Asian Journal of Economic Modelling
ISSN(e): 2312-3656
ISSN(p): 2313-2884
DOI: 10.18488/journal.8.2017.54.457.464
Vol. 5, No. 4, 457-464

URL: www.aessweb.com

TESTING THE FELDSTEIN-HORIOKA PUZZLE IN TRANSITION ECONOMIES

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ABSTRACT

Article History
Received: 25 September 2017
Revised: 17 October 2017
Accepted: 20 October 2017
Published: 26 October 2017

Keywords
Transition economies
Investment
Economic growth
Saving
Feldstein-Horioka
Panel data.

Jel Classifications
C12, E21,E22.

The relationship between domestic savings and investments has become one of the most important issues discussed in economic theory with globalization of national financial markets. Is really domestic investment financed by global funds or domestic savings are still an important fund source for domestic investments? In this study, the relationship between savings and investments between years 1995 and 2014 is tested by panel data method in the transition economies (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, Romania, Bulgaria) transited from the central planning to the free market economy. As a result of the empirical analysis, Feldstein-Horioka puzzle is not valid for most of the transition economies thanks to financial funds came from European Union's development funds.

Contribution/ Originality: This study contributes to existing literature in two ways. First of all, by examining transition economies in Eastern and Central Europe, we test the effect of foreign direct investments coming from Western European economies. Secondly, we employ numerous econometric analysis methods in order to obtain more robust results.

1. INTRODUCTION

Economics theory accepts domestic and foreign savings as a source of investments. When domestic savings are inadequate to promote investments, governments tend to channel foreign savings to investments via interest rate instrument. For this reason, it is an important argument in the theory of economics that how much domestic and foreign savings are used in financing investments.

In this study, we focus on three questions. Is the domestic savings determinant of domestic investments in an economy which transited from central planned economy to a market economy? Is the relationship between domestic savings and investments valid in both short and long term? If there is a uni-directional causality from domestic savings to investments, how it is strong?

The rest of the paper is organized as follows. The next section is devoted to summarize the existing literature investigating the Feldstein and Horioka (1980) puzzle. The second section, econometric methodology and the date are described. In the section three, empirical results are presented. We summarize and conclude empirical findings in the last section.

2. THEORETICAL BACKGROUND

Feldstein and Horioka (1980) investigate the relation between domestic savings, investments and foreign capital movements in 16 developed countries for 1960-1974 period. They build up an equation for domestic savings and investments as follows:

$$\left(\frac{I}{Y}\right)=\beta_0+\beta_1\left(\frac{S}{Y}\right)+\varepsilon \tag{1}$$

Coefficient β_1 denotes foreign capital mobility. Feldstein and Horioka (1980) imply that coefficient equals to one in a closed economy situation and the relation between domestic savings and investments is one to one ($\beta_1=1$), one the other hand the coefficient would dwindle in the developed economies in developed economies by positing foreign capital mobility is high in open economies. But the results of the analysis indicate that the coefficient is between 0,85 and 0,98 for 16 developed economies. The results mean that there is a strong relation between domestic savings and investments. According to Feldstein and Horioka (1980) even in developed countries domestic investments are financed by domestic savings.[1]

3. METHODOLOGY

3.1. Cross-Section Dependency and Homogeneity Tests

For checking cross-section dependency, Lagrange multiplier (LM) test developed by Breusch and Pagan (1980) is applied. i=1,2,…,N indicates cross-section range, t=1,2,…,T indicates time range, α_i and β_i indicate constant term and slope term, respectively. x_{it} is kx1 explanatory variables vector and panel model is as follows; [2]

$$y_{it}=\alpha_i+\beta_i' x_{it}+\varepsilon_{it} \tag{2}$$

In panel data analysis, cross section dependency is tested in order to check validity of unit root initially. If there is no cross section dependency, we employ first generation unit root test and if there is a cross section dependency second generation unit root tests are employed. In order to test cross section dependency in panel data analysis, Pesaran (2004) CD_{LM} Breusch and Pagan (1980) CD_{LM1} and Pesaran (2004) CD_{LM2} tests are employed CD_{LM1} and CD_{LM2} are used if the time range is bigger than cross section range (T>N). CD_{LM} test is used if the cross section range is bigger than time range (N>T). Pesaran and Yamagata (2008) improves $\tilde{\Delta}$ delta test in order to test homogeneity of slope coefficient. The null hypothesis of the test claims for each i is as follows [$H_0:\beta_i=\beta$].[3]

[1] The detailed literature survey for Feldstein and Horioka (1980). puzzle please see Apergis and Tsoumas (2009).

[2] In the model, for LM statistics please see Pesaran (2004) for the assumption that there is no cross-section dependency.

[3] For test statistics please see Pesaran, Ullah and Yamagata (2008).

3.2. Cross-Sectionally Augmented Dickey–Fuller (CADF) Unit Root Test

Pesaran (2007) augments the ADF regressions with the cross-section averages of lagged levels and first-differences of the individual series. The cross-sectionally augmented Dickey–Fuller (CADF) regression is

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + d_0 \bar{y}_{t-1} + \sum_{j=0}^{p} d_{j+1} \Delta y_{t-j} + \sum_{k=1}^{p} c_k \Delta y_{i,t-k} + \varepsilon_{it} \tag{3}$$

where Δy_t is the average at time t of all N observations. The length of lag number is calculated by Schwarz information criterion. CIPS test statistics is the arithmetic average of CADF test statistics calculated for each i.

3.3. Panel Cointegration and Causality Test

In order to see relationship between variables we employ cointegration test developed by Westerlund (2007). In panel vector auto regression model, $\phi_{1i}\hat{\varepsilon}_{it-1}$ ve $\phi_{2i}\hat{\varepsilon}_{it-1}$ is the error correction coefficient;

$$\Delta inv = \delta_{1i} + \sum_{p=1}^{k} \delta_{11ip} \Delta inv_{it-p} + \sum_{p=1}^{k} \delta_{12ip} \Delta sav_{it-p} + \phi_{1i}\hat{\varepsilon}_{it-1} + v_{1it} \tag{4}$$

$$\Delta sav = \delta_{2i} + \sum_{p=1}^{k} \delta_{21ip} \Delta sav_{it-p} + \sum_{p=1}^{k} \delta_{22ip} \Delta inv_{it-p} + \phi_{2i}\hat{\varepsilon}_{it-1} + v_{2it} \tag{5}$$

Regressions above are obtained. In the model which is distributed asymptotically, critical values are calculated in order to take cross section dependency into account. The null hypothesis claims that there is no cointegration. The short and long run tests are obtained via panel VAR model. The error correction coefficient is added into panel VAR model. In panel cointegration model, first null hypothesis claims that there is no Granger causality running from savings ratio to investment ratio in the short run and second one is for long run;

$$\sum_{p=1}^{k} \delta_{12ip} \Delta sav_{it-p} = 0 \text{ and } \phi_{1i}\hat{\varepsilon}_{it-1} = 0 \tag{6}$$

Emirmahmutoğlu and Kose (2011) obtain causality for each i by employing bootstrap method for Fisher test statistics. Initially, the optimal lag length is obtained according to alternative information criterion for each I by employing unit root test ($dmax_i$). For each i;

$$inv_{i,t} = \alpha_{i,t} = \sum_{j=1}^{k_i + d\max_i} \beta_{ij} inv_{i,t-j} + \sum_{j=1}^{k_i + d\max_i} \gamma_{ij} sav_{i,t-j} + \varepsilon_{it} \tag{7}$$

and error terms are obtained. The null hypothesis claims that there is no Granger causality $[H_0 : \beta_{i1} = \beta_{i2} = ... = \beta_{ik_i} = 0]$. In the second step, critical values are obtained by using error terms via bootstrap method.[4]

3.4. Panel Data Estimation Test

Common Correlated Effects Pooled (CCE, hereafter) estimator is obtained via cointegration relationship. In CCE estimator, it is allowed to differentiate of autoregressive parameters between cross section when N>T and also

[4] For boostrap test statistics please see Emirmahmutoğlu and Kose (2011).

T>N (Pesaran, 2006). Regression equation used by CCE estimator is presented in the following heterogeneous panel model;

$$y_i = \alpha_i' d_t + \beta_i' x_{it} + \varepsilon_{it} \tag{8}$$

and $\varepsilon_{it} = \gamma_i' f_i + \varepsilon_{it}$ d_t term indicates obtainable constant, trend and seasonal deterministic terms and f_t term indicates unobservable terms.[5]

AMG (Augmented Mean Group) estimator is useful for when variables have unit root in level and it is possible to obtain cointegration coefficients belonging to whole panel and also cross sections belonging to panel. In this regard, AMG estimator presents more robust results compare to CCE developed by Pesaran (2006). AMG estimator also takes common factors in variables and dynamic effects into account and its performance is also better in unbalanced panel analyses (Eberhardt and Stephen, 2009).

4. EMPIRICAL RESULTS

In this study, we take ten transition countries into account. The eight of them belongs to first wave accession countries, which joined the European Union on 1 May 2004 (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia) and the two second-wave accession countries those joined on 1 January 2007 (Romania and Bulgaria) have completed the transition process. Analysis includes annual data belonging to 1995 - 2014 period. the variables are savings ratio (% of GDP, hereafter SAV) and investment ratio (% of GDP, hereafter INV). Data belonging to variables are obtained from World Bank Statistics.

In the first step cross section dependency is tested. In the test for cross section dependency null hypothesis claims the presence of cross section dependency and alternative hypothesis indicates the absence of cross section dependency.

Table-1. Cross Section Dependence Test Results

Constant	S	I
CD_{lm} (Breusch and Pagan, 1980)	68.421 (0.014)**	75.952 (0.003)***
CD_{lm} (Pesaran, 2004)	2.469 (0.007)***	3.263 (0.001)***
CD (Pesaran, 2004)	-0.795 (0.213)	0.105 (0.458)
LM_{adj} (Pesaran *et al.*, 2008)	17.992 (0.00)***	14.197 (0.00)***

Notes: In the following model, the number of lag (pi) is determined as four $\Delta y_{i,t} = d_i + \delta_i y_{i,t-1} + \sum_{j=1}^{p_i} \lambda_{i,j} \Delta y_{i,t-j} + u_{i,t}$. The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively.

When we take probability values into account, alternative hypothesis which claims validity of cross section dependency is accepted. In the second step of the analysis we test the presence of unit root in the series belonging to variables. In this regard, second generation unit root test which can test the validity of stationary for each country is employed. The tests named cross sectional augmented Dickey–Fuller (CADF) also allow to test series which number of countries is bigger than time frequency (T>N). In CADF test, null hypothesis claims the validity of unit root and the alternative hypothesis indicates absence of unit root in the series. If CADF statistics value is smaller than critical value that means related country series are stationary.

[5] Information belonging to CCE test statistics can be found in Pesaran (2006).

Table-2. CADF Unit Root Test Results

		Constant		Constant and Trend			Constant		Constant and Trend
	Lags	CADF -stat	Lags	CADF -stat		Lags	CADF-stat	Lags	CADF -stat
Savings					**Investments**				
Bulgaria	1	-1.06	1	-1.12	Bulgaria	3	-0.600	3	-0.735
Czech Republic	1	-2.24	1	-3.13	Czech Republic	1	-2.135	1	-3.018
Latvia	3	-0.497	2	-2.56	Latvia	3	-1.127	3	-2.299
Romania	1	-2.19	1	-2.04	Romania	2	-0.907	2	-0.997
Slovak Republic	3	-2.04	3	-1.25	Slovak Republic	3	-0.706	3	-2.699
Lithuania	1	-2.32	1	-2.62	Lithuania	1	-5.388***	1	-5.160***
Hungary	3	-1.54	3	0.234	Hungary	1	-2.762	1	-2.727
Estonia	1	-3.94**	1	-3.71*	Estonia	3	-3.033*	3	-3.343
Poland	1	-2.98	1	-2.62	Poland	3	-1.579	3	-3.878**
Slovenia	1	-2.31	1	-1.72	Slovenia	3	-1.514	3	-4.354**
Panel CIPS		-2.04		-2.15	Panel CIPS		-2.075		-2.921*

Notes: Maximum lag length is four and optimal lag length is determined via Schwarz information criterion. CADF statistics critical values are as follows; for model with constant -4.11 (%1), -3.36 (%5) and -2.97 (%10) (Pesaran, 2007) for model with constant and trend -4.67 (%1), -3.87 (%5) and -3.49 (%10) (Pesaran, 2007). Panel statistics critical values are as follows; for model with constant -2.57 (%1), -2.33 (%5) and -2.21 (%10) (Pesaran 2007, table II(b), p:280); for model with constant and trend -3.10 (%1), -2.86 (%5) and -2.73 (%10) (Pesaran, 2007). Panel statistics are average of CADF statistics.

When the test statistics are compared with critical valuations obtained by Pesaran (2007) domestic savings ratio has unit root in level in every country except Estonia. The situation with the second variable is similar. It has unit root in level for all countries except Lithuania.

Table-3. Cross Section Dependency and Homogeneity Tests

Regression Model:		
$investment_{it} = \alpha_i + \beta_{1i} saving_{it} + \varepsilon_{it}$	Statistic	p-value
Cross-section dependency tests:		
LM (Breusch and Pagan, 1980)	153.95	0.00***
CD_{lm} (Pesaran, 2004)	10.298	0.00***
CD (Pesaran, 2004)	3.670	0.00***
LM_{adj} (Pesaran *et al.*, 2008)	32.421	0.00***
Homogeneity tests:		
$\tilde{\Delta}$	5.860	0.00***
$\tilde{\Delta}_{adj}$	6.330	0.00***

Notes: The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively

In the light of results, we employ cointegration tests taking cross section dependency into account and based on heterogeneous estimations.

Table-4. Panel Cross Section Dependency Co-integration Tests Not Taking Structural Breaks into Account

Tests	Constant			Constant and Trend		
	Statistic	Asymptotic p-value	Bootstrap p-value	Statistic	Asymptotic p-value	Bootstrap p-value
Error Correction						
Group_tau	-4.640	0.00***	0.021**	-7.452	0.00***	0.00***
Group_alpha	-7.696	0.00***	0.041**	-8.390	0.00***	0.057*
Panel_tau	-7.920	0.00***	0.00***	-9.215	0.00***	0.00***
Panel_alfa	-12.782	0.00***	0.00***	-11.178	0.00***	0.014**
LM bootstrap						
LM_N^+	2.226	0.013**	0.286	2.070	0.019**	0.538

Notes: The null hypothesis of both tests implies the invalidity of cointegration relation. In error correction test, lag and premise values are one. Bootstrap probability value is obtained via 1.000 reputation. Asymptotic probability value is obtained from standard distribution. The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively.

We interpret error correction test results as follows; it is possible to conclude that there is a cointegration relation between variables when we take both asymptotic and bootstrap probability values into account. In LM bootstrap test, the asymptotic test statistics indicate the validity of cointegration relation between variables.

Table-5. Test Results of Panel Cointegration Estimators Measuring Cross Section Dependency

Estimator	Constant		Savings	
	Coefficient	p value	Coefficient	p value
CCE	15.909	0.938	0.575	0.001***
AMG	18.488	0.00***	0.318	0.021**

Notes: The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively.

Coefficients obtained from CCE and AMG estimators are presented in table 5. In CCE estimator, constant term coefficient is statistically insignificant. But the coefficient of slope statistically significant and means if domestic savings increase 1 %, domestic investments would increase 0,575 %. According to AMG estimator results, both constant term coefficient and slope coefficient are statistically significant. Coefficients imply that the share of autonomous investment share is 18 % and a 1 % increase in domestic savings would increase domestic investments nearly 0,318 %. According to results, Feldstein and Horaika puzzle is not valid for the transition economies which we analyzed. Because Feldstein and Horioka (1980) find in their novel study the coefficient between 0,95 and 0,85, but the results imply that the coefficient much more below than they estimate. The reason why the puzzle of Feldstein and Horaika is not valid in transition economies is that the investments are financed by funds canalized by European Union to transition economies in the context of integration to European Union process. Dependency of domestic investments to domestic savings sharply decreased by the unblocking of international capital mobility into transition economies.

Table-6. Panel VECM Causality Test Results

		Short Run Causality	Long-run causality
	Δ (INV)	Δ (SAV)	ECT(-1)
Δ (INV)	-	5.567 (0.134)	-0.408 (0.125)
Δ (SAV)	10.480 (0.014)**	-	-0.360 (0.071)*

Notes: The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively

The panel VECM causality test results are presented in table 6. According to results, the relation between domestic savings and investments is uni-directional and runs from savings to investments. The relation is valid in both short and long run. The results support Feldstein Horaika puzzle in transition puzzle as in whole group.

Table-7. Emirmahmutoğlu and Kose (2011) Panel Causality Test Results

Country	Lag	SAV=>INV	INV=>SAV
Bulgaria	3	7.091 (0.069)*	1.685 (0.640)
Czech Republic	1	0.232 (0.232)	0.056 (0.811)
Latvia	1	0.694 (0.404)	1.441 (□.229)
Romania	2	2.086 (0.352)	0.084 (0.958)
Slovak Repu□lic	3	2.752 (0.431)	1.055 (0.787)
Lithuania	3	29.561 (0.00)***	6.601 (0.085)*
Hungary	1	1.201 (0.272)	0.041 (0.839)
Estonia	2	6.909 (0.031)**	0.505 (0.776)
Poland	3	23.540 (0.00)***	2.693 (0.441)
Slovenia	1	1.273 (0.259)	0.502 (0.478)
Fisher Stat.		**71.373 (0.00)*** **	**13.688 (0.845)**

Notes: The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively

When we investigate the relationship in the context of single economy, it is possible to imply that the relation is valid in only Lithuania and Poland strongly, in Estonia and Bulgaria some weakly. In Lithuania, the relation occurs bi-directional. In Bulgaria, Estonia and Poland, unidirectional causality runs from savings to investments. These results mean in four of ten countries Felstein - Horaika puzzle is valid. On the other hand, it is possible to say that domestic investments are financed by domestic savings, contrary to Feldstein and Horaika's findings in 1980s for developed countries.

5. CONCLUSION

Effect level of domestic savings to domestic investments is one of the important issues for the policymakers to discuss. In economies which are transited from central planning economy to market based economy, increased capital mobility and process of integration to European Union are the most important factors determining the relationship between investments and savings. The results obtained from initial panel data analysis tests do not support Feldstein and Horaika puzzle in the whole group. The reason is that transition economies are financed by European Union funds in initial years of transition and so they do not need domestic savings.

In the second step of empirical analysis, individual tests are made. According to Emirmahmutoğlu and Kose (2011) test results, Feldstein and Horaika puzzle is valid in Poland and Lithuania strongly and Estonia and Bulgaria some weakly. That means Poland and Lithuania are financed domestic investments themselves, others are financed by EU. The economic integration programs like "Phare" started in 1993 helped them in the construction of market based economy and in development of the economy. So, they do not need to domestic savings in most of them.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
Contributors/Acknowledgement: All authors contributed equally to the conception and design of the study.

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