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The Hypothesis of Neutrality of Money: Panel Data Analysis

Paranın Yansızlığı Hipotezi: Panel Veri Analizi

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Abstract: In the present study, it was examined if the hypothesis of neutrality of money applies to Turkey and the member countries of Shanghai Cooperation Organization. For this purpose, the data obtained for the period between 2000 and 2016 were examined using panel data analyses. Economic growth was used as dependent variable, whereas the annual growth rate of monetary supply as used as independent variable. Within the context of analysis, firstly the horizontal cross-sectional dependence tests were implemented. Then, according to the results of tests, the CADF unit root test was applied. Since the variables are stationary at various levels, the cointegration test was implemented. The results of Durbin-Hausmann Cointegration Test showed that there was no cointegration relationship for the groups but there was a cointegration relationship in the panel. In this case, the hypothesis of neutrality of money does not apply to the current panel. In the present study, Dumitrescu-Hurlin Panel Causality Test was applied finally, and it was revealed that there was a causality relationship between the money supply and output.

Keywords: Cointegration, Panel Data Analysis, Neutrality of Money, Shanghai Cooperation Organization, Turkey

Öz: Çalışmada paranın yansızlığı hipotezinin Türkiye ve Şanghay İşbirliği Örgütü'ne üye ülkelerde geçerli olup olmadığı araştırılmıştır. Bu amaç doğrultusunda 2000-2016 yılları arasında ele alınan verilere panel veri analizleri uygulanmıştır. Bağımlı değişken olarak ekonomik büyüme ve bağımsız değişken olarak para arzındaki yıllık büyüme oranı kullanılmıştır. Analiz kapsamında ilk olarak yatay kesit bağımlılığı testlerine yer verilmiştir. Daha sonra test sonuçlarına uygun olarak CADF birim kök testi uygulanmıştır. Değişkenlerin farklı derecede durağan olmaları sebebiyle eşbütünleşme testine geçilmiştir. Durbin-Hausmann Eş-Bütünleşme Testi sonuçları grup için eşbütünleşme ilişkisinin olmadığını, panelde ise eşbütünleşme ilişkisinin varlığını göstermiştir. Bu durumda paranın yansızlığı hipotezi grup için geçerli panel için geçerli değildir. Araştırmada son olarak Dumitrescu-Hurlin Panel Nedensellik Testi yapılmış ve bulgular para arzı ile çıktı arasında nedensel ilişki olduğunu ortaya koymuştur.

Anahtar Kelimeler: Eşbütünleşme, Panel Veri Analizi, Paranın Yansızlığı, Şanghay İşbirliği Örgütü, Türkiye

1. Introduction

The monetary policy influences the economy through the monetary transmission mechanism. The effect of monetary policy on the macroeconomic variables is examined using the response of these variables to the change in money supply and the efficiency of monetary policy is determined. In the long-term, the responses of real indicators such as economic growth and employment to the money supply are known as the neutrality of money.

The hypothesis of neutrality of money, as an expression of quantity theory of money, reveals if the change in money supply has any effect on the macroeconomic variables. According to this hypothesis, the real variables behave independently from the changes in money supply in the long-term. The changes in the money supply affect not the real but the nominal variables. The super neutrality of money occurs when it is not possible to make effective policies money illusion environment by continuously arranging the quantity of money. However, the neutrality of money is valid in the short-term and it may not be valid in the long term because there are the sticky prices in the market (Moosa, 1997). The schools in economics have different opinions regarding the neutrality of money. The classical school of economics advocates that the money had neutrality regardless of the term, whereas the Keynesians advocate the opposite. The monetarist approach advocates that the money is non-neutral in the short-term and, since the long-term consists of the combination of short-terms, it might be non-neutral even in long-term. Finally, the new classical approach claims that, depending on the changes in real prices, the monetary indicators do not have important effect on the formation of real values such as employment, production, and income (Güney and Alacahan, 2012; Sulku, 2011).

In the studies testing the neutrality of money, the relationship between money and real variables is examined by adopting different approaches. In some of the studies, the horizontal cross-sectional data are used in testing the neutrality hypothesis (Tawadros, 2007). Two-Staged Test, Non-Linear Least-Squares Autoregressive Equation System, and Two-Variable Structural Autoregressive Equation System are some of the methods used in testing the neutrality of money. However, since these methods ignore the degree of short- and long-term relationship and cointegration between the variables, it is required to use the cointegration analyses in testing the neutrality of money (Tuğcu, 2015).

The neutrality of money has been examined in studies from both theoretical and empirical aspects. In literature, there are some national and international studies, in which the neutrality of money has been accepted, such as Barro (1977), Khatri-Chhetri et al. (1990), Smith and McAleer (1993), Moosa (1997), Serletis and Kosukas (1998), Coe and Nason (2004), Bae et al. (2005), Tawadros (2007), Cunado et al. (2009), Sulku (2011), Büyükılgaz (2016). On the other hand, the studies carried out by Mishkin (1982), Bohara (1991), Lee and Zilberfarb (1993), Evans (1996), Fung and Kasumovich (1998), Jha and Donde (2001), Aslan and Korap (2007), Rahman and Toyoda (2008), Saatçioğlu and Korap (2009), Westerlund and Costantini (2009), and Tuğcu (2015) are those, in which the neutrality of money has been rejected.

Table 1 Literature Review

Author(s)/Year	*Countr(ies)/Period*	*Method*	*Result*
Barro (1977)	USA (1941-1977)	Regression	Accepted
Mishkin (1982)	USA (1954-1976)	OLS	Rejected
Khatri-Chhetri et al. (1990)	Thailand (1960-1984)	McGee and Stasiak	Accepted
Bohara (1991)	USA (1959-1986)	VAR Analysis	Rejected
Lee and Zilberfarb (1993)	Korean (1964-1987)	Regression	Rejected
Smith and McAleer (1993)	USA (1946-1973)	Two-Step OLS	Accepted
Evans (1996)	27 countries (1960-1992)	Regression	Rejected
Moosa (1997)	India (1972-1990)	Seasonal Cointegration	Accepted
Fung and Kasumovich (1998)	G-6 (1954-1995)	VAR Analysis	Rejected
Serletis and Kosukas (1998)	10 countries (1914-1945)	Cointegration Test	Accepted
Jha and Donde (2001)	India (1959-1997)	VAR Analysis	Rejected
Coe and Nason (2004)	6 countries (1871-1997)	Structural VAR and OLS	Accepted
Bae et al. (2005)	6 countries (1880-2001)	ARFIMA Model	Accepted
Aslan and Korap (2007)	Turkey 1987Q1-2006Q4	Cointegration Test	Rejected
Tawadros (2007)	Egypt, Jordan and Morocco (1972:1 to 2002:4)	Seasonal Cointegration	Accepted
Rahman and Toyoda (2008)	Japan (1955:Q2–2006:Q1)	Seasonal Integration and Granger Causality	Rejected
Cunado et al. (2009)	6 countries (1880-2001)	Fisher and Seater's (1993) Reduced-Form Test	Accepted
Saatçioğlu and Korap (2009)	Turkey (1987Q1 – 2007Q2)	Cointegration Test	Rejected
Westerlund and Costantini (2009)	10 countries (1870-1986)	Panel Cointegration	Rejected
Sulku (2011)	Turkey (1987:Q1-2006:Q3)	Fisher and Seater (1993) ARIMA	Accepted
Tuğcu (2015)	Turkey (1960-2012)	Cointegration	Rejected
Büyükılgaz (2016)	12 countries (1980-2015)	Panel Cointegration	Accepted

The neutrality of money is a very important subject for the policy recommendations. For this reason, in the present study, the hypothesis of neutrality of money was examined using the panel of the period between 2000 and 2016 for Turkey and the member countries of Shanghai Cooperation Organization. In this research, following the introduction section presenting the theoretical information, the empirical analyses are presented and the study is completed with the conclusion section.

2. Empirical Analysis

In the present study, the neutrality of money was tested for the panel including the Shanghai Five (Shanghai Cooperation Organization) and Turkey. The Shanghai Five was established in 1996 by China, Kazakhstan, Kırghizia, Russia, and Tajikistan. Then, Uzbekistan has become 6th member of this organization in 2001. The reason for choosing Shanghai Cooperation Organization in the present study is the discussions regarding if Turkey could be member to this organization. In the present study, the annual data covering the period between 2000 and 2016 were included. GDP and BM (Broad Money) representing the annual growth rates of money supply are used in representing the economic growth. The relevant statistics were obtained from the database of World Bank. Since there is a time limitation on the data, it was possible to perform analysis with T (number of year)=17 years. Moreover, since there is no data of monetary supply of Uzbekistan, the number of countries was set to be 6 (N) including Turkey. Thus, the panel data analyses meeting the criterion of T>N were adopted.

3. Methods and Results

Which unit root and cointegration tests will be used in panel data analyses depends on the results of cross-sectional dependence test that was preliminarily implemented. The tests to be implemented under the cross-sectional dependence or independence vary. For instance, in cases of cross-sectional independence (i.e., there is no correlation between the

units), the first generation unit root tests are used, whereas the second generation unit root tests are used when the cross-sectional dependence is accepted. Moreover, the cross-sectional dependence (independence) indicates if the other units are affected from any unexpected shock, with which a unit faced. Thus, CD_{LM1} and CDL_{M2} tests meeting the criterion of T>N were implemented. In CD_{LM1} test developed by Breusch-Pagan (1980) by using Breusch-Pagan Lagrange Multiplier (Lagrange Multiplier-LM), the hypotheses tested are as follows;

H_0=There is no cross-sectional dependence;

H_1= There is cross-sectional dependence.

On the other hand, $CDLM_2$ test is calculated using test statistics of $\mathrm{CDLM}_2 = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{J=i+1}^{N}(T\hat{\rho}_{ij}^2 - 1)$ and, when $T\rightarrow\infty$ and $N\rightarrow\infty$, it is assumed according to the null hypothesis that there is no cross-sectional dependence (Pesaran, 2004).

In Table 2, the results of cross-sectional dependence test are presented for both variable and panel. The results indicate the presence of cross-sectional dependence at both variable level and at the panel. In other words, any unexpected event in one of the countries would affect the other countries.

Table 2. The results of cross-sectional dependence

Variables	$CDLM_1$	*Probability Value*	$CDLM_2$	*Probability Value*
GDP	27.871**	0.022	2.350***	0.009
BM	27.143**	0.028	2.217**	0.013
Panel	31.115***	0.008	2.942***	0.002

Note: *, **, and *** indicate the statistical significance at 10%, 5%, and 1% levels, respectively.

Detection of cross-sectional dependence required the implementation of second generation unit root tests. For this reason, among the second generation unit root tests, the CADF (Cross-Sectionally Augmented Dickey-Fuller) test was implemented. CADF test is the version of standard ADF unit root test, in which the primary differences of individual series and the lag levels are extended based on the horizontal averages. The main equation, in which the hypotheses of H_0: $\beta_i = 0$ (there is root) and H_1: $\beta_i < 0$ (there is no root), are expressed as follows:

$$y_{it} = (1-\phi_i)\mu_i + \phi_i y_{i,t-1} + u_{it} \quad (1)$$

In Equation (1), i = 1,…,N; t = 1,…,T and $u_{it} = \gamma_i f_t + \varepsilon_{it}$. f_t refers to the unobserved common effects, and ε_{it} refers to the individual specific errors. If $\phi_i = 1$, H_0: $\beta_i = 0$ (for all *i*s). The test equation is expressed as follows:

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \varepsilon_{it} \quad (2)$$

In Equation (2), $\alpha_i = (1-\phi_i)\mu_i$, $\beta_i = -(1-\phi_i)$ and $\Delta y_{it} = y_{it} - y_{it-1}$. Thus, the equation transforms into version of $Y_{i,t}$, which is the extended regression equation that includes the lagged primary differences, and the estimation is performed. After estimating the CADF regression, the validity of H_0 hypothesis can be tested using CIPS (Cross-Sectionally Augmented IPS) statistics for the whole of panel. In CIPS statistics expressed as $\mathrm{CIPS} = N^{-1}\sum_{i=1}^{N}\mathrm{CADF}_i$, the mean value of t statistics of lagged variables ($CADF_i$) are calculated (Pesaran, 2007).

The results of CADF and CIPS tests are presented in Table 3. According to the results of CIPS test, GDP variable is not stationary at the level, whereas BM variable is stationary at the level. Since GDP variable was not stationary at the level, no difference calculation was performed and the relevant variable became stationary.

Table 3. Unit Root Test Results

	Level				*Difference*			
	GDP	*Lag*	*BM*	*Lag*	*GDP*	*Lag*	*BM*	*Lag*
China	-1.359	2	-7.470[a]	4	-1.802	2	-0.883	3
Russia	-2.345	2	-2.390	2	-2.805	2	-2.553	2
Kazakhstan	-0.180	4	-2.130	2	-2.397	2	-2.906	2
Kirghizstan	-1.422	4	-4.450[b]	2	-7.926[a]	4	-3.075	2
Tajikistan	-1.705	2	-3.610[b]	4	-2.578	2	5.074[a]	4
Turkey	-0.777	2	-7.000[a]	2	-1.652	2	4.423[b]	2
CIPS	-1.298		-4.51[a]		-3.194[a]		-3.152[a]	

Note 1: Determined based on Schwarz Information Criterion, where the lag is the length of lag.

Note 1: The critical values of CADF statistics were obtained from Pesaran's (2007) Table 1c. The critical values are 1% (-4.97), 5% (-3.99) and 10% (-3.55), and they are expressed with as a, b, and c, respectively.
Note 1: The critical values of CIPS statistics were obtained from Pesaran's (2007) Table 2c. the critical values are 1% (-3.15), 5% (-2.88) and 10% (-2.74) and they are expressed with as a, b, and c, respectively.

Before passing to the cointegration test after the unit root tests, it was examined if the slope coefficient is homogeneous for each country. For this purpose, the Delta Test developed by Pesaran and Yamagata (2008) was utilized. For the hypotheses that H_0: $\beta_i = \beta$ (Slpoe coefficients are homogenous [for all β_is]) and H_1: $\beta_i \neq \beta$ (slope coefficients are not homogeneous [for minimum 1 i]), the Delta Test statistics is calculated using Equation $\widehat{\Delta} = \sqrt{N}\left(\frac{N^{-1}\hat{S}-k}{\sqrt{2k}}\right)$. The adjusted Delta Test statistics expressed with $\widetilde{\Delta}$ is calculated using the equation $\widetilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S}-E(\tilde{Z}_{it})}{\sqrt{Var\tilde{Z}_{it}}}\right)$. If the estimated probability value is statistically significant, then H_0 hypothesis is rejected and it is found that the slope coefficients are heterogeneous (Pesaran and Yamagata, 2008). According to the homogeneity results presented in Table 4, it was determined that the probability values calculated are statistically significant at 1%. In other words, the slope coefficients are heterogeneous and the cointegration test to be performed for each country is reliable and valid.

Table 4. Homogeneity Test Results

Test	*Test Statistics*	*p Values*
Delta_tilde	2.927	0.002
Delta_tilde_adj	3.206	0.001

At this phase of study, the cointegration test that takes the cross-sectional dependence and heterogeneity into consideration was selected. For the purpose of study, the Durbin-Hausmann Cointegration Test developed by Westerlund (2008) was implemented. The hypotheses of test, which handles the cointegration from the panel and group dimensions, are "H_0: There is no cointegration and H_1: There is cointegration." It was determined that, for the group being analyzed, there was no cointegration relationship but the cointegration relationship exists for the panel. This indicates that the hypothesis of neutrality of money is not valid for the current panel. Since the panel shows heterogeneous characteristic, the cointegration results of the group was taken into consideration and it was decided that the hypothesis of neutrality of money is valid for the group.

Table 5. Cointegration Test Results

Test	*Test Statistics*	*p Values*
dh_g	-0.482	0.635
dh_p	2.496	0.006

Simple Granger (1969) causality test improved by Dumitrescu and Hurlin (2012) for the panel data models is based on the average individual Walt statistics of Granger causality test between the horizontal cross-sectional units. In this causality test, the heterogeneity of slope coefficients and the cross-sectional dependence are taken into consideration (Altıner and Toktaş, 2017).

Dumitrescu-Hurlin causality test is performed using the linear model below;

$$y_{i,t} = \propto_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \qquad (3)$$

K refers to the optimum lag length, and it is assumed that the individual effects, $\propto_i$, do not change in the course of time, that the lag length is similar for all the cross-sectional units, and that the autoregressive parameter $\gamma_i^{(k)}$ and regression coefficient slope $\beta_i^{(k)}$ may differ between the groups. In this test, the average of individual Wald statistics is calculated using Equation (4).

$$W_{N,T}^{Hnc} = \frac{1}{N}\sum_{i=1}^{N} W_{i,T} \qquad (4)$$

$W_{i,T}$, in harmony with $H_0: \beta_i = 0$ individual test, is the individual Wald statistics for i^{th} cross-sectional unit, and $W_{N,T}^{Hnc}$ is the average value of statistic in harmony with the null hypothesis. In determining the distribution of average of $W_{N,T}^{Hnc}$, there are the asymptomatic condition, in which the T and N go to infinity, and the semi-asymptomatic condition, in which T is constant. When T and N go to infinity (T,N $\rightarrow\infty$), the average test statistics of $Z_{N,T}^{Hnc}$ having asymptomatic distribution can be used, whereas Z_N^{HNC} test statistics can be used under semi-asymptomatic conditions, in which T is constant (N>T) (Dumitrescu and Hurlin, 2012). The results of Dumitrescu-Hurlin panel causality test implemented in the present study are shown in Table 6.

Table 6. Panel Causality Test Results

Direction of causality	$W_{N,T}^{Hnc}$	$Z_{N,T}^{Hnc}$	Z_{N}^{Hnc}
GDP → BM	5.0161 (0.0000)	2.0161[c] (0.0522)	0.3569 (0.3743)
BM → GDP	10.5526 (0.0000)	7.5526[a] (0.0000)	2.7786 (0.0084)

Note: a, b, and c indicate the presence of causality relationship at the statistical significance levels of 1%, 5%, and 10%.

According to the results of panel causality test, it was determined that there is bidirectional causality between growth and money supply. In this case, it can be stated that the changes in money supply play have effects on the outcome.

4. Conclusion

The Quantity Theory is based on the idea that the money (in other words, the changes in money supply) affects the nominal variables in the long-term but not the real variables. In the present study, the neutrality of money was examined for Turkey and the member countries of Shanghai Cooperation Organization. On the data obtained for the period between 2000 and 2016, the horizontal cross-sectional dependence was determined using $CDLM_1$ and $CDLM_2$ tests. Then, CADF unit root test taking the cross-sectional dependence into consideration was implemented. The results of unit root test showed that the growth was stationary at the difference, whereas the money supply was stationary at the level. For this reason, it was decided to implement the cointegration test. Before the cointegration test, the homogeneity test was applied to the slope coefficients, and it was decided that the slope coefficients were heterogeneous. And then, the Durbin-Hausmann Cointegration test yielding separate results for panel and group was implemented. The results indicated that there was no cointegration relationship for the groups. In other words, it was determined that the hypothesis of neutrality of money doesn't apply to the group. In the panel, however, the presence of cointegration relationship was shown. In other words, the hypothesis applies to the panel. Since the panel showed heterogenic characteristic, the cointegration results were taken into consideration and it was concluded that the hypothesis of neutrality of money applies to the group. Thus, it can be stated that the changes in money supply affect not the variables such as real output, real consumption expenditures, real wages, and real interest rates but the variables such as nominal prices and wages. In other words, the monetary policy is not efficient. No effect can be created on the real variables in economy by using the monetary policy. On the other hand, Dumitrescu-Hurlin panel causality test showed in the present study that there was bilateral relationship between the growth and the money supply. This suggests that, for the future studies, the relationships between output and money supply should be discussed from the aspect of real business cycle theory.

REFERENCES

Altıner, Ali and Toktaş, Yılmaz. 2017. "The effects of Innovation on economic Growth in the Emerging Market Economics: Panel Data Analysis". *Journal of Current Researches on Business and Economics* 7(2): 478-496.

Aslan, Özgür and Korap, Levent. 2007. "Testing Quantity Theory of Money for the Turkish Economy". *BDDK Bankacılık ve Finansal Piyasalar Dergisi* 1(2):93-109.

Bae, Sang-Kun. and Jensen, Mark J. and Murdock, Scott G. 2005. "Long-Run Neutrality in a Fractionally Integrated Model". *Journal of Macroeconomics* 27(2):257-274.

Barro, Robert J. 1977. "Unanticipated Money Growth and Unemployment in the United States". *American Economic Review* 67(2):101-115.

Bohara, Alok K. 1991. "Testing the Rational-Expectations Hypothesis: Further Evidence". *Journal of Business & Economic Statistics* 9(3):337-340.

Büyükılgaz, Utku. 2016. "Paranın Yansızlığı Hipotezinin Orta Doğu Ülkeleri için Test Edilmesi". *Ekonomi, Politika & Finans Araştırmaları Dergisi* 1(1-2):6-12.

Cuñado, Juncal and Gil-Alana, Luis A. and Pérez De Gracia, Fernando. 2009. "New Evidence on Long-Run Monetary Neutrality". *Journal of Applied Economics* 12:229-248.

Dumitrescu, Elena-Ivona and Hurlin, Christophe 2012. "Testing for Granger Non-Causality in Heterogeneous Panels". *Economic Modelling* 29(4):1450-1460.

Evans, Paul. 1996. "Growth and the Neutrality of Money". *Empirical Economics* 21(1):187-202.

Güney, Selami and Alacahan Dilbaz, Nur. 2012. "Parasal Aktarım Mekanizmaları ve Türkiye Değerlendirmesi". *Akademik Bakış Dergisi* 33(Kasım-Aralık):1-13.

Jha, Raghbendra and Donde, Kshitija 2001. "The Real Effects of Anticipated and Unanticipated Money: A Test of the Barro Proposition in the Indian Context". *Indian Economic Journal*, 49(1):21-30.

Khatri-Chettri, Janardan, Ampon, Kittiampon and Myles, S. Wallace. 1990. "Anticipated and Unanticipated Money in Thailand". *The American Economist* 34:83-87.

Lee, Junsoo and Strazicich, Mark C. 2003. "Minimum Lagrange Multiplier Unit Root Test with Two Structural Breaks". *The Review of Economics and Statistics* 85(2):1082-1089.

Mishkin, F. S. 1982. Does anticipated monetary policy matter? An econometric ınvestigation. *Journal of Political Economy*, 90(1):22-51.

Moosa, Imad A. 1997. Testing the Long-Run Neutrality of Money in a Developing Economy: The Case of India". *Journal of Development Economics* 53(1):139-155.

Pesaran, M. Hashem. 2004. *General diagnostic tests for cross section dependence in panels*. (Working Paper No:0435), University of Cambridge, Cambridge.

Pesaran, M. Hashem. (2007). "A Simple Panel Unit Root in the Presence of Cross-Section Dependence". *Journal of Applied Econometrics* 22:265-312.

Pesaran, M. H. and Yamagata, T. 2008. "Testing Slope Homogeneity in Large Panels". *Journal of Econometrics*, 142(1):50-93.

Rahman, Jahanur and Toyoda, Toshihisa 2008. "An Empirical Study on Long-Run Neutrality of Money in the Japanese Economy". *Japanese Economy* 35(3):87-117.

Saatçioğlu, Cem and Korap, Levent. 2009. *The Search for Co-Integration between Money, Prices and Income: Low Frequency Evidence from the Turkish Economy*. MPRA Paper No. 19557.

Serletis, Apostolos and Koustas, Zisimos. 1998. "International Evidence on the Neutrality of Money". *Journal of Money, Credit, and Banking* 30(1):1-25.

Smith, Jeremy and McAleer, Michael. 1993. "On the Robustness of Barro's New Classical Unemployment Model". *Applied* Economics 25(3):349-360.

Sulku, Seher Nur. 2011. "Testing the Long Run Neutrality of Money in a Developing Country: Evidence from Turkey". *Journal of Applied Economics and Business Research* 1(2):65-74.

Tawadros, George B. 2007. "Testing the Hypothesis of Long-Run Money Neutrality in the Middle East". *Journal of Economic Studies* 34(1):13-28.

Tuğcu, Can Tansel. 2015. "Paranın Yansızlığı Hipotezinin Testi: Türkiye Ekonomisi için Yapısal Kırılmalı Eşbütünleşme Analizi". *İktisat Politikaları Araştırmaları Dergisi* 2(1):17-31.

Westerlund, Joakim. 2007. "Testing for Error Correction in Panel Data". *Oxford Bulletin of Economics and Statistics* 69(6):709-748.

Westerlund, Joakim and Costantini, Mauro. 2009. "Panel Cointegration and the Neutrality of Money". *Empirical Economics* 36(1):1-26.