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Re-Visiting Fisher Effect for Fragile Five Economies

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Abstract: In this study, we aim to investigate the relationship between interest rate and inflation rate in the context of the Fisher effect hypothesis for Fragile five economies. In this regard, we employ recently developed panel co-integration and panel causality test methods. The bi-directional causal relation between interest rate and inflation rate exists only in Brazil and Indonesia. On the other hand, there is no causation linkage in India. Results imply that Fisher effect exists only in Brazil and Indonesia.

Keywords: Fisher effect, panel data, fragile five economies.

JEL Codes: C22, E43, E58

1. Introduction

The definition of a new country group was made by James Lord from Morgan Stanley in August 2013. That was the “Fragile five” consisting of Indonesia, India, Brazil, Turkey and South Africa. The main idea of the group is the beginning of fragility in the financial system of each country after the announcement of the end of QE. In May, Bernanke emphasized that the FED would finish the program in near future.

The importance of the declaration for emerging market economies was the end of cheap international capital. The international capital flow to emerging market economies would stop and they will turn to mainland of the capital, United States. Course of financial system resulted in the increasing risk premium for emerging financial systems. Decreasing capital flow into emerging markets has made emerging market countries' currencies weak and made it difficult to finance current account deficits. Lack of new investments also made it impossible to finance many growth projects, which has contributed to a slowdown in their respective economies.

It is important to explain how the countries were selected into the group. According to the Morgan Stanley's ranking system for emerging market economies, medium term risks such as inflation, real exchange rate, industrial metal prices, current account positions and balance of payments reliance on income inflows are taken into consideration and then the overall external vulnerability of the given country is calculated.

According to table 1, the highest vulnerability ranking is of the Chilean economy and its national currency, followed by the Turkish lira, Peruian sol, Indonesian rupiah, Brazilian real, Mexican peso, South African rand, and Indian rupee. When we take the economic magnitudes, Lord accepted Turkey, Indonesia, India, Brazil and South Africa as "Fragile Five" economies.

Table 1 Ranking Vulnerabilities* of Emerging Market Economies

	CPI	REER	Net Indus Metal Exp	C/A	FI Flows	ECR	Av.
CLP	-0.33	0.13	3.31	0.94	0.31	0.50	0.69
TRY	1.44	-0.32	-0.59	1.34	0.70	1.06	0.40
PEN	-0.69	0.65	1.65	0.85	-	-0.63	0.34
IDR	0.97	0.54	-0.03	0.41	-0.20	0.66	0.30
BRL	1.15	0.65	0.09	0.64	-0.70	-0.05	0.25
MXN	0.02	-0.71	-0.27	0.13	1.95	0.64	0.23
ZAR	1.03	-2.41	0.52	1.15	0.78	0.92	0.16
INR	1.97	-0.31	-0.26	0.78	-1.17	0.52	0.15
COP	-0.39	1.21	-0.27	0.50	-0.50	0.28	0.07
THB	-0.21	1.20	-0.59	-0.27	-0.04	-0.26	0.01
PLN	-1.16	-0.81	-0.23	0.50	1.62	0.57	-0.01
CZK	-1.22	0.28	-0.46	0.15	0.83	0.69	-0.02
RUB	0.97	1.59	-0.07	-0.78	-1.06	-2.57	-0.04
HUF	-0.10	-0.47	-0.36	-0.90	-0.50	0.59	-0.26
ILS	-0.92	0.76	-0.26	-0.50	-1.28	0.06	-0.32
MYR	-0.75	0.13	-0.55	-1.46	-	-0.64	-0.44
KRW	-63.00	-1.32	-0.84	-1.15	0.43	-0.13	-0.50
SGD	-2.22	-0.31	-0.25	-0.20			-0.58
TWD	-1.16	-0.80	-0.80	-2.32	-1.16	-2.22	-1.03

Source: Bloomberg, Haver, Morgan Stanley Research data in z-scores terms
* Higher Av value indicates greater risk; normalized.

Another issue with the fragile five countries is the uncertainty about the condition of the economy. In this context, basic financial and economic indicators become important in predicting course of the economy, such as inflation rate, economic growth, etc. Fisher (1930) claims the relation between nominal interest rate and inflation rate in order to predict future inflation.

According to Fisher's theory of interest, movements in nominal bond yields originate in two sources: changes in real interest rates and changes in expected inflation (Gul and Acikalin, 2008). While this information is an important indicator for policymakers, equation is able to make a significant contribution towards understanding the dynamics between nominal interest rate, real interest rate and expected inflation (Mitchell-Jones, 2006). It can be useful for investigating the extent to which long term bond yields serve as reliable indicators of long term inflationary expectations. In his novel study Fisher (1930) investigates the relation between nominal fund rate and inflation rate in the United States and the United Kingdom historically and he finds high correlations between the variables. Theoretically, his equation can be presented as follows:

$$i_t = r_t + \pi_t^e \quad (1)$$

In the equation, the nominal interest rate i_t equals the sum of real interest rate r_t and inflation expectations π_t^e.

According to Fama (1975), inflation expectations bases on the rational expectations hypothesis in the hypothesis of Fisher, $\pi_t^e = \pi_t + \varepsilon_t$ and error term is distributed normally $\varepsilon_t \sim WN(0, \sigma^2)$. In this regard, equation is shown as follows:

$$i_t = \beta_0 + \beta_1 \pi_t + \varepsilon_t \quad (2)$$

Fisher hypothesis tests whether a change in inflation rate changes nominal interest rate or not. Equation 2 shows that there is an interaction between nominal interest rate and inflation rate and it is not affected by real interest rate. However, if i_t and π_t are co-integrated and $\beta_1<1$, weak Fisher effect is valid and if $\beta_1=1$ exact Fisher effect is valid. If there is no co-integration relationship between the variables, the basic components of nominal interest rate and inflation are different from each other.

In this study, we aim to analyse the validity of Fisher hypothesis in economies called "Fragile Five". By doing so, we will be able to better understand the condition of each economy and predict the fragility of financial system via estimating the relation between inflation and interest rate. This might be important for economies have fragile financial systems because the estimation of relation

- could explain the connection between monetary policies and financial market interest rate and this would give sign for policymakers who want to sustain financial system stability.

In the second section, we summarize the existing literature and papers investigating the hypothesis for the related economies. Methodology is introduced in the third section, while dataset and model are described in the following section. Empirical findings are presented in section five.

2. Literature Review

There is a vast literature investigating Fisher effect hypothesis. Cagan (1956), Meiselman (1962), Sargent (1969) and Fama (1970) are among them. Initial studies take the U.S. economy into account. Historical analyses imply that there is a strong relation between inflation rate and federal funds rate like in Fama (1975) and Mishkin (1992). The studies investigating developed economies are in favour of Fisher hypothesis. Some of them belong to Peng (1995) for France, the United Kingdom, the United States, Germany and Japan, Macdonald and Murphy (1989) for Canada and the United States, Dutt and Glosh (1995), Mishkin and Simon (1995) and Atkins and Coe (2002) for Canada, Australia and the United States, Bajo-Rubio et al. (2005) for Spain, and Granville and Mallick (2004) for the United Kingdom. Kruskovic (2017) investigates the effect of interest rate on macroeconomic variables such as inflation rate and economic growth in emerging market economies.

Another point of view of initial studies is about the difficulty of measurement of inflation expectations and discussion of rational expectations – adoptive expectations hypothesis of the Fisher effect belong to Cagan (1956), Meiselman (1962), Sargent (1969) and Fama (1970). Carlson (1977), Joines (1977) while Hess and Bicksler (1975) criticize the study of Fama (1975) who employs the short term interest rate as an important determinant of inflation. The main bearing of these criticisms is the use of past cyclical inflation rates to predict future inflation rate and seasonal effects in the error term do not fully reflect the Fisher effect.

There are a number of studies testing Fisher effect related to emerging market economies. Phylaaktis and Blake (1993) investigate Argentina, Brazil, and Mexico economies which experienced high inflation problem in 1970s and 1980s. Garcia (1993) analyses Brazil between 1997 and 1990. Thornton (1996) investigates the Mexican economy between 1978 and 1994. They all conclude strong Fisher effect.

Nam (1993) claims that there is liquidity effect on the relation between inflation and interest rate in South Korea between 1974 and 1991. Zilberfarb (1989) investigates the Israeli economy in the context of Fisher effect and finds that it is valid between 1980 and 1988. According to him, inflation and supply shocks are effective on interest rates. Payne and Ewing (1997) indicate that Fisher effect is strong in Sri Lanka, Singapore and Pakistan while the effect is not valid in Argentina, Fiji, Niger, Thailand. Ahmad (2010) finds weak Fisher effect in Pakistan between 1971 – 2006, in India between the years 1975 and 2006, in Saudi Arabia between 1997 and 2006, and in Kuwait in the period 1997 – 2006 period. Fabris (2015) investigates the situation with monetary policy of the central bank for the Serbian economy.

For the Turkish economy, Turgutlu (2004) investigates the Fisher effect and employs the wholesale price index and finds that the effect is not valid, but when the researcher employs the consumer price index, the Fisher effect is valid. Şimşek and Kadılar (2006) in 1978 – 2004 period, Gül and Açıkalın (2007) in 1990 – 2007 period, conclude that the effect is valid in the Turkish economy. Contrary to the studies listed above, Yilanci (2009) finds results for the 1989 – 2008 period supporting invalidity of the effect. Bulut (2016) also investigates the central bank of the Republic of Turkey in the context of inflation uncertainity.

On the other hand, the validity of Fisher effect may depend on the exchange rate regime and we summarize the related literature. According to Peng (1995), MacDonald and Murph (1989), Yuhn (1996), and Dutt and Ghosh (1995), the Fisher effect is invalid if the policymakers implement floating exchange rate, whereas a strong Fisher effect is experienced in economies where fixed exchange rate regime is implemented. Also price indices chosen are effective on validity of relation between inflation and interest rate. Garcia (1993), Zilberfarb (1989), Payne and Ewing (1997) and Turgutlu (2004) imply that the consumer price index is better than the wholesale price index in the context of validity of Fisher effect.

3. Methodology

3.1. Cross-sectional dependence and homogeneity

For testing cross-section dependence we employ the Lagrange Multiplier (LM) test developed by Breusch ve Pagan (1980). While i denotes cross – section size i=1,2,…,N, t denotes time period t=1,2,…,T, α_i and β_i denote constant term and slope parameter, respectively. Lastly, x_{it} is kx1 descriptive variables vectors and panel model;

$$y_{it} = \alpha_i + \beta_i' x_{it} + \varepsilon_{it} \tag{1}$$

In the light of no cross-section dependence hypothesis [$H_0 : Cov\ (\varepsilon_{it}, \varepsilon_{jt}) = 0$] LM test statistics;

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 : \chi^2_{N(N-1)/2} \tag{2}$$

where $\hat{\rho}_{ij}^2$ is the sample estimate of the pair-wise correlation of the residuals from individual ordinary least squares (OLS) estimation of the Eq. (1) for each i. When N>T, Peseran (2004) calculates a new LM test statistics for size distortions;

$$CD = \sqrt{\left(\frac{2T}{N(N-1)}\right)} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right) : N(0,1) \tag{3}$$

CD test has a mean of zero for fixed T and N and is robust to heterogeneous dynamic models including multiple breaks in slope coefficients and/or error variances as long as the unconditional means of the dependent and independent variables are time-invariant and their innovations have symmetric distributions. Peseran et al., (2008, hereinafter: PUY) calculates bias-adjusted LM test statistics for large panel data because pairwise correlation is not distributed with zero mean;

$$LM_{adj} = \sqrt{\left(\frac{2}{N(N-1)}\right)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{v_{Tij}^2}} : N(0,1) \tag{4}$$

where k is the number of descriptive variables, μ_{Tij} exact mean and v_{Tij}^2 is the exact variance of $(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}$. The first step of unit root test in the panel data analysis is to test cross section dependence. If there is no cross section dependence first generation unit root test, otherwise second generation unit root test methods are employed. Cross section dependence is tested by Peseran (2004) CD_{LM}, Breusch-Pagan (1980) CD_{LM1}, Peseran (2004) CD_{LM2} test. If T>N CD_{LM1} and CD_{LM2} are employed. If N>T, CD_{LM} test is employed.

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,

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + d_0 \overline{y}_{t-1} + \sum_{j=0}^{p} d_{j+1} \Delta y_{t-j} + \sum_{k=1}^{p} c_k \Delta y_{i,t-k} + \varepsilon_{it} \tag{5}$$

where Δy_t is the average at time t of all N observations. We use Schwarz information criteria in order to calculate lag length.

3.3. Im, Lee and Tieslau (2005) Unit Root Test with Structural Breaks

Im et al. (2005) calculate regression $Y_{i,t} = \gamma_i' Z_{i,t} + u_{i,t}$ where $Z_{i,t} = (1, t, D_{i,t})$ is external variables vector and it is estimated that for each i AR(1) $u_{i,t} = \delta_i u_{i,t-1} + \varepsilon_{i,t}$ process is experienced. $T_{B,i}$ is the time of structural break. $D_{i,t}$,s dummy variable;

$$D_{i,t} = \begin{pmatrix} 0; & \mathrm{t<T_{B,i}} \\ t - T_{B,i} & \mathrm{t \geq T_{B,i}} \end{pmatrix} \tag{6}$$

Test process is modified version of Lee and Strazicich (2003, 2004) double internal structural break unit root test.[1]

3.4. Panel Co-integration and Causality Test

In order to see long term relation between variables, we employ the co-integration test developed by Westerlund (2007). $\phi_{1i}\hat{\varepsilon}_{it-1}$ is the error correction coefficient in the panel vector auto regression;

$$\Delta \operatorname{int} = \delta_{1i} + \sum_{p=1}^{k} \delta_{11ip} \Delta \operatorname{int}_{it-p} + \sum_{p=1}^{k} \delta_{12ip} \Delta cpi_{it-p} + \phi_{1i}\hat{\varepsilon}_{it-1} + \nu_{1it} \tag{7}$$

$$\Delta cpi = \delta_{2i} + \sum_{p=1}^{k} \delta_{21ip} \Delta cpi_{it-p} + \sum_{p=1}^{k} \delta_{22ip} \Delta \operatorname{int}_{it-p} + \phi_{2i}\hat{\varepsilon}_{it-1} + \nu_{2it} \tag{8}$$

In this asymptotically dispersed model, critical values are calculated by bootstrap method in order to take horizontal section dependence into account. The null hypothesis is that there is no co-integration. Short- and long-term causality tests are obtained by adding the error correction coefficient to the panel VAR model. In order to test the Fisher effect in the co-integration model, we test two hypothesis, for short term $\sum_{p=1}^{k} \delta_{12ip} \Delta cpi_{it-p} = 0$ and for long term $\phi_{1i}\hat{\varepsilon}_{it-1} = 0$. The null hypothesis is that there is no Granger causality running from consumer price index to policy interest rate.

[1] For the test statistics please see Im et al. (2005).

Emirmahmutoğlu and Köse (2011) employ bootstrap method to Fisher test statistics and obtain causality for each i. Initially, unit root test is employed and optimal lag length is determined. For each i:

$$y_{i,t} = \alpha_{i,t} = \sum_{j=1}^{k_i + d\max_i} \beta_{ij} x_{i,t-j} + \sum_{j=1}^{k_i + d\max_i} \gamma_{ij} y_{i,t-j} + \varepsilon_{it} \tag{9}$$

Error terms are identified via regression above. Null hypothesis is there is no Granger causality [$H_0 : \beta_{i1} = \beta_{i2} = ... = \beta_{ik_i} = 0$]. In the following step, critical values are obtained by employing the bootstrap method on the error terms.[2]

4. Empirical Results

In this study we employ data relating to Brazil, India, Indonesia, South Africa, and Turkey between January 2000 and June 2016. The variables are the consumer price index (CPI) and the policy interest rate (INT). Data for each variable are obtained from the International Financial Statistics. In the context of the analysis, we take logarithmic version of the series in order to solve the autocorrelation problem.

In the first step, we control cross section dependence and the null hypothesis of the test claims there is no cross section dependence. The alternative one implies there is cross section dependence.

Table 2: Cross Section Dependence Test Results

Constant	INT		CPI	
	Statistic	p-value	Statistic	p-value
CD_{lm}(BP,1980)	233.600	0.00***	147.873	0.00***
CD_{lm} (Pesaran, 2004)	49.998	0.00***	30.829	0.00***
CD (Pesaran, 2004)	-7.337	0.00***	-9.549	0.00***
LM_{adj} (PUY, 2008)	32.396	0.00***	101.304	0.00***

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

Taking the probability values into account, the alternative hypothesis is accepted as horizontal cross section dependence. The second generation unit root test re-

2 For boostrap test statistics please see Emirmahmutoğlu ve Köse (2011).

sults are employed due to cross section dependence. The null hypothesis confirms unit root in the CADF test and alternative hypothesis claims no unit root in series. If the CADF test statistics is smaller than critic value, this means related country series is stationary and vice versa.

Table 3: CADF Unit Root Test Results

	Constant		Constant and Trend	
	Lags	CADF-stat	Lags	CADF-stat
INT				
Brazil	1	-2.672	1	-2.279
India	1	-2.125	1	-2.449
Indonesia	3	-3.520**	3	-3.715*
South Africa	1	-2.021	1	-1.789
Turkey	1	-2.688	1	-2.341
Panel		-2.605		-2.514
CPI				
Brazil	1	-1.25	1	-0.763
India	2	-2.29	2	-0.951
Indonesia	1	-1.52	3	-2.709
South Africa	4	-1.63	4	-1.214
Turkey	1	-2.39	1	-1.663
Panel		-1.79		-1.460

Notes: The minimum lag length is determined as four and optimal lag length is determined according to Schwarz information criterion. CADF statistics is -4.11 (%1), -3.36 (%5) and -2.97 (%10) in model with constant (Pesaran 2007, table I(b), p:275); -4.67 (%1), -3.87 (%5) and -3.49 (%10) in model with constant and trend (Pesaran 2007, table I(c), p:276). Panel statistics critic values are -2.57 (%1), -2.33 (%5) and -2.21 (%10) in model with constant (Pesaran 2007, table II(b), p:280); -3.10 (%1), -2.86 (%5) and -2.73 (%10) in model constant and trend (Pesaran 2007, table II(c), p:281). Panel statistics are the average of CADF statistics.
When we compare test statistics with critical values obtained by Peseran (2007), we find that all variables belonging to fragile five economies have unit root out of Brazil. We consider all variables have unit root in the context of long run memory and employ first difference of all variables in the analysis.

The results of Im et. al. (2005) test are presented in table 4. The structural breaks for the interest rate are: May and October of 2002, July 2003, April 2009 for Brazil, December of 2006, May, August and October of 2010 for India, January and May of 2002 for Indonesia, October of 2001 and 2002 for South Africa and July and August of 2001 and May and July of 2004 for Turkey. The structural breaks for the inflation rate are: March 2012 and June 2014 for Brazil, March 2007, February 2008, September 2012 and April 2013 for India, May, October and December of 2005 and August of 2012 for Indonesia, October and December 2002 and April and November of 2011 for Turkey.

Table 4: Im, Lee and Tieslau (2005) Panel Unit Root Tests Results with Structural Breaks

	One break model					
	Level shift model: Break in constant			Level and trend shift model: Break in constant and trend		
INT	Lag	LM-stat.	Break Time	Lag	Transformed LM-stat.	Break Time
Brazil	1	-3.119	2006:02	1	-5.437***	2003:07
India	0	-3.381	2006:12	0	-2.942	2010:05
Indonesia	1	-3.206	2002:11	1	-2.908	2002:10
South Africa	2	-2.830	2003:08	2	-4.824***	2001:10
Turkey	1	-12.995***	2001:06	1	-14.548***	2001:07
Panel-LM		-12.050			-13.642	
p-value		0.00***			0.00***	
	Two breaks model					
Brazil	1	-5.490***	2003:07-2009:04	1	-7.357***	2002:05-2002:10
India	0	-4.489**	2006:12- 2010:10	0	-14.691***	2010:05-2010:08
Indonesia	1	-3.530	2002:10-2013:10	1	-5.682***	2002:01-2002:05
South Africa	2	-3.596	2002:10-2007:06	2	-5.579***	2001:10-2002:10
Turkey	1	-7.313***	2001:08-2004:07	1	-7.444***	2001:07-2004:05
Panel-LM		-11.196			-19.596	
p-value		0.00***			0.00***	

	One break model					
	Level shift model: Break in constant			Level and trend shift model: Break in constant and trend		
CPI	Lag	LM-stat.	Break Time	Lag	Transformed LM-stat.	Break Time
Brazil	1	-2.852	2012:03	1	-3.400	2010:04
India	1	-3.255	2008:01	1	-3.259	2008:01
Indonesia	1	-3.491	2003:01	1	-4.626*	2013:02
South Africa	1	-3.020	2005:07	1	-2.757	2013:12
Turkey	1	-2.361	2005:01	1	-2.954	2011:04
Panel-LM		-3.936			-2.982	
p-value		0.00***			0.00***	
	Two breaks model					
Brazil	1	-3.399	2006:03-2013:03	1	-4.672**	2012:03-2014:06
India	1	-5.319***	2007:03-2012:09	1	-5.959***	2008:02-2013:04
Indonesia	1	-5.115***	2005:12-2012:08	1	-9.446***	2005:05-2005:10
South Africa	1	-3.433	2004:06-2004:07	1	-4.175	2007:08-2008:01
Turkey	1	-5.556***	2002:12-2002:10	4	-5.142**	2011:04-2011:11
Panel-LM		-9.960			-10.728	
p-value		0.00***			0.00***	

Notes: Critical values for individual statistics for one break model: -4.604 (1%); -3.950 (5%); -3.635 (10%)
Critical values for individual statistics for two breaks model: -5.365 (1%); -4.661 (5%); -4.338 (10%)
The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively

Table 5: Cross Section dependence and Homogeneity Tests Results

Regression Model: $\ln int_{it} = \alpha_i + \beta_{1i} \ln cpi_{it} + \varepsilon_{it}$	Statistic	p-value
Cross-section dependence tests:		
LM (BP,1980)	145.174	0.00***
CD_{lm}(Pesaran, 2004)	30.226	0.00***
CD (Pesaran, 2004)	7.470	0.00***
LM_{adj}(PUY, 2008)	256.284	0.00***
Homogeneity tests:		
$\Delta\%$	23.984	0.00***
$\Delta\%_{adj}$	24.172	0.00***

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

In the cross section dependence test, the null hypothesis confirms there is no dependence and the alternative hypothesis claims there is a dependency between countries. According to the results, there is cross section dependence and the alternative hypothesis is accepted. In this regard, we have to employ co-integration test which takes cross section dependence and heterogeneity estimation into account.

Table 6: Panel Co-integration Test Results

Tests	Constant			Constant and Trend		
	Statistic	Asymptotic p-value	Bootstrap p-value	Statistic	Asymptotic p-value	Bootstrap p-value
Error Correction						
Group_tau	-4.106	0.00***	0.00***	-2.954	0.00***	0.00***
Group_alpha	-4.578	0.00***	0.00***	-2.639	0.00***	0.00***
Panel_tau	-8.845	0.00***	0.00***	-8.715	0.00***	0.00***
Panel_alfa	-26.638	0.00***	0.00***	-18.542	0.00***	0.00***
LM bootstrap						
LM_N^+	10.958	0.00***	0.856	25.848	0.03**	0.00***

Notes: The null hypothesis claims that there is no co-integration in both tests. The lag length is chosen as one in error correction model. Bootstrap probability value is 1.000. Asymptotic probability values are obtained from standard normal distribution. The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively

The null hypothesis of LM tests based on both error correction and bootstrap methods confirms that there is no co-integration. According to the results, there is co-integration between the variables.

Table 7: Panel VECM Causality Test Results

	Short Run Causality		
	Δ(INT)	Δ(CPI)	ECT(-1)
Δ(INT)	-	26.646 (0.00)***	-0.105510 (0.013)**
Δ(CPI)	19.160 (0.00)***	-	-0.0002019 (0.00)***

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

In the whole panel, there is a bi-directional causality between the variables in both short and long run. Results imply that in emerging market economies, inflation expectations of economic actors due to exchange rate volatility may guide policy applications of central banks in both short and long term. In fragile five economies which belong to a group of emerging market economies, monetary policies are designed to prevent pass through effect of exchange rate, so exchange rate volatility may affect the consumer price index and policy interest rate which is an important monetary policy tool.

In determination of loanable fund supply and demand, the policy interest rate is an important tool in the fragile five economies. In this regard, bi-directional causality between the variables implies that monetary policy has an important role in providing investment – savings balance.

In the second step we employ the Emirmahmutoğlu and Köse (2011) panel causality test. While the panel vector error correction model finds the causality for whole countries, Emirmahmutoğlu and Köse (2011) panel causality test finds causality for each economy. The result of the panel causality test is presented in table 8.

Table 8: Emirmahmutoğlu and Köse (2011) Panel Causality Test Results

Country	Lag	INT=>CPI		CPI=>INT	
		Wald	p-value	Wald	p-value
Brazil	5	15.743	0.00***	11.097	0.049**
India	2	3.324	0.189	0.118	0.942
Indonesia	4	44.027	0.00***	18.408	0.00***
South Africa	4	19.656	0.00***	6.483	0.165
Turkey	6	12.791	0.00***	6.767	0.342
Fisher Stat.		**71.865**	**0.00*** **	**25.628**	**0.00*** **

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

There is a bi-directional causality between policy interest rate and consumer price index in Brazil and Indonesia. There is a unidirectional causality running from policy interest rate to consumer price index in South Africa and Turkey. There is no causality between variables in India. Basically, the Fisher effect is valid only Brazil and Indonesia. According to Peng (1995), strong anti-inflationist policies implemented by monetary authorities weaken the relationship between policy interest rate and inflation rate and that reduces the power of the Fisher effect. Bayat (2011) and Yilanci (2009) claim that there is no Fisher effect because there is no regime change in the implementation of monetary policy in Turkey and South Africa. On the other hand, the main reason for the non-existence of the Fisher effect in India is that short term interest rates usually change and it does not affect long term interest rates.

5. Conclusion

In the fragile five countries which have been experiencing structural economic problems for many years, the interest rates of the central banks in terms of both stabilizing the inflation rate and attracting capital from international markets constitute the basis of monetary policy strategies. In this study, we investigate the relation between consumer price index and policy interest rate variables in Brazil, India, Indonesia, South Africa and Turkey in the context of Fisher hypothesis in the period between January 2000 and January 2016. In the initial finding of the empirical analysis, we find cross – sectional dependence between the countries. Cross – sectional dependence shows that investors take the countries into account in the same pool.

The structural breaks test developed by Im et. al. (2005) confirms that central banks of the fragile five economies move together in implementing monetary policy actions and policy interest rate is effective on the economy between years 2001 and 2004. We obtain a unidirectional causality from consumer price index to policy interest rate in both short and long run via the panel vector error correction model. Results of the Emirmahmutoğlu and Köse (2011) causality test results imply that the Fisher effect is valid only in Brazil and Indonesia. On the other hand, there is no relation between the consumer price index and the interest rate in India and the relation between variables does not confirm the Fisher effect in Turkey and South Africa.

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