THE DETERMINING FACTORS OF CURRENCY REDENOMINATION SUCCESS: EXPERIMENTAL AND HISTORICAL APROACH

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Abstract

Redenomination is a simplification of nominal value of currency by reducing digit (zero number) without reducing the real value of the currency. The main objective of this research was to examine whether the economic conditions at the time of redenomination may affect the success of currency redenomination. The methods used were regression analysis on historical data of 30 countries which are involved in redenominating their currencies, economic experiments with t-test, and survey of people' perspective.Based on regression analysis, inflation will decrease and economic growth will rise higher after redenomination, if previously a country have experienced high economic growth as well. Based on experimental research, when inflation was high, redenomination could increase the selling price. Otherwise, when inflation was low, redenomination could decrease the selling price. Changes in selling price after redenomination was not affected significantly by differences in economic growth conditions. In different economic conditions, redenomination policy did not significantly affect the changes number of transactions and total value of transactions in the market. From the survey results, public did not believe government can control inflation after redenomination. Redenomination also will not affect consumption pattern.

Keywords: Redenomination, Inflation, Economic Growth, Experiment

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I. INTRODUCTION

Redenomination is a simplification of nominal value of a currency by reducing digits (zero number) without reducing the real value of the currency. Bank Indonesia (BI) has planned the redenomination of Rupiah by reducing three zero digits of the currency value, goods prices as well as wages. Too big nominal value of a currency reflects that in the past, a country had encountered high inflations or it had experienced a pretty bad economic fundamental condition (Kesumajaya, 2011). Moreover, if a country constantly encounters a high inflation every year, the value of the currency towards the goods will be lower (Amir, 2011). 55 countries have redenominated, some of them result in success and some result in failure. One of the indicators of the redenomination application success is the inflation rate after the redenomination being applied. It will be considered a failure if a high inflation or a hyperinflation happens after the implementation.

Nowadays, Indonesia, that plans to perform redenomination, has encountered some turmoil and instabilities in its both currency value and inflation rate. Before its independence, in 1944 the value of Rupiah was almost as valuable as USD; Rp 1,88 per USD. Then on March 7th 1946 the value crash of Rupiah happened for the first time as much as 30 percent, so it was Rp 2,65 per USD. In 1950 the government performed sanering of Rp 5 and above so the value became only half of the previous value. The government then performed the second sanering on 25th August 1959 by cutting the value of Rupiah.

The high rate of inflation results in the weakening of currency value. This can be seen that in 1960s, Indonesia encountered an extremely high hyperinflation that hit its peak in 1966 as much as 1136 percent. Subsequently, in 1971 the value of Rupiah was depreciated and it reached the value of Rp 415 per USD (*World Bank*, 2012). After 68 years of independence, the value of Rupiah now is about Rp 9.700 per USD. That more depreciated value becomes one of the government's reasons to have determination to boost Rupiah's prestige. This moment is considered right because Indonesia's current inflation rate is relatively stable in the last few years. Even, it can be declared that the inflation is creeping (creeping inflation) in type or occurs in around one digit every

year. This constant inflation reflects price stability for some goods that form consumers' price level.

The government aims at increasing Rupiah's credibility is a positive effect of redenomination, yet its implementation also has negative effects. One of them is the people's misperception that they think it is a sanering. Sanering is a policy of omitting zeros in a currency, yet this cutting is not done to the goods price so the people's purchasing power decreases. This people's misconception of redenomination may cause a state of panic resulting in economic situation turmoil. In addition, redenomination will increase companies and banking operational expenses because they have to replace their information and technology system. They certainly need some time to implement new accounting technology to adjust to nominal simplification. Bank Indonesia will also spend high expense to issue new redenominated money as well as public dissemination. Redenomination will also cause other social effects in terms of public distrust to Rupiah (Kesumajaya, 2011).

According to Wibowo (2013), an effect that will come into view because of this currency nominal change is the emergence of psychological bias so called money illusion. Most people will assume that goods price is cheaper because of the omission of zeros from the previous currency. For instance, there is an escalation of goods price as much as of Rp 7.000, consumers will find this very hard. However, after redenomination the escalation is only Rp 7 and they will find it trouble-free whereas they have exactly the same value. Consumers pay less attention to the re- scaling process of the old Rupiah nominal value to the new one. Money Illusion will affect the consumers more when they review the real value of goods they have bought because of the simultaneous nominal change. Redenomination drives into bigger consumption behavior. New prices are perceived cheaper because of *money illusion* and consumers' willingness to pay increases. By seeing this people's behavior, producers will escalate the price up to consumers' tolerated limit.

Pros and cons of redenomination policy scheme reflect a public speculation about unpredictability of consequence that might happen if redenomination of Rupiah is implemented at the moment. Research on probable effects needs to be scientifically investigated through experimental method. According to Juanda (2010) the data of

experiment results will be more easily interpreted in the effort of concluding causal relationship compared to data of survey result or secondary data. This investigation is aimed at noticing contributing factors to the success of the currency redenomination. The factors are economic condition when redenomination policy is implemented. The condition covers among others inflation rate. The success of redenomination can be seen through the change of inflation rate and the economic growth after redenomination being implemented.

The scope of this study is divided into three sections. First, it gives identification of contributing factors to the success of redenomination policy in a country through a study to secondary data that come from some historical information of countries that have redenominated. Second, it analyzes the impacts of Rupiah redenomination policy on the behaviors of economic subjects (pelaku ekonomi). The behaviors effects of the subjects will be further investigated to see the economic performance (kinerja perekonomian). Third, it records people's perspective as producers and consumers on the currency redenomination policy. In the effort of investigating the second section of this study, the data used will be gathered through experimental method. The economic performance being investigated, like inflation rate and economic growth will be viewed based on the change of the number of transaction and the average prices after redenomination generated from the responses of experiment simulation. The term redenomination in this paper refers to the policy of three zeros reduction in the value of Rupiah, price unit, wage unit (unit harga, unit upah) and everything valued by the currency.

II. THEORETCAL REVIEW

2.1 The Linkage of Redenomination and Economic Performance

There are relatively not many studies investigating the role of redenomination in economic performance. Yet, there are some opinions stating that a country's decision to redenominate is strictly influenced by the prior economic condition. Additionally, the change of economic indicators in a country can also be influenced by the implementation of currency redenomination policy.

Suhendra and Handayani (2012) investigated the connection between redenomination policy and the inflation rate, exchange rate, economic growth and

export value (nilai ekspor). The data on the economic indicators of 27 countries redenominated showed that inflation and economic growth were two variables significantly influenced by currency redenomination. Meanwhile, the high inflation rate was the most dominant driving factor for a country to decide to redenominate its money value. This finding is in line with what Mosley (2005) says that the current and the past inflation are the most important predictors whether or not to redenominate.

Iona (2005) investigated long-term advantages of redenomination, reasons of redenomination implementation timing, their influence to the price. The result of the study revealed that the long- term impacts of redenomination were: 1) public trust establishment to domestic currency; 2) the increase of saving in domestic currency; and 3) the money saved out of national monetary system will flow to market. Redenomination will be successfully implemented if it meets the two requirements as follow: 1) low inflation rate with decreasing tendency; and 2) the success of economic reformation and reconstruction program, like the high growth of real GDP (Gross Domestic Product). If those two requirements are met, redenomination will be useful. Iona (2005) also says that indicators that have to be monitored to assess the impacts of redenomination are Consumer Price Index, purchasing power, exchange rate, 1- month deposit average (rata-rata deposito 1-bulan), Consumer Trust Index, Business Trust Index. (Indeks Kepercayaan Konsumen, dan Indeks Kepercayaan Bisnis).

2.2 The Relation between Redenomination and Economic Subjects' Behaviors

Some impacts that might occur in the implementation of redenomination are the emergence of psychological bias called money illusion (Wibowo, 2013). This illusion can come into view because of the nominal change of goods price resulted from redenomination. Most people will perceive cheaper goods price due to the value omission of zero from the previous currency. Hobijn *et al* (2006) point out that money illusion has occurred in some European country changing their currency into Euro. Euro whose fewer nominals (nominal yang lebih sedikit) compared to the prior currency is perceived cheaper by the people. Hobijn *et al* (2006) thinks that the escalation of the price after redenomination can be explained by the general model of biaya harga menu (menu cost price), by inputting companies' decision when they adopt new currency.

Furthermore, consumers will reevaluate their financial strategy management to adapt to new currency especially when the new and the old currency are used in concert, waiting for the old to disappear. Marques and Dehaene (2004) state that there are two major processes that can take place when a country adapt a new currency : rescaling (changing all prices in old currency into the new money values all at once) or re-learning (remembering new price of the consumers' good one at a time). The first process is predicted to experience effortless adjustment to the new currency; meanwhile the latter will encounter more complex and longer adjustment.

In the meantime, *Money/Euro Illusion* shows that the price perception in new denomination is smaller and lower currency than when it is stated in the previous currency if it has higher nominal (Gamble *et al*. 2002). This demonstrates that individuals adjust themselves to the new currency with its smaller nominal value, at least, they encounter difficulty in understanding the real value of goods and services. Money illusion's effect can also happen to cheap goods or when the escalation of the price is only few cents. If the availability of cents (coins) is not fulfilled by the government, consumers will tend to allow the escalation of the price without demanding change from the seller. This phenomenon is called trivialization.

Trivialization case can be observed in Ghana whose inflation rate increases as much as 5% per year after redenomination. One of the factors causing the redenomination failure is that 70% of money circulating in Ghana is out of banking system. Ghana's cash transactions are more dominant than its banking transaction. To make things worse, the government hasn't been able to change the new currency into the old currency after two years of redenomination. Mehdi and Reza (2012) also state that the reduction of the currency nominal value will invite psychological and social impacts. When a currency has a low nominal value, then the people will think that the currency has a strong value.

Lianto and Suryaputra (2012) did a research to identify the impacts of redenomination implementation in Indonesia based on Indonesian's perspective. The data gathered through surveying 100 people who have knowledge on redenomination and the data were then analyzed by employing Structural Equation Modelling. It could be seen that the most influential impact of redenomination was that it could increase the credibility of Indonesia in front of other countries. The other finding was that the

Indonesian considered redenomination to be beneficial for them. If it was implemented successfully, Rupiah would be stronger and it would boost the people's trust to their currency.

2.3 The Experiment in the Study of Economic Policy

Economic experiment can be used to study an economic policy as well as to review an economic theory. One of the illustrations is what Juanda et al (2011) did in studying and comparing systemic impacts resulted from the policy of Century Bank rescue effort and its closure policy issued by the government. The result of the study showed that Century Bank closure resulted in a relatively very low impact. A sufficiently huge systemic impact would emerge if the closure in that critical time was done to an immense bank. In a normal situation (in the absence of turmoil), the closure of a small problematic bank like Century will not cause systemic impacts. Bank pressure and failure potential were extremely low since the economic stability was maintained. Thus, there was no decrease in the trust of the customers to banking.

Another research investigating a policy through experimental method is a study of tax compliance rate in the self- assessment tax collection system implemented in Indonesia (Juanda, 2010). The study looked into the influence of assessment chance impacts, fine, and educational level to the compliance of taxpayers in reporting Letter of Notification (Surat Pemberitahuan (SPT)), by controlling other factors, they were arranged to be the same (ceteris paribus). Factors that influenced taxpayers' compliance rate were difficult to do through survey design because of environmental influences or objects of the study. Study result confirmed that the higher the tax assessment change and the bigger the fine would positively influence the taxpayers' compliance in doing tax liabilities. Additionally, Juanda (2010) observed the tax compliance rate of "experiment subject" undergraduate students was higher compared to graduate students whose relatively higher knowledge. Moreover, the higher the taxpayers' income, the lower their compliance was.

III. METHODOLOGY
3.1 Kinds and Data sources

The data used in this study were both primary and secondary data. Primary data were gathered through experiment. The primary data gathered were the responses of the subjects (simulation subjects) as the economic subjects in the experiment could be observed from the decisions they took. Additionally, the primary data were also collected through a survey to 168 respondents consisted of 86 lecturers of IPB, 27 IPB students, and 55 of the general public to see their perspectives on redenomination policy impacts on the national economy. This survey was intended to gain judgements, opinions and perspectives about the redenomination policy that would be implemented by the government.

Table 1

Countries that Have Redenominated Their Currency

No	Countries	Redenomination time	Omitted Zeroes
1	Finland	1963	2
2	Iceland	1981	2
3	Israel	1985	3
4	Bolivia	1987	6
5	Uganda	1987	2
6	Nicaragua	1988	3
7	Peru	1991	6
8	Argentina	1992	4
9	The Sudan	1992	1
10	Latvia	1993	2
11	Letonia	1993	200 Rublu = 1 Lats
12	Macedonia	1993	2
13	Mexico	1993	3
14	Moldova	1993	3
15	Uruguay	1993	3
16	Brazil	1994	2,750 Cruzeiros Reais = 1 Real
17	Croatia	1994	3
18	Georgia	1995	6
19	Poland	1995	4
20	Ukraine	1996	5
21	Russia	1998	3
22	Angola	1999	6
23	Bulgaria	1999	3
24	Belarus	2000	3
25	Romania	2005	4
26	Turkey	2005	6
27	Azerbaijan	2006	1
28	Mozambique	2006	3
29	Ghana	2007	4
30	Venezuela	2008	3

Source: Iona (2005)

In the interim, the secondary data employed in this study were the historical data of 30 countries that had redenominated their currency since 1963 until 2008 and they are presented in Table 1. The historical data consisted of some macro-economy indicators in the year, in which redenomination was implemented in a certain country and a year after that. The variables used were inflation rate, economic growth, exchange rate, the growth of money in circulation and the government form. The secondary data were collected from

the publications of World Bank, International Monetary Fund, and Center for Systemic Peace. Information about the resources of the employed variables in the analytical model is presented as follow.

Indicator	Source
Inflation rate (%)	World Bank, 2012, *World Development Indicators 2012*. (http://data.worldbank.org/indicator/FP.CPI.TOTL.ZG)
Economic growth (%)	World Bank, 2012, *World Development Indicators 2012*. (http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG)
Exchange rate to USD ($ US)	World Bank, 2012, *World Development Indicators 2012*. (http://data.worldbank.org/indicator/PA.NUS.FCRF)
The growth of money in circulation (%)	World Bank, 2012, *World Development Indicators 2012*. (http://data.worldbank.org/indicator/FM.LBL.BMNY.ZG)
The government form index	The Center for Systemic Peace, 2012, *Polity IV Project* (http://www.systemicpeace.org/polity/polity4.htm)

3.2 Multiple Regression Model

The estimation method that was used to study influential factors to the implementation of redenomination employed multiple regressions. Exogenous variables or independent variables in this study were inflation rate, economic growth, exchange rate, the growth of money in circulation and the government form. Meanwhile, observed variables (endogenous) or dependent variable was the success or failure of the redenomination implementation that was measured through inflation rate and economic growth a year after redenomination was implemented in each country.

In this study, regression process was done by regressing independent variables in form of economic performance of a country that was influential to the success or the failure of redenomination (dependent variables). Dependent variable (Y) or influenced variable was economic performance indicators that reflected the success of redenomination implementation. Thus, this variable used economic performance accomplishment a year after the policy. In the meantime, independent variables (X) or the influential variables was a country economic performance when redenomination was

implemented for the first time. This model had never been applied before in its relation to currency redenomination. And, the linier regression model in this study was as follow.

$$Y_{\text{after redeno}i} = \beta_0 + \beta_1 D_{\text{lowinflation-}i} + \beta_2 GRO_i + \beta_3 LnEXR_i + \beta_4 MON_i + \beta_5 POL_i$$
$$+ \beta_6(D_{\text{lowinflation-}i} * GROt_i) + \beta_7(D_{\text{lowinflation-}i} * LnEXR_i)$$
$$+ \beta_8(D_{\text{lowinflation-}i} * MONt_i) + \beta_9(D_{\text{lowinflation-}i} * POLt_i) + \varepsilon_i \qquad (1)$$

where:

β_0	=	Intercept
$\beta_1,... \beta_9$	=	Parameter
$Y_{\text{after redeno}i}$	=	Success indicator of currency redenomination for country number-i:
		a) Low inflation <u>a year after redenomination</u> (percent)
		b) Economic growth <u>a year after redenomination</u> (percent)
$D_{\text{lowinflation-}i}$	=	Dummy condition low inflation rate <u>in the year of redenomination implantation for country number</u>-i, with the value of:
		1 = low inflation (< 10%) and 0 = high inflation (≥10%)
GRO_i	=	Economic growth <u>in the year of redenomination implementation</u> for country number-i (percent)
$LnEXR_i$	=	Natural Logarithm of currency exchange rate to dollar <u>in the year in which redenomination is implemented</u> for country number -i ($ US/ Domestic Currency)
MON_i	=	The growth of money in circulation <u>in the year of redenomination implementation</u> for country number -i (percent)
POL_i	=	The government form index <u>in the year of redenomination implementation</u> for country number -i (percent), with the value of min = -10 (very autocratic); max = 10 (very democratic)

Some assumptions underlying the model are: (i) dependent variable is a non-stochastic (fixed) variable, it means that it has been specified or not a random variable; (ii) there is no perfect linier relationship between independent variables or there is no collinear problem; (iii) a residual component ε_i has expectation value equal zero or $E(\varepsilon_i) = 0$; (iv) constant variance for all observations or $var(\varepsilon_i) = \sigma^2$; (v) there is no relation or correlation between residue ε_i or $cov(\varepsilon_i, \varepsilon_j) = 0$ for $i \neq j$; and, (vi) residual component is normally distributed.

<u>Hypothesis Testing of Regression Parameter</u>

Subsequently, to partially see the influence of the independent variables, t-test was used. This test will be useful if variance analysis test shows, at least, one independent variable influence the dependent one. This t-test employment is advantageous to show which independent variable is the most influential to the dependent variable. The partial hypothesis could be formulated as follow.

$H_0 : \beta_i = 0$

$H_1 : \beta_i \neq 0; (i=1,2,3,4)$

While the statistical test could be formulated as follow.

$$t = \frac{\hat{\beta}_i - \beta_i}{s_{\hat{\beta}_i}} \quad\quad\quad (2)$$

Null hypothesis is accepted if the absolute value of t is bigger than the t-table or if the p-value is smaller than level level of significance (α) as big as 10 percent, then null hypothesis is rejected or in other words H_1 is accepted. It means that independent variable i is influential to dependent variable if other factors are constant (*cateris paribus*). Value-p is a probability (risk) of error in drawing conclusion of H_1.

3.3 Experiment Simulation Design

This experiment was a simulation of economic activity to see the influence or response of currency redenomination towards producers and consumers behavioral change. The response to economic behavior change could be seen from the percentage of selling price change after redenomination as a proxy of inflation rate, the percentage of number of transaction change after redenomination as well as the percentage of transaction value change after redenomination as a proxy of the economic growth rate.

The economic experiment in this study involved 48 undergraduate students of IPB Economy and Management Faculty as experimental subjects. They were divided into four treatment combinations, so each combination consisted of 10 or 14 students. In the group of high growth economy treatment, 5 people acted as sellers and 5 others as buyers. In the other group of high-growth economy treatment, both buyers and sellers were seven people. The choice of respondents acting as buyers or sellers was done through drawing system. Factors that would be observed to see their influences were:

1. Economic growth, consisted of two levels: 1) high- economy growth (seven sellers and seven buyers); and 2) low-growth economy (five sellers and five buyers).
2. Inflation rate consisted of two levels: 1) high inflation (the unit cost of seller is big); and 2) low inflation (the unit cost of seller was small).

Each seller of each group was given a *unit cost* to goods they were going to sell. At the same time, each buyer was also given a unit value for goods they were going to buy. The sellers acted as two producers by offering two kinds of product and so did the subject. Each one of experiment subject acting as buyers also became two consumers, thus they had two different unit values. The first unit value and the second couldn't be accumulated because they were assumed as different buyers. The unit costs held by the sellers would form a theoretical supply curve and the unit values of the buyers in each experimental group would also form a theoretical demand curve.

Table 2
The Explanation of Treatment Condition in the Simulation Treatment

Economic Growth	High	In the experiment simulation, it was determined that the economic subjects were 14 people consisted of seven sellers and seven buyers.
	Low	In the experiment simulation, it was determined that the economic subjects were 10 people consisted of five sellers and five buyers.
Inflation Rate	High	High inflation was described by higher unit cost compared to the low-inflation treatment group.
	Low	This high inflation was described by lower unit cost compared to the high-inflation treatment group

Based on the observed responses, the experiment instructions in the study referred to Juanda's research (2000) in form of buying and selling transactions which is elastic to the price, with Posted Offer market system. In the Posted Offer market system, there is no price bargaining in buying and selling transaction, the real instance is the

transactions in supermarket retails. Thus economic experiment simulation was based on induced value theory, in which the use of right and real incentive would enable the experiment subject to emerge (induced) certain characteristics in line with the purpose of the experiment. Thus, the data gained through experiment came from a controlled condition or they were not influenced by other factors were in investigating impacts of a policy towards the behavior of economic subject compared to the data gained through survey (Juanda, 2012).

Generally, the procedure of the experiment was as follow:

1) The participants of the experiments were randomized by the researcher to be 5 buyers and five sellers (condition of low economy growth) or seven sellers and seven buyers (condition of high economy growth).

2) The participants of the experiment previously read and comprehended the experiment instructions depended on their role. The researcher explained the instructions in detail to help the participants who had lack of understanding on the given instructions.

3) The participants were given a decision sheet based on their own role. Every participant had to jot down every transaction they did during the experiment period on the decision sheet for every repetition.

4) The sellers and the buyers got their own unit value and cost value.

5) In the first repetition, the buyers would be separated with the sellers in which the buyers would leave the room. The sellers had to determine the selling price above the unit cost for the condition before redenomination, then the sellers directly decided the selling price for the condition after redenomination in which the selling price could stay the same, more than or less than the price before redenomination.

6) The order of the buyers was drown then they entered the seller room to buy something one by one. The buyers had to buy goods with the price below their unit value.

7) Every seller and buyer had to note the result of their transaction on the available decision sheet.

8) Every experiment participant had the same procedure for every repetition, but the initial condition was determined randomly by the researcher in the initial repetition.

9) At the end of the experiment (repetition), the participants submitted their decision sheet to the researcher.

10) The revenue gained by each participant was then calculated based on the transaction attached on the participants' decision sheet.

3.4 Uji Beda (Mean Difference Testing for two independent populations)

The primary data resulted from economy experiment design would be analyzed by using **Mean Difference Testing for two independent populations** where they were two treatment combination groups or different economic conditions. Two groups are considered independent to each other if the choice of first example units doesn't depend on how the second example units are chosen and vice versa (Matjik and Sumertajaya, 2002). Before comparing the two populations, firstly, we had to pay attention to the homogeneity condition of the populations that would be compared.

According to Matjik and Sumertajaya (2002), data homogeneity of the two populations can be divided into two, homogenous or $\sigma_1^2 = \sigma_2^2 = \sigma^2$ and heterogeneous or $\sigma_1^2 \neq \sigma_2^2 \neq \sigma^2$. The two aforementioned conditions will actually determine the accuracy of the gained conclusion. Thus, the right decision method is needed for every condition. The hypotheses for the two conditions were the same as follow.

1. $H_0 : \mu_1 - \mu_2 \geq 0$
   $H_1 : \mu_1 - \mu_2 < 0$; or
2. $H_0 : \mu_1 - \mu_2 \leq 0$
   $H_1 : \mu_1 - \mu_2 > 0$

Although the hypotheses for the two homogenous conditions were the same, the standard error that was used in the calculation of statistik uji (statistic test) was different. This could be shown as follow:

If it is proven to have the same variance ($\sigma_1^2 = \sigma_2^2 = \sigma^2$) then the statistical test is as follow.

$$T_{\text{calc (same variance)}} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{S_g \sqrt{\left(\frac{1}{n_1}\right) + \left(\frac{1}{n_2}\right)}} \tag{3}$$

Where $S_g = \sqrt{\dfrac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$ (4)

With the degree of freedom $n_1 + n_2 - 2$. In this case, S_g was stated as combined of the example 1 variance and the example 2 variance. Meanwhile if the variances were different $(\sigma_1^2 \neq \sigma_2^2 \neq \sigma^2)$, the statistical test was as follow.

$$T_{\text{calc (differentvariance)}} = \dfrac{(\overline{X}_1 - \overline{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\left(\dfrac{s_1^2}{n_1}\right) + \left(\dfrac{s_2^2}{n_2}\right)}}$$ (5)

where,

$\overline{X}_1$	= mean of the units in the first example
$\overline{X}_2$	= mean of the units in the first example
μ_1	= mean of the first population
μ_2	= mean of the second population
s_1^2	= variance of the first example
s_2^2	= variance of the first example
n_1	= the number of the first example units
n_2	= the number of the second example unit

To determine the critical region to reject null hypotheses, it extremely depends on three things namely the form of research hypothesis (H_1), statistical test that is used and the size of level of significance (α). The direction of null hypotheses rejection is in the same direction with the research hypothesis, as follow.

- If $H_1 : \mu_1 - \mu_2 < 0$ then the critical region $T_{\text{calc}} < - T_{\alpha, \text{db}}$
- If $H_1 : \mu_1 - \mu_2 > 0$ then the critical region $T_{\text{calc}} > T_{\alpha, \text{db}}$

Besides employing T_{calc}, the rule in deciding whether it is significant or not in the conditions being compared is if the value of probability (p-value) is smaller than the significance level or level of significance is 10% ($\alpha = 0.1$). If so, thus between those two different conditions, the observed responses is significant or significantly different.

IV. RESULT AND ANALYSIS

4.1 Factors Determining the Success of Currency Redenomination: Historical Data Approach to 30 Countries

Based on the hypothesis formulated by Mosley (2005) it is mentioned that there are three reasons why a country redenominates its currency: 1) stopping or eliminating a high inflation rate; 2) economy stabilization; and 3) improving the currency's credibility. A country is considered successful if those three purposes of redenomination are achieved, for instance inflation rate is low, economic growth is high and exchange rate is strong. Thus, this study investigated those economic variables after the redenomination in a country by doing a multiple regression analysis to the inflation rate, economic growth, and exchange rate as the variables. The variable used as a success indicator of redenomination implementation was the economic condition after the implementation.

The countries analyzed in this study were countries that had redenominated since 1963 until 2008. The result of the multiple regressions of those 30 countries is presented in the following table. The table gives information on how the economic condition in the year of the redenomination implementation influenced the economic condition a year after the redenomination.

Table 3

The Result of Multiple Linear Regression Test to 30 Countries that Redenominated

Variable	INFLATION $_{\text{1 a year after}}$ redenomination			GROWTH$_{\text{1 a year after redenomination}}$		
	Coef	*T-stat*	*Prob*	*Coef*	*T-stat*	*Prob*
Constant	35.05	0.64	0.528	0.864	0.41	0.688
$D_{\text{lowinflation}}$	-12.1	-0.01	0.989	3.62	0.17	0.864
GRO	**-8.002***	**-1.74**	**0.097**	**0.591****	**2.39**	**0.026**
LnEXR	-0.85	-0.05	0.961	-0.239	-0.26	0.794
MON	**0.580****	**26.34**	**0.000**	0.0005	0.47	0.646
POL	-6.107	-1.06	0.300			
$D_{\text{lowinflation}}$* **GRO**	9.17	0.16	0.871	-0.158	-0.08	0.934
$D_{\text{lowinflation}}$***LnEXR**	8.4	0.02	0.983	1.09	0.07	0.948
$D_{\text{lowinflation}}$***MON**	-1.15	-0.03	0.973	0.064	0.08	0.940
$D_{\text{lowinflation}}$***POL**	5.77	0.14	0.891			
Variance analysis						
R-Squared	99.0 %			40.4 %		
R-Squared (Adj)	99.3 %			21.4		
F-Statistic	329.0			2.13		
Prob (F-stat)	0.000			0.083		

Remark: *   : shows that the variable is significant in the level 90%

\   **   : shows that the variable is significant in the level 95%

Source: formulated data

4.1.1 Inflation Rate a Year After Redenomination

Based on Table 3, it can be seen that R^2 for inflation rate model a year after redenomination was 99.0 %, it meant that 99.0 % of inflation rate variable a year after redenomination could be explained by all independent variables in the model. Meanwhile, the rest was explained by other factors excluded in the model. Based on the F test done, it was identified that the probability was 0.000, in which, it is smaller than the level of significance 0.05, thus, this model could be used in the research.

According to the significance test of the individual parameter in the inflation rate model a year after redenomination, it could be seen that dummy variable of the inflation rate in the implementation year ($D_{\text{lowinflation-t}}$) had a coefficient value equal12.1. It meant that countries experiencing a low rate of inflation when they redenominated (<10%) tended to have lower rate of inflation than countries experiencing high inflation (≥10%), with 12.1% as the average difference between them, *cateris paribus*.

Nevertheless, this result had the risk of error 98.9 %. Thus, it could be claimed that there was not any significant difference between the two different inflation rates.

The coefficient value of this negative dummy variable for low rate inflation was in line with a theory saying that a low inflation rate results in people's expectation on the escalation of prices in the future becomes lower (Blanchard, 2006). People form expectation towards the inflation based on the inflation being observed or the previous year inflation ($\pi_t^e = \pi_{t-1}$), Mankiw (2003) label this as adaptive expectations. Past inflation influences future inflation expectation, Solow in Mankiw (2003) states that "we encounter inflation because we expect it, and we expect inflation because we encounter it". To put it in other words, the escalation of past inflation influences the escalation of inflation expectation and eventually, it can cause actual inflation in the following year.

In countries that are implementing redenomination, they even tend to encounter money illusion where people make mistake in perceiving the nominal change or real. The policy of currency nominal value change along with high inflation rate will compound people to compare the previous real value and after the policy implementation. Blanchard (2006) also categorizes money illusion as the cost of inflation. Because of that, if there is a policy to change currency nominal when the inflation rate is high, sellers will take advantage of it to escalation the selling price because the people's expectation on inflation has already been high due to the inflation rate currently happening and the escalation of those prices will be deceived by money illusion resulted from currency redenomination.

The significant variables influence inflation rate a year after redenomination with probability value below level of significance 10% were the economic growth in the year of redenomination implementation (GRO) and the growth of money in circulation in the same year (MON). The better the economic growth in the year of implementation is, the lower the rate of inflation in the following year will be. Meanwhile, the positive MON coefficient shows that the more money is circulating, so after redenomination, the inflation rate tends to increase. Other variables in the model, like the interaction between dummy condition low inflation rate and other variables didn't have a significant influence. The result of this analysis could explain why some countries achieved low and stable inflation rate after redenominated their currency while others

achieved different rate. The role of economic condition at the moment of redenomination becomes a very important thing to be taken into account because it can influence the economic condition after redenomination being implemented.

4.1.2 Economic Growth a Year After Redenomination

Regression model for the economic growth a year after redenomination had R^2 value equal to 40.4%, meaning that the total variance in the data was explained 40.4% while the rest was explained by factors outside the model. F statistical test in this model could be seen from Prob (F-stat) equal to 0.083, it meant that the four independent variables significantly influenced the economic growth in the year after redenomination simultaneously in the 10% trust level.

In the regression model of the economic growth in the year after redenomination, dummy variable of inflation rate ($D_{lowinflation}$) had coefficient value equal to 3.62. It meant that a country with low inflation when redenomination was being implemented tended to have higher economic growth in the year after redenomination compared to countries with high inflation. Yet, in this model $D_{lowinflation}$ variable was not significant since it had 86.4% the risk of error or above 10% level of significance. The only significant variable influenced the economic growth in the year after redenomination was the growth of the year when redenomination was implemented. The higher the economic growth was, the higher the growth in the following year would be. In the mean time, other variables did not significantly influence the economic growth a year after the implementation. Again, this result presented that expectation played an important role in determining economic condition achievement of a country, especially the 30 countries that had redenominated.

4.2 Experiment Simulation Result of Posted Offer Market Transaction System

Causality direction between currency redenomination and economic condition is hard to determine, one of the ways of determining it is by doing an experiment or controlled trial. The experiment was done to see the responses towards redenomination policy, i.e. the omission of 3 zero digits in the nominal value of Rupiah towards the selling price, the number of transaction and the total number of transaction in rice commodity market with posted offer buying and selling system. The responses of that experiment also compared different influences of redenomination in some different economic

conditions, like the inflation rate and the economic growth. This experiment simulation was done with the procedures explained earlier in the methodology section.

4.2.1 The Implication of Redenomination Policy Towards the Change of Selling Price in the Posted Offer Market System

Based on the experience of the countries that had redenominated, there are two possibilities that might happen after this policy implementation. The first is the goods price is controlled and stable and the second is that the price increases. The experiment simulation conducted showed that redenomination without considering economic conditions didn't have a significant influence to the selling price. Before redenomination, the average of selling prices of all experimental group was Rp 7 498.2 and after redenomination, the average was Rp (new) 7.529 or Rp 7 529. This can be seen in Figure 8 below. Although they were not far different, there was a tendency of price escalation after redenomination. Nevertheless, for commodities whose elastic demands to prices, like car, after redenomination the selling price tends to decrease (Astrini, 2014).
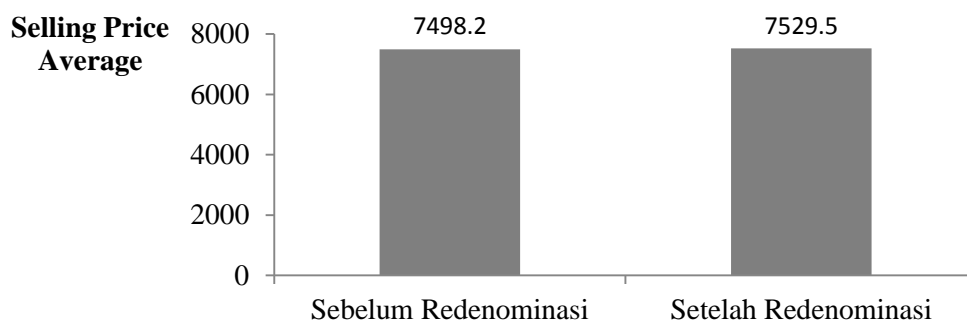

Figure 1

The Average of the Selling Price of Rice Commodity Before and After Redenomination

Nonetheless, it was necessary to see the price change difference after redenomination in different economic conditions like inflation rate and economic growth. This was intended to see whether different conditions resulted in different results or not regarding the price change resulted from redenomination. This difference was tested with Mean difference test, and the results are presented in Table 4. The table

shows that redenomination had various effects to the price change, it depended on the economic condition accompanying it.

In the table it can be generally sees that from all different conditions, the selling price after redenomination in the low inflation condition either when it was combined with economic growth or when it was not, decreased or the change was negative in value. Meanwhile, the contrary happened to high inflation condition in which after redenomination, the percentage change of selling price was positive in value and improved.

Table 4
<mark>Mean Difference Test</mark> of the Change Percentage of Selling Price After Redenomination in Various Conditions

Kondisi	Price Change percentage after redenomination (%)	variance (σ^2)	T-value	P-value
Low inflation and low growth	**-0.4559**	The	1.44	**0.090***
High inflation and low growth	**1.259**	same		
Low Growth and low growth	0.19594	The	0.32	0.379
High Growth and low growth	0.60719	same		
Low inflation and *Low Growth*	-0.5126	The	0.69	0.263
High inflation and *Low Growth*	0.9045	same		
Low inflation and *High Growth*	-0.3992	The	1.21	0.147
High inflation and *High Growth*	1.6136	same		
Low inflation and *Low Growth*	-0.5126	The	0.06	0.478
Low inflation and *High Growth*	-0.3992	same		
High inflation and *Low Growth*	0.9045	The	0.39	0.359
High inflation and *High Growth*	1.6136	same		

Ket: * significant in the level of level of significance 10%
Source: formulated data

Next, in Table 4, from the mean of difference test, it could be seen that the difference in the change of selling price after redenomination only significant in the condition of low inflation and high inflation. This was shown by the value of calculated t equal to of 1.44 with the p=0.09 that was smaller than 10% level of significance. This significance could also be seen in Figure2 that when the condition of inflation was low, redenomination tended to lower the price. Meanwhile, when the rate of inflation was high, on the contrary, the selling price increased after redenomination. In the condition of low inflation, the price change after redenomination decreases in the amount of 0.456 percent. Meanwhile if the economy was in the condition of high inflation

reflected by the increase of unit costs of sellers, the selling price would increase in the amount of 1.259 percent after redenomination.
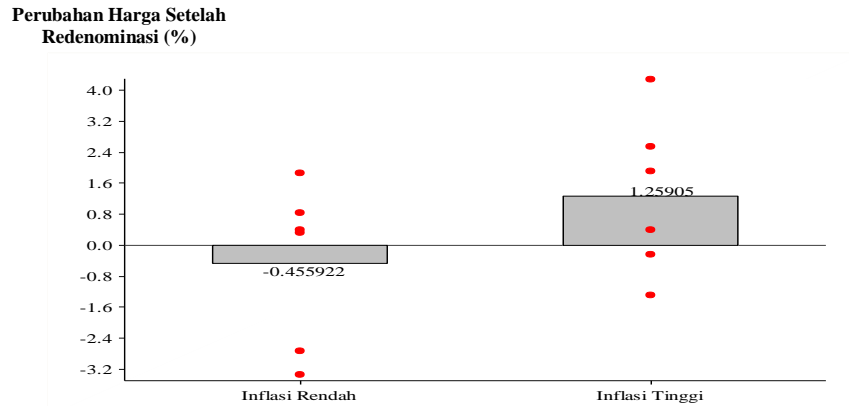
Perubahan Harga Setelah Redenominasi (%)

Figure2
The Percentage of Prices after Redenomination in the Condition of Low and High Inflation

Source: formulated data

From this result, it can be seen that redenomination policy would be better if it was implemented when the economy was in the low inflation compared to high one. The result of the experiment was in line with the analysis of the 30 countries' historical data that has been discussed previously and the economic theory where the current inflation rate influenced the future inflation expectation. In the experiment simulation of the buying and selling of rice commodity, the sellers took advantage of redenomination to change the price lower or higher than before. In the group with low inflation treatment (low *unit cost*) the price change done by sellers tended to be 2-3% lower compared to before redenomination, although there was a price increase but the increase was only around 1%. In the mean time, in the group with high inflation treatment (high *unit cost*) if redenomination was implemented, most of sellers would change the price 1-4% higher compared to before redenomination. But, there was also some sellers decreasing the price less than 1%.

Meanwhile, if we compare the high economic growth and the low one, the price change after redenomination in those two conditions was not significantly different.[3]. This can be seen in Table 4 above that the value of p was 0.379 (more than 10% level of

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[3] In the experiment simulation, the economic growth was reflected by the total number of sellers and buyers involving in the market of rice commodity. In the high economic growth, the economic subject in the market is 40% higher compared to the low growth.

significance). Nevertheless, it needs to be observed here that in either low or high growth, currency redenomination resulted in the selling price of rice commodity kept increasing, 0.195 and 0.607 % for each.
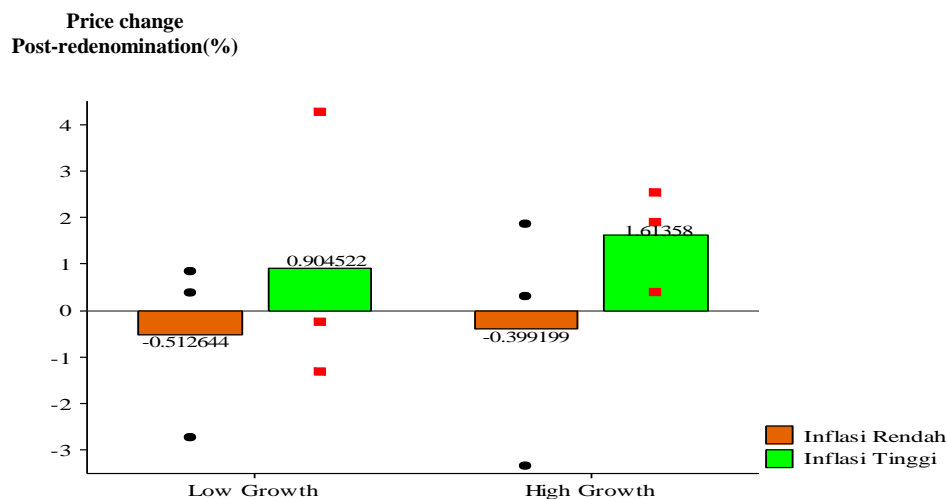
Graphic 3
Post-Redenomination Price Change percentage in different inflation conditions and economic growths
Source: Developed data

The highest price escalation after redenomination is experienced by a combination group of high inflation rates in high economic growths. In that group, redenomination causes the price of goods to rise as much as 1.61%. Compared to the percentage of price change in low inflation and similar economic growth, this change has the risk of failing as much as 14.7% (p-value=0.147) or less significant. This is shown in Graphic 3 above. Nevertheless, this fact indicate that if redenomination is applied while experiencing high inflation and high economic growth at the same time, there is a tendency for sellers to raise the price in hop for perception bias or *money illusion* in the buyers. So the sellers will recieve higher income from the redenomination.

The experiment result shows that if sellers only have small profit margin, this happens when the inflation rate is high or seller's *unit cost* is large, so the seller will raise the price post-redenomination in hope to get bigger profit than before. The sellers

think that by raising the pricethey will get higher profit as well. On the contrary, if the seller had already got sufficiently large profit margin, with the relatively small *unit cost,* the seller will lower the price post-redenomination so that the goods will sell out more on the market. This is dine to avoid unsold goods due to the high price. It can be stated that the redenomination policy has different influence for each sellers, depending on their characteristics pre-redenomination, whether they belong in the high inflation or low inflation group.

The result goes along with the research done by Hobijn *et al.* (2006) and Gamble *et al.* (2002) where the Euro redenomination case, people had already percieve that the prices will get lower due to the removal of some digits from their previous currency although the real value of the goods itself is actually rising. The study done by Shafir *et al.* (1997) also shows the mistake people have done in counting the real value in economic transaction, due to only viewing the nominal value itself. These studies and the result shows that *money illusion* is common on economic subjects. The median difference analysisi can also be used as benchmark of the difference in redenomination influence towards price change in different economic conditions, especially the inflation rate. So it can be seen how redenomination policy could bring a currency to a better or even worse state.

4.2.2 The Redenomination Policy Implication Towrds Transaction ammount change in *Posted Offer* Market System

Without concerning the economic condition, the amount of average transaction tends to decrease as much as 0.33 litre compared to the previous one. The decrease in total number of transaction response goes along with the increasing response of selling price post-redenomination.this fact suits the demand law in economic theory where the amount of goods request will decrease if there are any rising price. (Lipsey *et al.,* 1995). Furthermore, in any economic condition, redenomination doesn't have any different influence to the response of total number of transaction response in rice comodity market. This is show by table 5 below where from the percentage media difference experiment, the total number of transaction change is not at all significant for any experiment group which is seen from p value where all the ratio of each group is bigger than their real degree as much as 10%.

Table 5

The median test of Post-redenomination total number of transaction change percentage in different economic conditions.

Conditions	Post-redenomination total number of transaction change percentage (%)	manner (σ^2)	T-value	P-value
Low Inflation	-4.2328	Similar	0.14	0.446
High Inflation	-3.3796			
Low Growth	-1.8254	Similar	0.67	0.260
High Growth	-5.787			
Low Inflation and *Low Growth*	-4.7619	Similar	0.51	0.320
High Inflation and *Low Growth*	1.1111			
Low Inflation and *High Growth*	-3.7037	Similar	0.77	0.242
High Inflation and *High Growth*	-7.8704			
Low Inflation and *Low Growth*	-4.7619	Similar	0.18	0.435
Low Inflation and *High Growth*	-3.7037			
High Inflation and *Low Growth*	1.1111	Similar	0.79	0.236
High Inflation and *High Growth*	-7.8704			

Source: Developed data

The change of total number of transaction post-redenomination tends to decrease higher when the economic growth is high with -5.79% mean (rataan) compared to low economic growth with only -1.83% decreaseof mean.however, based on table 5, the difference between this condition has an error ratio as much as 0.26% or stated as less significant change. This condition goes along with the theory that suggests that the nominal variable change, in this cas the currency and price change doesn't influence real variables (Mankiw, 2003)

4.2.3 The Implication of Redenomination Policy towards the Change of Transaction Value in *Posted Offer* Market System

Based on the experiment result, the redenomination policy commonly (without considerimg economic condition) will tend to decrease a little of transaction value which generated in rice comodity market. Before redenomination is implied, the mean of the total transaction value which occurs in every treatment group is as much as Rp 54675, while the mean of total transaction value post-redenomination tends to decrease to Rp 52483.

Meanwhile, if different economic conditions are compared using median difference test towards the percentage of transaction value change post-redenomination, the result shows that there are no real or significant difference. This is shown in table 6 below where p for all comparisons between (economic conditions) groups are bigger compared to 10% real degree (taraf nyata).

Tabel 6

Transaction Valur Change Percentage Median Difference Test In Different Economic Conditions

| Conditions	Post redenomination transaction value change percentage(%)	Manner (ragam) (σ^2)	T-value	P-value
Low Inflation	-4.5614	Similar	0.36	0.363
High Inflation	-1.9855			
Low Growth	-1.3856	Similar	0.53	0.302
High Growth	-5.1613			
Low Inflation and *Low Growth*	-5.1442	Similar	0.55	0.306
High Inflation and *Low Growth*	2.3729			
Low Inflation and *High Growth*	-3.9786	Similar	0.35	0.373
High Inflation and *High Growth*	-6.3439			
Low Inflation and *Low Growth*	-5.1442	Similar	0.15	0.443
Low Inflation and *High Growth*	-3.9786			
High Inflation and *Low Growth*	2.3729	Similar	0.66	0.273
High Inflation and *High Growth*	-6.3439			

Source: Developed data

4.3 People's Perspective Towards The Redenomination Policy

To find out the people's opinions towards the impact from the policy of rupiah's redenomination in Indonesia, thus executed surveys in form of interviews and polls with questionnaires to 168 respondents in Bogor during May-June 2013.

4.3.1Redenominasi The Governmen's Ability to Control Inflation Post-Redenomination

Based on the simulation of economic experiments result, a tendency occured where the prices of goods will increase after redenomination. The survey data based on people's perspective shows similar result with the previously mentioned experiment result, it is seen that most of the respondents or as many as 53% are not sure that the government could control the inflation steadily post-redenomination. These respondents have several reasons, mostly because they believe that the prices, mainly basic needs(kebutuhan pokok) will rise post-redenomination. This is based on the experience where prices tend to rise during economic fluctuations or major events such as religious holidays, or national disasters. The redenomination policy could also be included as one of the major events that will change people's behavior especially in purchases and sells transactions. However, as many as 32% respondents still believe that the government still can control the inflation post-redenomination, and the last 15% admitted that they are unaware. The result can be seen in the graphic below.
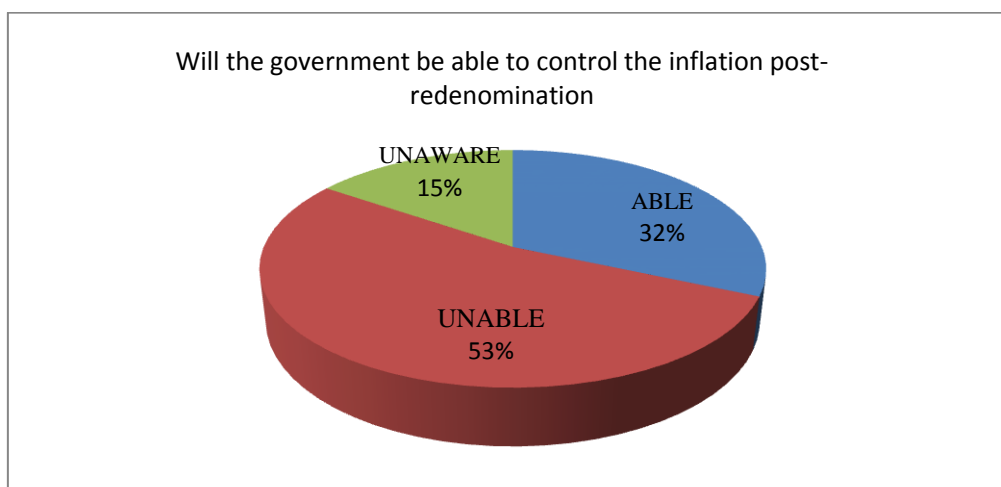
Graphic 4
**People's Trust Level In Government's Control Ability Post Redenomination**

This survey result shows that the inflation expectation post-redenomination is quite high. According to Dornbusch *et al.* (2004) only a credible policy could change the inflation expectation to be appropriate with what the government targeted. The respondents who don't believe the government in controlling the inflation post-redenomination argued that Indonesia's economic condition is not yet ready to face the redenomination policy due to the lack of public dissemination and education regarding the policy and the lack of introduction to the new type of currency to society. Meanwhile, the uncertainty of redenomination policy will also give psychological effect, especially the low trust to the government in economic improvement. While the respondents who believe that the government can control the inflation post-redenomination argued that rupiah's redenomination will not significantly impact Indonesia's economy, namely in the inflation rate. The argued that the controllable inflation rate by the government has no relation to redenomination policy. While those who are unaware, mostly haven't know anything about the redenomination policy yet.

4.3.2 Consumption Pattern Change Post-Redenomination

The anxiety of high inflation post-redenomination, will surely impact the consumption pattern change in society. Namely buying more real assets than before,with the hope of the wealth owned does not decrease due to the inflation. Nevertheless, from the survey to 168 respondents, it is revealed that only 38.10 percent thinks that it is better to buy real assets post-redenomination as shown in graphic 5 below. While the majority of 59.52% tend to choose not to change their consumption pattern, this is due to the fact that redenomination will only change the nominal writing of a currency, so that the prices of goods will not significantly change. Many respondents understood that redenomination will not change the real value of goods, money, wealth, and people's purchase force (daya beli). While they also argued that there will be no influence between the policy and inflation rate change.

Several respondents who chose to buy more real asset post-redenomination stated that the price of real assets like gold psychologically will look cheaper. Besides, the real assets price will rise in the near futuew anyway, so they feel it safer to store their wealth in the form of real asstes. While the respondents who chose to buy more

consumption good post-redenomination are as many as 2.38%, they stated that the prices will become a lot cheaper so their consumption rate will increase. They consider that redenomination will reduce the value of money so the money they have will be better spent than store. Based on this survey, it can be seen that most respondents are not affected by the *money illusion* from redenomination, only 2.38% are affected by it.
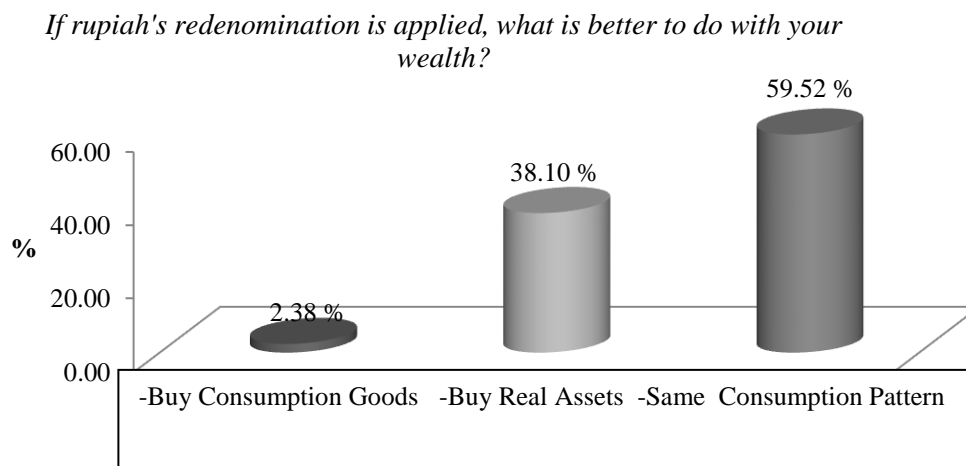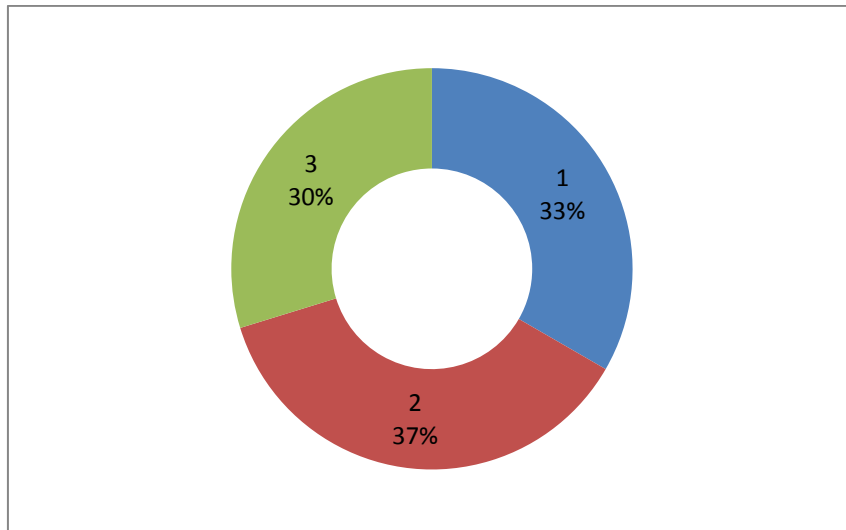

Graphic 5

Consumption Pattern Change Post-Redenomination

Source: Primary Data

4.3.3 Rupiah's Exchange Rate Reinforcement Post-Redenomination

The redenomination policy by removing 3 digits in rupiah's currency mainly aim to give an impact of rupiah being equal or even stronger than other currencies, concidering rupiah is now the third country with the highest exchange rate. The interview result to 168 respondents shows that 37 respondents answered that the redenomination policy will not strengthen the value of rupiah since the exchange rate (apreciation and depreciation) will be influenced more by other factors outside the change of nominal value of the currency, mainly by remittance scale (neraca pembayaran). This can be seen in graphic 6 below.

Graphic 6.

People's Perspective Towards Rupiah's Exchange Rate Amplification Post-Redenomination

Source: Primary Data

Meanwhile, as many as 33% percent of respondents answered that the redenomination policy will strengthen rupiah's nominal calue, the reason is because th rupiah's nominal value will approach that of US dollars so that rupiah will seem stronger than before and will improve the society's trust in keeping rupiah. While 30% of the respondents answered unaware about the connection between redenomination and rupiah's exchange rate.

V. CONCLUSION

Based on several analysis results which have been done using historical data approach, economic experiments, and interviews along with the discussion explained earlier regarding redenomination policy, therefore this research concludes:

If the success of the implication od redenomination policy is measured by the low inflation rate and the high economic growth, the success of redenomination tends to be influenced by economic condition of the country when it applies redenomination. Countries which applies redenomination during low inflation rate (<10%), they will have lower inflation rate after a year compared to other countries that applies redenomination while having high inflation rate (≥10%). Meanwhile, the economic

growth post-redenomination could escalate if the economic growth is high wile apllying redenomination.

Based on the result of experiment regarding rice transaction in *posted-offer* market system, the rise or fall of price post-redenomination significantly influenced by the inflation rate condition along with it. During high inflation, redenomination policy will excalate selling price. On the contrary, the selling price will decrease when redenomination is applied during low inflation. Meanwhile, the economic growth does not affect the selling price change post-redenomination. From the result, it can be concluded that with different economic conditions, the redenomination policy does not significantly affect the change of total number of transaction and the total transaction which occured in the market. However, if the economic condition is ignored, redenomination will commonly cause selling price excalation, total number of transaction decrease, and transaction value decrease. The survey revealed most of the respondents do not believe that the government could control the inflation post-redenomination. Redenomination will neither influence the society's consumption pattern and they do not believe that redenomination will strengthen the rupiah's exchange rate.

Seen from the research result, the important factor in the implementation of redenomination is the economic condition during that time. It will be better if the redenomination is applied during a steady and good economic condition, like low inflation rate and high economic growth. The public dissemination of the redenomination policy to society should be done previously intensively and consistently to give clear information to the public regarding the policy.

In addition, the author suggests that further research needs to be done which focused on the impact of redenomination directly to economic condition. Other than that, further research with similar economic experiment needs to be done to other transaction systems besides *posted-offer* which are decentralization and *double auction.* That research should preferably use different experiment subjects for every repetition and treatmen, so that the experiment subject does not go through the same encounter as before. This is meant to get relatively better experiment results. The next researches is expected to expand the coverage of response influence and add other factors, so they can give more vivid image regarding the redenomination policy towards economy. The

experiment simulation will be better if connected computers are used between experiment subjects, to minimize the influence of other factors outside the treatment.