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THE CONSTRUCTION SECTOR AND ECONOMIC GROWTH: A SUSTAINABLE RELATIONSHIP?

İNŞAAT SEKTÖRÜ VE EKONOMİK BÜYÜME: İLİŞKİ SÜRDÜRÜLEBİLİR Mİ?

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ABSTRACT

In this study, the relationship between growth in the construction sector and economic growth in Turkey which is one of the developing countries was examined. Total Construction Turnover Index and Gross Domestic Product data between 2005/Q1 and 2017/Q4 periods were accessed from the official website of the Turkish Statistical Institute. Structural breaks were also taken into consideration due to the crises encountered in the construction sector and economy in the period under review. In order to determine the stationarity of the variables, one and two-break Lee-Strazicich unit root tests were used in addition to the conventional unit root tests. In this period, where significant breaks were determined, the long-run relationship between the variables was investigated by Hatemi-J two unknown structural breaks cointegration analysis. According to this, considering two significant breaks in the periods of 2009/Q4 and 2013/Q3, a long-run relationship was determined between growth in the construction sector and economic growth. Then, the Wald coefficient test was performed to identify whether this determined relationship was sustainable.

Keywords: Construction Sector, Economic Growth, Structural Break, Cointegration, Sustainability

ÖZ

Bu çalışmada gelişmekte olan ülkeler arasında yer alan Türkiye'de inşaat sektöründeki büyüme ile ekonomik büyüme arasındaki ilişki incelenmiştir. 2005/Q1 ve 2017/Q4 dönemleri arasındaki Toplam İnşaat Ciro Endeksi (CTU) ve Gayri Safi Yurt İçi Hasıla (GSYİH) verilerine Türkiye İstatistik Kurumu resmi web sayfasından ulaşılmıştır. İncelenen dönemde inşaat sektöründe ve ekonomide yaşanan krizlerden dolayı yapısal kırılmalar da göz önüne alınmıştır. Değişkenlerin durağanlığının saptanmasında klasik birim kök testlerinin yanı sıra tek ve iki kırılmalı Lee-Strazicich (LS) birim kök testleri kullanılmıştır. Anlamlı kırılmaların belirlendiği bu periyotta değişkenler arasındaki uzun dönem ilişki Hatemi-J iki kırılmalı eşbütünleşme analizi ile araştırılmıştır. Buna göre 2009/Q4 ve 2013/Q3 dönemlerindeki iki anlamlı kırılma göz önüne alındığında inşaat sektöründeki büyüme ile ekonomik büyüme arasında uzun dönemde ilişki olduğu saptanmıştır. Ardından belirlenen bu ilişkinin sürdürülebilir olup olmadığını belirlemek için Wald katsayı testi yapılmıştır.

Anahtar Sözcükler: İnşaat Sektörü, Ekonomik Büyüme, Yapısal Kırılmalar, Eşbütünleşme Analizi, Sürdürülebilirlik

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1. Introduction

The complexity of the relationship between a country's construction activity level and its economic development is remarkable. Especially in countries facing severe economic crises, the construction sector is of vital importance in order to emerge from stagnation due to their direct relations with more than 200 different sectors (Ozkan et al., 2012). The importance of the construction sector in economic development was first noted in the 1960s by D. A. Turin. There are many studies in the literature about that there is a relationship between infrastructure investments and economic growth for developed countries, and that public infrastructure investments slow down productivity (Aschauer, 1989; Wylie, 1996). In most of the developing countries, on the other hand, it is emphasized that approximately half of the Gross Fixed Capital Formation investments come from construction (Wells, 1985). Therefore, it is understood that the construction sector plays a dominant role in a country's Gross Fixed Capital Formation (Gruneberg, 1997). Moreover, it affects the employment and production process significantly due to the fact that it concerns more than a hundred professions. The construction sector, at the same time, plays an important role in achieving sustainable development (Majdalani et al., 2006). It is clear that the issues related to the economic, social and environmental qualifications required for sustainable development are covered by the construction sector (Robin, Poon, 2009).

The prerequisite for making valid comparisons and analyses of the construction sector must always be the availability of valid, reliable and transparent data (Ruddock, Lopes, 2006). Ofori (1990) reviewed data access issues for developing countries and argued that quality construction data is the basis for policy-making and planning. When performing multivariate time series analyses, the observation size of the variable of interest must be at an adequate level. Otherwise, it would be doubtful that the results achieved are reliable in terms of estimation and policy determination.

In this study, Total Construction Turnover Index (CTI) representing the growth in the construction sector between 2005/Q1 and 2017/Q4 periods and GDP data showing the economic growth were used. The long-run relationship between total CTI and GDP variables was examined by cointegration analyses. Structural changes experienced worldwide and in Turkey during the inspected period were not ignored as well. In order to determine the structural variations, LS unit root tests, which take into account one and two-breaks, were applied. The reason for choosing this test is its superiority resulting from the presence of structural breaks in both the null and the alternative hypothesis. Since significant structural breaks were detected in the examined period, the Hatemi-J test, which is used in two-break cointegration analysis, was preferred in the investigation of a long-run relationship. Although many studies show that the construction sector is related to economic growth, it should be examined whether this relationship is sustainable or not. In this study, sustainability is tested by the Wald test.

2. Literature Review

In the oldest and most comprehensive study, 87 countries were reviewed using cross-sectional data analysis and the relationship between the level of GDP per capita and the amount of construction formation per capita between the years of 1955-1965 was examined; and a very strong linear correlation was found between these two variables (Turin, 1969). It was put forward that the construction sector needed to grow faster than the economy during periods of accelerated economic growth (Strassman, 1970). The studies show that the interdependence between the construction sector and other sectors is not static, but it grows and develops national economies (Lean, 2001). When the literature is reviewed, it is seen that the effect of the construction sector on the economy is evaluated separately for developed and developing countries. In the analyses conducted with the data collected after the 1970s, it was suggested that there was a significant relationship between the construction sector and economic growth in developing countries (Giang, Pheng, 2011). In a study on Hong Kong, it was found that in the short term, GDP led to construction flows but the reverse was not always applicable (Tse, Ganesan, 1997). However, in studies, it is seen that there is mainly one-way causality from the construction sector to GDP. According to the Granger causality analysis conducted for Sri Lanka, it was determined that the growth in the construction sector triggered growth in GDP (Ramachandra, Rameezdeen, 2006). In the literature, there are also studies showing that there is two-way causality from economic growth to the construction sector and from the construction sector to economic growth. Nigeria and Saudi Arabia were cited as examples of the countries with two-way causality (Oladinrin et al., 2012, Alhowaish, 2015). On the other hand, in Western Europe, it was shown that the causal effect between construction investments and GDP was weak in the long term (Wilhelmsson, Wigren, 2009). In the case of China, it was found that while construction investment had a short-term effect on economic growth, economic growth had a long-term impact on the construction (Zheng, Liu, 2004). And in Turkey, it was found that there was a relationship between the construction sector and economic growth in the long run, however, the sector was excessively affected by the crises in the short term (Ozkan et al., 2012). In the study where Granger Causality test was employed using Turkey's data of 1987-2010 period, it was determined that there was a one-way causality relationship heading both from public sector construction investments to GDP and from GDP and public sector construction investments to private sector construction investments (Kaya et al., 2013). In the Baltic States (Lithuania, Latvia, and Estonia), the causal relationship between foreign direct investment in construction (CFDI) and the contribution of the construction industry to gross domestic product was analyzed and it was found that, in the case of Lithuania and Estonia, direct foreign investments were not the Granger cause of the GDP growth (Banaitiene et al., 2015). Other than long-term and causality relations, the effects of economic crises are also an important consideration that is analyzed in the construction sector. The crisis that started in the years 2008-2009 severely affected the construction sector markets of the European Union countries and the majority of the countries were confronted with a reduction in the outputs, real estate transactions, employment of the population, and the number of construction companies (Kildiene et al., 2011). In Spain, which has the largest construction sector among the European Union countries (Eurostat, 2012), the construction sector was negatively affected with a contraction by almost a third at the end of 2009 due to the financial crisis (Eurostat, 2012; Kapelko et al., 2014).

3. Methodology

It is of great importance to investigate the stationarity of the series before starting the relationship analysis through time series. It is known that macroeconomic variables are generally nonstationary. In the literature, there are different methods such as line charts and analysis of autocorrelation coefficients to examine the stationarity. However, with the implementation of unit root tests since 1979, these tests have formed the most important part of the stationarity tests.

Stochastic unit root process is expressed as follows:

$$Y_t = \rho Y_{t-1} + u_t - 1 \leq \rho \leq 1 \tag{1}$$

In equation 1, u_t is the term white noise. When $\rho = 1$, there is unit root, so the equation is a random walk model. And this is a nonstationary stochastic process (Gujarati, Porter, trans. 2012 p.754). Unit root tests were first applied by Dickey and Fuller in 1979, and then developed, and many researchers such as Dickey & Fuller (1981), Bhargava (1986), Phillips & Perron (1988), Schwert (1989), Kwiatkowski & Phillips & Schmidt & Shin (1992), and Elliot & Rothenberg & Stock (1996) have made contributions to these tests. These tests assume that the series are linear, so they give inconsistent and unreliable results in cases where there are structural breaks in the series. Structural breaks are examined in two groups as the cases where the break date is known (exogenous) and the cases where the break date is unknown (endogenous). First by Perron, in 1989, the one-break unit root test, which was considered as exogenous, was developed (Perron, 1989). Then, in 1992, Zivot and Andrews criticized Perron's exogeneity and applied the endogenous one-break unit root test (Zivot & Andrews, 1992). Studies in the literature mostly focused on the endogeneity of the break date. Christiano (1992), Banerjee, Lumsdaine, Stock (1992), Perron, Vogelsang (1992), Lumsdaine, Papel (1997), Perron (1997), Lee-Strazicich (2004) tests are those in which the break date is determined endogenously. Especially if the period examined is long, it is seen that evaluating one-break is inadequate. For this reason, unit root tests with two and more breaks were developed. The Lee-Strazicich test has great importance among the two-break unit root tests. Since in the LS test, break tests are carried out in both the null hypothesis and in its alternative hypothesis, it is suggested to be stronger (Lee & Strazicich, 2003, 2004).

$$\begin{aligned} H_0&: y_t = \mu_0 + d_1 B_1 t + d_2 B_2 t + y_{t-1} + u_1 t \\ H_1&: y_t = \mu_1 + \gamma t + d_1 D_1 t + d_2 D_2 t + u_2 t \end{aligned} \tag{2}$$

Encountering one or more structural breaks in the time series examined over a long period has proved the results of the classical cointegration analyses insufficient. In order to eliminate this deficiency, cointegration tests, which give more consistent results when there are one, two or more breaks in the series, were developed. The first of them is Gregory and Hansen's (1996) cointegration model, which contains an endogenous break. And Hatemi-J, in his study in 2008, showed that cointegration analysis can be performed even in the presence of two breaks in the series. The models that allow two breaks:

Model 2: Level Shift (Model C)

$$y_t = \alpha_0 + \alpha_1 D_{1t} + \alpha_2 D_{2t} + \beta_0 x_t + u_t \tag{3}$$

Model 3: Level Shift with Trend (Model C/T)

$$y_t = \alpha_0 + \alpha_1 D_{1t} + \alpha_2 D_{2t} + \gamma_t + \beta'_0 x_t + u_t \tag{4}$$

Model 4: Regime Shift (Model C/S)

$$y_t = \alpha_0 + \alpha_1 D_{1t} + \alpha_2 D_{2t} + \beta'_0 x_t + \beta'_1 D_{1t} x_t + \beta'_2 D_{2t} x_t + u_t \tag{5}$$

D_{1t} and D_{2t} are dummy variables and defined as in equation (6).

$$D_{1t} = \begin{cases} 0 \; if \; t \leq [n\tau_1] \\ 1 \; if \; t > [n\tau_1] \end{cases} \qquad D_{2t=} \begin{cases} 0 \; if \; t \leq [n\tau_2] \\ 1 \; if \; t > [n\tau_2] \end{cases} \tag{6}$$

Here, the unknown parameters $\tau_1 \varepsilon (0,1)$ and $\tau_2 \varepsilon (0,1)$ indicate the regime shift point and the square brackets indicate an integer. The null hypothesis tests that there is no cointegration. For this, the ADF, Z_α, Z_t test statistics are utilized. Here, the ADF test statistic is calculated based on the t test value, which is the slope of $\widehat{u}_{t-1}$. In order that Z_α, Z_t values can be calculated, $\widehat{p}^*$ (bias-corrected) rank correlation coefficient must be estimated first. $\widehat{p}^*$ is defined as in Equation 7;

$$\widehat{p}^* = \frac{\sum_{t=1}^{n-1} \left(\widehat{u}_t \widehat{u}_{t+1} - \sum_{j=1}^{B} w(j/B) \widehat{\gamma}(j) \right)}{\sum_{t=1}^{n-1} \widehat{u}_t^2} \tag{7}$$

After the coefficient $\widehat{p}^*$ is estimated,

$$Z_\alpha = n(\widehat{p}^* - 1) \tag{8}$$

$$Z_t = \frac{(\widehat{p}^* - 1)}{\left(\widehat{\gamma}(0) + 2\sum_{j=1}^{B} w(j/B) \widehat{\gamma}(j) \right) / \sum_{1}^{n-1} \widehat{u}_t^2} \tag{9}$$

since this test method is based on the smallest values of the three test statistics, it can also be calculated according to τ_1 and τ_2 values as follows:

$$ADF^* = \inf_{(\tau_1,\tau_2)\varepsilon T} ADF(\tau_1, \tau_2) \tag{10}$$

$$Z_t^* = \inf_{(\tau_1,\tau_2)\varepsilon T} Z_t^*(\tau_1, \tau_2) \tag{11}$$

$$Z_\alpha^* = \inf_{(\tau_1,\tau_2)\varepsilon T} Z_\alpha^*(\tau_1, \tau_2) \tag{12}$$

It is calculated here as T=(0,15n, 0,85n) . The reduction (discontinuation) of data by 15% comes from Gregory Hansen. The same thinking was adopted here as well and the distance between the two regime shifts was determined as at least 15%. If $\rho < 1$, it is understood that the variables are cointegrated.

4. Empirical Results

The datasets used in the present study were accessed on the official website of the Turkish Statistical Institute. The data were analyzed using RATS and Gauss programs. Logarithmic transformation was performed on the series before starting the analyses. Since seasonal effects were observed in the series, they were seasonally adjusted by the Census X13 method. Stationarity analyses were started with the Classical Unit Root Tests. The models in Table 1 and 2 are respectively; (A): contains only constant, (B): contains trend and constant (C): do not contain trend and constant.

Table 1. Seasonally adjusted logarithmic GDP series and their first differences

	Model A		Model B		Model C	
	t-stat.	Sig.	t-stat.	Sig.	t-stat.	Sig.
ADF	-2.39 -5.24′	0,15 0.00′	-2.71 -5.33′	0.23 0.00′	1.44 -5.12′	0.96 0.00′
PP	-2.29 -5.21′	0.18 0.00′	-2.24 -5.12′	0.46 0.00′	1.26 -5.09′	0.95 0.00′
	Model A			Model B		
KPSS	LM	0.7756	0.1812′	0.1821	0.0351′	
ERS-Nok.Opt.	P	30.2169	1.0361′	11.5743	3.7571′	
DF-GLS	t	-0.4859	-5.2632′	-2.2766	-5.4339′	
"′" It indicates the values after the first differences of the series are taken.						

When Table 1 is reviewed, it is seen that the GDP series is not stationary in level yet it is when its first differences are obtained.

Table 2. Seasonally adjusted logarithmic Total Construction Turnover Index series and their first differences

	Model A		Model B		Model C	
	t-stat.	Sig.	t-stat.	Sig.	t-stat.	Sig.
ADF	-1.48 -10.39′	0.54 0.00′	-2.15 -10.31′	0.51 0.00′	2.48 -9.55′	0.99 0.00′
PP	-1.71 -9.91′	0.42 0.00′	-2.68 -9.84′	0.25 0.00′	2.24 -9.14′	0.99 0.00′
	Model A			Model B		
KPSS	LM	0.8147	0.1496′	0.0908	0.1418′	
ERS-Nok.Opt.	P	92.2269	1.1447′	25.7584	4.1359′	
DF-GLS	t	0.7607	-10.4303′	-2.1988	-10.5007′	
"′" It indicates the values after the first differences of the series are taken.						

When Table 2 is examined, it is seen that the Total CTI series is not stationary in level yet it becomes stationary after the first differences are obtained. Since the studied period was long and included global financial crises, stationarity analysis was additionally examined by one- and two-break unit root tests. The LS test focuses on two models. Model A takes into account only a break in the constant, while Model B considers a break in both the constant and trend.

Table 3. Lee-Strazicich One-Break Unit Root Test Results

	GDP			CTI		
ModelA	S{1}	Break date	t-stat.	S{1}	Break date	t-stat.
	-2.7981	D(2016:04)	-2.7115	-3.3989	D(2014:02)	-3.2479
ModelB	-4.5155	D(2013:01)	0.1267′	-3.3939	D(2014:02)	-2.9629
		DT(2013:01)	-2.3698		DT(2014:02)	-1.1340′

When one-break is taken into account, significant breaks were found in both variables only in the models that contain constant. Looking at the break, it is seen that the series is not stationary. Series were retested considering the probability of two-breaks.

Table 4. Lee-Strazicich Two-Break Unit Root Test Results

	GDP			**CTI**		
	S{1}	Break date	t-stat.	S{1}	Break date	t-stat.
ModelA	-3.0741	D(2009:01)	2.2869	-2.8930	D(2008:02)	1.4823
		D(2015:01)	-1.0882		D(2014:01)	-2.2390
ModelB	-5.0682	D(2009/02)	2.3743	-4.8299	D(2011:03)	1.8984
		DT(2009/02)	-3.8195		DT(2011:03)	-3.5792
		D(2014/03)	1.3998		D(2013:04)	6.1691
		DT(2014/03)	-4.6970		DT(2013:04)	-4.1116

When Table 4 is reviewed, it is found that the breaks of GDP series in both trend and constant in 2009/Q2 and 2014/Q3 periods are found to be significant, in addition to this, it is determined that the series is not stationary. This result indicates that the effects of the financial crisis in the world towards the end of 2008 were also felt in Turkey in 2009. As to the year 2014, it is the period in which the Dollar/TL exchange rate started to increase sharply. In the total construction turnover index series, breaks in both trend and constant in 2011/Q3 and 2013/Q4 periods are found to be significant and it is determined that the series is not stationary. The cointegration models showing the relationship between the two variables, in the long run, are given below. In the models, Y_t represents the GDP variable, X_t is the total construction turnover index variable.

Hatemi-J two-break Cointegration Analysis Results;

Model 2: Level shift (C)

$$Y_t = 2.278 + 0.262D_{1t} - 0.128D_{2t} + 0.598X_t + e_r \tag{13}$$

Model 3: Level shift with trend (C/T)

$$Y_t = 4.508 + 0.208D_{1t} - 0.041D_{2t} + 0.006T + 0.81X_t + e_r \tag{14}$$

Model 4: Regime shift (C/S)

$$Y_t = 1.343 + 0.254D_{1t} + 4.708D_{2t} + 0.803X_t - 0.003D_{1t}X_t - 0.983D_{2t}X_t + e_r \tag{15}$$

Among the 3 models that were formed according to the Hatemi-J cointegration analysis, only “model 2” was found to be significant. The results of model 2 are given in Table 5.

Table 5. Hatemi-J Cointegration Analysis Results

Test Statistics	Statistic Value	τ_1	τ_2
ADF*	-5.075	2009/Q2	2012/Q4
Z_t^*	-4.174	2009/Q4	2013/Q3
Z_α^*	-28.117	2009/Q4	2013/Q3

The critical values for ADF , Z_t^* and Z_α^* test statistics are collected from Hatemi-J (2008).

It is identified that the series are cointegrated. In this case, it is understood that the growth in the construction sector and economic growth co-move in the long run. At the same time, the variables show co-breaking in 2009/Q4 and 2013/Q3 periods. The sustainability of a long-run relationship is tested by the Wald coefficient test. In this model, the hypothesis (strongly sustainable), is rejected at the significance level of prob= 0.000. Therefore, it is determined that the relationship between economic growth and the construction sector is not strongly sustainable.

Conclusion

TThe contribution of the construction sector to the economy in developing countries has always been a topic of interest. In this study, the relationship between the rapid growth in the construction sector and economic growth in Turkey was investigated and it was tested whether this relationship was sustainable or not. The studied period was a term when several financial crises were experienced worldwide and in Turkey, and their effects were felt on macroeconomic variables. Especially in the studies where long-run relationships with economic variables are investigated, structural variations created by these crises should not be ignored. Although there are many tests in the literature which detect structural breaks, Lee-Strazicich unit root test was preferred in this study. The LS test is used in situations when the break date is not known. Besides, it is known as a powerful test because it takes into account the break in both hypotheses. In this study, when the LS test results pertaining to the two variables of interest were examined, it was observed that the stationarity could not be achieved even in the case that 2 breaks were significant. According to the cointegration model in which the comovements of both variables were analyzed, it was observed that there were significant breaks in the periods of 2009/Q4 and 2013/Q3. Because of the breaks, the two variables are in a comovement in the long run. The correlation of variables in a given period does not necessarily mean that this relationship is always sustainable. In order to determine the sustainability of this relationship, the Wald Coefficient test was performed and the Ho hypothesis which indicates strong sustainability was rejected. As a result, although the construction sector is an important part of sustainable development, it is not adequate alone. The fact that the construction sector in Turkey is based on import is also an important risk in terms of sustainability.

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