Determinants of Construction Sector Activity in Turkey: A Vector Autoregression Approach

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Received: April 1, 2011 Accepted: April 16, 2011 doi:10.5539/ijef.v3n5p130

Abstract

This study analyzes the effects of some major macroeconomic variables on construction sector activity in Turkey by employing a Vector Autoregression (VAR) model from 1990*Q*1 to 2010*Q*3. The 4-variable VAR model includes the log of construction sector activity (*COACT*), the log of real gross domestic product (*RGDP*), weighted averages of 12-month interest rate on deposit (*INT*) and the log of banking sector total domestic credits (*CRE*). According to VAR model impulse response analysis, the sector booms related to a positive one standard deviation shock in *RGDP*. Thereby, the importance of maintaining economic stabilization is revealed since economic contractions may affect the sector negatively. In addition to this finding, impulse response analysis indicates that a positive one standard deviation shock in *INT* deteriorates the construction sector activity. Therefore, interest rates should be kept low by the coordination of monetary and fiscal policy. Moreover, impulse response analysis results emphasize that credit supply and demand should be equalized for minimizing default risk. On the other hand, forecast error variance decomposition (FEVD) analysis infers the importance of real gross domestic product, weighted averages of 12-month interest rate on deposit and banking sector total domestic credits in determining construction sector activity.

Keywords: Construction sector, Economic activity, Interest rates, Total credits, VAR model, Turkey

1. Introduction

After the World War II, construction sector has grown rapidly in volume all over the world. Investments have been devoted to construction sector in big proportions since 1950. In this process, real estate investments have increased especially in order to hedge the inflation risk. On the other hand, construction sector has also influenced the macroeconomic variables of countries. As a result of the development of the sector, especially real economic activity has been affected positively. But, increases in the volume of construction sector have become one of the important causes of inflation. In addition, construction sector has had impact on the sub-sectors and other sectors of economies. The expansion in the construction sector has served as one of the major employment factors and is expected to provide additional work opportunities for the people. Therefore, sustaining the development of construction sector has proved to be an indispensable factor for sustaining the economic development.

Construction sector and its sub-sectors have also influences on the other sectors in economies. According to the General Industrial Classification of Economic Activities within the European Communities known as NACE (Rev.2) construction sector comprises three main sub-sectors; Construction of buildings, civil engineering, specialized construction activities. While the construction of buildings sub-sector is divided into development of building projects and residential and nonresidential construction, the civil engineering sub-sector includes firms that specialize in projects like construction of roads and railways, construction of utility and construction of other civil engineering. The third sub-sector, specialized construction activities contains demolition and site preparation, electrical plumbing and other construction installation activities, building completion and finishing and other specialized construction activities. Among all, housing has been a vital part of the whole sector and has become a key factor of the sector and economy.

Growth of construction sector has accelerated since 1970 as a result of the economic, political, social and demographic changes in Turkey. Moreover, structural change and development of construction sector in Turkey has become rapid especially after TOKI (Republic Of Turkey Prime Ministry Housing Development Administration) that specialize in housing and urbanization fields by providing informational flow through international institutions. In this process, Turkey has implemented policies to promote the sector to sustain the economic development. Accordingly, the share of construction sector activity in real gross domestic product (RGDP) has been 6% approximately for the period 1990 and 2010. On the other hand, economic contractions also affected the construction sector negatively during this period. As a result of the 1994 economic crisis in Turkey, construction sector activity decreased by 11.05% in 1995 as shown in Table 1. Besides, real-estate demand dampened and construction sector activity decreased by 1.78% and 12.44% in 2000 and 2001, respectively as a consequence of the Marmara Earthquake and the 2000-2001 financial crisis in Turkey.

After the recession of construction sector that arose from the financial crisis in Turkey counter cyclical measures were taken to overcome the crisis, maintain price stability and sustain the economic development. Parallel to the fall of inflation and interest rates as a result of the implemented macroeconomic policies, mortgage system began to be applied as of the year 2007. With the system, expanding housing opportunities to meet the needs of lower income households and booming the construction sector by channeling funds into real-estate and especially into the housing sector were targeted in Turkey for the following years. However, the 2008 global financial crisis that resulted from the spread of the financial crisis aroused by non-return mortgage credits in USA, showed its effects all over the world as of the year 2008. Thus, construction sector activity in Turkey decreased by 8.71% and 11.97% in 2008 and 2009, respectively since financial crises have become more contagious related to financial globalization process.

Over the past few years, construction sector has become a leading sector of Turkey's economy. Furthermore, the sector has had great potential for growth since demand for housing, commercial and institutional construction projects has been continuously increasing parallel to social and economic needs of citizens in Turkey. For instance, number of constructed buildings by TOKI has reached to 430 000 in 2010. Therefore, construction sector of Turkey has become a target of economic policy aimed at achieving price stability, low unemployment, and balanced growth since changes of construction sector activity may influence macroeconomic variables seriously. On the other hand, fluctuations in construction sector activity are affected by the implementation of monetary and fiscal policy. For instance, as a consequence of an expansionist monetary policy, total credits increases and interest rates fall leading to an expansion in construction sector activity. In this respect, interactions between construction sector activity and macroeconomic variables are to be studied. Consequently, among a number of economic, social, geographic and demographic factors, possible effects of the macroeconomic changes in Turkey on construction sector are to be exposed.

As a result of increasing interactions between macroeconomic variables, it is quite common in economics to have models where some variables are not only explanatory variables for a given dependent variable, but they are also explained by the variables that they are used to determine. In those cases simultaneous equations models are used, in which it is necessary to identify which are endogenous and which are exogenous variables. The decision regarding such a differentiation among variables was heavily criticized by Sims (1980). According to Sims, if there is simultaneity among a number of variables, then all these variables should be treated in the same way. In other words there should be no distinction between endogenous and exogenous variables. Therefore, once this distinction is abandoned, all variables are treated as endogenous. This means that in its general reduced form each equation has the same set of regressors which leads to the development of Vector Autoregression (VAR) models (Asteriou and Hall, 2007:279).

This study fills the gap in the literature by analyzing the possible effects of some major macroeconomic variables such as, RGDP, weighted averages of 12-month interest rate on deposit and banking sector total domestic credits on construction sector activity by adapting a VAR model using quarterly data obtained from CBRT for the period from 1990*Q*1 to 2010*Q*3. The main goal of the study is to make inferences about the construction sector by considering the consequences of fluctuations in real economic activity and economic policy stance. Accordingly, the four-dimensional VAR system (*COACT*, *RGDP*, *INT*, *CRE*) is employed, where *COACT* is the log of construction sector activity, *RGDP* is the log of RGDP, *INT* is the weighted averages of 12-month interest rate on deposit and *CRE* is the log of banking sector total domestic credits. In this context, VAR model impulse response and forecast error variance decomposition (FEVD) analysis are carried to measure the possible impacts of *RGDP*, *INT*, *CRE* on *COACT* for the following quarters in Turkey. As for the estimation procedure of the VAR model, Ordinary Least Squares (OLS) method is applied. The empirical analysis is carried out by using JMulTi version.4.23 (Interactive software designed for univariate and multivariate time series analysis).

The remainder of the paper is structured as follows. In Section 2, we review some theoretical considerations and previous studies related to construction sector. Section 3 introduces the data and empirical methodology of the study. Section 4 discusses empirical results and findings of the paper. Section 5 contains concluding remarks and points out some issues for further research.

2. Theoretical Considerations and Previous Research

Analyzing the possible impacts of macroeconomic changes on construction sector has become important for the sustainable development of the sector. The studies that make future projections about the sector by considering macroeconomic variables enable both public and private sectors to plan construction investments properly. Thus, risks associated with macroeconomic conditions can be well examined and uncertainties can be reduced. In addition, firms competing in the sector benefit from the inferences of this kind of studies. Thereby, firms may improve their marketing and management strategies and efficient management of the firms may be maintained. On the other hand, effects of construction sector and its sub-sectors on macroeconomic variables are to be examined considering the importance of the sector for economies.

There are variety of studies in the literature examining the relations between macroeconomic variables and construction sector activity such as, Muellbauer (1992), Baffoe-Bonnie (1998), Ellis and Berger-Thomson (2004) and Tkacz and Wilkins (2006). In order to cognize the factors affecting the economic fluctuations and exposing the economic situation of a country, the analysis of construction sector and especially housing sector are required since changes in the volume of construction and housing sector and real economic activity are usually parallel to and also interacted with each other. In this context, Fullerton and West (1998) studied the residential construction activity for Florida and its six largest metropolitan areas between 1985 and 1995 with quarterly data. Autoregressive Integrated Moving Average (ARIMA) and random walk prediction rule were used in their study. It was concluded that empirical results about the residential construction activity were not parallel to state and metropolitan non-agricultural employment predictions. It was also suggested that additional research is necessary to make inferences about the sector.

House prices that indicate housing demand cause fluctuations in macroeconomic variables especially in inflation rate. Therefore, factors determining the housing demand have to be examined carefully. There are numerous studies in the literature examining the housing demand such as, Andersen and Kennedy (1994), Iacoviello (2002), Iacoviello and Minetti (2002) and Bao and Wan (2007). At this point, identification of the factors that determine the housing demand both in short and long-run has become important. Thus, cointegration techniques can be used to expose short and long-run relationships. Within this framework, Apergis (2003) investigated the impact of some major macroeconomic variables on house prices in Greece from 1981 to 1999 by applying a Vector Error Correction (VEC) model with quarterly data. It was exposed that housing mortgage rate caused more variation in real housing prices than employment and inflation according to variance decompositions. Similar to Apergis (2003), Abelson et.al (2005) studied the housing demand both in short and long-run in Australia using quarterly data from 1970 to 2003. A Dynamic Ordinary Least Squares (DOLS) and a non-linear error correction model were estimated in their study. It was revealed that real disposable income, consumer price index, unemployment, equity prices, real mortgage rates and supply of housing were the determinants of house prices significantly in long-run. In addition to this finding, the coefficients on the lagged error correction terms showed that the long-term disequilibrium in log of real house prices was being corrected in short-run.

Investments in housing sector affect the stock of dwellings that is an indicator of housing supply. Subsequently, the volume of construction sector changes since housing sector has been a vital part of construction sector. Therefore, determinants of housing supply are to be analyzed. In the literature, a study taking this point into consideration is carried out by Zhou (1997) examining the dynamics of the housing supply in short and long-run using econometric techniques. Causality between housing market sales and price in the USA was examined in the study by constructing a VAR model with Error Correction using monthly data from 1970 to 1994. It was exposed that while price affected sales significantly, sales affected price weakly. In another study, Tse (2008) used OLS model to analyze the factors affecting the stock of dwellings in United Kingdom for the period 1964-1996 with annually data. It was concluded that changes in house prices and interest rates caused fluctuations in the stock of dwellings. On the other hand, REITs (Real Estate Investment Trusts) are also to be considered when analyzing the dynamics of housing supply. In addition, interactions between capital flows into the REIT (Real Estate Investment Trust) sector and REIT returns have been increasing as a consequence of the financial integration process. For this purpose, Ling and Naranjo (2003) constructed a VAR model for USA to examine the interactions between REIT investments and REIT returns using data from the 1^{st} quarter of 1979 to the 2^{nd} quarter of 2002 are used in their study. They found that while REIT flows were positively related to REIT returns, the effect of REIT flows on REIT returns were not statistically significant.

There are also studies in the literature that both analyze the short and long-run dynamics of housing demand and supply. One of the studies on both housing demand and supply is by Kenny (1999) analyzing the Irish housing market using cointegration analysis with data from the 4^{th} quarter of 1975 to the 1^{st} quarter of 1997. It was revealed that there was a stable relationship between house prices, the housing stock, income and mortgage interest rates in long-run, whereas on supply side, there were severe constraints like a shortage of suitable land or problems with the housing services infrastructure in long-run. In addition to the study by Kenny (1999), Barot and Yang (2002) estimated an Error Correction Model (ECM) to evaluate the dynamic housing demand and supply for Sweden and

UK from 1970 to 1998 using quarterly data. The results of their study indicated that factors affecting the housing demand were very similar considering the estimated coefficients in each country, whereas on the supply side, nominal house prices and building cost determined the housing investment for both countries.

3. Data and Empirical Methodology

3.1. Data

Stationary among the variables is to be tested to specify the appropriate econometric model before the estimation procedure. Unit root tests determine whether series are stationary or not. The most widely used is the augmented Dickey-Fuller test (Makridakis et al., 1998:329). In this study, the Pantula principle proposed by Pantula (1989) is followed. According to this principle, if a linear trend term is needed in the test for y_t, then only a constant term should be used in the test for Δy. Similarly, if just a constant is necessary in the test for y_t, the test for Δy is to be carried with no deterministic term. Series are to be differenced a maximum number of times necessary for inducing stationary (Lütkepohl, 2004:55). There are three main versions of the ADF test basing on the estimation of the three different regression models below;

$$\Delta y = \mu + tr + \varphi y_{t-1} + \vartheta_1 \Delta y_{t-1} + \vartheta_2 \Delta y_{t-2} + \ldots + \vartheta_p \Delta y_{t-p} \tag{1}$$

$$\Delta y_t = \mu + \varphi y_{t-1} + \vartheta_1 \Delta y_{t-1} + \vartheta_2 \Delta y_{t-2} + \ldots + \vartheta_p \Delta y_{t-p} \tag{2}$$

$$\Delta y_t = \varphi y_{t-1} + \vartheta_1 \Delta y_{t-1} + \vartheta_2 \Delta y_{t-2} + \ldots + \vartheta_p \Delta y_{t-p} \tag{3}$$

In the regression models above, $\Delta y_t = y_t - y_{t-1}$ denotes the first-differenced series, p is the number of lagged differences, φ and $\vartheta_1 \ldots \vartheta_p$ are the parameter coefficients. Finally, μ is the intercept and tr is the trend term. The pair of hypothesis, H_0 : φ =0 versus H_1 : $\varphi < 0$ is tested based on the t-statistic of the coefficient φ from an OLS estimation of the selected model. If the null hypothesis is accepted, y_t is stationary but if the null hypothesis is rejected, y_t is non-stationary.

ADF test was applied to *COACT* and *INT* series just with constant term since they don't have a linear trend component. On the other hand, *RGDP* and *CRE* series have a linear trend component. Thus, ADF test of *RGDP* and *CRE* series are carried with linear trend. The number of lagged differences in the regressions allowing a maximum lag length (p) of 10 is set by the Akaike Information (AIC). As shown in Table 2, *COACT* and *INT* series are integrated of order 1, *I*(1), whereas *RGDP* and *CRE* series are *I*(2).

Some authors like Sims (1980), Cooley and Leroy (1985), Sims et.al (1990), Enders (1995) and Doan (2004) recommend against differencing time series, although they may contain a unit root since differencing throws away the possibility of cointegrating relations. A VAR in differences would cause loss of information on the co-movement among the variables (Enders, 1994:301). In addition, VARs with non-stationary variables incur some loss in the estimator's efficiency Sims et.al (1990). But, the majority view, highlighted by Granger and Newbold (1974) and Phillips (1986) is that stationary data should be used since non-stationary data can cause spurious regression. As can be shown from Table 2, the series are not integrated in the same order. While *COACT* and *INT* are *I*(1), *CRE* and *RGDP* are *I*(2). When a mix of *I*(0), *I*(1) and *I*(2) variables are present in the model, cointegrating relationships might exist. If a model includes two *I*(1) and two *I*(2) variables, the two *I*(2) variables may cointegrate down to a *I*(1) relationship and this relationship may cointegrate with one of the two *I*(1) variables to form another cointegrating vector (Asteriou and Hall, 2007:322). But this situation (variables with different order of integration) is very complicated. In this study, series used in the VAR model are not differenced. Thus, VAR model in levels form is estimated considering that the series are not integrated in the same order. It is attempted to expose the interrelationships among the variables not the parameter estimates.

3.2. VAR Model

VAR system is an useful econometric tool to examine the dynamic impact among the variables of the model for the following periods. In VAR approach, endogenous variables in the system are treated as a function of the lagged values of all of the endogenous variables in the system unlike basic regression or time series analysis. The basic VAR model has the form below;

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + u_t \tag{4}$$

where y_t=(y_{1t},.... y_{Kt})$'$ is a $(K \times 1)$ vector of observable endogenous variables. The A$_i$ are fixed $(K \times K)$ coefficient matrices. Finally, $u_t = (u_{1t},...,u_{Kt})$ is a K-dimensional unobservable zero-mean white noise or innovation process, that is, E(u_t)=0 with positive definite covariance matrix $E(\mu_t \mu_t') = \Sigma_u$ (Lütkepohl, 2005:13).

Impulse response analysis is a useful tool to explain the interactions between the endogenous variables of a VAR model. In this analysis, the deterministic variables such as, a constant, a linear trend and dummies and also exogenous variables are regarded as fixed and dropped from the system. The part of the conditional mean of the endogenous variables attribute to these variables is eliminated (JMulti Help System, 2008). Impulse response analysis traces out the effect of a shock or innovation in one of the endogenous variables on some or all of the other endogenous variables (Lütkepohl, 2005:51). If the process y_t is stationary *I*(0), the Wold moving average (MA) representation below exposes the effects of the shocks in the variables of a system.

$$y_t = \Phi_0 \mu_t + \Phi_1 \mu_{t-1} + \Phi_2 \mu_{t-2} + \dots, \tag{5}$$

where $\Phi_0 = I_K$ and the Φ_s can be computed recursively as;

$$\Phi_s = \sum_{j=1}^{s} \Phi_{s-j} A_j, \qquad s = 1,2,\dots, \tag{6}$$

where $A_j = 0$ for $j > p$. The responses to impulses hitting the system are reflected by the coefficients of the representation above. The $(i,j)^{th}$ elements of the matrices Φ_s, are a function of s, trace the expected response of $y_{i,t+s}$ to a unit change in y_{it}, holding the past values of y_t. The elements of Φ_s represent the impulse responses of the components of y_t with respect to the u_t innovations since the change in y_{it} given $\{y_{t-1}, y_{t-2},...\}$, is measured by the innovation u_{it} (Breitung et.al, 2007:165-166). The Φ_s impulse response matrices can be computed in the same way for non-stationary processes. In contrast to the stationary case, impulses hitting a non-stationary system may have permanent effects (JMulti Help System, 2008). If the components of u_t are instantaneously correlated, that is, if Σ_u is not diagonal, orthogonal innovations are preferred in an impulse response analysis. Orthogonal innovations are obtained by using a Choleski decomposition of the covariance matrix Σ_u. If P is a lower triangular matrix such that $\Sigma_u = PP'$, the orthogonalized shocks are given by $\varepsilon_t = P^{-1} u_t$ (Breitung et.al, 2007:166).

$$y_t = \Psi_0 \varepsilon_t + \Psi_1 \varepsilon_{t-1} + \dots, \tag{7}$$

where $\Psi_i = \Phi_i P$ (i=0,1,2,…). $\Psi_0 = P$ is lower triangular so that an ε or one standard deviation shock in the first variable may have an instantaneous effect on all the variables, whereas a shock in the second variable cannot have an instantaneous impact on y_{1t} but only on the other variables of the VAR model. On the other hand, different ordering of the variables in the vector y_t may produce different impulse responses (JMulti Help System, 2008). Thus, robustness of VAR model impulse response functions should be determined by examining a range of alternative specifications of VAR model differing with respect to ordering of variables.

Impulse responses functions trace out the responsiveness of the dependent variables in the VAR to shocks to each of the variables, whereas variance decompositions offer a different method for examining VAR system dynamics. Variance decompositions give the proportion of the movements in the dependent variables that are due to their own shocks, versus shocks to the other variables. They determine 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). FEVDs are popular tools for interpreting VAR models. But similar to VAR model impulse responses, different ordering of the variables in the vector y_t may produce different FEVD results. Therefore, robustness of VAR model FEVDs should be determined by considering alternative orderings of the variables of VAR model. Denoting the ij^{th} element of the orthogonalized impulse response coefficient matrix Ψ_n by $\upsilon_{ij,n}$, the variance of the h-step ahead forecast error at forecast origin T, $y_{k,T+h} - y_{k,T+h|T}$ can be expressed as below;

$$\sigma_k^2(h) = \sum_{n=0}^{h-1}(\upsilon_{k1,n}^2 + ... + \upsilon_{kK,n}^2) = \sum_{j=1}^{K}(\upsilon_{kj,0}^2 + ... + \upsilon_{kj,h-1}^2) \quad (8)$$

The term $(\upsilon_{kj,0}^2 + ... + \upsilon_{kj,h-1}^2)$ is interpreted as the contribution of variable j to the h-step forecast error variance of variable k. When the above terms are is divided by $\sigma_k^2(h)$, the percentage contribution of variable j to the h-step forecast error variance of variable k is obtained JMulti Help System (2008).

$$\omega_{kj}(h) = (\upsilon_{kj,0}^2 + ... + \upsilon_{kj,h-1}^2) / \sigma_k^2(h) \quad (9)$$

4. Empirical Results

In this study, a VAR model in levels form for the time series vector $(COACT_t, RGDP_t, INT_t, \mathrm{CRE}_t)'$ with constant terms is employed. For determining the optimal lag length of the VAR model, Prediction Error (FPE) and Hannan-Quinn Criteria (HQ) are also used in addition to AIC. While AIC and FPE suggest a lag length of 6, HQ suggests a lag length of 4. Therefore, the VAR model is estimated with a lag length of 6 basing on AIC and FPE.

VAR model impulse response functions are estimated to expose the dynamic behavior of the system and especially show the accumulated response of *COACT* to a positive one standard deviation shock in the other variables of the model for the next 20 quarters. Alternative ordering of variables of the VAR model produced similar impulse response analysis results. Thus, robustness of impulse response analysis results is exposed.

The figure 1 reveals that a positive one standard deviation shock in *RGDP* leads to an increase *COACT* from the 1^{st} quarter. Thus, construction sector activity expands in long-run. This finding implies that development of Turkey's economy is also an important factor for the development of construction sector. According to another finding of impulse response analysis, *COACT* declines dramatically related to a positive one standard deviation shock in *INT* as can be shown from the Figure 2. Finally, an inspection of Figure 3 shows that a positive one standard deviation shock in *CRE* leads to a jump in *COACT* from the 1^{st} quarter. It reveals that an increase in banking sector total domestic credits causes demand for real-estates to grow and is also a promising factor for investments in construction sector. Accordingly, development of the sector is affected positively.

On the other hand, FEVD analysis exposes the degree of importance of *RGDP* and *INT* and *CRE* influencing the construction sector activity for the following 20 quarters. The total variance of *COACT* is decomposed in each of the future periods. Thereby, how much of this variance each macroeconomic variable explains is determined. Different Choleski ordering provided support for the robustness of FEVD results.

FEVD results show that *COACT* explains 72% of the 20-step forecast error variance of itself and has the highest explanatory power over the variation of *COACT*. In addition, Table 3 indicates that shocks to *INT* cause more variation in *COACT* than variation produced by shocks to *RGDP* and *CRE* for the following 20 quarters. For instance, %17 of the 20-step forecast error variance of *COACT* is accounted for *INT*, whereas *RGDP* and *CRE* innovations account for 6% and 5% of the variation in *COACT* up to 20 quarters. FEVD results reveal that the importance of RGDP, weighted averages of 12-month interest rate on deposit and banking sector total domestic credits are increasing gradually. Therefore, the possible effects of these three factors should be analyzed for sustaining the development of the construction in long-run.

5. Concluding Remarks

Impulse response and FEVD analysis indicate that *COACT* responds to shocks in the other variables in the system. Moreover, the construction sector is very sensitive to the changes in macroeconomic conditions.

VAR model impulse responses show that a positive one standard deviation shock in *RGDP* increases *COACT* beyond the sample period. It points out that as Turkey's economy grows, construction sector also grows. Therefore, CBRT and government of Turkey should implement economic policies that do not cause instability in the sector. Furthermore, firms in the sector should use management and marketing strategies considering the macroeconomic conditions. In this context, firms may follow different pricing strategies for different market segments and as promotion is closely linked to the sales, integrated marketing communication may also be used. Besides, according to the impulse response analysis, a positive one standard deviation shock in *INT* causes *COACT* to reduce. Hence, interest rates should be kept low for the sustainable development of the sector. At this point, monetary and fiscal policies should be implemented to maintain price stability. Then, macroeconomic policy coordination should be ensured. Impulse response functions also reveal that a positive one standard deviation shock in *CRE* booms the construction sector for the following quarters. For, the sustainable development of the sector, credits to construction sector should be increased. However, credit demand or supply should be equalized since increasing credits may engender credit default risk as in 2008 financial crisis. Accordingly, CBRT should control the credit supply by using monetary policy tools efficiently. Implementation of credit rationing by the banks that has influence on tenure choice and the total volume of housing expenditures may also be a good way. Efficient credit rationing can regulate and stabilize the construction sector that is also an important factor for the sustainable development of the sector.

FEVD results imply that *COACT* is the variable with the highest explanatory power over the variation in itself, followed by *INT* up to 20 quarters. On the other hand, effects of RGDP, weighted averages of 12-month interest rate on deposit and banking sector total domestic credits on construction sector activity are increasing gradually for the following quarters. Therefore, the possible effects of these three factors should be considered when analyzing the sector. Besides, the structure of construction sector and in its sub-sectors should be well analyzed both on micro and macro basis for eliminating the factors destabilizing the sector.

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Table 1. Construction Sector Activity Indicators In Turkey

Years	Construction Sector Activity (%) Change	Construction Sector Activity/RGDP (%)
1990	-9.49	6.67
1991	0.22	6.68
1992	0.23	6.70
1993	-0.15	6.69
1994	3.61	6.93
1995	-11.05	6.16
1996	-1.09	6.10
1997	-2.34	5.96
1998	-2.27	5.82
1999	0.23	5.83
2000	-1.78	5.73
2001	-12.44	5.02
2002	7.29	5.38
2003	2.38	5.51
2004	4.36	5.75
2005	0.87	5.80
2006	10.85	6.43
2007	0.96	6.49
2008	-8.71	5.93
2009	-11.97	5.22
2010	7.91	5.63
Note: Both two measures are obtained using yearly purchaser's prices based construction sector activity and RGDP series of the Central Bank of Turkey (CBRT) that are at Constant (1998) Prices.		

Source: CBRT

Table 2. Augmented Dickey-Fuller Test Results

Variables	Augumented Dickey-Fuller Test Statistic	Deterministic Terms	No. of Lagged Differences
COACT	-1.12	Constant	5
Δ *COACT*	-4.47	None	4
RGDP	-2.31	Constant, trend	8
Δ *RGDP*	-3.10	Constant	7
$\Delta\Delta$ *RGDP*	-7.19	None	6
INT	-0.88	Constant	0
Δ *INT*	-8.72	None	0
CRE	-1.02	Constant, trend	6
Δ *CRE*	-1.61	Constant	7
$\Delta\Delta$ *CRE*	-5.24	None	6

Notes: Δ denotes first, $\Delta\Delta$ second differences. %1 critical values for ADF test with constant and trend, constant and no deterministic terms are -3.96, -3.43 and -2.56 respectively. Critical values are from Davidson and McKinnon 1993, Table 20.1, p. 708.

Table 3. Forecast Error Variance Decomposition of *COACT*

Forecast Horizon h	Proportions of Forecast Error Variance h quarters ahead accounted for by innovations in			
	COACT	*RGDP*	*INT*	*CRE*
1	1	0	0	0
2	1	0	0	0
3	0.93	0.02	0.02	0.04
4	0.79	0.05	0.11	0.05
5	0.78	0.05	0.11	0.05
6	0.80	0.05	0.10	0.05
7	0.80	0.05	0.10	0.05
8	0.78	0.05	0.11	0.05
9	0.78	0.06	0.11	0.05
10	0.78	0.06	0.11	0.05
11	0.77	0.05	0.12	0.05
12	0.76	0.06	0.14	0.05
13	0.75	0.06	0.14	0.05
14	0.75	0.06	0.14	0.05
15	0.75	0.05	0.15	0.05
16	0.74	0.05	0.16	0.05
17	0.73	0.06	0.16	0.05
18	0.73	0.06	0.16	0.05
19	0.73	0.06	0.17	0.05
20	0.72	0.06	0.17	0.05

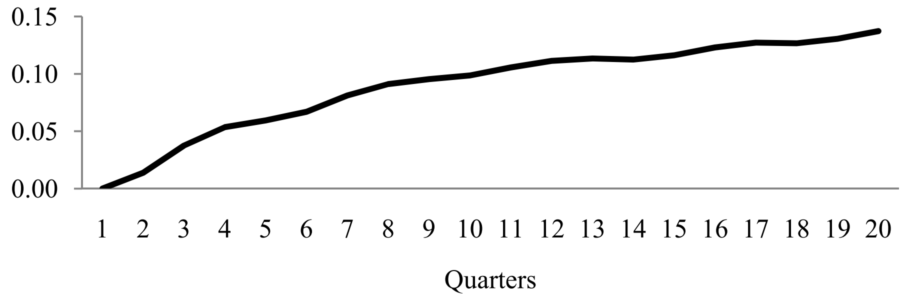

Figure 1. Response of *COACT* to Impulse of *RGDP*

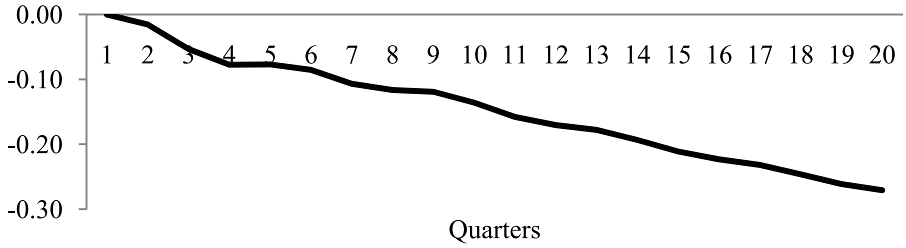

Figure 2. Response of *COACT* to Impulse of *INT*

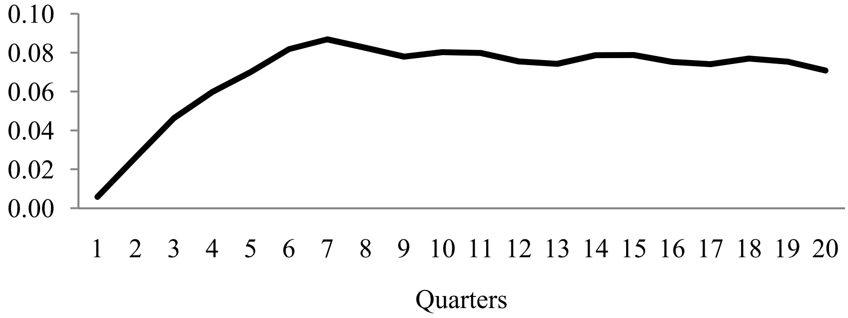

Figure 3. Response of *COACT* to Impulse of *CRE*