MONETARY POLICY IN THE PRESENCE OF EXTERNAL ECONOMIC UNCERTAINTY IN SELECTED DEVELOPED AND DEVELOPING COUNTRIES

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SULTAN IDRIS EDUCATION UNIVERSITY

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MONETARY POLICY IN THE PRESENCE OF EXTERNAL ECONOMIC UNCERTAINTY IN SELECTED DEVELOPED AND DEVELOPING COUNTRIES

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I, YEE KOK JING, M20171000796, FAKULTI PENGURUSAN DAN EKONOMI hereby declare that the work entitled MONETARY POLICY IN THE PRESENCE OF EXTERNAL ECONOMIC UNCERTAINTY IN SELECTED DEVELOPED AND DEVELOPING COUNTRIES is my original work. I have not copied from any other students' work or from any other sources except where due reference or acknowledgement is made explicitly in the text, nor has any part been written for me by another person.

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I, ASSOCIATE PROFESSOR DR. NORIMAH BINTI RAMBELI@RAMLI hereby certifies that the work entitled MONETARY POLICY IN THE PRESENCE OF EXTERNAL ECONOMIC UNCERTAINTY IN SELECTED DEVELOPED AND DEVELOPING COUNTRIES was prepared by the above named student, and was submitted to the Institute of Graduate Studies as a full fulfillment for the conferment of MASTER OF ECONOMICS, and the aforementioned work, to the best of my knowledge, is the said student's work.

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ABSTRACT

The general objective of this study is to examine the monetary policy reaction function with the presence of exchange rate and terms of trade (TOT) in an economic uncertainty. The specific objectives of this study are to examine the causal relationship between monetary policy and economic uncertainty variables; and to examine the cointegration relationship between monetary policy by including the external economic uncertainty variables without neglecting the output uncertainty and inflation uncertainty. The data of this study are collected on a quarterly basis from the year 1995 quarter one until the year 2018 quarter one based on a sample of 30 countries. This study employs the causality tests (i.e., Toda Yamamoto causality test and Granger causality test) and panel heterogeneous cointegration approach. The findings from the causality tests and panel heterogeneous cointegration approach shows that the economic uncertainty variables have a causal relationship with monetary policy, and there is a significant long-run and short-run relationship between monetary policy and economic uncertainty variables, respectively. Overall, this study shows that the monetary policymakers are able to optimise the functions of the external economic uncertainty variables in the monetary policy reaction function without ignoring the role of the output uncertainty and inflation uncertainty. The policy implications of this study are monetary policymakers are able to design an alternative economic policy; to combat the economic uncertainty via interest rate uncertainty; to mitigate the negative impact from economic uncertainty; and to design a better economic policy for open economies to achieve the monetary policy goals.

DASAR MONETARI DALAM KEHADIRAN KETIDAKPASTIAN EKONOMI LUARAN DI NEGARA MAJU DAN MEMBANGUN TERPILIH

ABSTRAK

Objektif utama kajian ini adalah untuk mengkaji tindak balas fungsi dasar monetari dengan adanya kehadiran kadar pertukaran dan kadar syarat perdagangan di dalam ketidakpastian ekonomi. Secara khususnya, objektif kajian ini adalah untuk mengkaji hubungan sebab-menyebab antara dasar monetari dan faktor-faktor ketidakpastian ekonomi; dan untuk mengkaji hubungan kointegrasi antara dasar monetari dengan faktor-faktor ketidakpastian ekonomi luaran tanpa mengabaikan ketidakpastian keluaran negara dan ketidakpastian inflasi. Data dalam kajian ini dikumpulkan mengikut suku tahunan dari tahun 1995 suku pertama sehingga tahun 2018 suku pertama berdasarkan pada sampel 30 buah negara. Kajian ini menggunakan ujian sebab-menyebab (iaitu, ujian sebab-menyebab Toda-Yamamoto dan ujian sebab-menyebab Granger) dan pendekatan kointegrasi panel heterogen. Dapatan kajian daripada ujian sebab-menyebab dan pendekatan kointegrasi panel heterogen menunjukkan bahawa faktor-faktor ketidakpastian ekonomi mempunyai hubungan sebab-menyebab dengan dasar monetari, dan wujudnya hubungan kointegrasi jangka panjang dan jangka pendek yang signifikan antara dasar monetari dan faktor-faktor ketidakpastian ekonomi, mengikut ujian masing-masing. Kesimpulanya, kajian ini menunjukkan bahawa penggubal dasar monetari dapat mengoptimumkan fungsi-fungsi faktor-faktor ketidakpastian ekonomi luaran dalam fungsi dasar monetari tanpa mengabaikan peranan ketidakpastian keluaran negara dan ketidakpastian inflasi. Implikasi dasar bagi kajian ini menunjukkan bahawa penggubal dasar monetari dapat menjana satu alternatif polisi ekonomi; dapat memerangi ketidakpastian ekonomi melalui ketidakpastian kadar bunga; dapat mengurangkan kesan negatif daripada ketidakpastian ekonomi; dan dapat menjana satu polisi ekonomi yang lebih baik bagi ekonomi terbuka untuk mencapai matlamat dasar kewangan.

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LIST OF ABBREVIATIONS

AIC	Akaike Information Criterion
ADF	Augmented Dickey-Fuller
ARCH	Autoregressive Conditional Heteroscedasticity
ARDL	Autoregressive Distributed Lag
BIS	Bank for International Settlements Statistics
CD	Cross-section Dependence
CPI	Consumer Price Index
CUSUM	Cumulative Sum
CUSUMSQ	Cumulative Sum Square
DF	Dickey-Fuller
DSGE	Dynamic Stochastic General Equilibrium
ECM	Error Correction Model
GDP	Gross Domestic Product
GMM	Generalized Methods of Moments
HP	Hodrick-Prescott
IFS	International Financial Statistic
IMF	International Monetary Fund
IPS	Im, Pesaran and Shin
IRFs	Impulse Response Functions
JB	Jarque-Bera
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
LLC	Levin, Lin and Chu
LM	Lagrange Multiplier
MCI	Monetary Conditions Index
MG	Mean Group
MULTIMOD	Multi-country Macroeconomic Model

MW	Maddala and Wu
MWald	Modified Wald
NGDP	Nominal Gross Domestic Product
PMG	Pooled Mean Group
PP	Phillips-Perron
REER	Real Effective Exchange Rate
RESET	Regression Specification Error Test
SIC	Schwarz Information Criterion
SUR	Seemingly Unrelated Regression
SVAR	Structural Vector Autoregressive
TOT	Terms of Trade
TR	Taylor Rule
UK	United Kingdom
US	United States
VAR	Vector Autoregressive
VEC	Vector Error Correction

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CHAPTER 1

INTRODUCTION

1.1 General Introduction

Monetary policy often plays an important part in various economic sectors as it is commonly related to interest rate and money supply, which can help to stimulate the economic growth. Central banks or monetary policymakers will use the interest rate or money supply or both to balance the economic sector in order to achieve the monetary policy goals (i.e., price stability, output stability, stability of the financial market and high employment rate). Hence, changes in the monetary policy should be taken seriously as the decision-making process can affect the future economic performance either positively or negatively. For a further detailed discussion, this chapter provides the background of the study in Section 1.2. Section 1.3 and 1.4 provides the discussions on the problem statements and research questions, respectively. Then, followed by the

hypothesis of the study and objectives of the study in Section 1.5 and 1.6, respectively. Section 1.7 discusses the framework of the study and Section 1.8 discusses the operational definition of the study. Section 1.9 discusses research limitations. Section 1.10 provides discussions on the significance of the study. Section 1.11 provides a summary of this chapter and a brief explanation of the structure of this study.

1.2 Background of the Study

Most monetary policy decisions decided by the monetary authorities (i.e., central bank or monetary policymakers) play an important role in improving future economic performance. Monetary policy in this study refers to the actions taken by the monetary authorities (hereafter, monetary policymakers) to influence the interest rate or money supply to achieve the ultimate monetary policy goals. In other words, monetary policymakers are given the authority and responsibility to conduct an effective monetary policy that is able to achieve the monetary policy goals leading to a well-functioning economy (Freedman, 2005). Conventionally, the common monetary policy goals that are often monitored and prioritised by the monetary policymakers include price stability, stable economic growth, stability in the foreign exchange market and financial market, and to achieve lowest the unemployment rate (Mishkin, 2016). Undoubtedly, the monetary policy goals may vary according to economic conditions, but the primary purpose of the monetary policy in maintaining the price stability with low inflation and output should always remain unchanged (Clarida, Gali, & Gertler, 1999). Other than that, it is important for the monetary policymakers to consider a

number of different economic variables and tools that are able to influence the economic outcomes to achieve the monetary policy goals.

Traditionally, in countries that apply a closed economy, monetary policymakers only consider economic variables such as output gap and inflation in the monetary policy decision making process because those countries are capable of self-sustaining economies and have low tolerance towards trading internationally. On the other hand, monetary policymakers in the open economies are able to conduct the monetary policy effectively, which they tend to include other external variables (e.g., exchange rate, terms of trade (TOT) and many more) into their decision-making process. Compared to the conventional monetary policy variables (i.e., output gap and inflation), these external variables may potentially be of secondary importance in the monetary transmission mechanism because unexpected changes in the external factors are able to pose risks to future economic activity and the decision making process (Mundell, 1957; Mohanty & Klau, 2004; Kohli, 2006; Aizenman, Hutchison, & Noy, 2011; Fender, 2012). For instance, Clarida, Gali, and Gertler (2001), Gunter and Volker (2003), Goldfajn and Gupta (2003), and Hove, Mama, and Tchana (2015) are some of the many previous researchers that included and/or considered the role of the external factors in the monetary policy decision making process. After knowing the importance of these external variables, there are still monetary policymakers that do not consider the external variables in the monetary policy transmission, in other words, the external variables are being ignored (Mishkin, 2000; Taylor, 2001; Edwards, 2006; Batini, Levine, & Pearlman, 2007).

Furthermore, choosing a suitable monetary policy instrument for an economic condition is as important as identifying the most appropriate economic variables that can help the monetary policymakers to achieve the monetary policy goals. Monetary policymakers must be able to identify the best monetary policy instrument to support the recovery and/or improve the economic performance in future economic events because, initially, the monetary policy only appeared to be a structural framework (Adelina-Geanina, 2011). However, arguments among monetary policymakers often happen especially when it comes to choosing the best instruments to control money supply or interest rate in attaining the monetary policy goals because different applications of instruments in different economic conditions can result in different economic outcomes (Allsopp & Vines, 2000). There are a few instruments that had been put into practice and successfully contributed to the different economies, such as, Friedman's k-percent rule, monetary conditions index (MCI) and Taylor Rule (Ericsson, Jansen, Kerbeshian, & Nymoen, 1998; Vuslat, 2004; Ftiti, 2008). The seminal work of Friedman (1956), also known as Friedman's k-percent rule, serves as a monetary policy rule which controls a fixed percentage of money supply that cannot be changed by the monetary policymakers in order to achieve several monetary policy goals. Then, the monetary conditions index (MCI) that was developed by the Bank of Canada in the late 1980s (or early 1990s) to influence the monetary policy in order to have better economic performance, especially by controlling the level of inflation, through the use of interest rate and exchange rate (Ericsson et al., 1998; Qayyum, 2002; Hyder & Khan, 2007). Another similar instrument that is favoured by the monetary policymakers is the Taylor Rule, first introduced by John Taylor in 1993, that became an important instrument that is used to conduct monetary policy effectively by setting the most appropriate short-term interest rate in controlling the inflation and the output gap to

stabilise the economic fluctuations (Taylor, 1993; Orphanides & Williams, 2007). These instruments are further discussed in the following chapter (See Chapter 2, Section 2.2 for further discussions).

It is an undeniable fact that instruments play an important role in the monetary policy decision making process. However, one should not neglect the significance of identifying the most appropriate external economic variables to be included in the monetary policy. This study includes two relevant external economic variables, namely, exchange rate and TOT in the monetary policy transmission in order to achieve the monetary policy goals. The exchange rate is relevant to be included in monetary policy transmission because it can either promote or hinder the ultimate monetary policy goals (i.e., inflation and stability of price) to be achieved (Orphanides & Wieland, 2000; Santacreu, 2015; Carstens, 2019). For instance, the depreciation in the exchange rate can harm the stability of the price. As for TOT, monetary policymakers can use TOT to determine the number of goods to be purchased by an economy in exchange for the goods to be supplied by that economy, potentially boosting the economic performance (Mundell, 1957; Markusen, 1983; Kohli, 2006). Besides that, this study does not only include the external economic variables but also encompasses the economic uncertainty in the economic variables. Economic uncertainty in this study refers to the unknowability of the unknowns about the future economic events and applies a broader definition of uncertainty that encompasses fluctuation, volatility and shock (Orabi & Alqurran, 2015). Even though, economic uncertainty can inflict fear, insecurity and uneasiness in the monetary policymakers because of unpredictable future economic events especially economic collapse, however, the assumption from the economic uncertainty can also be very impactful in the decision making process that aims to

improve the economic performance (Tiedens & Linton, 2001; Ben-Haim & Demertzis, 2016).

As mentioned earlier, there are a variety of external economic variables and instruments to be considered in order to achieve the ultimate monetary policy goal. In general, those economic variables and instruments are able to assist monetary policymakers to attain their goals and provide the best economic outcomes, especially when the most relevant economic variables have been identified and to be employed along with the most appropriate instruments (Poole, 1970). Therefore, this study only focuses on one monetary policy rule, namely, the Taylor Rule and extends the model by encompassing two relevant external economic variables, namely, exchange rate and TOT without neglecting the presence of economic uncertainty in the economic variables (i.e., interest rate uncertainty, output uncertainty, inflation uncertainty, exchange rate uncertainty and TOT uncertainty).

1.3 Problem Statements

This study attempts to address two problem statements, detailing the specifies of each in the discussion as follows:

1.3.1 Does monetary policy response to the external variable?

Apart from output and inflation, the exchange rate may influence the monetary policy strategies through the changes in prices of foreign goods to the domestic prices indicating that the exchange rate could be a determinant for both net exports and inflation (Taylor, 2000). The movements of the exchange rate could have a significant effect in forecasting the changes in inflation that may lead to better economic events, in which, the exchange rate may signify the policymakers in order to make a better decision in the monetary policy to keep inflation and output closer to their objectives (Bianchi & Deschamps, 2017). Svensson (2000) collaborates the arguments from Taylor (2000) in which the exchange rate can serve as an additional channel for the monetary policy transmission, for instance, (i) both the relative price of domestic and foreign goods can be affected by the real exchange rate, resulting in a contribution to the aggregate demand channel; (ii) the exchange rate affecting domestic currency price of imports leading it to influence the consumer price; and (iii), exchange rate influences the price of imported intermediate goods, in which, the price eventually pressuring the domestic firm in price decisions making. Undoubtedly, the presence of the exchange rate in monetary policy may serve as a potential transmission mechanism due to the different levels of magnitude and timing of the exchange rate that may influence the output and inflation (Smets & Wouters, 1999; Taylor, 2001). Along with the exchange rate being one of the variables, the terms of trade (TOT) may be another significant variable in the monetary policy response. Edward (1988) argues that a fall in the exchange rate due to an elevation in domestic inflation can trigger negative TOT shocks, also known as cost-push shock. Monetary policymakers can enhance and tighten their economic policy decision making and might increase the interest rate due to these

effects from the TOT. Deterioration in TOT may influence the income gap and inflation gap to increase which may lead to sluggish economic growth in the future economic events resulting the policymakers to make a better decision in the monetary policy (Fatima, 2010). TOT remains impactful in the economies of developing countries especially since the growth recoveries of a country depends on the depreciation of the exchange rate after knowing TOT shocks are negative (Funke, Granziera, & Imam, 2008). Therefore, the role of the exchange rate and TOT in monetary policy remains debatable.

1.3.2 Does monetary policy respond to economic uncertainty?

Economic uncertainty may influence the monetary policymaker's decision making process, hence, influencing the economic outcomes. Economic uncertainty is an unpredictable future economic event that may influence the decision-making process and indirectly affect the economic performance (Ben-Haim & Demertzis, 2016). The economic uncertainty that is considerably high can alert the policymakers to take immediate actions to curb the issue because high economic uncertainty may have an unfavourable effect on the economic performance induces greater recession and the slow recovery of the economy (IMF, 2008; 2012). Increasing economic uncertainty may prompt the economic agents to delay the decision making process and to wait for clearer information that can result in slow response towards the changes in the real economic activity including monetary policy (Bernanke, 1983; Dixit & Pindyck, 1994). Economic uncertainty may have unexpectedly influenced the monetary policy because the market participants are pressured in predicting the direction of monetary policy

when the uncertainty is high (Moore, 2016). A sudden increase in the uncertainty may lead to negative responses and tightening in real activities like decreased consumption, weaker investments and limited output (Caggiano, Castelnuovo, & Pellegrino, 2017). Hence, the policymakers may consider to wait and see the situation before deciding on a monetary policy that can influence economic performance during the presence of economic uncertainty (Evans, Fisher, Gourio, & Krane, 2015; Seneca, 2016). As suggested by Bernanke (2010), monetary policymakers need to improve their knowledge and skills in facing economic uncertainty in order to achieve better economic outcomes.

1.4 Research Questions

The research questions in this study are in line with the objectives of the study and needed to be answered in this study. The general research question of this study, is that, does monetary policy respond to the presence of exchange rate and TOT in an economic uncertainty?.

The specific research questions of the study are as follows:

1. Does the monetary policy and economic uncertainty variables have a causal relationship?

2. Does the monetary policy have a cointegration relationship with the inclusion of external economic uncertainty variables without neglecting the internal economic uncertainty variables?

1.5 Hypothesis of the Study

The null hypotheses of this study are as follows:

1. Null Hypothesis: There is no causal relationship between monetary policy and economic uncertainty variables.

2. Null Hypothesis: There is no cointegration relationship between monetary policy and economic uncertainty variables.

1.6 Objectives of the Study

The general objective of this study is to examine the monetary policy reaction function with the presence of exchange rate and TOT in an economic uncertainty based on a sample of 30 countries, namely, Argentina, Australia, Brazil, Canada, China, Colombia, Czech Republic, Denmark, Finland, Hong Kong, Indonesia, Ireland, Italy, Japan, Malaysia, Mexico, New Zealand, Philippines, Poland, Russia, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom and the United States.

The specific objectives are as follows:

1. To examine the causal relationship between monetary policy (i.e., interest rate uncertainty) and economic uncertainty variables (i.e., output uncertainty, inflation uncertainty, exchange rate uncertainty and TOT uncertainty).

2. To examine the cointegration relationship between monetary policy (i.e., interest rate uncertainty) by including the external economic uncertainty variables (i.e., exchange rate uncertainty and TOT uncertainty) without neglecting the output uncertainty and inflation uncertainty.

1.7 Framework of the Study

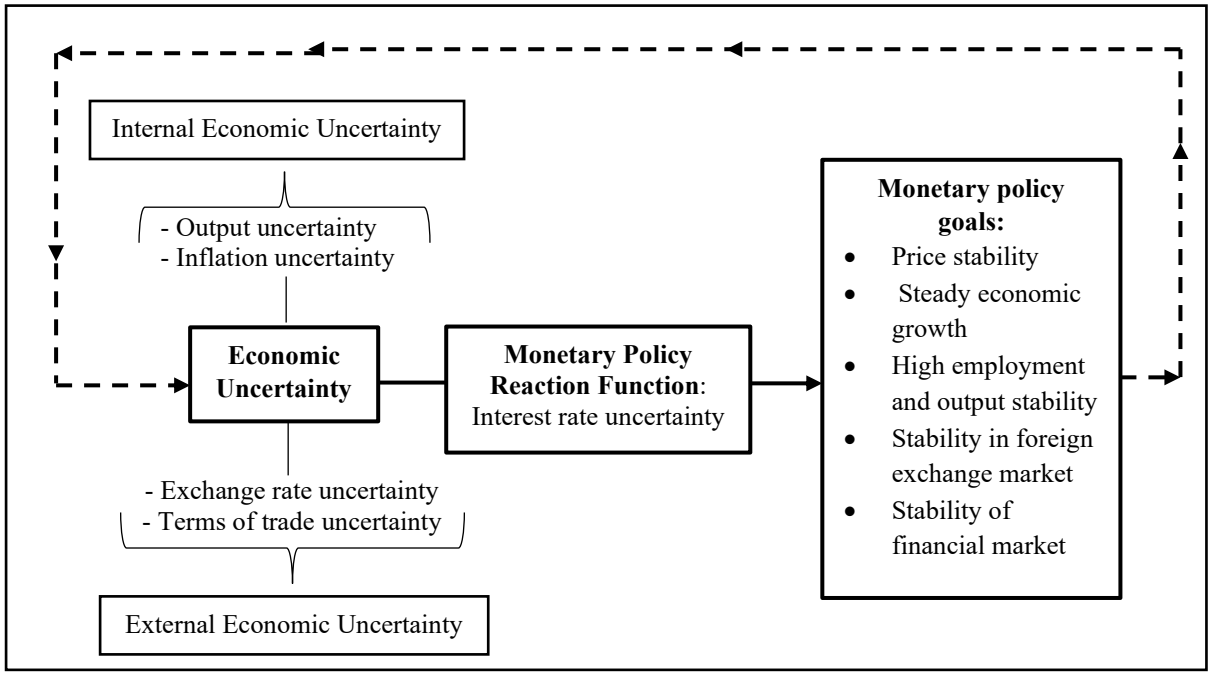

Figure 1.1. The external economic uncertainty variables in the monetary policy reaction function

The framework in Figure 1.1 shows the economic variables that are included in the monetary policy reaction function in this study to achieve the monetary policy goals. The economic uncertainty in the monetary policy reaction function can serve as useful information for the monetary policymakers to attain the monetary policy goals. Therefore, the presence of the economic uncertainty is in the economic variables, namely, output uncertainty, inflation uncertainty, exchange rate uncertainty and TOT uncertainty as the independent variables to influence the interest rate uncertainty as the dependent variable. This is to indicate how well the economic uncertainty variables are able to contribute to the economic performance and used by the monetary policymakers in pursuing their monetary policy goals.

1.8 Operational Definition

This section discusses and applies the definition of the terms used in this study. If the terms explained in this study are not clear and concise, the results obtained from the study can be inconsistent and inaccurate. Thus, the discussion of the operational definition plays as an important role to acknowledge other researchers to have a similar or same understanding of the terms used and results obtained from this study. The discussions of the terms applied in this study are as follows.

1.8.1 Economic Uncertainty

The term for the economic uncertainty in this study can be defined as an unforeseeable event that may happen in the future economy which can cause an unpredictable economic outcome (Black, Hashimzade, & Myles, 2017). Uncertainty was first described in the seminal work of Knight (1921) that includes both 'risk' and 'uncertainty'; inducing that the context of economic uncertainty in this study can be better described by the Knightian uncertainty with the inclusion of economic uncertainty that applies a broader definition encompassing fluctuations, volatility and shock. Orabi and Alqurran (2015) stated that fluctuations, volatility and shock can be implied to be considered as a broader definition of uncertainty. Note that Bloom (2013) stated that fluctuation is a kind of measure of uncertainty; Jurado, Ludvigson, and Ng (2013) stated that volatility is a kind of measure of uncertainty; and, Denis and Kannan (2013) stated that shock can be a kind of measure of uncertainty.

According to Ben-Haim and Demertzis (2016), and Ben-Haim, Demertzis, and den End (2017), the economic uncertainty (i.e., interest rate uncertainty, output uncertainty, inflation uncertainty, exchange rate uncertainty and TOT uncertainty) can be measured by the gap approach without affecting the robustness of the variables. The gap form can be calculated by taking the difference between the actual value and the potential value, which the potential value is obtained through the calculation from Hodrick-Prescott (HP) filter and can be considered as an uncertainty to address the economic uncertainty (Ben-Haim et al., 2017). This study does not focus on the economic uncertainty measures individually but focus the economic uncertainty as a comprehensive measure; according to Gan (2014), the definition of economic

uncertainty should include the interest rate uncertainty, output uncertainty, inflation uncertainty, exchange rate uncertainty and TOT uncertainty.

It is an undeniable fact that, initially, economic uncertainty is often viewed as a negative impact on the economic activities. However, the economic uncertainty is able to provide or design a better economic decision and can counter the impact to our own favour if the monetary policymakers are able to successfully managed and fine-tuned the economic uncertainty information. According to Aastveit, Natvik, and Sola (2017), limited information on the future economic events are able to cause the economic uncertainty to influence the economic outcome because monetary policymakers are being extra cautious during the decision making process causing the monetary policy to be less efficient. This is because economic agents tend to delay or to "wait and see" in their decision-making process in the presence of economic uncertainty that could potentially influence the future economic outcomes due to the precautionary measure or cautiousness effect (Evans et al., 2015; Seneca, 2016). The effect of postponing the decision making process due to a high level of uncertainty is able to decrease the performances of the economic activities and causing the monetary policy to be less responsive and less effective in the environment of economic uncertainty (Dow, 2004). On the other hand, the inclusion of economic uncertainty in the economic variables in this study is able to help the monetary policymakers to benefit from the waiting process to develop innovative ideas and creating various decisions to mitigate the problems that arise from various forms of uncertainties in order to achieve monetary policy goals (Dennis, 2005). According to Greenspan (2003), the presence of economic uncertainty in the feature of monetary policy can be influential and important for the monetary policymakers in the process of decision making for better economic outcomes.

1.8.2 Interest Rate

The use of the interest rate in this study serves as a dependent variable. According to Black et al. (2017), the definition of the interest rate in this study can be defined as a cost charged by a lender to a borrower that uses the assets of the lender, in which, can also be known as debt by the borrower and rate of return by the lender. In other words, the amount of money needed to return to the lender will be increased in order to compensate for the loss of the use of the assets during that period of time. As mentioned previously, this study includes the economic uncertainty in the variables and interest rate is known as interest rate uncertainty in this study.

The presence of interest rate uncertainty in this study serves its purposes as a monetary policy variable that is controlled by the monetary policymakers to manage the economic uncertainty variables. According to Gan (2014), the interest rate can stand as proxy of money market rate, in other words, the money market rate obtained from a relevant data source is able to serve as interest rate in this study. To obtained the interest rate uncertainty estimation of this study, the current real interest rate is used to deduct the potential interest rate which is then calculated as a percentage point change. The current potential interest rate is calculated and estimated by using the HP filter that the smoothing parameter is set equal to 1600.

1.8.3 Output

The term output in this study serves as the independent variable that includes the economic uncertainty, which can be known as output uncertainty. The definition of output can be defined as the value of the end products and services produced by a country in a certain time period and are purchased by the end user (Black et al., 2017; Callen, 2017). According to Nalewaik, Diebold, and Landefeld (2010), the output can stand in proxy of either as the gross domestic product (GDP) or gross domestic income (GDI), and the data for the output variables in this study is collected based on GDP. This study includes the economic uncertainty in the variables by calculating the difference between the logged time series of real output value and the potential output value, and the value of the difference is then multiplied by 100 to obtain the value for output uncertainty. Potential output is obtained through the calculation from the HP filter and shows that the number of products and services that are at maximum productivity when the economy is assumed to be at its full capacity (Jahan & Mahmud, 2017).

According to Smets (2002), the presence of output uncertainty in the monetary policy reaction function may serve as a useful indicator for the monetary policymakers to achieve better economic performances. This is because output uncertainty is able to signal the monetary policymakers to carry out a specific economic policy when the economy is overheating or underperforming the productive capacity (Billi, 2012). For instance, an overheating economy shows that the level of output is higher than the potential level, which leads the monetary policymakers to increase the interest rate in order to cool the overheating economy. It goes the same if the level of output is lower

than the potential value indicating that the economy is underperforming, the monetary policymakers will reduce the interest rate in order to stabilise the economy. In addition, Mahadeva and Sinclair (2004) suggested that monetary policymakers are interested in output uncertainty because of the shock identification that is able to help the monetary policymakers to understand various types of shocks that occurred, which can be helpful in making the right decision to design an efficient monetary policy.

Besides that, the calculation or estimation of the output uncertainty should be measured accurately in order to serve as a reliable indicator for the monetary policymakers that can help to improve the future economic performances (Orphanides & van Norden, 2002). Countiño (2016) suggested that the output uncertainty should be estimated in a range of time rather than pinpointing the exact timing with the aim that monetary policymakers are able to gather more useful information and minimise the error during the decision making process. Measuring and understanding the estimates of output uncertainty plays a more significant role than the variable itself because an error in evaluating or calculating the estimate of the output uncertainty can influence the variable itself to be less effective and reduce the usefulness of its existence in setting a monetary policy (Orphanides, Porter, Reifschneider, Tetlow, & Finan, 2000). It can also be said that failing to estimate the movement of output uncertainty accurately can increase the possibility of the economic activity to be unstable that can result to poor economic performance (Orphanides, 1998). Hence, the understanding of the output uncertainty required to be estimated correctly in this study plays an important role.

1.8.4 Inflation

The definition for inflation in this study can be defined as the persistency of the prices to increase in a period of time and is able to inflict a negative impact on the consumer purchasing power (Black et al., 2017). This is because people will lose their purchasing power over time and they are not able to purchase the same amount of goods as they always did before inflation goes worse. During the inflation period, the prices of goods and services will just increase in that period of time causing the cost of living in a country to increase which will bring more harm to the economy (Oner, 2017). If certain countries are unable to curb or control the inflation rate, it might put a country into a hyperinflation situation which can reduce the economic activity and force the central banks to take extreme measures, such as introducing a contractionary policy that can lead a country to a higher unemployment rate and decrease in economic growth (Fischer, 1993; Fishcer, Sahay, & Végh, 2002).

The data for the inflation rate in this study is expressed from the consumer price index (CPI), which is a common measurement for inflation (Oner, 2017). The calculation for the CPI is that the price of a market basket in the current or given year deduct the previous year then divided by the price of a market basket in the previous year, and the value obtained is then multiplied by 100 (*Note* that the value for the CPI in the base year is always 100). After obtaining the value for the CPI, one can obtain the value for inflation rate by taking the CPI of the current year deduct with the CPI in the previous year then divide with the CPI of the previous year and multiply by 100 (Gan, 2019). As for this study, the economic uncertainty is included in the variables and is known as inflation uncertainty. The value of inflation uncertainty is obtained

through the deviation of the actual value of inflation from the potential value of inflation, which the potential value of inflation is calculated by using the HP filter.

The presence of inflation uncertainty should not be ignored or to be considered as least important in the monetary policy reaction function because the absence of inflation uncertainty in the economy can cause the monetary policymakers to be biased in the decision making process that may result to a negative economic outcome (Evans & Lewis, 1992). Falahi and Hajamini (2015) suggested that monetary policymakers should carry out certain strategies to eliminate the public's expectation during the inflation period to reduce the spreading of misleading information between the policymakers and the public, which may result to better economic performance and increase the economic activities. One can also increase their business spending on improving the resources in forecasting the uncertainty in the inflation in order to be able to minimise – not eliminating – the risk that is associated from the inflation (Golob, 1994). This is because the higher the level of inflation uncertainty, the higher the level of risk that can affect the future economic events and may cause the economic agents to be discouraged to invest in an economy (Grier, Henry, Olekalns, & Shield, 2004). By investing in resources that can help to forecast the level of inflation uncertainty, the public might have higher confidence in investing in a country if the level of their expectation for inflation uncertainty is low and can help to increase the economic activities; hence, monetary policymakers might need to provide several approaches to prevent the level inflation uncertainty from increasing (Ball, 1992).

1.8.5 Exchange rate

The exchange rate in this study can be referred to as the price of one country's currency in terms of another. According to Black et al. (2017), a par exchange rate can only occur when there is an agreement between two parties or countries, which the parties included are either between the government and a registered central authority, namely, the International Monetary Fund (IMF). It is often that the exchange rate is expressed in the price of one currency in terms of another and is known as the nominal exchange rate (Catáo, 2017). For instance, the exchange rate between the United States and Malaysia is 1 US Dollar (USD) to 4.06 Ringgit Malaysia (RM), indicates that one needs to give RM4.06 in order to exchange with 1 USD. As for real exchange rate, it can be expressed as the relationship between prices of two countries, in other words, we can see what we can purchase by spending RM 1 in the United States and by spending 1 USD in Malaysia. However, this study uses the data of real effective exchange rate (REER), which is a measurement between the value of a country’s currency and a weighted combination of other country’s currency; and includes the economic uncertainty in the variable and known as the exchange rate uncertainty. In other words, the exchange rate variable is presented by using the real effective exchange rate index. To obtain the value of exchange rate uncertainty, the value is computed by the differences between the logged time series of the actual real effective exchange rate and the potential real effective exchange rate then is multiplied by 100. The potential real effective exchange rate is computed by using the HP filter.

According to Wollmershäuser (2006), the exchange rate uncertainty in the monetary policy reaction function is able to provide reliable and meaningful

information for the monetary policymakers to design the optimal monetary policy for an economy in order to improve the economic performances. The presence of exchange rate uncertainty can potentially influence the motivation of economic agents to invest in an economy, for instance, economic agents might feel more confident and motivated to invest in an economy if the degree of exchange rate uncertainty is low (Servén, 2003). Darby, Hallett, Ireland, and Piscitelli (1999) stated that a lower degree of exchange rate uncertainty is able to attract other economic agents to invest in the economy and vice versa, in which, suggests that exchange rate uncertainty can either encourage or discourage investment in an economy. The movement of the exchange rate uncertainty has the potential to provide a signal for the monetary policymakers to improve the state of the economy, in other words, monetary policymakers are able to fully utilise the exchange rate uncertainty in order to achieve better economic outcomes (Pavasuthipaisit, 2010).

However, the exchange rate uncertainty can be unpredictable and have the potential to negatively influence the future economic event because economic agents need sufficient time to adapt to the changes before conducting a policy and might encounter several problems when forecasting the exchange rate uncertainty (Zietz & Homaifar, 1994). There are also arguments that show that the inclusion of exchange rate uncertainty in the monetary policy reaction function does not play a significant role because exchange rate uncertainty only contributes a small improvement (or nearly to none) to the economic performances (Ball, 1999). Batini, Harrison, & Millard (2003) stated that the role of exchange rate uncertainty has its limitations in improving the economic performances. If the role of exchange rate uncertainty can only gain a small improvement or contributions in stabilising the economy, monetary policymakers

might ignore the importance of the existence of exchange rate uncertainty in the decision making process (Adolfson, 2007). Thus, Bauwens and Sucarrat (2010) suggested that economic agents or monetary policymakers needed to fully understand and well-engineer the existence of the exchange rate uncertainty in order to be able to obtain more meaningful and useful information for the monetary policymakers to design an appropriate and effective monetary policy.

1.8.6 Terms of trade

The definition of terms of trade (TOT) referred to the ratio of a country's export prices to its import prices (Black et al., 2017) and is an independent variable in this study. The positive and negative movement of the country's TOT is able to indicate whether the country needs to reduce or increase the intake of the amount of imported and exported goods. For instance, if a country has a negative TOT, this shows that the country's export prices have decreased more than the import prices indicating that the country should reduce the purchase or intake of imported goods without making any changes to the amount of exported goods. This study encompasses the economic uncertainty in the variable and the TOT in this study is TOT uncertainty. The TOT uncertainty is the deviation of the potential value of the TOT from the actual value of TOT, which is then multiplied by 100. The potential value for the TOT uncertainty is calculated via HP filter with the smoothing parameter of 1600.

The role of TOT uncertainty is important for the monetary policymakers in the decision making process because TOT uncertainty has the potential to affect the

movement of the interest rate uncertainty which would influence the economic performances (Hove et al., 2015). According to Obstfeld (1982), and Svensson and Razin (1983), the presence of TOT uncertainty should not be ignored because the influence of TOT uncertainty can be seen mostly in the export-oriented industries, in which, TOT uncertainty is able to influence the investment through the expected returns and might have a favourable effect on consumption. Baxter and Kouparitsas (2000) stated that TOT uncertainty may have more influence in developing countries because developing countries rely mostly on export-oriented industrialisation and encourage foreign trade into the countries, in which, a change in TOT uncertainty is able to influence a big part of the country's economies. The effect of TOT uncertainty can also be more visible in the developing countries compared to developed countries due to the fact that most developing countries are more exposed to the export-oriented industries that are able to disclose the importance of TOT uncertainty in their economies (Kose & Riezman, 2001; Hove et al., 2015).

Besides that, TOT uncertainty can serve as a potential indicator to give meaningful information to the monetary policymakers on the country's economic performances (Corsetti & Pesenti, 2005). According to Mendoza (1997), the presence of TOT uncertainty can be reasonable and able to serve as a risk indicator for the monetary policymakers in carrying out an effective economic policy because the role of TOT uncertainty can have a significant effect on economic growth. On the other hand, Bleaney and Greenaway (2001) stated that economic agents tend to invest more in a country economy when the TOT uncertainty is more favourable as the economic agents will profit from the appreciation of the exchange rate, however, the volatility in TOT can be incalculable and might have a negative effect on growth. Erten (2011)

stated that an improvement in TOT uncertainty can indicate that prices of export are increasing compared to the prices of import, in which, may result in positive feedback for the monetary policymakers to design an effective monetary policy; yet, the possibility for the country to suffer from the effect of deterioration in TOT uncertainty is still high considering the fact that the negative effect of TOT uncertainty outweighed the positive effect of TOT uncertainty. Brueckner and Carneiro (2017) mentioned that the monetary policymakers may find TOT uncertainty to be a challenge in the decision making process because TOT uncertainty has the potential to induce unstable and unpredictable economic growth in certain countries, especially in the developing countries.

1.9 Research Limitations

This study has identified several limitations that can be improved in further research. For instance, first, this study only examines the monetary policy reaction function by using the Taylor rule and is restricted to only five variables, namely, interest rate uncertainty, output uncertainty, inflation uncertainty, exchange rate uncertainty, and TOT uncertainty. Second, this study limits its sample sizes to 30 countries, namely, Argentina, Australia, Brazil, Canada, China, Colombia, Czech Republic, Denmark, Finland, Hong Kong, Indonesia, Ireland, Italy, Japan, Malaysia, Mexico, New Zealand, Philippines, Poland, Russia, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom and the United States.

Third, this study is only restricted to two main analyses, namely, the causality test and the cointegration test. This study conducted two causality tests, namely, the Granger causality test proposed by Granger (1969) and the Toda-Yamamoto causality test proposed by Toda and Yamamoto (1995). As for the cointegration test, this study employed the panel heterogeneous cointegration approach proposed by Pesaran, Shin, and Smith (1999) which is also known as the panel autoregressive distributed lag (ARDL). Fourth, this study limits the data period and only apply a quarterly basis dataset, in which, the dataset started from quarter one in the year 1995 until quarter one in the year 2018 due to data availability. Nevertheless, the findings from this study are able to achieve the research objectives and provide appropriate results for the research questions.

1.10 Significance of the Study

Generally, in most countries, monetary policymakers can employ the most appropriate instrument for the country to keep the level of the output gap and inflation low in order to mitigate the negative impact on the economic performance. Most monetary policymakers choose to control an instrument (e.g., money supply or interest rate) to achieve the monetary policy goals. For this study, the interest rate is the main instrument applied to influence the movement of the output gap and inflation, in which, suggested the model of Taylor rule to be considered by the monetary policymakers as a benchmark to design better economic policy that is able to stimulate the economic growth and have positive economic outcomes in the future economic events. Typically, monetary policymakers only consider the role of interest rate, output gap and inflation

to improve the economic performance. However, the presence of external economic variables (i.e., exchange rate and TOT) must not be ignored or considered as the least important. According to Svensson (2000) and Hove et al. (2015), the importance of the exchange rate and TOT must not be neglected by the monetary policymakers in the monetary policy transmission. Hence, this study encompasses two external economic variables, namely, exchange rate and TOT into the monetary policy reaction function without neglecting the conventional variables, namely, output gap and inflation. The incorporation of external economic variables is able to provide useful information for the monetary policymakers to design an efficient and effective economic policy. Monetary policymakers can further improve their knowledge and understanding of utilising the external economic variables to ease the process of decision making for better economic outcomes.

Besides that, this study also includes the economic uncertainty in the monetary policy transmission mechanism. The economic uncertainty in the economic variables can be measured by the gap approach, namely, interest rate uncertainty, output uncertainty, inflation uncertainty, exchange rate uncertainty and TOT uncertainty. The economic uncertainty in this study focuses on a comprehensive measure of economic uncertainty that uses the broader definition of uncertainty (i.e., fluctuation, volatility and shock) instead of studying the economic uncertainty individually. Economic uncertainties can be considered as an unpredicted and unforeseen economic event in the future that can result in a positive or negative economic event. Monetary policymakers might need to put a great effort in conducting or constructing an effective monetary policy when the economic uncertainty is presence because the degree of the economic uncertainty in the economy can affect the decision making process and

influence the progress of the monetary policymakers in attaining the monetary policy goals (Ferrara, Lhuissier, & Tripier, 2018). Therefore, monetary policymakers might need to reconsider the importance of the external economic variables (i.e., exchange rate and TOT) and the presence of economic uncertainty in the monetary policy reaction function. By doing so, monetary policymakers might be able to reduce the possibilities of facing economic turbulences in the future and benefits the researchers who study the monetary policy with respect to external economic variables and economic uncertainty.

1.11 Summary

This current chapter provides a discussion on the background and problem statements for the study. For the upcoming chapters, the arrangement is as follows. Chapter 2 discusses the theoretical and empirical reviews of the previous literature on the competing theories and variables in this study. This is followed by the discussions of methodology in Chapter 3 that provides detailed data and methods applied in this study. Chapter 4 presents and discusses the result obtained from the analysis of the monetary policy reaction function to achieve the objectives of this study. Chapter 5 concludes the study, provides implications of the study and suggests some recommendations for future research.