Investigating Causal Linkages between International Stock Markets in Hungary and Austria in Terms of Economic Globalization

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ABSTRACT

The main objective of this article is to investigate causal linkages between international stock markets in Hungary and Austria in terms of economic globalization. We consider data from January 2000 to December, 2013. ATX index represents Austria index where as BUX represents Hungary. We noticed that Hungary financial markets are comparatively more volatile and provides comparatively interesting opportunities for returns. There are strong evidences of no casual linkages of Austria markets (ATX) with Hungary market, both sides. None of the market excluded from global financial crisis. However the recovery scales are comparatively found higher in Hungary market where as ATX market follows lower escalation rates. We followed BDS and Granger casality tests. The results classified in comparative manner. This paper will support decision makings on escalation ratios depending on the international financial market transmitting patterns.

Keywords : Stock Market Linkages, Spillover Effects, Volatility Clusters, Granger Causality, Risk Management, Portfolio diversification

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Introduction

Financial market volatility has been the subject of greater interest for international investors, researchers and academicians. It has delivered plenty number of research in the areas of stock market volatility, transmitting pattern, risk evaluations, investment opportunity, international linkages and so on. This paper focuses particularly on the casual linkages between the stock market of Hungary (BUX) and Austria (ATX). According to FTSE Country Classification as at September 2014 which is the most recent official report, Austria is included in the category of developed countries and Hungary is included in the category of advanced emerging countries. Austria financial market follows comparative more stable investment opportunity for the international investors all over the world. The risk ratios and volatility patterns are less escalated with international financial market moments. The Hungary market (BUX) classified as the advance emerging markets which represents higher escalation rates at upper side and lower side with market volatility.

The advance emerging markets provides greener opportunities for risk taker investors. It is investigated from previous studies that not only developed countries but also financial markets of developed and developing countries become interrelated (Aktar, I. 2009). Eun and Shim (1989) have provided interesting results regarding the international transmission of stock market movements among several mature markets, such as: Australia, Japan, Hong Kong, U.K, Switzerland, France, Germany, Canada and U.S.A., considering the fact that a series of multilateral interconnections were identified. Panton, Lessig, and Joy (1976) investigated co-movements of international equity markets in the light of investment opportunities arising from portofolio diversifications.

There are vast number of research papers on financial market volatilites linkages and provided the greater support to investors in decision makings. This paper basically emphasized on the international financial market volatility linkages on advance emerging market and developed market. This paper will support decision makings on escalation ratios depending on the international financial market transmitting patterns. For instance Tokyo and New York major stock indices, namely Nikkei 225 and S&P500. Kasa (1992) investigated common stochastic trends in international stock markets. J. Trivedi & R. Birau (2013) investigated the distinguishing characteristic is stability of developed capital market and stable emerging market.

Those groups of capital market stays in the particular bracket have spreading impact of volatility (bullish and bearish) reflected from stable and developed capital market. The impact spreads through inter-linkage between developed and emerging markets. These findings can be idle to bridging the pattern gap and impact on volatility.

Methodological Approach and Empirical Results

The empirical analysis is based on the daily returns of the major stock indices during the sample period between January 2000 and December 2013. The continuously-compounded daily returns are calculated using the log-difference of the closing prices of stock markets selected indices, ie ATX Index (Austria) and BUX Index (Hungary), as follows:

$$r_t = \ln\left(\frac{p_t}{p_{t-1}}\right) = \ln(p_t) - \ln(p_{t-1})$$

In the above formula, *p* represents the daily closing price. Data series consists of the daily closing prices for each sample stock index during the period between January 2000 and December 2013 with the exception of legal holidays or other events when stock markets have not performed any financial transactions. *Augmented Dickey-Fuller (ADF) test* is used in order to determine the non-stationarity or the integration order of a financial time series. A series noted y_t is integrated of order one, i.e. $y_t \sim I(1)$ and contains a unit root if y_t is non-stationary, but on the other hand Δy_t is stationary, i.e. $\Delta y_t = y_t - y_{t-1}$. Moreover, extrapolating the previous expression, a series y_t is integrated of order d, i.e. $y_t \sim I(d)$ if y_t is non-stationary, but $\Delta^d y_t$ is stationary. The ADF diagnostic test investigates the potential presence of unit roots divided into the following categories: unit root with a constant and a trend, unit root with a constant, but without a time trend, and finally unit root without constant and temporal trend. The ADF test is based on the following regression model:

$$\Delta y_t = c + \beta \cdot t + \delta \cdot y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta y_{t-i} + \varepsilon_t$$

where *p* represents the number of lags for which it was investigated whether fulfilling the condition that residuals are white noise, *c* is a constant, t is the indicator for time trend and Δ is the symbol for differencing. In addition, it is important to emphasize the essence of a stochastic trend that can not be predicted due to the time dependence of residual's variance. Strictly related to the ADF test, if the coefficients to be estimated β and δ have the null value then the analyzed financial time series is characterized by a stochastic trend.

The null hypothesis, namely if the time series has a unit root, is rejected if t-statistics is lower than the critical value. We followed basic statistical characteristics of selected indices are represented by the following issues: Jarque-Bera test's statistic which allows to eliminate the normality of distribution hypothesis, parameter of asymmetry distribution or Skewness and Kurtosis parameter which measures the peakedness or flatness of the distribution, ie leptokurtic distribution.

The BDS test was used in order to determine whether the residuals are independent and identically distributed. BDS test is a two-tailed test and is based on the following hypothesis:

H_0: sample observations are independently and identically distributed (I.I.D.)

H_1: sample observations are not I.I.D.

This includes aspect involving that the time series is non-linearly dependent if first differences of the natural logarithm have been calculated. The BDS statistics converges in distribution to N(0,1) thus the null hypothesis of independent and identically distributed is rejected based on a result such as $|V_{m,\varepsilon}| > 1{,}96$ in terms of a 5% significance level. The null hypothesis was rejected in both cases based on selected stock indices.

Granger (1969) suggested that, if some other time series Y_t contains information regarding the past periods which are useful in the prediction of X_t and in addition this information are included in no other series used in the predictor, then this implies that Y_t caused X_t. Moreover, Granger suggested that if X_t and Y_t are two different stationary time series variables with zero means, then the canonical causal model has the following form:

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + \varepsilon_t$$

$$Y_t = \sum_{j=1}^{m} c_j X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + \eta_t$$

where ε_t and η_t play the role of two uncorrelated white-noise series, namely: $E[\varepsilon_t \varepsilon_s] = 0 = E[\eta_t \eta_s]$ for $s \neq t$ and simultaneously: $E[\varepsilon_t \varepsilon_s] = 0$ for $\forall_{t,s}$.

Practically, the very idea of causality requires that in the case when Y_t is causing X_t some b_j is different from zero and vice versa, i.e. in the case when X_t is causing Y_t some c_j is different from zero.

A different situation implies that causality is valid simultaneously in both directions or simply a so-called "feedback relationship between X_t and Y_t". The F-distribution test is used to test the Granger causality hypotheses based on the following formula:

$$F = \frac{(RSS_R - RSS_{UR}) / m}{RSS_{UR} / (n-k)}$$

where RSS_R is the residual sum of squares, RSS_{UR} represents the unrestricted residual sum of squares, m is the number of lagged X_t variables, K is the number of parameters in the restricted regression. According to representation theorem, the null hypothesis H_o implies that lagged X_t terms do not belong in the regression. The null hypothesis is rejected if the *F*-value exceeds the critical F value at the selected level of significance (5%) or if the P-value is lower than the α level of significance.

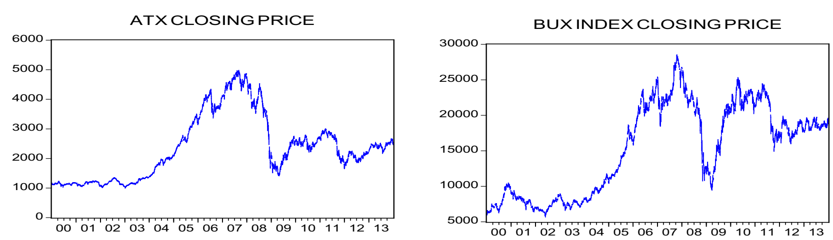

Figure 1: The Trend of ATX Index (Austria) and BUX Index (Hungary) Individual Graphics

Source: Author's computation using financial series of ATX and BUX stock indices.

The historical data series represents the financial indices from Jan 2000 to Dec 2013. Austria (ATX) index returns represents the developed country and Hungary (BUX) represents advance emerging market. We can notice that from the begininning of the study period there are comparatively more ups and down sketches in the advance emerging market comparated to the developed market. See stationary graph for more clerity.

(see Fig. 2). Emerging markets and advance emerging markets are always more volatiline compared to the developed markets. The transmitting pattern changes are clearly visible with higher escalation rates and with observation we can find that advance emerging markets follows the developed market with higher degree of escalation rates for both sides. It also increases the risk factor for the investors and offers exciting opportunities for the investors and researchers in daily based stock trading.

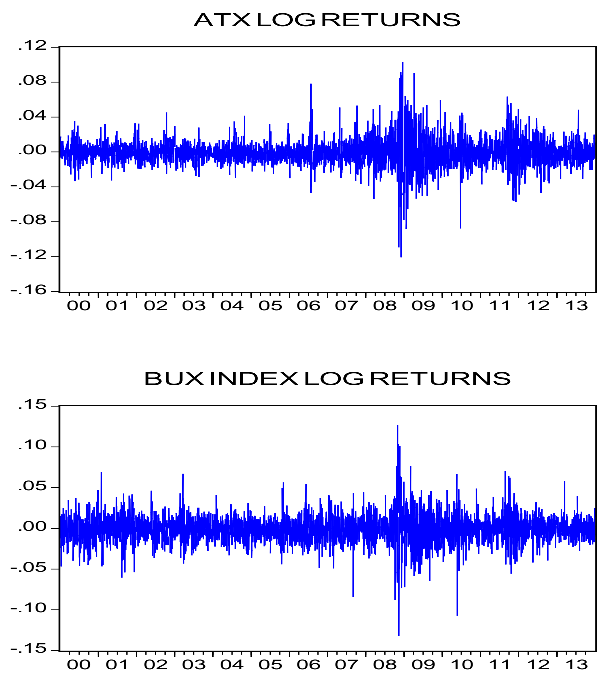

Figure 2: The Log-returns of ATX Index (Austria) and BUX Index (Hungary)

Source: Author's computation using financial series of ATX and BUX stock indices.

The basic stock statistics includes 3524 observations for Austria market and Hungary market. The log returns and histogram chats suggests higher degree of volatility and changes of stock prices at higher sides in advance emerging market during the comparative study (see Fig 3). It also increases the degree of standard deviations and min to max rates. We can see that Skewness is higher in ATX log returns where as Kurtosis is lower in BUX log returns. It means that stock moments are making more stronger impact on stock prices compared to the developed market of ATX.

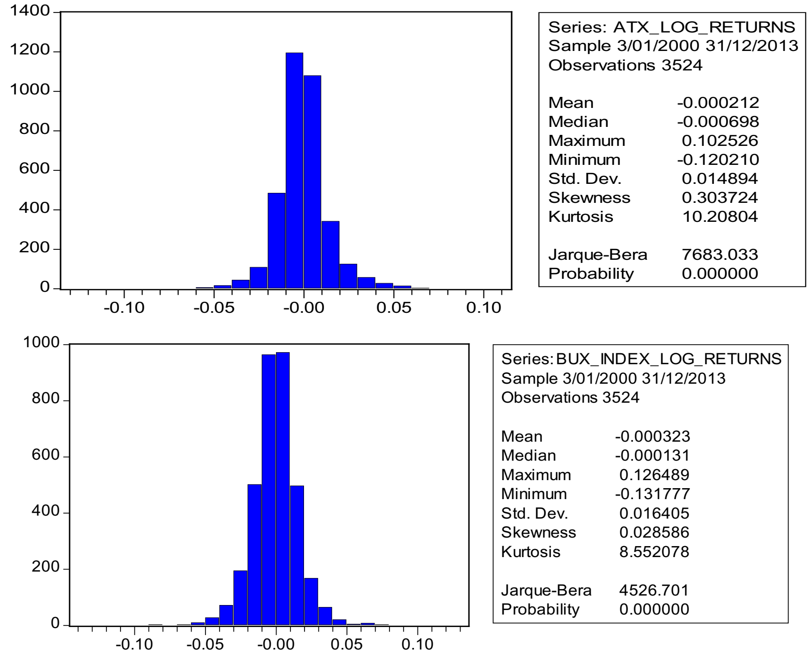

Figure 3: ATX and BUX Log returns Histograms – OBS 3524

Source: Author's computation using financial series of ATX and BUX stock indices.

Table 1: Augmented Dickey-Fuller (ADF) Test

Null Hypothesis: ATX_LOG_RETURNS has a unit root			
		t-Statistic	*Prob.**
Augmented Dickey-Fuller test statistic		–10.07775	0.0000
Test critical values:	1% level	–3.432033	
	5% level	–2.862169	
	10% level	–2.567148	
Null Hypothesis: BUX_INDEX_LOG_RETURNS has a unit root			
		t-Statistic	*Prob.**
Augmented Dickey-Fuller test statistic		–23.56008	0.0000
Test critical values:	1% level	–3.432022	
	5% level	–2.862164	
	10% level	–2.567146	

Source: Author's computation using financial series of ATX and BUX stock indices.

The Augmented Dickey-fuller test results are significant for Austria (ATX) and Hungary (BUX) (see Table 1).

Table 2: BDS Test for ATX and BUX Indices

BDS Test for ATX_LOG_RETURNS				
Sample: 3/01/2000 31/12/2013				
Dimension	*BDS Statistic*	*Std. Error*	*z-Statistic*	*Prob.*
2	0.029273	0.001645	17.79286	0.0000
3	0.059810	0.002619	22.83755	0.0000
4	0.082977	0.003124	26.55777	0.0000
5	0.097385	0.003263	29.84695	0.0000
6	0.104193	0.003153	33.04710	0.0000
BDS Test for BUX_INDEX_LOG_RETURNS				
Sample: 3/01/2000 31/12/2013				
Dimension	*BDS Statistic*	*Std. Error*	*z-Statistic*	*Prob.*
2	0.014479	0.001412	10.25199	0.0000
3	0.028827	0.002238	12.88295	0.0000
4	0.039747	0.002656	14.96375	0.0000
5	0.046320	0.002760	16.78362	0.0000
6	0.048644	0.002653	18.33404	0.0000

Source: Author's computation using financial series of ATX and BUX stock indices.

The BDS tests results suggests independent and identifyable distributions of Austria stock market and Hungary stock market. It represents that time series is non-linearly dependent in case of the first differences of the natural logarithm been calculated. In Table 2, it rejects the distributions of n(0,1) and thus the null hypotheses of independent and identically distribution is rejected for Austria (AUX) market and Hungary (BUX) market returns. It means that the statistical distribution of BDS tests arrives to result such as $|V_{m,\varepsilon}| > 1,96$ in terms of a 5% significance level. The null hypothesis was rejected in both cases based on selected stock indices of AUX and BUX from year Jan 2000 to Dec 2013.

BDS test results has identified and varified that there are no independent and identifyable relationship between the develop market and advance emerging market. However the transmitting pattern seems similer because of international transmitting pattern linkage and no evidence found for independent casual linkage. We now follow Granger casuality tests to check on result 1. We disclosed the theoretical quantile test results for AUX and BUX market visible in Fig. 4.

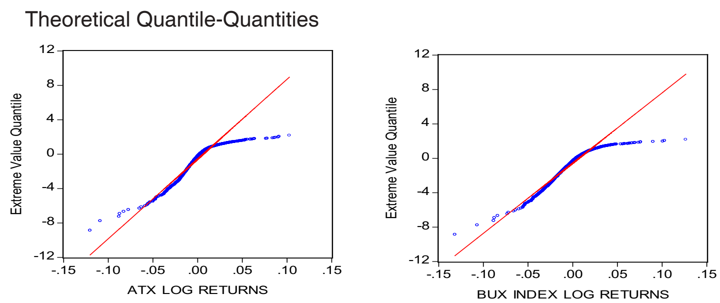

Figure 4: Theoretical Quantile Tests for AUX and BUX Stock Indices (Extreme values)

Source: Author's computation using financial series of ATX and BUX stock indices.

Table 3: Granger Causality Tests

Pairwise Granger Causality Tests			
Sample: 3/01/2000 31/12/2013			
Null Hypothesis	*Obs*	*F-Statistic*	*Probability*
BUX_INDEX_LOG_RETURNS does not Granger Cause ATX_LOG_RETURNS	3522	0.01525	0.98487
ATX_LOG_RETURNS does not Granger Cause BUX_INDEX_LOG_RETURNS		0.36763	0.69240

Source: Author's computation using financial series of ATX and BUX stock indices.

As we have understood and learned in methodology chapter about the evaluation and analysis of Granger casuality tests, this tests strongly identifies the casual linkages where (if) Y_t contains information regarding the past periods which are useful in the prediction of X_t, in such case Y_t caused X_t. Moreover, Granger suggested that if X_t and Y_t are two different stationary time series variables with zero means, then the canonical causal model has the following form only if Y_t caused X_t.

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + \varepsilon_t$$

$$Y_t = \sum_{j=1}^{m} c_j X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + \eta_t$$

In Table 3, we computed Granger casuality tests and we arrieve to conclude that the study data series of AUX and BUX markets are not being followed by the above mentioed form. The financial time series follows the feedback distribution forms since the F value exceeds the critical F value at the selected level of significance, i.e. 5% and in alternate if the P value is lower than the a level of significance. It proves that there is no casual linkage or significance between the developed financial series AUX (Austria) and BUX (Hungary).

Conclusions

This paper covers the empirical study based on casual linkages between developed specimen stock market (AUX) and emerging specimen stock market (BUX). Economic globalization can be defined as a dynamic process of growth and dependency links between national states with complex long-term implications. Austria and Hungary are neighboring countries with a significant common history and both are European Union member states. However, the empirical results of Granger causality tests between international stock markets in Hungary and Austria suggests the absence of a causal relationship. According to the methodology, the null hypothesis is rejected if the F-value exceeds the critical F value at the selected level of significance (5%) or if the P-value is lower than the α level of significance, so there is no particular causality between Hungary and Austria, in the period between January 2000 and December 2013. In other words, the null hypothesis of Granger causality is not rejected, so there is no causal relationship between selected stock markets. Nevertheless the financial series patterns seems to relevant and similar reasonwith international transmitting patterns of financial markets.

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