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Abstract

There are several mechanisms that can account for short-run business cycle transmission. International trade is probably the major vehicle, and it forms a direct channel through which income and price shocks may be transmitted. Capital flows provide a second mechanism which is most likely to be responsible for the transmission of interest rate, monetary and exchange rate shocks. The study attempted to focus on the income shocks transmitted between a developed country and a developing country such as the USA and Indonesia. The transmission of industrial production, prices and interest rate shocks between the two countries have been examined along with an objective to test this proposition focusing on Indonesia. The study also considered the USA-Indonesia proposition by estimating a vector error correction model. The findings of the study show that there is no co-integration between U.S. and Indonesian industrial production. Therefore it does not appear that the USA drives Indonesian business cycle fluctuations and vice versa.

Keyword: Business cycle; co-integration; error correction model, business transmission

INTRODUCTION

There are many definitions about business cycle. Semmler (1994) defined business cycle as the type of fluctuations found in the aggregate economic activity of nations that organize their work mainly in business enterprise. Cycle consists of expansions occurring at about the same time in many economic activities, followed by general recessions, contractions and revivals that merge into the expansion phase of the next cycle. trade cycle theory is cyclical itself which related to the existence of (negative) serial correlation in key real macroeconomic aggregate series (Real Business Cycle Theory (RBC)), such as inflation, and co-movement between various series; in the sense that there are leading and lagging (as well as coincident) relationships between them over time, which may or may not imply causality.

There are several mechanisms that can account for short-run business cycle transmission. International trade is probably the major vehicle, and it forms a direct channel through which income and price shocks may be transmitted. Capital flows provide a second mechanism which is most likely to be responsible for the transmission of interest rate, monetary and exchange rate shocks (Selover, 1997). There is already a substantial theoretical literature on international business cycle transmission and many models of how an income shock may be transmitted from one country to another. Based on the above explanation, this study has attempted to analyze the business cycle transmission between the USA and Indonesia by focusing on the transmission of industrial production, prices and interest rate shocks. The issue has been inspired by the saying that if the USA sneezes, the ASEAN Countries catches a cold in almost all ASEAN countries. The saying implies that the U.S. economy drives the ASEAN Countries economy. The present study has attempted to examine the proposition focusing on Indonesian by testing co-integration and estimating a vector error correction model.

LITERATURE REVIEW

The USA-drives-Indonesia model reflects an implicit belief that the U.S. economy drives the Indonesian economy implying that there is a long-run relationship between the two economies. If it is the case, it might be expected that the economic fluctuations in the two economies to be co-integrated. There is already a substantial theoretical literature on international business cycle transmission and many models of how an income shock may be transmitted from one country to another, but there is relatively small but growing body of empirical literature investigating international interdependence and business cycle transmission. Examples of this study include Selover (1997), investigated the transmission of business cycle fluctuations between the USA and Japan using vector error correction model which includes industrial production, prices, interest rates and exchange rate. He found that there was only short-term link between the USA and Japan. Furthermore, the transmission between the two economies was relatively modest implying that USA did not drive the Japanese economy; rather it transmitted shocks which partially synchronized the two economies through the 'mode-lock' phenomenon (Selover, 1999b).

Meanwhile, Grohe (1997) examined the international transmission of economic effects of the U.S. business cycle on the Canadian economy. He reported that transmission through financial markets and through export-demand varied individually as well as for both transmission channels jointly. When allowing transmission through financial markets only, the predicted output and employment responses were too small compared to those estimated from postwar data for the small–large country pair Canada and the USA. Selover (1999), in another study investigated the international transmission of business cycles among the ASEAN countries of Indonesia, Malaysia, Philippines, Singapore and Thailand, and between the ASEAN nations and their major trading partners, the United States, Australia, Japan, and the European Union, using trade flows to show the pattern of economic interdependence. He used principal components analysis, vector auto-regressions, and spectral analysis to explore the possibility of a unique ASEAN business cycle. Binominal VARs were used to examine the relative impacts of each country upon the others, whereas spectral analysis was used to check the possibility of "mode-locking" between the countries that may serve to bring about some synchronization. Interestingly, there is evidence of the existence of a specific ASEAN regional business cycle. However, the VARs give only weak evidence of transmission of business cycles among the ASEAN economies and between the ASEAN economies and their major trading partners. The apparent weakness of the transmission is explained by the fact that commodity price fluctuations, wars, and major political disturbances. These factors have interrupted the natural generation of business cycles due to the process of nation-building and dominated the interdependence effects between nations leading a hindrance to the measurement of international business cycle transmission.

Kearney (2000) examined another aspect of business cycle transmission, using end-monthly data on stock market returns, interest rates, exchange rates, inflation, and industrial production for five countries (Britain, France, Germany, Japan, and the USA) from July 1973 to December 1994. His study tried to extend the literature on low-frequency analysis of the causes and transmission of stock market volatility. Efficient portfolios of world, European, and Japanese/USA equity were first constructed, the existence of multivariate co-integrating relationships between them was demonstrated and the transmission of conditional volatility between them was described in the study. The transmission of conditional volatility from world equity markets and national business cycle variables to national stock markets was then modeled. The major findings were: firstly, world equity market volatility was caused mostly by volatility in Japanese/USA markets and transmitted to European markets; and secondly, changes in the volatility of inflation were associated with changes of the opposite sign in stock market volatility in all markets where a significant effect was found to exist. To the extent that the volatility of inflation was positively related to its level implying low inflation tends to be associated with high stock market volatility.

Canova and Marrinan (1998) studied the generation and transmission of international cycles in a multi-country model with production and consumption inter-dependencies. Two sources of disturbance were considered and three channels of propagation were compared. Technological disturbances which were mildly correlated across countries were more successful than government expenditure disturbances in reproducing actual data. The presence of a common component to the shocks and of production inter-dependencies appeared to be crucial in quantitatively matching the properties of the data.

Ambler and Cardia (2000) in their study found that the standard multi-country models do not replicate important features of the international transmission of business cycles. The model does not also predict cross-country correlations of output and consumption which are respectively too low and too high. Furthermore, the authors modified the supply side of a two-country model by adding multiple sectors and trade in intermediate goods. The model generated a higher cross-country correlation of output than standard one-sector models. It also predicts cross-country correlations of employment and investment that are closer to the data. The study analyzed the relative impact of multiple sectors, trade in intermediate goods, imperfect substitution between domestic and foreign goods, home preference, capital adjustment costs and capital depreciation in order to pinpoint the features which move the model predictions closer to the data.

The business cycle condition in U.S. is near constant during the time of the study, whereas the business cycle in Indonesia fluctuates. Only the inflation rate and the interest rate sometime coincide between the two countries. It is to be noted that the Indonesian interest rate was very high during the period of economic crisis in 1998. Though Selover (1999) has investigated the international transmission of business cycles among the ASEAN nation including Indonesia and its trading partner, particularly the USA, this study is still important for the business transmission issues. Since, Selover (1999) employed principal components analysis, vector auto-regressions, spectral analysis and binominal VARs to investigate international transmission of business cycles, meanwhile this study attempted to employ vector error correction model approach to reach more necessary findings on the business cycle between the USA and Indonesia.

METHODS

The study analyzes quarterly data for the period 1985.01-2000.04[1]. Figure 1-4 in Appendix 1 display the time series plots of some major macroeconomics variables for both the USA and Indonesia including industrial production, consumer price index (CPI), inflation rate and interest rate. All variables have been transformed to log levels.

There are many method used to measure business cycle transmission such as input output coefficient, macro-econometric model, regression analysis, VARs and cross-spectral techniques, spectral analysis, correlation and principle components analysis, spectral analysis and VAR model, vector error correction model. VAR model is one of the famous methods to measure the business cycle transmission.

[1] First part stands for the year and the following number stands for the month of the respective year

The present study is similar to the study conducted by Selover (1997, 1999a) that focused on the business cycle transmission between the USA and Japan: A vector error correction approach. An error correction model framework has been used to quantify the impact of shocks from the USA to Indonesia and vice versa. However, in this study the VAR system has been tested for co-integration using both the Granger-Engel and Johansen procedures. The results of the Granger-Engel and Johansen procedure have been employed to determine the method to measure the business cycle transmission. The hypothesis constructed in the study to examine the co-integration between U.S. industrial production, prices and interest rate and Indonesian industrial production, prices and interest rate. Finally the Vector Error Correction (VEC) model has been applied.

It has been assumed that if there is co-integration between U.S. industrial production, prices and interest rate and Indonesian industrial production, prices and interest rate or within the system, a VEC system could be modeled. If growth in U.S. industrial production is found to be explaining the growth in Indonesian industrial production partially, the relationships between prices and interest rates of the two countries are also to be examined.

The following steps have been incorporated in the study by following the study carried out by Selover (1997):

a) Testing each variable for unit roots using the Dickey-Fuller test.
b) Testing various combinations of variables for possible co-integration using both the Granger-Engle method and the Johansen procedure.
c) Testing the overall VAR system for co-integration using the procedure and test various hypothesized co-integration relationship (vectors) for existence within the co-integration space using the Johansen-Juselius procedure.
d) Estimating the vector error correction model (VEC) system and test various short-run relationships using tests of Granger causality.
e) Testing the equations of the VEC model for possible structural breaks using recursive least squares (RLS) estimation. Compute the impulse response from the vector error correction model.

The basic model is a variation of the Burbidge-Harrison VAR model used to examine the inter-dependence between the USA and Canada. However, in the present study, the number of endogenous variables has been reduced to eight: the log of industrial production, the log of consumer prices, log of inflation and short-term interest rate (not logged) for both countries.

There are three major statistical procedures employed in this study. The first is the Granger-Engle two-step test for co-integration Engle and Granger (1987) that involves estimating a hypothesized co-integration relationship with ordinary least squares, with the variables in the levels or log levels. The second step consists of testing the residuals from this 'co-integrating' regression for unit roots using the augmented Dickey-Fuller (ADF) test. A rejection of the null hypothesis of a unit root indicates the existence of a co-integrating relationship. Failure to reject the null hypothesis of a unit root indicates no co-integration. This test was employed where only two or three variables were in the hypothesized co-integrating relationship.

The second, more powerful, test procedure involves the use of the Johansen technique (Johanson, 1988) for testing the co-integration in higher order systems. This is a more complex procedure that utilizes Eigen-values as a measure of canonical correlations between two sets of regression residuals. The procedure presents a sequence of null hypotheses, each given for the number of co-integrating vectors (0, 1, 2, 3,…), and a sequence of test statistic. The number of times the null hypotheses can be rejected indicates the number of co-integrating vectors. The procedure also provides maximum likelihood estimates of the co-integrating vectors. In cases where co-integration is found, the best specification of the phenomenon is a vector error correction model (VEC), and hypothesis tests can be validly performed on the coefficients of the model.

The Vector Error Correction Model

The co-integrating vectors estimated in the Johansen test procedure has been used to form error correction terms by multiplying the co-integrating vectors by the appropriate data matrix. The three error correction terms constructed lagged one period have been employed as regressors ($CA1_{t-1}$, $CA2_{t-1}$ and $CA3_{t-1}$) in the vector error correction model. The vector error corrected model is specified as follows:

$$\Delta X_t = \alpha + \sum_{i=1}^{4} \beta_i \Delta I_{t-1}^{US} + \sum_{i=1}^{4} \lambda_i \Delta P_{t-i}^{US} + \sum_{i=1}^{4} \delta_i \Delta R_{t-1}^{US} + \sum_{i=1}^{4} \omega_i \Delta E_{t-1} + \sum_{i=1}^{4} \lambda_i \Delta I_{t-1}^{I} + \sum_{i=1}^{4} \mu_i \Delta P_{t-i}^{I} + \sum_{i=1}^{4} \pi_i \Delta R_{t-i}^{I} + \theta_1 CA1_{t-1} + \theta_2 CA2_{t-1} + \theta_3 CA_{T-1} + \varepsilon_T$$

Where

a) $\Delta I =$ First difference of the log of industrial production (DLIPUS, DLIPI),
b) $\Delta P =$ First difference of the log of consumer prices (DLPUS, DLPI),
c) $\Delta R =$ First difference of the log of the short term interest rates (DIRUS, DIR), CAn = nth co-integrating relation error correction term (CA1, CA2, CA3), $\Delta X =$ each endogenous variable, $\Delta I, \Delta P, \Delta R$ sequentially for both countries and ΔE. ('D' is used as prefix for variable names in order to indicate a first difference, 'L' represents a log, and 'US' = United state of America, and 'I' = Indonesia).

The regression has been run for each of the eight endogenous variables, thus forming a vector error correction model in which the entire variable were stationary. Thus, the classical distribution theory was applied, and hypothesis testing was performed. The third major procedure involved computing impulse responses using Cholesky decomposition for error orthogonalization. The resultant VEC impulse responses showed more persistence than those computed from an ordinary VAR.

RESULTS AND DISCUSSION

This section discusses the findings of the study and provides a constructive synthesis. Tow appendices provided at the end of the manuscript on the time series plots of some major macroeconomics variables for both the USA and Indonesia including industrial production, consumer price index (CPI), inflation rate and interest rate and graphical representation of the impulse response function.

Unit Root Tests for Non-stationary

The unit property of the series is crucial for co-integration and causality analysis. It was examined by the standard augmented Dickey Fuller (ADF) and Phillips-Perron Test. It is generally known that the results of these tests often depend on the number of lags included; therefore careful attention was paid to the lag length selection. Table 1 reports the Augmented Dickey-Fuller unit root test results in levels and first differences. All series have been log-transformed before the analysis. The results indicate that the null hypothesis of a unit root could not reject for all variables in the levels. It implies that all the variables in the model are found to be non-stationary. Because of this non-stationary, hypothesis testing is invalid for regression run in this level. This hypothesis, however, was rejected for the first difference. Regressions therefore should be run either in first differences, or, if there is co-integration, in an error correction model.

Table 1. Augmented Dickey-Fuller tests[2] (with trend) period: 1985.1-2000.1

Variable	Level	First difference
Lcpi	-1.822054	-3.565056***
Lcpius	-1.687604	-3.173920***
Linf	-2.861939	-4.017517***
Linfus	-2.751405	-5.576245***
Lip	-1.444844	-4.168107***
Lipus	0.641508	-3.166242***
Lir	-2.881697	-3.975618***
Lirus	-2.273396	-3.375377***

[2] Augmented Dickey-Fuller test is used for testing the Unit property. MacKinnon critical values for rejection of hypothesis of a unit root= -2.9118

Co-integration between the USA and Indonesia Variables

Table 2 displays some initial tests for simple co-integration between the USA and Indonesian variables using the Johansen Procedure. No co-integration was found between the USA and Indonesia industrial production (LIP and LIPUS). This conforms to economic theory because although the trade repercussion model suggests that one economy should impact the other, it does not suggest any long-run equilibrating mechanism that would force them into co-integration.

Both inflation and consumer price index for the USA and Indonesia provide possible long-run relationship. In theory, interest rates will move together over time after adjusting exchange rate fluctuation in different countries. Here, too, co-integration between interest rates in the USA and Indonesia has been rejected. Consequently there is no sign of interest rate parity. It is concluded that there is no co-integration between U.S. and Indonesia's industrial production, or between U.S. and Indonesian interest rates.

Table 2. Results of the tests for co-integration by Johanson procedure

Regression	Eigen-value	Trace Statistic	Max-Eigen Statistic
LIP=F(LIPUS)			
None	0.098803	7.723153	6.345895
At most 1	0.022325	1.377258	1.377258
Conclusion : No co-integration at both 5 percent and 1 percent level both Trace and Max-Eigen test			
LINF=F(LINFUS)			
None	0.315690	23.25506	16.31181
At most 1	0.149109	6.943259	6.943259
Conclusion: Trace test indicates 2 co-integrating equation(s) at both 5 percent and 1 percent level. Max-Eigen value test indicates 2 co-integrating equation(s) at the 5 percent level, and no co-integration at the 1 percent level			
LIR=F(LIRUS)			
None	0.149527	10.12264	9.879700
At most 1	0.003975	0.242939	0.242939
Conclusion: No co-integration at both 5 percent and 1 percent level both Trace and Max-Eigen test			
LCPI=F(LCPIUS)			
None	0.165320	18.56176	10.11962
At most 1	0.139940	8.442145	8.442145
Conclusion: Trace test indicates 2 co-integrating equation(s) at the 5 percent level and no co-integration at the 1 percent level. Max-Eigen value test indicates no co-integration at both 5 percent and 1 percent level			

Multivariate Co-integration Analysis (Johansen procedure)

The multivariate co-integration technique developed by Johansen and Jeselius (1990) has been employed to the system of three variables which are integrated of order one (as reported in Table 1). The uniform lag structure of the system is set up through a search process using Likelihood Ratio test with a potential lag length of 1 through 12. The null hypothesis is a system of variables generated from a Gaussian VAR with ρ_0 lags against the alternative specification of ρ_1 lags, where $\rho_1 > \rho_0$. The test statistic computed is asymptotically distributed as χ^2 with n^2 (ρ_1 - ρ_0) degree of freedom.

The results of the multivariate co-integration analysis reported in Table 3. It shows the results of the Johansen procedure for co-integration. Rejecting the null hypothesis of less than ρ co-integrating relationship at a 1 percent level indicates the existence of three co-integrating relationships.

Table 3. Johansen co-integration test (Unrestricted co-integration rank test)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.874716	269.6323	87.24127	156.00	168.36
At most 1 **	0.826939	182.3910	73.67271	124.24	133.57
At most 2 **	0.736636	108.7183	56.03715	94.15	103.18
At most 3	0.470712	52.68113	26.72138	68.52	76.07
At most 4	0.350565	25.95975	18.12944	47.21	54.46
At most 5	0.124422	7.830312	5.580596	29.68	35.65
At most 6	0.052114	2.249716	2.247895	15.41	20.04
At most 7	4.34E-05	0.001821	0.001821	3.76	6.65

(**) denotes rejection of the hypothesis at the 5 percent (1 percent) level. Trace test indicates 3 co-integrating equation(s) at both 5 percent and 1 percent level

Note on co-integration test:

Sample (adjusted):	1987:2 2000:4
Included observations:	42
Excluded observations:	13 after adjusting endpoints
Trend assumption:	Linear deterministic trend
Series:	LCPI, LCPIUS, LINF, LINFUS, LIP, LIPUS, LIR, LIRUS
Lags interval (in first differences):	1 to 2

Table 4. Unrestricted co-integrating coefficients (normalized by b'*S11*b=I)

LCPI	LCPIUS	LINF	LINFUS	LIP	LIPUS	LIR	LIRUS
-11.98873	-161.1930	2.974034	-2.247722	34.00016	84.65731	-7.118352	8.850434
14.55492	161.4981	8.557364	-0.083611	-23.56315	-80.49753	4.177945	4.284874
-0.409882	-44.12205	-6.433412	4.032759	13.50327	15.99102	-0.003209	-1.966468
0.838158	61.32957	-5.971703	0.174111	-15.88858	-20.27748	2.649442	-3.675600
-8.894543	-84.14498	-2.427938	2.762937	19.47673	31.75363	-8.327066	9.384920
1.741484	-27.18335	0.429832	-1.334241	16.95748	-8.179033	-4.852363	4.962058
6.113338	102.3943	-0.642279	0.441169	-28.34928	-39.70019	-0.753943	-7.929785
-14.09927	-153.8572	-2.361720	2.249819	29.64167	62.83119	-2.355346	-10.55144

The Vector Error Correction Model

The results of the vector error correction model are condensed in Table 5 by presenting only the statistically significant coefficients (at the 0.05, and 0.01 level). Each column represents a separate regression of the VEC with the independent variables listed in the column on the left. At the bottom of the table, diagnostic test statistics for each regression have been reported. Table 6 presents the diagnostics of the model.

In fourth equation (ΔLCPIUS, ΔLINF, ΔLINFUS, AND ΔLIPUS) from eight equations, at least one of the error correction terms, CA1, CA2, AND CA3, is significant that provides additional support for finding co-integration. In other words the significant of the error correction terms indicates the existence of long run Granger sense causal relationship between the variables of the equation. The effect of the error correction term is to slow down the short-term growth of the dependent variable as evident by the negative sign of its coefficient. The magnitude of the coefficient of the error term reveals that the magnitude of the response. If it is big implies its response is very high and a very high speed of adjustment of the dependent variable to the error correction model. This result further proves that there is a long-run equilibrium relationship between the variables in the equation.

In the short run, Indonesian consumer price index (ΔLCPI) is slightly significant in explaining changes of the U.S. consumer price index (ΔLCPIUS) with a positive impact elasticity of 0.603666. These changes are also significantly influenced by Indonesian inflation (LINF) with elasticity 0.014958 and by Indonesian interest rate (LIR) with elasticity 0.017250. The findings with regard to U.S. consumer price index suggest that changes in U.S. consumer price index are due to changes in the ΔLCPI, LINF, and LIR, even though the impact of the two latest variables is small. The equation suggests that a one percentage point increase in the ΔLCPI would result in 0.63 percent increase in the ΔLCPIUS.

The effect of U.S. consumer price index (ΔLCPIUS) and U.S. industrial production (ΔLIPUS) with a lag 2 on the LCPIUS are significant in the short run at 5 and 1 percent level respectively. With a lag 2, rising in U.S. consumer price index and U.S. industrial production have a net negative effect of U.S. consumer price index (ΔLCPIUS). None of the Indonesia's variable has impact to the

LCPIUS. This indicates that changes in the LCPIUS depend on their own market, none from Indonesia market.

Table 5. The results of the error correction model[3]

Item	ΔLCPIUS	ΔLINF	ΔLINFUS	ΔLIPUS
ΔLCPI (-1)				-1.037152[b] (-2.22288)
ΔLCPI (-2)	0.603666[a] (3.06475)			
ΔLCPIUS (-2)	-0.453365[b] (-2.23400)			
ΔLINF (-1)	0.014958[a] (3.47379)			
ΔLINF (-2)			-0.371174[a] (-3.77287)	
ΔLINFUS (-1)		0.669417[a] (2.26409)		
ΔLINFUS (-2)		0.337355[b] (1.69778)	0.265935[a] (2.51221)	
ΔLIPUS (-1)		-21.40609[b] (-1.77444)	-12.57727[b] (-1.95703)	0.387581[b] (1.95094)
ΔLIPUS (-2)	-0.224999[a] (-2.85719)		-20.32688[a] (-3.35639)	
ΔLIR (-1)		2.863289[a] (2.71280)	-1.235801[b] (-2.19779)	
ΔLIR (-2)	0.017250[a] (2.88047)		1.416443[a] (3.07556)	-0.032790[b] (-2.30322)
ΔLIRUS (-2)	0.033990[a] (2.51420)		3.185673[a] (3.06400)	
CA1 (-1)	-0.007345 (-0.74272)	-4.162467[a] (-2.91576)	-3.225576[a] (-4.24125)	0.034582 (1.47099)
CA2 (-1)	-0.105139 (-0.86284)	-44.75625[a] (-2.54437)	-34.66221[a] (-369886)	0.539996[b] (1.86412)
CA3 (-1)	-0.018976[a] (-3.25715)	-1.039277 (-1.23576)	-0.337756 (-0.75386)	0.024896[b] (1.79762)

Indonesian interest rate (ΔLIR) is slightly significant in explaining changes are the inflation rate in Indonesia (ΔLINF) with a positive impact elasticity of 2.863289. These changes are also significantly influenced by U.S. inflation rate (LINFUS) both in lag 1 and lag 2. It is influenced also by U.S. industrial production index (ΔLIPUS) with a net negative effect of Indonesian-inflation rate (ΔLINF) at 5 percent level. The results imply that in the short run Indonesia's inflation rate depends on the variable in the USA market (lag 1 and 2 of

[3] Estimating using OLS, heteroskedasticity-consistent errors, statistically significant coefficient only, 1985:1 – 2000:4

LINFUS). It means that inflation in US market will transmit to the Indonesian market.

Indonesian inflation (ΔINF) is slightly significant in explaining changes are the U.S. inflation (ΔLINFUS) with a negative elasticity of 0.371174 in the short run. These changes are also significantly influenced by Indonesian interest rate (LIR) in a lag 1 and 2. Another factor that influenced the U.S. inflation is lag 2 of U.S. inflation with elasticity 0.265935, whereas the U.S. industrial production has a negative impact to U.S. inflation rate. This finding gave more evidence that there is a co-integration (long run relationship between Indonesia and the USA) in the short run since the previous results also suggest that in the short run Indonesia's inflation rate depends on U.S. market (lag 1 and 2 of LINFUS).

Table 6. Diagnostics for the vector error correction model

R-squared	0.668168	0.837146	0.898611
Adj. R-squared	0.381586	0.696499	0.811048
Sum sq. residuals	0.000254	5.293376	1.502318
S.E. equation	0.003398	0.490518	0.261318
F-statistic	2.331508	5.952104	10.26245
Log likelihood	192.7366	-16.09993	10.34845
Akaike AIC	-8.225552	1.719044	0.459597
Schwarz SC	-7.398091	2.546506	1.287059
Mean dependent	0.007899	0.087834	-0.021951
S.D. dependent	0.004321	0.890378	0.601166
Determinant Residual Covariance		1.70E-25	

The effect of Indonesian-consumer price index (ΔLCPI) and interest rate (ΔLIR) are significantly negative impact on the U.S. industrial production index at 5 percent level. It means rising in both variables will decrease the U.S. industrial production. The elasticity of U.S. industrial production index not only depends on the variable in the USA market (lag 1 of U.S. industrial production) but also depends on the two variables from Indonesia such as ΔLCPI and ΔLIR. This indicates that the variations in the Indonesian market have a large effect on the U.S. Industrial production index. It may be due to Indonesia is a big market for the USA; whereas, the lag 1 of U.S. industrial production have a positive impact on changing U.S. industrial production index.

Impulse Response Function

The impulse response functions (IRFs), presented in figure 5-8 (Appendix 2), illustrate the fifteen years responses of the Indonesian endogenous variables {consumer price index (LCPI), Inflation (LINF), interest rate (LIR), Industrial production index (LIP)} to an initial shock of the USA variables {consumer price index (LCPIUS), Inflation (LINFUS), interest rate (LIRUS), production index (LIPUS)}. For example, response of Indonesian consumer price index is positive if there is changes in U.S. consumer price index; whereas for other variables {Inflation (LINFUS), interest rate (LIRUS), Industrial production index (LIPUS)}, the response is negative.

The response of Indonesian inflation rate for changes in the variables studied in the USA is both positive and negative, but the biggest response is from the changes in U.S. consumer price index. Short run shock in U.S. interest rate gives a negative response to Indonesian interest rate; whereas shock in LCPIUS, LINFUS and LIPUS give a positive response to Indonesian-interest rate. Short run shock in U.S. industrial production and U.S. interest rate give a negative response to Indonesian industrial production index; whereas shock in LCPIUS and LINFUS give a positive response to Indonesian-industrial production index.

CONCLUDING COMMENTS

This study attempted to measure the extent of business cycle transmission between the USA and Indonesia. No co-integration was found between the USA and Indonesian industrial production. Therefore, it does not appear that the USA drives Indonesian business cycle fluctuations and vice versa.

Firstly, the causal observation of graphs of the major economic variables indicates that the business cycles between the two countries do not coincide to a certain degree, except for inflation and interest rate.

Co-integration between the U.S. and Indonesian industrial production was tested using the Johansen procedure and none was found. Similarly, no clear co-integration was found between U.S. and Indonesian prices and interest rate but co-integration was found between U.S. and Indonesian inflation. When the entire system of both the USA and Indonesia variables together was estimated using Johansen procedure, a co-integrating space is found.

A vector error correction model was estimated, and found that U.S. industrial production is not Granger-caused Indonesian industrial production. In the absence of co-integration between U.S. and Indonesian industrial production, it could be concluded that the USA-drives-Indonesia model of business cycle transmission was incorrect.

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Appendix 1

Figure 1-4 displays the time series plots of some major macroeconomics variables for both the USA and Indonesia including industrial production, consumer price index (CPI), inflation rate and interest rate

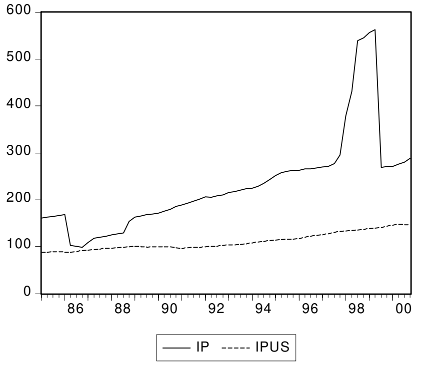

Figure 1

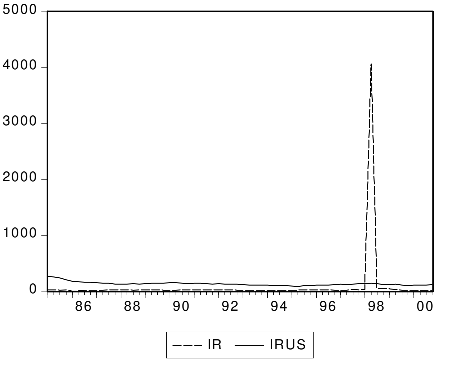

Figure 2

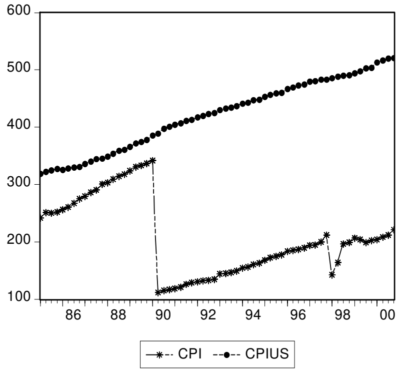

Figure 3

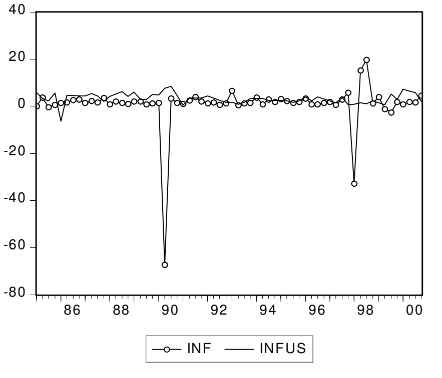

Figure 4

Appendix 2

The impulse response functions