

Co-integration and Causal Relationships: The Case of the Jordanian and Developed Stock Markets

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Abstract

The main purpose of this study is to investigate co-integration and causal relationships among the Jordanian, the US, and the UK stock markets. The vector error correction model is applied using yearly stock market indices series for the period, 1978 – 2018. The results reveal the existence of co-integration and causal relationships among stock markets indices. These results indicate the scope for diversification profits, where the Jordanian investors secure higher levels of mean returns on the diversified portfolios. This study is important for individual investors and policy makers in macroeconomics and finance, as stock markets affect consumption, wealth, and capital flows. The contribution of this study to the present literature is threefold. Firstly, it adds to the empirical literature an up-to-date dataset and employs a dynamic and causal approach, vector error correction model, which establishes whether market long-run equilibrium (i.e., co-integration) is stable for stock markets of Jordan, the USA, and the UK. Secondly, it analyses the performance of the Amman stock exchange for the period 1978-2018. Finally, this paper has implications for international portfolio diversification. If stock markets are co-integrated, this implies that there is an opportunity of arbitrage activity. In other words, stock markets are moving together towards long-term, and there are limited possibilities of gaining abnormal returns by diversifying investment portfolios.

Keywords: co-integration, international portfolio diversification, Amman Stock Exchange, developed stock market

1. Introduction

The universal financial system is the worldwide structure of authorized agreements, institution, and both official and unofficial economic actors that together smoothen international flows of financial capital for purposes of investment and trade financing. Stock market interdependencies are the main feature of the development of global financial system. The well-known theories in the finance field (i.e., capital assets pricing model and modern portfolio investment theory) explain that international portfolio investment can be used to reduce risk. This happens because of existing difference in the levels of economic growth and timing of business cycles among different countries. Saiti et al. (2014) documented that co-integration breaks down international portfolio diversification among stock markets. Baele and Inghelbrecht (2009) argued that the absence of co-integration and correlation among equity markets can increase potential gains from international portfolio diversification. Harvey (1995) pointed out that emerging equity markets are weakly correlated with developed equity markets. Thus, a portfolio risk-reduction strategy is feasible in which an investor holds financial assets in emerging and developed stock markets simultaneously. However, stock markets have recently become integrated due to the following: (1) explosive growth in international capital flows, (2) expansion of global and multinational corporations, (3) development in information technology, and (4) deregulation of the financial system.

The liberalization of the Jordanian economy was adopted in the late 1980s and early 1990s after signing agreements with the World Bank and international monetary fund. It aimed to remove the constraints and raise the capacity of financial system by increasing investment rates to acquire sustained economic growth rates. The liberalization smoothed the inflows of foreign direct investments into Jordanian economy although the inflows of foreign direct investments into Jordanian economy registered a negative growth rate of -17% and -34% in 2008 and 2009, respectively (World Bank, 2019). This shows that the global financial crisis 2007-2009 made the Jordanian economy less attractive to international investors. The Jordan stock market has developed rapidly since the early 2000s. The

market capitalization (as a percentage of gross domestic product (GDP)) registered 65.1%, 61.8%, and 56.7% in 2016, 2017, and 2018 respectively (ASE, 2019).

The importance of this study stems from examining the performance of the Amman Stock Exchange (ASE) and the extent to which the ASE is integrated with developed stock markets. The integration of the ASE with other developed stock markets is important from a portfolio diversification point of view. The contribution of this study to the literature is threefold. Firstly, it adds an up-to-date dataset and employs a dynamic and causal approach, Vector Error Correction Model (VECM), to the empirical literature. The VECM establishes whether market long-run equilibrium (i.e., co-integration) is stable for stock markets of Jordan, the USA, and the UK. Secondly, it analyses the performance of the ASE for the period 1978-2018. Finally, this paper has implications for international portfolio diversification. If stock markets are co-integrated, this implies that there is an opportunity of arbitrage activity. In other words, stock markets are moving together towards long-term, and there are limited possibilities of gaining abnormal returns by diversifying investment portfolios.

The structure of the paper is as follows: section 2 provides literature review. Section 3 presents an overview of ASE. Section 4 outlines model description and results analysis. In Section 5, conclusions are provided.

2. Literature Review

During the last three decades, financial market integration has been the focus of many scholars. In the literature, different studies examined the linkages among international equity markets. Gilmore and McManus (2002) examined equilibrium relationships between the US stock market and three central European stock markets (Czech Republic, Hungary, and Poland). The co-integration test results indicated the absence of a long-run relationship between these stock markets. Cardona et al. (2017) tested the financial linkages between the US and six largest Latin American stock markets (Argentina, Brazil, Chile, Colombia, Mexico, and Peru). The results revealed strong evidence of financial linkages from the US stock market to the Latin American Stock markets, but not so in the opposite direction. Marfatia (2017) investigated the financial linkages across 22 leading stock markets using wavelet approach. The results showed that there were significant differences in integration of risks at high frequencies (short-term) versus low frequencies (long-term) across time. Mensi et al. (2017) examined the dynamic correlations and portfolio diversification between the major developed and Brazil-Russia-India-China-South Africa (BRICS) stock markets. The results revealed a significant variability in the time-varying conditional correlations between these markets during upturn and downturn periods.

Shen (2018) investigated the financial linkages between the US and major Asian stock markets. The results showed that the US and major Asian stock markets were highly integrated. Oikonomikou (2018) examined the linkages among transition stock markets (i.e., Russia, Ukraine, Poland, and Czech Republic) using E-GARCH model. The results indicated significant returns and volatility among these stock markets. Vinh Vo and Ellis (2018) examined the interdependence between the Vietnamese stock market and the leading equity markets of the US, Hong Kong, and Japan. The results showed some evidence of statistically significant correlation, return spillover, and volatility linkages between Vietnamese stock market and other markets.

Caporale et al. (2019) examined global and regional stock market integration in Asia at aggregate and disaggregate levels for two sub-sample periods (i.e., pre-and post-2008 global financial crisis periods). The results showed that the Asian stock markets were integrated both globally vis-à-vis the US and regionally vis-à-vis Asia. Gkillas et al. (2019) examined the integration and co-movement between sixty-eight international stock markets using RS-GARCH model. The results showed that co-movements were detected either on the regional or global level. Kapar et al. (2019) examined the financial integration among Dubai financial market stock exchange, Abu Dhabi stock exchange, and the FTSE Nasdaq Dubai UAE 20 index. They applied VECM and the results revealed the existence of a long-run relationship between the three financial indices. Nguyen et al. (2019) investigated the dynamic linkages among equity markets of Hong Kong, Singapore, Thailand, and Malaysia. The results revealed that only Hong Kong's stock market shared a causal relationship.

In general, there are few studies that examined financial integration among stock markets for the Jordanian case. Sedik and Petri (2006) examined the financial integration between the ASE index and stock markets indices of Kuwait and Saudi Arabia. Their results showed that there was no co-integration. Salem et al. (2011) evaluated the financial linkages among different stock market indices (USA, Germany, Japan, Brazil, Jordan, Saudi Arabia, and Oman) using simple correlation for the period December 2008 to December 2010. The results showed that investors can enjoy the benefits of international portfolio diversification.

3. An Overview of Amman Stock Exchange

The ASE was established in March 1999 as an independent institution, authorized to function as a regulated market for trading securities in Jordan. The ASE signed many memorandums of understanding to enhance the mutual

corporation with the Arab and international stock exchanges. In August 2019, the number of listed companies at ASE reached 191. The value of shares purchased by non-Jordanians equaled 26.1 (JD million), 93.4% of which were shares purchased by Arabs. The value of shares sold by non-Jordanians was 24.3 (JD million), with 85.5% of shares sold by Arabs. During this month, net non-Jordanian investments showed a positive balance of 1.8 (JD million) (ASE, 2019).

By the end of August, shares owned by non-Jordanians represented 50.4% of ASE capitalization, with 35.5% of shares owned by Arab investors and 14.9% by non- Arabs (ASE, 2019). The ASE price index reached the peak in 2007 with 7519.3 points (Figure 1). It decreased gradually to 6243.1 points and 5520.1 points in 2008 and 2009 respectively, due to the global financial crisis. The trading value at ASE (Figure 2) grew progressively from 1978 till 2006, before gradually declining till 2018. However, Figure 3 shows that market capitalization at ASE increased from 286,118 (JD million) in 1978 to 16,123 (JD billion) in 2018.

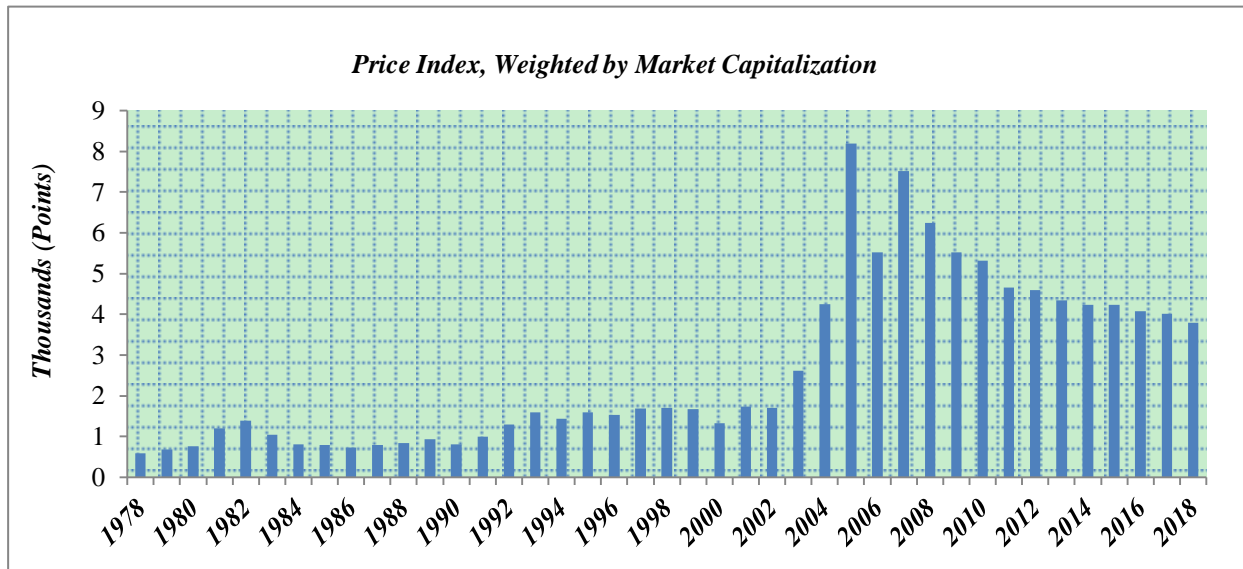


Figure 1. ASE price index (Note 1), weighted by market capitalization

Source: ASE, available on line at: <https://www.ase.com.jo/en>

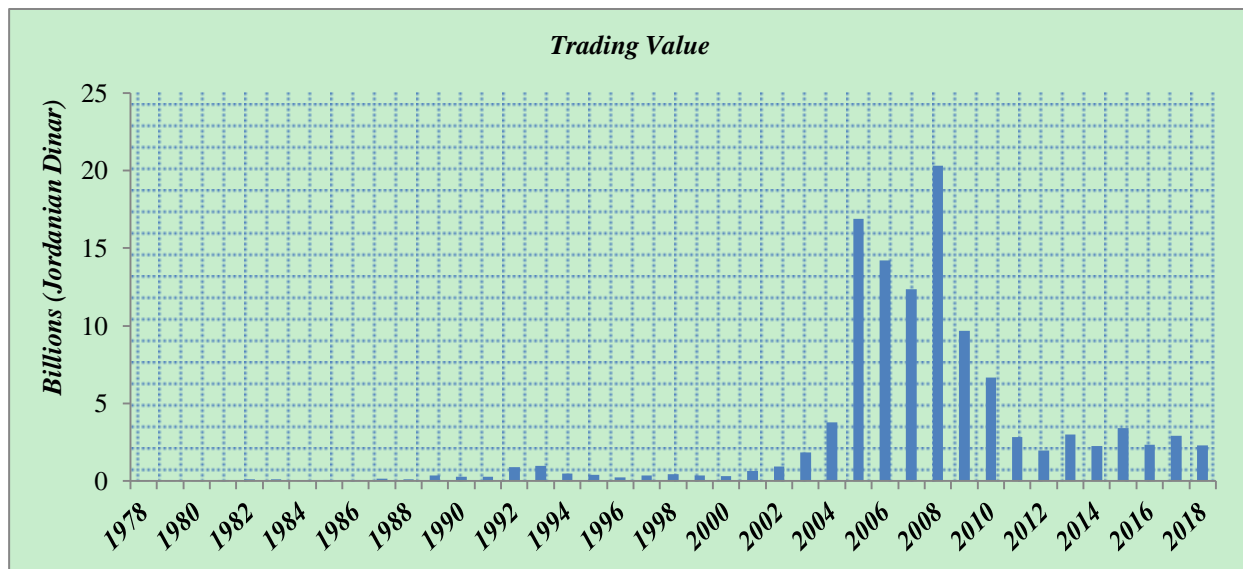


Figure 2. Trading value at the ASE

Source: ASE, available on line at: <https://www.ase.com.jo/en>

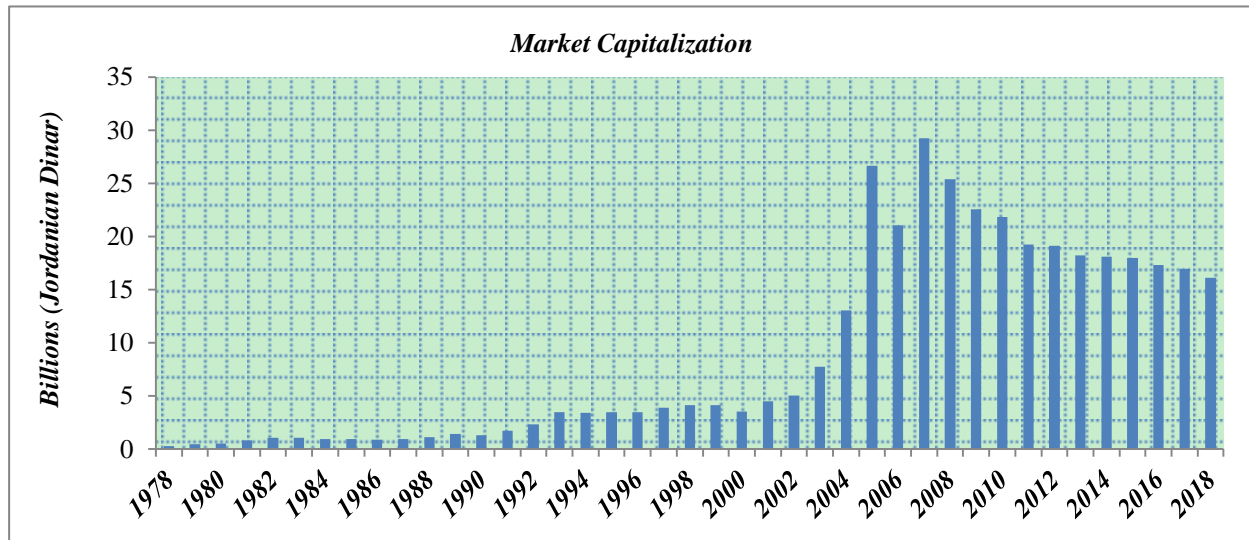


Figure 3. Market Capitalization at the ASE

Source: ASE, available on line at: <https://www.ase.com.jo/en>

4. Model Description and Result Analysis

4.1 Dataset

The main purpose of this study is to examine co-integration and causal relationships among the Amman Stock Exchange (ASE 100) Index, the New York Stock Exchange (S&P 500) Index (Note 2), and the London Stock Exchange (FTSE 100) Index (Note 3). Yearly time-series data on all share indexes were obtained from Bloomberg (<https://www.bloomberg.com/markets/stocks>) for the period, 1978-2018. The general log-linear model can be written as in Eq. (1):

$$\text{LogASE}_t = \beta_0 + \beta_1 \text{LogS\&P}_t + \beta_2 \text{LogFTSE}_t + \varepsilon_t \tag{1}$$

4.2 Methodology

In the current paper, a few steps are applied to gauge the existence of co-integration and causal relationships between different financial indices. The first step is to detect the stationary level of variables. Then the next step is to discover if the variables are co-integrated. The lag length is two and is chosen by applying the Akaike Information Criterion (AIC) and Schwarz Bayesian Information Criterion (SBIC). Johansen (1988) and Johansen and Juselius (1990) applied the two criteria to test co-integration under the framework of VECM. If a stationary linear combination exists, the non-stationary variables are said to be co-integrated, and this stationary linear combination is known as a long-run equilibrium (Bekhet & Mugableh, 2016; Mugableh & Oudat, 2018). The VECM is formulated as in Eq. (2):

$$\begin{bmatrix} \Delta \text{LogASE}_t \\ \Delta \text{LogS \& P}_t \\ \Delta \text{LogFTSE}_t \end{bmatrix} = \begin{bmatrix} \alpha_{1t} \\ \alpha_{2t} \\ \alpha_{3t} \end{bmatrix} + \sum_{s=0}^h \begin{bmatrix} \Gamma_{11t} & \Gamma_{12t} & \Gamma_{13t} \\ \Gamma_{21t} & \Gamma_{22t} & \Gamma_{23t} \\ \Gamma_{31t} & \Gamma_{32t} & \Gamma_{33t} \end{bmatrix} \begin{bmatrix} \Delta \text{LogASE}_{t-s} \\ \Delta \text{LogS \& P}_{t-s} \\ \Delta \text{LogFTSE}_{t-s} \end{bmatrix} + \begin{bmatrix} \gamma_{1t} \\ \gamma_{2t} \\ \gamma_{3t} \end{bmatrix} [\text{ECT}_{t-1}] + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix}$$

where Δ is the first difference operator, α_{it} are intercept terms, Γ_{ijt} ($i, j = 1, \dots, 3$) captures the short-run Granger causal relationships between the variables in first differences, γ_{it} ($i = 1, \dots, 3$) are the coefficients of lagged error correction terms (ECT_{t-1}). These coefficients test the long-run Granger causal relationships between the variables.

4.3 Results Analysis

Table 1 reports the correlation coefficients between stock market indices for the entire 1978-2018 period. The results indicate that correlation coefficients are relatively low. Table 2 provides the relevant descriptive statistics of yearly stock market indices. It shows that equity market indices are negatively skewed and leptokurtic. The results obtained from using the AIC and SBIC are presented in Table 3. For the level series (i.e., $I(0)$), Table 4 displays that the null

hypothesis of a unit root is not rejected at the 5% confidence level. Its however, rejected once the level series are differenced indicating that they are stationary at I(1). According to the results reported by trace and maximal eigenvalues statistics tests in Table 5, only one co-integrating relationship is found among stock market indices. As the co-integrating relationship is confirmed among stock market indices, the next step is to estimate long-run and short-run causal relationships.

Table 1. Correlation coefficients of yearly stock market indices series

Stock market index	ASE	S&P	FTSE
ASE	1	0.4523	0.2354
S&P	0.4523	1	0.2897
FTSE	0.2354	0.2897	1

Source: Author's estimation using Eviews software package 10.

Table 2. Summary statistics of yearly stock market indices series

Statistics	Stock market index		
	ASE	S&P	FTSE
No. of observations	41	41	41
Mean	0.0031	0.0042	0.0023
Median	0.0033	0.0013	0.0015
Maximum	0.2012	0.2293	0.4567
Minimum	-0.1412	-0.1789	-0.1982
Standard deviation	0.0345	0.0567	0.0345
Skewness	-0.1456	-0.1345	-0.345
Kurtosis	5.623	6.723	4.567
Jarque-Bera	86.34	76.98	69.68
Probability	0.00	0.00	0.00

Source: Author's estimation using Eviews software package 10.

Table 3. Lag selection for co-integration tests

Lags	FBE	AIC	HQIC	SBIC
0	5.2e-09	-9.23	-10.21	-12.21
1	3.2e-12	-10.1	-11.12	-13.19
2	4.1e-12	-11.2*	-13.24	-12.17*
3	5.0e-12	-12.2	-12.21	-13.16

Notes: (1) FBE is final prediction error. (2) AIC represents Akaike information criterion. (3) HQIC denotes hannan-quinn information criterion. (4) SBIC represents schwarz bayesian information criterion.

Source: Author's estimation using Eviews software package 10.

Table 4. Unit root test results of the stock market indices for the entire period 1978-2018

Stock market index	ADF test		PP test	
	I(0)	I(1)	I(0)	I(1)
ASE	-1.23	-20.3*	-1.29	-22.5*
S&P	-1.67	-25.2*	-1.78	-24.3*
FTSE	-1.32	-26.1*	-1.90	-29.5*

Notes: (1) ADF test is augmented Dickey Fuller test. (2) PP test denotes Philipps Perron test. (3) *Significance at the 5% level.

Source: Author's estimation using Eviews software package 10.

Table 5. Results of co-integration tests

Null hypothesis	Trace statistics	5% critical value	1% critical value	Maximal eigenvalue statistics	5% critical value	1% critical value
$r = 0$	130.2*	119.1	131.2	40.23*	33.21	42.24
$r \leq 1$	77.28	80.21	82.23	33.22	38.23	44.21
$r \leq 2$	60.21	63.34	67.45	23.45	31.21	33.56

Note: *Significance at the 5% level and 1% level.

Source: Author's estimation using Eviews software package 10.

Table 6. Causality test results based on VECM

Causality		χ^2 test statistic-Short-run	ECT (t-statistic) - Long-run	Nature of causality	Direction of causality
From	To				
ΔLogASE_t	$\Delta \text{LogS\&P}_t$	8.23	3.80	No causality	-
$\Delta \text{LogS\&P}_t$	ΔLogASE_t	7.38**	-3.80*	Short and long-run	Feedback
ΔLogASE_t	$\Delta \text{LogFTSE}_t$	1.95	3.80	No causality	-
$\Delta \text{LogFTSE}_t$	ΔLogASE_t	7.67**	-3.80*	Short and long-run	Feedback

Notes: (1) Significance at: *1 and **5 percent level, respectively. (2) Feedback means that the causal relationships run in both directions (i.e., long-run and short-run).

Source: Author's estimation using Eviews software package 10.

Table 6 results showed that there are two feedback relationships existing: the first is from the US stock market index to Jordanian stock market index, and the second is from the UK stock market index to Jordanian stock market index.

5. Conclusions

This paper investigates co-integration and causal relationships among stock market indices of Jordan, the USA, and the UK. The results of co-integration tests show the existence of a single co-integrating relationship among the stock markets' indices. The results of causality tests reveal that a feedback relationship exists from the US and the UK stock markets to Jordanian stock market. The countries in this study have implemented different privatization projects. In 2018, the US and Jordanian government signed a non-binding Memorandum of Understanding (MOU) to provide USD 6.375 billion during the next 5 years (U.S. Department of State, 2019). This MOU was a bilateral foreign assistance intended for covered the financial and social programs in Jordan. In addition, the UK's department for international development provided Jordan with grant to fund the areas of economics, education, privatization, and poverty reduction (Ministry of Planning and International Cooperation, 2019).

The findings of this paper have some implications for investors and decision makers in the ASE. The results reveal that investing in the US and the UK stock markets offers limited opportunity for international portfolio diversification. In the contrary, investors desiring to diversify their portfolios may be able to achieve additional profits by investing in the ASE. In fact, the ASE compares favorably with other emerging stock markets in terms of low-price instability, transparency, regulations, and investment constraints. However, the decision makers in the ASE ought to continue improving supervision and regulations. This would be a significant platform to attract foreign capital inflows.

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Notes

Note 1. The Amman Stock Exchange (ASE) Stock Index made up of the most liquid and largest 100 listed companies at Amman stock exchange from the first and second markets.

Note 2. The S&P 500 Index measures the stock performance of 500 large companies listed on stock exchange in the USA.

Note 3. The FTSE 100 Index is a share index of the 100 companies listed on the London stock exchange with the highest market capitalization.

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