THE ROLE OF ENERGY COMMODITIES IN MIDDLE EAST STOCK MARKET INTEGRATION

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ABSTRACT
Given the importance of stock market integration as an indicator of portfolio benefits on the merits of global fund diversification, we test whether the integration of frontier stock market in Middle East (Jordan, Kuwait, Lebanon, and Oman) can be justified by the movement of energy commodities prices. Using the International capital asset pricing model (ICAPM) in the period January 1997–March 2010, our results indicate that there is a dynamic relationship between energy commodities in the long run. However, the sort linkages of Granger causalities show that only coal and oil Granger-cause market integration. As robustness check, this study investigates the integration of those markets into the European, Australasia, and Far East (EAFE), US, and UK stock markets. Using multivariate regression and after controlling for the size and trading liquidity, we found that there is significant relationship between energy commodities and market integration.

Keywords
Frontier market integration, Energy commodities, Portfolio management, Middle East

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1. INTRODUCTION

The dependence of the world economy on energy was again reflected in the strong association between the declining of stock markets and Middle Eastern conflicts. It shows the strong role of energy on the possibility of world economy detrimental. But somehow, its function on the elimination of the portfolio returns just left unobservable, especially in Middle East Frontier stock markets; a gap where this paper will contribute.

Given that energy commodities play an important role in economic activities, several studies have investigated the effect of energy prices on the economy. For example, in macroeconomic scale, many studies have examined the effect of energy commodities on economic damage (Cong, et al., 2008; Oberndorfer, 2009; Regnier, 2007); inflation and interest rate (Ferderer, 1996; Mork, 1989; Papapetrou, 2001; Sadorsky, 1999); investment intensity (Schwartz, 1997); real wage (Wei, 2003); and GDP (Hamilton, 1983). In microeconomic scale, extensive research has investigated the role of energy in stock returns (Basher & Sadorsky, 2006; El-Sharif, et al., 2005; Faff & Brailsford, 1999; Hammoudeh & Aleisa, 2004; Hammoudeh, et al., 2004; Hammoudeh & Li, 2005; Henriques & Sadorsky, 2008; Nandha & Faff, 2008; Park & Ratti, 2008; Sadorsky, 1999, 2001, 2008); firm fundamental (Boyer & Filion, 2007); and firm cost (Cong, et al., 2008).

Back to its effect on stock markets, much research has investigated how the volatility of energy prices has impacted on the market behavior. For instance is Sadorsky (1999) who addressed an evidence of the relationship of oil price volatility shocks on the stock returns. Papapetrou (2001) also found the dynamic relationship among oil prices, stock prices, interest rate, real economic activity, and employment under vector-autoregression approach. Another research is by Kilian and Park (2009) who found a relationship between energy price and US stock returns. However, the impact of it on the diminishing world portfolio benefits is rarely found.

As other similar research, we propose market integration as the proxy of diminishing world portfolio. By definition, perfect market integration is a situation where the correlation among the stock markets is equal to one. This occasion will not give any portfolio benefits as the markets are moving together. Relate back to our hypothesis, we believe the energy prices have played important role on generating the market integration. In other words, the energy prices can eliminate the portfolio benefits through market integration.

Market integration means that stock markets move proportionally to each other; therefore, this co-movement diminishes portfolio benefits. The degree of stock market integration has important implication on international portfolio benefits, financial stability, and market efficiency. The more stock markets around the world are integrated, the less the portfolio benefits. If there is a relationship between energy commodities and market integration, global fund managers and policy makers will know the importance of energy commodities in sustaining portfolio benefits or maintaining financial stability.

This study aims to investigate the dynamic relationship between the prices of energy commodities and market integration. Unlike most existing literature, which focuses on the relationship between the prices of energy commodities and stock markets, we analyze the role of energy commodities in global portfolio fund. This case is interesting for several reasons. Firstly, one vital issue is that it is important for global fund managers to have comprehensive understanding of the role of energy commodities in market integration. In terms of the relationship between energy commodities and market integration, if the movement of energy commodities affects market integration, it implies that energy commodities are associated with international portfolio benefits and financial stability. In other words, energy commodities might influence international portfolio benefits and financial stability.

Another issue that this research tackles is that of Middle East frontier markets. Our literature review showed that most studies focus on emerging and developed markets. However, research on frontier markets, especially Middle East frontier markets, was not found. Frontier markets are described as being smaller in terms of size and capitalization compared with emerging markets. Thus, frontier markets benefit global diversification because of their low correlation to other markets. Additionally, to increase our results' robustness, we chose Middle East frontier markets because they are important players in energy commodities. The ones included in this study are Jordan, Lebanon, Kuwait, and Oman.

In summary, whether energy commodities play an important role in global diversification will receive considerable attention from investors, global fund managers, and policy makers. It will shed light on the role of price movement of energy commodities in international diversification, especially in frontier markets.

The study is structured as follows. A literature review is presented in section 2, followed by the methodology and data description in section 3. Section 4 addresses the empirical results and discussion. Section 5 concludes and offers potential areas for future work.

2. Literature Review

2.1 Brief of Market Integration

Market integration is defined as the situation where prices among different locations have similar patterns in a long period. If market prices are integrated, there is no space for arbitrageur and portfolio benefit as it has a covariant of one. The more the market is integrated, the less portfolio benefits investors achieve.

Market integration has been hugely investigated in both developed (Arshanapalli & Doukas, 1993; Hardouvelis, et al., 2006; Meric & Meric, 1997) and developing countries (Chen, et al., 2003; Daly, 2003); in trading blocs (Fredriksson & Mani, 2004); in regionalism (Bussière, et al., 2005); in political economics (Baldwin & Venables, 1995); and in stock markets (Majid, et al., 2009; Mansor, 2005). For example, in the developed market perspective, Hardouvelis et al. (2006) conclude that there is stock market integration after the European Monetary Union (EMU) was formed in 1999. They mentioned that regulatory harmonization, bond yields convergent, strict fiscal cross-border regulation, and regulated inflation rate are the drivers of stock market integration after EMU. In the case of developing markets, Palac-McMiken (1997) investigates the long-run relationship between the ASEAN-5 equity markets using the unit root model. He surmises that members of the ASEAN-5, except Indonesia, have long-run relationship in terms of stock markets. Roca et al. (1998) examine comovement of ASEAN-5 stock markets from 1988 to

1995. They found that in short-run interaction, excluding Indonesia, there is significant comovement.

However, in terms of regionalism, not much insight was provided on the integration between one region and the world, especially that of frontier markets. Several studies investigated developed and developing markets. For example, Akdogan (1992), Choudhry (1996), Corhay et al. (1993), Fratzscher (2002), Johnson et al. (1994), Johnson and Soenen (1993), Kanas (1998), and Monadjemi and Perry (1996) studied the European Union; Adler (1995), Adler and Qi (2003), and Ewing et al. (1999) investigated the case for NAFTA; Chen et al. (2002), Edwards and Susmel (2001), Heaney et al. (2002), Johnson and Soenen (2003), Seabra (2001), and Soydemir (2000) studied the case for MERCOSUR; and Click and Plummer (2005) and Ng (2002) covered AFTA.

One of the studies that investigated the case of the Middle East is that of Darrat et al. (2002). This study looked into the market integration of Jordan, Morocco, and Egypt using Johansen–Juselius cointegration and the Gonzalo–Granger tests and found that there is integration between the Middle East and the global market. In addition, other research (e.g., Alkulaib, et al., 2009; Beirne, et al., 2010) also found that there is cointegration between the Middle East and the world. However, there is no research investigating the role of energy commodities in market integration.

2.2 Energy Commodities and Their Role in the World Economy

This section briefly discusses the role of energy commodities, such as oil, gas, and coal, in the world economy, especially in stock markets. Very few empirical studies investigate the role of energy commodities in the economy. Thus, this makes our research important as it contributes to energy commodities literature.

2.2.1 The Role of Oil

As mentioned earlier, scholars have extensively examined the role of oil price in stock markets. Some studies investigated the relationship between oil prices and market indices, whereas others examined the relationship of oil prices to various industries. Previous studies on energy markets, however, focus on developed and developing markets, and not on frontier markets. For example, Jones and Kaul (1996) revealed that oil price changes have a critical effect on US, Canadian, Japanese, and UK stock markets. Sadorsky (1999) found that oil price shocks and their volatility play a more important role in US stock returns than interest rate. Still in the US context, Huang et al. (1996) observed that crude oil future returns can explain oil companies' stock returns. Hammoudeh et al. (2004) found that there is no cointegration among oil stock price of S&P 500, WTI energy price, and 1– to 4– month future prices in the New York Mercantile Exchange (NYMEX). However, there was cointegration after adding oil price. Based on the analysis of the United States and 13 European countries, Park and Ratti (2008) found that there is a negative relationship between oil price and shocks returns in oil-importing countries, whereas there is a positive relationship between oil price and shocks returns in oil-exporting countries. Similar results were found in other stock market contexts. For example, study of Faff and Brailsford's (1999) in the Australian Stock Market revealed that oil price has a positive association with stock prices of the oil and gas industry, whereas it has a negative association with that of the papermaking, packing, and transportation industries. In Greek stock markets, Papapetrou (2001) found that oil price is an important component of stock returns. Cong et al. (2008), who investigated the relationship in Chinese stock market, came up with the same conclusion. Additionally, Sadorsky (2001) investigated the role of oil prices in Canadian companies. He found that increases in stock market index and oil price have a positive effect on oil companies, but a negative effect if the interest rates and exchange rates are increasing.

In a nutshell, there is a relationship between oil prices and stock markets regardless of relationship scopes; whether it is on the market, industry, or firm, oil prices still have a positive association with stock markets.

2.2.2 The Role of Gas

Gas is also an important energy commodity, especially in Europe and the United States. Soderholm (2000) revealed that natural gas is important in Europe, especially in the transportation sector. This is also confirmed by the study of Serletis and Herbert (1999), who found that natural gas plays an important role in the world economy. In addition, Ewing et al. (2002) concluded that natural gas has an economic effect and can cause spillover to other markets.

In terms of the relationship between natural gas and the stock market, Boyer and Filion (2007) highlighted that gas pricing changes have an impact on the cash flows and liquidity of stock returns. Furthermore, they surmised that gas prices have a strong relationship with the fundamental factors of stock returns. These results are in line with those of Hampton (1995), who stated that the volatility of gas energy markets might have an impact on the discounted expected cash flows of energy corporations. Moreover, volatility may cause augmented expenditures for affected corporations and reduce the value of the firm's stocks, especially in oil, gas and utilities corporations.

2.2.3 The Role of Coal

Coal is another important but rarely investigated energy commodity. Its prices are determined by productivity, but productivity depends on the demand for this energy commodity (Ellerman, 1995). The largest users of coal are European countries, China, the Middle East, and the United States.

Indeed, the role of coal in economic development cannot be underestimated. Thomson (2003) found that coal has an important role in China's economic development. This result is confirmed by Peng (2009), who revealed that coal is the major energy source that supports China's economic growth. Further, Oberndorfer (2008) found that coal price developments affect the stock returns of European utilities companies. Another study conducted by Pindyck (1999) found that coal price has the lowest volatility among energy commodities; however, it has the same effect on economic development.

3. METHODOLOGY

3.1 Procedures

This research consists of three procedures. First, we determine the value of market integration. The value of market integration was retrieved by rolling regression of ICAPM. We took the intercept as the market integration proxy. The window size of the rolling regression is 60 days with one looping day. Then, after we retrieved the intercept (proxy of market integration), we tested the relationship between market integration and energy commodities in dynamic linkages using the error correction model (ECM). Before testing it, we conducted the unit root test and the cointegration test. Then, we estimated the relationship by controlling the size and liquidity in regression as robustness check.

3.2 Measuring Market Integration

In asset pricing perspective, market integration is commonly referred to as the law of one price, where companies that have similar risk in future cash flows should have the same pricing regardless of their location (Adler, 1995; Bekaert & Harvey, 1995; Bekaert, et al., 2002). According to Korajczyk (1996), perfect market integration is a situation where there is no pricing error in stock market indices to the global portfolio.

This pricing error can be captured by adapting the ICAPM model (Bekaert & Harvey, 1995; Dumas & Solnik, 1995; Ferson & Harvey, 1991; Hardouvelis, et al., 2001). The model is:

$$E_{t-1}(r_{i,t}) = \lambda_w \beta_{i,w} + \lambda_d \beta_{i,d} \qquad (1)$$

where $r_{i,t}$ is the excess return on the domestic portfolio i, λ is the market risk premium, $\beta_{i,w}$ is the risk of portfolio i relative to world portfolio w defined as $\beta_{iw} = COV_{t-1}[r_{i,t}, r_{w,t}]/VAR_{t-1}[\mathrm{r}_{\mathrm{i,t}}]$, and $\square_{i,d}$ is the domestic market portfolio d. The null hypothesis of the integration is λ_d equal to zero.

In other words, this research constructed the ICAPM model to capture market integration by taking its intercept. To capture the integration, we developed an integration index using time-varying model of rolling regression. Following Bekaert and Harvey (1995) and Korajczyk (1996), we estimate the market integration in the following specification:

$$R_{w,t} - R_{FW,t} = \alpha_i + \beta_i (R_{m,t} - R_{FM,t}) + \varepsilon_{i,t} \qquad (2)$$

where $R_{w,t}$ is the returns of the world portfolio in time t, $R_{FW,t}$ is the returns of international risk-free rate, $R_{m,t}$ is the returns of the market, and $R_{FM,t}$ is the risk-free rate of domestic market. This equation implies that the domestic market integrates into the world. The level of integration is represented by *a*. The more it closes to zero, the more it is integrated (Bekaert & Harvey, 1995; Korajczyk, 1996). If the four Middle East frontier markets are integrated into the world, the intercept will be close to zero.

As mentioned earlier, the intercept or α was obtained by implementing rolling regression with a window size of 60 days. After running the rolling regression of Equation (2) with one looping day, we adjusted the market integration index (the intercept) by following Levine and Zervos's method (1998):

$$MI_{i,t} = -\left|\hat{\alpha}_{i,t}\right| \qquad (3)$$

A zero index shows a perfect integration with world market. The index is positively correlated with the degree of market integration. This index was taken as our dependent variable (*Y*).

3.3 Data Description

A total of eight stock markets are considered. Four markets are the MSCI Barra–listed frontier markets in the Middle East (Jordan, Kuwait, Lebanon, and Oman). We excluded the United Arab Emirates (UAE) from our list due to data limitation. UAE was established in 2001, whereas data used in our study date back to 1 January 1997. This long time horizon is intended to make the research more robust. In addition, rolling regression, cointegration, and ECM required many observations for robustness and precision purposes.

We chose frontier markets for two reasons. First, for the theoretical point of view, portfolio diversification between developed and frontier markets are much better than that between developed and emerging markets. The correlation between frontier and developed markets is about zero (Table 1). It indicates that the portfolio benefits by adding frontier market to the global fund should be good. Second, very few studies investigate the frontier markets.

Table 1. Correlation among Stock Markets.

	Jordan	Kuwait	Lebanon	Oman
World	0.009534	-0.00868	-0.00262	0.010263
EAFE	0.01029	0.002553	0.01102	0.020019
US	0.040523	0.002604	0.031622	0.039574
UK	0.059954	0.029139	0.053779	0.083135

This research uses the MSCI All Country World Index as the proxy for world index. It also implies that this research examined the integration of the Middle Eastern frontier market into the world. For robustness of portfolio benefits, this research also tested the integration of Middle East frontier markets into EAFE (European, Australasia, and Far East), US, and UK stock markets. Therefore, there were four integration models.

For energy commodities, this research retrieved data from the Brent Oil Price, London Gas Price, and Global Coal Price, for oil, gas, and coal, respectively. In the computation of excess returns, US T-bills rate is the proxy for world risk-free rate. Meanwhile, each country has its own T-bills for the risk-free rate purpose. All the data were downloaded from Thomson DataStream. The period is 1 January 1997–1 March 2010. The data frequency is on daily basis.

4. Results

4.1 Unit Root Test Results

Time series research assumes that the underlying time series are stationary. The use of nonstationary data in regression analysis leads to spurious regression results, prompting the belief that there is a statistically significant relationship between variables. The unit root test is derived from the random walk model. According to Harris (1995), the model is:

$$Y_t = pY_{t-1} + u_t \tag{4}$$

It is obvious that the current values of Y_t depend on the prior value Y_{t-1} and a disturbance term u_t. Variable Y_t is to be stationary if $|\varrho| < 1$, and nonstationary if $\varrho = 1$. A stationary series returns to its mean and has finite variance, as opposed to a nonstationary series that has a different mean at different points and variance that boosts with sample size. Most financial data often display nonstationary properties; this can be overcome by differencing, namely, ($Y_t - Y_{t-1}$). If a series has to be differenced d times, it consists of d unit roots and is integrated of order I(d).

Given the importance of stationary properties, this research used the augmented Dickey–Fuller (ADF) test to examine the unit root. Through this test, we can gauge the robustness of the integrational properties of market integration and energy commodity price.

The ADF test is a modified version and extension of the Dickey–Fuller approach. It allows for constant and deterministic trends in the data. The first procedure was testing the stationary and the order of integration of the variables, at levels as well as first differences. Specifically, this study tested whether the variables are integrated of order zero, I(0), that is, whether they are stationary. It is based on a standard regression with a constant and a time trend as follows:

$$\Delta Y_t = \alpha_0 + \alpha_1 T + \alpha_2 Y_{t-1} + \sum_{i=1}^{k} \lambda_i \Delta Y_{t-i} + \varepsilon_t \tag{5}$$

where a_2 is equal to $p - 1$, T is the time trend, Δ is the first difference operator, and ε_t is white noise error. The lag length k is selected so that all the residuals ε_t is white noise. The null hypothesis is that Y_t has unit root (nonstationary), that is, H_0: $\alpha_2=0$, versus the alternative hypothesis that Y_t is stationary or H_1: $\alpha_2<0$. The test is done by Mackinnon test statistic at the 1% and 5% significant levels.

Table 2. Unit Root Test Results.

	Level			First Difference		
	Coefficient	T-Statistic	Probability	Coefficient	T-Statistic	Probability
Coal	-0.000938	-1.146422	0.6993	-0.6584	-6.116555	0.0000
Gas	-0.006421	-2.767278	0.0632	-0.871249	-7.193232	0.0000
Oil	-0.000731	-0.64785	0.8574	-1.070898	-47.1887	0.0001
MI_WORLD	-0.019523	-4.459176	0.0002	-0.965018	-31.49533	0.0000
MI_EAFE	-0.020737	-4.60396	0.0001	-1.013434	-14.83886	0.0000
MI_US	-0.027147	-5.172527	0.0000	-1.168833	-18.45876	0.0000
MI_UK	-0.023509	-4.399176	0.0003	-1.209652	-15.48175	0.0000

Comparing the calculated ADF statistic to the MacKinnon critical value, as reported in Table 2, we surmise that only coal and oil do not achieve the stationarity at level; however, in the first difference, the entire variables have achieved stationarity, indicating that all variables are integrated of order one. Therefore, we continued the procedure not to regression, but to Johansen and Juselius cointegration test.

4.2 Cointegration Test Results

After finding the order of integration of the individual series, this study proceeds to test for cointegration of Johansen and Juselius (cointegration test). The idea was to determine whether the stochastic trends in market integration and energy commodity prices that contain unit roots have a long-run relationship. First, this study conducted the following cointegrating regressions:

$$Y_t = \beta_0 + \beta_1 X_t + u_t \qquad (6)$$

The null hypothesis is that Y_t and X_t are not cointegrated. Second, after conducting the first regression, the research tested if the residuals u_t is of I(0) or I(1) via the ADF technique. If u_t is found to be consistent with I(0), one may claim that cointegration exists between Y_t and X_t.

The results of the cointegration test are presented in Tables 3–5. They clearly indicate cointegration between market integration and energy commodities for all sample periods. As we took three energy commodities (coal, gas, and oil), we have three results of cointegration. First, it is the cointegration between coal and market integration. Consider first the cointegrating vector, which includes the market integration and coal, our calculated trace value larger than its critical value at 95% level, indicating the fact of rejecting the null hypothesis of no cointegration.

Table 3. Cointegration Results between Coal and Market Integration.

	World		EAFE		US		UK	
Ho	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value
r=0	26.5579*	26.0200*	23.0513*	22.4699*	31.9181*	31.5102*	31.3972*	31.0265*
r≤1	0.53796	0.53796	0.58143	0.58143	0.40786	0.40786	0.37064	0.37064

*significant in 1% level

Intuitively, this result (Table 3) shows that there is cointegration or dynamic relationship between market integration and coal in the long-run relationship. It implies that the price of coal has a significant relationship with market integration. If the price of coal is increasing, the market will be more integrated, and vice versa.

Then, we tested the role of the price of coal in the integration of Middle East frontier market into three other markets. The purpose is to have comprehensive results for robustness. We aim to see the power of coal price in achieving market integration.

The results of testing the relationship of coal prices and three other markets' integration have no difference with the result of market integration into the world. It shows that the price of coal has a significant relationship not only with world market integration, but also with EAFE, US, and UK market integration.

These results imply that if the price of coal is increasing, it will make Middle East stock markets more integrated, not only into the world market, but also into EAFE, US, and UK markets. In other words, the price of coal plays an important role in making the integration of Middle East stock markets and developed stock markets possible.

Table 4. Cointegration Results between Natural Gas and Market Integration.

	World		EAFE		US		UK	
Ho	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value
r=0	33.3623*	27.8389*	31.3678*	25.7914*	39.5083*	32.4829*	35.2082*	28.8972*
r≤1	5.52335	5.52335	5.57639	5.57639	7.02541	7.02541	6.310981	6.31098

*significant in 1% level

Now we examine the results of natural gas prices' role in market integration. Looking at Table 4, natural gas price has long-run relationship with market integration. It implies that the price of natural gas has dynamic linkages with the integrating process of Middle East stock markets into the world or developed stock market.

The results show that if the price of natural gas climbs, it will have an impact on the integration of Middle East stock markets. Again, the integration is not only into the world stock markets, but also into EAFE, US, and UK stock markets. In other words, the price of natural gas has the muscle to affect global portfolio benefits or global market stability.

Table 5. Cointegration Results between Oil and Market Integration.

	World		EAFE		US		UK	
Ho	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value
r=0	22.841*	22.3638*	21.4513*	21.0068*	30.208*	29.8061*	30.8962*	30.5509*
r≤1	0.47714	0.47714	0.44454	0.44454	0.40189	0.40189	0.34532	0.34532

*significant in 1% level

Lastly, another energy commodity, oil, indicates the comovement with market integration. Table 5 shows that oil price has a significant long-run relationship with market integration. Again, the integration is not only between Middle East and world stock markets, but also between Middle East and EAFE, US, and UK stock markets. It can be surmised that oil has implication on global portfolio benefits if we add Middle East stock markets as the "eggs" of portfolio.

4.3 ECM Results

In market integration models, ECM specification is the popular method because of its intuitively appealing interpretation. Our research used ECM to retrieve comprehensive understanding of the dynamic linkages between energy commodities and market integration. ECM is generated by:

$$\Delta Y_t = \mu + \sum_{i=1}^{K-1} G_i \Delta Y_{t-i} + G_k Y_{t-1} + \epsilon_t \qquad (7)$$

where Δ is the vector of drift; G's is the parameters matrices; and $\in_t$ is the white noise vector. The null hypothesis in this model is that there are at most r cointegrating vectors $0 \leq r \leq n$, and (n – r) is the stochastic trends, which proxy by trace value.

$$trace = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \qquad (8)$$

$\hat{\lambda}_i$'s are the $n - r$ smallest squared canonical correlation of Y_{t-1} with respect to ΔY_t corrected for lagged differences and T is the sample size actually used for estimation.

First of all, we determine the deviations from the long-term equilibrium of lag-length of the ECM using Akaike Information Criterion (AIC). This suggests the inclusion of one lag (k = 1) into the model. Surprisingly, this AIC lag is not only for the relationship between the energy commodities and integration into world stock market, but also for the integration into EAFE, US, and UK stock markets.

To illustrate the described threshold model of the relationship between energy commodities and market integration, we show the ECM results. Again, for the robustness purpose, three other major and developed stock markets (EAFE, US, and UK) are investigated in terms of market integration. Therefore, by examining the integration between Middle East stock markets and the world plus EAFE, US, and UK stock markets, we can deliver more comprehensive results.

Table 6 demonstrates several interesting results. First, in terms of coal prices, ECM in long-run relationship shows that the linkages are significant at the 1% level, which means that if the price of coal climbs, the Middle East stock price will integrate into the world, EAFE, US, and UK stock markets. In other words, if there is an increase in the price of coal, global fund managers cannot add the Middle East stock market as part of portfolio because of the absence of portfolio benefits. Moreover, if the price of coal is increasing, the financial stability of Middle East stock markets and the entire developed stock market will be similar.

Table 6. Long-run Relationship between Coal and Market Integration.

$MI_{world} = 0.002262 + \underset{[-2.07155]}{0.001336^{***}\, Ln\, Coal}$	$MI_{EAFE} = 0.002203 + \underset{[-1.77998]}{0.001341^{***}\, Ln\, Coal}$
$MI_{US} = 0.002203 + \underset{[-2.36557]}{0.001351^{***}\, Ln\, Coal}$	$MI_{UK} = 0.002864 + \underset{[-2.97417]}{0.001751^{***}\, Ln\, Coal}$

Note: *** Means it significant in 1%

The relationship between natural gas prices and market integration (Table 7) is the next interesting finding. ECM shows the long-run relationship between natural gas and market integration. Therefore, natural gas has long-run comovement with the integration of Middle East stock markets into world, EAFE, US, and UK stock markets. In other words, we conclude that natural gas can be used by global fund managers as the signal of diminishing portfolio benefits. Even though frontier markets, such as Jordan, Lebanon, Kuwait, and Oman, have the lowest correlation to developed market, natural gas price hikes can give financial contagion to the global portfolio. It will reduce the gain in portfolio-ing Middle East stock markets. Therefore, we can finally state that adding Middle East frontier stock markets into global portfolio during natural gas price hikes will give no benefit at all.

Table 7. ECM of the Relationship between Natural Gas and Market Integration.

$MI_{world} = 0.001810 + 0.001317^{***}\ Ln\ Gas$ [−2.61610]	$MI_{EAFE} = 0.002019 + 0.001505^{***}\ Ln\ Gas$ [−2.66672]
$MI_{US} = 0.000911 + 0.000718^{***}\ Ln\ Gas$ [−1.55034]	$MI_{UK} = 0.001514 + 0.001199^{***}\ Ln\ Gas$ [−2.29462]

Note: *** Means it significant in 1%

Lastly, we investigate the role of oil price in market integration under ECM. It is important to note that oil is an essential energy commodity not only for the Middle East but also for the rest of the world.

Table 8 shows that there is long-run linkage between oil price and market integration. In other words, it surmises that there is comovement between oil price and the integration of Middle East frontier stock markets into the world, EAFE, US, and UK stock markets. It indicates that oil price has important role in integrating Jordan, Kuwait, Lebanon, and Oman into the developed market, diminishing the global portfolio benefits, and implying financial contagion. If there is a positive movement of oil price, it indicates the Middle East frontier markets will have more integration into developed market. If there is financial contagion caused by oil price movement, it will also spread from the Middle East into the world.

Table 8. ECM of the Relationship between Oil Price and Market Integration.

$MI_{world} = 0.001382 + 0.000896^{***}\ Ln\ Oil$ [−1.47717]	$MI_{EAFE} = 0.001422 + 0.000956^{***}\ Ln\ Oil$ [−1.39859]
$MI_{US} = 0.001248 + 0.000855^{***}\ Ln\ Oil$ [−1.67656]	$MI_{UK} = 0.001879 + 0.001230^{***}\ Ln\ Oil$ [−2.34677]

Notes: *** Means it significant in 1%

4.4 Granger Causalities Results

To further examine the relationship between energy commodities changes and market integration, we proceed with testing the Granger causalities (Table 9). As a general summary, there are no bidirectional Granger causalities between energy commodities and market integration.

Table 9 presents three important results. First, there is a unidirectional causality between coal price and market integration. Indeed, coal prices Granger-cause the changes in market integration at the 5% level for one autoregressive lag. Second, result shows that there is no dynamic relationship or Granger-cause between gas and market integration. Lastly, Table 9 also shows that there is unidirectional causality between oil price and market integration. Specifically, oil prices Granger-cause changes in market integration at the 10% level for one autoregressive lag.

Taken together, the results of our Granger causality tests corroborate previous findings and suggest significant interaction between energy commodities and market integration, except for natural gas.

These results are interesting at least for two reasons. First, they imply some predictability in coal and oil into the integration of Middle East frontier markets. Second, they shed light on the direction of relationship. We observed that a reverse relationship may exist. If we added it with the findings of Granger causality, it can be surmised that there is a power of forecasting of coal and oil in predicting the Middle East integration into the world. If the commodities' prices decrease, the stock market will be integrated, indicating less portfolio benefits. However, if the commodities' prices increase, the stock market will not be integrated, signaling portfolio benefits.

We observed that the Granger Causality validates the inward relationship. This result infers the power of forecasting of coal and oil in predicting the Middle East integration into the world.

Table 9. Granger Causalities Results.

Granger Causalities Hypotheses	Chi-Square	Probability
The Market integration towards the world does not Granger Cause the Coal Price	2.687794	0.2608
The Coal Price does not Granger Cause the market integration	5.819974	0.0365
The Market integration towards the world does not Granger Cause the Gas Price	1.855608	0.3954
The Gas Price does not Granger Cause the market integration	2.45958	0.2924
The Market integration towards the world does not Granger Cause the Oil Price	1.109887	0.5741
The Oil Price does not Granger Cause the market integration	5.419974	0.0665

4.5 Robustness Check

To check for the robustness of our empirical results, the following changes were made. Given previous literature that market integration can be determined by market size and liquidity, we reestimated our model and reran the regression. Theoretically, many determinants of market integration can be used to control the equation model. Thus, we chose market size and liquidity as these are widely accepted as the determinants of market integration. Finally, our empirical results showed significant relationship.

Coal price has a significant relationship to the market integration of Middle East markets into the world after controlling for size and liquidity. This result confirms the earlier results of this study. The price of natural gas has a significant relationship to market integration after controlling for size and liquidity. Again, it confirms our earlier results showing a significant relationship between price of natural gas and market integration, and its significance at the 10% level.

Lastly, the robustness check also found a relationship between oil prices and market integration. Table 10 shows that the more the oil prices increase, the more the Middle East markets are integrated into the world. This also confirms our earlier findings on the significant relationship between oil prices and market integration.

These robustness check results demonstrate that there is indeed a relationship between energy commodities and market integration. It also confirms the results of the dynamic relationship approach. Using market size and liquidity, we can surmise that energy commodities play an important role in market integration. Therefore, increase in the price of energy commodities could be used as a signal not to diversify into Middle East frontier markets.

Table 10. Regression Results with Control Variable.

	MI_world	
	Coefficient	Probability
LnCoal	0.000183	0.0000
Market_Size	0.814019	0.0000
Trading_liquidity	0.020753	0.0323
LnGas	0.0011	0.0659
Market_Size	0.8254	0.0000
Trading_liquidity	0.0103	0.0888
LnOil	0.0015	0.0609
Market_Size	0.8322	0.0000
Trading_liquidity	0.0053	0.0592

5. CONCLUSION

In this study, we examined the relationship between energy commodities and market integration. We initially conducted an analysis of the dynamic linkages of three important energy commodities (coal, natural gas, and oil) with market integration, specifically integration of Middle East frontier markets into the world market. To increase our results' robustness, we also investigated the role of energy commodities in the integration of Middle East frontier stock markets into EAFE, US, and UK stock markets. Moreover, we tested the relationship between energy commodities and market integration by adding controlling variable in the regression.

This study aims to investigate the role of energy commodities in market integration. Preceding the explanation of results, market integration confers financial stability but diminishes portfolio benefits. Prior studies on energy commodities indicate that energy commodities have an effect on economics, specifically on stock markets. Therefore, this study seeks to investigate thoroughly the role of these energy commodities in financial markets. If coal, natural gas, and oil have effects on diminishing portfolio benefits, it will benefit global fund managers.

We obtained several interesting results. First, we found that there is a long-run relationship between energy commodities and market integration of Middle East frontier stock markets. The Middle East is regarded as a big player in terms of energy commodities. This region is very sensitive to changes in the price of energy commodities (Bilgin, 2009; DeCanio, 2009; Kilian, 2008; Shwadran, 1985; Stork, 1973). Heavily weighted on the energy, some studies found a relationship between energy commodities and stock prices, either at the firm, industry, or market level (Basher & Sadorsky, 2006; Bley & Chen, 2006). Meanwhile, global portfolio theoretically adds the low correlation stock market, like Middle East frontier stock market, to gain the benefit of diversification. However, Darrat et al. (2000) concluded that there is market integration from the Middle East into the world stock market, indicating the elimination of portfolio benefits. Since energy commodities have an influence on stock returns as well as the stock returns in Middle East have integration into the world; it is not surprising that our results show a relationship between energy commodities and the Middle East frontier stock market. Indeed, it confirms the results of previous studies, which cite the important role of energy commodities in the global economy (e.g., Basher & Sadorsky, 2006; Hamilton, 1983; Henriques & Sadorsky, 2008; Nandha & Faff, 2008; Oberndorfer, 2009; Papapetrou, 2001; Sadorsky, 1999, 2001, 2008).

To achieve more comprehensive results, we investigated short-run dynamic linkages using the Granger causality method. Interestingly, the results show that only coal and oil, and not natural gas, Granger-cause market integration in unidirectional relationship. The Granger causality results show that the market integration does not Granger-cause energy commodities. These results give rise to two important issues.

First, in the short run, natural gas does not affect market integration. However, after oil and coal affect market integration, then natural gas follows the movement. This is in line with the study of Ghoshray and Johnson (2010), who surmised that oil prices influence the movement of natural gas prices. Natural gas volatility will follow the volatility of oil prices in the short run.

Second, it implies that natural gas is not the main information for active global investors. If gas related economy has got influenced by certain financial turbulence, thus, investors should not consider the role of natural gas on construction of active investing strategy. Thereof, it is important for future research to investigate the role of natural gas in industry-level market integration in regards of capturing the role of Natural Gas Price in detail.

There are very limited studies that comprehensively discuss the relationship between energy commodities and market integration; however, we surmise that the prices of coal, natural gas, and oil have an important role in financial contagion, especially in portfolio benefits. The price movement of these energy commodities has a significant relationship with the market integration of Middle East frontier markets in the long and short run under one lag daily prices. Therefore, global fund managers and policy makers have to pay attention to this matter to achieve better economic conditions.

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