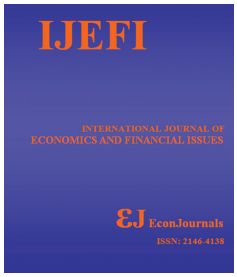

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Redenomination: Why is It Effective in One Country but Not in Another?

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ABSTRACT

The real impact of redenomination is still an on-going debate in the academic world. Redenomination is process decreasing values of a currency without changing its real currency exchange rate. In this research, we are using a panel data set obtained from The World Bank to estimate the impact of redenomination on macroeconomic variables such as inflation rate, real gross domestic product (GDP) per capita and real currency exchange rate. We decided to use fixed effects estimators to take into account the impact of specific characteristics of each country. We concluded that redenomination can significantly decrease estimated inflation rate and increase estimated real GDP per capita. We also concluded that redenomination has no significant impact on estimated real currency exchange rate. However, the effectiveness of redenomination depends on the country's government effectiveness and political stability which will improve country's economic conditions and their competitiveness.

Keywords: Fixed Effects Estimators, Redenomination, Government Effectiveness, Political Stability
JEL Classifications: C5, E0, E5

1. INTRODUCTION

The real impact of redenomination in a country is a topic that invites many dissenting arguments. Redenomination policy is a policy that is implemented by the government to change the denomination values of their currency by a certain ratio (Dogarawa, 2007). As an example, in 1983, Argentina implemented a redenomination policy that changed the denomination value of 1000 Peso into 1 Peso, without changing its real exchange rate (Mosley, 2005). In general, redenomination is considered to be symbolic, however based on previous cases, redenomination can become one of the factors that can improve a country's economy. In contrast, redenomination is not effective in some countries, as persistence hyperinflation causes the currency to naturally get back to the old denomination values.

In Section 2, we will discuss further regarding redenomination theories. Why does a country implement redenomination policy, and what was the impact of the policy? Furthermore, we will discuss arguments and results that support the implementation of the policy. Of course, we are going to talk about arguments and results that are against redenomination as well.

In Section 3, we will talk about the methods that are used in this paper. The easiest way to estimate the relationship between redenomination and macroeconomic variables is by using ordinary least squares (OLS). However, OLS estimators are not consistent in this case, so we decided to use fixed effects estimators. The panel data set consisting macroeconomic variables are obtained from The World Bank.

In Section 4, we estimate the impact of redenomination on inflation rate, gross domestic product (GDP), real exchange rate, government effectiveness and other factors using fixed effects estimators. In addition, we observe the impact of redenomination on those variables for countries with specific characteristics separately. We grouped the countries based on their level of government effectiveness and political stability using dummy variables. Then, we discuss our results by estimating what would happen if a country adopts redenomination policy, using Indonesia as an example.

In Section 5, we concluded that redenomination has a significant negative impact on inflation rate, and a significant positive

impact on a country's real GDP per capita. However, the impact of the policy can only be statistically significant if the country is politically stable. We also discussed the limitations of this paper, and wrote several recommendations to Bank Indonesia and future researchers who are interested in this topic.

2. LITERATURE REVIEW

In general, redenomination policy is implemented as a response of hyperinflation. According to Suhendra and Ozdemir (2011), inflation is a significant predictor of redenomination policy. However, there are other factors that can influence the government's decision in implementing redenomination policy. Mosley (2005) argues that political factors can influence the likelihood of implementing redenomination policy. These political factors include remaining length of current government's period of governance, government ideology, division between executive and legislative and the country's diversity. In addition, Mosley also concludes that inflation is a significant predictor of redenomination. If the inflation rate is high and the current government still has a long period of governance remaining, the chance of implementing redenomination policy is higher.

Why is redenomination policy implemented? According to Agyepong et al. (2010), redenomination can increase the currency's credibility. Normally, the currency of a developed country uses small denomination values, and so redenomination can show the public a better perception of the country. In other words, redenomination can be a signal to the public that the hyperinflation period is over and the government is serious in dealing with country's economic problems. Currency credibility can increase the country's credibility in general, and hence it can increase the public's trust on the government (Stokes, 2001). In addition, currency credibility can also improve the economic image a country gives to other countries (Jensen, 2005). For example, the youths of Ghana feel embarrassed of their currency before they implement their redenomination policy (McDonnell and Fine, 2011). Influences from the international market can also affect a country's decision in implementing redenomination policy (Stone, 2002).

Redenomination, most of the time, is implemented as a response of hyperinflation. As mentioned in the previous paragraph, it is usually implemented by the government after the hyperinflation period has passed, as a signal to the public that the hyperinflation period is over. In this case, it is argued that redenomination is implemented by countries whose economies have stabilized (Bernholz, 1995). As public's trust on the government increases, an arguably symbolic policy such as redenomination can improve a country's economy. In contrast, some countries implement redenomination before or during the stabilization process. Using a currency with high denomination values is a constant reminder to the public that their country is not doing well economically, and this causes them to be more likely to save and use other currencies (Cohen, 2004). Implementing redenomination policy can increase the public's confidence in their currency, which can improve the country's economy. In addition, Priyono (2013), argued that although redenomination does not have a real concrete effect, it can increase a country's efficiency and reduce transaction costs. This argument is supported by Suhendra and Handayani (2012), who concluded that redenomination has a significant impact on a country's inflation rate and economic growth.

The arguments in the previous paragraph are consistent with the conclusion drawn by Dzokoto et al. (2010). In 2007, Ghana implemented redenomination policy by changing "New Cedi" to "Ghana Cedi" (The Bank of Ghana, 2016). The denomination value of the currency is divided by 10000 (1 Ghana Cedi = 10000 New Cedi). Interestingly, their research found that there is a significant increase in consumption after redenomination. They concluded that although the impact of redenomination in Ghana is only nominal, redenomination causes a currency illusion effect that can influence the public behavior.

However, in the same paper, Dzokoto et al. also found that inflation rate has surprisingly increased after redenomination. Although there is a currency illusion effect that influences the public's perspective on the government, the real effect of redenomination on macroeconomic variables are not significant in Ghana. In addition, Dzokoto and Mensah (2010) observed Ghana's public perception regarding redenomination policy, before and after it is implemented. Before the policy is implement, there are many voiced who criticize the policy. However, after it is implemented, there are many respondents who are satisfied with the policy. They argued that the new currency feel safer and easier to use. The small denomination values also increase the amount of donations, because coins are more likely to be donated. Furthermore, from a psychological perspective, Dzokoto et al. (2010) also found that the resident of Ghana values the new currency higher than the old one. Interestingly, in their next research, Dzokoto et al. (2011) found that the old currency is still used in Ghana after redenomination. The old currency is still being used in daily life, and so they used a hybrid system where both currencies can be used. So, the effectiveness of the policy depends on the public's readiness on implementing the policy.

As mentioned by Mosley (2005), the effectiveness of redenomination policy depends on the timing of the implementation. For example, Taylor (2006) argued that redenomination in Azerbaijan ended up increasing inflation rate. Taylor concluded that this is caused by the fact that in Azerbaijan the policy was implemented in January, when prices are high. Redenomination is usually followed by "technical" changes in prices caused by the rounding of prices, so the policy should not be implemented when prices are at their seasonal peak, usually from January to March.

Another example can be drawn from the research done by Calomiris (2007), who argued that the impact of redenomination on investment rate in Argentina is not significant. On the other hand, by using chow test, Zidek and Chribik (2015) found that redenomination has a significant negative impact on inflation growth rate in Turkey. Why is redenomination policy effective in Turkey, but not Argentina? Surely, each country has their own specific characteristics that can affect the impact of redenomination on their economic variables. For example, Fiq and Saqib (2006) concluded that political stability can affect a country's real

interest rate. On the other hand, Odior and Shodeinde (2013) argued redenomination can have a positive or negative impact in Nigeria, and so more attention must be given to their political stability. According to Somoye and Onakoya (2013), a country's productivity can also affect the effectiveness of the country's redenomination policy.

Throughout history, Indonesia has also revalued their currency, in both 1950 and 1959. However, the policy that they implemented was not redenomination. In those years, they implemented currency remediation instead, where the policy would affect the real value of the currency. This policy significantly reduced the value of the Rupiah. However, redenomination is not the same as currency remediation (Bank Indonesia, 2010). Redenomination can change the denomination values of the currency without changing the currency's real exchange rate. Thus, as an example, we can argue that the effects of Indonesia's currency remediation cannot be used to estimate the impact of redenomination, if they choose to implement it.

As for Indonesia's public perception, the research has been done by Lianto and Suryaputra (2012). Using structural equation modeling, they concluded that according to public perspective, redenomination has a significant impact on Indonesia's credibility. Furthermore, they found that most Indonesian residents support the decision of implementing redenomination policy. As of 2017, they are considering to implement redenomination policy, but they have not made any confirmations.

3. METHODOLOGY

3.1. OLS

One way – the simplest way – to estimate the impact of redenomination to any macroeconomic variable is to use OLS on a time-series data set. We can start by using inflation as our dependent variable, as normally the main purpose of redenomination is to decrease hyperinflation. Consider the following equation

$$\ln(\text{inflationt})=\beta_1+\beta_2\ \text{redenominationt}+\beta_3\ \text{trend}_t+\mu_t \quad (3.1)$$

where inflation_t represents inflation rate (GDP deflator) at period t, redenomination_t is a dummy variable that takes the value of 1 if period t is during or after redenomination period and 0 otherwise, trend_t represents the trend value at period t and μ_t represents any unobserved variables that can affect inflation.

In order to consistently estimate equation (3.1) using OLS, there are several assumptions that need to be satisfied. One of them is the assumption that the explanatory variables must not be correlated with the error term. In this case, this means that we need.

A1: $\text{cov}(\text{redenomination}_t, \mu_t)=0$

In order to consistently estimate Equation (3.1). However, it is very unlikely that we are able to satisfy assumption A1. In Section 2, we discussed several country-specific variables that may affect the decision to redenominate currency, such as the political variables we discussed in Section 2. Thus, redenomination is very likely to be correlated with these political variables. Furthermore, it is reasonable to argue that these political variables can have a significant impact on inflation rate, which means they are in the error term of Equation (3.1). Therefore, it is reasonable to argue that in Equation (3.1), redenomination is correlated with the error term. If that is the case, then redenomination is endogenous in Equation (3.1), the estimator $\hat{\beta}_2$ is biased and any inferences such as t-tests and F-tests will be invalid.

One way to satisfy assumption A1 is to add the country-specific political variables to Equation (3.1). However, it is difficult to obtain data that can represent the political variables we are looking for. Thus, we must consider other approaches to estimate the relationship between redenomination and inflation.

3.2. Fixed Effects

Another way to estimate the relationship between redenomination and the macroeconomic variables (such as inflation) is to use a fixed-effects estimation method. Consider the following equation:

$$\ln(\text{inflation}_{it})=\beta_1+\beta_2\text{redenomination}_{it}+\beta_3\text{trend}_t+h_i+v_{it} \quad (3.2)$$

Where inflation_{it} represents inflation rate of country i at period t, $\text{redenomination}_{it}$ is a dummy variable that takes the value of 1 if period t is during or after redenomination for country i and 0 otherwise, trend_t represents the trend value at period t (this does not vary across countries), h_i represents any unobserved country-specific variables that can affect inflation (this does not vary across time) and v_{it} represents any time-varying unobserved variables that can affect inflation.

In order to consistently estimate Equation (3.2), there are criteria that we need to fulfill. First, we need a panel data set. Fortunately, it is not difficult to obtain panel data for macroeconomic variables from The World Bank. The second criterion is we need to satisfy the following assumption:

$$\text{A2: } E(v_{it}|\text{redenomination}_{it}, h_i)=0$$

Which means that the error term cannot be correlated with redenomination and the country-specific time-constant variables (the trend variable is fixed) for all periods. Although assumption A2 is a very restrictive assumption, we can argue that redenomination decision tends to only significantly be affected by two types of variables: Inflation (hyperinflation) and political variables. We can argue that although the political variables can technically change over time, but the changes happen slowly and rarely i.e. they do not consistently vary across time. This means that we can argue that the political variables are captured by h_i in Equation (3.2) Thus, it is reasonable to argue that redenomination decision is not significantly correlated with the error term in Equation (3.2).

The main benefit of using fixed effects estimation is the fact that we are allowing the explanatory variables to be correlated with the unobserved time-constant country-specific variables, that is,

$$\text{A3: } \text{cov}(\text{redenomination}_{it}, h_i)\neq 0$$

Which means we do not need to specifically obtain and include the time-constant country-specific variables in the model, as we can consistently estimate Equation (3.2) without them. In fact, assumption A3 needs to be satisfied in order to efficiently estimate Equation (3.2). Otherwise, we are better off using random effect estimators. In Section 4, we are going to use Redundant Fixed Effect tests and Hausman tests to test whether the fixed effect estimators are better than the pooled OLS estimators and the random effect estimators respectively.

3.3. Data Description

As discussed in the previous subsection, we decided to use a panel data set to estimate the relationship between redenomination and the macroeconomic variables. We got most of our data from The World Bank. The macroeconomic variables obtained from The World Bank consists of 264 countries and 56 periods (from 1960 to 2015). This makes our total sample to be 264 * 56 = 14784 observations.

The inflation rate is obtained from The World Bank (2016e). The inflation data that we use is the one that represents the GDP deflator. It represents the price change in a country as a whole, and it is calculated by dividing nominal GDP by real GDP. It is measured in percentage. Other than inflation, we also obtained several other macroeconomic variables; we want to know the impact of redenomination to these variables as well.

First, we have real GDP per capita, which is obtained from The World Bank (2016g). We chose to use the one that uses international dollars, also known as purchasing power parity GDP. This means that the GDP of each country is converted into international dollars, which has the same purchasing power over GDP as U.S. dollars in the United States. GDP, by itself is the gross value added by producers to the economy, and GDP per capita means GDP divided by population. Our real GDP per capita is measured in constant 2011 international dollars.

We also want to see how redenomination affects real GDP per capita growth. We easily obtained this variable from The World Bank (2016f). It is measured as the percentage change in real GDP per capita, and it is measured in percentage.

Next, we want to see the impact of redenomination on real exchange rate. We obtained the real exchange rate data from The World Bank (2016h). The real exchange rate is the nominal exchange rate divided by a price deflator. We use the 2010 exchange rate as the basis (2010 = 100).

Redenomination can also have an impact on the real interest rate. Real interest rate is the inflation-adjusted lending rate measured by the GDP deflator. We obtained this data from The World Bank (2016b). The data is measured in percentage.

We obtain the variable trade from The World Bank (2016d). Trade measures the sum of exports and imports of a country as a percentage of GDP. Arguably it can represent the openness of a country, hence we want to see the impact of redenomination on the variable. It is measured in percentage of GDP.

Another variable that we are interested in is gross capital formation (GCF). We obtain this data from The World Bank (2016c). Formerly known as gross domestic investment, it measures domestic investment in fixed assets such as plants, land and schools. This data is measured in constant 2010 U.S. dollars.

Finally, we are interested in seeing the impact of redenomination on foreign direct investment (FDI). We obtain this data from The World Bank (2016a). FDI measures investment in a country made by a foreign country. In this case, FDI is measured in percentage of GDP.

As for the redenomination variable, we decided to input the data manually based on the information we get from Mosley (2005). We give the value of 1 to the period when a country first decided to redenominate its currency due to hyperinflation. We also give the value of 1 to the periods afterwards. Then we give the value of 0 to anything before redenomination. When a country does not redenominate its currency at all, the redenomination dummy variable will take the value of 0 for all periods.

4. RESULTS AND DISCUSSION

4.1. Preliminary Analysis and Tests

In Section 3, we have decided to use a panel data set to estimate the relationship between redenomination and the macroeconomic variables. However, there are several issues that we first need to tackle. First, the data that we obtained from The World Bank is not complete i.e. what we have is an unbalanced panel data set. Fortunately, it is possible to estimate unbalanced panel data using advanced statistical applications such as EViews 9. The second thing that we want to confirm is the fact that the fixed effect estimator is better for this model than a pooled OLS estimator and/or a random effect estimator. Thus, there are formal tests that we need to do. First, consider the following equations

$$\ln(\text{inflation}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\text{trend}_t+\mu_{it}+\varepsilon_{it} \quad (4.1)$$

$$\ln(\text{inflation}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\text{trend}_t+h_i+v_{it}+\varepsilon_{it} \quad (4.2)$$

$$\ln(\text{inflation}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\text{trend}_t+w_i+v_{it}+\varepsilon_{it} \quad (4.3)$$

Where inflation_{it} represents inflation rate (GDP deflator) for country i at period t, $\text{redenomiation}_{it}$ is a dummy variable that takes the value of 1 if period t is during or after redenomination for country i and 0 otherwise and trend_t represents the trend value at period t. The difference between the three variables is the methods that we are using. In Equation (3.1), we are using a pooled OLS estimator, where we basically just pooled all the data into one huge cross-section data. The term μ_{it} in Equation (3.1) represents any unobserved variables that can affect inflation. In contrast, h_i and w_i represents only time-constant country-specific unobserved variables that can affect inflation. The difference between h_i and w_i is that h_i is correlated with $\text{redenomiation}_{it}$, while w_i is not. The term v_{it} in Equation (3.2) and (3.3) both represent any time-varying unobserved variables that can affect inflation. Finally, ε_{it} represents any errors caused by the lack of several values in our panel data set, i.e. the unbalanced panel error.

We estimate Equation (4.1), (4.2) and (4.3) using EViews 9. The results can be summarized by the following Table 1.

Table 1 shows the parameter estimates (and their t-statistics) of model (4.1), (4.2) and (4.3). It can be seen that the estimated marginal effect of redenomination on inflation varies greatly between model (4.1), model (4.2) and model (4.3), although all of them show that redenomination has a statistically significant impact (at 1% level of significance) on inflation. Using the Redundant Fixed Effects test, we can conclude that there is heterogeneity between the countries and hence fixed effects estimators are better than the pooled OLS estimators. Based on the Hausman test, we can conclude that the estimators are correlated with the country-specific variables, and thus the fixed effects estimators are consistent and efficient. Furthermore, the R^2 value of model (4.2) is higher than the ones in model (4.1) and (4.3). Therefore, we decided to use fixed effect estimator to estimate the model. Note that the R^2 value is not extremely important when the main goal is just to examine the relationship between the independent and dependent variables.

We can see from Table 1, model (3.2) that redenomination has a statistically significant negative impact on inflation. After redenomination, a country is expected to have lower inflation rate, on average, by 61.86%, ceteris paribus. Note that we are talking about percentage change, not a change in percentage point (a change from 4% to 8% is a 4% points increase, and is a 100% increase). This is consistent with the argument that redenomination can help decrease inflation rate, and shows that in general, the redenomination policy can work and achieve the goal that is pursued.

4.2. Impact of Redenomination on Inflation, Real GDP per Capita and Other Macroeconomic Variables

The next thing we want to examine is how redenomination affect other macroeconomic variables such as real GDP per capita, real exchange rate and real GCF. Consider the following equations

$$\ln(\text{inflation}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\text{trend}_t+h_i+v_{it}+\varepsilon_{it} \quad (4.4)$$

$$\ln(\text{realgdppercapita}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\ln(\text{inflation}_{it})+\beta_4\,\text{trend}_t+h_i+v_{it}+\varepsilon_{it} \quad (4.5)$$

$$\ln(\text{gdppercapitagrowth}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\ln(\text{inflation}_{it})+\beta_4\,\text{trend}_t+h_i+v_{it}+\varepsilon_{it} \quad (4.6)$$

$$\ln(\text{realexchangerate}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\ln(\text{inflation}_{it})+\beta_4\,\text{trend}_t+h_i+v_{it}+\varepsilon_{it} \quad (4.7)$$

$$\ln(\text{realinterestrate}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\ln(\text{inflation}_{it})+\beta_4\,\text{trend}_t+h_i+v_{it}+\varepsilon_{it} \quad (4.8)$$

$$\ln(\text{trade}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\ln(\text{inflation}_{it})+\beta_4\,\text{trend}_t+h_i+v_{it}+\varepsilon_{it} \quad (4.9)$$

$$\ln(\text{gcf}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\ln(\text{inflation}_{it})+\beta_4\,\text{trend}_t+h_i+v_{it}+\varepsilon_{it} \quad (4.10)$$

$$\ln(\text{fdi}_{it})=\beta_1+\beta_2\,\text{redenomiation}_{it}+\beta_3\,\ln(\text{inflation}_{it})+\beta_4\,\text{trend}_t+h_i+v_{it}+\varepsilon_{it} \quad (4.11)$$

Where inflation_{it} represents inflation rate (GDP deflator) for country i at period t, $\text{redenomination}_{it}$ is a dummy variable that takes the value of 1 if period t is during or after redenomination for country i and 0 otherwise, trend_t represents the trend value at period t, $\text{realgdppercapita}_{it}$ represents GDP divided by population, measured in constant dollars for country i at period t, $\text{gdppercapitagrowth}_{it}$ represents annual percentage change in GDP per capita for country i at period t, $\text{realexchangerate}_{it}$ represents currency exchange rate divided by price deflator for country i at period t, $\text{realinterestrate}_{it}$ represents inflation-adjusted inflation rate for country i at period t, trade_{it} represents total imports and exports for country i at period t, gcf_{it} represents GCF (gross domestic investment) for country i at period t, fdi_{it} represents FDI for country i at period t, h_i represents any unobserved time-constant country-specific variables that affect the dependent variable, v_{it} represents any unobserved time-varying variables that affect the dependent variable and ε_{it} represents the unbalanced panel data set error.

Using fixed effects estimation, we estimate equation (4.4) to (4.11). The following Table 2 summarizes the output.

Table 2 summarizes the estimation output of model (4.4) to (4.11). First, we confirm that redenomination has a statistically significant negative impact on inflation. After redenomination, a country is expected to have lower inflation rate, on average, by 61.84% (not percentage points), than before redenomination, ceteris paribus. Model (4.4) also shows that in 1959, a country that has not redenominate its currency is expected to have ln(inflation) value of 2.648, although this interpretation does not make any useful sense. Furthermore, it shows that on average, inflation decreases by 1.18% every year, ceteris paribus. The R^2 value means that 27.62% of the variation in ln(inflation) is explained by the variation in redenomination and trend. Note that the sample size is only 9858 instead of 14784 observations because of the missing values i.e. we are using an unbalanced panel data set. These results are reasonable, as we want redenomination to decrease hyperinflation.

Table 1: Pooled OLS, fixed effect and random effect estimations

Estimation	Model (4.1)	Model (4.2)	Model (4.3)
Constant	2.157 (71.2108)***	2.2648 (80.1015)***	2.2725 (49.0007)***
Redenomination	0.6165 (13.6009)***	−0.6184 (−7.7057)***	−0.2625 (−3.7191)***
Trend	−0.0117 (−13.6606)***	−0.0118 (−14.2469)***	−0.0122 (−14.9426)***
Sample size	9858	9858	9858
R^2	0.0318	0.2762	0.0267
Redundant fixed effects χ^2 statistic	-	2867.3802	-
Hausman χ^2 statistic	-	-	97.2076

***Significant at 1%. OLS: Ordinary least square

Table 2: Impact of redenomination on inflation, real GDP per capita, GDP per capita growth, real exchange rate, real interest rate, trade, GCF and FDI

Estimation	(4.4) - ln (inflation)	(4.5) - ln (real GDP per capita)	(4.6) - ln (GDP per capita growth)	(4.7) - ln (real exchange rate)	(4.8) - ln (real interest rate)	(4.9) - ln (trade)	(4.10) - ln (real GCF)	(4.11) - ln (FDI)
Constant	2.2648	7.9057	1.1541	5.0812	2.6956	3.6903	22.3850	−1.6451
	(80.1015)***	(458.5996)***	(30.8813)***	(154.3474)***	(37.1926)***	(355.3692)***	(1104.775)***	(−24.7823)***
Redenomination	−0.6184	0.0381	0.2354	−0.0482	−0.9489	0.0801	0.2742	0.4607
	(−7.7057)***	(2.0964)**	(2.7756)***	(−1.1094)	(−6.8073)***	(3.7295)***	(7.5296)***	(4.3277)***
ln (Inflation)	-	−0.0063	0.0237	−0.0367	−0.3350	0.0024	0.0122	−0.0545
		(−2.5663)**	(2.0677)**	(−5.4679)***	(−21.0111)***	(0.8285)	(2.3972)**	(−3.6132)***
Trend	−0.0118	0.0232	−0.0064	−0.0094	−0.0072	0.0117	0.0419	0.0542
	(−14.2469)***	(67.5427)***	(−7.7119)***	(−14.3895)***	(−4.8961)***	(50.5392)***	(97.6183)***	(41.6804)***
Sample size	9858	5389	7305	3129	3591	8994	6575	7370
R^2	0.2762	0.9811	0.1588	0.3101	0.3829	0.8045	0.9792	0.5464

**Significant at 5%, ***Significant at 1%. GDP: Gross domestic product, GCF: Gross capital formation, FDI: Foreign direct investment

Model (4.5) shows the relationship between redenomination and real GDP per capita. It can be seen that at 5% level of significance, there is sufficient evidence to conclude that there is a significant positive relationship between redenomination and real GDP per capita. It means that after redenomination, the real GDP per capita of a country is expected to be higher, on average, by 3.81%, ceteris paribus. It also shows that there is a statistically significant relationship between inflation and real GDP per capita, as an increase in inflation by 1% is expected to decrease real GDP per capita, on average, by 0.01%, ceteris paribus. Furthermore, in model (4.6), we can see that after redenomination, a country is expected to have higher GDP per capita growth, on average, by 23.54%, ceteris paribus. The relationship is shown to be statistically significant. Based on these results, we can argue that perhaps redenomination can have a positive impact on a country's well-being.

Next, we look at model (4.7) and (4.8) to look at the impact of redenomination on interest rate and exchange rate. After redenomination, a country is expected to have lower real interest rate, on average, by 94.89%, ceteris paribus. This relationship is statistically significant. In contrast, the relationship between redenomination and real exchange rate is shown to be statistically significant. This is consistent with the argument given by Bank Indonesia (2010).

Finally, model (4.9), (4.10) and (4.11) shows the impact of redenomination on trade, GCF and FDI. After redenomination, a country is expected to have higher trade, on average, by 8.01%, ceteris paribus. Redenomination is also expected to have positive impact on GCF, as on average redenomination is expected to increase GCF by 27.42%. Furthermore, after redenomination, a country is expected to have higher FDI, on average, by 46.07% than before redenomination, ceteris paribus. All these three relationships are shows to be statistically significant at 1% level of significance.

All the results that we get from model (4.4) to (4.11) show that in general, redenomination has a positive impact on the economy. If anything, at the very least it decreases inflation rate and increases real GDP per capita. Therefore, the results we get so far supports redenomination policy as its effect on a country's economy seems to be very positive.

The question we then need to ask is: How come redenomination works for some countries, but not for others?

4.3. Government Effectiveness and Political Stability

We introduce a new variable to the data set: Government Effectiveness. We obtain this data from The World Bank (2016i). Government Effectiveness measured the perceptions of the quality of public services, civil services and its independence from political pressures (Kaufmann et al., 2010). It also measures the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. It is measured as an index, and it ranges from approximately −2.5-2.5.

Similar to the previous section, we first want to see the impact of redenomination on government effectiveness. Consider the following equation:

$$goveff_{it}=\beta_1+\beta_2\ redenomination_{it}+\beta_3\ ln\ (inflation_{it})+\beta_4\ trend_t+h_i+v_{it}+\varepsilon_{it} \quad (4.12)$$

Where $goveff_{it}$ represents government effectiveness of country i at period t. We estimate Equation (4.12) and summarize the result in the following Table 3.

From Table 3, we can see that the estimated parameter value of redenomination is positive. However, its t-statistics suggests that it is not statistically significant. In general, this result shows that redenomination has no significant impact on a country's government effectiveness. Of course, this is not a result that would support redenomination policy.

The question that we need to address is still the same: Why does redenomination policy works effectively in one country, but not in another? Based on Table 2, we conclude that redenomination has a significant negative impact on inflation rate and a significant positive impact on real GDP per capita, but we know that it does not work for all countries. On the other hand, our results in Table 3 shows that redenomination does not improve government

effectiveness, but history suggests that redenomination can improve a country's economy and effectiveness.

In order to answer this question, we need to group our observations based on the characteristics that can affect the effectiveness of redenomination. So, we add another variable: Political stability, which we obtained from The World Bank (2016i). Our political stability variable is an index that measures a country's public perception on the possibility of political instability or politically-motivated violence (such as terrorism). This index ranges from −2.5 (very unstable) to 2.5 (very stable).

Consider the following equation:

$$goveff_{it}=\beta_1+\beta_2\ redenomination_{it}+\beta_3\ ln(inflation_{it})+\beta_4\ trend_t+\beta_5\ (redenomination_{it}\times highpol_{it})+h_i+v_{it}+\varepsilon_{it} \quad (4.13)$$

Where $highpol_{it}$ is a dummy variable that takes the value of 1 when country i has positive political stability index period t, 0 otherwise. The estimated parameter $\hat{\beta}_5$ is a parameter that represents the marginal impact of the interaction dummy variable ($redenomination_{it}\times highpol_{it}$) on government effectiveness. With this parameter, we can estimate the impact of redenomination on government effectiveness for countries with positive and negative political stability index separately. We estimate Equation (4.13) using fixed effects to obtain the following output (Table 4).

From Table 4 we can see that $\hat{\beta}_2$ is not statistically significant in both model (4.12) and (4.13). However, the estimated parameter $\hat{\beta}_5$ is significant in model (4.13). This means after redenomination, the estimated government effectiveness is higher for countries with positive political stability index, on average by 10.04% than for countries with negative political stability index, ceteris paribus. In contrast, for countries with low political stability, the impact of redenomination on government effectiveness is not statistically significant.

Table 3: Impact of redenomination on government effectiveness

Estimation	Model (4.12)
Constant	0.0201 (0.5621)
Redenomination	0.0091 (0.2772)
ln (Inflation)	−0.0132 (−3.1279)***
Trend	−0.0004 (−0.4666)
Sample size	2747
R^2	0.9624

***Significant at 1%

Table 4: Impact of redenomination on government effectiveness, with political stability dummy

Estimation	Model (4.12)	Model (4.13)
Constant	0.0201	0.0075
	(0.5621)	(0.1980)
Redenomination	0.0091	−0.0400
	(0.2772)	(−1.1238)
ln (Inflation)	−0.0132	−0.0148
	(−3.1279)***	(−3.5746)***
Trend	−0.0004	−0.0002
	(−0.4666)	(−0.1901)
Redenomination*highpol	-	0.1004
		(2.9310)***
Sample size	2747	2712
R^2	0.9624	0.9643

***Significant at 1%

The result in Table 4 is one of the answers we can use to our question above. From the results, we found that the impact of redenomination on a country's government effectiveness depends on the country's political stability. In general, this result supports the redenomination policy because so far, we did not find any significant negative impact of the policy on government effectiveness. However, the effectiveness of the policy depends on the country's political stability.

How about the impact of redenomination on real GDP per capita? We consider the following equations:

$$ln\ (inflation_{it})=\beta_1+\beta_2\ redenomination_{it}+\beta_3\ trend_t+\beta_4\ (redenomination_{it}\times highpol_{it})+h_i+v_{it}+\varepsilon_{it} \quad (4.14)$$

$$ln\ (inflation_{it})=\beta_1+\beta_2\ redenomination_{it}+\beta_3\ trend_t+\beta_4\ (redenomination_{it}\times highpol_{it})+h_i+v_{it}+\varepsilon_{it} \quad (4.15)$$

$$ln\ (realgdppercapita_{it})=\beta_1+\beta_2\ redenomination_{it}+\beta_3\ ln\ (inflation_{it})+\beta_4\ trend_t+\beta_5\ (redenomination_{it}\times highpol_{it})+h_i+v_{it}+\varepsilon_{it} \quad (4.16)$$

$$ln\ (realgdppercapita_{it})=\beta_1+\beta_2\ redenomination_{it}+\beta_3\ ln\ (inflation_{it})+\beta_4\ trend_t+\beta_5\ (redenomination_{it}\times higheff_{it})+h_i+v_{it}+\varepsilon_{it} \quad (4.17)$$

Where $higheff_{it}$ is a dummy variable that takes the value of 1 if country i has positive government effectiveness index at period t, 0 otherwise. The interaction dummy ($redenomination_{it}\times higheff_{it}$) is used to measure the impact of redenomination on the dependent variable for countries with positive government effectiveness index.

Using fixed effects, we estimate Equation (4.14) to (4.17) to obtain the following output (Table 5).

Based on Table 5, we can see that redenomination has a significant impact on inflation and real GDP per capita. However, the effectiveness of this impact depends on the country's political stability and government effectiveness. From model (4.14) and (4.15), we can see that redenomination has a significant impact on inflation rate. For countries with high government efficiency, redenomination is expected to decrease estimated inflation more than countries with low government efficiency, on average by 71.93%, ceteris paribus. On the other hand, redenomination is only expected to decrease estimated inflation by −33.37% for countries with low government efficiency, ceteris paribus. So, the effectiveness of redenomination policy in decreasing inflation in a country depends on the country's government effectiveness.

The results of model (4.16) and (4.17) show that the impact of redenomination on real GDP per capita in a country depends on the country's political stability. On average, redenomination is

expected to increase estimated real GDP per capita for countries with high political stability by 10.7% more than countries with low political stability, ceteris paribus. As for countries with low political stability, redenomination is expected to increase estimated real GDP per capita by 7.77%, ceteris paribus.

The conclusion that we can draw from Table 5 is that redenomination has a significant negative impact on inflation rate and positive impact on real GDP per capita. However, the effectiveness of redenomination depends on a country's political stability and government effectiveness. In a country with high government efficiency, redenomination policy will decrease inflation rate more than a country with low government efficiency. On the other hand, a country with high political stability will experience higher increase in real GDP per capita from redenomination than a country with low political stability. Thus, the impact of redenomination is different for each country, because each country has a different level of political stability and government effectiveness.

Based on this conclusion, should a country adopt redenomination policy?

4.4. Discussion – Should a Country Implement Redenomination Policy?

Based on the fixed effects estimation, we can conclude that in general, redenomination can decrease inflation rate and increase the level and growth of real GDP per capita. This is consistent with the results obtained by Suhendra and Handayani (2012), who concluded that redenomination has a significant impact on inflation rate and economic growth. In addition, redenomination does not have a significant impact on real interest rate. This is consistent with the statement made by Bank Indonesia (2010), who argued that redenomination does not reduce real interest rate, unlike currency remediation. The results obtained are also consistent with the conclusion drawn by Odior and Shidoinde (2013), that political stability can affect the effectiveness of redenomination policy.

So, should a country implement redenomination policy? As of 2017, Indonesia is considering implementing redenomination policy, but they have made any confirmations as they are still unsure. So as an example, we are going to use Indonesia. Based on our results, we generally support Bank Indonesia's willingness to implement redenomination policy. Our fixed effects analysis did not find any significant negative impact on economic growth. Furthermore, the research made by Lianto and Suryaputra (2012) concluded that most Indonesian residents support implementing redenomination policy. So, based on our results and the impact redenomination has on other countries, we argue that there is no significant damaging risk in implementing the policy.

However, using Nigeria as an example, redenomination policy will not be effective if Indonesia is politically unstable. According to The World Bank (2016i), Indonesia's government effectiveness index in 2014 is −0.0109, and its political stability index in 2014 is −0.3687. So, since both indices are negative, in 2014, Indonesia is politically unstable and its government is not effective. If these problems persist, redenomination policy will not be effective in improving Indonesia's economy.

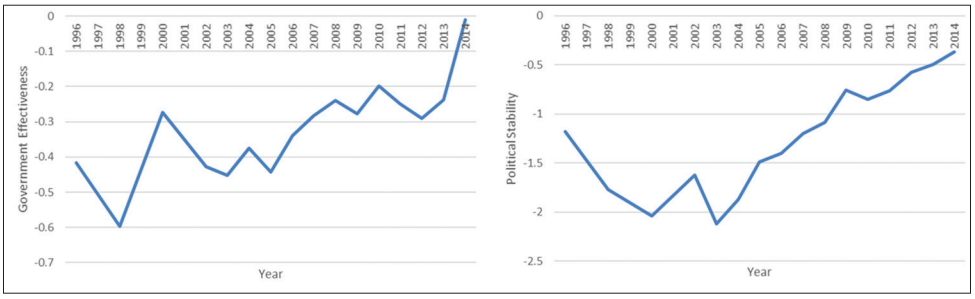
How about Indonesia's political stability and government effectiveness index values in 2017? The data is still unavailable as of 2017. However, in Indonesia's case, it is reasonable to be optimistic. According to the surveys done by Indonesia-investments (2016), most Indonesian residents show high level of confidence on Joko Widodo's governance. Furthermore, we can see a positive trend in Indonesia's political stability and government effectiveness index (Figure 1).

Table 5: Impact of redenomination on inflation and real GDP per capita, with interaction dummies

Estimation	(4.14) - ln (inflation)	(4.15) - ln (inflation)	(4.16) - ln (real GDP per cap)	(4.17) - ln (real GDP per cap)
Constant	3.5644 (21.4204)***	3.5774 (21.6213)***	7.7861 (269.4063)***	7.7850 (299.6814)***
Redenomination	−0.4001 (−2.3389)**	−0.3337 (−2.0940)**	0.0777 (3.1275)***	0.1184 (5.2043)***
ln (Inflation)	-	-	0.0040 (1.3565)	0.0040 (1.3631)
Trend	−0.0405 (−11.3226)***	−0.0402 (−11.3155)***	0.0251 (47.3213)***	0.0251 (47.8825)***
Redenomination*highpol	−0.1421 (−0.8617)	-	0.1070 (4.2676)***	-
Redenomination*higheff	-	−0.7193 (−3.4243)***	-	0.0445 (1.4477)
Sample size	2731	2747	2662	2689
R^2	0.4654	0.4645	0.9896	0.9896

**Significant at 5%, ***Significant at 1%

Figure 1: Government effectiveness and political stability trend in Indonesia



Thus, in Indonesia's case, we support the redenomination policy considered by Bank Indonesia. In addition, it is reasonable to be optimistic about the effectiveness of the policy.

5. CONCLUSIONS

The conclusions that we can draw from our research are the following. First, we conclude that in general, redenomination can decrease estimated inflation rate and increase the level and growth of estimated real GDP per capita. Second, redenomination does not have a significant impact on real currency exchange rate. Third, redenomination has a significant positive impact on government effectiveness, if the country is politically stable. If the country is politically unstable, redenomination will not have a significant impact on government effectiveness. Fourth, redenomination is more effective in lowering inflation and increasing real GDP per capital if the country has strong government effectiveness and political stability.

As an example, we discussed the possible impact of redenomination in Indonesia based on our results. We concluded that although Indonesia has weak political stability and government effectiveness in 2014, we still support their willingness in implementing redenomination policy, because there are reasons to argue that there is positive trend in Indonesia's political stability and government effectiveness in the future.

It is important to remember that this paper has some limitations. Because of the incomplete nature of the panel data set obtained from The World Bank, we are using an unbalanced panel data set, which will increase residual values. In the future, it is better to use a balanced panel data set if possible. Furthermore, in the next research, it is recommended to estimate the impact of a country's productivity on the effectiveness of redenomination policy.

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