Role of Construction Sector in Economic Growth: New Evidence from Turkey

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Abstract

After the 2001 financial crisis, Turkey's economy moved full-speed ahead, except for a temporary reversal in 2009 during the global financial crisis. Throughout the years of accelerated growth in 2002-2007 and 2010-2011, construction output increased at a faster rate than the economy as a whole, but in the periods of stagnation in 2001 and 2008-2009, construction industry was the first to suffer. This paper investigates the causal relationship between construction investments and economic growth in Turkey from 1998Q1 to 2014Q4. Unlike the previous studies that use two variable – real GDP and construction industry growth – Granger causality tests, the present study additionally employs three-variable – real GDP growth, construction industry growth, and real interest rate – VAR models to investigate the causal relationships in a multivariate setting. The paper also employs Zivot-Andrews test for determining structural breaks in data and then extends the causality analysis by dividing the seventeen-year sample period into smaller sub-periods that are defined according to the location of breaks in data.

The results for the entire sample of 1998-2014 indicate that economic growth in Turkey has preceded construction activities with two- to four-quarters lags, but not vice versa. Hence, unlike the widespread belief that the construction plays a crucial role in Turkey's economic growth, construction industry is not a driver of GDP growth but a follower of fluctuations in the macro-economy. However, our sub-sample analysis reveals that the causal relationship between economic growth and construction investments varies noticeably across the sub-periods in the national economy. We find that expansion in construction sector caused GDP growth over the last five years. The low interest rate environment with the help of radical changes in urban legislation and city building boosted up the construction industry, which resulted in economic growth in sub-period 2010-2014. Hence, we conclude that the temporary effect of construction industry growth on the GDP growth in the sub-period 2010-2014 is not justified for the overall sample period. Provided that much of the cyclicality in construction investment stems from the sector's sensitivity to interest rates, we also find that there exists a bidirectional relationship between construction activities and real interest rates both for the entire sample period and for the sub-period 2002-2014. Lastly, construction activities have short-lived effects on the economic growth and thus cannot offer permanent solutions for the economic troubles in Turkey.

JEL Classification: C32; O4

Key words: Construction industry, Economic growth, Granger causality, VAR models, structural breaks, Turkey

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1. Introduction

Turkish economy is rapidly becoming a service economy without having had a proper experience of industrialization as a result of neoliberal economic policies followed by the governments since the mid-1980s and the rapid financialization process through deepening of financial globalization. Like most other developing countries, Turkey has been experiencing a premature deindustrialization process that was accelerated by the Justice and Development Party (AKP government) that came into power in 2002 just after the 2001 economic crisis. The urban policy consequences of premature deindustrialization have been the creation of a 'new' middle-income class – *the urban rich* – who easily takes risk, demands and consumes a lot, and the commodification of cities and urban spaces by the AKP government through a radical change in urban legislation and city building. Recently, effective legislative changes that include major modifications in planning regulations and ratification of new laws have been recognized. Specifically, in May 2012, two effectual laws regarding construction sector were ratified by the Turkish Parliament. The *Law on the Transformation of Areas under Natural Disaster Risk* authorized public sector involvement in urban transformation process with an initial estimation of 6.5 million dwelling units with natural disaster risk. The second newly amended *Reciprocity Law* substantially eased foreign investment restrictions in Turkey and accordingly the European and especially Gulf-based property investors have turned their attention to the Turkish real estate markets (Erol, 2016). Hence, within the region including the Eastern Europe, Middle East and Russia, Turkey has been one of the region's fastest developing real estate markets as a result of the economic growth, favorable demographics, continuing urbanization process and the neoliberal urban policies adopted by the AKP government.

After the 2001 financial crisis, Turkey's economy moved full-speed ahead, except for a temporary reversal in 2009 during the global financial crisis. Indeed, during periods of accelerated economic growth, construction output grew at a faster rate than the economy as a whole, but during periods of stagnation, the construction industry was the first to suffer (Erol, 2015). Currently, construction industry is the sixth largest economic sector in Turkey based on its value added to GDP and employs 7.4% of the total workforce. During the period from 1998 to 2014, the annual construction investment increased cumulatively by 80.6%. The cumulative increase in construction investments had been 61% for the period 1998-2007, but then decreased to about 12% for the period 2007-2014.

Certainly, the importance of the construction sector is not only related to its size but also to its role in economic growth. This paper aims to investigate the causal relationship between the rapidly growing construction industry and aggregate economy in Turkey by using both the two-variable Granger causality analysis and the multivariate VAR model. Using quarterly data for the period from 1998Q1 to 2014 Q4, the present study tests whether construction activities stimulate economic growth or economic growth leads the construction activities, or if there exist a feedback effect between construction flows and the aggregate economic activities in Turkey. This study provides an empirical test of the main hypothesis of "Economy drives construction industry in Turkey" through the usage of causality analyses.

The present study is one of the initial attempts to investigate the lead-lag relationship between construction industry and economic growth in Turkey. Gaining a better understanding of the causal

relationship between construction investments and national economies requires more evidence, especially from developing economies like Turkey, which is a rapidly growing economy with its significant growth potential in construction sector.

Existing studies analyzing the construction sector in developed countries generally emphasized the role of construction industry in economic growth (see Turin, 1969; Wells, 1986; Field and Ofori, 1988; Bon and Pietroforte, 1990; Bon, 1992; Green, 1997; Hillebrandt, 2000; Lean, 2001; Rameezdeen, 2007 among others). Admittedly, a limited number of studies investigated the direction of the causal relationship between the construction industry and the economic growth in developing countries such as Sri Lanka (Ramachandra, Rotimi and Rameezdeen, 2013), Korea (Kim, 2004), Hong Kong (Tse and Gnesan, 1997; Yiu, et al., 2004), Ghana (Anaman and Osei-Amponsah, 2007), Singapore (Lean, 2002), China (Hongyu et al., 2002), Barbados (Jackman, 2010) and Cape Verde (Lopes, Nunes and Balsa, 2011). Empirical findings on the causal relationship between economic growth and construction investment are mixed for the developing economies. While several studies showed that the economic expansion causes growth in construction output (Wang and Zhou, 2000; Tse and Ganesan, 1997; Tan, 2002; Yiu *et al*., 2004; Lopes, Nunes and Balsa, 2011; Kim, 2004; Ramachandra, Rotimi and Rameezdeen, 2013), some other studies concluded that construction industry influences the economic growth because of its strong linkages with other sectors of the economy (see Anaman and Osei-Amponsah, 2007; Lean, 2002; Khan, 2008 among others). According to Wang *et al.* (2000), it is reasonable to believe that the cross-country differences in the market structure of construction industries affect the dynamics of construction activities.

A few recent studies, including Ozkan *et al.* (2012), Kargi (2013), and Bolkol (2015), studied the causal relationship between economic growth and construction industry in Turkey and provided mixed empirical results. The present study differs from previous investigations in a couple of ways. First, this study might be accepted as an updated and enriched version of the existing studies by using a larger sample size. That is, a longer period of time from 1998 to 2014 is used to examine the causal relationship between the real growth in construction production and the real economic growth (production-based GDP growth) in Turkey. Second, using a longer period of time or larger sample size enables us to carry out sub-sample analyses in addition to the overall sample period and interpret our empirical findings for different periods of the Turkish economy. For this purpose, the present study employs Zivot -Andrews test for determining structural breaks in the data and then extends the causality analysis by dividing the 17-year sample period into smaller sub-periods, which are defined according to the location of structural breaks in data. Third, in contrast to the previous studies that use two variable (real GDP and construction industry growth) Granger causality tests, this paper additionally employs three-variable (real GDP growth, construction industry growth, and real interest rate) VAR(m) model to investigate the causal relationships in a multivariate setting. Evidently, construction investment is one of the most cyclical components of GDP. Much of that cyclicality stems from the sector's sensitivity to interest rates, but it is also possible that construction lags generate intrinsic cyclicality in this sector (Berger-Thomson and Ellis, 2004). Since the construction sector is generally considered to be more interest-sensitive than the economy as a whole we include real interest rates as a third variable in our multivariate VAR model. Last but not least, previous studies mainly applied different econometric methods, including correlation coefficients, Granger causality test, cointegration tests, regression analysis, and discussed empirical results in a technical way without an adequate discussion on the dynamics

of construction industry in Turkish economy. Tthe present paper bridges this gap in the sense that it provides detailed discussion on the increasing role of construction sector in the national economy along the lines of macroeconomic developments and the neoliberal urban policies adopted by the government.

The results for the entire sample of 1998-2014 indicate that economic growth in Turkey has preceded construction activities with two- to four-quarters lags, but not vice versa. Hence, the main hypothesis of "Economy drives construction industry in Turkey" is supported by our causality analyses. In order to understand if the causal effect of economic growth on the expansion of construction activities that is observed throughout the entire period is effective or not for the different periods of the national economy, we carry out both the two-variable Granger causality test and the three-variable VAR model for three sub-sample periods, which are suggested by Zivot-Andrews structural break test, separately. We find that the causal relationship between economic growth and construction investments varies noticeably across the sub-periods in the economy. Empirical results for the sub-period 2010-2014 demonstrate that expansion in construction activities caused GDP growth over the last five years in the country. The low interest rate environment with the help of essential legislative reforms that made investing in Turkish real estate markets easier and more profitable than it used to be boosted up the construction industry during the period 2010-2014 period. The substantial increase in construction activities, therefore, resulted in economic growth. Correspondingly, we argue that the temporary effect of construction industry growth on the GDP growth in the sub-period 2010-2014 is not justified for the overall sample period.

The remainder of the paper is organized as follows. The next section presents a summary of the existing studies on the causal relationship between construction industry and economic growth, mainly in developing countries. The third section discusses the role of construction industry in Turkish economy for the period of 1998-2014. A detailed analysis of data and the methodology used in the study are provided in Section 4. Section 5 provides the empirical results of two-variable Granger causality test and the multivariate VAR model both for the overall sample period of 1998-2014, and for the sub-sample periods of 2002-2007, 2002-2014, and 2010-2014. Finally, Section 6 concludes the paper.

2. Literature Review on the Causal Relationship between Construction Industry and Economic Growth

Existing literature on the economic role of the construction sector can be examined in three main parts. The first one studies the relationship between construction and economic development. Strassmann, 1970; Turin, 1969 and 1974; Drewer, 1980; Wells, 1985; Bon, 1992 are among the most important seminal papers investigating the role of construction in economic development. These studies tried to assess whether "the construction sector, like agriculture or manufacturing, follows a pattern of change that reflects a country's level of development", as Strassmann (1970) emphasizes it. The second segment of studies assess whether construction sector investment leads GDP growth or vice versa, or whether there is simultaneous causality (De Long and Summers, 1991, 1992; Ball and Wood, 1996; Green, 1997; Hillebrandt, 2000; Lean, 2001; Rameezdeen, 2007; Hosein and Lewis, 2005; Chang and Nieh, 2004). The third part of studies employs input-

output tables to study the role of construction in a national economy (see Bon and Pietroforte, 1990; Bon and Yashiro, 1996; Pietroforte and Gregori, 2003 among others). The present study is related with the second segment of studies and provides empirical evidence on the lead-lag relationship between construction industry and economic growth in Turkey, which is a rapidly growing economy with significant growth potential in its construction sector.

Empirical studies analyzing the construction sector in developed countries have generally emphasized the role of construction industry in economic growth (see Turin, 1969; Wells, 1986; Field and Ofori, 1988; Bon and Pietroforte, 1990; Bon, 1992; Green, 1997; Hillebrandt, 2000; Lean, 2001; Rameezdeen, 2007 among others). Only a limited number of studies have examined the causal relationship between economic growth and construction investment in developing economies and provided mixed empirical findings for the direction of causality. More specifically, some studies have suggested that construction industry influences the economic growth because of its strong linkages with other sectors of the economy. That is to say, an increase in residential construction is often associated with increased employment and income for workers in the housing sector and also in related sectors that provide goods and services associated with housing (see, for example, Anaman and Osei-Amponsah, 2007; Lean, 2002; Khan, 2008 among others for a detailed discussion). For instance, Anaman and Osei-Amponsah (2007) analyze the causality links between the growth in the construction industry and the macroeconomic growth in Ghana using data from 1968 to 2004 and show that the growth in the construction industry Granger-causes growth in GDP, with a three-year lag. The authors conclude that although the government aims to use the agricultural sector as the major vehicle for achieving high growth rates in the aggregate economy, the construction industry needs to be considered as one of the major drivers of economic growth in Ghana. Similarly, Lean (2002) concludes that construction sector leads other sectors' output as well as GDP in Singapore.

On the other hand, several studies have shown that the economic expansion or GDP growth causes growth in construction output; see for example Tse and Ganesan (1997), Yiu et al. (2004) for Hong Kong, Lopes, Nunes and Balsa (2011) for Cape Verde. Kim (2004) performs a series of Granger causality tests using 1970-2002 quarterly Korean data and concludes that housing is not a driver of GDP but a follower of fluctuations of the wider economy. One possible explanation of the passive role of housing investment as a follower of the macro-economy is that the government has used residential investment to counter business fluctuations. Similarly, a recent study by Ramachandra, Rotimi and Rameezdeen (2013) investigate the direction of the causal relationship between construction and the economy of Sri Lanka using the Granger causality test for the period 1990 to 2009. The findings reveal that national economic activities precede construction activities for all indicators except construction investment. The study concludes that the national economy in Sri Lanka has been inducing growth in the construction sector and not vice versa for the studied sample period. Moreover, Hongyu et al. (2002) and Jackman (2010) investigate the causal relationship between the residential construction and economic growth in China and Barbados, respectively and conclude that there has been bidirectional causality between housing investment and GDP for these countries. According to Wang et al. (2000), it is reasonable to believe that the cross-country differences in the market structure of construction industries affect the dynamics of construction activities.

Recently, a few numbers of studies have investigated the causal relationship between construction investments and economic growth in Turkey. For instance, Ozkan *et al.* (2012) study the causal relationship between construction growth and GDP growth by using monthly data from January 1987 to December 2008. The study uses both public sector and private sector construction expenditures (infrastructure investments and residential buildings) as a proxy for construction activities. After employing the Engle–Granger cointegration, Error Correction Model and Granger causality tests, the study concludes that there exist bidirectional relations between infrastructure investments and GDP growth, and also between public sector construction investments and GDP variables and that the causality running from infrastructure and residential building investments to GDP is stronger than that in reverse direction. Another recent study Kargi (2013) also studies the causal relationship between public and private construction expenditure and the economic growth in Turkey. The study applies both Granger causality tests and regression analysis and uses quarterly data for the period January 2000 to March 2012. Kargi (2013) concludes that the private sector's construction expenditures and the public sector expenditure on the infrastructure move in conjunction with the economic growth and that the process of growth supports the construction industry over the sample period. Bolkol (2015) investigates the causal relationship between construction production (not expenditure) and GDP growth between the first quarter of 2005 and the fourth quarter of 2013 and concludes that there is no long run relationship between construction production and GDP and that in short run the causality runs from GDP to construction production activities. Bolkol (2015) also claims that the growth strategy, which is mainly based on construction sector growth is not the best alternative for Turkey.

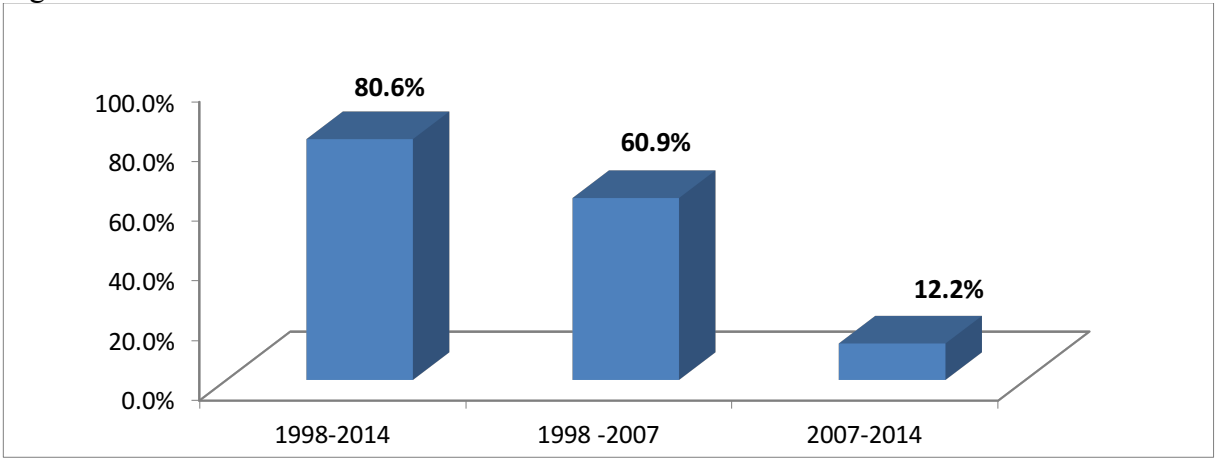
3. Construction Industry and Economic Growth in Turkey: 1998-2014

The construction industry as a sub-sector in the real estate sector has been considered as one of the engines of economic growth in Turkey since the adoption of import substitution industrialization as development strategy from the 1960s onwards. With the reorientation of economic policies starting with the 1980 stabilization program, the industry has been assigned a new role as part of the export oriented growth strategy as Turkish contractors have expanded their activities abroad, especially in the Middle East and North Africa (MENA) region (Erol, 2016). Meanwhile, within the domestic economy, the construction industry has been prominent with the foundation of the Housing Development Administration (HDA) in 1984. The HDA has been instrumental in undertaking numerous projects of mass housing and landscaping from mid-1990s onwards, and it has gained significant momentum with the AKP government since 2002. During the period from 2003 to 2012, Turkey had one of the highest volumes of housing production in Europe and housing starts by the HDA reached 562,000 dwelling units, accounting for nearly 11% of all national starts during the same period of time (Türel and Koç, 2015).

Figure 1 displays the cumulative growth rates in construction activities between 1998 and 2014, and reveals that annual construction investment increased cumulatively by 80.6% during this period. Indeed, a significant amount of increase in construction activities – approximately 61% cumulative increase – took place between 1998 and 2007, and then it declined to only 12% increase

for the period 2007 to 2014. Hence, the growth in construction activities started to slow down remarkably over the recent years.[1]

Figure 1. Cumulative Growth Rates in Construction Activities between 1998 and 2014*



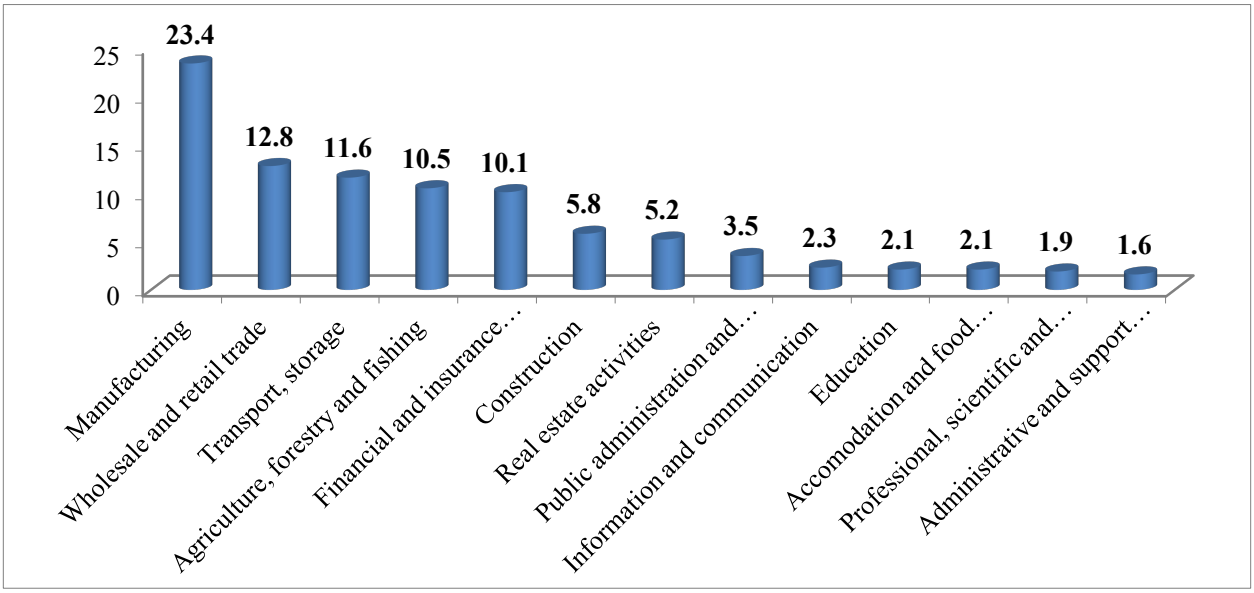
* GDP in Constant Prices by Kind of Economic Activity - at 1998 Basic Prices
Value of construction industry, GDP by Production approach

The construction industry had a share of 5% to 6.5% of Gross Domestic Product (GDP) over the past seventeen years from 1998 to 2014. The share of overall real estate sector, including the construction activities and real estate business activities, increased from 8.3% in 1998 to 10.5% in 2014 at 1998 fixed prices. As of the end of 2014, while the construction sector-to- GDP ratio was 5.9%, the real estate, renting and business activities had a 4.6% share in GDP.

Currently, construction industry is the sixth largest economic sector based on its value added to GDP, and employs 7.4% of the total labor force. As presented in Figure 2, construction industry had been the sixth largest sector of the national economy for the period 1998-2014 as well. Figure 2 displays the average annual shares of each sector and shows that construction industry had a share of 5.8% in GDP after following the manufacturing (23.4% share in GDP), wholesale and retail trade (12.8% share in GDP), agriculture, forestry and fishing (11.6% share in GDP), and financial and insurance activities (10.1% share in GDP). With a 5.2% share in GDP, real estate business activities had been the seventh largest sector following the construction activities.

[1] During the period 2002-2014, which excludes the 2001 economic crisis in Turkey, annual construction investment has increased cumulatively by 89%. The cumulative increase in construction sector investment was 68.4% for the period 2002-2007, but then decreased by about only 12% for the period 2007-2014.

Figure 2: Sector Shares in GDP (%) 1998-2014



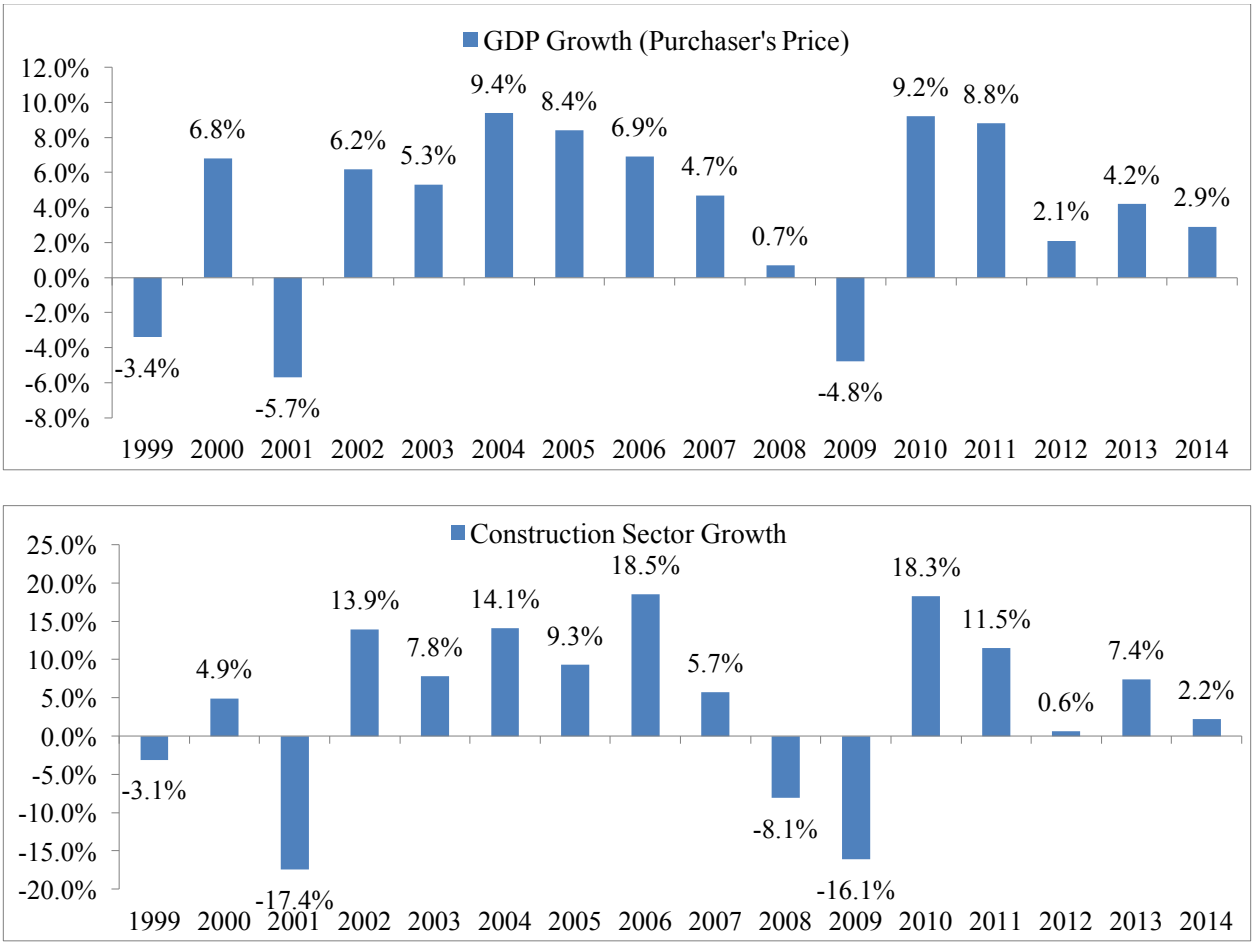
Turkey experienced a severe banking crisis in 2000-2001. The measures, taken after the crisis have been effective in suppressing inflation, building investor confidence and attracting substantial and record amounts of foreign investments to Turkey. Similar to other developing economies, Turkish economy has entered into a rapid and premature deindustrialization process that was accelerated by the AKP government since 2002 (See Rodrik (2015) for a detailed discussion on premature deindustrialization in the developing world). The urban policy consequences of premature deindustrialization have been the creation of a 'new' middle-income class – *the urban rich* – who easily takes risk, demands and consumes a lot, and the commodification of cities and urban spaces by the current government through a radical change in urban legislation and city building.

In detail, essential legislative reforms introduced in line with the EU harmonisation process, made investing in the real estate market even easier and more profitable than it used to be. The amendments to the Land Registry Law, the Housing Finance Law[2], and the redrafting of Tax Laws are designed to improve the competitiveness of the Turkish real estate sector in the global market. More specifically, in May 2012, the Turkish parliament passed the Law on the Transformation of Areas under Natural Disaster Risk (Law No. 6306) and also enacted certain amendments for Article 35 and 36 of the Land Registry Law No 2644 which redefined rules of reciprocity and substantially eased foreign investment restrictions in Turkey. Urban Transformation Law authorised public sector involvement in urban regeneration process with an initial estimation of 6.5 million dwelling units which have natural disaster risk. Additionally, the newly amended Reciprocity Law substantially eased foreign investment restrictions in Turkey and accordingly the European and especially Gulf-based property investors have turned their attention to Turkish real estate markets.

[2] The Law Amending the Laws Related to Housing Finance No 5582 (March 2007).

Figure 3 displays the real growth rate of construction industry in conjunction with the fluctuations in real GDP growth rate between 1999 and 2014. After the 2001 financial crisis, Turkey's economy had been moving full-speed ahead, except for a temporary reversal in 2009 during the global financial crisis. The real GDP growth had been significantly negative in the past three financial crises of 1999, 2001, and 2009. It is clearly seen that, the 1999 and 2001 financial crises in Turkey and the recent global financial crisis in 2008-2009 directly resulted in negative growth rates in construction sector as well. Specifically, growth of the construction industry declined to -3.1% in 1999, -17.4% in 2001 and to -16.1% in 2009. One may conclude that during periods of accelerated economic growth (2002-2007 and 2010-2011), construction output grows at a faster rate than the economy as a whole, but during periods of stagnation (2001, 2008-2009), the construction industry is the first to suffer.

Figure 3: Real Growth Rates in Construction Activities and GDP



In an attempt to understand the relative value–additions of the sectors to the national economy, we analyze the growth rates of main sectors in comparison to the real GDP growth. Figure 4a displays the average annual growth rates of the sectors for the period 1999-2014. Whilst the real GDP growth per annum was 3.8%, construction activities increased by 4.3% on average. Financial and insurance activities had been the fastest-growing sector with a 7.5% real growth rate on average. Finance and insurance sector was followed by professional, scientific and technical activities and

administrative & support service activities with growth rates of 7.5% and 7.4%, respectively. Indeed, manufacturing industry and construction sector had relatively lower growth rates during the overall sample period of 1999 to 2014. The real growth rates of the sectors for the period 2002-2014, which excludes the impact of 2001 financial crisis, are presented in Figure 4b. Once again, professional services, administrative& support services, and finance& insurance sector are the three sectors that had the highest growth rates of 9.1%, 7.5%, and 7.2%, respectively. Construction sector was the 5th rapidly growing sector with a real growth rate of 6.5%. Manufacturing industry and wholesale& retail trade activities have relatively lower growth rates of 5.5% and 5.6%, respectively.

To sum, over the past sixteen years, manufacturing industry experienced the lowest growth rates among the major sectors of the economy, which implies for a premature deindustrialization period in the Turkish economy. Evidently, the national economy has been growing with the main support of professional, technical and administrative services and financial activities. Construction sector did not play a leading role in the national economy in terms of its value-addition to the real GDP growth, and it has been fragile and highly volatile during the period 1999-2014.

Figure 4a: Average Sectoral Growth Rates between 1999 and 2014

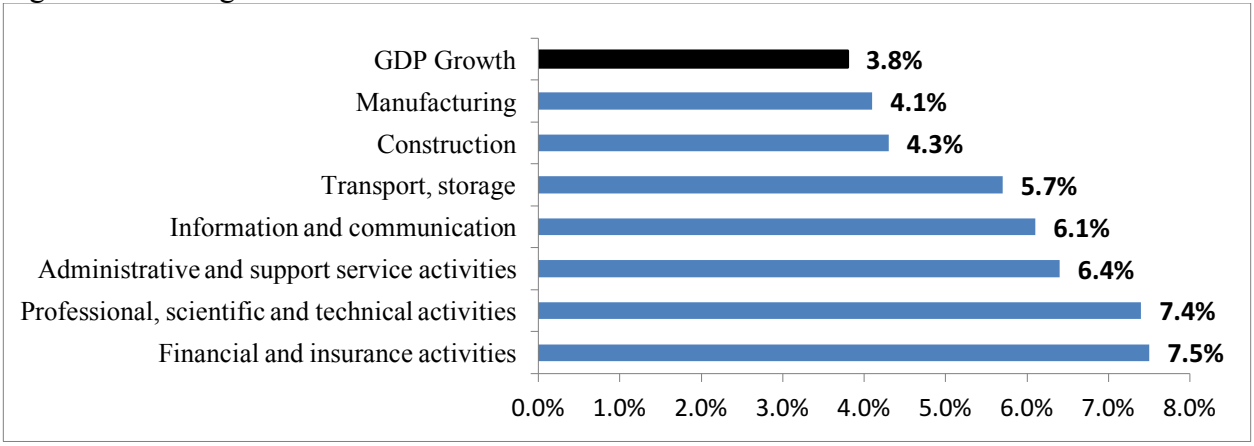
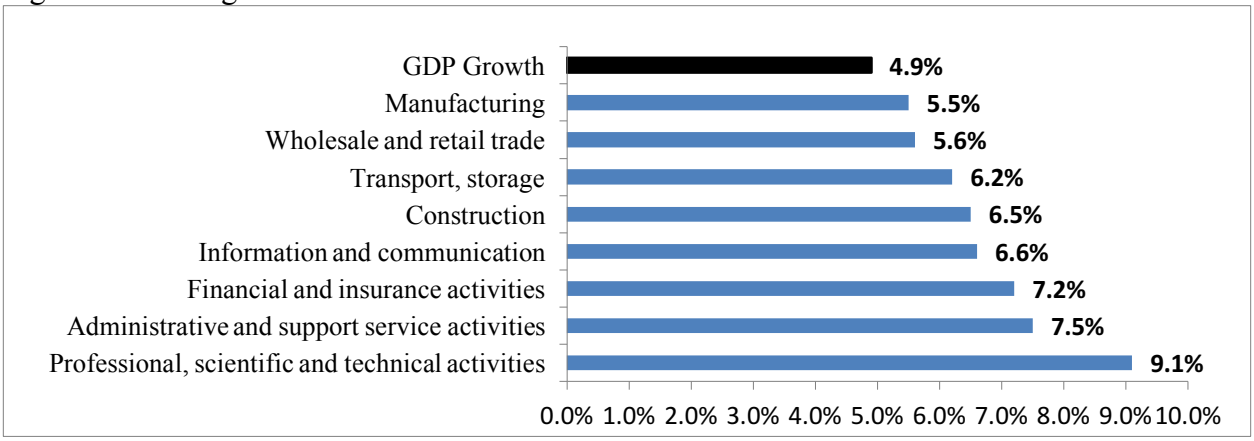


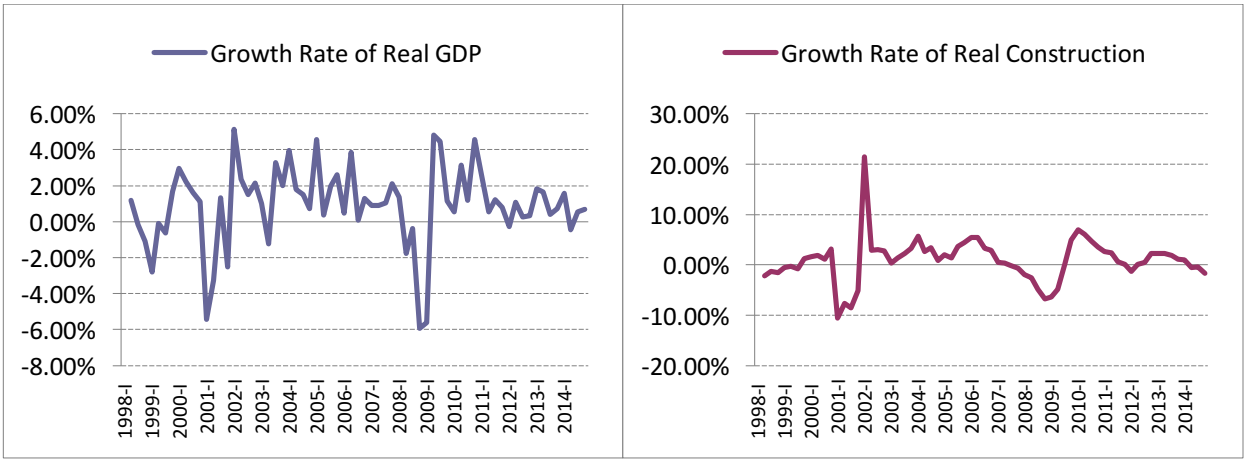
Figure 4b: Average Sectoral Growth Rates between 2002 and 2014

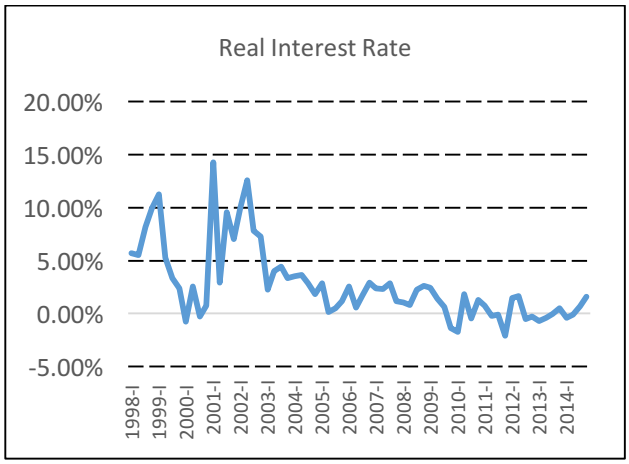


4. Data and Methodology

The present study uses quarterly data on real production-based GDP series (GDP), real construction activities (CONST), and the real interest rate (R) series between 1998Q1 and 2014Q4, giving in total 68 quarterly points within a span of 17 years. Whilst the construction activity is measured by using the value of construction output in the total gross domestic production in the country, real interest rates are obtained by the conventional Fisher (1930) equation.[3] Time series data used in this study are in real terms to discount price inflation. If not already so in the original data, all variables are seasonally adjusted by the X12-ARIMA method to avoid seasonal irregularities that may distort the underlying properties of the time series data. The GDP and the CONST series are obtained from Turkish Statistical Institute database, and R series are obtained from the Thomson Reuters DataStream. Figure 5 displays the time series plots for all variables employed in the study.

Figure 5: Time Series Data for real GDP, Construction activities and real interest rates in Turkey





[3] Construction value added is chosen as the main indicator of the construction industry activity rather than gross fixed capital formation in construction or gross construction output. This is because the production approach (value added components) has generally been utilized by international bodies as a more reliable way to compound a country's national aggregate (Lopes *et al.*, 2002).

Descriptive statistics of data reveal that both real GDP and real construction activities grew, on average, 0.9 percent per quarter, and the average real interest rate was 2.7 percent per quarter. The measures of dispersion show that real construction activities had significantly higher standard deviation of 4.3 percent than that of the GDP growth, which experienced 2.2 percent standard deviation per quarter during the period under consideration.[4]

To test whether growth in real GDP stimulates growth in construction sector or construction sector leads the aggregate economic activity, or if there is a feedback loop between construction sector and real GDP, the Granger causality test is used. It should be noted that Granger causality test requires the use of stationary time series data. In other words, if the data is non-stationary in the level form, it needs to be transformed into stationary form in order to be used for the Granger causality test (Huang, 1995; Feige and Pearce, 1979). Therefore, before we run the causality tests we carry out augmented Dickey Fuller (ADF) unit root tests in order to investigate the stationarity of our time series.

4.1. Unit Root Test

The present study uses the ADF test that considers situations in which the white noise error terms are correlated, and thus is accepted as an improvement over the Dickey-Fuller test. ADF test is mainly based on the following formulation:

$$\Delta Y_t = \alpha + \delta t + \beta Y_{t-1} + \sum_{i=1}^{n} \varphi_i \, \Delta Y_{t-i} + \varepsilon_i \qquad (1)$$

where n stands for the number of lags necessary to obtain white noise, ε is the error term, α is constant term, and t is the time trend under the null hypothesis $H_0: \beta = 0$ and its alternative $H_1: \beta \neq 0$. Note that failing in rejecting null hypothesis implies that the time series is non-stationary.

Table 1: Unit root test results

Variables	At Level		At First Difference *(Growth Rate)*	
	With Intercept and No Trend	**With Trend and Intercept**	**With Intercept and No Trend**	**With Trend and Intercept**
Real GDP (Base year 1998)	0.543 (0.9861)	-2.462 (0.3474)	-6.166*** (0.000)	-6.148*** (0.000)
Real Construction (Base year 1998)	-0.079 0.9515	-1.790 (0.3474)	-5.064*** (0.000)	-5.015*** (0.000)
Real Interest Rate			-3.862*** (0.002)	-5.388*** (0.000)

***indicates 1% level of significance.

[4] In addition, the maximum increase in real construction growth had been 21.4% in 2002Q1, and the minimum growth was in 2001Q1 with -10.5% rate. The maximum growth in real GDP had been 5.13% in 2002Q1 and the minimum growth rate or reduction was in 2008Q4 with -5.9%.

According to Table 1, which reports the results of ADF unit root tests, the null hypothesis of non-stationary series for the real GDP and CONST, in level form with and without time trend is not rejected at all conventional levels of significance. All time-series are, therefore, non-stationary in level terms. When the series are first-differenced, the ADF test statistic rejects the null hypothesis of a unit root at 1% significance level for real GDP, CONST and R time-series. As all variables appear to be first-difference stationary, I(1), this study uses the first differenced terms of the time series, which can be interpreted as the growth rates of the variables, in the causality analysis.

Furthermore, in order to uncover breaking trend and mean in a series and considering for non-stationarity at the same time, we employ Zivot-Andrews (ZA) test, which is an endogenous structural break test designed to sequentially test the unit root hypothesis against the alternative of one endogenously determined break in the mean of trend of a series (Mallick and Marques, 2008). The ZA test allows us to extend our analysis by dividing the entire sample into smaller sub-samples regarding the location of breaks in data.

4.2. Tests for Structural Break in the Data

We undertake Zivot-Andrews (ZA) tests for determining the location of structural endogenous break[5] in our data. The ZA test allows for a single break in the intercept and the trend of the series (Zivot and Andrews, 1992), and mainly includes a sequential test that utilizes the entire sample by using a different dummy variable for each possible break date (Perman and Bryne, 2006). Indeed, the ZA test is a unit root test with structural break and uses three different models to check a possible one-time structural break in an unknown date. Namely, Model 1 includes the change in intercept, Model 2 includes the change in trend, and Model 3 involves both.[6]

$$\Delta y_t = c + \alpha y_{t-1} + \beta t + \gamma DU_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \qquad Model\ 1$$

$$\Delta y_t = c + \alpha y_{t-1} + \beta t + \theta DT_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \qquad Model\ 2$$

$$\Delta y_t = c + \alpha y_{t-1} + \beta t + \gamma DU_t + \theta DT_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \qquad Model\ 3$$

[5] Evidently, the ZA test allows for a single break in the data. Although some other tests, such as Clemente, Montanes and Reyes (1998) relax the assumption of only one structural break and allow for multiple breaks in data, this study does not use multiple structural break tests for two main reasons. First, our sample covers a period of 17 years, expecting more than one break is not appropriate (For detailed discussion see Bai and Perron (2006), which concluded that multiple structural break tests work well in large samples, whereas in smaller samples there are substantial deviations in both the size and power of their tests. Second, according to Perman and Byrne (2006), tests allow for the possibility of multiple breaks do not allow for breaks under the unit root null hypothesis, which may potentially bias these tests.

[6] Here, the relevant model is selected according to a combination of theory and visual inspection of the data. In our case, for both GDP and CONST, change in intercept, or Model 1, is allowed since the graph of these series does not show a trend over time. However, for R, we adopted Model 3 as the data apparently shows a downward trend over time.

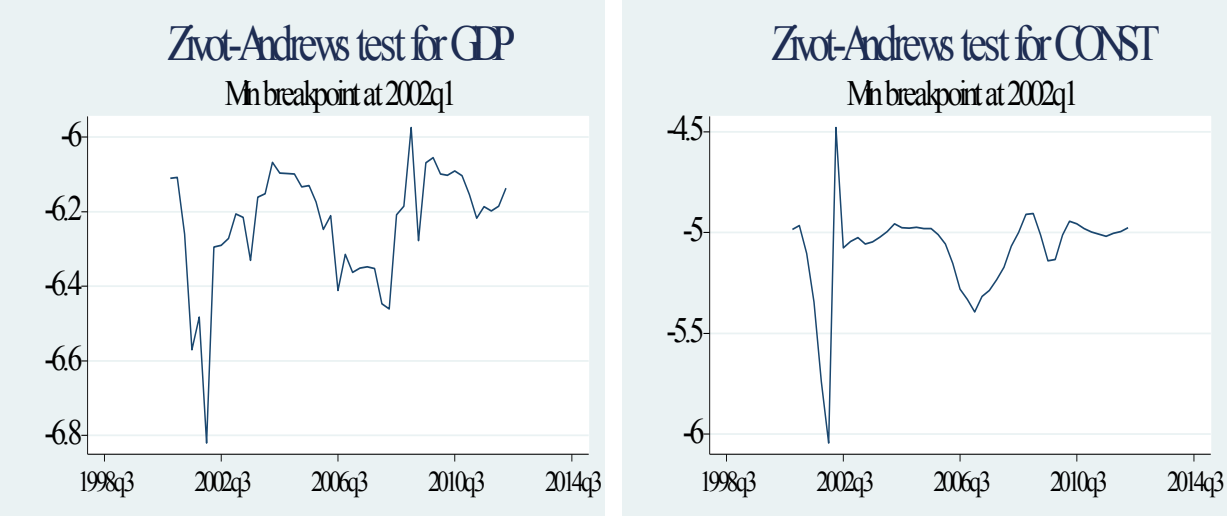
where DU_t is an indicator dummy variable for a mean shift occurring at each possible break-date or time break (TB) while DT_t is corresponding trend shift variable. More formally, they take the following forms (Waheed and Ghauri, 2006):

$$DU_t = \begin{cases} 1 \dots\dots\dots\dots if\ t > TB \\ 0 \dots\dots\dots\quad otherwise \end{cases} \quad \text{and}$$

$$DT_t = \begin{cases} t - TB \dots\dots\dots\dots if\ t > TB \\ 0 \dots\dots\dots\dots\dots\quad otherwise \end{cases}$$

The null hypothesis in all models is that α=0 implying that the series contains a unit root with a drift that excludes any structural break whereas the alternative hypothesis indicates that the series is stationary with a structural break occurring in an unknown date. The exact date, therefore, is assumed to be unknown as the ZA test treats every point as a potential break-point (Waheed and Ghauri, 2006). When using this test, the location of the break date[7] is chosen where the evidence is least favorable for the unit root null. In other words, the break date is chosen from the minimum t-statistics depending on and ADF test because the t-statistics is calculated from the variance that varies over time when a series is non-stationary (Nilsson, 2009).

Figure 6: Plots for the Zivot-Andrews Endogenous Structural Break Test



[7] It should kindly be noted that the test has its own asymptotic theory and provides small sample critical values.

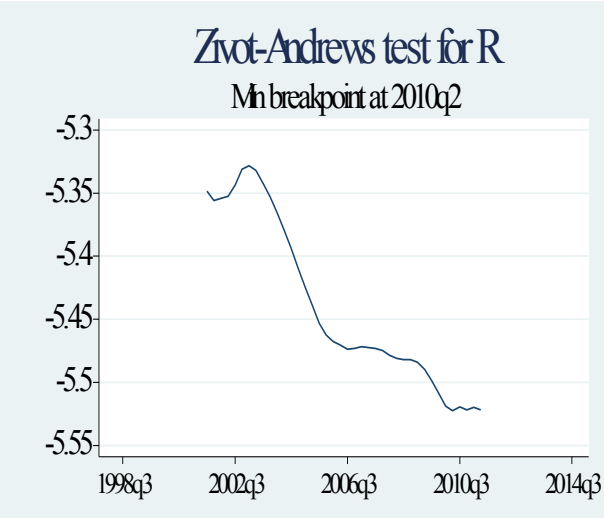


Figure 6 displays the ZA test results for our series with the null hypothesis that series has a unit root with a structural break (see Appendix Table A.9 for the ZA unit root test results). The break date is chosen where t-statistic from the ADF test (vertical axis in the graphs) of as unit root is at a minimum. Such a date is break date where there is least favorable for the unit root null. While, for GDP and CONST variables, the null hypothesis of unit root is rejected which implies that there is a structural break in GDP and CONST in 2002Q1, for the R variable we can again reject the null hypothesis of unit root at the breakpoint of 2010Q2.

Once the stationarity of the series are verified, and sub-periods are determined in line with the ZA test results, we investigate the direction of causality between GDP and CONST series, and as a further analysis, we employ three-variable VAR model including the R series both for the entire sample period and sub-samples, respectively.

4.3. Granger Causality Test and Multivariate VAR Framework

We proceed with Granger causality test to investigate whether construction sector growth Granger-causes economic growth or economic growth stimulates construction sector in Turkey, or if there exists feedback effects between economic growth and construction activity. Such a relationship is represented by Granger (1969):

$$GDP_t = \sum_{i=1}^{m} \alpha_i CONST_{t-i} + \sum_{j=1}^{m} \beta_j GDP_{t-j} + u_{1t} \quad (2)$$

$$CONST_t = \sum_{i=1}^{m} \lambda_i CONST_{t-i} + \sum_{j=1}^{m} \delta_j GDP_{t-j} + u_{2t} \quad (3)$$

where it is assumed that the disturbances u_{1t} and u_{2t} are uncorrelated. Equation (2) indicates that CONST Granger-causes GDP provided that α_i's are statistically different from zero as a group whereas δ_j's are not statistically different from zero as a group . Similarly, GDP Granger-causes CONST given that α_i's are not statistically different from zero in Equation (2) while the set of the lagged GDP coefficients in Equation (3), δ_j's, are statistically different from zero. Feedback, or

bilateral causality, is indicated when the sets of GDP and CONST coefficients are statistically different from zero in both equations.

As the number of lags in the causality model arbitrarily set at two in STATA, and it is clear from the existing literature that Granger-causality test is sensitive to the chosen lag, we are interested in finding the correct lag length, i.e. correct order, by using the order selection criteria. There are many information criteria provided for this purpose, including but not limited to, Akaike Information Criteria (AIC), Schwarz Bayes Information Criteria (SBIC), Hannan-Quinn Information Criteria (HQ), Final Prediction Error (FPE) and Likelihood Ratio (LR). It is important to note that these selection criteria techniques are used to provide similar results, in the sense that they usually provide correct lag length. However, the lag length may change depending on the sample size. Even though in small samples AIC and FPE choose correct order more often than HQ and SBIC, it does not necessarily mean that AIC and FPE are superior to HQ and SBIC[8]. Following Lutkepohl's (2005) approach, which argues that it is a good strategy to compare estimates obtained with different criteria, the present study performs causality tests by using different optimal lag lengths provided by different criteria, and shows that our results are insensitive to this exercise.[9]

As a further step, we extend our analysis into a multivariate VAR framework and we estimate a 3-variable VAR model with real GDP, CONST and R series. One substantial advantage of the VAR is to bring forth the dynamic structure between variables. The reduced-form VAR is specified by the following equation:

$$\boldsymbol{Y_t = B_0 + \sum_{k=1}^{K} B_k Y_{t-k} + U_t} \tag{4}$$

where $\mathbf{Y}_t$ is the vector of variables $(GDP_t, CONST_t, R_t)$, $\mathbf{B}_k$ is the matrix of coefficients for the k-th lag of $\mathbf{Y}_t$, and $\mathbf{U}_t$ is the vector of reduced form innovations. The value of k, the number of lags included in (4), is to be determined by the aforementioned selection criteria.

5. Discussion of Empirical Findings

Data analysis reveals that there are structural breaks in our time-series data. Precisely, while a structural break both in GDP and CONST series occurs in 2002Q1, another structural breakdown in R series appears in 2010Q2 (see Figure 6 above). Due to the structural shifts in data, we extend our analysis by dividing the 17-years sample period into smaller sub-periods of 2002-2007, 2002-2014, and 2010-2014, which are defined with the locations of breaks in the data. This section firstly describes the main characteristics of sub-periods and then provides the empirical results of two-variable Granger causality test and the multivariate VAR model both for the overall sample period 1998-2014, and for the sub-sample periods of 2002-2007, 2002-2014, and 2010-2014, separately.[10]

[8] Lutkepohl (2005) has an extensive discussion with regards to this issue. Since such a discussion is beyond the scope of this present paper, interested readers are encouraged to see Lutkepohl (2005) for further details.

[9] Same is valid for the next sub-section discussing the 3-variable VAR model.

[10] Small-sample degrees of freedom adjustment is employed for our sub-samples when estimating the variance-covariance matrix throughout our analyses.

We define 2002-2007 sub-period as the catching-up period of the Turkish economy after 2001 crisis, and describe 2010-2014 sub-period as another recovery period of the national economy after the global financial crisis of 2008-2009. Briefly, we extend our causality analysis of the entire sample by carrying out systematic investigation of sub-periods and aim to identify possible changes in the causal relationship between economic growth and construction investments across different periods in the national economy.

5.1. Turkish Economy and Construction Industry for the 2002-2007, 2010-2014, and 2002-2014 Sub-periods

Turkey has undergone a profound economic transformation after the 2001 financial crisis, and it has recorded a remarkable GDP growth rate of 6.8% in average during the period 2002-2007 due to the successful macroeconomic stabilization program implemented in this period.[11] More specifically, the Turkish economy recovered promptly from the 2001 crisis as a result of a clear medium-term roadmap, strong external anchors in the form of IMF programs and the prospect of EU accession, and domestic structural reforms. Macroeconomic stability was attained first and foremost by means of tight fiscal and monetary policies. It was complemented by structural reforms in the area of enterprise restructuring and privatization, business environment, trade liberalization, labor market and in particular by a thorough reform of the banking sector. As a result, foreign and domestic investments shot up, increasing labor productivity and the sectoral transformation of the economy and spurring real convergence with the EU. The main contributor of the recovery and real GDP growth was the recovery of domestic demand, in particular of booming investment and increasing private consumption. Furthermore, political uncertainties greatly receded once a single-party majority government (the first AKP government) emerged from the November 2002 elections, which promised well for the future stability of the economy (Macovei, 2009).

To sum up, the catching-up process of the Turkish economy accelerated markedly during 2002-2007 period, when real GDP grew on average by 6.8% annually, more than double the average posted during the boom-bust decade of the 1990s. In terms of construction industry, the cumulative growth rate in construction activities reached up to 68.4% during the period of 2002-2007. The sector experienced record growth rates of 14.1 percent and 18.5 percent in 2004 and 2006, respectively. This remarkable growth in construction industry was mainly driven by the delayed-demand for real estate developments because of the high-inflation environment throughout the late 1980s and 1990s. 1999-Marmara region earthquake and the macroeconomic uncertainty in 2000-2001 financial crises were other influential factors, resulting in delayed-demand for the Turkish real estate markets.

In addition to 2002-2007 sub-period, which includes catching-up and recovery years of the national economy after 2001 crisis, we also investigate the causal relationship between economic

[11] According to Kemal Derviş, the economy minister in 2001-2002 responsible for launching Turkey's recovery from a huge financial crisis, Turkish economy had a 'golden age' between 2002 and 2007 due to its robust maintenance of the independence of institutions adopting monetary policy and structural reforms that the country started to make after becoming a candidate state for EU membership in 1999. However, he added that the perception that election winners "could do whatever they want" and the distancing from the EU have played a role in the slowing of the Turkish economy after 2007. http://www.hurriyetdailynews.com/turkish-economy-had-a-golden-age-between-2002-2007-says-former-economy-tsar.aspx?pageID=238&nid=75501

growth and construction investments for the 2002-2014 sub-period of time. As the main structural break in GDP and CONST series occurs in 2002Q1, we attempt to understand how the lead-lag relationship between the national economy and construction sector behaved after this break point up to date.

Finally, the third sub-period of 2010-2014 can be defined as another recovery period in the Turkish economy and covers the post-global financial crisis period with high foreign capital, remarkably low interest rates and resilient neo-liberal urban policies implemented by the AKP government. Indeed, Turkish economy has recovered very quickly from the global financial crisis of 2008-2009 and high economic growth return in 2010. This recovery was the result of the economic program that was applied with discipline during the pre-global crisis period. In 2010-2011, Turkey experienced impressive GDP growth, which reached an annual 9 percent, and it was largely driven by foreign investment, debt-fueled private consumption and property investments of both domestic and international construction firms. In addition, the real interest rates experienced the lowest levels of -1.75 percent as of 2010Q1. Such a rate was uncharacteristically low as it had been in double digits since 1990s. The main reason behind the historically low real interest rates was the adoption of FED's bond-buying program, called quantitative easing or QE, which stimulates capital outflows to emerging markets as a result of weakening of the US Dollar. As seen in Figure 6 above, the structural break in real interest rates appears to be just one quarter ahead, 2010Q2. This break is also obvious in Figure 5 in the sense that the average real interest rate during 1998Q1-2010Q1 period was 3.69 percent, whereas it went down to 0.24 percent between 2010Q2 and 2014Q4. Hence, there was a clear shift in the economy towards a lower real interest rate environment after 2010.[12]

Excessive private financial capital inflows to Turkey coupled with the increase in foreign exchange reserves and depreciated USD as an outcome of QE caused a sharp decline in interest rates throughout the 2010Q1-2014Q4 period in Turkey. Low interest rates not only decreased the cost of financing but also increased the availability of housing loans (mortgages), resulting in a significant amount of construction in the country. Construction sector, therefore, experienced remarkable growth rates of 18.3 percent in 2010 and 11.5 percent in 2011. More importantly, the growth in construction industry delivered the largest contribution to the real GDP growth in the years of 2010 and 2011. Furthermore, in May 2012, two effectual laws regarding construction sector were ratified by the Turkish Parliament. The *Law on the Transformation of Areas under Natural Disaster Risk* authorized public sector involvement in urban transformation process with an initial estimation of 6.5 million dwelling units with natural disaster risk. The second newly amended *Reciprocity Law* substantially eased foreign investment restrictions and foreign property investors have turned their attention to the Turkish real estate markets.

Immediately after this notable growth in the economy, the Central Bank of the Republic of Turkey (CBRT) introduced a tightening monetary policy. The measures taken by the CBRT resulted in a significant decline in the debt-based domestic spending. According to the Standard &Poor's Global Credit Portal (May 2012), the fall in domestic demand in 2012 was not the sole contributor to the low growth. Economic developments in the world also limited the flow of foreign capital

[12] The short-term nominal interest rates exhibit a similar trend: following a sharp decline from 10.20% in 1998Q1-2010Q1 to only 2.02% during the 2010Q2-2014Q4 period.

into Turkey, which directly affected growth since the economy was reliant on exports. Hence Turkish economy expanded only 2.1 percent in a year after impressive figures of 9.2 and 8.8 percent growth rates in 2010 and 2011.

To sum up, in comparison to the first sub-period of 2002-2007, which recorded a remarkable GDP growth rate of 6.8 percent, real GDP grew on average by 5.4 percent during the third sub-period of 2010-2014. The average real interest rates declined from 3.53 percent in 2002-2007 to 0.14 percent in 2010-2014. The growth in construction industry has slowed down and the cumulative growth rate in construction activities; that was 23.04 percent, had not been as strong as the first sub-period of 2002-2007.

5.2. Empirical Results for overall sample period of 1998 to 2014

The two-variable Granger causality test results and the multivariate VAR model estimation results, both for the overall sample and three sub-samples, are presented in Table 2 and Table 3, respectively. For the overall period of 1998-2014, the economic expansion (reel GDP growth) Granger causes construction industry growth at the 1% significance level both for 2 lags and 4 lags, but not vice versa (Table 2). The first panel of Table 3 presents the results for 3-variable VAR model estimation at 2 lags and reveals that real GDP growth again causes construction industry growth at 1% significance level, but not vice versa.

The second panel of Table 3 presents 3-variable VAR model estimation results at 5 lags and shows that there is bidirectional causality relationship between GDP and CONST series at 5% significance level and also between CONST and R series at 1% significance level. There is no doubt that construction industry is very sensitive to a change in interest rate. For instance, lower interest rates directly affect the credit market by lowering the cost of borrowing which will stimulate demand and spending and in turn helping the economy to grow, and accordingly the growing economy leads to the construction growth. Similarly, higher interest rates will damage construction projects given that almost all projects rely on financing costs. It should here be noted that as a result of expansionary phase in an economy, the interest rates are expected to rise, even though they are relatively low at the beginning of an expansionary period. This is mainly why there exists a feedback effect between real interest rate and construction activities in an economy.

Hence, our empirical results indicate that the null hypothesis of "*Construction industry does not cause GDP growth*" cannot be rejected at the conventional significance levels (1% and 5% levels) for 2 and 4 lags. During the period between 1998 and 2014, economic growth in Turkey has preceded construction activities with two- to four-quarters lag, but not vice versa. This result supports the findings of Tse and Ganesan (1997), Yiu *et al.* (2004), and Ramachandra *et al.* (2013) in that expansion of construction activity is headed by an increase in economic output and that the changes in GDP initially will affect demand for construction projects, then housing credit availability, and then the level of construction output.

Table 2: Empirical Results for Two-variable Granger Causality Test

	The Overall Period of 1998 to 2014		Sub-Period of 2002 to 2007		Sub-Period of 2010 to 2014		Sub-Period of 2002 to 2014	
	F statistics							
Direction of causality	**At 2 lags**	**At 4 lags**	**At 1 lag**	**At 4 lags**	**At 3 lags**	**At 4 lags**	**At 2 lags**	**At 4 lags**
GDP → CONST	10.44*** (0.005)	15.55*** (0.004)	2.93 (0.1018)	0.81 (0.54)	1.73 (0.21)	1.01 (0.45)	9.65*** (0.008)	12.397 (0.015)
CONST → GDP	3.5219 (0.172)	9.0215* (0.061)	2.11 (0.1615)	0.22 (0.92)	5.02** (0.016)	6.11*** (0.007)	2.26 (0.32)	7.83* (0.098)

*, **, *** indicates that the null hypothesis of no causality is rejected at the significance level of 10%, 5% and 1%, respectively.

Table 3: Empirical Results for the Multivariate VAR Model Estimation

	The Overall Period of 1998 to 2014					
	At 2 Lags			**At 5 Lags**		
Dependent variable	**Source of causation (independent variables)**			**Source of causation (independent variables)**		
	GDP	**CONST**	**R**	**GDP**	**CONST**	**R**
GDP	…	3.66 (0.16)	4.69* (0.096)	…	13.065** (0.023)	7.67 (0.175)
CONST	11.619*** (0.003)	…	3.050 (0.218)	12.08** (0.034)	…	38.665*** (0.000)
R	1.422 (0.491)	8.62** (0.013)	…	10.383* (0.065)	20.054*** (0.001)	…

Sub-period of 2002-2007						
	At 1 Lag			**At 4 Lags**		
Dependent variable	**Source of causation (independent variables)**			**Source of causation (independent variables)**		
	GDP	**CONST**	**R**	**GDP**	**CONST**	**R**
GDP	…	1.332 (0.262)	0.866 (0.363)	…	1.120 (0.421)	0.349 (0.869)
CONST	2.697 (0.116)	…	1.453 (0.242)	0.914 (0.517)	…	1.893 (0.201)
R	5.688** (0.027)	6.883** (0.016)	…	2.181 (0.156)	3.034* (0.079)	…

Sub-period of 2010-2014			
	At 4 Lags		
Dependent variable	**Source of causation (independent variables)**		
	GDP	**CONST**	**R**
GDP	…	3.444* (0.074)	0.076 (0.987)
CONST	1.008 (0.464)	…	1.068 (0.439)
R	0.340 (0.843)	0.530 (0.718)	…

Sub-period of 2002-2014						
	At 1 Lag			**At 4 Lags**		
Dependent variable	**Source of causation (independent variables)**			**Source of causation (independent variables)**		
	GDP	**CONST**	**R**	**GDP**	**CONST**	**R**
GDP	…	1.527 (0.217)	0.584 (0.445)	…	13.179*** (0.010)	5.959 (0.202)
CONST	0.172 (0.678)	…	0.969 (0.325)	12.43** (0.014)	…	38.337*** (0.000)
R	8.247*** (0.004)	9.014 (0.003)	…	13.269*** (0.010)	31.17*** (0.000)	…

*, **, *** indicates that the null hypothesis of no causality is rejected at the significance level of 10%, 5% and 1%, respectively.

5.3. Sub-Sample Analysis

In an attempt to understand if the causal effect of economic growth on the expansion of construction activities that is observed throughout the entire period of 1998-2014 is effective or not for the different periods of the national economy, we carry out both the two-variable Granger causality test and the three-variable VAR model for the sub-sample periods of 2002-2007, 2002-2014, and 2010-2014, separately.

Granger-causality test results for the first sub-period of 2002 to 2007 are displayed in the second panel of Table 2 and show that there is not a statistically significant causal relationship between GDP and CONST series both for 1 lag and 4 lags. This sub-period involves the catching-up and recovery years of the national economy after 2001 crisis with a remarkable growth rates in GDP and construction activities. However, we could not find out a lead-lag relationship between economic growth and construction industry growth in this sub-period of time. Three-variable VAR model estimation results for the first sub-period are given in Table 3 and show that once again there is not a statistically significant causal relationship between GDP and CONST series at the optimal lag lengths of 1 and 4 quarters.[15]

Granger-causality test results for the third sub-period of 2010-2014 are displayed in the third panel of Table 2, and indicate that the expansion in construction industry Granger causes the economic growth at the 1% (5%) significance level for 4 lags (3 lags). Unlike the entire sample period of 1998-2014, there is no causal effect running from the economic growth to construction industry growth throughout the sub-period of 2010-2014. Results for the three-variable VAR model also show that construction industry growth causes GDP growth at 10% significance level for the optimal lag length of 4 quarters. Hence, we argue that the causal relationship between economic growth and construction investment varies considerably across different periods in the national economy.

As explained earlier, the sub-period of 2010-2014 experienced high levels of foreign capital inflows, the lowest levels of interest rates since mid-1990s and the rapid commodification of urban spaces through a radical change in urban legislation. 2010 and 2011 are very influential years in this sub-period of the economy in that construction sector experienced remarkable growth rates of 18.3% and 11.5% in 2010 and 2011, respectively and that the growth in construction industry delivered the largest contribution to the real GDP growth, which reached an annual 9%, during these years. Hence, the low interest rate environment with the help of essential legislative reforms that made investing in Turkish real estate markets easier and more profitable than it used to be boosted up the construction industry, and the substantial increase in construction activities resulted in economic growth. However, empirical results for the overall sample show that this temporary effect of construction industry on economic growth throughout the 2010-to-2014 period could not be sustainable in the longer period of time; that is for the entire sample period of 1998 to 2014.

Finally, empirical findings on the causal relationship between economic growth and construction investments are mixed for the sub-period of 2002-2014. More specifically, the results of Granger causality test show that the null hypothesis of "real GDP growth does not cause construction industry

[15] There is causality running from GDP to R and from CONST to R at 5% significance level for 1 lag. According to Kim and Roubini (2008), as 1 lag is often regarded as too short to capture enough economic interpretations among variables for a model with quarterly data, we do not interpret the results for 1 quarter lag in our study.

growth" is rejected at the significance level of 1% for 2 lags, and that the null hypothesis of "construction industry growth does not cause real GDP growth" is also rejected at 10% significance level for 4 lags. Three-variables VAR model estimation results, on the other hand, point out that there exist bidirectional relations between construction activities and economic growth, and also between construction activities and real interest rates and that the causality running from construction investments to GDP is stronger than that in reverse direction. There is also a significant (at 1% significance level) causality running from the real GDP growth to real interest rates for 4 lags.

6. Conclusion

After the 2001 financial crisis, Turkey's economy moved full-speed ahead, except for a temporary reversal in 2009 during the global financial crisis. During the period 2002-2014, while the economy grew by 4.9% per year on average, the real growth in construction sector activities had been 6.5% per annum. Through the years of accelerated economic growth, construction output increased at a faster rate than the economy as a whole, but in the periods of stagnation, the construction industry was the first to suffer.

This study is one of the initial attempts to investigate the causal relationship between construction investments and economic growth in Turkey and provides an updated and enriched version of the existing studies on this topic by using a longer period of time, testing the causal relationships in a multivariate model setting with sub-period analyses, and providing a detailed discussion on the increasing role of construction sector in the national economy along the lines of neoliberal urban policies adopted by the government.

Empirical results for the entire sample period of 1998 to 2014 indicate that economic growth in Turkey has preceded construction activities with two- to four-quarters lag, but not vice versa. This result supports the findings of Tse and Ganesan (1997) and Yiu *et al.* (2004) for Hong Kong, Kim (2004) for Korea, Lopes et al. (2011) for Cape Verde, and Ramachandra *et al.* (2013) for Sri Lanka. The expansion of construction activity is directed by an increase in economic output and that the changes in GDP initially will affect demand for construction projects, then housing credit availability, and then the level of construction output.

In an attempt to understand if the causal effect of economic growth on the expansion of construction activities that is observed throughout the entire period of 1998-2014 is effective or not for the different periods of the national economy, we carry out both the two-variable Granger causality test and the three-variable VAR model for the sub-sample periods of 2002-2007, 2002-2014, and 2010-2014, separately. We define these three sub-periods according to the location of structural breaks in data and conclude that the causal relationship between economic growth and construction investments varies considerably across the sub-periods in the economy. While the empirical results for the first sub-period of 2002 to 2007 show that there is not a statistically significant causal relationship between GDP and CONST series, the results for the sub-period of 2002-2014 are mixed. For the sub-period 2010-2014, both the two-variable Granger causality test and three-variable VAR model estimation results indicate that expansion in construction activities causes GDP growth over the last five years in the country. In this period, the interest rates reached its lowest levels since mid-1990s and radical changes in urban legislation resulted in rapid commodification of urban spaces all around the country. Hence, construction industry experienced remarkable growth rates of 18.3% and 11.5% in 2010 and 2011,

respectively and the growth in the sector delivered the largest contribution to the real GDP growth, which reached an annual 9%, during these years. However, this temporary effect of construction industry on economic growth throughout the period 2010-2014 could not be sustainable for the entire sample period of 1998 to 2014. Hence, we argue that the temporary effect of construction industry growth on the GDP growth in the sub-period 2010-2014 is not justifiable for the overall sample period.

Finally, we find that there exists a bidirectional relationship between construction activities and real interest rates both for the entire sample period and for the sub-period 2002-2014. Obviously, much of the cyclicality in construction investment, especially in the housing production, stems from the sector's sensitivity to interest rates (Berger-Thomson and Ellis, 2004). Lower interest rates not only decreased the cost of financing but also increased the availability of credits (mortgages), resulting in a significant amount of construction in the country. A low-interest rate environment stimulates the demand and spending and in turn helps the economy to grow, and accordingly the growing economy leads to the construction growth. Similarly, higher interest rates damage construction projects given that almost all projects rely on financing costs. It should here be noted that as a result of expansionary phase in an economy, the interest rates are expected to rise, even though they are relatively low at the beginning of an expansionary period. This is mainly why there exists a feedback effect between real interest rate and construction activities in an economy.

To conclude, the share of construction industry in the Turkish economy is relatively small when compared to the countries like China, Russia, India, Indonesia, Mexico, and Korea. In addition, the sector has been fragile and highly volatile in the past seventeen years. The most notable result of this study is that construction industry growth had short-lived effects on the economic growth and thus could not offer permanent solutions for the economic troubles in Turkey.

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Appendix:

Table A.1 Order Selection Criteria Results for the Optimal Lag Length: Two-Variable Granger Causality Test (Period: 1998-2014)

lag	LL	LR	p	FPE	AIC	HQIC	SBIC
0	-268.123			63.2372	9.82264	9.85087	9.89563
1	-260.664	14.917	0.005	55.7759	9.69688	9.78156	9.91586
2	-250.405	20.519	0	44.4564	9.46926	**9.61039***	**9.83423***
3	-246.738	7.3321	0.119	45.0792	9.4814	9.67899	9.99236
4	-241.975	**9.5271***	0.049	**43.9837***	**9.45363***	9.70768	10.1106
5	-240.359	3.2328	0.52	48.2061	9.54031	9.85081	10.3432
6	-238.133	4.4517	0.348	51.795	9.60483	9.97178	10.5537
7	-237.379	1.5082	0.825	58.8756	9.72286	10.1463	10.8178
8	-235.58	3.5966	0.463	64.6484	9.80292	10.2828	11.0438

Table A.2 Order Selection Criteria Results for the Optimal Lag Length: Two-Variable Granger Causality Test (Period: 2002-2007)

lag	LL	LR	p	FPE	AIC	HQIC	SBIC
0	-106.701			29.4518	9.05841	9.08446*	9.15658*
1	-102.286	8.8293	0.066	**28.5236***	**9.02386***	9.10199	9.31837
2	-100.063	4.446	0.349	33.4004	9.17194	9.30217	9.6628
3	-95.9982	8.1302	0.087	33.9757	9.16652	9.34883	9.85372
4	-90.7564	**10.484***	0.033	31.9506	9.06303	9.29743	9.94657

Table A.3 Order Selection Criteria Results for the Optimal Lag Length: Two-Variable Granger Causality Test (Period: 2010-2014)

lag	LL	LR	p	FPE	AIC	HQIC	SBIC
0	-73.0351			6.22097	7.50351	7.52295	7.60309
1	-55.1505	35.769	0	1.55871	6.11505	6.17336	6.41377
2	-48.2694	13.762	0.008	1.18867	5.82694	5.92413	6.3248
3	-35.6417	**25.255***	0	**0.522145***	4.96417	**5.10023***	**5.66118***
4	-31.2691	8.7451	0.068	0.543329	**4.92691***	5.10185	5.82307

Table A.4 Order Selection Criteria Results for the Optimal Lag Length: Two-Variable Granger Causality Test (Period: 2002-2014)

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-247.59				50.5966	9.59963	9.6284	9.67468*
1	-244.65	5.8811	4	0.208	52.714	9.64038	9.72669	9.86552
2	-236.375	16.551	4	0.002	**44.763***	**9.47594***	**9.6198***	9.85118
3	-233.579	5.5915	4	0.232	46.9834	9.52226	9.72366	10.0476
4	-228.49	**10.178***	4	0.038	45.2252	9.48037	9.73931	10.1558

Table A.5 Order Selection Criteria Results for the Optimal Lag Length: Multivariate VAR Model (Period: 1998-2014)

lag	LL	LR	p	FPE	AIC	HQIC	SBIC
0	-441.233			695.841	15.0587	15.1	15.1644
1	-420.961	40.543	0	475.157	14.6767	14.8416	15.0992
2	-395.85	50.222	0	275.958	14.1305	**14.4192***	**14.87***
3	-390.082	11.537	0.241	309.926	14.2401	14.6524	15.2964
4	-372.041	36.08	0	230.908	13.9336	14.4697	15.3069
5	-361.721	**20.641***	0.014	**225.192***	**13.8888***	14.5486	15.579
6	-356.741	9.96	0.354	265.806	14.0251	14.8086	16.0322
7	-353.86	5.762	0.763	341.112	14.2325	15.1397	16.5566
8	-345.559	16.601	0.055	370.04	14.2562	15.2872	16.8972

Table A.6 Order Selection Criteria Results for the Optimal Lag Length: Multivariate VAR Model (Period: 2002-2007)

lag	LL	LR	p	FPE	AIC	HQIC	SBIC
0	-164.228			226.364	13.9356	13.9747	14.0829
1	-140.846	46.763	0	68.9217	12.7372	12.8935	**13.3262***
2	-131.821	18.051	0.035	71.7908	12.7351	13.0085	13.7659
3	-121.659	20.323	0.016	72.7161	12.6383	13.029	14.1109
4	-108.642	**26.036***	0.002	**65.2942***	**12.3035***	**12.8113***	14.2178

Table A.7 Order Selection Criteria Results for the Optimal Lag Length: Multivariate VAR Model (Period: 2010-2014)

lag	LL	LR	p	FPE	AIC	HQIC	SBIC
0	-99.4265			5.63652	10.2426	10.2718	10.392
1	-80.1428	38.567	0	2.04837	9.21428	9.33091	9.81172
2	-69.9621	20.361	0.016	1.96451	9.09621	9.30031	10.1417
3	-50.7112	38.502	0	0.863579	8.07112	8.36269	9.56472
4	-34.6322	**32.158***	0	**0.671243***	**7.36322***	**7.74225***	**9.30489***

Table A.8 Order Selection Criteria Results for Multivariate VAR Model (Period: 2002-2014)

lag	LL	LR	p	FPE	AIC	HQIC	SBIC
0	-370.144			343.113	14.3517	14.3948	14.4642
1	-334.406	71.475	0	122.806	13.3233	13.4959	**13.7736***
2	-318.429	31.955	0	94.279	13.055	13.3571	13.843
3	-310.829	15.2	0.086	100.456	13.1088	13.5404	14.2345
4	-292.292	**37.073***	0	**70.8706***	**12.742***	**13.3031***	14.2054

Table A.9 Zivot Andrews Unit Root Test Results

	GDP*	CONST*	R**
Lags included* **	0	0	0
Minimum t-statistics	-6.820	-6.045	-5.523
At period	2002q1	2002q1	2010q2
1% Critical Value	-5.34	-5.34	-4.93
5% Critical Value	-4.80	-4.80	-4.42
10% Critical Value	-4.58	-4.58	-4.11

*Allowing for break in intercept

**Allowing for break in trend

***Lag selection method is BIC