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Oil Price Volatility, Macroeconomic and Islamic Banking Investments: Evidence in Indonesia

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Oil price volatility refers to fluctuations in oil prices over time due to changes in supply, demand, geopolitical events, market speculation, and other factors. High volatility can have widespread economic implications, particularly for oil-dependent economies and industries. The unpredictable volatility of world crude oil prices has caused the world economy to be in uncertainty and disrupt economic stability. The drastic and rapid movement of world crude oil prices will also affect the macroeconomy and microeconomy in each country. The objectives of the study are: Understand the effect of world crude oil prices, FDI and GDP on Islamic banking investment in Indonesia. The results show that the world crude oil price of Brent oil significantly affects the growth of Islamic Investment Bank in Indonesia. The negative coefficient indicates that an increase in the world price of crude oil brent oil can reduce the growth rate of Islamic Investment Bank in Indonesia.

Keywords: Oil Price Volatility; Macroeconomic; Islamic Banking; VECM

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INTRODUCTION

Oil is one of the main natural resource commodities needed by every country as a raw material to support the movement of the industrial sector, but unfortunately not all countries have reserves of oil natural resources. So to meet these needs, some countries import it from other countries that have excess oil reserves such as Saudi Arabia, Kuwait, Qatar and others. These oil exporting countries form an organization called the Organization of Petroleum Exporting Countries (OPEC).

Indonesia was a member of OPEC from 1962-2003, at which time Indonesia could produce up to 1,685 thousand barrels per day in 1977 with an average production of around 1,317 thousand barrels per day. However, since 2004, Indonesia's oil production has not been able to meet the needs of domestic consumption so that the shortage is met by imports. The average shortage difference from 2004-2017 reached 474 thousand barrels per day with the highest difference occurring in 2014 which reached 828 thousand barrels per day. The following graph details Indonesia's oil production and consumption from 1965-2017:

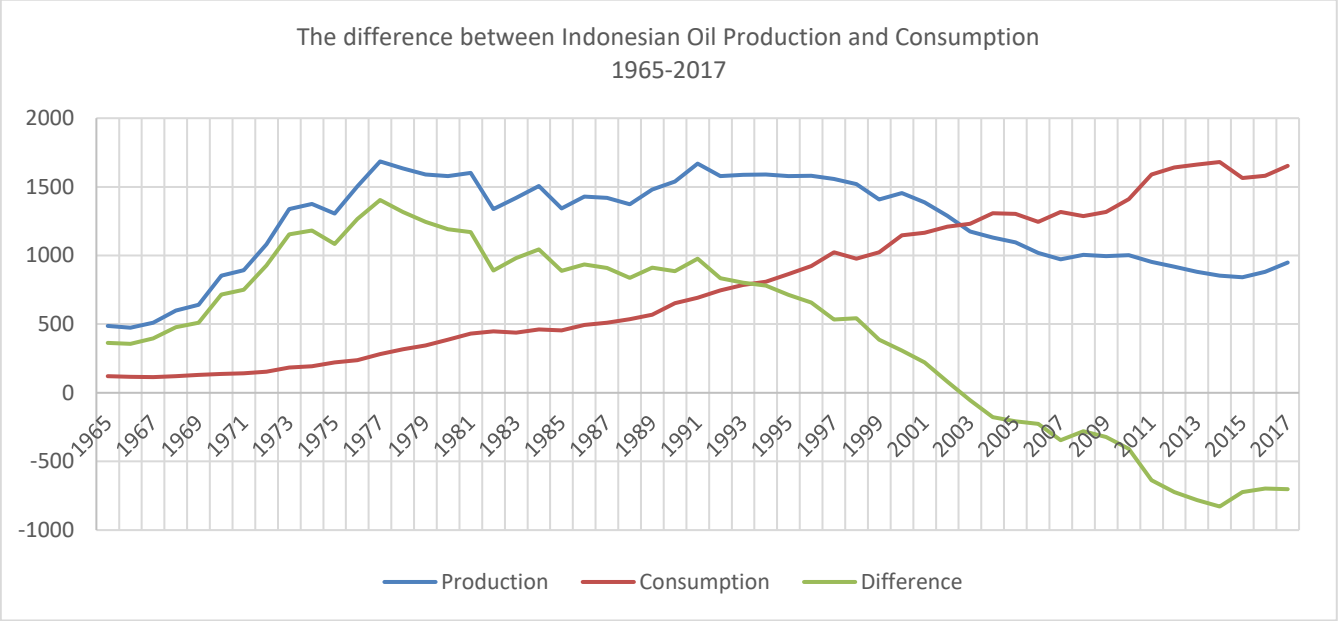

Figure 1. Indonesian Oil Production and Consumption (1965-2017)
Source: BP World Statistic data, processed

The unpredictable volatility of world crude oil prices has caused the world economy to be in uncertainty and disrupt economic stability. In 1987 the price of brent crude oil was quite stable until 2006, but since 2007 the price of brent cride oil has increased to reach $132 per barrel and this increase did not last long because in 2009 the price of brent crude oil experienced a sharp decline which reached $39.95 per barrel. Then in 2011 the price of brent crude oil increased again to $125 per barrel and decreased again in 2015 to reach $30 per barrel. Likewise, the price of West Texas Intermediate (WTI) crude oil fluctuated, the price increase occurred in the 3rd semester of 2008 which reached $133 per barrel but in the 4th semester of 2008 the price of WTI crude oil decreased dramatically to reach $41 per barrel. The following are details of data on the movement of world crude oil prices for Brent crude oil and WTI crude oil.

Drastic and rapid movements in world crude oil prices will affect the macroeconomy and microeconomy in each country. In macroeconomics, Jones at el (2004) in his research stated that fluctuating world crude oil prices can affect GDP and Balcilar et al (2018) also stated that world crude oil prices can affect inflation in a country. In microeconomics, world crude oil prices affect the banking sector, Zaccheaus (2018) examined the relationship between oil price fluctuations and banking profitability in Nigeria. The conclusion of the study states that oil price shocks have a positive and significant effect on banking profitability in Nigeria which is directly related via direct transmission mechanisms.

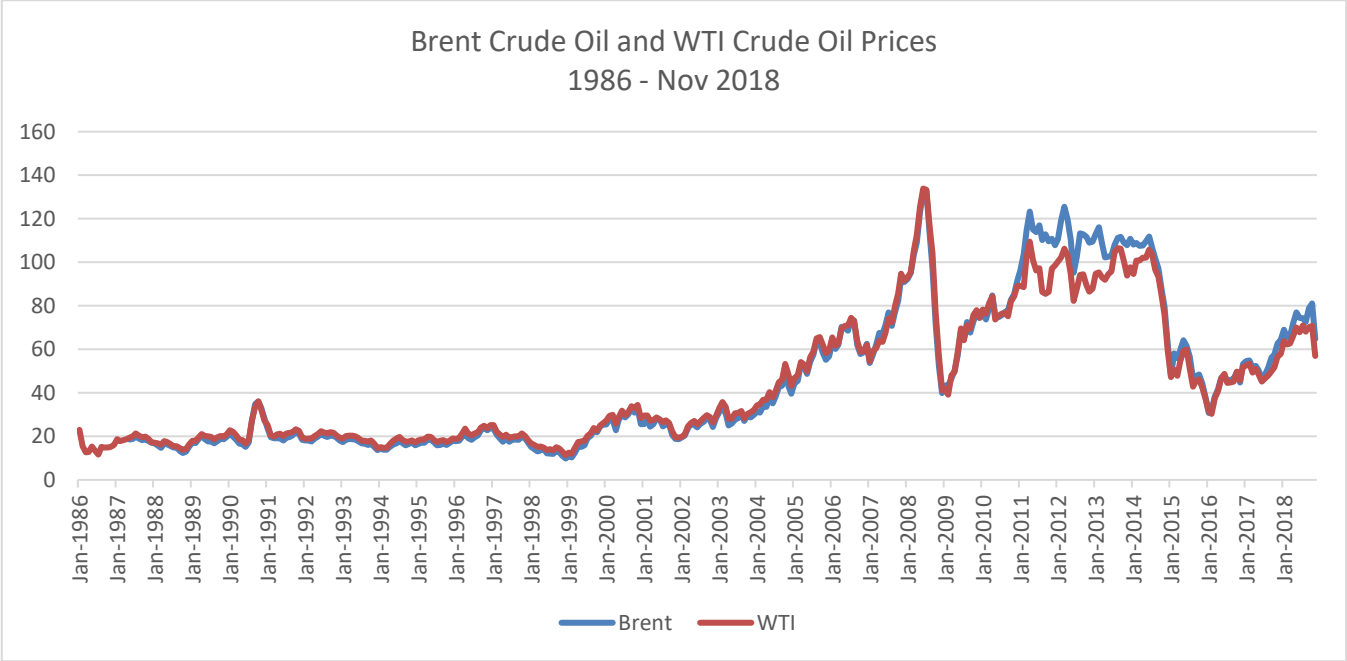

Figure 2. Brent Crude Oil and WTI Crude Oil Price (1986-2018)
Source: U.S. Energy Administration Information, processed

On the other hand, the volatility of world crude oil prices also affects Islamic banking investment growth in the United Arab Emirates (UAE), this is evident from Tabash and Khan's research (2018) which concluded that changes in world crude oil prices in the long term and short term affect Islamic banking investment. Nurfalah, et al (2018) examined the leading indicators of crises in dual financial systems in Indonesia which resulted in the conclusion that the Islamic financial system is more resistant to crisis attacks, meaning that this study shows that the extreme changes in the world economy can still be passed by the Islamic financial system. In addition, Tabash (2018), Tabash and Anagreh (2017) and Yahya, et al (2017) in their research also stated that Islamic banks in the UAE are stable under different shocks and crises. This is what makes Islamic banks calculated to bring Foreign Direct Investment (FDI) and increase gross fixed capital formation into the UAE economy. (Furqani and Mulyani, 2009; Majid and Kassim, 2010; Tabash and Dhankar, 2014).

Based on these findings which state that the Islamic financial system in Islamic banks are stable even more stable than the conventional system will bring FDI which will increase GDP. The author is interested in examining the effect of world crude oil prices, FDI and GDP on Islamic banking investment in Indonesia. The objectives of the study are:

- Understand the effect of world crude oil prices, FDI and GDP on Islamic banking investment in Indonesia.
- Testing the relationship between long-run and short-run effects between research variables

METHODOLOGY

Data Collection

This research data is a monthly time series data taken from several sources over the period 2003-2018. the variables used are world crude oil prices using the price of brent crude oil (BCO), Foreign Direct Investment (FDI), Gross Domestic Product (GDP) and Islamic Banking Investment (IBI). BCO data is collected from the U.S. Energy Information Administration, petroleum and other liquid data section. FDI and GDP data are collected from World Databank, World Development Indicators interpolated. Meanwhile, IBI data is obtained from Islamic banking statistical data, Financial Services Authority (OJK). This study uses the Vector Autoregression (VAR)/Vector Error Correction Model (VECM) analysis method with eViews 9 software.

The steps of testing the VAR/VECM method are data stationarity, VAR model stability test, optimum lag test, cointegration relationship test, causality test (granger causality), VAR/VECM analysis and IRF/FEDV analysis. (Ascarya, 2012; Rusydiana, 2009).

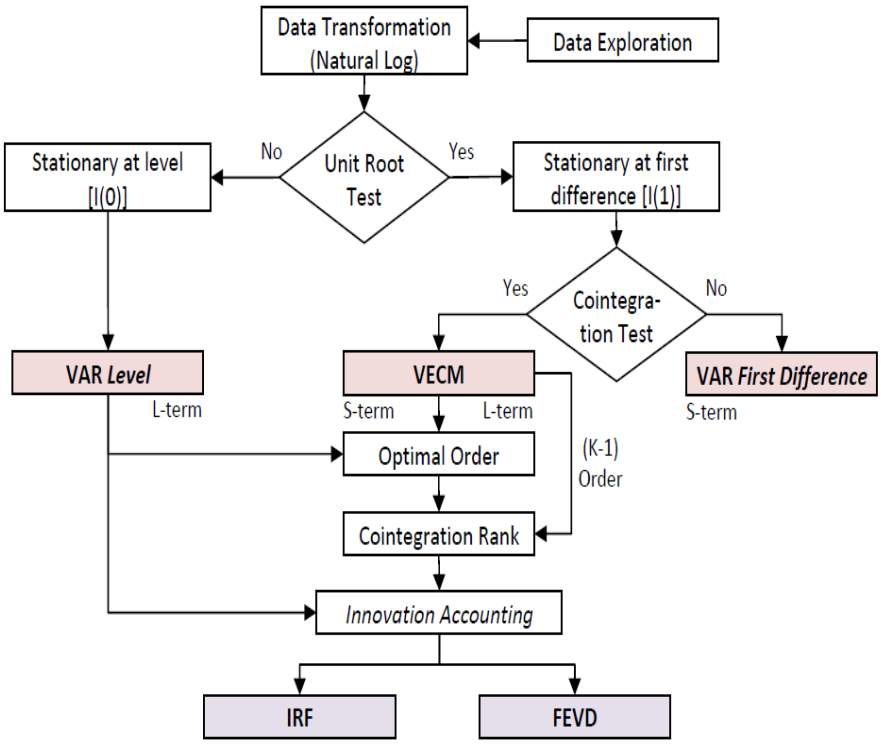

Figure 3. VAR-VECM Stages

Source: Ascarya (2012)

The study model

$$IBI_{it} = \beta_0 + \beta_1 BCO_t + \beta FDI_{2\,t} + \beta_3 GDP_t + \acute{\varepsilon}_t$$

Where,

IBI_{it} : the dependent variable which represents the proxy of Islamic banking investment in the Indonesian economy.

β : Constant,

BCO_t : independent variable which presents the brent crude oil price volatility.

FDI_t : independent variable which presents the FDI inflow in Indonesia.

GDP_t : independent variable which presents the GDP flow growth in Indonesia.

$\acute{\varepsilon}_t$: Error term.

RESULTS AND DISCUSSION

Descriptive Analysis

There are four variables in this study, namely IBI, BCO, FDI and GDP which are processed based on the research period Jan 2003 - Nov 2018, around 191 observation data. IBI as a dependent variable that describes the total Islamic investment managed by Islamic banking in the research period. The value of investment managed by Islamic banking every month has increased with a maximum value of Rp. 62,197 million in November 2018 and a minimum value of Rp. 1,081 million in August 2003 and the average value of IBI in this period is Rp. 21,698 million and a median value of Rp. 12,446 million.

BCO as an independent variable that describes the level of volatility in world crude oil prices (brent oil), this variable is used because the level of price volatility fluctuates sharply and cannot be predicted so that it can affect the growth of Islamic banking investment. In the research period, the highest value of brent oil price was $132.72 per barrel in July 2008 and the lowest value of brent oil price was $25 per barrel in April 2003. The average value of the price of brent oil was $71.87 per barrel and the median value was $67.49 per barrel.

Another independent variable is FDI as a macroeconomic variable that indicates the presence of foreign investment funds entering Indonesia. The minimum value of FDI is Rp. 145 million and the maximum value is Rp. 32,198 million, the average value of FDI is Rp. 10,563 million and the median value is Rp. 7,960 million. Then the GDP variable is used as Indonesia's economic growth rate in 2003-Nov 2018, where the largest GDP value is in Nov 2018 with a total of Rp. 903,486 million and the lowest value is in July 2009 with a total of Rp. 101,447 million. Meanwhile, the average value of GDP is Rp. 529,670 million and the median value is Rp. 563,154 million. The following table details the values of the research variables:

Table 1. Descriptive Statistics

Statictics	*IBI (Rp. Million)*	*FDI (Rp. Million)*	*GDP (Rp. Million)*	*OIL (US$)*
Mean	21.698	10.563	529.670	71,87
Median	12.446	7.960	563.154	67,49
Max	62.197	32.198	903.486	132,72
Min	1.081	145	101.447	25
Obs	191	191	191	191

Source: Data processed

Stationary test

The data stationarity test or more widely known as the unit *root* test (Gujarati, 2009) can be done in several ways, namely: a) Augmented Dickey-Fuller test and b) *Phillip-Perron Unit Root Test* (Dick*e*y and Fuller, 1981; Philips, 1987; Gujarati, 2009) to determine the test results is to see the significance of the *Q-statistics* value through the probability value (*p-value*). If the p-value is smaller (*p-value <a=5%*) than the critical value or five percent real level (α=5%) or ten percent real level (α=10%), then the autocorrelation is significant so that the data series tested is stationary. Conversely, if the probability value (p-value) is greater than the critical value or the real level of five percent (α=5%) or ten percent (α=10%) then the data series tested is non-stationary.

The ADF test t-statistic value at the level level for the IBI variable is 2.4091 with a probability value of 1.0000 and the t-statistic value at the first difference level is -11.9102 with a probability value of 0.0000. Meanwhile, the PP test, the t-statistic value of IBI at the level level is 1.2646 with a probability value of 0.9985 and the t-statistic value of IBI at the first difference level is -27.8434 with a probability value of 0.0000. The unit root test results for the IBI variable show that this variable is significant at the first difference level for the ADF test and PP test. Furthermore, the BCO variable unit root test, the t-statistic value at the level level for the ADF test and PP test is -2.0951 with a probability value of 0.247 and -5.6206 with a probability value of 0.0000, respectively. Then the t-statistic value at the first difference level for both tests is -10.6724 and -33.6855 with a probability value of 0.0000 and 0.0001. The stationarity value of the PP test of the BCO variable at the level level shows the level of significance while the ADF test shows that the BCO variable is significant at the first difference level.

The next variable studied is FDI, the t-statistic value of FDI with the ADF test and PP test shows the same results, where this variable is significant at the first difference level with a value of -11.6672 (0.0000) and -11.9107 (0.0000) and at the level level of -1.8778 (0.3422) and -2.2397 (0.1931). The last variable is GDP which has a t-statistic value at the level of -1.8789 (0.3417) for the ADF test and -7.3223 (0.000) for the PP test, the t-statistic value at the first difference level is -13.5489 (0.0000) and -67.3949 (0.0000). The PP test results show that the GDP variable is significant at the level and first difference level while in the ADF test the GDP variable is only significant at the first difference level. Overall the unit root test results, all variables will use stationary data at the first difference significance level.

Table 2. Unit Root Test

Variable with intercept	**ADF Test**		**PP Test**	
	Level	First Diff	Level	First Diff
IBI	2,4091	-11,9102	1,2646	-27,8434
	1,0000	0,0000	0,9985	0,0000
BCO	-2,0951	-10,6724	-5,6206	-33,6855
	0,247	0,0000	0,0000	0,0001
FDI	-1,8778	-11,6672	-2,2397	-11,9107
	0,3422	0,0000	0,1931	0,0000
GDP	-1,8789	-13,5489	-7,3223	-67,3949
	0,3417	0,0000	0,0000	0,0000

VAR Stability Test

The VAR Stability Test needs to be done first before conducting further analysis because if the VAR estimation results that will be combined with the error correction model are unstable, the *Impulse Response Function* and *Variance Decomposition* will be invalid. In testing the stability of the VAR, it is necessary to check the VAR *stability* condition in the form of *roots of characteristic polynomial*. A VAR system is considered stable if all of *its roots* have a modulus smaller than one (modulus value < 1) (Ascarya: 2012). However, if the VAR model is unstable, then the IRF analysis results are invalid. Based on the VAR stability test results in the following table shows that the stability of the research model is under the modulus range between 0.272267 - 0.991414 with a maximum of lag 1.

Optimum lag test

The optimum *lag* test is carried out with the aim of eliminating autocorrelation problems in the VAR system. So that with the use of *lag* optimum, it is expected that autocorrelation problems will no longer arise. Determination of the optimum lag is determined based on several information such as the *Likelihood Ratio* (LR), *Final Prediction Error* (FPE), *Akaike Information Criterion* (AIC), *Schwartz Criterion* (SC) or *Hanna-Quin Criterion* (HQ) criteria (Arsana, 2004). The following are the results of the optimum lag test in tabular form:

Table 3. Optimum Lag Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-15171.96	NA	3.70e+79	1.945.635	1.946.417	1.945.953
1	-14629.20	1.050.723	4.32e+76	1.878.102	188.2013*	1.879.691
2	-14591.17	7.166.214	3.26e+76	1.875.279	1.882.317	187.8137*
3	-14578.95	2.241.689	3.42e+76	1.875.762	1.885.929	1.879.891
4	-14558.08	37.18545*	3.22e+76*	187.5138*	1.888.433	1.880.538

Based on the optimum lag test results in the table above, it can be seen that the model of the *optimum* lag test results of the research model with lag 4, there are 5 *optimum lag* information, namely LR, FRE, AIC, SC and HQ. The maximum lag for LR is at lag 4, the maximum lag for AIC is at lag 4, the maximum lag for FPE is at lag 4, the maximum lag for SC is at lag 1 and the maximum lag for HQ is at lag 2. This study will take the optimum lag of HQ which is lag 2.

Cointegration Test

Cointegration test is one of the methods used to determine whether there is a long-term relationship and equilibrium between variables in data that are stationary at the *first diffence* level or not stationary at the level level. Cointegrated variables indicate that the variables have a long-term relationship over the equilibrium relationship between them (Gujarati, 2009). Determination of the amount of cointegration relationship between variables can be known according to the *trace* method which can be seen from the *trace statistic* value. The *trace statistic* value that exceeds its critical value indicates that there is cointegration in the model used. The results of the cointegration test between variables can be seen as follows:

Table 4. Cointegration test

Hypothesized		Trace	0.05	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.**
None*	0.156002	5.839.012	4.785.613	0.0038
At most 1*	0.122880	3.091.406	2.979.707	0.0371
At most 2	0.057786	9.673.930	1.549.471	0.3067
At most 3	0.000193	0.031227	3.841.466	0.8597

The table shows that there is cointegration between variables, this can be seen from two significant probability values smaller than the real level of 5%, namely 0.0038 and 0.0371. The conclusion from the cointegration test results of the research model is that this model has a long-term relationship and can be studied using the VECM method.

Causality Test

Causality test is a test used to measure the level of relationship between two or more variables and shows the direction of the relationship between the independent variable and the dependent variable. In addition, the causality test is a test that questions the cause and effect of movement between variables. The advantage of this causality test is that it can see the direction of the relationship between the two variables that are thought to be interconnected. Causality testing uses the Granger causality test with decision-making criteria, namely comparing the probability value obtained from the test results with the specified significance level (5%). If the probability value is greater than 5% then H_0 is accepted and H_1 is rejected and vice versa if the probability value is less than 5% then H_0 is rejected and H_1 is accepted. The following are the results of the research model causality test:

Table 5. Granger Causality Test

Null Hypothesis:	F-Statistic	Prob.
D(BCO) does not Granger Cause D(IBI)	0.81482	0.4446
D(IBI) does not Granger Cause D(BCO)	**151.561**	**1.E-06**
D(FDI) does not Granger Cause D(IBI)	0.01915	0.9810
D(IBI) does not Granger Cause D(FDI)	0.00586	0.9942
D(GDP) does not Granger Cause D(IBI)	0.38090	0.6838
D(IBI) does not Granger Cause D(GDP)	**659.231**	**0.0017**

The table shows the results of the causality test of the research model, in the first row the probability value is greater than the real level of 5%, namely 0.4446, meaning that H_0 is accepted and H_1 is rejected or in other words the price of crude oil brent oil does not granger causes the growth of Islamic Investment Bank in Indonesia. Conversely, in the second row, the probability value is smaller than the real level of 5%, namely 0.000006, so H_0 is rejected and H_1 is accepted or it can be concluded that Islamic Investment Bank in Indonesia granger causes the price of crude oil brent oil. Furthermore, for the relationship between IBI and FDI, where the causality test results show that in row 3 and row 4 the probability value is greater than the real level of 5%, H_0 is accepted and H_1 is rejected, meaning that IBI and FDI do not have granger causality between them. Meanwhile, in row 5 the probability value is greater than the real level of 0.6838 which means that H_0 is accepted and H_1 is rejected, meaning that GDP does not granger cause Islamic Investment Bank in Indonesia. But in row 6 the probability value is smaller than the real level of 5% which means that H_0 is rejected and H_1 is accepted, meaning that Islamic Investment Bank in Indonesia has granger causes to Indonesia's GDP. The results of the causality test of this study are the same as previous studies studied by Tabash and Khan, 2018; Tabash and Dhakar, 2016.

VECM Analysis

A variable is declared significant in influencing other variables if the *t-statistic* value of the variable is greater than the t-table (191) at the 5% real level (α = 5%), namely 1.96 (*t-statistic* > 1.96) and -1.96 (*t-statistic* <-1.96). Table 6 shows the results of the VECM test for the short term and long term, in the short term the data processing results on the first lag and the second lag have a t-statistic value that is in the range of t-table (191), namely 1.96 / 1.96. The world crude oil price of brent oil significantly affects the growth of Islamic Investment Bank in Indonesia with a coefficient of -0.0382 on lag 1 and -0.0421 on lag 2. The negative coefficient indicates that an increase in the world crude oil price of brent oil can reduce the growth rate of Islamic Investment Bank in Indonesia.

FDI affects IBI can be seen in the short term significant t-statistic value at the real level of 5% which is -0.2003 for lag 1 and -0.1405 for lag 2 with a negative coefficient meaning that an increase in FDI will reduce the growth rate of Islamic Investment banks by -0.0156 in lag 1 and -0.0108 in lag 2. Likewise with GDP which in the short term has an influence on Islamic Investment Bank with a significant t-statistic value of 0.2969 on lag 1 and 0.2600 on lag 2. The GDP coefficient shows a positive value meaning that an increase in GDP will affect the increase in Islamic Investment Bank Indonesia in the first month and the second month.

Table 6. VECM Analysis

Long Term		
Variables	**Coefficient**	**T-Statistics**
BCO	**2,5306**	**[0,7874]**
FDI	**-1,0772**	**[-0,9261]**
GDP	19,2185	[13,9848]
Short Term		
Variables	**Coefficient**	**T-Statistics**
CoeintEq1	-0,0031	[-0.3400]
D(IBI(-1),2)	-0,8934	[-13,1364]
D(IBI(-2),2)	-0,4326	[-6,3726]
D(BCO(-1),2)	**-0,0382**	**[-0,1483]**
D(BCO(-2),2)	**-0,0421**	**[-0,1642]**
D(FDI(-1),2)	**-0,0156**	**[-0,2003]**
D(FDI(-2),2)	**-0,0108**	**[-0,1405]**
D(GDP(-1),2)	**0,0373**	**[0,2969]**
D(GDP(-2),2)	**0,0213**	**[0,2600]**

Note: bold is significant at 5% real level

In the long run, the significant variables on Islamic investment bank are BCO and FDI, while GDP is not significant. In other words, BCO and FDI have an influence on IBI but GDP has no influence at all on IBI. The t-statistic value for the BCO variable is 0.7874 and the t-statistic value for FDI is -0.9261 which is significant at the 5% real level with coefficients of 2.5306 and -1.0772 respectively. The long-term BCO coefficient shows a positive value, meaning that an increase in the world crude oil price of brent oil will increase the growth of Islamic investment banks in Indonesia, while the long-term FDI coefficient has a negative value, meaning that an increase in the flow of funds into Indonesia will reduce the growth of Islamic Investment Banks in Indonesia. Overall, these three variables have an influence on Islamic Investment Bank in Indonesia.

Impulse Respond Function (IRF) Analysis

Impulse Response Function (IRF) analysis is a *vector moving average* application method used to determine the current and future response of an endogenous variable to certain variable shocks. (Ascarya, 2009). *Impulse Response Function* is also used to see the current or future response of each variable due to changes or *shocks* from certain variables. The IRF results of the research model are as follows. In the following figure, the response of BCO to IBI shows the effect of BCO variable shocks on IBI. Shocks to BCO are responded negatively by IBI and begin to stabilize in the 25th period. The variable price of world crude oil brent oil will greatly affect the growth of Islamic Investment in Indonesia.

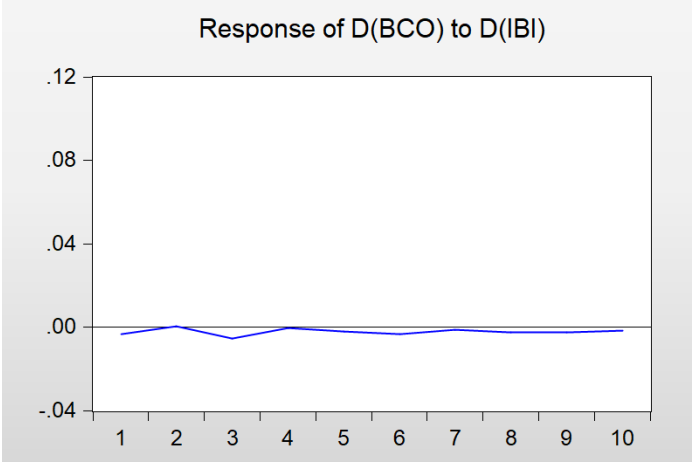

Figure 4. Impulse Response Function (BCO to IBI)

- **FDI response to IBI**

In the following figure, the response of FDI to IBI shows the effect of shocks to FDI variables on IBI. Shocks to FDI are responded negatively by IBI and begin to stabilize in the 29th period. Foreign Direct Investment variables will greatly affect the growth of Islamic Investment in Indonesia.

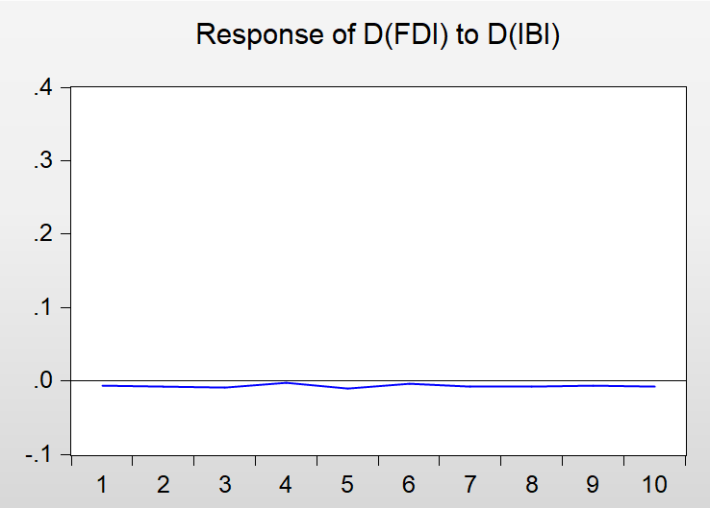

Figure 5. Impulse Response Function (FDI to IBI)

- **GDP response to IBI**

In the following figure, the response of GDP to IBI shows the effect of shocks to FDI variables on IBI. The shock to GDP is responded negatively by IBI and begins to stabilize in the 34th period. Economic growth variables will greatly affect the growth of Islamic Investment in Indonesia.

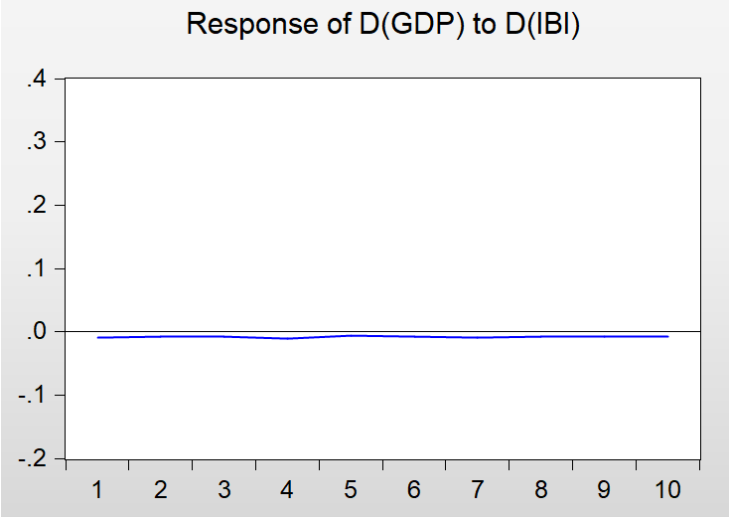

Figure 6. Impulse Response Function (GDP to IBI)

Forecast Error Variance Decomposition (FEVD) Analysis

Model characteristics can be seen through *Forecast Error Variance Decomposition* (FEVD), FEVD serves to predict the percentage contribution of each variable to shocks or changes in certain variables (Ascarya, 2009). In the following figure, the FEVD results of all variables show that the movement of IBI is influenced most dominantly by IBI itself in the research period January 2003-November 2018, followed by GDP, BCO and FDI variables. At the beginning of the period, IBI shocks were influenced 93% by IBI itself, followed by GDP by 4%, BCO influence by 2%, and FDI influence by 1%. However, at the end of the research period there was a change in

the influence of the variables on IBI. The most dominant variable affecting IBI at the end of the study period was IBI by 91.41%, then each influence of IBI variables in dominance and sequence was GDP by 4.95%, BCO by 2.34% and FDI by 1.31%.

Oil prices play a significant role in shaping the banking and investment landscape, as they influence corporate profitability, credit risks, investment opportunities, and overall market sentiment. The relationship is particularly pronounced in oil-dependent economies and among banks and financial institutions with exposure to the energy sector (Hesse & Poghosyan, 2016). Oil prices play a significant role in shaping the banking and investment landscape, as they influence corporate profitability, credit risks, investment opportunities, and overall market sentiment. The relationship is particularly pronounced in oil-dependent economies and among banks and financial institutions with exposure to the energy sector.

The collapse in oil prices during COVID-19 led to widespread bankruptcies in the shale sector, impacting banks with significant energy exposure. High oil prices after the Russia-Ukraine conflict spurred investments in renewables, with banks promoting transition finance as part of ESG strategies.

CONCLUSIONS

This study tries to see the effect of world crude oil prices, FDI and GDP on Islamic banking investment in Indonesia. This study uses the Vector Autoregression (VAR)/Vector Error Correction Model (VECM) analysis method. The results showed that the world crude oil price of brent oil significantly affected the growth of Islamic Investment Bank in Indonesia. The negative coefficient indicates that an increase in the world crude oil price of brent oil can reduce the growth rate of Islamic Investment Bank in Indonesia. With these results, it is hoped that relevant stakeholders will be able to find the right solution so that negative impacts can be avoided and mitigated properly.

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