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Conference Paper

The Analysis of Exchange Rate Pass-Through in Indonesia

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Abstract

The aims of this research are to identify and analyze the exchange rate pass through towards domestic price in Indonesia. The aforementioned objective is reflected through the short-term and long-term influence variable, inflation fluctuation response due to other macroeconomic shock variable, which then reveals the characteristics of pass-through degree in Indonesia. The data used on this research was the quarter time series data from 1997 Q3 until 2017Q4. The variable used in this research were Consumer Price Index, Rupiah exchange value per Dollar, Import Price Index and SBI Interest Rate. The resource of the data variable were from Bank Indonesia and International Monetary Fund (IMF). The method being employed was Vector Error Correction Model (VECM). The result of the research shows that in the long-term and short-term period, all variable influences inflation by a different lag. Moreover, the impulse response function assessment reveals that shock variable of import price index receives a positive response by consumer price index. The result of variance decomposition assessment also concludes that the import price index has the biggest contribution.

Keywords: Inflation, Exchange Value, Shock, VECM

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1. Introduction

The monetary sector crisis in Indonesia, for instance, one that began in August 1997 in which the crisis was marked by the exchange rate crisis as the torch to economic crisis. The financial crisis in Asia began when Thailand government decided to do devaluation of Bath value on July 2nd, 1997 (Sutthirak and Gonjanar, 2012). During the monetary crisis, Indonesia faced the lowest growth compared to other countries until it reached negative value at -14%. The currency crisis had also occurred to some Asian countries during 1997-1998. The crisis that happened to Indonesian economy was the most severe compared to other countries experiencing crisis during that period.

According to Santosa (2012), the influence of exchange value policy towards the economy can be seen from two sides, which are demand and offer. The demand means when rupiah exchange value is depreciated toward dollar, hence the number of goods

demanded abroad will be higher compared to the import demand. The offer means that if rupiah exchange value was depreciated, hence the offer within the country will decline due to the high price of imported goods (Santosa, 2012). The effort by domestic producer can be done by increasing the goods production cost, thus impacting on the rise of price. Based on this phenomenon, it can be concluded that there is a positive relationship between exchange rate and inflation rate (Langi, Masinambow, &Siwu, 2014). Sahminan 2002 and Syafri (2003), stated that the indirect impact of currency exchange rate's depreciation happened through raw materials import price or intermediate goods.

Below is the diagram reflecting rupiah exchange rate flow and IHK in Indonesia in 1990-2017.
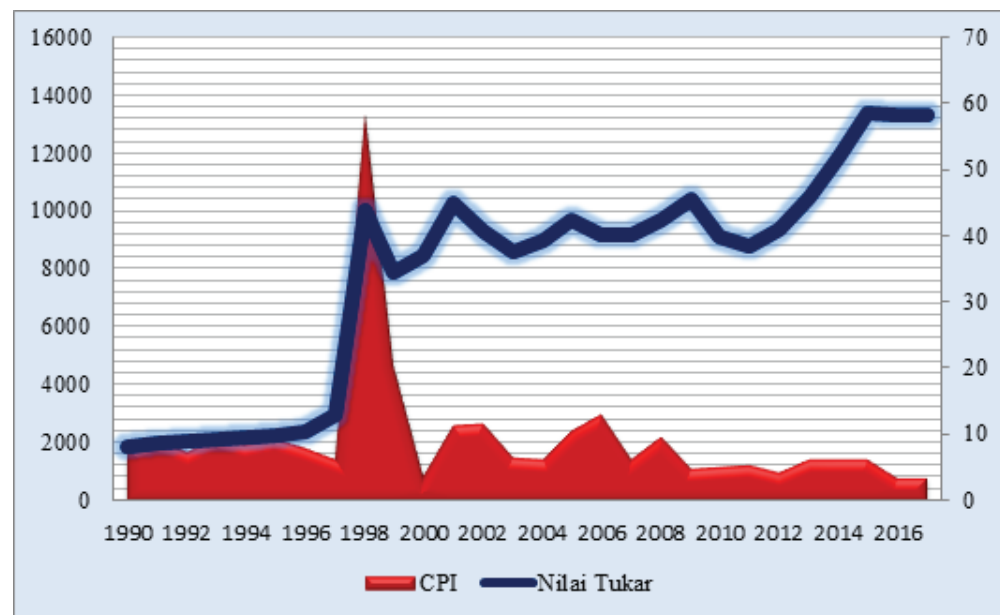

Figure 1: Fluctuation of Rupiah Exchange Value Flow towards US Dollar and IHK in Indonesia in 1990-2017. (Source: International Financial Statistics, 2017).

Based on the data from Figure 1.1, it can be explained that rupiah exchange value towards USD within the period of the implementation of controlled floating exchange value system until 1997 had a stable tendency. However, after the system change to free floating exchange value in 1997-2017, the exchange value tended to be fluctuated. Rupiah exchange value towards dollar moved in a fluctuated manner and tended to weaken or depreciated, specifically in 1997, 2000, 2005, 2007, and 2013. The factor causing depreciation in 1997-2005 was due to the international economic condition highly influenced by the United States of America which created inflation flow pressure from imported goods and increase the cost (Bank Indonesia, 2005). From December 2008 – February 200, the exchange rate weakened until it reached Rp. 11.980,-/dollar, this was due to the impact of monetary crisis.

The exchange value system was replaced with free flow exchange system, however the recovery process toward monetary crisis has yet to run normally. The weakening of rupiah exchange rate which was bigger than expected pushed the increase of price through imported goods price.

Campa and Goldberg (2002) used domestic price data on the imported goods for OECD countries with the purpose to assess Taylor preposition and to find that monetary variables are fitting if connected to the pass-through degree.

Exchange Rate Pass-Through or ERPT is defined as the percentage of domestic price change, import price and export price because the changes of exchange rate value (Villavicencio & Mignon, 2017). Both are a theoretical and empirical study, Campa and Goldberg (2005).

The mechanism of price exchange from the exchange rate value is divided into two, which are direct pass-through impact and indirect pass-through impact. Direct pass-through will directly impacts toward inflation towards imported goods, which can be in the form of consumption goods, raw materials, and capital goods. On the other hand, indirect pass-through impacts indirectly, Sato, *et al* (2005) through the shock on demand and offer.

The method used in this research is Vector Error Correction Model (VECM), this model is used within a non-structural VAR model if the time series data is not stationary within level, but stationary within differentiated and co-integrated data, hence shows a theoretical relationship within variable. Therefore, this method is suitable to be used in this research (Widarjono, 2013). This research aims to analyzethe influence of shock index, consumer index, and rupiah exchange value towards USD, Import Price Index, SBI Interest Rate within short-term and long-term period in Indonesia over the period of 1997Q3-2017Q4, how the pass-through degree characteristic of Consumer Price Index, the response of Consumer Price Index from the exchange rate shock of rupiah per dollar, import price index, SBI exchange rate and the contribution of each variant which contributes most toward inflation.

2. Research Methodology

The data used in this research was the secondary data in the form of time series. The period of data being used were from the quarter of 1997:W3-2017:Q4 with the number of 44 observation, all data were transformed in the form of natural logarithm. The data is acquired from Bank Indonesia, International Financial Statistic, and Organization Emerging Country Development (OECD).

Variable used in this research is Rupiah Exchange Value towards Dollar, Consumer Price Index, Import Price Index, and SBI Exchange Rate. Before being analyzed, the stationary of the data was then assessed, and it shows the long lag assessment. This was needed because the change of one explanation variable which can be seen after a certain period. Afterwards, a stability assessment of VAR/VECM is performed using roots characteristic polynomial. An Impulse Response Function (IRF) is performed afterwards. IRF identifies the impacts of interference of a standard error as the innovation towards a certain endogen variable towards other endogen variable, hence a period length of shock of a certain variable towards other variables can be seen, showing the impacts of missing and return of stability. The aims of Variance Decomposition analysis to measure how big the contribution is and the composition of impacts of each independent variables generated-shock towards dependent variable (Firdaus, 2012). The Variance Decomposition analysis results the explanation about how big and how much is the shock proportion of shock of one variable towards the mentioned variable and other variables (Basuki and Yuliadi, 2015). In addition, the calculation of pass-through degree is performed.

The calculation method of pass-through degree refers to the Hyder and Shah (2004), McCarthy (2006) and Ito (2005) where Cholesky Decomposition is used to identify structural interference and calculate pass-through degree through impulse response analysis. The coefficient (degree) of pass-through is calculated according to impulse response cumulative from exchange rate shock toward price and the exchange rate shock to the exchange rate itself.

$$\text{Pass-Through Degree} = \frac{\sum_{i=1}^{n} \varphi_{nt}^{ihk}}{\sum_{i=1}^{n} \varphi_{nt}^{e}}$$

In which:

$\sum_{i=1}^{n} \varphi_{nt}^{p}$ = cumulative response of IHK toward the innovation of exchange rate shock and from the first horizon until -n

$\sum_{i=1}^{n} \varphi_{n}^{p}$ = cumulative response of exchange rate toward shock innovation according to the similarity of each IHK structural interference

3. Result and Discussion

The result of stationarity assessment happened within the index variable level, Consumer Index Price (IHK) in the significant number of 0,05. On the stationarity assessment of first difference level, all data are stationer within the significant level of 0,05.

The result of lag optimal assessment through the approach of Akaike Information Criteria (AIC), Final Prediction Error (FPE), and Hannan-Quinn Information (HQ), shows that the star mark was dominated by the fourth inaction level. To do the VAR/VECM estimation in this research two long lag numbers are chosen. This implicated that the response shown by the inflation variable in responding the change of endogen variable will be seen (the longest) after the second quarter after shock happened.

The stability assessment aims to identify whether the model being is stable or not to further identify the validity of Impulse Response Function (IRF) and Variance Decomposition (VD). The result of the VAR/VECM estimation can be marked stable if all AR roots values have a smaller modulus value from one and all the points of Inverse Roots of Characteristics Polynomial result is in the unit circle (Basuki and Yuliadi, 2015).

TABLE 1: Result of VAR/VECM Stability System Assessment.

Root	Modulus
0.977867	0.977867
0.686812 - 0.348555i	0.770195
0.686812 + 0.348555i	0.770195
0.710362 - 0.153906i	0.726843
0.710362 + 0.153906i	0.726843
0.593548	0.593548
-0.055565	0.055565
0.048222	0.048222
0.686812 - 0.348555i	0.977867
0.686812 + 0.348555i	0.770195
0.710362 - 0.153906i	0.770195
0.710362 + 0.153906i	0.726843
0.593548	0.726843
Source: result of the researcher-processed data using E-views 9 (2018)	

Table 1 shows the result of stability assessment through a stable and valid VAR/VECM model since all modulus value are less than one, hence it can be concluded that VAR/VECM model is valid for further analysis using Response Function (IRF) and Variance Decomposition (VD).

Furthermore, a co-integration assessment is performed using Johansen Cointegration method (Basuki and Yuliadi, 2015). If the trace statistic value or max-eigen statistic is smaller than the critical value, the data has a short-term stability. Otherwise, if the trace statistic or max-eigen statistic is bigger than the critical value, the data experience co-integration or shows the long-term stability.

TABLE 2: The VAR/VECM Co-integration System Assessment.

Trace Statistic	0.05 Critical Value	Prob**	Max-Eigen Value	0.05 Critical Value	Prob **
58.56228	47.85613	0.0036	0.371881	27.58434	0.0048
23.68532	29.79707	0.2141	0.170260	21.13162	0.3652
9.687133	15.49471	0.3056	0.103831	14.26460	0.3566
1.465203	3.841466	0.2261	0.019346	3.841466	0.2261

Source: researcher-processed data using E-Views 9 (2018)

Based on the co-integration assessment on Table 2, it shows that the probability value of trace statistic has three co-integration equation in the significant level of 0,05, while the max-eigen statistics probability value shows that there are three co-integration equation in the level of 0,05. This assessment concludes that trace statistics value is bigger than the max-eigen statistics value at 5%. Both results concludes that there is a long-term relationship between variables, hence the research can utilize VECM estimation model.

The VECM estimation result in the exchange rate pass-through model can be marked significant if the value of t-statistics shows a bigger value compared to the t-table value at 1,99125. The long-term impacts from the VECM estimation model is explained in in the second equation. The VECM estimation model can be seen from Table 3.

TABLE 3: VECM Estimation Result.

Variable	Coefficient	T-Statistics	Remarks
Long Term			
IHK(-1)	1.000000		
LNKURS(-1)	0.712717	[-2.11848]	Significant
LNINDEKS_HARGA_IMPOR(-1)	0.017500	[2.25375]	Significant
SUKU_BUNGA_SBI(-1)	1.134125	[3.18633]	Significant
Short Term			
D(IHK(-1))	-0.218865	[2.59616]	Significant
D(IHK(-2))	-0.050115	[-0.32263]	Not Significant
D(LOGKURS(-1))	1.631979	[1.05732]	Not Significant
D(LOGKURS(-2))	1.626359	[3.19893]	Significant
D(INDEKS_HARGA_IMPOR(-1))	-0.020855	[-0.53463]	Not Significant
D(INDEKS_HARGA_IMPOR(-2))	-0.042263	[2.32460]	Significant
D(SUKU_BUNGA_SBI(-1))	0.810822	[4.77207]	Significant
D(SUKU_BUNGA_SBI(-2))	0.297054	[1.23981]	No Significant
R-squared 0.936559			
Adj.R-squared 0.891686			
F-statistic 20.87143			

Source: Result from researcher-processed data using E-Views 9 (2018)

Table 3 reveals that in the long-term, all variables of research impacts significantly toward IHK inflation. Rupiah exchange rate impacts positively towards IHK inflation with t-statistic at -2.11848 > 1.99125. The import price index influences positively towards IHK inflation with t-statistic at -2.11848 > 1.99125. Import price index affects positively towards IHK inflation with t-statistics of 2.25375 > 1.99125. SBI Interest Rate also affects positively towards IHK inflation with t-statistics of 3.18633 > 1.99125. It is interpreted that if there was a increase rate of 1% in import price index variable, SBI Interest Rate, hence inflation will rise as much as the coefficient value sequentially at 2.25375 and 3.18633. If there is a 1% increase of the exchange rate, inflation will decrease to 2.11848.

The VECM estimation assessment in the short-term shows that exchange rate variable affects positively, also significantly toward inflation in the short-term run at the second lag at 3.19893 > 1,99125, which means that if there is a 1% increase of exchanger rate, the inflation will increase to 3.19893. The Import Price Variable also affects favorably and significantly towards short term inflation at the second lag at 2,32460 > 1,99125. SBI Interest Rate impacts favorably and significantly towards short-term run in the first and the third lag at 4.77207. It means that if 1% increase in SBI Interest Rate occurred, inflation will rise to 4,77207 at the first lag. The Model Suitability shows that the most selected models are sufficient enough since all variables can explain the IHK inflation variables at 93,66%, and the remaining 6,345 is explained by other impertinent factors of this research.

The IRF analysis aims to see how long is the shock received by one variable (Batubara &Saskara, 2013)

The changes of IHK during shock response to IHK variable at the first quarter shows that only interference caused by IHK inflation itself can be responded by the inflation at 0,27%, while the shock caused by other variables within model can be responded by the inflation in the second quarter. According to Figure 2, it can be seen that the impact of inflation variable shock itself can be responded positively above the stability in the second quarter at 0.27% thus some shocks within the quarter affects favorably and in the lowest response level in the 8th quarter at 0,05%. Generally, it was favorably responded. IRF inflation towards the variable itself also leads up to stability in the 34th quarter at 0,05%. The response of inflation level towards shocks on the exchange rates is responded negatively at the 2nd quarter at -0,04%, this result shows that the shock of rupiah exchange rate per dollar tends to be responded negatively by IHK inflation from the early period. Inflation level response towards shocks in import price index is also responded negatively in the 2nd quarter at -0,09%, which then followed by the surge of
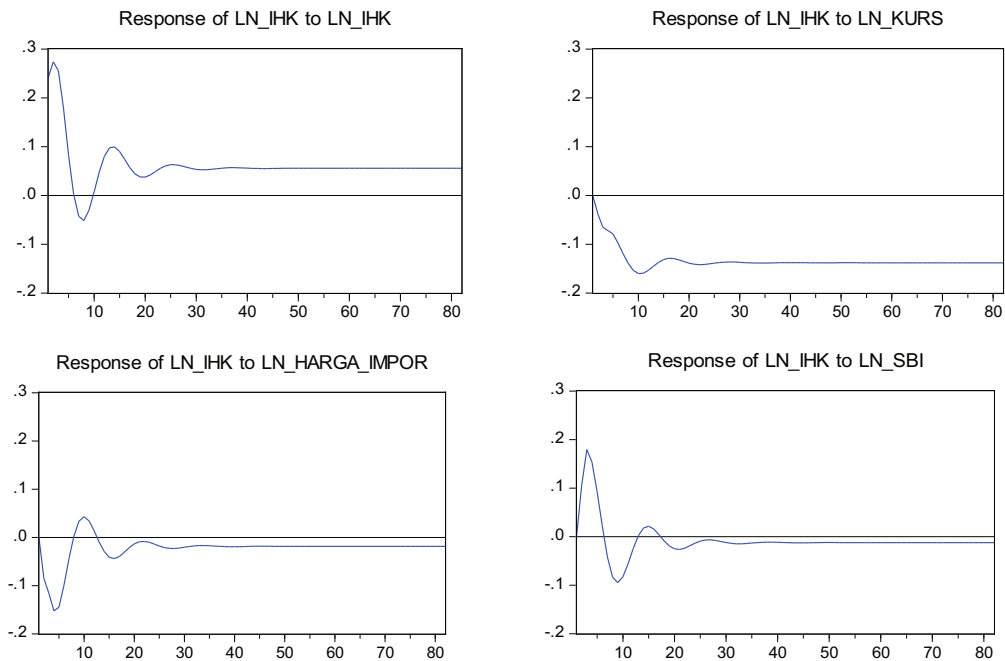
Figure 2: The Result of Impulse Response Function (Source: result from researcher-processed data (2018)).

its peak in the 10th quarter at 0,04%. A positive response is followed by a slump at the 16th quarter at -0,04% until it reaches stability in the 36th quarter.

The IRF result shows that the inflation level response towards shock in SBI Interest Rate just began to show its positive response at the 2nd quarter at 0,011%, which then identified at the 9th quarter to have a negative response at -0,09%. The SBI Interest Rate response leads to stability at the 3th quarter period.

The information acquired through Variance Decomposition (VD) assessment is the sequential flow proportion caused by the shock and other variables.

According to Figure 3, the result of variance decomposition analysis reveals that the inflation variable fluctuated at the first quarter affected by the internal inflation shock at 100%. At the first quarter, it is identified that there has yet been an influence from other economic variable in the model which is responded by inflation in the second quarter. In the 5th quarter, the IHK inflation impacts faces a significant decline until it reaches 84% and other variables explains that the influence in the 5th quarter is at 0,49% from rupiah exchange rate, import price index is at 2,45%, and SBI Interest Rate is at 1,3%.

In the 25th quarter, inflation fluctuation affected by the variable shock itself experiences another slump until it reaches 63%. Other variables explain the influence in the 25th quarter at 5,1% from rupiah exchange rate, import price index at 10%, SBI Interest Rate at 1,45%.
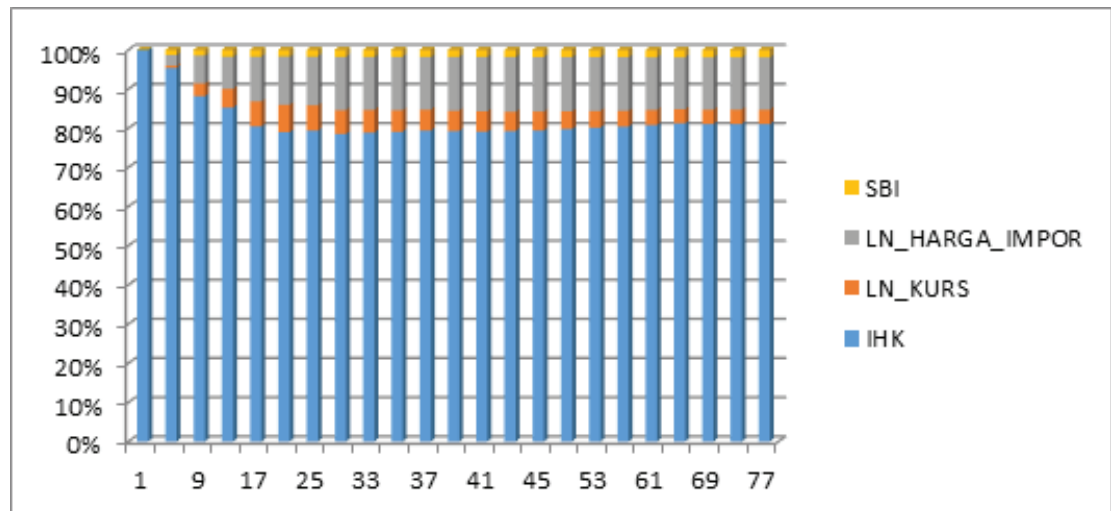
Figure 3: Result of Variance Decomposition VECM Analysis. (Source: result from processed-data through E-Views (2018), as attached).

At the 45th quarter period, inflation fluctuation affected by the variable shock itself faces another decline until it hits 64,5%. Other variables explain its influence at the 41st quarter at 3,9% from rupiah exchange rate, import price index at 11,2%, SBI Interest Rate at 1,5. In the 45th period, import price index is the variable which gives the highest influence compared to other variables except IHK inflation variable itself. Similar things happened at the 65th quarter period where inflation variable is affected by the variable shock itself which then caused decline to 66,95% and the most influential variables then becomes import price index at 11,1%.

At the 77th quarter period, inflation fluctuation affected by the shock of variable itself experiences another plunge until it reaches 67,2%. Other variables explain its impacts at the 77th quarter at 2,9% by rupiah exchange rate, import price index at 11%, SBI Interst Rate at 1,6%. In the 77th period, import price variable is the highest contributing variable compared to other variables except IHK inflation variable itself. Similar occurrence happens in the 65th quarter, where inflation variable is affected by the shock of the variable itself, which then faces decline to 66,95% and the biggest contribution is from import price index at 11,1%. Starting from the 37th quarter until the forecast of the 79th period, the value of import price index keeps dominating to the inflation variable at 11,07% while the contribution of each variable such as rupiah exchange rate is at 2,9%, SBI Interest Rate at 1,6%. It can be concluded that the variable with the highest composition to influence the consumer price index sequentially is the variable itself and the consumer index price, exchange rate, and SBI Interest Rate

The impacts of Rupiah Exchange Rate to USD towards IHK as referred to the previous research done by Hyder and Shah, 2004, it shows that the degree of pass-through is

calculated from the cumulative impulse response from exchange rate shock towards the price level divided by the exchange rate shock towards the exchange rate itself. This analysis also answers the first and second problems in this research. The accumulated effect of exchange rate changes towards IHK identified by pass-through degree within 82 quarters. Based on the assessment result, it can be analyzed that the IHK pass-through degree at -0,002% which can mean that the characteristic of the degree to be incomplete pass-through due to different value of 0 and 1 that can be interpreted if the exchange value is depreciated at 1% if IHK value is decreased to 0,002%. This is suitable with the economic phenomenon happening in Indonesia, if there is a rise in rupiah exchange rate to dollar, inflation will decline.

4. Conclusion

Based on the findings and discussion, it can be concluded that Consumer Price Index (IHK), Rupiah Exchange Rate per Dollar, Import Price Index, and SBI Interest Rate have a co-integrated relationship. Therefore, each variable in the short-term run tends to be connected and adjusted to reach the long-term stability. The pass-through degree characteristic is the incomplete pass-through and positive which means that if there is a 1% increase to exchange value hence creating a decline in IHK to 0,002%. The result of Impulse Response Function (IRF) assessment analysis reveals that IHK responds to all shock variable in this research both positive and negative. Shock variable of IHK faces the strongest response to the variable itself, then the import price index is responded strongly by consumer price index (IHK) at 0,73% at the 2nd quarter. This shows that shock import price index has the biggest influence which then responded by inflation. The Variance Decomposition (VD) analysis shows that between variables used in the research, the contribution of import price index shock variable is the biggest in affecting IHK and gives a relatively increasing tendency from time to time,

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