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THE IMPACT OF WORLD CRUDE OIL PRICES ON THE VIETNAMESE STOCK MARKET

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Abstract: *This paper reports the impact of world crude oil prices on the Vietnamese stock market from March 2006 to June 2015 using the autoregressive-distributed lag (ARDL) model. Results indicate a positive short-term impact, but a negative long-run impact. Furthermore, results indicate that the economic crisis affected the relationship between the crude oil prices and the Vietnamese stock market index only in the short-run.*

Keywords: *ARDL model, stock return, oil prices, Vietnam stock prices*

I. INTRODUCTION

Oil price has a significant and large impact on the world's economy. However, there is a large but inconclusive literature describing the relationship between oil and stock market prices. High oil price volatility has been shown to create unstable economic conditions around the world (Prajitno, 2011). Kaul and Seyhun (1990) and Sadorsky (1999) reported that higher oil price volatility lowers stock market prices. However, Jones and Kaul (1996) indicated that international stock prices were not affected by oil shocks. Narayan and Narayan (2010) estimated the impact of oil prices on Vietnam's stock prices using daily data for the period 2000–2008. The study found that stock prices, oil prices and nominal exchange rates were cointegrated, and that oil prices had a positive impact on stock prices.

When oil price rises, oil-importing countries may experience inflation and economic recession (Ferderer, 1996; Huang et al., 1996). In oil-exporting countries, a decrease in the oil prices may create political and social instability (Yang and Huang, 2002). Vietnam is a crude oil exporter but a refined-oil importer. Vietnam's stock market grew rapidly in the period from 2000-2008, but decreased sharply during the economic crisis of 2008-2012. How did this economic crisis affect the relationship between oil prices and Vietnam stock market prices? To answer this question, this study examines the relationship between the VN-index, the HNX-index, and world crude oil prices from August 2006 to June 2015. The research used the Autoregressive-Distributed Lag (ARDL).

This article is constructed as follows. Section 2 reviews the literature on oil price volatility. Section 3 describes our data. The methodology is described in section 4. Section 5 discusses the results. The final section presents the conclusions.

II. LITERATURE REVIEW

The relationship between crude oil-price changes and stock returns is a controversial issue. Table 1 summarizes previous studies of the correlation of crude oil price and stock markets.

Table 1. The summary of the studies on the relationship of crude oil prices and stock market prices

Region	Correlation	Related previous studies
World	+/-	Jones and Kaul (1996), Sadorsky (1999), Park and Ratti (2008), Killian and Park (2009), Gogineni (2010), Le and Chang (2011), Prajitno (2011), Mohanty et al. (2013), Degiannakis et al. (2013).
	Irrelevance	Sawyer and Nandaha (2006), Apergis and Miller (2009).
Vietnam	+	Narayan and Nayaran (2010), Nguyen and Bhatti (2012), Nguyet and Thao (2013).

Hamilton (1983) concluded that oil price shocks are significant causes of US economic recession. The relationship of oil price shocks and US stock markets is reported by Huang et al. (1996), Sadorsky (1999) and Guo and Kliesen (2005). Papapetrou (2001) reports results in Greece. Park and Ratti (2008) reports results for the US and other 13 European countries. Kaul and Seyhun (1990) and Sadorsky (1999) report a negative impact of oil prices on stock market prices. Huang et al. (1996) supported a causal impact of oil prices on stock prices. Narayan and Narayan (2010) reported a positive long-term impact of oil prices on stock prices. Why these differences in reported results?

There are two channels by which oil prices can affect stock market prices (Narayan & Narayan, 2010). First, oil leads to changes in production costs, affecting earnings and stock dividends. Second, oil prices affect discount rates, which consist of expected inflation rate and real interest rate (Huang et al., 1996). Gogineni (2007) reported a positive effect on stock prices when there is a change in aggregate demand for crude oil, but a negative affect when there is a change in aggregate supply. In net oil importing countries, oil price increases pressures on exchange rates and inflation. Inflationary pressures may cause central banks to raise interest rates.

Narayan and Narayan (2010) examined the impact of crude oil prices and foreign exchange rates on the Vietnamese stock market using daily data from the years 2000 to 2008. Results showed that the stock prices, oil prices, and nominal exchange rates had a positive relationship, and that and oil prices had a positive long term impact on stock prices. However, prior studies have not recorded a significant short-term impact of oil prices on the Vietnamese stock market.

Nguyen and Bhatti (2012) studied the relationship between oil price and stock market in China and Vietnam using the nonparametric methods, Chi-plot and K-plot, plus a parametric approach for copula modeling. The results showed a left tail dependency between world oil prices and the Vietnamese stock market. The Chinese market showed opposite results, indicating a relationship between oil prices and stock prices in Vietnam. Nguyen and Thao (2013) examined the relationship between macroeconomic factors and the Vietnamese stock market. The results showed that there was a positive linear correlation between monetary supply, inflation, world oil price, industrial output and the stock market. However, there was an apparent negative correlation between interest rate, VND/USD foreign exchange rate and Vietnam stock market.

III. DATA COLLECTION

Our study uses daily world crude oil prices, the VN-index and the HNX-index. The data collected and their processing methods are shown in tables 2 and 3.

Table 2. Data description

Variables	Symbol	Data collection and processing methods
World oil price	*POIL*	Monthly average
HNX-index	*HNX*	Monthly average
VN-index	*VNI*	Monthly average
Economic crisis dummy	D_t	D_t=1 in the period of June 2008 to December 2012, D_t=0 in other periods
Interaction variable	D_tLPOIL	The relationship between economic crisis and crude oil prices

Notes: WTI's oil prices were collected on www.intervesting.com. HNX-index and VN-index were collected on www.shbs.com.vn.

Table 3. Descriptive statistics of the sample

Variables	Mean	Maximum	Minimum	Standard Deviation
VNI	543.61	1110.99	261.54	185.17
HNX	135.40	430.72	51.49	84.65
POIL	83.05	133.88	39.09	19.71

Notes: VNI is a monthly average value of the VN-index. HNX is a monthly average value of the HNX-index. POIL is the mean of world oil prices. All observations are in the period of March 2006 to June 2015.

Note that the mean of VN-index is four times that of HNX-index mean, and the standard deviation of the VN-index is roughly double that of the HNX-index. This implies that the VN-index is more liquid than the HNX-index. Note also that the WTI has greatly fluctuated since 2006. During the period mentioned, the WTI average was $83.05/barrel while the lowest price was $39.09/barrel. The standard deviation was $19.71/barrel. There were especially large fluctuations during the 2008 economic crisis.

IV. METHODOLOGY

Our study used the popular ARDL method proposed by Pesaran et al. (1997). It has been shown to be a valuable tool for testing for the presence of long-run relationships between economic time-series. The advantage of the ARDL model is its ability to estimate both the long and short-term model parameters. This avoids the problems posed by non-stationary time series. In addition, this approach does not require a prior determination of the order of the cointegration of the variables. Furthermore, the ARDL procedure is robust to small samples, allowing different optimal lags of variables. We conducted our analysis in the sequence shown in table 4 below.

Table 4. The steps of analysis

1. Performed the Augmented Dickey – Fuller test (ADF).
2. Tested the cointegration using the bounds test;
3. Selected an appropriate ARDL Model. The Akaike Information Criteria (AIC) was used in the determination of lag length.
4. Estimated long-term coefficients in the ARDL Model;
5. Estimated short-term coefficients using the Error Correction Models (ECM) developed from the ARDL Model;
6. Tested the stability and errors of the Model, including Autocorrelation and Heteroskedasticity.

In addition, CUSUM and CUSUMSQ graphics were applied to examine the model's stability. The Pesaran et al., (2001) test was applied to test the cointegration among the variables. That procedure first corrects for error, then estimates the model's parameters and uses the F-statistic to test for cointegration.

The study's model is represented by equations (1) and (2) below:

ARDL 1:

$$LVNI_t = \alpha_0 + \alpha_1 D_t + \sum_{l=1}^{p_0} \alpha_{2,i} LVNI_{t-i} + \sum_{g=0}^{p_1} \alpha_{3,j} LPOIL_{t-j} + \sum_{h=0}^{p_2} \alpha_{4,k} D_t.LPOIL_{t-k} + \varepsilon_{2t} \quad (\mathbf{1})$$

ARDL 2:

$$LHNX_t = \beta_0 + \beta_1 D_t + \sum_{l=1}^{q_0} \beta_{2,l} LHNX_{t-l} + \sum_{g=0}^{q_1} \beta_{3,g} LPOIL_{t-g} + \sum_{h=0}^{q_2} \beta_{4,h} D_t.LPOIL_{t-h} + \varepsilon_{2t} \quad (\mathbf{2})$$

where *LVNI, LHNX, LPOIL* are respectively *logVNI, logHNX, logPOIL*. D_t is an economic crisis's dummy variable equal to 1 in the period of June 2008 to December 2012 and 0 for the other periods. $D_t.LPOIL$ is the interaction variable. p_0, p_1, p_2, q_0, q_1, q_2 represent maximum lag lengths used for *LVNI, LHNX, LPOIL* and D_tLPOIL. *i, j, k, l, g, h* are lag lengths of the variables. α_0, β_0 is the model's intercept. α_1, β_1 is the coefficient of D_t. $\alpha_{2,i}$, $\alpha_{3,j}$, $\alpha_{4,k}$,$\beta_{2,l}$,$\beta_{3,g}$,$\beta_{4,h}$ is coefficients of lagged variables. ε_{1t} and ε_{2t} are random error terms.

The bound test was done as follows.

Equation (3) models the cointegration of *logVNI* and *logPOL*.

$$\Delta LVNI_t = \delta_0 + \delta_1 D_t + \sum_{i=1}^{p_0} \delta_{2,i} \Delta LVNI_{t-i} + \sum_{j=0}^{P_1} \delta_{3,j} \Delta LPOIL_{t-j} + \sum_{k=0}^{p_2} \delta_{4,k} \Delta D_t.LPOIL_{t-k} + \lambda_0 LVNI_{t-1} + \lambda_1 LPOIL_{t-1} + \lambda_2 D_t LPOIL_{t-1} + \varepsilon_{1t} \quad (\mathbf{3})$$

If $\lambda_0 = \lambda_1 = \lambda_2 = 0$, there is no cointegration.

Equation (4) models the the cointegration of *logHNX* and *logPOIL*.

$$\Delta LHNX_t = \varphi_0 + \varphi_1 D_t + \sum_{l=1}^{q_0} \varphi_{2,l} \Delta LHNX_{t-l} + \sum_{j=0}^{q_1} \varphi_{3,j} \Delta LPOIL_{t-j} + \sum_{k=0}^{q_2} \varphi_{4,k} \Delta D_t.LPOIL_{t-k} + \gamma_0 LHNX_{t-1} + \gamma_1 LPOIL_{t-1} + \gamma_2 D_t LPOIL_{t-1} + \varepsilon_{2t} \quad (\mathbf{4})$$

where: $\Delta LVNI_t = LVNI_t - LVNI_{t-1}$; $\Delta LHNX_t = LHNX_t - LHNX_{t-1}$;

$\Delta LPOIL_t = LPOIL_t - LPOIL_{t-1}$; $\Delta D_tLPOIL_t = D_tLPOIL_t - D_tLPOIL_{t-1}$

where: Δ is first-difference operator, $\beta_{0,i}$, $\beta_{1,j}$ are short-term parameters of variables. δ_0, φ_0 are constants. δ_1, δ_2, δ_3, δ_4, φ_1, $\varphi_2 \varphi_3$, φ_4 are short-term multipliers. $\lambda_0, \lambda_1, \lambda_2$, $\gamma_0, \gamma_1, \gamma_2$ are long term multipliers of lagged variables in the model.

Equations (3) and (4) were estimated using the OLS method where optimal lag lengths were chosen for each variable. Next, the calculated F-statistics were compared with critical values to determine if there are cointegrating relationships among variables (Persaran, 2001).

According to Persaran (2001), the critical bounds value is calculated based on the number of regressive variables and the model's critical value. There are both upper and lower bounds. The upper critical bounds value assumes that all variables are cointegrated at level 1 or I(1), while all variables' co-integration is at level 0 or I(0) when calculating the lower bound. If the calculated F-statistic exceeds the upper critical bounds value, then H_0 is rejected with the significance at 1%. In this case, there is cointegration among variables. If the F-statistic falls within the bounds, then the test is inconclusive. If the F-statistic falls below the lower bound, then H_0 is accepted. This implies that there is no cointegration. To examine the cointegration of crude oil prices and the HNX-index, a similar test is done with coefficients $\gamma_0, \gamma_1, \gamma_2$ in equation (4).

V. RESULTS AND DISCUSSION

5.1. Stationary or unit root testing

The ADF root unit test, shown in table 5, indicates that both the VN-index (*LVNI*) and the HNX-index (*LHNX*) are nonstationary in three models. World oil price (*LPOIL*) is stationary in models 2 and 3 the at 1% and 5% significant levels respectively. The difference variables, VN-index ($\Delta LVNI$), HNX-index ($\Delta LHNX$), and world oil prices ($\Delta LPOIL$) are stationary with significance at 1% in the three models.

Table 5. The results of ADF root unit test

Variable	Model 1		Model 2		Model 3	
	Lag length	t- value	Lag length	t- value	Lag length	t- value
LVNI	1	-0.179	1	-2.458	1	-2.406
LHNX	1	-1.844	9	-2.606	9	-3.989
LPOIL	1	-0.230	2	-3.811 ***	2	-3.902 **
$\Delta LVNI$	0	-7.164***	0	-7.128 ***	0	-7.093 ***
$\Delta LHNX$	0	-7.135***	0	-7.105 ***	0	-7.066 ***
$\Delta LPOIL$	0	-6.946***	0	-6.915 ***	0	-6.901 ***

*Note: ***, **, * denote significance at 1%, 5%, and 10% levels, respectively. All variables (LVNI, LHNX, LPOIL) are natural logs. Δ is first difference of variables. Lag lengths are chosen in line with AIC standards. Model 1 is ADF model with no intercept and trend. Model 2 is ADF model with intercept. Model 3 is ADF model with intercept and trend.*

5.2. Cointegration testing

Table 6. The results of Bound test

Model	d.f	F-value	Critical F-value					
			10%		5%		1%	
			I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
3	2	8.881***	2.63	3.35	3.1	3.87	4.13	5
4	2	4.632***	2.63	3.35	3.1	3.87	4.13	5

*Note: ***, ** and * denote at 1%, 5% and 10% significance levels, respectively. I(1) are upper critical bounds values based on assumption that all variables are cointegration at level 1 or I(1). I(0) are lower critical bounds values based on assumption that all variables are cointegration at level 0 or I(0). Model 3 tests the cointegration between variables in ARDL 1 while Model 4 tests the cointegration between variables in ARDL 2.*

The results of the cointegration test shown in Table 6 present F-values greater than the upper critical bounds at the 5% significance level in both models. Therefore, the null hypothesis (H_0) of no integrating links between variables is rejected in both model 3 and 4. This implies that world oil prices have a long-term relationship with VN-index and HNX-index.

5.3. Determination of lag lengths

The lag lengths of the variables in models ARDL 1 and ARDL 2 were determined based on the Akaike Information Criterion (AIC). The findings indicate that the models ARDL (12, 4, 3) are most suitable for ARDL 1. The maximum lag lengths for *LVNI, LPOIL,* D_t*LPOIL* are 12, 4, 3 respectively. Meanwhile, ARDL 2 model has appropriate maximum lag lengths of *LHNX, LPOIL,* D_t*LPOIL* of 10, 4 and 3, respectively. The results of maximum lag length selection and estimation of models ARDL 1 and 2 are shown in table 7.

Table 7. Results of model selection

ARDL 1: ARDL (12, 4, 3) LVNI is a dependent variable			**ARDL 2: ARDL (10, 4, 3) LHNX is a dependent variable**		
Variables	**Coefficient**	**t-value**	**Variables**	**Coefficient**	**t-value**
$LVNI_{t-1}$	1.077***	10.718	$LHNX_{t-1}$	1,188***	12,173
$LVNI_{t-2}$	-0.231	-1.468	$LHNX_{t-2}$	-0,175	-1,086
$LVNI_{t-3}$	-0.144	-0.931	$LHNX_{t-3}$	-0,261	-1,628
$LVNI_{t-4}$	0.230	1.555	$LHNX_{t-4}$	0,210	1,311
$LVNI_{t-5}$	0.008	0.055	$LHNX_{t-5}$	-0,047	-0,294
$LVNI_{t-6}$	-0.278**	-2.002	$LHNX_{t-6}$	-0,094	-0,609
$LVNI_{t-7}$	0.182	1.383	$LHNX_{t-7}$	0,127	0,837
$LVNI_{t-8}$	-0.046	-0.342	$LHNX_{t-8}$	0,006	0,042
$LVNI_{t-9}$	0.229*	1.704	$LHNX_{t-9}$	0,264*	1,859
$LVNI_{t-10}$	-0.313**	-2.292	$LHNX_{t-10}$	-0,291***	-3,390
$LVNI_{t-11}$	0.233*	1.741	*LPOIL*	0.099	0.835
$LVNI_{t-12}$	-0.166**	-1.998	$LPOIL_{t-1}$	-0.270	-1.552
LPOIL	0.072	0.868	$LPOIL_{t-2}$	0.014	0.080
$LPOIL_{t-1}$	-0.243*	-1.957	$LPOIL_{t-3}$	0.363**	2.087
$LPOIL_{t-2}$	0.126	1.024	$LPOIL_{t-4}$	-0.348***	-2.807
$LPOIL_{t-3}$	0.193	1.553	D_tLPOIL	-0.063	-0.905
$LPOIL_{t-4}$	-0.292***	-3.318	D_tLPOIL_{t-1}	0.051***	2.642
D_tLPOIL	0.054	1.089	D_tLPOIL_{t-2}	-0.005	-0.239
D_tLPOIL_{t-1}	0.046***	10.718	D_tLPOIL_{t-3}	-0.026*	-1.720
D_tLPOIL_{t-2}	-0.006	-1.468	D_t	0.166	0.530
D_tLPOIL_{t-3}	-0.020*	-0.931	*Constant*	0.971***	3.216
D_t	-0.392*	1.555			
Constant	2.037***	0.055			
R^2		0.972	R^2		0.982
R^2 adjusted		0.964	R^2 adjusted		0.977
F-value		123.049***	F-value		217.346***

*Note: ***.** and * denote significance at 1%. 5% and 10% levels. respectively. Model ARDL 1 invests the link between crude oil prices and VN-index. Model ARDL 2 examines the relationship between crude oil prices and HNX-index. LVNI. LHNX. LPOIL are respectively VN-index. HNX-index and world oil price variables which are taken natural logarithm.* D_t*LPOIL is an interaction variable.*

5.4. Estimation of long-term coefficients

To estimate long-term coefficients, step 4 (see Table 4) was performed for both ARDL 1 and 2. Table 7 shows the results. The long-term coefficients of LPOIL are less than 0 in both the ARDL models with significance levels at 1% and 5% respectively. This indicates a negative relationship between world oil prices and variables VN-index and HNX-index. This contrasts with former studies that indicated a worldwide long-term positive relationship (Narayan and Nayaran, 2010; Nguyen and Bhatti, 2012). However, our findings agree with most Vietnamese studies. Vietnam imports oil for domestic uses. Thus, an increase in world oil prices results in a rise in Vietnamese domestic oil prices. In long term, when the price of oil increases, production costs increase, and the profits of manufacturing companies decease, negatively affecting the VN-index, and the HNX-index.

Table 8. Results of long-term coefficient estimation

ARDL 1 *(LVNI is dependent variable)*			***ARDL 2*** *(LHNX is dependent variable)*		
Variables	**Coefficient**	**t-value**	**Variables**	**Coefficient**	**t-value**
LPOIL	-0.663***	-3.388	*LPOIL*	-1.951**	-2.316
D_tLPOIL	0.341	1.475	D_tLPOIL	-0.574	-0.593
D_t	-1.793*	-1.744	D_t	2.275	0.532
Constant	9.306***	10.702	*Constant*	13.352**	3.571

*Note: ***, **, * denote significance levels of 1%, 5% and 10%. LVNI, LHNX, LPOIL which respectively stand for VN-index, HNX-index and world oil prices are in natural logarithm. D_t is economic crisis dummy variable. D_tLPOIL is interaction variable of economic crisis and world oil prices.*

The long-term correlation coefficient of economic crisis variable ($D_t = -1.793$) is less than 0 with a significance level of 10% in ARDL 1. However, D_t has no statistical significance in ARDL 2. As a result, the structure of the long-term coefficient in ARDL 1 was different during the economic crisis. Thus, we showed no major impact on the long-term relationship between world crude oil price and the VN-index. During the economic crisis, the VN-index declined more than in the period of no crisis, but there was no change in the HNX-index. The correlation coefficient of the interaction variable (D_tLPOIL) was not significant in either the ARDL 1 or the ARDL 2 models. Therefore, the economic crisis did not affect the long-term relationship between world crude oil prices, the VN-index and the HNX-index.

5.5. Estimation of short-term coefficients

To examine the short-term relationship between world oil prices, the VN-index and the HNX-index, we estimated the short-term coefficients in ARDL 1 and ARDL 2. The results are presented in table 9. The correlation coefficient of the difference variable in the third lag length ($\Delta LPOIL_{t-3}$) is greater than zero with statistical significance at 1% in both models. This implies that the change of world oil prices in the third lag length had a positive relationship with the changes in the VN-index and the HNX-index. In other words, rising world oil prices increased the VN-index and the HNX-index in the following three months. This result is contrary to Narayan and Narayan, (2010), which found no short-term relationship between world oil prices and the VN-index. The price of crude oil took about three months to cause an impact on the VN-Index. This is mainly due to the Vietnamese oil price adjustment mechanism, which is less efficient than the world's.

Our results indicate that crude oil prices can be used to assess world economic health in the short-term. Rising oil prices signifies that the world economy is developing well, and will need more oil products for manufacturing. A growing world economy a positively effects the stock market. In contrast, the decline of crude oil prices is usually associated with a decline of the world economy and the stock markets.

The correlation coefficients of the difference of interaction variables at the first and second lag lengths (ΔD_tLPOIL_{t-1}, ΔD_tLPOIL_{t-2}) are significantly greater than zero in both models ARDL 1 and ARDL 2. This indicates that the structure of the short-term relationship between world crude oil prices and VN-Index changed in the examined period. During the crisis period, the change in crude oil prices quickly and positively impacted the VN-Index and and the HNX-Index. It only took a month to realize the impact, and it lasted for two months. In this period, crude oil prices had large variations. This, combined with the herd mentality in the Vietnamese stock market, sped the process.

Table 9. Results of short-term coefficient estimation

ARDL 1 (ΔLVNI is dependent variable)			**ARDL 2** (ΔLHNX is dependent variable)		
Variables	**Coefficient**	**t-value**	**Variables**	**Coefficient**	**t-value**
$\Delta LVNI_{t-1}$	0.301***	3.358	$\Delta LHNX_{t-1}$	0.272***	2.896
$\Delta LVNI_{t-2}$	0.053	0.555	$\Delta LHNX_{t-2}$	0.070	0.719
$\Delta LVNI_{t-3}$	-0.074	-0.836	$\Delta LHNX_{t-3}$	-0.167*	-1.738
$\Delta LVNI_{t-4}$	0.150*	1.759	$\Delta LHNX_{t-4}$	0.037	0.395
$\Delta LVNI_{t-5}$	0.151*	1.716	$\Delta LHNX_{t-5}$	-0.015	-0.169
$\Delta LVNI_{t-6}$	-0.124	-1.553	$\Delta LHNX_{t-6}$	-0.111	-1.207
$\Delta LVNI_{t-7}$	0.066	0.829	$\Delta LHNX_{t-7}$	0.031	0.332
$\Delta LVNI_{t-8}$	0.012	0.152	$\Delta LHNX_{t-8}$	0.018	0.215
$\Delta LVNI_{t-9}$	0.242***	3.026	$\Delta LHNX_{t-9}$	0.283***	3.538
$\Delta LVNI_{t-10}$	-0.070	-0.841	$\Delta LPOIL$	0.013	0.086
$\Delta LVNI_{t-11}$	0.157*	1.984	$\Delta LPOIL_{t-1}$	-0.038	-0.349
$\Delta LPOIL$	0.029	0.272	$\Delta LPOIL_{t-2}$	-0.016	-0.142
$\Delta LPOIL_{t-1}$	-0.029	-0.378	$\Delta LPOIL_{t-3}$	0.343***	2.992
$\Delta LPOIL_{t-2}$	0.097	1.241	$\Delta D_t LPOIL$	0.072	0.398
$\Delta LPOIL_{t-3}$	0.286***	3.552	$\Delta D_t LPOIL_{t-1}$	0.029**	2.132
$\Delta D_t LPOIL$	0.124	0.999	$\Delta D_t LPOIL_{t-2}$	0.025*	1.792
$\Delta D_t LPOIL_{t-1}$	0.025***	2.728	ΔD_t	-0.467	-0.553
$\Delta D_t LPOIL_{t-2}$	0.019**	2.072	$ECM2_{t-1}$	-0.070***	-4.333
ΔD_t	-0.720	-1.238			
$ECM1_{t-1}$	-0.210***	-5.997			
$ECM1 = LVNI -(-0.6627LPOIL + 0.3414D_t LPOIL -1.793D_t + 9.306)$					
ECM2 = LVNI $-(-0.574LPOIL -1.951D_tLPOIL + 2.275Dt + 13.352)$					

*Note: ***, ** and * denote significance levels of 1%, 5% and 10%. LVNI, LHNX, LPOIL, which respectively stand for VN-index, HNX-index and world oil prices are in natural logs. D_t is economic crisis dummy variable. D_tLPOIL is interaction variable of economic crisis and world oil prices. ECM1 and ECM2 are adjusted error variables. Δ is first difference.*

The correlation coefficient of the crisis dummy variable (ΔD_t) was not statistically significant. Therefore, the change in these indices was the same during the crisis period as it was during the other periods.

5.6. Autocorrelation and heteroskedasticity tests

The Breusch-Godfrey serial correlation LM test was used to check the presence of Autocorrelations. The Breusch-Pagan-Godfrey method was used to test for heteroskedasticity. The results in Table 10 indicate that the autocorrelation and heteroskedasticity hypotheses can be rejected at 5% level because all values of F-critical are larger than the F-statistics in both models.

Figures 1 and 2 illustrate the results of CUSUM and CUSUMSQ tests of ARDL 1 and 2. Thus, we conclude , that the models are stable over time, and could be used in analysis and forecasting.

Table 10. Results of Autocorrelation and Heteroskedasticity Tests

Test	**ARDL 1**			**ARDL 2**		
	d.f	**F-critical**	**F-statistic**	**d.f**	**F-critical**	**F-statistic**
Autocorrelation	(1,76)	3.966	0.163	(1,80)	3.960	1.741
Heteroskedasticity	(22,77)	3.426	0.989	(20,81)	1.702	1.248

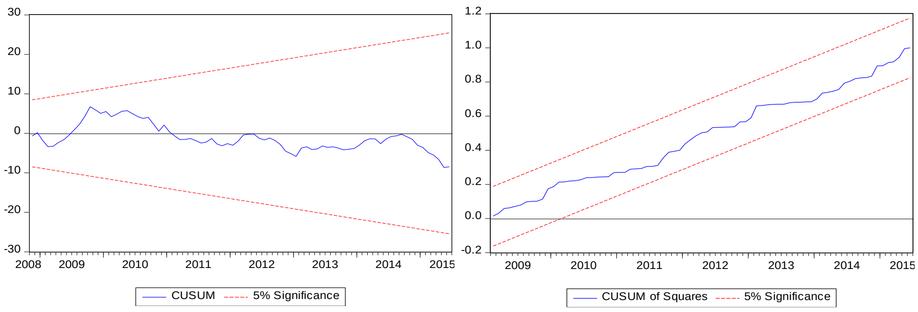

Figure 1. Results of CUSUM and CUSUMSQ of ARDL 1

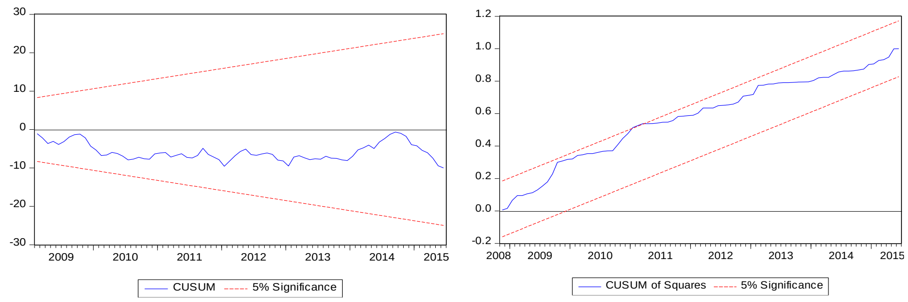

Figure 2. Results of CUSUM and CUSUMSQ of ARDL 2

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VI. CONCLUSIONS

Using monthly average data from March 2006 to June 2015, the paper presented results of the Autoregressive-Distributed Lag (ARDL) method (Persaran et al., 1997, 2001) to examine the impact of world crude oil prices on Vietnamese stock market indices. The results showed that world crude oil prices and the Vietnam stock market had a long-term relationship. The result is similar those of Narayan & Narayan (2010), Nguyen & Bhati (2012), and Nguyet & Thao (2013). However, when comparing the long-term and short-term impacts, our results differ from those of the previous studies. Our results indicated a short term, positive impact of crude oil prices on the Vietnamese stock market, whereas Narayan and Narayan (2010) did not detect this. In the long term, our results reported a negative impact of crude oil prices on the Vietnam stock market, while Narayan and Narayan (2010) reported a positive relationship. These differences may be explained by the differences in the time of the study and changes in policies governing the Vietnamese oil and stock markets. In addition, we studied how the economic crisis affected the relationship between crude oil and stock market prices. The economic crisis sped up the impact of crude oil prices on the stock market.

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