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1. Introduction

Long-run monetary neutrality (LRMN) is an idea expressed from the quantity theory of money, which posits that a permanent change in money stock has no real effect in the long-run. This theory suggests that all of the money supply alterations will proportionally be offset by the increase in price levels. In other words, any change in money supply will not affect the real variables in the economy but will eventually change the nominal prices. The LRMN theory is an empirical matter with regard to monetary policy, where it helps to define the monetary transmission and is able to identify the effectiveness of monetary policy by investigating the role of money in the long run. Therefore, it is important for monetary authority to have prior knowledge on LRMN before implementing monetary policy. As a result, the study of LRMN has attracted great interest for a long period of time.

2. Literature Review on Monetary Neutrality

Since late 1980s, many empirical studies have been conducted to test the precision of monetary neutrality proposition and the role of money in reality. Indeed, from the numerous literatures related to the role of money, the findings are rather varied (see Bae et al., 2005; Habibullah et al., 2002a; Habibullah et al., 2002b; Hammond, 1990; Leong & McAleer, 2000; Leong et al., 2010; Liew et al., 2009; Noriega, 2004; Puah et al., 2010; Puah & Hiew, 2010; Wallace, 1999).

For decades, voluminous studies have attempted to ascertain the precision of the LRMN proposition. One of the early studies in this field was done by Hammond (1990) in 20 OECD countries. By employing Generalized Box-Cox extended (GBCE) model, Hammond (1990) examined the effect of money supply growth on real output and the performance of general functional form with the linear and other specific functional forms. From the empirical findings, Hammond (1990) found that money is non-neutral in the context of OECD. He further stated that the LRMN is dependent on the speed of growth between money and real output as money will be neutral if the growth of money supply overtake the real output growth.

Malliaropulos (1995) investigated the proposition of LRMN in UK using quarterly data from 1965:1 to 1994:2. Besides of using price, nominal and real income as the analyzed variables, this study also examined LRMN with respect to two important monetary transmission channels in UK namely, nominal and real equity prices. Through the empirical examinations conducted with Fisher and Seater (1993) LRMN test, Malliaropulos (1995) concluded that LRMN proposition in relation to price, income and equity prices are supported by UK data. However, there is empirical evidence, which showed that monetary policies do have transitory effect on real output in short and medium terms. The findings of real equity prices in the study is consistent with the one concluded by Fama and Schwert (1977) where real equity price showed proportional inverse relationship with money supply.

Another study on LRMN was conducted by Wallace (1999) in the economy of Mexico. The purpose of the study is to investigate the sensitivity of bank nationalism in Mexico toward the

LRMN proposition. Therefore, a sample period of 1932 to 1992 which included the period of bank nationalism (1982-1990) is applied in the study. Fisher and Seater (1993) neutrality test is employed in the estimation part while ADF is used as preliminary test to make sure the validity of neutrality test. Through the empirical result, Wallace (1999) illustrated that LRMN was hold in Mexico when the value of lag length is smaller than 16 and larger than 17. Subsequently, Wallace (1999) added in the dummy data for the period from 1982 to 1990 to represent the bank nationalism. He found that LRMN proposition appeared in the sub-sample with the lag length smaller than 18. Hence, Wallace (1999) concluded that time period does played an important role in affecting the point estimation.

In addition to the bank nationalism effect on LRMN proposition, Bae and Ratti (2000) evaluated the influences of financial disruption that bring toward the hypothesis of LRMN in their study. They used the sample of Argentina and Brazil, with the time period of 1884 to 1996 and 1912 to 1995, respectively. In the preliminary unit root test, money is found to be integrated in the order of two for Argentina and Brazil, which indicate that money is neutral in both countries. As money is $I(2)$, estimation test is needed to examine the appearance of long-run superneutrality. The empirical results showed evidence of rejecting the hypothesis of long-run superneutrality in both countries. Bae and Ratti (2000) included the intercept dummy data for the period of 1930s to capture the effects brought by bank insolvencies and financial disruption in Argentina and Brazil. The findings of superneutrality remained the same even with the introduction of dummy data. In addition, the relationship of money growth and real output growth are found to be highly negative and significant which indicated that bank solvencies have high negative impact on real output.

The LRMN hypothesis is sensitive to the economy context used in the analysis, as different countries used in the analysis tend to provide different conclusions about the LRMN proposition. Serletis and Krause (1996) initiated a study on quantity theory of money for 10 developed countries, namely Australia, Canada, Denmark, Germany, Italy, Japan, Norway, Sweden, UK and US. They utilized long, low-frequency data obtained from Backus and Kehoe in the Fisher and Seater (1993) neutrality test to analyze the hypothesis of LRMN. In the study, the model is divided into two parts which are money with respect to real output and money with respect to price. When Zivot and Andrews (1992) unit root test is employed, Serletis and Krause (1996) found that both Germany and Japan are unable to proceed into Fisher and Seater (1993) neutrality test as both of the countries do not show permanent stochastic shocks in their data. From the Fisher and Seater (1993) neutrality test, they found that Canada, Denmark, Italy, UK and US show evidence in supporting LRMN hypothesis with respect to real output, while LRMN hypothesis are rejected by Canada and UK with respect to price.

Noriega (2004) conducted a study to evaluate the performances of different countries and different monetary definitions toward the proposition. This study covered Argentina, Brazil, Canada, Denmark, Italy, Mexico, Sweden, UK and US. The sample period is from 1975 to 2001. From the analysis, mixed results were obtained. Noriega (2004) revealed that money is said to be neutral for Brazil, Canada, Mexico's M2 and for Sweden. However, for Argentina, Australia, Mexico's M1, Italy and UK, the data do not support LRMN. For Denmark and US, as their monetary series do not show permanent stochastic under unit root test, LRMN test cannot be conducted. Thus, LRMN is not addressable in both countries.

Further investigation is carried out by Bae et al. (2005) using a fractionally integrated autoregressive moving average model (ARFIMA) to investigate the effect of money on real

output. They applied the estimation to six countries namely, Argentina, Canada, Italy, Sweden, UK and US, with over a century worth of annual data. From the LRMN empirical results, they discovered that five out of the six countries namely, Argentina, Canada, Italy, UK and US showed evidence on supporting LRMN hypothesis while Sweden does not. They further concluded that in low inflation economies, monetary shock would bring positive effects toward output even LRMN does hold in those countries.

Puah et al. (2008a) inspected the question of whether the relationship between money supply and real output occurred in the context of ASEAN-5 countries namely, Indonesia, Malaysia, the Philippines, Singapore and Thailand. Besides the real output, they also investigated the LRMN proposition with respect to real export. The study carried out the analysis using Fisher and Seater (1993) with annual data from 1970 to 2001. The results obtained in the study are rather mixed. M1 in the Philippines and Singapore are found to be neutral while M1 in Indonesia is non-neutral in the long-run. On the other hand, M1 is proved to have short and medium term effect on the real output in Malaysia and Thailand. For the results of LRMN with respect to real export, Puah et al. (2008a) revealed that narrow money M1 do not play the role of primer engine in leading real export growth in Indonesia, Malaysia, the Philippines and Singapore. However, the innovation of money supply is proven to have impact on the real export growth in the economy of Thailand.

Further investigation was carried out by Puah et al. (2008b) on the LRMN and long-run superneutrality of proposition in some Asian countries. They used a sample of 10 countries, namely Indonesia, Malaysia, Myanmar, Nepal, Philippines, Singapore, South Korea, Sri Lanka, Taiwan and Thailand. Their study was conducted using annual monetary data from 1950 to 2002. The study showed mixed results about LRMN proposition. The empirical results supported LRMN for five of the countries which are Malaysia, Myanmar, Nepal, Philippines and South Korea. On the other hand, data from Indonesia, Taiwan and Thailand had strong ground to reject LRMN of proposition.

Moreover, some evidences has indicated that different measures of monetary aggregates used in analysis tend to provide different results on LRMN tests. Thus, reaction of different definitions of monetary aggregates toward macroeconomic variables has inspired a lot of studies. Tan and Baharumshah (1999) ascertained the nexus of monetary aggregates and real output in their study, using quarterly Malaysian data from 1975 to 1995. They utilized Johansen multivariate cointegration analysis, vector error correlation model and granger causality to identify the performance of three differences monetary measurements (M1, M2 and M3) as monetary target to curb inflation. The empirical results illustrated that both narrow and broad money supply have the impact to stimulate economic growth in Malaysia. In the role of sustained high economic growth, M3 performed better than M1 and M2 as it has the strongest causal effect on real output. On the other hand, M1 is more effective in curbing inflation as it showed higher causal effect on price compared to other.

In Australia, Leong and McAleer (2000) utilized Fisher and Seater's test to study the proposition of money neutrality in the long-run. Their study encompassed the period between 1975 and 1995 in Australia. In this study, they found that different types of money supply provided disparity results on LRMN. The results indicated that LRMN of money proposition could not be rejected when M1 was used as measures of money supply. However, money was not neutral when money supply was replaced by M3. Leong and McAleer (2000) pointed out that the disparity result on LRMN was due to the easing of monetary policy and demand-side disturbances during that period.

Wallace and Cabrere-Castellanos (2006) using Fisher and Seater's test and Granger's causality depicted the LRMN of money of the Guatemalan economy from 1975 to 1995. From the study, he also deduced that difference measures of money affected the result of LRMN. In Guatemala, LRMN hypothesis was supported when M1 was used as monetary aggregate. However, when M2 was used, the opposite result occurred. The findings of Wallace and Cabrere-Castellanos (2006) were similar with the one of Leong and McAleer (2000) where narrow money was neutral and broader money was not neutral in the case of Australia.

In addition to LRMN of proposition, the performance of money supply could be evaluated in various aspects. Pua et al. (2006) revised the LRMN in the context of Malaysia, using Divisia M1 and M2 as the measure of monetary aggregates. The study was conducted using quarterly data from 1981:1 to 2004:4 with Fisher and Seater's (1993) neutrality test. For the preliminary test, both Divisia M1 and M2 showed permanent stochastic and non-cointegration with the real output, thus neutrality test can be proceeded. The empirical results illustrated that both Divisia M1 and M2 are non-neutral in Malaysia. Hence, Divisia M1 and M2 have the impact of influencing the economic growth in Malaysia.

Pua and Jayaraman (2007) investigated the the causal relationship between capital stock prices and macroeconomic activities for the period 1997:2 to 2004:4 in Fiji. Pua and Jayaraman (2007) utilized the ADF and PP unit test, Johansen and Juselius Cointegration, Error correction model and Granger causality test for the empirical analysis. The study revealed that all the explanatory variables have been found to contribute to long-run equilibrium relationship in Fiji. There was also evidence showed that stock price index is cointegrated with real economic activities and it adjusts rather fast from short run deviation toward long-run equilibrium. They also found that real output, M2, and exchange rate do Granger cause stock price in the short-run.

Pua et al. (2010) used the stock indexes to estimate the LRMN of money. The data used was the quarterly data from 1978 to 2009. The results showed that LRMN of money did not hold in Malaysia using M1 and M2. The data using M2 showed long-run equilibrium relationship with all the stock indexes while cointegration test was taken. This indicated that M2 was not neutral. M1, although did not show long-run equilibrium with stock indexes in the cointegration test, the empirical result from Fisher and Seater's test indicated that LRMN did not hold when M1 was used.

By employing Fisher and Seater's (1993) neutrality test, Tang et al. (2013) investigated the LRMN proposition in Singapore for the period of 1980-2009. This study aimed to discover the relative performance of simple sum monetary aggregates and Divisia monetary aggregates in being a useful policy indicator in Singapore. The empirical findings showed that monetary neutrality does not hold in Singapore when both the simple-sum money and Divisia money are employed. In other words, these monetary aggregates have long lasting impact towards real economic activity, indicating that expansionary monetary policy can be used to stimulate the economic growth.

By using P-Star model, ADF test, and Johansen and Juselius Cointegration test, Tang et al. (2015) tested the forecasting performance of P-Star model based leading indicator inflation for Indonesia. Using quarterly data from 2000 to 2013 for analysis, they found that Divisia M2 based P-Star model is marginally outperformed simple sum M2 based P-star model in

forecast inflation. P-Star model provided additional information about the future rate of inflation. Therefore, it could be used to obtain the leading indicator of inflation in Indonesia.

Puah et al. (2015) employed a ARIMA LRMN test for investigating impact of money supply in long-run. Using quarterly data from 1981 to 2011, they compared the performance of Divisia money and the traditional simple sum monetary aggregate in Indonesia. They found that both Divisia money and simple sum monetary aggregate are non neutral in the long-run. This indicated that money supply can be used to influence the growth of economy in long run in the case of Indonesia. Puat et al. (2015) further indicated that Indonesia can consider the use of both Divisia money and simple sum monetary aggregate as an effective policy variable as the expansion of these monetary aggregates are able to stimulate the weak economy.

Although there are numerous pieces of research on LRMN proposition, the debatable issues of LRMN are still inconclusive. The findings of LRMN proposition are mixed from the perspectives of the performance of broad and narrow monetary aggregates as well as the analyzed countries. Therefore, more studies are needed in this field, especially with difference measurement of monetary aggregates used as money supply.

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