the United States, relatively weak in Japan and strong in the euro area.

Lahura (2011) investigates the empirical relationship between credit and output in Peru using vector error correction (VEC) model. The results show that there exist a stable long-run relationship between real credit growth and output, real credit growth is useful in forecasting output in the long-run and a structural permanent shock in real credit has positive permanent effects on output. Therefore, credit aggregates could be a useful indicator variable for policymakers.

Meeks (2012) examines the role of credit shocks in explaining US business cycles using a structural VAR model. He finds out that credit shocks play an important role during financial crisis, but have a lesser role during normal business cycles. According to his analysis, credit shocks account for three-fifths of the decline in output during the 2007–2009 contraction. However, on average credit shocks account for only a fifth of business cycle fluctuations.

Karfakis (2013) examines the relationship between real output and real credit in Greece using quarterly data between 2000 and 2011. He conducts the empirical analysis by using cross correlation, regression and VAR analysis. He finds out that real credit is procyclical and leading real output. Granger causality tests indicate that real credit is important in order to understand future movements in real output. The impulse-response analysis implies that the recovery of the Greek economy requires a positive credit shock which will stimulate real output.

Another part of the literature on the relationship between output and credit focus on the fact that there might be economic recovery without credit growth. Calvo et al. (2006) argue that there are episodes when output recovers with virtually no recovery in either domestic or foreign credit. They focus on a sample of 32 emerging market countries integrated to world capital markets. They found out that output recovers quickly after a collapse in economic activity and the recovery is without an increase in credit, which they call as “Phoenix Miracles”.

Biggs et al. (2009) state that the finding of recovery without credit growth is because of incorrect comparison between levels and flows. They show that a rebound in the flow of credit has closer relationship with economic recovery than a rebound in the stock of credit. Flow of credit has a higher correlation with output than the stock of credit. They argue that, to the extent that spending is credit financed, GDP will be a function of new borrowing, or the flow of credit.

There are also studies trying to explain output fluctuations using indicators other than the quantity of credit. Lown and Morgan (2004) examine the role of bank lending standards in explaining business cycles in the United States. They demonstrate that changes in credit standards explain variations in banking lending and real output.

Gilchrist and Zakrajsek (2012) analyze the relationship between credit spreads and economic activity. Their study indicates that an increase in credit spreads leads to a contraction in the supply of credit with significant adverse consequences for the macroeconomy.

In a recent study, Kara and Tiryaki (2013) highlight the role of credit impulse in explaining the relationship between aggregate credit and economic growth cycles in Turkey. They argue that credit impulse has an important role in reconciling the credit developments with aggregate demand especially during sharp changes in the credit growth. According to their analysis, flow of credit and the change in the flow of credit is important in affecting output

Table 1 shows the summary of the literature about the relationship between credit and output.

Table 1. Summary of The Literature

Author	Period	Country	Method	Conclusion
Perri and Quadrini (2011)	1965-2010 quarterly	G-7 Countries	Dynamic Stochastic General Equilibrium (DSGE) Model	Recessions are more severe if they happen after a prolonged period of credit expansion
Helbing et al. (2011)	1988-2009 quarterly	G-7 Countries	VAR model	Credit shocks have been influential in driving global activity during latest crisis
Zhu (2011)	1950-2009 quarterly	US, Euro Area and Japan	Time and frequency domain methods	Relationship between two variables is weak in the United States, relatively weak in Japan and strong in the euro area
Lahura (2011)	1994-2011 quarterly	Peru	Cointegration, structural vector error correction	There exists a stable long run relationship between credit and output
Meeks (2012)	November 1982-April 2009 monthly	US	VAR model	Adverse credit shocks have contributed to declining output in every post-1982 recession, and account for three-fifths of the decline in output during the 2007–2009 contraction
Karfakis (2013)	2000-2011 quarterly	Greece	Regression, VAR	Credit–output link is significant, robust and temporally stable in Greece.
Calvo et al. (2006)	1990-2001 monthly	32 developed and developing economies	Panel Probit model	Output recovers quickly after a collapse in economic activity and the recovery is without an increase in credit
Biggs et al. (2009)	Crisis episodes for each country	US and 22 emerging markets	Regression, event studies	Rebound in the flow of credit has closer relationship with economic recovery than a rebound in the stock of credit
Lown and Morgan (2004)	1968-2000 quarterly	US	VAR model	Changes in credit standards explain variations in banking lending and real output in US.
Gilchrist and Zakrajsek (2012)	1973-2009 period micro data	US	VAR model	An increase in credit spreads leads to a contraction in the supply of credit with significant adverse consequences for the macroeconomy
Kara and Tiryaki (2013)	2004-2013 quarterly	Turkey	Regression	Credit impulse has an important role in reconciling the credit developments with aggregate demand especially during sharp changes in the credit growth

3. SOME STYLIZED FACTS AND THE DATA

In Figure 1, we plot the levels of real output and real credit from 2003:Q1 to 2012:Q4. The real output is measured by the real GDP and it is seasonally adjusted. The data is obtained from Turkish Statistical Institute. Real credit is measured by the total loans excluding loans to financial sector. Loan data is in local currency (TRY) and is discounted by the consumer price indices. The data is obtained from Banking Regulation and Supervision Agency (BRSA) database and adjusted for exchange rate fluctuations in order to avoid ups and downs due to exchange rate movements. Since credit data contains some form of seasonality, the data is seasonally adjusted by using Tramo-Seats method.

Figure 1. Real Output and Real Credit (in logs)

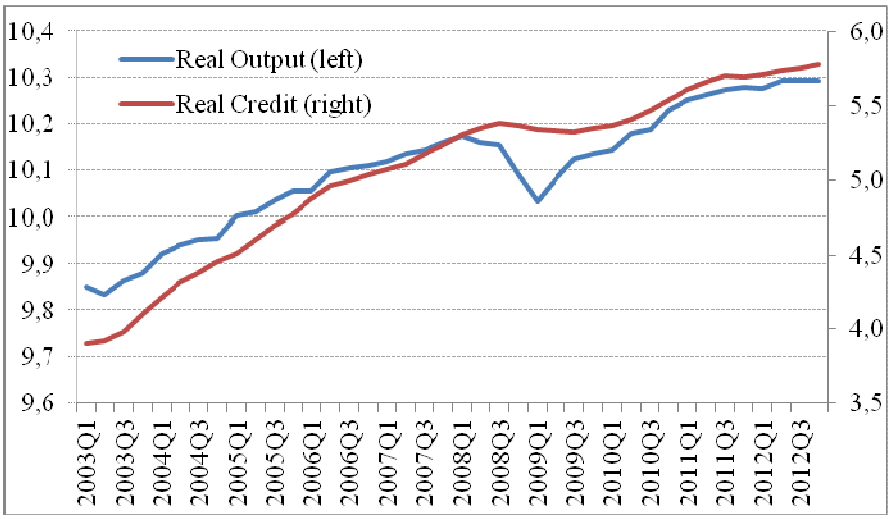


Figure 1 shows that both real output and real credit increase until 2008. Seasonally adjusted real GDP contracts by 13.2 percent from 2008:Q1 to 2009:Q1. On the other hand, seasonally adjusted real credit falls by 5.8 percent from 2008:Q3 to 2009:Q3. Contrary to many other countries, credit did not collapse in Turkey in the global crisis. This is mainly because Turkey strengthened its banking sector after 2001 crisis and entered the crisis with a solid banking sector. Thanks to high capital adequacy ratio, low credit/deposit ratio, no open FX position in banking sector and effective measures taken to support economic growth, there was no credit collapse in Turkey during the crisis. One other interesting and important initial finding about output and credit relationship in Turkey is that real output peaks 2 quarters before real credit in the latest global crisis. In addition, recovery in real output starts 2 quarters before real credit. Possible reasons for this may be because of solid banking sector and enough sources, banks could continue to lend even though economy started to slow down. Another reason may be that economic agents could not see the crisis coming. Banks continued to lend, firms and consumers continued to borrow.

In figure 2, we plot the cyclical components of real output and real credit, which are derived after applying the Hodrick-Prescott (HP) filter with a smoothing parameter of 1600 to the logarithms of real GDP and real credit. Two variables seem to move together. Similar to the argument of Calvo et al. (2006), output in Turkey recovered with virtually no recovery in domestic credit in 2003. Again, the cycles in real output and credit also show that output leads credit. In figure 3, we plot quarterly growth rate of real output and real credit. In general, these two variables move together.

Figure 2. The Cycles in Real Output and Credit

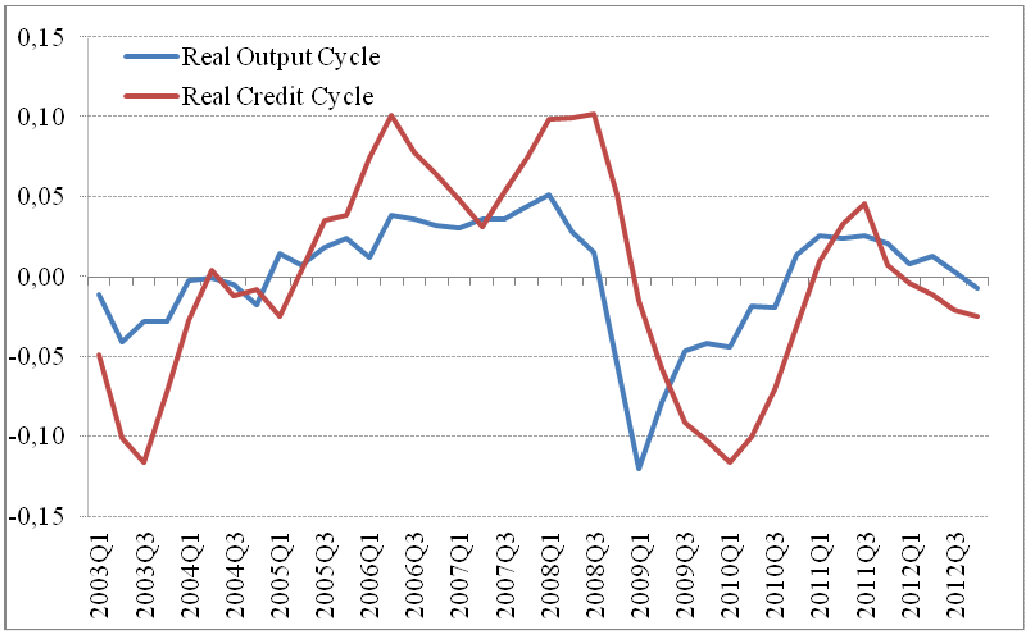
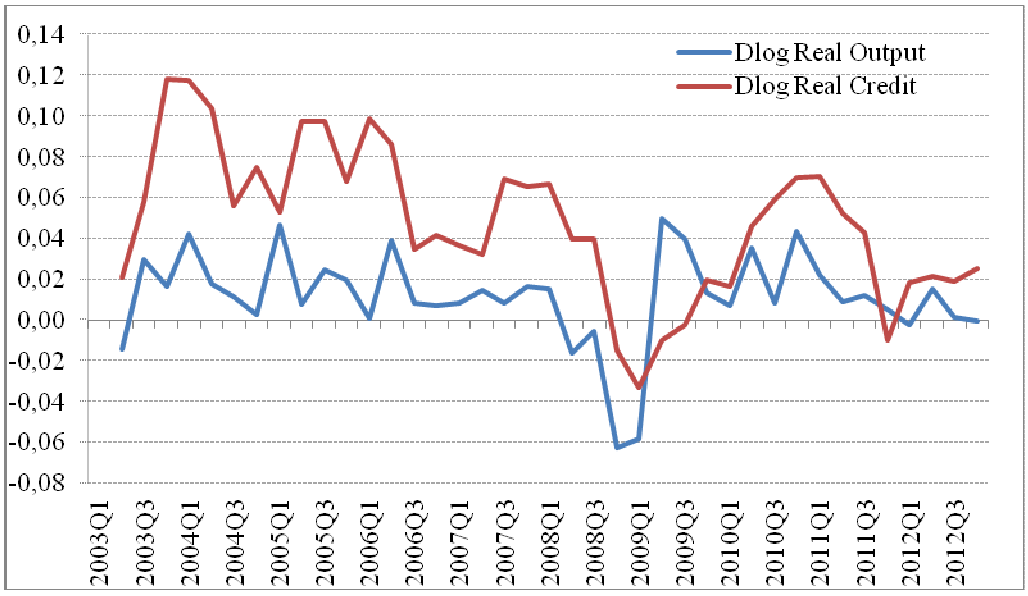


Figure 3. The Growth Rates of Real Output and Real Credit (First Differences In Logs)



4. EMPIRICAL ANALYSIS

4.1 Cross Correlation and Regression Analysis

Initially, we examine the credit-output link by looking at the co-movements of the two variables, using cross correlation analysis. We say that the real credit cycle is leading by j quarters, is synchronous, or is lagging by j quarters the real output cycle, if the correlation coefficients $corr(y_t, x_{t-j})$ $corr(y_t, x_t)$, $corr(y_t, x_{t+j})$, respectively, take on the largest value (in absolute value)

at that quarter, where y_t is the real output cycle and x_t is the real credit cycle. A positive and significant value shows that the real credit cycle is procyclical with the real output cycle, a negative and significant value indicates that the real credit cycle is countercyclical with the real output cycle, and a number close to zero implies that the two cycles are uncorrelated.

Table 2. Cross Correlations of Real Output with Real Credit at Various Leads and Lags

	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}
HP Filter	0.055	0.144	0.426	0.667	**0.785**	0.777	0.677
First Difference	-0.117	-0.115	0.198	0.436	**0.462**	0.382	0.247

The results reported in Table 2 indicate that the cyclical component of real output is leading the cyclical component of real credit by one quarter and the relationship between the two cycles is procyclical. On the other hand, the growth rate of real output is also leading the growth rate of real credit by one quarter. However, in this case the relationship between the two variables is weakly procyclical.

Another method we employ to investigate credit output relationship is regression analysis. Similar to Karfakis (2013), we will run 2 different regressions, one with cycle component of variables and the other with first difference of the variables.

$$LGDPC = \beta_0 + \beta_1 LCRC + \beta_2 LEVIC + u_t \quad (1)$$

In the first regression above, dependent variable output cycle (LGDPC) is regressed on credit cycle (LCRC) and cycle of export volume index (LEVIC). All variables are in log (L) forms and u_t is error term. Karfakis (2013) uses trade deficit to GDP ratio to capture external effects but we prefer to include export volume index into the regression. The reason is that trade deficit to GDP ratio is affected from terms of trade changes but export volume index shows only the changes in volume. Terms of trade changes may affect trade deficit especially during the crisis.

$$DLGDP = \beta_0 + \beta_1 DLCR + \beta_2 DLEVI + u_t \quad (2)$$

In the second regression above, similar to Karfakis (2013), dependent variable output growth over previous period (DLGDP) is regressed on credit growth (DLCR) and export volume index growth (DLEVI) over previous period. All variables are in difference log (DL) forms in this regression.

Before analyzing the credit-output link using regression analysis, we investigate stationarity properties of variables used in the analysis in order to avoid the spurious regression problem. In this respect, we employ conventional unit root tests including Augmented Dickey-Fuller (ADF, 1979) and Phillips-Perron (PP, 1988) with constant and intercept. The results of these tests are presented in Table 3 and 4.

Table 3. ADF Test Results

Variable	Lag Length (Level)	Lag Length (Difference)	ADF Test Statistics (Level)	ADF Test Statistics (First Difference)	1 % Critical Value	5 % Critical Value	Order of Integration
With Constant							
LGDPC	1	0	-2.9804*	-5.1627	-3.6156	-2.9411	I(0)
DLGDP	0	1	-4.8373**	-6.3626	-3.6156	-2.9411	I(0)
LCRC	1	0	-3.0223*	-3.8906	-3.6156	-2.9411	I(0)
DLCR	0	1	-3.7132**	-6.2700	-3.6156	-2.9411	I(0)
LEVIC	0	0	-2.9679*	-8.6175	-3.6104	-2.9389	I(0)
DLEVI	0	0	-8.2069**	-13.825	-3.6156	-2.9411	I(0)
Constant and Trend							
LGDPC	1	0	-3.6088*	-5.1271	-4.2191	-3.533	I(0)
DLGDP	0	1	-4.9228**	-6.2679	-4.2191	-3.533	I(0)
LCRC	1	0	-4.0348*	-4.9763	-4.2191	-3.533	I(0)
DLCR	0	6	-3.783*	-4.3485	-4.2191	-3.533	I(0)
LEVIC	0	0	-4.7972**	-8.4862	-4.2118	-3.5297	I(0)
DLEVI	0	0	-8.1349**	-13.628	-4.2191	-3.533	I(0)

Note: ** and * denote 1% and 5% significance level respectively.

Table 4. PP Test Results

Variable	Lag Length (Level)	Lag Length (Difference)	ADF Test Statistics (Level)	ADF Test Statistics (First Difference)	1 % Critical Value	5 % Critical Value	Order of Integration
With Constant							
LGDPC	1	2	-3.1567*	-5.1630	-3.6105	-2.9390	I(0)
DLGDP	0	3	-4.8373**	-25.245	-3.6156	-2.9411	I(0)
LCRC	1	3	-2.9668*	-3.8767	-3.6105	-2.9390	I(0)
DLCR	2	6	-3.802**	-14.436	-3.6156	-2.9411	I(0)
LEVIC	2	0	-2.9725*	-8.6175	-3.6105	-2.9390	I(0)
DLEVI	2	9	-8.0821**	-29.492	-3.6156	-2.9411	I(0)
Constant and Trend							
LGDPC	0	2	-3.9422*	-5.1244	-4.2118	-3.5297	I(0)
DLGDP	0	2	-4.9228**	-24.241	-4.2191	-3.5330	I(0)
LCRC	0	4	-3.6176*	-4.952	-4.2118	-3.5297	I(0)
DLCR	3	6	-3.7763*	-13.964	-4.2191	-3.5330	I(0)
LEVIC	2	0	-3.7916*	-8.4862	-4.2118	-3.5297	I(0)
DLEVI	2	10	-8.0147**	-28.529	-4.2191	-3.5330	I(0)

Note: ** and * denote 1% and 5% significance level respectively.

For ADF and PP tests, the null hypothesis suggests that the series include unit root. According to ADF test, calculated t statistics for all variables are greater (in absolute value) than the critical values in their level forms for ADF test. Thus, the null hypothesis is rejected, suggesting that all variables are stationary in their level forms. All variables are integrated of order I(0) according to ADF test. For PP test, the calculated t statistics for all variables are greater (in absolute value) than the critical values in their level forms. All series are integrated of order I(0) according to PP test.

After finding that all variables are stationary in their level forms, now we can run two regressions we have introduced before. Table 5 present regression results.

Table 5. Regression Results

Variables	Coefficient	t-Statistic	Prob.
A. Model with cycles			
LCRC	0.2314	3.0825	0.0039
LEVIC	0.2824	3.1219	0.0035
Diagnostic Checks			
Adjusted R^2	0.5397		
χ^2 *BG* (A)	16.179 [0.000]		
χ^2 *WHITE* (B)	0.397 [0.847]		
χ^2 *NORM* (C)	130.341 [0.000]		
B. Model with first differences			
DLCR	0.2397	2.8515	0.0072
DLEVI	0.1377	1.9655	0.0571
Diagnostic Checks			
Adjusted R^2	0.2509		
χ^2 *BG* (A)	0.012 [0.988]		
χ^2 *WHITE* (B)	2.487 [0.051]		
χ^2 *NORM* (C)	9.963 [0.007]		

(A) Breusch-Godfrey Serial Correlation LM Test, (B) White Heteroskedasticity Test, (C) Jarque-Bera Normality Test

Note: For model A, dependent variable is output cycle (LGDPC), for model B it is output growth over previous period (DLGDP). Number of data is 40.

According to the first model with cycles, coefficients of credit cycle and export volume index cycle are positive as expected. Both of the variables are significant. However, diagnostic checks show that the model has autocorrelation problem and normality is violated. According to the second model with first differences, again, coefficients are positive and both variables are significant. Diagnostic checks point out to some heteroskedasticity problem and non-normality. Problems in both of these regressions indicate it is not reasonable to use these models to make inferences and draw conclusions about the relationship between output and credit.

4.2 Vector Autoregression (VAR) Analysis

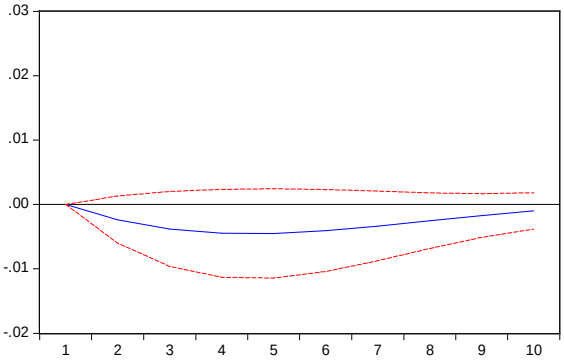
We proceed further to analyze the effects of a real credit shock on real output in the context of a VAR model of the form,

$$Y_t=A+B(L)Y_t+u_t \qquad (3)$$

where Y_t is a 3x1 vector of endogenous variables, A is a 3x1 vector of constant terms, B(L) is a 3x3 matrix polynomial in the lag operator L and u_t is a 3x1 vector of white noise error terms. The maximum lag order is set at four and the optimal length is selected with reference to Akaike information criterion and Schwarz Bayesian criterion. For both of the VAR models, with cycle component of variables and first difference of variables, optimal lag length is equal to one quarter.

Figure 4. Impulse Response Results (VAR Model with Cycle Components)

Response of Output to Credit Shock



Response of Credit to Output Shock

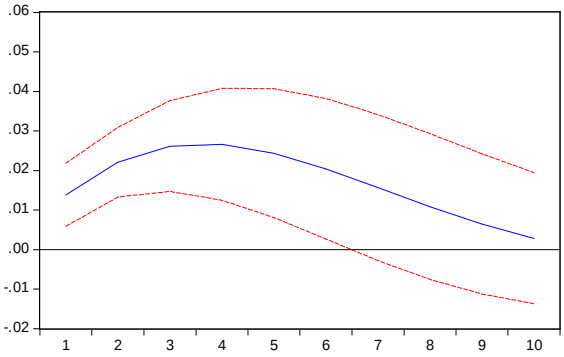
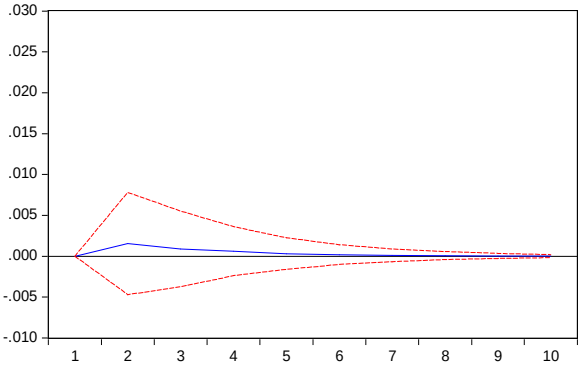


Figure 4 shows impulse response results for the VAR model with cycle components. We observe that output does not significantly respond to a shock in credit. However, credit significantly increases above trend for a period of about 6 quarters and then it smoothly dies out when there is an output shock. This result supports the finding of cross correlation analysis that output is leading credit in Turkey.

Figure 5. Impulse Response Results (model with first differences)

Response of Output to Credit Shock



Response of Credit to Output Shock

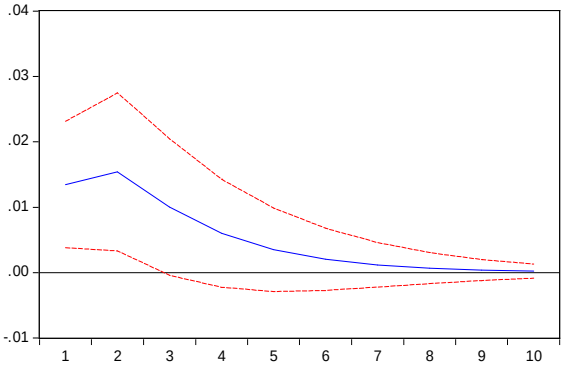


Figure 5 shows impulse response results for the VAR model with first difference of the variables. Findings are similar with the VAR model with cycle components. This time, credit rises significantly above trend for a period of about 3 quarters as a result of output shock.

4.3 Analysing Output-Credit Relationship Using Flow Data for Credit

Up until now, we have investigated output credit relationship using credit stock. However, Biggs et al. (2009) state that, to the extent that spending is credit financed, GDP will be a function of new credit, or the flow of credit. They found out that the rebound in domestic demand after a financial crisis is highly correlated with the rebound in the flow of credit, even if it is poorly correlated with developments in its stock. A consequence of that is that GDP growth should be related to changes in the flow of credit rather than the stock. To test this argument for Turkey, we will first define net credit usage (NCU) and credit impulse (CI) variables similar to Biggs et al. (2009) and Kara and Tiryaki (2013).

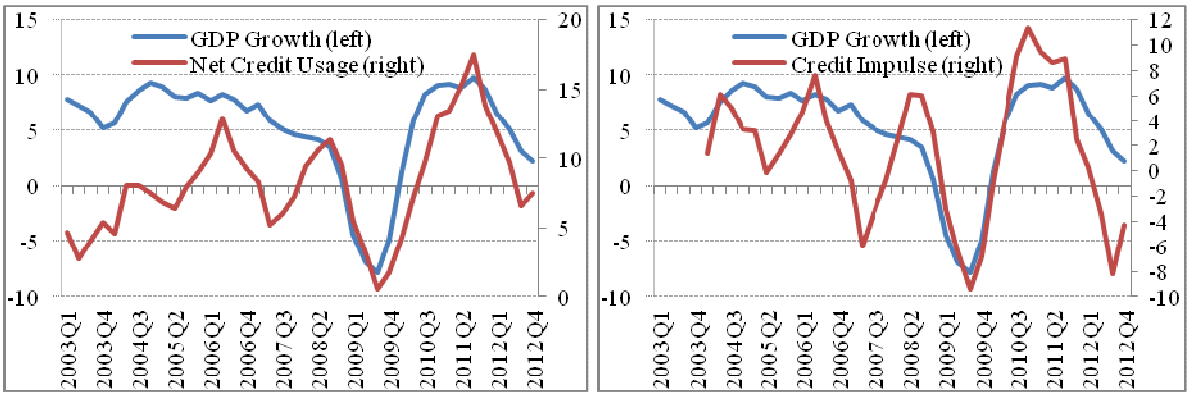
Net credit usage is the credit used in the related period, or the flow of credit. We do not have credit flow data in Turkey. According to Mutluer-Kurul (2012) credit flow and the change in credit stock data are very similar for consumer credit. Therefore, for total credit, we use the change of total credit stock as a proxy for credit flow. Credit impulse implies the change in the change of credit, or second derivative of credit. Net credit usage (NCU) and credit impulse (CI) for the fourth quarter of 2012 are defined as follows:

$$NCU_{2012Q4} = \frac{(CS_{2012Q4} - CS_{2011Q4})}{GDP_{2011Q4} + GDP_{2011Q3} + GDP_{2011Q2} + GDP_{2011Q1}} \quad (4)$$

$$CI_{2012Q4} = \frac{(CS_{2012Q4} - CS_{2011Q4}) - (CS_{2011Q4} - CS_{2010Q4})}{GDP_{2011Q4} + GDP_{2011Q3} + GDP_{2011Q2} + GDP_{2011Q1}} \quad (5)$$

In the equations, CS implies nominal credit stock for that period, GDP shows nominal gross domestic for the related quarter. Figure 6 displays the relationship between GDP growth, net credit usage and credit impulse. It is important to note that the relationship is closer starting from the third quarter of 2008. Therefore, it has been more crucial to analyze this relationship after the financial crisis.

Figure 6. GDP Growth, Net Credit Usage and Credit Impulse



Before employing econometric methods to these variables, we will first investigate the stationarity of three series, GDP growth (GDPG), net credit usage (NCU) and credit impulse (CI) using ADF and PP tests as before.

Table 6. ADF Test Results

Variable	Lag Length (Level)	Lag Length (Difference)	ADF Test Statistics (Level)	ADF Test Statistics (First Difference)	1 % Critical Value	5 % Critical Value	Order of Integration
With Constant							
GDPG	1	9	-3.731**	-2.8184	-3.6394	-2.9511	I(0)
NCU	4	3	-1.9048	-5.7980**	-3.6329	-2.9484	I(1)
CI	4	3	-1.8609	-6.9099**	-3.6616	-2.9604	I(1)
Constant and Trend							
GDPG	9	9	-4.1387*	-2.6490	-4.3561	-3.5950	I(0)
NCU	4	3	-2.0703	-5.7091**	-4.2436	-3.5442	I(1)
CI	4	8	-1.8057	-4.4459**	-4.2845	-3.5628	I(1)

Note: ** and * denote 1% and 5% significance level respectively.

Table 7. PP Test Results

Variable	Lag Length (Level)	Lag Length (Difference)	ADF Test Statistics (Level)	ADF Test Statistics (First Difference)	1 % Critical Value	5 % Critical Value	Order of Integration
With Constant							
GDPG	3	2	-1.8971	-2.6973	-3.6329	-2.9484	I(2)
NCU	3	3	-2.4126	-4.1471**	-3.6104	-2.9389	I(1)
CI	2	2	-2.3979	-3.7964**	-3.6329	-2.9484	I(1)
Constant and Trend							
GDPG	3	2	-1.9930	-2.6618	-4.2436	-3.5442	I(2)
NCU	3	3	-2.4405	-4.1556*	-4.2191	-3.5330	I(1)
CI	2	2	-2.4208	-3.6619*	-4.2436	-3.5442	I(1)

Note: ** and * denote 1% and 5% significance level respectively.

ADF test indicates that only GDP growth is stationary at 1% significance level. Net credit usage and credit impulse are stationary when the series are differenced, implying that they are I(1) series. According to PP test, GDP growth is I(2) and the other two series are I(1).

Level forms of net credit usage and credit impulse contain important information. Therefore, it is not reasonable to use them by differencing. Regression between the levels will not be accurate.

4.4 Bound Test Co-Integration Approach

After investigating stationarity of series, we investigate cointegration relationship between GDP growth, net credit usage and credit impulse by using Bounds Test approach developed by Pesaran et al. (2001). Bound test can be used when all series are not I (1) or when it is not known with certainty whether the underlying regressors are trend or first difference stationary. Bound test is preferred also because it gives accurate results with small samples (Narayan and Narayan, 2004).

For the Bound test analysis, we first form the Unrestricted Error Correction model (UECM). UECM specification for our study is shown in equation 6.

$$\Delta GDPG_t = \beta_0 + \sum_{i=1}^{m} \beta_{1,i} \Delta GDPG_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta NCU_{t-i} + \sum_{i=0}^{m} \beta_{3,i} \Delta CI_{t-i} + \beta_4 GDPG_{t-1} + \beta_5 NCU_{t-1} + \beta_6 CI_{t-1} + \mu_t \quad (6)$$

Where, GDPG is real GDP growth, NCU is net credit usage and CI is credit impulse. In UECM model in equation 6, “m” represents number of lags. For testing the existence of co-integration relationship, the statistic underlying the procedure is the Wald or F-statistic in a generalized Dickey-Fuller type regression, which is used to test the significance of lagged levels of the variables under consideration in a conditional UECM (Narayan and Narayan, 2004).

Null hypothesis for F test is established as $H_0 = \beta_4 = \beta_5 = \beta_6 = 0$ for our study and calculated F statistics is compared with table bottom and upper critical levels in Pesaran et al. (2001). If the computed F-statistic falls outside the critical bounds, a conclusive decision can be made regarding co-integration without knowing the order of integration of the regressors. For instance, if the empirical analysis shows that the estimated F statistics is higher than the upper bound of the critical values, then the null hypothesis of no co-integration is rejected. If the estimated F statistics is lower than the bottom bound of critical values, there is no co-integration relationship between the series. If the calculated F statistics is between the bottom and upper critical values, no exact opinion can be made (Narayan and Narayan, 2004).

Maximum lag number for UECM model is taken as 8 and according to Schwarz criteria, lag number is found as 1[1]. After determining lag number of UECM model, we investigate co-integration relationship. We compared the computed F-statistic from UECM model with table bottom and upper critical levels in Pesaran et al. (2001). Table 8 shows the bound test results.

Table 8. Bound Test Results

K	**F statistics**	**Critical Value at %5 Significance Level**	
		Bottom Bound	Upper Bound
2	6.68	3.79	4.85

k is number of independent variable number in equation 1. Critical values are taken from Table C1.iii at Pesaran et. al. (2001)

According to Table 8, F statistics is higher than the upper bound of the critical values, and the null hypothesis of no co-integration is rejected. As a result, we found a significant long run cointegration relationship GDP growth, net credit usage and credit impulse employing Bound test analysis.

4.5 ARDL Model

After Bound test analysis, we investigate the long and short run static relationship between the variables using ARDL model. ARDL model specification for our study is presented in equation 7.

$$GDPG_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i} GDPG_{t-i} + \sum_{i=0}^{n} \alpha_{2i} NCU_{t-i} + \sum_{i=0}^{p} \alpha_{3i} CI_{t-i} + \mu_t \quad (7)$$

[1] Serial correlation for UECM model investigated by employing Breusch-Godfrey serial correlation LM test and no serial correlation found in UECM model.

In order to determine the optimal lag length in equation 4, maximum lag number of 8 is taken and ARDL (3,0,0) model is selected employing the Schwarz information criterion. The estimated long and short term coefficient using ARDL (3,3,0) model are shown in Table 9. According to diagnostic checks, error terms in ARDL model are normally distributed and there are no serial correlation, heteroscedasticity and misspecification problems in the model.

Table 9. ARDL (3,3,0) Model Long and Short Term Parameter Estimations

Estimated Long Term Coefficients Using ARDL(3,3,0) Model		
Variables	Coefficient	T statistics
NCU	0.596	0.837
CI	1.396	1.069
C	-0.296	-0.557
Error Correction Representation for the ARDL(3,3,0) Model		
Variables	Coefficient	T statistics
DGDPG(-1)	1.013	6.170*
DGDPG(-2)	-0.377	-2.123**
DNCU	0.374	2.164**
DNCU(-1)	-0.342	-1.838
DNCU(-2)	-0.397	-2.566**
DCI	0.166	1.223
ECT(-1)	-0.119	-2.253**
Diagnostic Checks		
X^2_{BG} (A)	2.6035 [0.626]	
χ^2_{NORM} (B)	0.398 [0.819]	
χ^2_{WHITE} (C)	2.683[0.101]	
X^2_{RAMSEY} (D)	2.323[0.127]	

*denotes %1 significance level, ** denotes %5 significance level

(A) Lagrange multiplier test of residual serial correlation, (B) Based on a test of skewness and kurtosis of residuals (C) Based on the regression of squared residuals on squared fitted values, (D) Ramsey's RESET test using the square of the fitted values.

According to long term coefficients obtained from ARDL (3,3,0) model, coefficients of net credit usage and credit impulse are positive as expected. However, both variables are not statistically significant.

The error correction term, ECT(-1), is the one period lagged value of error terms obtained from the equilibrium relationship. The coefficient of ECT(-1) shows eliminated rate of the short run disequilibrium in the long run. ECT coefficient is negative and and statistically significant as expected and estimated as -0.12. It means, approximately 12% of disequilibrium from the previous quarters shock eleminated in the current quarter.

5. CONCLUSION

The aim of this paper is to investigate output and credit growth relationship for Turkey for 2003:Q1-2012:Q4 period. In order to do this, we have used different econometric methods.

Cross correlation analysis indicates that credit is procyclical and is lagging output by 1 quarter in Turkey. In the literature, it is usually found that credit is a leading variable. Findings using cross correlation analysis present further motivation to analyze the reasons of lagging behavior in Turkey.

Before regression analysis, we have conducted unit root tests and found all variables to be stationary at levels. We estimate 2 different regressions, one with cycle component of variables and the other with first difference of the variables. In both of the regressions, coefficients of credit and export volume index variables are found out to be positive as expected and they are significant. However, diagnostic checks indicate that both models have problems such as autocorrelation and normality.

Impulse response results from the VAR models indicate that output in Turkey does not respond to a shock in credit. However, credit significantly responds to a shock in output.

As Biggs et al. (2009) states, it is more reasonable to analyze output-credit relationship using flow data for credit. Therefore, in the second part of our study we have defined net credit usage and credit impulse to investigate this relationship. After testing for stationarity, we employ Bounds Test approach developed by Pesaran et al. (2001) which has some advantages over the conventional co-integration models. According to Bound Test tesults, we found a significant long run cointegration relationship between GDP growth, net credit usage and credit impulse.

Then, we investigate the long and short term static relationship between the variables by employing an ARDL model. According to this model, coefficients of net credit usage and credit impulse are positive as expected. However, both variables are not statistically significant. Error

correction term (ECT) coefficient is found negative and statistically significant as expected. Estimated ECT coefficient of -0.12 implies that approximately 12% of disequilibrium from the previous quarters shock is eleminated in the current quarter.

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