EXCHANGE RATE PASS THROUGH TO DOMESTIC PRICE IN INDONESIA BASED ON CONSUMER PRICES

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Abstract: *The aims of this research were to build the model of Exchange Rate Pass Through in Indonesia. The research used an analytical tool of Error Correction Model (ECM). The results show that the Exchange Rate Pass Through in Indonesia was 0.6. The effect of price ratio to consumer price in the short term was positive, but the long run it was negative. The effects of national income variable in the short term and long term were positive. The forward exchange rate has positive effect on consumer price in the short and long terms.*

Keywords: *Exchange Rate Pass Through, consumer price, Error Correction Model*

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INTRODUCTION

Along with changes in the exchange rate regime from fixed exchange rate to floating exchange rate, it further increased the interest in the study of Exchange Rate Pass Through. The change in exchange rate regime is one of the external adjustment components of inflation transmission. The changes in exchange rates to floating exchange rate since 1973 led to increasingly floating exchange rate volatility.

In general, economists have studied Exchange Rate Pass Trough since the 1970s (Goldberg & Knetter, 1997). The interest to look at the association of exchange rate and price was based on the desire for a test of the global monetarism base by examining the Law of One Price (LOP) and Purchasing Power Parity (PPP). Exchange Rate Pass Through (ERPT) is closely related to the Law of One Price (LOP) and Purchasing Power Parity (PPP) since the basis of ERPT is the law of one price and purchasing power parity. In the law of one price and purchasing power parity, they are related to the arguments of market efficiency and price dynamics. LOP states that all goods are identical and there is only one price in an efficient market. In an efficient market, price convergence occurs quickly. The convergence process of one price may occur through

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arbitrage among different markets, but the Law of One Price is not always applicable in reality. The reason is that, in commercial transactions, there are transaction costs and trade barriers, particularly for two markets between two countries. In other hand, in the theory of Purchasing Power Parity (PPP), the movement of exchange rates is sourced from the price levels between the two countries. According to the theory of Purchasing Power Parity, when purchasing power declines, it is followed by the depreciation of money proportionally in foreign exchange market.

There are so many studies on Exchange Rate Pass Through, but they mostly focused on the developed countries. (Bacchetta & van Wincoop, 2003; Beirne & Bijsterbosch, 2011; Hüfner & Schröder, 2002) examined the Exchange Rate Pass Through in Europe with the measurement of consumer price.(Rowland, 2004; Sheets, Vigfusson, & Marazzi, 2005; Taylor, 2000) examined the Exchange Rate Pass Through by measuring the import price in the United States. Meanwhile,(Choudhri, Faruqee, & Hakura, 2005; Gagnon & Ihrig, 2004; Sheets et al., 2005) studied in many countries by measuring import and export prices. There are not many research conducted on Exchange Rate Pass Through in Indonesia. The researches conducted in Indonesia were performed by (Arintoko, 2011; Wimanda, 2011).

As a country that adheres to open economy, the economy in Indonesia is highly affected by exchange rate movements. The exchange rate movements cannot be separated from the dynamics that occurs in the world and domestic macro economy. Since the application of free floating exchange rate system in Indonesia in August 1997, the exchange rate in Indonesia has very fluctuating. With the fluctuations in the exchange rate, the movement of the exchange rate is high.

Exchange rate fluctuation is the result of increasingly open economy known as globalization. Globalization engulfing the world today has changed the economy in various countries is increasingly open. The openness causes the flows of goods, services and capital which are increasingly easier to penetrate state borders. The borderless concept is strengthened along with the openness of domestic economy against foreign penetration. One of the macro-economic indicators which are sensitive to external economic shocks is exchange rate. In this case, exchange rate reflects the strength of an economy as a result of the penetration and effects of global economy. The changes in exchange rates will affect domestic economy, and one thing that is very sensitive is that it would affect domestic price.

The aim of this research was to build a model of Exchange Rate Pass Through in Indonesia. The Exchange Rate Pass Through measurements used consumer price. This research was intended to measure the Exchange Rate Pass Through indirectly or at the second stage. It was intended to be able to measure the changes of exchange rate to the goods consumed by people in Indonesia. The analytical tool used in this research was the Error Correction Model because, by using the Error Correction Model, the short-term and long-term impacts of the changes in the variables used in the research to consumer price variable in Indonesia can be identified.

The research results are expected to provide additional understanding of Exchange Rate Pass Through occurred in Indonesia, particularly Indonesia adheres Inflation targeting today. Furthermore, this research results can be used as a consideration in the making of international monetary policy.

The remainder of the article is organized as follows : literature review is presented in the second section. Research method is explained in the third section. The fourth section presents a result and discussion and fifth section presents conclusion.

LITERATURE REVIEW

The Basis of *Exchange Rate Pass Through*

The basis of ERPT is the Law of One Price (LOP). In the law of one price (LOP), it is mentioned that the same product is sold at the same price in different countries. The assumption used in the LOP is the presence of profit maximization and the absence of transportation cost, distribution cost and resale cost (Rogoff, 1996).

The law of one price is as follows:

$$p_i = Ep_i^* \tag{1}$$

Where $p_{i'}$ is the price of goods in local currency, p_i^* is the price of goods in foreign currency, and E is the exchange rate of local currency to foreign currency (Goldberg & Knetter, 1997).

This equation shows that the price of goods will be the same in every country. When the LOP is run in all countries for the same product, this leads to an integrated world market. When the LOP is maintained for all products between two countries, the theory of Purchasing Power Parity (PPP) applies (Goldberg & Knetter, 1997).

$$p = E \, p^* \tag{2}$$

Where p is the rate of domestic price and p^* is the rate of foreign currency

Assuming the absence of transportation, distribution and resale costs, it is difficult to find in practice so that the LOP and absolute PPP are later modified to:

$$p_i = \alpha Ep_i^* \tag{3}$$

The equation (3) is then called relative LOP (PPP) where α show the expenses, such as transportation and trade barrier costs. In the two equations, the change percentage of p_i is equal to the change percentage of E, and the other things are equal.

The open economy model of monetarists which was known in 1960s and early 1970s uses the assumption of absolute PPP and the same cost between two countries to reduce the theory of exchange rate behavior. The emergence of global monetarism is an important paradigm that encourages researches on the validity of this assumption.

The Factors Affecting Exchange Rate Pass Through

There were debates on the factors that affect ERPT. Some reviewed the aspects of macro and. The study of macro aspect states that the factors affecting ERPT are inflation and exchange rate volatility, and that of micro aspects states that the factors affecting ERPT are the level of product differentiation and market forces. The research of (Taylor, 2000) is a reference to the study of ERPT with macro study, the research of (J M Campa & Goldberg, 2005) examined the phenomenon of micro. Macro variables are the variables directly related to monetary policy implemented by monetary authorities such as inflation. The research results using macro variables show that ERPT degradation occurred after the 1990s was not permanent.

Meanwhile, from the study of micro, the research results show that the role of product differentiation is ambiguous as two different effects(Bussière & Peltonen, 2008); The first, the more differentiated a product, the higher the market power so that pass-through is higher. It is consistent with the research results of (Bacchetta & van Wincoop, 2003). Second, the more differentiated a product, the greater the effect of mark-up on pricing-to-market so that it causes the lower degree of ERPT (J M Campa & Goldberg, 2005).

In relation with the method used in the conducted research of Exchange Rate Pass Through, there are some using the analytical tools of single equation and Vector Autoregresive (VAR). The researches using single equation were conducted by (José Manuel Campa & Goldberg, 2002) and (Bouakez & Rebei, 2008) who used ECM (Error Correction Model). Meanwhile, the studies using the analytical tool of VAR were the studies of (Beirne & Bijsterbosch, 2011; Choudhri et al., 2005; Rowland, 2004; Zorzi & Hahn, 2007).

Estimation of *Exchange Rate Pass Through*

There are three studies in ERPT measurement. The first study measures ERPT in consumer price, the second one measures ERPT in import price, and the third measures ERPT value in export price.

The researches on ERPT relating the changes in exchange rate with consumer price index were conducted by (Bacchetta & van Wincoop, 2003; Beirne & Bijsterbosch, 2011). From the conducted research, it was found that ERPT working through Consumer Price Index is usually less sensitive to the changes in exchange rates since the Consumer Price Index within it is included in non-tradable goods (Sheets *et al.*, 2005; Zorzi & Hahn, 2007).

ERPT measurement in import price measures the price changes in a country that imports goods caused by the changes in exchange rates. The research was conducted by (Gopinath, Itskhoki, & Rigobon, 2010; Rowland, 2004; Taylor, 2000) who measured ERPT in America .(Bacchetta & van Wincoop, 2003; Gopinath *et al.*, 2010) had conducted the research of ERPT in import price in Europe, and (Bussière & Peltonen, 2008; J M

Campa & Goldberg, 2005; Choudhri *et al.*, 2005) conducted the study of ERPT in import price in many countries.

Model

A consumer consumes goods and services, and then consumer will get total utility. From here the utility function can be created, namely the function which shows the relationship between Total Utility and the goods consumed. It is assumed that consumers have the preference of Constant Elasticity Substitution (CES) to different goods so that the demand elasticity for individuals is assumed to be constant. In this research, consumers consume two kinds of goods; foreign goods and domestic goods, ceteris paribus, so that the utility function can be denoted as follows:

$$U = u(x^f, x^d) \tag{4}$$

Where u = Utility Function

x^f = Quantity of consumed imported goods

x^d = Quantity of consumed domestic goods

Based on the equation (4), consumers will maximize their utility by consuming a combination between x^f and x^d. Every consumer tries to achieve the highest level of utility, however, a consumer is constrained by his/ her income level. The constraint of utility function is budget constraint that can be denoted as follows:

$$I = P^f . x^f + P^d . x^d \tag{5}$$

$$P^f . x^f = I - P^d x^d \tag{6}$$

$$x^f = \frac{I}{P^f} - \frac{p^d}{p^f} x^d \tag{7}$$

From the equation of budget line, it can be found that the slope of the budget line is $\frac{p^d}{p^F}$. The amount of $\frac{p^d}{p^F}$ shows the ratio between domestic and foreign prices indicating the exchange rate. If there is an increase (foreign price), there will be a decrease in the value of domestic currency or domestic currency depreciation occurs. In the event of depreciation, the number of foreign goods consumed by individuals will decline. Consumer equilibrium occurs under the following conditions:

$$\frac{MU_x f}{MU_x d} = \left(\frac{p^d}{p^f} \right) \tag{8}$$

Where $MU_x d$ is the Marginal Utility of domestic goods, $MU_x f$ is the Marginal Utility of imported goods, p^d is the price of domestic goods, p^f is the price of foreign goods. In fact, when consumers consume domestic goods and imported goods are affected by

several factors such as level of income, price of domestic goods, price of foreign goods, and taste.

Expenditure switching will result in consumption changes between domestic goods and imported goods. The changes in the consumption of domestic and imported goods lead to the changes in exports and imports. From these changes, it will cause the changes in trade balance, which in turn will affect the changes in the exchange rate of a country.

Consumers consume domestic goods (x^d) and imported goods (x^f). According to Ramsey-Cass-Koopmas, the model of household *utility intertemporal* function can be denoted as follows:

$$(X^d, X^f) = \int_0^\infty e^{-\rho t} u(C_t) dt \tag{9}$$

$$C_t \mid \frac{p^d}{p^f}, s_t, GDP, s^f \tag{10}$$

Where $C(_t)$ is household consumption in time t. C_t is total consumption of domestic goods (C^d) and the consumption of imported goods (C^f).

$Ct = C^d + C^f$

u($_.$) is *instantaneous utility function*, showing consumer utility in particular time.

(X^d, X^f) is aggregate consumption in time t

e is natural number = 2,7128…….

ρ   is *discount factor.*(Romer, 2012)

$\frac{p^d}{p^f}$ is *Real Exchange Rate* (RER). *Real Exchange Rate* is the relative price of goods

between two countries (Krugman, Obstfeld, & Melitz, 2012).

GDP is Gross Domestic Product

s_t is nominal exchange rate, s^f is forward exchange rate

In the equations (9) and (10), the factor determining the combination between the consumptions of domestic and imported goods is the level of relative price between the price of foreign goods (P^f) and the price of domestic goods (p^d) which is *Real Exchange Rate*. Nevertheless, it is still conditional to nominal exchange rate, the level of income measured in GDP, and forward exchange rate.

The equations (4) and (5) are the theoretical framework for consumers in combining the consumptions of domestic and foreign goods. Then, in this research, the equations (9) and (10) were empirically tested using the model as follows:

$$(X^f, X^d) = f\left[\left(P^d\big/P^f\right), s_t, GDP, s^f\right] \tag{11}$$

Empirically, the changes (X^f, X^d) show the changes in *Trade Balance*, particularly for *consumer goods*. When (X^f, X^d) are greater, the changes in trade balance are getting more deficit.

From the equation (11), it can be explained that when a change in exchange rates (local currency depreciation), consumers change their consumption from imported goods to domestic goods since import price is more expensive. When consumers shift the consumption of import goods to domestic goods due to the changes in the exchange rate, it is called Expenditure Switching. In this research, it was assumed that substitution can occur between domestic and imported goods. From the equation (11), it is found that, instead of exchange rate factor, Expenditure Switching is not only affected by exchange rate, but also the price ratio between the prices of domestic and foreign goods, the level of national income and forward exchange rate.

The changes in the consumptions of domestic and foreign goods made by consumers will affect Aggregate Demand. The change in Aggregate Demand will affect the domestic price in Indonesia.

From the explanation above, the empirical models can be derived as follows:

$$P_k = \alpha_0 + \alpha_1 RP_t + \alpha_2 s_t + \alpha_3 GDP_t + \alpha_4 s^f{}_t + u_t \tag{12}$$

Where :

P_k is domestic price

RP   is ratio between the prices of domestic and foreign goods

s   is the exchange rate of Rupiah to Dollar

GDP   is the value of Gross Domestic Product

s^f is forward exchange rate

RESEARCH METHOD

Research Model

By using the model in the equation (12), it is then changed into the form of Error Correction Model (ECM) equation as follows:

$$\Delta P_k = \sigma + \beta_1 \Delta RP_t + \beta_2 \Delta s_t + \beta_3 \Delta GDP_t + \beta_4 \Delta s^f{}_t + \delta_5 RP_t(-1) + \delta_6 s_t(-1) +$$
$$\delta_7 GDP_t(-1) + \delta_8 s^f{}_t(-1) + \delta_9 EC_t + \varepsilon_t \tag{13}$$

Where σ is drift component, β_i is representing short run estimate, δ_i is representing long run estimate ε_t, is the white noise residual, $EC_t = RP_{t-1} + s_{t-1} + GDP_{t-1} + s^f{}_{t-1} - Pk_{t-1}$

In analyzing the data used, it was transformed into logarithmic form.

The data used in this research was the secondary data published by the Bank of Indonesia and the International Financial Statistic. The data used was the quarterly data from 1997.3 to 2013.3. the periods selected were the periods after 1997.3 because after the period of August 1997 Indonesia adheres to the regime of floating exchange rate.

Model Testing

One important concept in econometric theory is the assumption of stationarity. Thus, it is necessary to observe the behavior of time-series economic data used in this research. This means that the data used must be identified as stationary data or not. The method used was testing of unit roots and testing for degree integration.

Testing of Unit Roots

This test is conducted to determine the presence of spurious regression earlier and more definitely. The economic data which is not stationary causes spurious regression.

The stationary test was conducted using Dickey Fuller way and Augmented Dickey-Fuller (ADF) (Gujarati, 2004).

Testing of Degree Integration

Degree integration test is conducted when the data is not stationary at the time of stationary test. This test is intended to see at which degree the data is stationary. When a data used is not stationary, regression will produce a regression wit high determination coefficient (R^2) but it has low Durbin Watson statistic. This gives an indication that the regression resulted is a spurious regression. The consequences caused by spurious regression is that the estimator regression coefficient is not efficient, the forecasting using the regression is missed, and a common standard test for the associated regression coefficient associated is invalid.

In general, when data requires differentiation until d to be stationary, it can be expressed as I (d). This test is similar to the testing of unit root. Thus, it is is necessary to estimate the following autoregressive model for the test using OLS:

$$D2X_t = c_0 + c_1 BDX_t + \Sigma f_i B^i D2X_t \tag{14}$$

$$D2X_t = g_o + g_1 T + g_2 BX_t + \Sigma f_i B^i D2X_t \tag{15}$$

Cointegration Test

This research used Johansen's cointegration test. (Søren Johansen, 1988) and (S. Johansen & Juselius, 1990) had developed the testing procedures of maximum-likelihood to determine the cointegration of a number of variables (vector). Johansen suggested maximum likelihood estimator for the statistical test of Q and R to determine

the cointegration vector. The presence and absence of cointegration are based on likelihood ratio test (LR). When the calculated value of LR is greater than the critical value of LR, the presence of cointegration in a number of variables is accepted. Johansen provides the alternative LR statistical test known as maximum eigenvalue statistic.

RESULTS AND DISCUSSION

The Testings of Unit Root and Degree Integration

One important concept in econometric theory is the assumption of stasionarity. Thus, it is necessary to observe the behavior of time series economic data used in this research. It means that the data used must be identified whether the data is stationary or not. As it has been initially discussed, the methods used were the testing of unit roots, the testing for degree integration, and the Augmented Dickey-Fuller test (ADF).

Table 1
Testing of Unit Roots

Variable	Constant	Constant and Intersep	None
LP	-3,8821*	-3,2319***	5,1440*
LS	-4,8086*	-4,7410*	1,2858#
LRH	-3,9674*	-4,4239**	-1,1481#
LGDP	0,2290#	-7,9630*	2,2247#
LSF	-6,3167*	-6,7208*	-0,6536#

Notes:
*: stationary at 1%, ** : stationary at 5%, *** : stationary at 10%,
#: not stationary at 10 %
Source: Processed Data

Based on the calculations to the testing of roots units in Table 1, it was then compared with the critical value of Mac Kinnon, and it appears that the stationary variables used in this research at zero degree, either by using constants, trends and constants, and none (without trend and constant) are only the variable of consumer price (LPD). Therefore, it is necessary to conduct the testing of degree integration to determine at what degree the observed variables are stationary.

Table 2
Testing of Degree Integration

Variable	Intercept	Trend and Intercept	None
D(LPD)	-3,8616*	-4,2881*	-3,3931*
D(LS)	-6,1984*	-6,1954*	-6,1018*
D(LRH)	-3,9881*	-6,3470*	-6,1018*
D(LGDP)	-2,9096**	-2,9347***	-1,8847***
D(LSF)	-6,5553*	-6,8593*	-6,5733*

Notes:: stationary at 1%, ** : stationary at 5%, *** : stationary at 10%, #: not stationary at 10 %
Source: Processed Data

Based on the calculation results for the degree integration that can be seen in Table 2, it shows that all variables (LPD, LS, LRH, LGDP and LSF) are integrated at the first degree (I(1)).

Cointegration Test

Cointegration test is used to find a long term and stable association between the variables integrated at the same degree. The calculation results for the cointegration test can be seen in Table 3.

Table 3
Cointegration Test

Series: LPD LS LRH LGDP LSF
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.499495	119.7516	69.81889	0.0000
At most 1 *	0.472570	75.45487	47.85613	0.0000
At most 2 *	0.289194	34.51159	29.79707	0.0133
At most 3	0.179218	12.66481	15.49471	0.1277
At most 4	0.000389	0.024926	3.841466	0.8745

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
Source: Processed Data

Based on the cointegration test using Johansen method, it shows that the value of trace statistic is greater than the critical value, so it can be concluded that the variables used by the research period (LDP, LS, LRH, LDP and LSF) are cointegrated in the long term.

The Calculation Results of *Exchange Pass Through* to Consumer Price Using *Error Correction Model*

The followings are the regression analysis results of ERPT to consumer price in Indonesia.

The empirical analysis results as shown in Table 4 shows that the estimate by using Error Correction Model can be used. It can be seen from the Error Correction Term (EC) of was correct sign (negative) and statisticly significant at 5 persent. This indicates that the Error Correction Model specification used is correct. The analysis results shown in Table 4 are the analysis results that has already been corrected for the autocorrelation deviation. The treatment conducted to address the autocorrelation used AR (1).

Table 4
Regression Analysis Results of ERPT to Consumer Price Using ECM

Variable	Coefficient	Error Standard	T-statistic
Dependent Variable : D(LPD)			
C	-0.440216	0.263667	-1.669591***
D(LRH)	0.870567	0.033898	25.68192*
D(LS)	0.607172	0.105960	5.730207*
D(LGDP)	0.561413	0.090509	6.202831*
D(LSF)	0.626337	0.110724	5.656762*
LRH(-1)	-0.104722	0.021543	-4.861009*
LS(-1)	0.617260	0.100874	6.119112*
LGDP(-1)	0.433072	0.076327	5.673929*
LSF(-1)	0.630164	0.113310	5.561433*
EC	-0.620717	0.110513	-5.616701*
AR(1)	0.634550	0.108555	5.845444*
Diagnostic Test			
R2	0.981467		
F statistic	285.9676		
DW	1.771156		

Note: ** indicate significance at the 10% and * significance at 1%
Source: Processed Data

Based on the analysis conducted, price ratio in the short term has positive effect on consumer price. This is consistent with the existing theories; if the ratio of domestic price to foreign price increases, the price of consumer price increases. However, in the long-term, the variable of price ratio shows different effect from that of short-term. In the long term, price ratio has negative effect on consumer price.

Furthermore, the effect of exchange rate changes on consumer price which was the main focus of this research, based on the research results, indicates that the value of the Exchange Rate Pass Through in the short term and the long term is positive at 0.6. This means that the value is relatively stable over the changes in the exchange rate of Indonesian Rupiah to the US dollar on consumer price in Indonesia. The figure of 0.6 shows that; if the exchange rate changes at one percent, consumer price increases to 0.6. The figure is almost the same value as the research conducted by (Beirne & Bijsterbosch, 2011) who did a similar study with the research place in several countries in Europe. This is supported by the studies carried out by (Zorzi & Hahn, 2007) who conducted the research of Exchange Rate Pass Through viewed from consumer price in twelve developing countries. The results show that in developing countries with the inflation at one digit, the value of the Exchange Rate Pass Through is almost the same as that in developed countries.

In Indonesia, expenditure switching occurred; when the ratio of Rupiah exchange rate against other currencies increases, or, in other words, the depreciation of Rupiah will make the people of Indonesia replace their consumption of foreign goods with domestic goods. The increase in the consumption of domestic goods increased the consumer price in Indonesia, so it increased inflation.

For the variable of national income, the short-term and long-term effect of this variable is positive. It means that the increase in national income rises consumer price. The rise in national income increases public consumption since the value of the marginal propensity to consume is positive. If consumption increases, people's consumption will increase. The rising of consumption will consequently increase consumer price.

The analysis results show that, for the variable of forward exchange rate, the regression coefficient is positive in the short term and long term. This means that; if a depreciation to exchange rate is expected to happen in the future, consumer price will increase or there will be an increase in inflation.

CONCLUSION

From the analysis results, it can be concluded that the variable of price ratio has positive effect on consumer price in Indonesia, especially in the short term.The Exchange Rate Pass Through in Indonesia is incomplete at 0.6. This value is similar to that in developed countries in Europe. With the positive value of Exchange Rate Pass Through, it shows that expenditure switching occurred in Indonesia.National income has positive effect on consumer price in Indonesia because the increase in national income will lead to increased consumption in Indonesia. Forward exchange rate has the same effect as exchange rate; it has positive effect on consumer price in Indonesia.

Implication

The research results show that the effect exchange rate to inflation in Indonesia (as measured by import price) is positive with the ERPT value of 0.56. Then, it can be taken into the consideration for determining the inflation control policy in Indonesia. The direct effect of exchange rate changes on inflation is quite high so that the Bank of Indonesia should pay more attention to the changes in exchange rates in order to maintain the inflation rate in Indonesia.

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