Crude Oil Price Changes and Inflation: Evidence for Asia and the Pacific Economies

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Abstract

This paper examines the influence of crude oil price on inflation in seven Asian and two of the pacific economies. The period of investigation is from 1987M5 to 2019M12. The results of cointegration tests reveal that there is stable positive long-run relationship between consumer price index and crude oil price in these countries. In the short run, there is unidirectional causality running from crude oil price change to inflation in most cases. The findings suggest accommodative monetary policy measures to combat high inflation rate.

Keywords: Crude oil price, inflation rate, Asia and the Pacific countries

JEL Classification: E31, Q43

1. Introduction

The finding that international oil price exerts stronger impact on price indexes than domestic oil price does is found by Huang and Chao (2012). On the contrary, Cunado and de Gracia (2005) find that the short-run impact of oil price changes on changes in price index is more pronounced for domestic oil price than international oil price. To measure domestic oil price, crude oil price can be converted to domestic oil price by domestic currency. Earlier study by Hamilton (1996) uses world crude oil prices to analyze the impacts of oil shocks on the US output while Cologni and Manera (2009) use the real price of oil to examine the impact of oil price shocks on output growth for the G7 countries. Recently, Askha and Naveed (2015) find that Pakistan's inflation rate is significantly affected by international oil prices in the long run. In the short run, there is unidirectional causality running from world oil price to inflation rate. Taking in to account of asymmetry, Ajmi et al. (2015) find both positive and negative oil price shocks positively cause inflation in South Africa, and the impact of negative shock is stronger, However, Choi et al. (2017) find that positive oil price shocks have larger impact on inflation than negative oil price shocks. Nevertheless, Bala and Chin (2018) use a panel data analysis to investigate

the impacts of crude oil price changes on inflation in African OPEC member countries. They find that negative oil price shocks have stronger impact on inflation than positive oil price shocks. Zakaria et al. (2021) find that world crude oil price shocks have positive impact on inflation in South Asian countries.

In fact, domestic oil price should be more reliable because the exchange rate should matter while international oil price might not signal overall cost of production in an economy. Nevertheless, international oil price may partially affect some price indices, thus some previous studies still employ world crude oil price to gauge the influence of oil price shocks on inflation and other macroeconomic variables.

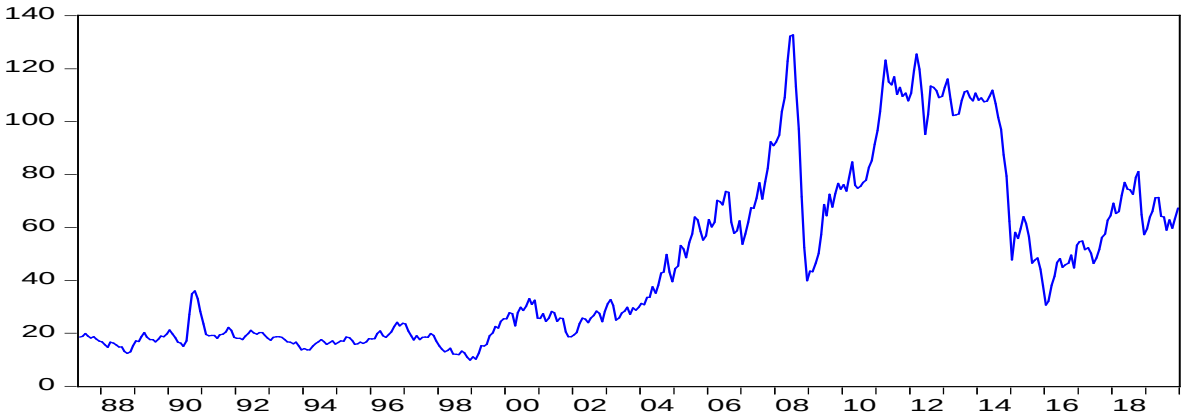

Figure 1. Crude oil price series, 1987M5-2019M12

Figure 1 plots the Brent crude oil price series. The stable period lasted from the beginning to 2001M1. The oil price started rising from 2001 with gradual increases and reached the highest point in 2008M6. The price dropped sharply and reached the lowest point in the end of 2008. This is due to the 2008 oil price shock. The price rose again due to the 2011-2013 oil shock, and declined again in 2014M5. After that, the oil price are less fluctuate for the remaining period. As shown in Figure 2, the degree of oil price shock is higher after the 2008 oil shock.

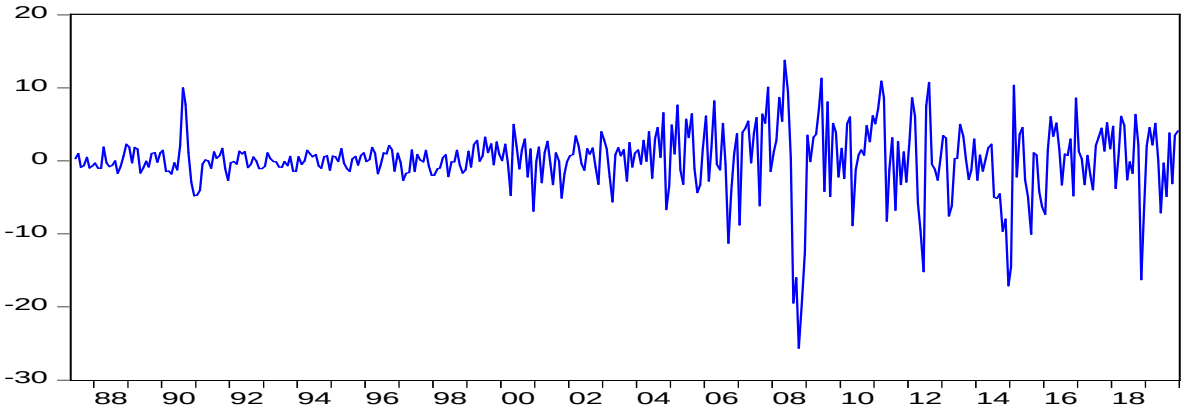

Figure 2. Crude oil price shocks, 1987M5-2019M12

This paper evaluates the influence of crude oil price shock on inflation rate in some Asia and the Pacific economies using Cointegration and causality tests. The results provide evidence that supports the importance of accommodative monetary policy to combat high inflation in these countries. The paper is organized as follows. Section 2 explains materials and methods. Section 3 presents empirical results, and the last section gives concluding remarks.

2. Materials and Methods

2.1 Data

This paper analyzes the impact of international oil price on inflation in 9 Asian and the Pacific economies. Crude oil price is the Brent spot price measured in US dollar per barrel. This series is obtained from the website of the US Energy Information Administration. The series of consumer price index (CPI) are obtained from the website of the Bank of International Settlement. All series are seasonally adjusted. Crude oil price change is measured as a change in the Brent spot price and the inflation rate is measured as a change in CPI for each economy.

2.2 Estimation Methods

The long run relationship between CPI and crude oil price is assumed to be linear and can be expressed as:

$$cpi_t = f(op_t) \tag{1}$$

where *cpi* is the log of CPI, and *op* is the log of crude oil price.

To test whether the long-run relationship in Eq. (1) exist, Johansen (1991) cointegration test in a bivariate framework is employed. The tests employ the maximum likelihood procedure to determine the existence of cointegrating equations in nonstationary time series as a VAR model. The reduced form VAR model of order *p* is expressed as:

$$\Delta x_t = \Gamma_1 \Delta x_{t-1} + \Gamma_2 \Delta x_{t-2} + ... + \Gamma_{p-1} \Delta x_{t-p-1} + \alpha\beta' x_{t-1} + e_t \tag{2}$$

where x is a vector of first differences of nonstationary variables, Γ_i is the matrix of short-run parameters, and $\alpha\beta'$ is the information coefficient matrix between the levels of nonstationary series. The relevant elements of the matrix a are adjusted coefficients while the matrix β contains cointetrating equations. There are two likelihood ratio test statistics for the number of cointegrating equations, i.e., trace and maximum eigenvalue statistics. If the two test statistics are greater than the critical values at the 5% level of significance, cointegrating equation(s) will exist.

The short-run analysis employs Granger (1969) causality test to find causality between crude oil price change and inflation. The optimal lag length is determined by AIC.

3. Empirical Results

Since the main purpose of the analysis is to investigate both long- and short-run relationship between crude oil price changes and inflation rate in Asia and the Pacific region, cointegration and causality tests are necessary. First of all, the time series property of variables is determined using the augmented Dickey-Fuller (ADF) test for unit root. The ADF tests with constant only and constant and a liner trend are performed on first difference of each series to determine whether each series contain 1 unit root. The test results are shown in Table 1.

Table 1. ADF test for unit root, 1985M05-2019M12

Panel A: Crude oil price change		
	ADF with constant	ADF with constant and linear trend
	-2.599[13]	-6.48***[12]
	(0.281)	(0.000)
Panel B: Change in CPI (Inflation)		
Indonesia	-5.715***[7]	-5.980***[7]
	(0.000)	(0.000)
Malaysia	-15.837***[0]	-16.026***[0]
	(0.000)	(0.000)
Philippines	-2.298[16]	-8.362***[2]
	(0.713)	(0.000)
Singapore	-4.686***[12]	-4.786***[12]
	(0.000)	(0.000)
Thailand	-7.073***[3]	-11.222***[1]
	(0.000)	(0.000)
India	-8.020***[2]	-8.194***[2]
	(0.000)	(0.000)
South Korea	-3.253**[12]	-5.176***[11]
	(0.018)	(0.000)
Australia	-4.788***[5]	-5.084***[5]
	(0.000)	(0.000)
New Zealand	-6.552***[3]	-6.860***[3]
	(0.000)	(0.000)

Note: The number in parenthesis is p-value, and the number in bracket is the optimal lag length determined by Akaike Information Criterion (AIC). ***' ** and * indicate significance at the 1%, 5% and 10%, respectively.

The results in Table 1 reveal that first differences of all series are stationary, except for crude oil price change and inflation in Malaysia that are not stationary from the

test with a constant only. Overall results indicate that all series are first-difference stationary. Therefore, it can conclude that crude oil price and consumer price indices are integrate of order 1 or they are I(1) series.

Next, the long-run relationship is examined using Johansen cointegration tests, the test results are shown in Table 2.

Table 2. Johansen cointegration tests, 1985M05-2019M12

Contry	Trace statistic	Max-eigen statistic	Long-run coefficient	ETC	Optimal lag
Indonesia	30.003	23.291	1.770***	0.001	8
	[20.262]	[15.892]	(6.177)	(0.872)	
Malaysia	73.125	67.258	0.265***	-0.005***	2
	[20.262]	[15.892]	(7.022)	(-3.828)	
Philippines	36.790	31.190	0.241***	-0.005***	4
	[15.495]	[14.265]	(2.886)	(-5.622)	
Singapore	22.892	20.225	0.236***	-0.006***	6
	[15.495]	[14.265]	(6.659)	(-3.149)	
Thailand	29.234	24.319	0.230***	-0.005***	2
	[15.495]	[14.265]	(4.622)	(-4.288)	
India	58.519	52.717	0.696***	-0.002**	3
	[20.262]	[15.892]	(5.286)	(-2.766)	
South Korea	58.991	52.696	0.156***	-0.005***	1
	[15.495]	[14.265]	(3.455)	(-7.441)	
Australia	22.502	18.547	0.271***	-0.005***	3
	[15.495]	[14.265]	(7.022)	(-3.707)	
New Zealand	25.837	22.972	0.245***	-0.006***	3
	[15.495]	[14.265]	(8.973)	(-3.732)	

Note: The number in bracket is the 5% critical value, and the number in parenthesis in t-statistic. The optimal lag length is determined by AIC. ***' ** and * indicate significance at the 1%, 5% and 10%, respectively.

The error correction term (ETC) in Table 2 is the one-period lagged residuals obtained from a cointegrating equation. It measures the speed of adjustment towards the long-run equilibrium. The tests assume no deterministic trend in the data for Indonesia, Malaysia, and India while the assumption of linear deterministic trend is applied to other Asian countries (Philippines, Singapore, Thailand and South Korea) and the Pacific countries (Australia and New Zealand). Both trace and max-eigen statistics reject the null hypothesis of no linear cointegration at least at the 5% level of significance in all cases because the test statistics are larger than the critical values. The positive impact of crude oil price on inflation rate is largest in the case of Indonesia. However, the ECT is not significant, which implies that the long-run relationship is not stable. For the remaining economies, the ETCs have correct sign with the absolute value of less than 1. This implies that the cointegrating

equations are stable. Any deviation from the long-run relationship will be corrected even though the speeds of adjustment are very low. The degrees of crude oil price pass-through to inflation range from 0.696 to 0.156. The lowest pass-through in South Korea may imply that this country uses high technology with energy efficiency. For the two pacific economies, Australia and New Zealand, the degrees of oil price pass-through is moderate.

The short-run impact of crude oil price on inflation is analyzed using the standard Granger causality tests. The results are presented in Table 3.

Table 3. Granger causality tests, 1985M05-2019M12

Country	H_o: Δop does not cause Δp	H_o: Δp does not cause Δop
Indonesia	0.852[8]	2.033**[8]
	(0.558)	(0.042)
Malaysia	11.533***[2]	4.313**[2]
	(0.000)	(0.014)
Philippines	1.989*[4]	1.247[4]
	(0.096)	(0.291)
Singapore	6.319***[6]	0.116[6]
	(0.000)	(0.995)
Thailand	5.115***[2]	0.294[2]
	(0.000)	(0.746)
India	4.913***[3]	0.522[3]
	(0.002)	(0.667)
South Korea	6.698***[1]	1.109[1]
	(0.000)	(0.293)
Australia	7.362***[3]	0.508[3]
	(0.000)	(0.677)
New Zealand	3.027**[3]	0.499[3]
	(0.029)	(0.683)

Note: The number in parenthesis is p-value, and the number in bracket is the optimal lag length determined by Akaike Information Criterion (AIC). ***' ** and * indicate significance at the 1%, 5% and 10%, respectively.

The results in Table 3 indicate that crude oil price change positively causes inflation in most of economies, except Indonesia and the Philippines. In most cases, inflation does not cause oil price change in most cases. The exception is the cases of Malaysia and Indonesia. There is short-run causation from inflation to crude oil price change in Indonesia and Malaysia. This feedback causality may be reasonable in a large oil producing economy like the US (e.g. Hamilton, 1996). Even though Indonesia and Malaysia are large oil-producing and oil-exporting in Asia, it is unlikely that inflation rates in these two economies will influence the world crude oil price.

The overall results of the present paper are in line with the results found by Bala and Shin (2018) in that the long- and short-run impacts of crude oil price should not be ignored by policymakers who are responsible for stabilizing price level.

Accommodative monetary policy measures might be necessary.

4. Concluding Remarks

This study examines the degree of crude oil price pass-through to inflation in 9 Asia and the Pacific countries. Johansen cointegration tests are used to investigate the long-run impact of world crude price on inflation while the standard Granger causality tests are employed to examine the direction of causality between crude oil price changes and inflation. The results show that the long-run impact of crude oil price on inflation is moderate in most cases. In the short-run, there is unidirectional causality running from oil price change to inflation in most of these economies. Theoretically, there are several factors that influence inflation rate. Oil price change is the one that can cause such that policymakers should take into account when formulating policy measures to alleviate high inflation rate.

This paper concludes with some reservations. Structural breaks might play an important role in the long-run relationship. In addition, the paper does not examine whether positive and negative crude oil price changes influence inflation in an asymmetric way.

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