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Did the contagion effect exist? Evidence from Abu Dhabi, Jordan and America

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This article aims to test the contagion effect between the stock markets of Abu Dhabi, Jordan and America. The Lagrange multiplier (LM) principle for causality in variance test is used in this study. Four American stock indexes, Dow Jones Industrial Average, NASDAQ Composite, RUSSELL 2000, and PHLX Semiconductor Sector Index, are in this study. The testing results of the four major American stock price indexes and the Jordan stock index (Amman) are significant. The testing results of the four American stock price indexes and the Abu Dhabi stock index (ADX) are also significant. This study finds that the variances of returns of four major American stock price indexes have the contagion effects on the variances of stock index returns of Jordan and Abu Dhabi.

Keywords: contagion effect; the stock market; Abu Dhabi; Jordan; America

JEL classification: G10, F00, E60

1. Introduction

A portfolio with low or negative correlations among assets within a country and low or negative correlations among the countries will be able to achieve the international diversification risk reduction purposes. A contagion effect may affect asset allocation and risk diversification for investors in the global financial markets. Most of the literatures study the contagion effects by the causality in mean methods. In other words, most of these literatures study the interdependence between assets return. Different from these literatures, the causality in variance tests is used in this article.

An isolated economy, Jordan for example, is believed to be immune from the global financial crisis. An open economy, Abu Dhabi for example, with heavy international trade should be affected by the global financial crisis. Will there be contagion effects on both isolated economy and open economy? Or only the open economy is affected by the contagion effect? The model of Lagrange multiplier (LM) principle to test for causality in variance is used to study the relationships between the American stock indexes and the Abu Dhabi stock index (ADX) and the American stock indexes and the Jordan stock index. The contagion effect between the American stock indexes and ADX and between the American stock indexes and the Jordan stock index are studied in this article.

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Contagion effects have been found by several studies, such as King and Wadhwani (1990), Baig and Goldfajn (2001), Horta, Mendes, and Vieira (2008), Markwat, Kole, and Van Dijk (2009), Longstaff (2010), Boschi and Goenka (2012), Celık (2012). Very often the investors try to infer information from price changes in other markets. Therefore, even under different economic situation among the countries, almost all the stock markets crashed together during October 1987 (King & Wadhwani, 1990). The global stock market crashes are preceded by local and regional crashes. This phenomenon is also proved by Markwat et al. (2009). They show that stock market contagion happening like a domino effect.

After the 1998 Russian financial crisis, even there were not many trades and direct financial linkages between Russia and Brazil, the contagion effect had caused the Brazilian financial crisis. If international investors holding a geographically diversified portfolio are induced to have asset re-allocation because of currency devaluation, this could spread internationally (Baig & Goldfajn, 2001). The contagion effects by the 2007 US subprime crisis on the European stock markets of the NYSU Euronext group and Japanese stock market are found by Horta et al. (2008). They show that investors anticipated a contagion effects by the US financial crisis to the industrial sector indexes way before the economic impact on the real economy is realised. The contagion effects in the foreign exchange markets, especially the emerging markets, during the 2007 US subprime crisis are found by Celik (2012). The US subprime crisis contagion effect on the other financial markets is also proved by Longstaff (2010). He shows that the financial contagion is spread through the liquidity and risk premium channels, not the correlated information channel. In the currency market, the changes in risk premium increase the cost of debt and make the defence of a currency pegged exchange rate less attractive for the policy holders. Under the condition that investors have decreasing relative risk aversion, rising risk will increase the risk premium required for the investors to hold risky assets. The financial crisis will increase the risk premium on all financial assets all over the countries. This will induce the investors' portfolio re-balancing behaviours. This behaviour will be magnified by the self-fulfilling expectations and the contagion effects will be spread to the world (Boschi & Goenka, 2012).

The causality in mean is the common theme in most of the literatures above. Most of these papers study the contagion effects by the causality in mean methods. In other words, most of these literatures study the interdependence between assets return. Different from these literatures, the causality in variance tests are used in this article. In the cases of structural breaks in volatility and the breaks are ignored in the causality in variance test, the traditional causality in variance tests will have size distortions problems. These problems can be mitigated a lot by pre-testing the structural changes in volatility (Dungey et al., 2005; Van Dijk, Osborn, & Sensier, 2005). Another contribution of this article is the study of contagion effects by the US stock markets on the Jordan and Abu Dhabi stock markets. The natural resources and economic development of Abu Dhabi and Jordan are very different. It is believed that Jordan is a small country with an isolated economy which should be immune from the global financial crisis. Abu Dhabi is an open economy with heavy international trade. It is believed that the Abu Dhabi stock market is affected by the global financial crisis.[1] On the other hand, Figure 1 shows that Jordan has higher investment freedom and financial freedom scores than the United Arab Emirates (UAE) (Abu Dhabi) in the year 2012. It will be interesting to study the contagion effects on these two different stock markets.

The study results of this article shows that the variances of the returns of four American stock indexes are contagious to the variances of returns of the Jordan stock

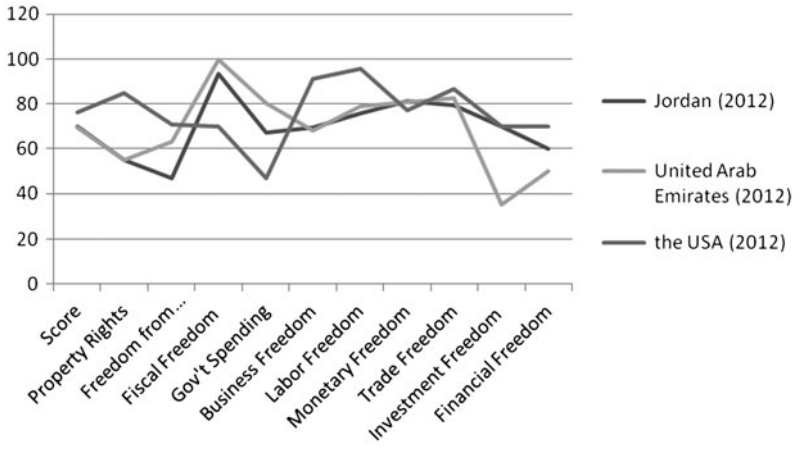

Figure 1. 2012 economic freedom of Jordan, United Arab Emirates and America.
Source: Heritage Foundation.

Figure 2. 2001.05.21–2012.07.31 ADX.
Source: Stock index data from Abu Dhabi Stock Exchange. Authors' calculation.

index (Amman) and ADX. Jordan is a smaller country with isolated economy compared with Abu Dhabi, however, Jordan has higher investment and financial freedoms than Abu Dhabi.

This article is organised as follows. Section 2 presents the data used in the study. Section 3 briefly describes the empirical methodology. Section 4 shows the empirical results and Section 5 concludes.

2. Data

The stock indices of this study are daily closing prices of America (Dow Jones Industrial Average: DJIA, NASDAQ Composite: NASDAQ, RUSSELL 2000, PHLX Semiconductor Sector Index: PHLX) and the Middle East (Abu Dhabi: ADX, Jordan: Amman). The research period is from May 21, 2001 to July 31, 2012. The data are taken from Taiwan

Figure 3. 2001.05.21–2012.07.31Amman.
Source: Stock index data from Amman Stock Exchange. Authors' calculation.

Figure 4. 2001.05.21–2012.07.31 DJIA.
Source: Stock index data from Taiwan Economic Journal. Authors' calculation.

Economic Journal (TEJ), the Abu Dhabi Securities Exchange and Amman Stock Exchange. The stock indexes series of Abu Dhabi (ADX), Jordan (Amman), Dow Jones Industrial Average (DJIA), NASDAQ Composite (NASDAQ), RUSSELL 2000, and PHLX Semiconductor Sector (PHLX) are shown in Figures 2–7, respectively.

Abu Dhabi is the capital of the UAE. Abu Dhabi has more than 90% of the oil reserves of the UAE. It has one of the highest GDP per capita in the world. Recently the government of Abu Dhabi had an economic plan to diversify its product mix. The non-oil GDP constitutes 64% of the UAE's total GDP. This trend is reflected in Abu Dhabi with substantial new investments in real estate, tourism and retail industries. Abu Dhabi is a modern city with broad boulevards, high rise office and apartment buildings, and busy shops The UAE has an open economy with a high per capita income and a

Figure 5. 2001.05.21–2012.07.31 NASDAQ.
Source: Stock index data from Taiwan Economic Journal. Authors' calculation.

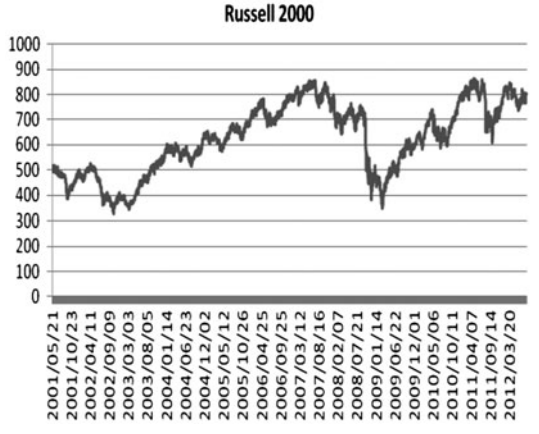

Figure 6. 2001.05.21–2012.07.31 Russell 2000.
Source: Stock index data from Taiwan Economic Journal. Authors' calculation.

sizable annual trade surplus. The free trade zones are used to attract foreign investors. It is believed that the global financial crisis has great impacts on the UAE's economy.[2]

Another Middle East country, Jordan is bordered by Saudi Arabia, Iraq, Syria, the West Bank and Israel. Over half of Jordan is covered by the Arabian Desert. Jordan's economy is among the smallest in the Middle East. It does not have sufficient supplies of water, oil, and other natural resources. The government heavily relies on foreign assistance. Since 1999, King ABDALLAH has implemented economic reforms, such as trade open, state-owned company privatisations, and fuel subsidies eliminations. These reforms have attracted foreign investments and created new jobs. It is believed that the Jordan economy has been relatively isolated from the international financial market because of its limited exposure to overseas capital markets and may be free from financial contagion.[3]

The stock exchanges of Jordan and Abu Dhabi were established more than 10 years ago. Based on the 2012 Heritage Foundation's Index of Economic Freedom, the

Figure 7. 2001.05.21–2012.07.31 PHLX.
Source: Stock index data from Taiwan Economic Journal. Authors' calculation.

Table 1. 2012 Economic freedoms in the Middle East and North Africa.

Country	Bahrain	Qatar	Jordan	United Arab Emirates	Oman	Israel	Saudi Arabia	Kuwait	Morocco
Overall score	75.2 (1)	71.3 (2)	69.9 (3)	69.3 (4)	67.9 (5)	67.8 (6)	62.5 (7)	62.5 (8)	60.2 (9)
Country	Lebanon	Tunisia	Egypt	Yemen	Syria	Algeria	Iran	Libya	Iraq
Overall score	60.1 (10)	58.6 (11)	57.9 (12)	55.3 (13)	51.2 (14)	51 (15)	42.3 (16)	35.9 (17)	NA (18)

Source: Heritage Foundation.

economic freedom of these two countries are among the tops in the Middle East and North Africa (Table 1). But the natural resources and economic development of Abu Dhabi and Jordan are very different. It will be interesting to study the contagion effects on these two countries.

Table 2. Summary statistics of variables.

	DJIA	NASDAQ	RUSSELL 2000	PHLX	ADX	AMMAN
Mean	10815.31	2177.090	638.458	408.333	2929.139	2510.738
Median	10645.40	2177.010	653.340	412.1900	2697.560	2402.584
Maximum	14164.53	3122.570	861.550	706.1500	6205.750	5043.722
Minimum	6547.050	1114.110	327.040	171.320	884.580	837.791
Std. Dev.	1508.306	417.395	133.472	86.557	1216.313	1055.177
Skewness	−0.085	−0.177	−0.329	−0.171	0.612	0.309
Kurtosis	2.485	2.537	2.082	3.010	2.726	2.239
Jarque-Bera	25.448***	29.452***	110.573***	10.266***	136.786***	90.606***

Note: ***, **, and, *denote the significant levels at 1%, 5%, and 10%.
Source: Authors' calculation.

The summary statistics of all variables in this study, such as mean, standard deviation, maximum, minimum, skewness, and kurtosis and Jarque-Bera value are reported in (Table 2). Among the three countries' stock indices, PHLX has the smallest standard deviation and DJIA has the largest standard deviation. Skewness statistics show that the American stock indexes are left-tailed. The stock indexes of the Middle East are right-tailed. The Jarque-Bera tests show that all variables reject the null hypothesis of normal distribution at 1% significance level.

3. Method

Different from the traditional Granger causality test that focuses on the mean changes, the causality in variance examines the conditional volatility dependence between two variables (Li, Refalo, & Wu, 2008). The causality in variance represents a general pattern to volatility transmission. The volatility could be transmitted between the markets where returns either are statistically uncorrelated or exhibit no causality in mean. This information can be used by the academics and practitioners to understand and forecast the volatilities in the global markets. The knowledge of the timing and direction of transmission can be used to facilitate the investment and hedge positions in response to foreign information shocks.

The Hafner and Herwartz (2006) LM principle is used to test for causality in variance. The relations between the stock markets of the Middle East and America are studied

Assuming stationarity of $\{\varepsilon_t\}$ and $\{\varepsilon_t|D_{t-1}\} = 0$, the following null hypothesis (H_0) is tested, given i, j=1, 2..., n, $i \neq j$:

$$H_0 : \mathrm{Var}(\varepsilon_{it}|D_{t-1}^{(j)}) = \mathrm{Var}(\varepsilon_{it}|D_{t-1}) \tag{1}$$

where $D_t^{(j)} = D_t/\sigma(\varepsilon_{jt}, \tau \leq t)$.

To examine H_0 consider the model:

$$\varepsilon_{it} = \xi_{it}\sqrt{\sigma_{it}^2 p_t}, p_t = 1 + m_{jt}'\pi, \quad m_{jt} = (\varepsilon_{jt-1}^2, \sigma_{jt-1}^2)' \tag{2}$$

where $\sigma_{it}^2 = \omega_i + \alpha_i\varepsilon_{i,t-1}^2 + \beta_i\sigma_{i,t-1}^2$.

In Eq. (2), a sufficient condition for Eq. (1) is $\pi = 0$, so that H_0 and H_1 of the LM test are $H_0 : \pi = 0, H_1 : \pi \neq 0$.

An LM statistic can be constructed by means of estimated univariate GARCH processes. The score of the Gaussian log-likelihood function of ε_{it} is given by $y_{it}(\xi_{it}^2 - 1)/2$, where $y_{it} = \sigma_{it}^{-2}(\partial\sigma_{it}^2/\partial\theta_i), \theta_i = (\omega_i, \alpha_i, \beta_i)'$. Hafner and Herwartz (2006) propose the following test statistic

$$\lambda_{LM} = \frac{1}{4T}\left(\sum_{t=1}^{T}(\xi_{it}^2 - 1)M_{jt}'\right)V(\theta_i)^{-1}\left(\sum_{t=1}^{T}(\xi_{it}^2 - 1)M_{jt}\right) \xrightarrow{d} \chi^2(2) \tag{3}$$

$$\text{where } V(\theta_i) = \frac{k}{4T}\left(\sum_{t=1}^{T}M_{jt}M_{jt}' - \sum_{t=1}^{T}M_{jt}y_{it}'\left(\sum_{t=1}^{T}y_{it}y_{it}'\right)^{-1}\sum_{t=1}^{T}y_{it}M_{jt}'\right), k$$

$$= \frac{1}{T}\sum_{t=1}^{T}(\xi_{it}^2 - 1)^2. \tag{4}$$

Table 3. Unit root test.

		DJIA	NASDAQ	RUSSELL 2000	PHLX	ADX	Amman
Panel A: Level							
Intercept	ADF	−1.662	−1.360	−1.711	−3.938***	−1.785	−1.512
	PP	0.432	−1.380	−1.717	−3.832**	−1.760	−1.502
Intercept And Trend	ADF	−2.216	−2.802	−2.234	−3.890***	−1.498	−0.878
	PP	0.451	−2.803	−2.260	−3.766**	−1.440	−0.843
Panel B:1st difference							
Intercept	ADF	−51.749***	−49.682***	−51.206***	−46.321***	−20.086	−43.457***
	PP	−51.840***	−49.741***	−51.357***	−46.726***	−39.855***	−43.438***
Intercept And Trend	ADF	−51.750***	−49.694***	−51.193***	−46.328***	−20.141	−43.528***
	PP	−51.874***	−49.762***	−51.344***	−46.766***	−39.892***	−43.488***

Note: Null Hypothesis: has a unit root.
*, **, ***: denotes rejection of the Null Hypothesis (H_0) at the 10, 5 and 1% level.
Source: Authors' calculation.

To facilitate the notation Hafner and Herwartz (2006) do not indicate estimated quantities by'^', but rather assume that unobservable variables have been estimated under the null hypothesis of causality in variance. The statistic λ_{LM} may also be obtained from auxiliary regressions as follows:

(1) Estimate a GARCH (1, 1) model for ε_{it} and ε_{jt} and obtain standardised residuals ξ_{it}, derivatives x_{it} and the volatility process σ_{jt}^2 entering M_{jt}.
(2) Regress $\xi_{it}^2 - 1$ on y'_{it} and the misspecification indicators in M'_{jt}.
(3) λ_{LM} is equal to T times the degree of explanation (R^2) of the latter regression.

The asymptotic distribution of λ_{LM} will depend on the number of misspecification indicators in M_{jt}. In this case there are two such indicators, so that they obtained an asymptotic $\chi^2(2)$ distribution under standard assumptions.

Table 4. Johansen cointegration test.

Data Trend	None	None	Linear	Linear	Quadratic
Abu Dhabi (ADX) and America Index (DJIA, NASDAQ, RUSSELL 2000, PHLX)					
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	0	0	0	1	1
Max-Eig	1	0	0	1	0
Jordan (Amman) and America Index (DJIA, NASDAQ, RUSSELL 2000, PHLX)					
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	1	1	1	2	3
Max-Eig	1	1	1	1	1

Note: Critical values based on MacKinnon-Haug-Michelis (1999).
Selected (0.05 level*) Number of Cointegrating Relations by Model.
Source: Authors' calculation.

4. Results

4.1. Unit Root Test

Variables stability are tested before the LM tests on causality in variance. The Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test are used for the variables unit root tests Sims (1988). The null hypotheses (H_0) is tested by the ADF. The ADF and PP tests results are shown in Table 3. The results show that only PHLX is stationary in level, the other variables are stationary after the first difference.

4.2. The Johansen Cointegration Test

The cointegration test is used to analyse the impacts of a crisis on the markets regarding the long-term equilibrium, causality, impulse response, and variance decomposition. To study whether the variables move together, cointegration is used to simultaneously model long-run persistence and comovement. The Johansen maximum likelihood in a fully specified error correction model is used in the cointegration vectors estimations (Gonzalo, 1994). The likelihood ratio trace statistics and the maximum Eigenvalue

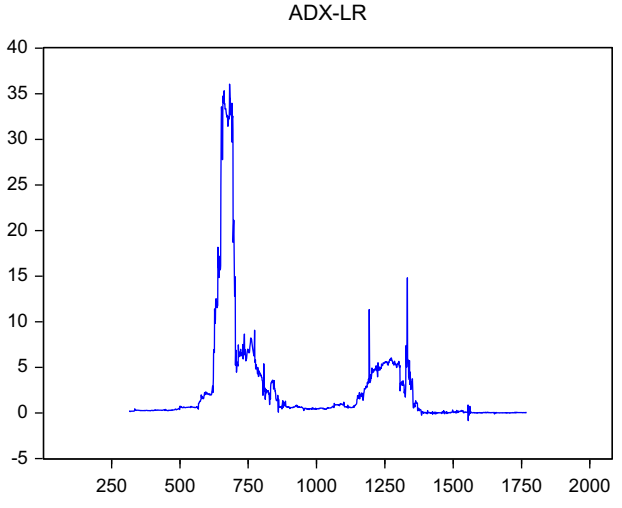

Figure 8. Q-A unknown breakpoint test: Abu Dhabi (ADX).
Source: Authors' calculation.

Table 5. Result of the Chow test.

Index	Breakpoint	F-statistic	Log likelihood ratio	Wald Statistic
ADX	682:2004/09	36.053***	71.01874***	68.72257***
Amman	970:2006/02	10.83586***	21.60652***	26.02597***
DJIA	1,335:2007/11	6.140***	12.268***	9.707***
NASDAQ	1,626:2009/5	2.855*	5.714*	5.511*
RUSSELL 2000	1,499:2008/9	3.728**	7.457**	0.0620
PHLX	1,311:2007/10	3.282**	6.567**	6.565**

Note: Null Hypothesis: No breaks at specified breakpoints.
*, **, ***: denotes rejection of the Null Hypothesis (H_0) at the 10, 5 and 1% level.
Source: Authors' calculation.

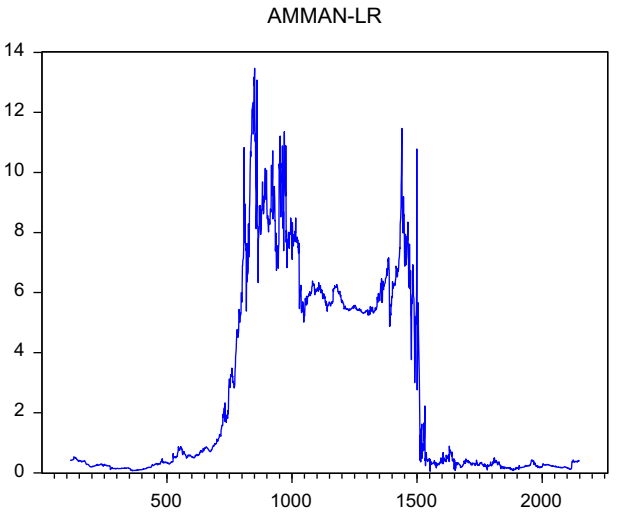

Figure 9. Q-A unknown breakpoint test: Jordan (Amman).
Source: Authors' calculation.

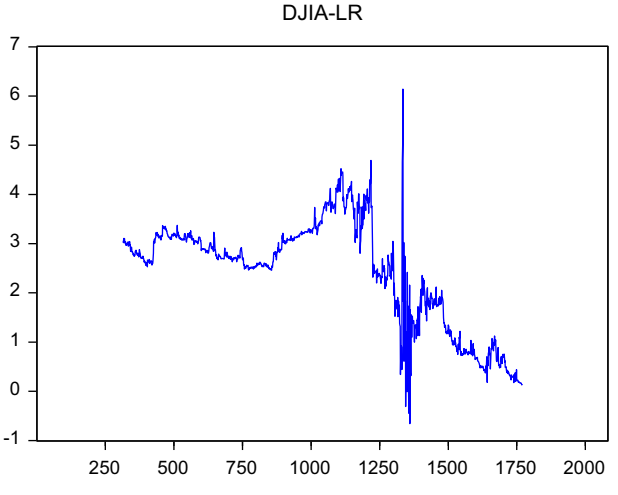

Figure 10. Q-A unknown breakpoint test: DJIA.
Source: Authors' calculation.

statistics for the cointegration test are used for evaluation. The results of five different models are shown in Table 4. The cointegration vectors both from the Mazimum Eigenvalue and Trace tests based on the 5% significant level are reported in Table 4. These results can be used to support the contagion effect studies.

Table 4 shows that the cointegration only exists under a linear and intercept trend between ADX and American stock indexes. The long-term equilibrium relationship between ADX and American stock indexes are not significant. On the contrary, the results show that there are steady long-term equilibrium relationships between the Jordan stock index (Amman) and American stock indexes.

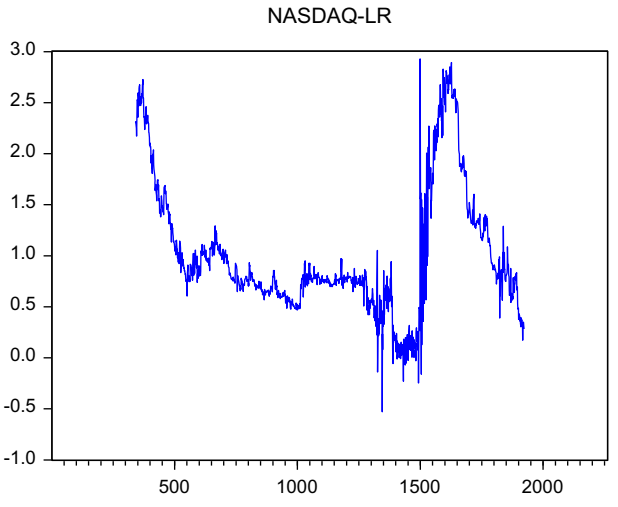

Figure 11. Q-A unknown breakpoint test: NASDAQ.
Source: Authors' calculation.

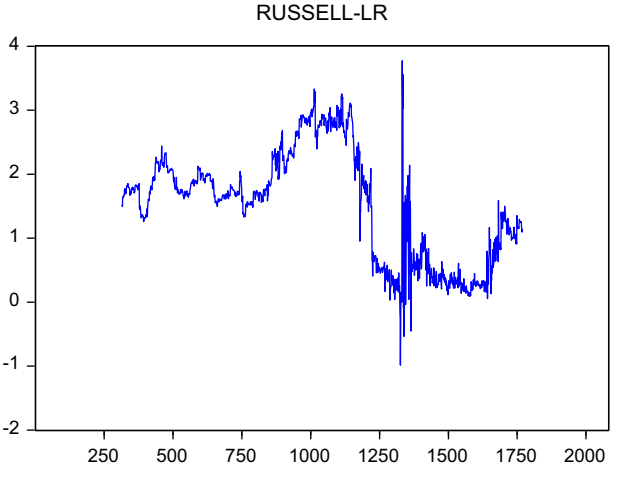

Figure 12. Q-A unknown breakpoint test: RUSSELL 2000.
Source: Authors' calculation.

4.3. Structural breaks – the Chow test

It is possible that there are structural changes during the study period of this study from May 21, 2001 to July 31, 2012. The Chow test and the Quandt-Andrews unknown breakpoint test are used to examine whether any structural changes occurred during the study period (Dungey, Fry, González-Hermosillo, & Martin, 2005).

The Quandt-Andrews unknown breakpoint test is used to search the breakpoints. The results are reported in Figures 8–13. The Chow test is used to confirm the breakpoints obtained from the Quandt-Andrews unknown breakpoint test. The results are reported in Table 5. It is shown in Figures 8 to 13 and Table 5 that there are structural changes during the study period. The breakpoint for the Jordan stock index (Amman) is

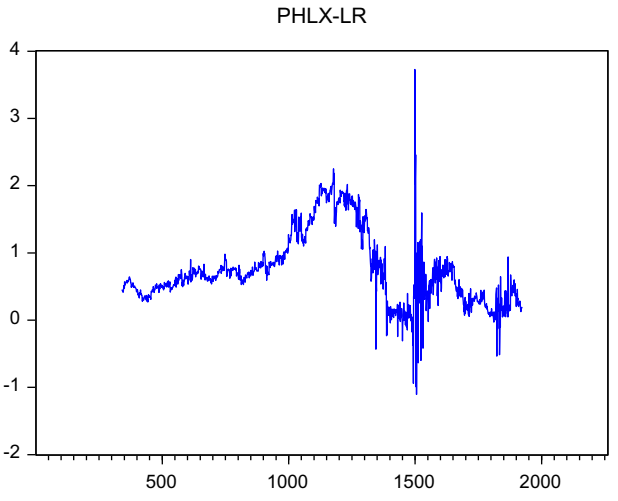

Figure 13. Q-A unknown breakpoint test: PHLX.
Source: Authors' calculation.

in 2006. The breakpoint for ADX is in 2004. The breakpoints of American indexes are in the year 2007. The Chow test is used to find the stock index return break points. Both the breakpoints of the Jordan stock index (Amman) returns and ADX returns are ahead of the breakpoints of American stock indexes returns.

4.4. Lagrange multiplier test on causality in variance

The contagion effects can be studied by the LM test on causality in variance. The LM test on causality in variance for the correlations between the American stock indexes and ADX are listed in Table 6. The LM test on causality in variance for the correlations

Table 6. Causality in variance – Abu Dhabi and America.

Independent variable Dependent variable	DJIA	NASDAQ	RUSSELL 2000	PHLX
Abu Dhabi (ADX)	**10.567*****	3.052 (0.217)	4.087 (0.129)	1.050 (0.591)
Abu Dhabi (ADX)	0.698 (0.705)	1.278 (0.527)	3.778 (0.151)	0.753 (0.686)

Note: (): *P*-value *, **, ***: denotes rejection of the Null Hypothesis (H_0) at the 10%, 5% and 1% level.
Source: Authors' calculation.

Table 7. Causality in variance – Jordan and America.

Dependent variable Independent variable	DJIA	NASDAQ	RUSSELL 2000	PHLX
Amman	**7.021****	**11.680*****	**9.848*****	**6.838****
	(0.029)	(0.002)	(0.007)	(0.032)
Amman	0.948	2.284	8.750**	3.279
	(0.622)	(0.319)	(0.012)	(0.193)

Note: (): P-value *, **, ***: denotes rejection of the Null Hypothesis (H_0) at the 10%, 5% and 1% level.
Source: Authors calculation.

between the American stock indexes and the Jordan stock index (Amman) are reported in Table 7.

Table 6 shows that the LM test results are not significant (i.e. H_0 not rejected) when ADX is an independent variable. This infers that the variance of returns of ADX is not contagious to the variances of returns of American stock indexes. On the other hand, when ADX is a dependent variable, only DJIA is significant. This indicates that the variance of return of DJIA is contagious to the variance of return of ADX.

Table 7 shows that, when the Jordan stock index (Amman) is a dependent variable, all test results are significant at 1%. This infers that, the variances of the returns of four American stock indexes are contagious to the variances of returns of the Jordan stock index (Amman). There are correlations between the variances of returns of the Jordan stock index (Amman) and the variances of returns of the American stock indexes.

ADX and the Jordan stock index (Amman) respond to the rates of returns of American stock indexes differently though they both are in the Middle East. The results of Johansen cointegration test and the LM test on causality in variance show that the relations between ADX and the American stock indexes are not as strong as the relations between the Jordan stock index (Amman) and the American stock indexes. The American stock indexes have more impact on the Jordan stock index (Amman). ADX is also affected by the American stock indexes in a smaller scope. The variance of return of DJIA is contagious to the variance of return of ADX. The variances of the returns of four American stock indexes are contagious to the variances of returns of the Jordan stock index (Amman).

5. Conclusions

The LM test on causality in variance results indicates that the variance of return of DJIA has contagion effect on the variance of return of ADX. The variances of the returns of four American stock indexes have contagion effects on the variances of returns of the Jordan stock index (Amman). The variances of ADX and the variances of the Jordan stock index (Amman) have no contagion effect on the variances of the returns of American stock indexes.

The natural resources and economic development of Abu Dhabi and Jordan are very different. Even though the common knowledge of economic and business believe that a small and isolated country, Jordan, should not be affected by the American stock market volatilities. An open economy with heavy international trade, such as Abu Dhabi, ought to be heavily affected by the American stock market volatilities. From the investment freedom and financial freedom point of views, Jordan has higher investment freedom and financial freedom scores than Abu Dhabi. This may mean Jordan is more heavily affected by the American stock market volatilities.

King and Wadhwani (1990) and Horta et al. (2008) claim that the contagion between markets occurs as a result of attempts by rational agents to infer information from the other markets. The research result of this article shows that the contagion between markets occurs because of the information about the volatility (variance of return) changes from another market. This empirical result supports the findings of King and Wadhwani (1990) and Horta et al. (2008).

Jordan is a smaller country with isolated economy compared to Abu Dhabi, however Jordan has higher investment and financial freedoms than Abu Dhabi. The empirical study results of this article show that the variances of the returns of four American stock indexes have contagion effects on the variances of returns of the Jordan stock index

(Amman) and ADX. These empirical evidences support the finding of King and Wadhwani (1990) and Horta et al. (2008). However, these empirical evidences do not support the finding of Longstaff (2010) who states that financial contagion is propagated primarily through liquidity and risk premium channels, rather than through a correlated information channel.

As the volatilities of the American stock indexes returns can have contagion effects on the stock index returns volatilities of both isolated and open economies. Governments of both isolated and open economies can use this information to understand the domestic stock return volatilities. This contagion effect information can be used by the American government to understand the impacts of its monetary policies, such as quantitative easing policy and interest rate policy, on the stock return volatilities of the other countries.

International investors can use this contagion effect information on international asset allocation strategies. International investors need to understand that the stock return volatilities of both isolated and open economies can be affected by the American stock return volatilities.

This article only studies the stock return volatilities between different countries. Most of the literatures support the notion that it is the investor behaviours that cause the contagion. Some variables, such as interest rates, exchange rates, investors ordering prices and quantities, are also important information for the studies of contagion effects. It will be useful for the international investors to have an optimal asset allocation model when there are contagion effects between the countries. Future research can study the contagion effects by looking at the investor ordering behaviours in the financial markets. Developing the optimal asset allocation models under the condition of contagion effects between the countries will be very helpful for the international investors.

Notes

1. The World Fact Book, UAE and Jordan at https://www.cia.gov/library/publications/the-world-factbook/geos/ae.html https://www.cia.gov/library/publications/the-world-factbook/geos/jo.html.
2. The World Fact Book, UAE. Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/ae.html.
3. The World Fact Book, Jordan. Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/jo.html.

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