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### The Effect Labor Wage and Exchange Rate on Inflation

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#### ABSTRACT

*This study aims to analyze the effect of changes in exchange rates on inflation in Indonesia. It is discussed changes in the exchange rate will affect the use of production factors, especially labor production factors which in turn affect inflation. The research was conducted in Indonesia, with a time period of 2000.1-2020.1. The data used is secondary data published by Bank Indonesia. The data analysis method used is multiple regression analysis with the Error Correction Model (ECM) method. The results showed that Error Correction Term was significant, so it could be concluded that the model specification was correct. In the short term, foreign wages have a positive effect on the inflation, while in the long term, foreign wages have a negative effect on inflation in Indonesia. Variable the level of domestic wages in the short term is not significant to inflation, while in the long term this variable has a negative and significant effect on inflation in Indonesia. The foreign price variable shows that the foreign price variable has an effect on the short and long term. For the exchange rate variable, the results of the study show that the exchange rate has a positive effect in the short and long term on inflation. The long term effect is greater than the short term. This shows that the Exchange Rate Pass Through which works through the use of labor in Indonesia has a greater impact in the long term.*

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#### INTRODUCTION

The exchange rate is an important determinant of economic activity and prices in open economies. Depreciation (appreciation) of domestic currency increases (reduces) the cost of imports expressed in domestic currency which is transmitted to domestic prices. Moreover, depreciation (appreciation) may

stimulate (depress) net exports by lowering (increasing) the cost of domestic products for foreign consumers, stimulating (depressing) the demand for domestically produced goods and hence their domestic prices.

In an open economy, exchange rate fluctuations have an impact on inflation. The impact of changes in the exchange rate on inflation propagates through a transmission mechanism known as the Exchange Rate Pass Through (ERPT).

Research on ERPT has been very much done. Research on this grows and develops in line with the increasingly open economy of a country. With economic openness, changes in exchange rates between countries will increasingly affect the economic activities of a country, either affecting the domestic economy or the country's export conditions.

Many studies on ERPT show that there is no uniformity regarding the definition of "pass through". Some researchers focus on the relationship between changes in exchange rates and import prices (Parsley, 2003) (Campa & Goldberg, 2005). Some other researchers have linked changes in exchange rates with the consumer price index ((Bacchetta & Wincoop, 2003) (Beirne & Bijsterbosch, 2011) (Bouakez & Rebei, 2008); (Hüfner & Schröder, 2002; Schröder & PHüfner, 2002). From the research that has been done, it turns out that Exchange Rate Pass Through which works through the Consumer Price Index is usually less sensitive to changes in exchange rates. This is because the Consumer Price Index includes non-tradable goods ((Vigfusson, Sheets, & Gagnon, 2007); (Zorzi, Hahn, & Sánchez, 2007).

There are two transmission lines for the impact of changes in the exchange rate on inflation, namely direct and indirect channels. Indirect transmission works through the demand pull side. In this case, the increase in the foreign currency exchange rate against the domestic currency will cause an increase in the price of foreign goods (imports). With the increase in the price of imported goods, domestic consumers will increase demand for domestic goods or services and reduce goods originating from abroad. This is known as expenditure switching. If there is an increase in the demand for domestic goods and services, there will be an increase in domestic prices, which in turn will encourage an increase in domestic inflation.

In direct transmission, changes in exchange rates will affect inflation through rising prices of imported goods. These imported goods can be in the form of consumer goods, raw materials and capital goods. An increase in the price of imported products will result in domestic inflation.

The production process requires input in the form of raw materials, capital goods and labor. The use of labor in the production process can use labor from within the country as well as from abroad. Changes in the exchange rate will result in changes in the wage rate which is the price of labor. Changes in the use of labor caused by changes in wage levels are an expenditure switching mechanism. Changes in the wage rate caused by changes in the exchange rate will affect the inflation rate indirectly. Here there is an indirect pass through mechanism.

This change in the use of production factors has an impact on production costs and will subsequently have an impact on domestic prices in the country, especially on wholesale trade prices. The purpose of this study is to determine the use of labor production factors on inflation in Indonesia.

## 1. LITERATURE REVIEW

Over the past two decades a large economic literature on exchange rate pass-through (ERPT) has developed. Starting from different stand-points, the empirical literature examines the role played by ERPT in small and large economies. Studies conducted for the case of developed countries include (Campa & Goldberg, 2005), (Gagnon & Ihrig, 2004), and (Ihrig, Marazzi, & Rothenberg, 2006). There is also a burgeoning literature applied to emerging market economies, including cross-country comparisons as in (Choudhri & Hakura, 2012), (Frankel, Parsley, & Wei, 2005) (Martina Jašová, 2016) and (Vigfusson et al., 2007) .

In subsequent developments, the ERPT studies are related to industrial characteristics, such as market structure and the nature of competition. With increasingly imperfect market structure, it encouraged the researchers to examine the ERPT in industry. One of the studies that had been conducted was the research of Freenstra (1989). The research showed that in monopolistic foreign markets, the response was the same (symmetrically) between the changes in exchange rates and the value of import tariffs.

The further studies were conducted by (Auer & Schoenle, 2012) which examined the relationship between ERPT and market structure. The result of the study by (Auer & Schoenle, 2012) found that : First, exactly the firms that react the most with their prices to changes in their own costs are also the ones that react the least to changing prices of competing importers. Second, the response of import prices to exchange rate changes is U-shaped in our proxy for market share while it is hump-shaped in response to the prices of competing importers. It show that both facts are consistent with a model based on (Dornbusch, 1985) that generates variable markups through a nested-CES demand system. The subsequent research that examined ERPT and market structure was the research conducted by (Ibid.). Dornbusch identified four factors that affected the level of pass-through to prices, i.e.: (i) the level of market integration or segmentation, (ii) the level of product differentiation, (iii) the functional form of demand curve, and (iv) market structure and the level of interaction between suppliers.

## 2. RESEARCH METHOD

### 2.1 Data

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 2000.1 to 2020.1. This period was chosen because during this period Indonesia used the floating exchange rate regime and in 2000.1 the macroeconomic data began to stabilize.

### 2.1 Research Model

To derive the research model, it begins by referring to the relationship between input and output shown in the Cobb Douglass production function which can be denoted as follows:

$$Y_t = A_t K L_t^{(1-\alpha)} \quad (1)$$

Where Y is the level of output,  $A_t$  is the level of technology in period t,  $K_t$  is capital in period t and  $L_t$  is a factor of labor production. The production function of Cobb Douglas is a production function at a certain period (static). In fact, the level of production is dynamic, and the level of production is intertemporal. Then, the input used is also dynamic.

In carrying out the production process, producers need inputs (factors of production). In this study, the inputs used are capital and labor inputs. The capital used can be from domestic capital and foreign capital. The labor used by producers can be from domestic workers and foreign workers. In this study focused on the use of labor input. Producers in Indonesia in carrying out production are very sensitive to changes in exchange rates, because the inputs used by producers are mostly inputs that must be imported. If there is a change in the exchange rate, producers will respond to the composition of the use of capital inputs and labor used. Changes in input prices (capital and labor) affect the production costs incurred by producers. Thus changes in the cost of capital will affect price changes and the mechanism will work through Aggregate Supply.

This labor input (L) is an effective labor, namely the amount of labor requested where the amount depends on the goods and services produced (Romer, 2012). Effective labor can consist of workers who come from within the country ( $L^d$ ) and workers who come from abroad ( $L^f$ ).

$$L^t = L^d + L^f \quad (2)$$

Between these two types of labor can be substituted for each other. If there is a change in the price of labor, namely labor wages ( $w$ ), for example due to changes in the exchange rate, it will affect producers in using labor inputs. In the equation, the factor that determines the combination of foreign workers and domestic workers is the foreign relative wage rate ( $w^f$ ) relative to the domestic wage level ( $w^d$ ). However, this is still conditional on another factor, namely the exchange rate ( $s$ ).

The combination of foreign workers and domestic workers stated in equation (2) is a static balance. Under these conditions, investors' decisions have not taken into account the expectations in the future. In reality, investors will consider future expectations. When there is an increase in the wage rate of foreign workers, an investor still uses foreign workers more, if an investor expects that the domestic exchange rate will depreciate in the future. The same thing will be considered for investors if there is a change in the relative price between prices from abroad and domestic prices. Thus equation (2) can be expressed in intertemporal form as follows:

$$(L^f, L^d) = \int_{t=0}^{\infty} e^{-\rho t} u(\pi_t) dt \quad (3)$$

$$\pi_t | \left( \frac{w^f}{w^d} \right), s_t, \left( \frac{p^f}{p^d} \right) \quad (4)$$

Where:  $u(\pi_t)$  is the use of labor input in period of  $t$ .  $\pi_t$  is the total use of labor from abroad and from domestic.

$L_t$  is the total of domestic workers ( $L^d$ ) plus foreign workers ( $L^f$ ).

$$L_t = L^d + L^f \quad (5)$$

$u^*$  is an instantaneous utility function, which shows the utility of labor at a given time.

$(L^d, L^f)$  is the aggregate labor force at time  $t$ . (6)

$e$  is a natural number = 2.7128.....

$\rho$  is the discount factor

The equations (3) and (4) are theoretical frameworks that explain investors' decisions in combining foreign workers and domestic workers. Based on equations (5) and (6), the theoretical equations are as follows:

$$(L^f, L^d)_t = f \left[ \left( \frac{w^f}{w^d} \right)_t, s_t, \left( \frac{p^d}{p^f} \right)_t \right] \quad (7)$$

Empirically the change of ( $L^f, L^d$ ) indicates worker remittances (labor remittances).  $\left( \frac{w^f}{w^d} \right)$  is the ratio of the foreign wage rate to the domestic wage rate,  $s_t$  is the nominal exchange rate,  $\left( \frac{p^d}{p^f} \right)$  is the ratio of foreign prices to domestic prices. From the equation (7) it can be interpreted that changes in the exchange rate will be responded to by producers in the use of labor inputs used. If there is a depreciation of the exchange rate, then the input price becomes more expensive, resulting in an expenditure switching mechanism. In this case, producers replace the use of labor inputs from abroad with labor inputs originating from within the country. However, labor inputs cannot be perfectly substituted, so producers cannot replace all workers from abroad with workers from within the country. With conditions like this, the cost of labor will increase, so that production costs will be more expensive. The increase in production costs due to the increase in labor costs will cause an increase in prices working through Aggregate Supply.

Furthermore, the equation (7) is transformed into logarithmic form so that the following equation is obtained:

$$p^d = \sigma_0 + \sigma_1 w^f - \sigma_2 w^d + \sigma_3 s_t - \sigma_4 p^f \quad (8)$$

Where:

$$\sigma_0 = \frac{\mu_0}{\mu_4}$$

$$\sigma_1 = \frac{\mu_1}{\mu_4}$$

$$\sigma_2 = \frac{\mu_2}{\mu_4}$$

$$\sigma_3 = \frac{\mu_3}{\mu_4}$$

$$\sigma_4 = \frac{\mu_4}{\mu_4}$$

Where:

$p^d$  is the domestic price.

$w^d$  is the domestic wage rate.

$w^f$  is the foreign wage rate.

$s_t$  is the rupiah exchange rate to the dollar.

$p^f$  is the foreign price.

Based on the equation (8) which is the basic model of the research, and then it is transformed to the Domowitz and Elbadawi Error Correction Model as follows:

$$\Delta p_t^d = c_0 + c_1 \Delta w_t^f - c_2 \Delta w_t^d + c_3 \Delta s_t - c_4 \Delta p_t^f + c_5 w_{t-1}^f - c_6 w_{t-1}^d + c_7 s_{t-1} - c_8 p_{t-1}^f + c_9 ECT_{t-1} + \varepsilon_t \quad (9)$$

$$\text{Where: } ECT_t = w_{t-1}^f - w_{t-1}^d + s_{t-1} - p_{t-1}^f - p_{t-1}^d \quad (10)$$

## 2.3 Variable Operational Definitions

Variable	Symbol	Measurement	Unit	Source
<i>Dependent variable</i>				
Domestic Price	$p^d$	Wholesale Price Index	-	Internatioanal Financial Statistic
<i>Independent variable</i>				
Domestic wage rate	$w^d$	Average nominal wage for industrial workers under foreman (for all industries)	Thousand Rupiah	From the available data, then calculated in the index
Foreign Wage Rate	$w^f$	Hourly Wage Index in America	-	
Exchange Rate	$s_t$	Rupiah to Dollar exchange rate, middle exchange rate	Rupiah/US \$	International Financial Statistic
Foreign Exchange Rate	$w^f$	Consumer Price Index in America	-	International Financial Statistic

## 2.4 Data Analysis Method

The methods and stages of analysis in this research included unit root test, integration test and cointegration test. The unit root test was used to observe whether the variables in the study are stationary in the long run. The tests were carried out using Augmented Dickey Fuller (ADF). The Dickey-Fuller unit root test model was used to determine whether time series data is stationary or not using autoregressive estimation, i.e.:

$$\Delta X_0 = a_0 + a_1 BX_t + \sum_{i=1}^k d_i B^i \Delta X_t + e_i \quad (11)$$

$$\Delta X_0 = c_0 + c_1 T + C_2 BX_t + \sum_{i=1}^K d_i B^i \Delta X_t + e_i \quad (12)$$

Note:

$$\Delta X_t = X_t - X_{t-1}$$

$$BX_t = X_{t-1}$$

T = time trend,  $X_t$  = observed variable in period t ,

B = lag time operation upstream

k = the amount of lag time where  $k = N^{1/3}$ , N is the number of samples

DF also helps to determine the degree of integration of the existing data whether the distribution is I(0), I(1), or I(2).

The degree of integration test is carried out if the data is not stationary at the time of the stationarity test. This test is intended to see to what degree the data is stationary. In general, if a data requires differentiation up to d to be stationary, it can be expressed as I(d).

The cointegration test is a continuation of the unit root test and the degree of integration. Cointegration test is intended to test whether the resulting regression residual is stationary or not [13]. To perform the cointegration test, the researcher first needs to observe the behavior of the time series economic data that will be used. This means that the researcher must be sure whether the data used is stationary or not. Tests that can be carried out are unit roots and degrees of integration (Insukindro, 1992). If one or more variables have different degrees of integration, then these variables cannot be cointegrated (Insukindro, 1992). In general, most discussions on related issues focus on variables that integrate 0, I(0) or first degree I(1). An important feature of first degree I(1) is that a variable can be a linear combination if integrated at the degree 0, I(0).

### 3.RESULT AND DISCUSSION

#### 3.1 RESULT

##### 3.1.1 Unit Roots and Integration Degree Tests

To test the stationarity of the data in this study, the testing of unit roots and the testing for integration degree were carried out.

**Table 1.** The testing of unit roots

Variable	Intercept	Trend and Intercept	Without Trend and Intercept
LPPI	-3,1302***	-3,3334***	3,6177#
LWf	-3,4609#	0,6288#	1,2483#
LWd	-2,7863***	-1,6263#	-5,6092#
LS	-4,8086*	-4,7410*	1,2858#
LPf	-3,9674*	-4,4239**	-1,1481#

Source: primary data processed (2021)

Note: \*: stationary at 1%, \*\*: stationary at 5%, \*\*\* : stationary at 10%; #: not stationary at 10%

Considering the ADF value, it appears that all the variables used in the study, if detailed with the ADF calculation by paying attention to the intercept, trend and intercept elements and not using intercepts and trends, show that each variable used in the study is the wholesale price index, domestic wage levels, foreign wage rates, exchange rates, foreign prices there are still elements that are not stationary at 10%.

For this reason, it is necessary to test the degree of integration to determine to what degree the observed variables will be stationary. The following is a test of the degree of integration that is used to see to what degree the variables will be integrated.

**Table 2.** Testing of Integration Degree

Variabel	Intersep	Tren dan Intersep	Tanpa tren dan Intersep
D(LPPI)	-5,4179*	-5,7740*	-4,6108*
D(LWD)	-7,3878*	-7,8499*	-1,6762***
D(LWF)	-1,6930#	-7,6319*	-1,1581#
D(LS)	-6,1984*	-6,1954*	-6,1018*
D(LPf)	-6,5553*	-6,8593*	-6,5733*

Source: primary data processed (2021)

Note : \*: stationary at 1%, \*\* : stationary at 5%, \*\*\* : stationary at 10%,

#: not stationary at 10%

Based on the calculation results in Table 6.9, it can be seen that the large trade price index, domestic wage rate, foreign wage rate, exchange rate, foreign price, forward exchange rate, domestic labor and foreign labor are integrated at degree 1, I(1). The next stage is a data cointegration test.

### 3.1.2 Cointegration Test

After finding that the variables used in this study have the same degree of integration, which is integrated at the first degree, then the next step is to perform a cointegration test. Based on the cointegration test, which can be seen in appendix 2, the results show that the trace statistic value is 159.5977 which is greater than the critical value (69.8189). Thus, it can be concluded that the large trade price index, domestic wage rate, foreign wage rate, exchange rate, and foreign price are cointegrated in the long run.

### 3.1.3 Exchange Pass Through Estimation results in terms of Labor Use.

The followings are the results of regression analysis using the Error Correction Model (ECM) to examine ERPT in terms of labor usage.

**Table 4.** ERPT Regression Estimation Results by using ECM

Dependent Variable: D(LPPI)

Variable	Coefficient	t statistic
C	-8,6612*	-7,0480
D(LWF)	0,5040*	13,2474
D(LWD)	7,53E-05#	0,1436
D(LS)	0,0738**	2,0441
D(LPF)	3,2750*	7,9845
LWF	-0,4802*	-13,1347
LWD(-1)	0,4794*	13,0712
LS(-1)	0,3753*	10,2493
LPF(-1)	1,1130*	3,6420
ECT3A	-0,4786*	-13,0649
AR(1)	-0,5532*	-6,1632
R <sup>2</sup>	0,9239	
F statistic	36,4645	
Breusch Godfrey	7,7976	
ARCH	2,0638	

Source: primary data processed (2021)

Note : \*: stationary at 1%, \*\* : stationary at 5%, \*\*\* : stationary at 10%,

#: not stationary at 10%

The results of the analysis can be seen in Table 4. Based on Table 4 it can be seen that the value of the Breusch Godfrey serial correlation LM test, the Chi squared probability value is 0.0504 where this value is greater than 0.05. Thus, it can be concluded that the model is not subject to autocorrelation problems. Furthermore, for the detection of heteroscedasticity using the ARCH method, the Chi square probability value is  $0.1508 > 0.05$ , so it can be concluded that the model does not experience heteroscedasticity problems.

## 3.2 Discussion

The results of the analysis shown in Table 4 can be seen that the ECT (error correction term) value in the model is  $-0.478601$  and significant at 0.00. The significance of the ECT value indicates that the model specification is valid and there is cointegration between the variables used in the model. The negative sign of the ECT value indicates that the trend in the analyzed model is toward equilibrium in the long run. How fast it goes to equilibrium is dependent on the coefficient of error term which indicates the speed of adjustment towards equilibrium.

Based on the estimation results in the short term, foreign wages (LWF) have a positive effect on the wholesale trade price index, meaning that an increase in foreign wages will increase the cost of foreign labor. With the increase in labor costs, it will cause an increase in production costs. This will result in an increase in the wholesale price index in Indonesia. This is in accordance with cost push inflation. The cost push inflation model is based on the idea that the main factor in price increases is rising costs (Banerji, 2005). Meanwhile, in the long term, foreign wages are responsive to the large trade price index, but the effect is negative. In the long run, if there is an increase in wages abroad, foreign workers will choose to work in countries with higher wages. Labor preferences will of course choose a higher wage than the Indonesian state. With the increase in the level of wages abroad, foreign workers will move abroad so that the cost of factors of production for foreign workers decreases, so that the wholesale trade price index in Indonesia decreases.

The domestic wage rate variable (LWD) in Indonesia based on the estimation results has shown insignificant results in the short term. This is because in Indonesia what happens is that the wage rate is determined by inflation. The adjustment of the Regional Minimum Wage (UMR) in Indonesia is corrected by the inflation rate in Indonesia, not the other way around. Meanwhile, the domestic wage level is responsive to the large trade price index in the long run. An increase in domestic wages will lower the wholesale price index. This indicates that wages in Indonesia in the long run are not a significant contributor to the increase in the wholesale price index in Indonesia. The results of this study are not in line with the theory of (Lafèche, 1996), (1996) regarding the Exchange Rate Pass Through path. In this theory, it is explained that in the direct path, the effect of changes in labor wages on inflation is positive, meaning that if there is an increase in labor wages, it will increase inflation. The results of this study are in line with research conducted in Mexico. The results of research in Mexico from 1980.1 to 2008.8 show that labor costs have a positive effect on inflation. Meanwhile, in the long term, the level of domestic wages in Indonesia has a positive effect on the large trading price index.

For the exchange rate variable (LS) the magnitude of the effect of the exchange rate on the wholesale price index in the short term is 0.07, meaning that when there is a depreciation of the exchange rate in Indonesia, it will cause an increase in the wholesale price index. In general, developing countries are dependent on imports of technology, intermediate goods and capital.

The depreciation of the local currency will greatly affect inflation, because the market power of domestic companies is strongly influenced by imported capital goods. Depreciation of the exchange rate will cause the price of goods to be cheaper abroad so that the demand price will increase. What is different is the result of the estimation of the long-term effect of the exchange rate on the wholesale price index, which is negative at 0.3753, meaning that when there is an appreciation of the exchange rate in Indonesia, it actually results in a decrease in domestic prices in Indonesia (deflation). The phenomenon that occurs in Indonesia is more often depreciation than appreciation. If there is an appreciation of the exchange rate, the prices of Indonesian products will be more expensive abroad. When the price of Indonesian products is more expensive, the demand for Indonesian products that do not have strong compet-



itiveness compared to products from developed countries causes production in Indonesia to decline. This will lead to a decrease in the wholesale price index in Indonesia in the long run.

The results of the foreign price variable (LPF) show that this variable is responsive to domestic prices in the short and long term. The influence of foreign prices is positive in the short and long term, meaning that when there is an increase in foreign prices, the wholesale price index will also increase. This is in line with the globalization of the world economy, changes in foreign prices will soon have an impact on domestic prices, which is known as imported inflation.

The results of the analysis of the effect of exchange rate changes on domestic prices from the labor market show that the influence of domestic variables from the labor market, namely the wages of domestic workers and the number of domestic workers, has no effect on the wholesale price index in the short term. Even in the long term, domestic wages and the number of domestic workers actually have a negative effect on the wholesale price index.

In the short term, factors that contributed to the wholesale price index came from abroad, namely foreign wages, exchange rates, foreign prices and the number of foreign workers. This indicates that in the short term changes in the wholesale price index are dominated by factors originating from abroad. Changes in macroeconomic variables from abroad have more of a role to play in changes in the wholesale price index. The results of this study indicate that the problem of inflation in Indonesia tends to be globe centric, meaning that inflation in Indonesia is caused more by global problems rather than by domestic sources of inflation.

## CONCLUSION

Based on the analyzed before, it concluded that Exchange Rate Pass Through in the long run is bigger than in the short run. The results of the variables influencing the wholesale prices in the short term are tingkat upah luar negeri, nilai tukar dan tingkat harga luar negeri. Meanwhile, in the long term, the variables that affect the wholesale prices are the foreign wage rate, the domestic wage rate, the foreign exchange rate and prices. This indicates that in the short term changes in the wholesale price index are dominated by factors originating from abroad. Changes in macroeconomic variables from abroad have more of a role to play in changes in the wholesale price index. The results of this study indicate that the problem of inflation in Indonesia tends to be globe centric

**Implication.** The research results show that the effect exchange rate to inflation in Indonesia (as measured by whole price) is positive with the ERPT value of 0.2308 in the short run and 0.8373 i the long run. 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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