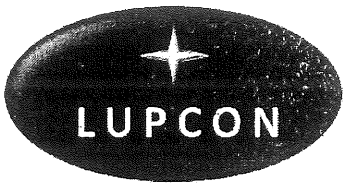

Lupcon Center for Business Research

Oguzhan Ozcelebi
Istanbul University
Turkey

Acceptance Letter for Presentation at Finance and Economics Conference 2015 in Germany

March 3, 2015

Dear Oguzhan Ozcelebi:

We are pleased to inform you that your abstract "Causality Relations among the Real Government Bond Yields of the USA, Germany, Japan, the UK and Russian Federation: VEC Framework" has been accepted for presentation at the Finance and Economics Conference 2015, which takes place in Frankfurt am Main, Germany, from August 5 until August 7, 2015.

We have selected your proposal from a large pool of applicants. Although most of the proposals that were reviewed during the review period were outstanding, only the best and most relevant top 20 percent were selected.

Your proposal will now be scheduled for presentation at the conference. We ask you to complete the registration process by April 10, 2015, to confirm your participation.

At the Finance and Economics Conference, your research will be critiqued by your academic peers from several dozens of countries. Papers presented at the conference will be published in the conference proceedings.

The conference is a great networking opportunity as the audience consists not only of academics, but also of businesspeople from Frankfurt's international business community who are looking to cooperate with academia. Local business students will be attending to meet researchers from universities around the world.

Our sincere congratulations to you! We look forward to meeting you in Frankfurt.

Sincerely,

Christian Wolf

Director
Lupcon Center for Business Research
Postfach 1120
D-91320 Ebermannstadt
Germany
Phone: +49 176 93123808
E-Mail: cw@cwolf-online.com
Website: www.lcbr-online.com

Causality Relations among the Real Government Bond Yields of the USA, Germany, Japan, the UK and Russian Federation: VEC Framework

Kaya Tokmakcioglu (Istanbul Technical University, Turkey)
Oguzhan Ozcelebi (Istanbul University, Turkey)

Abstract

In this study, we carry out causality analysis depending on Vector Error Correction (VEC) models to analyze whether there have been dynamics linking the real long-term government yields of USA, Germany, Japan, UK and Russian Federation quarterly data from 2000:01 to 2014:03. Our results generally stress the role of economic, political and social factors on the decisions of monetary policy authorities, money markets and inflation and thus on the long-term real actual and ex-ante bond yields. In this respect, we infer that trade and financial channels affecting the long-terms real yields should be exposed for the all countries under investigation despite the mixed causality analysis results for Japan and Russian Federation. For further studies and analysis, we suggest the identification of aggregate supply and demand dynamics of these countries by Dynamic General Equilibrium (DSGE) models allowing various types of shocks.

Introduction

According to the real interest rate parity (RIP) there exist dynamics originating from economic theory equaling the ex-ante real interest rates across countries. Additionally, if interest rates are equal, real interest rates are determined in world markets rather than the national credit markets. This phenomenon lowers the ability of monetary policy authorities aiming price stability to control interest rates with different maturities by changing their policy rates.

In this study, we intend to analyze whether there is a long-term relationship among the long-term interest rates of the USA, Germany, Japan, the UK and Russian Federation whose central banks may seriously influence financial flows due to the increased volume of financial flows. We explore the possibility of cointegration among the real long-term government bond yields of these countries to detect the presence of economic and financial structures linking long-term bond yields of the USA, Germany, Japan, the UK and Russian Federation. Thus, we employ Vector Autoregression (VAR)-type of modeling, namely the Vector Error Correction (VEC) model, whereupon the aims of the study are threefold (i) to examine the short and long-term relations among the actual and ex-ante real yields of long-term government bonds of the USA, Germany, Japan, the UK and Russian Federation by estimating VEC models (ii) to detect the possible causality relations among the actual and ex-ante long-term government bond yields of selected countries in real terms based on VEC modelling framework (iii) to make inferences about the possible consequences of financial flows on the government bond yields and thus make policy implication in open-economy framework.

Literature Review

The theoretical base of RIP is that changes in nominal interest rates equal the real interest rate differences among countries. On the other hand, financial flows lead to changes in nominal interest rates and inflation expectations due to the increased role of financial and economic globalization over the last decades. In this respect, RIP condition can be considered by the flow of funds among countries' bond markets and the level of economic activity influencing inflation expectations. There have been several contributions to the literature examining the consistency of RIP. The empirical effort by Jorion (1996) can be seen as one of the earliest studies in that extent. He analyzed the validity of RIP across US, Britain and Germany and his results pointed that there was no tendency for expected real interest rates to be equalized over longer maturities.

In an important research, Holmes (2002) provided evidence for the validity of RIP. He tested for long-run ex-post RIP among the major European Union (EU) countries over the period 1979–1998. According to his results, onshore RIP occurred during 1986–1990 and 1993–1998 with a random shock to parity estimated at 2–3 months. Moreover, there was no evidence of RIP during 1990–1993 despite the enabling of remaining capital controls in 1990. Examining the mean reverting behavior of real interest differentials in ten Asian economies using Japan as the base country, Baharumshah et al.

(2005) revealed that the conventional ADF test failed to support RIP for at least half of the countries, even for the post-financial liberalization period. However, their results pointed that the real interest rate differentials exhibited mean reverting behavior and deviations from RIP had approximately 6 to 7 months. Similarly, Ferreira and Leon-Ledesma (2007) investigated RIP for both developed and emerging markets. Their results showed the rapid reversion towards a zero differential for developed countries and towards a positive one for emerging markets, while mean reversion was faster for emerging market economies. Ferreira and Leon-Ledesma (2007) stressed that there existed a high degree of market integration for developed countries and that the importance of risk premia for emerging markets should seriously be considered. The study of Baharumshah et al. (2005) investigating Asian economies was differentiated by Baharumshah et al. (2013a) who tested the validity of real interest parity (RIP) for 10 Asian economies over the period 1977–2012 by using two-break unit-root tests and error correction model. They found that most of the real interest rate differentials with respect to Germany and the US took less than a year to adjust back to their respective equilibrium values. Moreover, Baharumshah et al. (2013b) investigated the RIP condition for the 13 Central and Eastern European countries, over the period 1996–2011. They used panel stationary test and exposed that the recent global financial crisis influenced most of the real interest differential series. Baharumshah et al. (2013b) exposed that financial market integration in these countries was invariant with respect to the US and EU. Also, Liu et al. (2013) investigated the long-run RIP by using stationary test with a flexible Fourier function to assess the non-stationary properties of the real interest rate convergence relative to China for ten East Asian countries. Their results provided robust evidence indicating that RIP held true for ten East-Asian countries. Thereby it is implied that the effectiveness of the monetary and fiscal policies in the East Asian economies would be highly affected by external factors originating from China. Most recently, Aristei and Martelli (2014) employed monthly panel data analysis over the period 2000–2012 for the European countries. Thereby, the importance of behavior indicators, namely consumer and market sentiment and expectations, were of great importance for government bond rate differentials during the crisis period.

On the other hand, non-linear techniques can be adapted to analyze the dynamics of RIP. Holmes and Maghrebi (2004) studied the nonlinearities in the real interest rate differentials of four South East Asian economies with respect to Japan and the United States. By using a logistic smooth transition autoregressive (STAR) model, they revealed that the extent of nonlinearities varied across the sample with the Singapore–Japan and Thailand– Japan differentials. Moreover, Holmes and Maghrebi's study (2004) were more likely to lead to the reestablishment of parity at a faster rate than small shocks. Thereby, modeling the nonlinear stochastic dynamics of RIP could be useful for policymaking purposes in recovering information on monetary and financial crises. Güney and Hasanov (2014) also used linear and non-linear unit-root tests for ten post-Soviet transition countries with respect to Russian Federation, the USA and Germany. Linear and non-linear unit-root tests exposed evidence for the consistency of real interest rate parity for most of the series, especially when possible nonlinearities in the adjustment process were considered.

The analysis of RIP condition can be extended by the role of transaction costs and imposed taxes by the government influencing financial flows (Chinn and Frankel, 1995; Modjtahedi, 1988; Throop, 1994). However, Goodwin and Grennes (1994) debated the conventional testing of equality of real rates that uses regression methods could be misleading since it ignored transaction costs. Furthermore, according to their research national real interest rates may fluctuate independently within a transaction costs band, even if financial markets were well integrated. Similarly, in their paper, Al-Awad and Grennes (2002) indicated that observed transaction costs were too small to account for differences among real interest rates by implementing two one-sided t tests. And also, there was clear evidence that transaction costs tend to decrease overtime.

Empirical Analysis

Following the pioneering study of Sims (1980), (VAR)-type models have been widely used by economic researchers to determine the interactions among the variables. According to the unit root properties of the variables and the possible cointegrating relations between variables, VEC models can be accepted as a major tool to expose the causality relations and analyze the economic conditions which is the driving force linking the dynamics of the economic variables to each other. In this study, we employ VEC modeling with quarterly data from 2000:01 to 2014:03 to investigate the relationship between real actual and ex-ante yields of long-term government bonds of the USA, Germany, Japan,

the UK and Russian Federation. Thereby, the effects these countries' central banks interest rate decisions on domestic long-term and foreign interest rates are considered along with the role of increased financial flows among economies. For the needed data, we apply to the statistical database of Federal Reserve Bank of St.Louis, and the following variables were obtained: long-term government bond yields (10-year); $yie_t^{usa}, yie_t^{ger}, yie_t^{jap}, yie_t^{uk}, yie_t^{rus}$, consumer price inflation; $cin_t^{usa}, cin_t^{ger}, cin_t^{jap}, cin_t^{uk}, cin_t^{rus}$. Accordingly, we derive the real yields of long-term government bonds of the USA, Germany, Japan, the UK and Russian Federation as; $ryie_t = yie_t - cin_t$, whereas ex-ante real yields of long-term government bonds of these countries as $eryie_t = yie_t - ecin_t$[1]. J-MuLTi software is used to conduct the empirical exercise.

VEC Model

The $\mathrm{VAR}(p)$ model with deterministic terms and exogenous variables as specified in (1) constitutes the base framework of VEC model.

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + B_0 x_t + \ldots + B_q x_{t-q} + CD_t + u_t \tag{1}$$

where $y_t = (y_{1t}, \ldots, y_{Kt})'$ denotes a vector of endogenous variables with K elements, $x_t = (x_{1t}, \ldots, x_{Mt})'$ is a vector containing the exogenous variables. The A_i, B_j and C are the parameter matrices of the $\mathrm{VAR}(p)$ model. u_t is an unobservable white noise process with positive covariance matrix $\mathrm{E}(u_t u_t') = \Sigma_u$ (JMulTi 4.23 Help System). Despite the $\mathrm{VAR}(p)$ model representation is general enough to accommodate variables with stochastic trends, it is not the most suitable type of model if interest centers on the cointegration relations since they do not appear explicitly. For this purpose, deriving from the VAR model framework in (1), VEC model excluding the exogenous variables can be specified as in equation (2);

$$\Delta y_t = \Pi y_{t-1} + \Gamma_1 \Delta y_{t-1} + \ldots + \Gamma_{p-1} \Delta y_{t-p+1} + u_t \tag{2}$$

Assuming that all variables can be at most $I(1)$ and thus Δy_t does not contain stochastic trends, only the long-run part Πy_{t-1} is $I(0)$ and includes $I(1)$ variables. Π can be accepted as a product of $(K \times r)$ matrices α and β with $\mathrm{rk}(\alpha) = \mathrm{rk}(\beta) = r$; $\Pi = \alpha\beta'$ when $\mathrm{rk}(\Pi) = r$, namely the rank of the Π is r and denotes the cointegrating rank of the system among the components of y_t. Since premultiplying an $I(0)$ vector by some matrix results again in an $I(0)$ process, $\beta' y_{t-1}$ including the cointegrating relations can be obtained by premultiplying $\Pi y_{t-1} = \alpha\beta' y_{t-1}$ with $(\alpha'\alpha)^{-1}\alpha'$. β denotes a cointegration matrix and the loading matrix α has the weights attached to the cointegrating relations in the individual equations of the model. On the other hand, Γ_i refers to the short-run parameters (Lütkepohl, 2007b, pp. 89-90).

---

[1] In this study, inflation expectations are represented by adaptive expectations. According to the theory of adaptive expectations, current inflationary expectations can be specified as; $p^e = (1-\lambda)\sum_{j=0}^{\infty}(\lambda^j p_j)$, where p^e is the next year's rate of inflation that is currently expected, whereas p_j equals actual inflation j years in the past. λ is between 0 and 1. Implication of adaptive expectations can be defined as exponential smoothing since Friedman (1957) used exponential smoothing to construct one of his measures of permanent income. We constructed the adaptive inflation expectations series using the Holt-Winters exponential smoothing method in this study.

Saikkonen cointegration test is based the VEC model framework and this test is employed to determine whether or not the linear combination of these variables are $I(0)$, more precisely the variables included in the $\mathrm{VAR}(p)$ model are cointegrated;

$$y_t = D_t + x_t \tag{3}$$

where $D_t = \mu_0 + \mu_1 t$ denotes the deterministic part with a linear trend term and x_t has a VAR representation as in equation 1. Assuming that $\mu_1 = 0$, $y_t - \mu_0 = x_t$, equation (3) has the VEC form as below (Lütkepohl, 2007b, p.112).

$$\Delta y_t = \Pi(y_{t-1} - \mu_0) + \sum_{j=1}^{p=1} \Gamma_j \Delta y_{t-j} + u_t \tag{4}$$

Equation (4) can also be specified assuming that $\mu_1 \neq 0$. More precisely, if the trend is confined to some individual variables but is absent from the cointegration relations, $y_t - \mu_0 - \mu_1 = x_t$ and VEC model has the form below:

$$\Delta y_t - \mu_1 = \Pi(y_{t-1} - \mu_0) + \sum_{j=1}^{p=1} \Gamma_j (\Delta y_{t-j} - \mu_1) + u_t \tag{5}$$

Within the framework of equation (5), Saikkonen cointegration test proposed by Saikkonen and Lütkepohl (2000) is performed where the mean and trend parameters are estimated in a first step by a feasible Generalized least squares (GLS) procedure, the trend is subtracted from y_t and thus the test statistic is computed based on the VEC model in (4). Accordingly, the pair of hypothesis below is tested to show the cointegrating rank of the system (Lütkepohl, 2007b, pp.112-113).

$$\begin{aligned} &\mathrm{H}_0(0): rk(\Pi) = 0 \qquad \text{versus } \mathrm{H}_1(0): rk(\Pi) > 0 \\ &\vdots \\ &\mathrm{H}_0 = (K-1): rk(\Pi) = K-1 \text{ versus } \mathrm{H}_1 = (K-1): rk(\Pi) = K \end{aligned} \tag{6}$$

Granger-Causality Analysis

According to the causality concept proposed by Granger (1969), y_{1t} is to be causal for a time series variable y_{2t} if the former helps to improve the forecasts of the latter. Within this context, when the $\mathrm{VAR}(p)$ model is written in matrix form in (6). The null hypothesis that y_{1t} is not Granger-casual for y_{2t} is tested by $\alpha_{21,i} = 0,\ i = 1,2,\ldots,p+1$. More precisely, y_{1t} is not Granger-causal for y_{2t} if its lags do not appear in the y_{2t} equation (JMulTi 4.23 Help System).

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \sum_{i=1}^{p+2} \begin{bmatrix} \alpha_{11,i} & \alpha_{12,i} \\ \alpha_{21,i} & \alpha_{22,i} \end{bmatrix} \begin{bmatrix} y_{1,t-i} \\ y_{2,t-i} \end{bmatrix} + CD_t + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix} \tag{7}$$

On the other hand, Granger-causality can also be explored in the framework of the VEC model (Lütkepohl, 2007b, p. 146).

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \alpha\beta' \begin{bmatrix} y_{1,t-1} \\ y_{2,t-1} \end{bmatrix} + \sum_{i=1}^{p-1} \begin{bmatrix} \gamma_{11,i} & \gamma_{12,i} \\ \gamma_{21,i} & \gamma_{22,i} \end{bmatrix} \begin{bmatrix} \Delta y_{1,t-i} \\ \Delta y_{2,t-i} \end{bmatrix} + u_t \tag{8}$$

Equation (7) is equivalent to $\gamma_{12,i} = 0$ $(i = 1,..., p-1)$ and the element in the upper right-hand corner of $\alpha\beta'$ is also zero. Assuming that $r = 1$, α and β are (2×1) vectors and $\alpha\beta' = \begin{bmatrix}\alpha_1 \\ \alpha_2\end{bmatrix}\begin{bmatrix}\beta_1 & \beta_2\end{bmatrix} = \begin{bmatrix}\alpha_1\beta_1 & \alpha_1\beta_2 \\ \alpha_2\beta_1 & \alpha_2\beta_2\end{bmatrix}$, $\alpha_1\beta_2 = 0$ needs to be checked in addition to $\gamma_{12,i} = 0$ and there must be Granger-causality in at least one direction since α and β have rank one (Lütkepohl, 2007b, p.146). y_{1t} can be accepted as instantaneously causal for y_{2t} when knowing the value of y_{1t} in the forecast period helps to improve the forecasts of y_{2t}. More precisely, y_{1t} is said to be instantaneously non-causal for y_{2t} if;

$$y_{2,t+1|\Omega_t} = y_{2,t+1|\Omega_t \cup y_{1,t+1}} \tag{9}$$

where Ω_t includes all the set of all the relevant information in the universe and $\cup$ refers to the union. y_{1t} is instantaneously causal for y_{2t}, if and only if u_{1t} and u_{2t} are correlated (Lütkepohl, 2007b, p. 147).

Empirical data and analysis

Empirical data

Firstly, we determine the unit root properties of the data included in our empirical exercise to specify the appropriate type of VAR model. In this respect, we use the most widely used test in the literature, the augmented Dickey–Fuller (ADF) test. Since the critical values of the test change according to the selection of the inclusion of deterministic variables, the Pantula principle[2] proposed by Pantula (1989) is followed. On the other hand, the lag orders used in the ADF tests are selected by the Akaike Info Creation (AIC).

Table 1: Augmented Dickey–Fuller Test Results

Variables	**ADF Test Statistic**	**Number of Lagged Differences**
$ryie_t^{usa}$ (c)	-2.31	5
$\Delta ryie_t^{usa}$	-4.24	7
$ryie_t^{ger}$ (c)	-1.65	1
$\Delta ryie_t^{ger}$	-6.00	0
$ryie_t^{jap}$ (c)	-0.39	4
$\Delta ryie_t^{jap}$	-5.55	3
$ryie_t^{uk}$ (c)	-1.93	1
$\Delta ryie_t^{uk}$	-4.98	1
$ryie_t^{rus}$ (c)	-1.46	5
$\Delta ryie_t^{rus}$	-7.11	3
$eryie_t^{usa}$ (c)	-2.67	5
$\Delta eryie_t^{usa}$	-3.67	4
$eryie_t^{ger}$ (c)	0.57	9

[2] The Pantula principle states that if a linear trend term is needed in the test for the time series S_t, then only a constant term should be used in the test for ΔS. On the other hand, if just a constant is required in the test for S_t, the test for ΔS is to be carried out with no deterministic term (Lütkepohl, 2007a: 55).

$\Delta eryie_t^{ger}$	-4.58	3
$eryie_t^{jap}$ (c)	0.29	4
$\Delta eryie_t^{jap}$	-5.28	3
$eryie_t^{uk}$ (c)	-1.50	2
$\Delta eryie_t^{uk}$	-5.14	1
$eryie_t^{rus}$ (c)	-0.77	10
$\Delta eryie_t^{rus}$	-3.43	9
Notes: The 1% critical values for the ADF test with constant (c) and no terms are -3.43 and -2.56, respectively. The critical values of the ADF test are from Davidson and McKinnon (1993).		

According to Table 1, all the series are integrated of order 1- $I(1)$, thus cointegrating relations may exist among the variables of the same case (real bond yields, ex-ante real bond yields). In this respect, we employ the Saikkonen cointegration test based on the VEC model framework presented in section 3 to consider a deterministic trend term in the data generation process. The ordering the of the variables in the models are as $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$ and $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$, reflecting our assumption that FED considers the foreign interest rates when determining its policy rate and thus real long-term yields of USA are influenced by foreign real bond yields.

Table 2: Johansen Cointegration Test Results for Real Yields

Series: $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$. **No. of Included Lags (Levels):**4[3]			
Null Hypothesis	**Test Value**	**%95 Critical Value**	**%99 Critical Value**
$r = 0$	78.77	59.95	67.24
$r = 1$	35.95	40.07	46.20
$r = 2$	23.83	24.16	29.11

Table 3: Johansen Cointegration Test Results for Ex-ante Real Yields

Series: $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4			
Null Hypothesis	**Test Value**	**%95 Critical Value**	**%99 Critical Value**
$r = 0$	74.28	59.95	67.24
$r = 1$	45.50	40.07	46.20
$r = 2$	24.77	24.16	29.11

Table 2 and 3 indicates that there is cointegration of the first order for both cases. Thus, VEC models can be estimated for the vectors $y_t = (ryie_t^{usa}, ryie_t^{ger}, ryie_t^{jap}, ryie_t^{uk}, ryie_t^{rus})'$ and $y_t = (eryie_t^{usa}, eryie_t^{ger}, eryie_t^{jap}, eryie_t^{uk}, eryie_t^{rus})'$. Within this model framework, we present the results of causality analysis along with estimations of long-run coefficients of the model to make inferences about the dynamics of real actual and ex-ante yields among the countries under investigation.

[3] When choosing the optimal lag length of the VAR type model, statistically information criterions such as AIC, Schwarz Criterion (SC), Hannan-Quinn Criterion (HQ) and Final Prediction Error can be used, however the researcher may want long enough lags to capture the Dynamics of the system. On the other hand, the longer the lags may lead to the fewer degrees of freedom. In this study, AIC suggested a lag length of 9 for our VEC model that led to insufficient number of observations to estimate the model. Thus, we used a lag length of 4 to capture the nature of dynamics of past one year data since the frequency of our series are quarterly.

According to Table 4, both Granger and instantaneous causalities expose that the actual real yields of USA are under the influence of the actual real yields of Germany, Japan, the UK and Russian Federation. More precisely, it can be asserted that monetary policies authorities of Germany, Japan, the UK and Russian Federation may affect their domestic interest rates of different maturities which in turn may influence the flow of funds into the USA indirectly. Similar impacts are also found for Germany and the UK by the causality analysis, implying that flow of funds in to the bond market of Germany and the UK can be determined by changes in foreign monetary policy decisions. Furthermore, since our causality results of the USA, Germany and the UK indicate that the actual long-term real yields of the bonds of these countries are influenced by the actual foreign long-term real bond yields, we can infer that the foreign inflation dynamics can be accepted as a major factor for the actual long-term real yields in the USA, Germany and the UK. In this respect, economic channels through which foreign inflations transmit through the price levels of the USA, Germany and the UK should be investigated. Therefore, our results highlight the importance of the identification of trade and financial channels to the USA, Germany and the UK. Our policy implications can also be suggested for Russian Federation, despite both causality analyses indicate that the actual long-term yields of the USA, Germany, Japan and the UK can be of importance for the actual long-term bond yields at the 10% percent level of significance. On the other hand, the causality results investigating the effects of the actual foreign long-term real yields on Japan and Russian Federation's are mixed. Causality analysis expose that the actual long-term real yields in Japan can be under the influence of the changes in the actual foreign real yields in the long-term, whereas instantaneous causality results point that the actual long-term real yields of the USA, Germany, Japan and Russian Federation do not have any impact on the actual real yields of the Japan's long-term bonds.

Causality relationship among the variables and discussion

Table 4: Granger Causality Tests' Results

<table>
<tr><td colspan="2">**Series:** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$.
No. of Included Lags (Levels):4
H_0 : $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$
do not Granger-cause $ryie_t^{usa}$</td><td colspan="2">**Series:** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$.
No. of Included Lags (Levels):4
H_0 : **No instantaneous causality between** $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$ and $ryie_t^{usa}$</td></tr>
<tr><td>**Test Statistic**</td><td>**p-value-** F</td><td>**Test Statistic**</td><td>**p-value-** χ</td></tr>
<tr><td>3.98</td><td>0.00</td><td>43.61</td><td>0.00</td></tr>
<tr><td colspan="2">**Series:** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$.
No. of Included Lags (Levels):4
H_0 : $ryie_t^{usa}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$
do not Granger-cause $ryie_t^{ger}$</td><td colspan="2">**Series:** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$.
No. of Included Lags (Levels):4
H_0 : **No instantaneous causality between** $ryie_t^{usa}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$ and $ryie_t^{ger}$</td></tr>
<tr><td>**Test Statistic**</td><td>**p-value-** F</td><td>**Test Statistic**</td><td>**p-value-** χ</td></tr>
<tr><td>2.74</td><td>0.00</td><td>31.24</td><td>0.00</td></tr>
<tr><td colspan="2">**Series:** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$.
No. of Included Lags (Levels):4
H_0 : $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{uk}$, $ryie_t^{rus}$
do not Granger-cause $ryie_t^{jap}$</td><td colspan="2">**Series:** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$.
No. of Included Lags (Levels):4
H_0 : **No instantaneous causality between** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{uk}$, $ryie_t^{rus}$ and $ryie_t^{jap}$</td></tr>
<tr><td>**Test Statistic**</td><td>**p-value-** F</td><td>**Test Statistic**</td><td>**p-value-** χ</td></tr>
<tr><td>6.15</td><td>0.00</td><td>4.77</td><td>0.31</td></tr>
<tr><td colspan="2">**Series:** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$.
No. of Included Lags (Levels):4
H_0 : $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{rus}$
do not Granger-cause $ryie_t^{uk}$</td><td colspan="2">**Series:** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$.
No. of Included Lags (Levels):4
H_0 : **No instantaneous causality between** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{rus}$ and $ryie_t^{uk}$</td></tr>
<tr><td>**Test Statistic**</td><td>**p-value-** F</td><td>**Test Statistic**</td><td>**p-value-** χ</td></tr>
<tr><td>4.04</td><td>0.00</td><td>33.16</td><td>0.00</td></tr>
<tr><td colspan="2">**Series:** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$.
No. of Included Lags (Levels):4
H_0 : $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$</td><td colspan="2">**Series:** $ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$, $ryie_t^{rus}$.
No. of Included Lags (Levels):4
H_0 : **No instantaneous causality between**</td></tr>
</table>

do not Granger-cause $ryie_t^{rus}$		$ryie_t^{usa}$, $ryie_t^{ger}$, $ryie_t^{jap}$, $ryie_t^{uk}$ and $ryie_t^{rus}$	
Test Statistic	**p-value-** F	**Test Statistic**	**p-value-** χ
1.63	0.05	9.03	0.06

In this study, we also use VEC modeling for the ex-ante real long-term bond yields of the USA, Germany, Japan, the UK and Russian Federation to consider the effects of adaptive inflation expectations. The causality results of ex-ante real long-terms yields of for the USA, Germany and the UK are in line to our previous analysis. Accordingly, it can be inferred that factors influencing the nominal exchange rates of the USA, Germany and the UK against the foreign currencies should be determined since nominal exchange rates is theoretically accepted as the driving force of the changes in real interest rate parity. Conversely, both causality analyses carried for Japan and Russian Federation Table 5. Nevertheless, trade and financial channels affecting the long-terms real yields can be investigated for Japan and Russian Federation when the prevalent economic liberalization and integration phenomena are concerned.

Table 5: Granger Causality Tests' Results for Ex-ante Real Yields

Series: $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4 H_0 : $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$ **do not Granger-cause** $eryie_t^{usa}$		**Series:** $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4 H_0 : **No instantaneous causality between** $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$ and $eryie_t^{usa}$	
Test Statistic	**p-value-** F	**Test Statistic**	**p-value-** χ
4.11	0.00	40.90	0.00
Series: $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4 H_0 : $eryie_t^{usa}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$ **do not Granger-cause** $eryie_t^{ger}$		**Series:** $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4 H_0 : **No instantaneous causality between** $eryie_t^{usa}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$ and $eryie_t^{ger}$	
Test Statistic	**p-value-** F	**Test Statistic**	**p-value-** χ
4.22	0.00	57.47	0.00
Series: $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4 H_0 : $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{uk}$, $eryie_t^{rus}$ **do not Granger-cause** $eryie_t^{jap}$		**Series:** $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4 H_0 : **No instantaneous causality between** $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{uk}$, $eryie_t^{rus}$ and $eryie_t^{jap}$	
Test Statistic	**p-value-** F	**Test Statistic**	**p-value-** χ
6.61	0.00	2.54	0.63
Series: $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4 H_0 : $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{rus}$ **do not Granger-cause** $eryie_t^{uk}$		**Series:** $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4 H_0 : **No instantaneous causality between** $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{rus}$ and $eryie_t^{uk}$	
Test Statistic	**p-value-** F	**Test Statistic**	**p-value-** χ
6.50	0.00	37.69	0.00
Series: $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4		**Series:** $eryie_t^{usa}$, $eryie_t^{ger}$, $eryie_t^{jap}$, $eryie_t^{uk}$, $eryie_t^{rus}$. **No. of Included Lags (Levels):**4	

H_0 : $eryie_t^{usa}, eryie_t^{ger}, eryie_t^{jap}, eryie_t^{uk}$ **do not Granger-cause** $eryie_t^{rus}$		H_0 : **No instantaneous causality between** $eryie_t^{usa}, eryie_t^{ger}, eryie_t^{jap}, eryie_t^{uk}$ and $eryie_t^{rus}$	
Test Statistic	**p-value-** F	**Test Statistic**	**p-value-** χ
3.95	0.00	3.15	0.53

The loading coefficients of the two VEC models containing actual and ex-ante real bond yields are as -0.55 and -0.38, respectively and they are also found statistically significant at the 5% level, showing that deviations from equilibrium are corrected at about 55% and 38% per quarters in two models. In this respect, real yields of Germany, Japan, the UK and Russian Federation do Granger-cause real long-term real yields of the USA in the long-run, implying that real bond yields can be driven by the same macroeconomic, political and social dynamics in the long-term. More precisely, this implication may indicate the consistency of economic, political and social influences on the decisions of monetary policy authorities, money markets and inflation in the long-term.

Conclusions

In this study, we employ VEC modeling to analyze the relations between the long-term real yields of the USA, Germany, Japan, the UK and Russian Federation using quarterly data from 2000:01 to 2014:03. Hereby, we use causality analysis both in the short- and long-run for two types of models, using the actual real interest rates and ex-ante real interest rates.

Our results show that in the short-run for both models; there existed causality relationship from the real long-term yields foreign yields to the long-term yields of the USA, Germany and the UK, whereas both causality analysis and instantaneous causality analysis expose that the long-term yields of the Japan and Russian Federation may be affected by the foreign real long-term yields. Thereby, we infer that domestic monetary policy implementations can have impacts on worldwide flow of funds and thus lead to changes in foreign real yields. In this respect, it is important for the monetary polices authorities of USA, Germany and the UK to analyze the influences of the changes in foreign short-term interest rates on domestic long-term interest rates. Our results also suggest that economic dynamics of inflation dynamics and inflation expectation should seriously been taken into consideration by the monetary policy authorities of the USA, Germany, Japan, the UK and Russian Federation. In this respect, examination of aggregate supply and demand dynamics of these countries in open-economy framework and identification of supply and demand shocks in macroeconomic variables have become important for the analyze of long-term real yields within DSGE modeling. Furthermore, we imply the importance of exchange rates for analyzing the actual long-term bond yields for the USA, Germany, Japan, the UK and Russian Federation since nominal exchange rates may influence inflation and nominal interest rates.

On the other hand, negative and statistically significant loading coefficients of the two VEC models expose that long-term real yields of Germany, Japan, the UK and Russian Federation have impact on the changes real long-term real yields of the USA in the long-run. In addition, these loading coefficients indicate that deviations from equilibrium are corrected at in the following quarters for the two models. Consequently, determination of the effects of domestic and foreign inflation, money markets and exchange rate markets on the actual and ex-ante real interest rates may be important for the monetary authorities of the USA, Germany, Japan, the UK and Russian Federation, which intend to control economy-wide interest rates to maintain price stability.

Bibliography

Al-Awad, M., Grennes, T.J., (2002), Real interest parity and transaction costs for the group of 10 countries, *International Review of Economics and Finance, 11,* 363–372

Aristei, D., Martelli, D., (2014), Sovereign bond yield spreads and market sentiment and expectations: Empirical evidence from Euro area countries, *Journal of Economics and Business, 76,* 55–84

Baharumshah, A.Z., Hawa, C.T. & Fountas, S., (2005), A panel study on real interest rate parity in East Asian countries: Pre- and post-liberalization era, *Global Finance Journal, 16,* 69 –85

Baharumshah, A.Z., Soon, S.V. & Borsic, D., (2013), Real interest parity in Central and Eastern European countries: Evidence on integration into EU and the US markets, *Journal of International Financial*
Markets, Institutions & Money, 25, 163 –180

Baharumshah, A.Z., Soon, S.V. & Hamzah, N.A., (2013), Parity reversion in real interest rate in the Asian countries: Further evidence based on local-persistent model, *Economic Modelling, 35,* 634–642

Chang, H.L., Jiang, C., Liu, L. & Su, C.W., (2013), Real interest rate parity in East Asian countries based on China with flexible Fourier stationary test, *Japan and the World Economy, 25–26,* 52–58

Chinn, M. D., Frankel, J.A., (1995), Who drives real interest rates around the Pacific Rim: the US or Japan?, *Journal of International Money and Finance, 14,* 801–821

Ferreira, A.L., Leon-Ledesma, M.A., (2007), Does the real interest parity hypothesis hold?, *Journal of International Money and Finance, 26,* 364–382

Friedman, M. (1957) A Theory of the Consumption Function. Princeton. Princeton. University Press.

Davidson, R. & and MacKinnon, J.G., (1993), Estimation and Inference in Econometrics. London, Oxford University Press.

Granger, C. W. J., (1969), Investigating causal relations by econometric models and cross-spectral methods, *Econometrica, 37,* 424-438.

Güney, P.Ö., Hasanov, M., (2014), Real interest rate parity hypothesis in post-Soviet countries: Evidence from unit root tests, *Economic Modelling, 36,* 120–129

Holmes, M.J., (2002), Does long-run real interest parity hold among
EU countries? Some new panel data evidence, *The Quarterly Review of Economics and Finance, 42,* 733–746

Holmes, M.J., Maghrebi, N., (2004), Asian real interest rates, nonlinear dynamics, and international parity, *International Review of Economics and Finance, 13,* 387–405

JMulTi *(Time Series Analysis with Java) Econometric Software Help System,* Version.4.23.

Jorion, P., (1993), Does real interest parity hold at longer maturities?, *Journal of International Economics, 40,* 105–126

Lütkepohl, H. (2007a). Univariate Time Series Analysis. In Lütkepohl, H., Kratzig., M. (Ed.), *Applied Time Series Econometrics* (8-85). Berlin. Springer.

Lütkepohl, H. (2007b). Vector Autoregressive and Vector Error Correction Models. In Lütkepohl, H., Kratzig., M. (Ed.), *Applied Time Series Econometrics* (86-158). Berlin. Springer.

Modjtahedi, B., (1988), Dynamics of real interest differentials, *European Economic Review, 32,* 1191–1211

Pantula, S. G., (1989), Testing For Unit Roots in Time Series Data, *Econometric Theory,* 5, 256–271.

Sims. C.A., (1980), Macroeconomics and Reality, *Econometrica,* 48, 1–48.

Saikkonen, P., Lütkepohl, H., (2000), Testing for the cointegrating rank of a VAR process with an intercept, *Econometric Theory,* 16, 373–406.

Throop, A.W., (1994), International financial market integration and linkages of national interest rates, *Economic Review*, 3–18