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Empirical Analysis of Money Demand Function with Economic Uncertainty

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ABSTRACT

The studies on the demand for money rarely focus on the economic uncertainty rather than the scale variable (i.e., output), opportunity cost variables (i.e., interest rate and inflation rate) and external variable (i.e., exchange rate). To overcome this matter, this paper examines the relationships between the demand for money and economic uncertainty in 9 selected countries, including 4 selected developed countries and 5 selected developing countries. The findings suggest that the optimal economic uncertainty index can serve as an uncertainty indicator in signaling central bank's economic policy decision making. This paper also suggests that the output, interest rate, inflation rate and exchange rate are useful indicators for the central bank's economic policy decision making.

Keywords: Demand for Money, Optimal Economic Uncertainty Index, Uncertainty
JEL Classifications: C1, C33, E44

1. INTRODUCTION

The demand for money refers to the demand for the real balances. According to Keynes (1936), people demand for money is essential to meet the purposes of precautionary, speculative and transaction. Numerous literatures have largely investigated the consequences of the financial innovation on the demand for money Khan et al., 2014). The reason may lie in the fact that the bulk of the money created through the products of financial innovation (e.g., giving out various types of loans) in banking sector can create uncertainty to the economy that eventually causes difficulties in predicting the behavior of the economic agents to hold money (Solans, 2003; Ho, 2006); the impact of credit creation (i.e., credit money) by the banking system is similar to the impact of money supply by the central bank. Odularu and Okunrinboye (2009) corroborate the above findings that the demand for money has affected by the financial innovations[1]. Undoubtedly, the uncertain economic conditions may affect the demand for money as economic agents prefer to hold less risker assets during the uncertain economic conditions (Atta-Mensah, 2004; Qureshi et al., 2013). Therefore, the question remains whether the economic uncertainty does play role to improve the knowledge on the demand for money theory.

The studies on the demand for money rarely focus on the economic uncertainty[2] rather than the scale variable (i.e., output), opportunity cost variables (i.e., interest rate and inflation rate) and external

1 Financial innovations refer to the development of new financial products (Parkin, 2003).

2 Economic uncertainty refers to the unknown future economic events (Bloom et al., 2013).

variable (i.e., exchange rate).[3] Although there are several studies that have provided evidence where the uncertainty measures does play role in the function of demand for money, but these studies do not take into account the unknown future economic events, i.e., economic uncertainty (Khan, 2014). For instance, Choi and Oh (2003) find that the output uncertainty does play role in the function of demand for money. Atta-Mensah (2004) constructs the economic uncertainty index to investigate the effects of the uncertain economic conditions on the demand for money and the result shows that the economic uncertainty does affects the monetary aggregates. Greiber and Lemke (2005) find evidence that the uncertainty measures which included into the function of demand for money helps to describe the movements of demand for money. Bahmani-Oskooee and Xi (2011) find that the uncertainty measures do affect the demand for money in both the long run and short run. Bahmani-Oskooee et al. (2013) proved that the demand for money become stable by including the monetary uncertainty and economic uncertainty into the function of demand for money.

The motivation of this paper is that not many research papers on demand for money consider the influence of economic uncertainty (Jamil and Hassan, 2014). The unstable economic conditions continue to grow after the outbreak of the subprime crisis in 2007 (Gan, 2014). The global financial crisis in 2008 has leads to a recession in the global economy (International Monetary Fund, 2009). The recession is related to the burst of asset price bubble and the problems in the banking sector and this eventually affects the growth of the money (European Central Bank, 2012). The recovery of global economy after the global financial crisis has been affected by the European sovereign debt crisis in 2009 (International Monetary Fund, 2010). These uncertainties have worsened the global economy and eventually affect the demand for money. The investors prefer to withdraw the money from the banks during the uncertain economic conditions (Bernanke, 2010). Moreover, the uncertain economic conditions may cause the panicky vending by the investors and increase the precautionary saving by the households. Therefore, it is seems reasonable to study the economic uncertainty with the demand for money. As stressed by Bernanke (2006), there are important information regarding the future economic developments contains in the growth of money.

The aim of this paper is to investigate the relationship between the demand for money and economic uncertainty index, such that the economic uncertainty index can serve as an uncertainty indicator in signaling central bank's economic policy decision making; in this paper, other control variables are also included, such as the scale variable (i.e., output), the opportunity cost variables (i.e., interest rate and inflation rate) and the external variable (i.e., exchange rate). Four selected developed countries, namely Canada, Japan, Switzerland and United States, and five selected developing countries, namely Indonesia, Malaysia, Philippines, Singapore, and Thailand are taken up as samples in this paper.[4] The main innovative of this paper is to include the optimal measure of economic uncertainty proposed by Gan (2014) into the function of demand for money; various macroeconomic conditions indicating by the optimal economic uncertainty index is useful for precise reaction policy control on demand for money. This paper uses Granger causality test to examine the causality relationship between the demand for money and its determinants. In line with this examination, this paper also applies the bivariate vector auto-regression (VAR) estimation to further investigate the response function of the demand for money.

The rest of the paper is organized as follows. Section 2 explains the theoretical model of both demand for money and optimal economic uncertainty index and the methodology used in this paper. Section 3 discusses the data and empirical results of this paper and Section 4 concludes the paper.

2. MODEL SPECIFICATIONS

Keynes (1936) categorizes the motive of holding money into three motives, namely the transactions motive, precautionary motive and the speculative motive. Keynes (1936) argues that both transactions motive and precautionary motive depends on the scale variable (i.e., output) and the speculative motive depends on the opportunity cost variable (i.e., interest rate). According to Keynes (1936), the demand for money is positively relates to the output and relates negatively to the interest rates. Therefore, the function of the demand for money can be expresses as follows:

$$M_t^d = f(y_t, r_t) \quad (1)$$

where M_t^d is the real demand for money, y_t denotes the output and γ_t interest rate.

2.1. Theoretical Model

In line with the aims of this paper, the standard function of demand for money as in Equation 1 is extended to encompass the optimal economic uncertainty index proposed by Gan (2014). In line with this specification, this paper also includes other control variables (i.e., the exchange rate and the inflation rate) into the function of demand for money. Arango and Nadiri (1981) argue that the exclusion of the exchange rate may cause misspecification biases in the function of demand for money. Therefore, the inputs of the function of demand for money applies in this paper are specifies as follows:

$$M_{\mathrm{gt}}^{\mathrm{d}} = \alpha + \beta_1 y_{g_t} + \beta_2 r_{g_t} + \beta_3 \pi_{g_t} + \beta_4 e_{g_t} + \beta_5 U_t + \mu_t \quad (2)$$

Note:

β_0 is a constant.

β_1 to β_5 are the coefficient for each variable.

All variables are in log form, except U, r and π

3 To this end, the work of economic uncertainty by Atta-Mensah (2004) is the only influential paper on the literature of demand for money; he contributes to the literature by introducing concept of unknown future economic events, however, his concept is not optimal and without precise theoretical derivation.

4 The countries classifications by development status, i.e., developed countries and developing countries, are described in United Nations (2012).

The economic rationale suggests that $\beta_1 > 0$ while $\beta_2 < 0$, $\beta_3 < 0$, $\beta_4 < 0$ and $\beta_5 < 0$.

where,

M_{gt}^{d} =real demand for money gap (i.e., M1 or M2)

y_{g_t} =real output gap

r_{g_t} =real interest rate gap

π_{gt} =inflation gap

e_{g_t} =real exchange rate gap

U_t=economic uncertainty index, μ_t=shocks

Because the economic uncertainty index used in this paper is not available in the reality, the optimal economic uncertainty index proposed by Gan (2014) can be used to construct the index. This paper reiterates the Gan's (2014) approach for a quick perusal of the index. The optimal economic uncertainty index is a function-based index computed by using the grid search method where the index is assumed to describe the combination effects of the economic variables, and therefore captures the stability index for the economic activity. The extension of the small structural model explained by Svensson (2000) is used to construct the optimal economic uncertainty index and the inputs of the small structural model are specifies as follows:

$$y_{g_t} = \propto_1 y_{g_{t-1}} - \lambda_1 r_{g_{t-1}} - \delta_1 e_{g_{t-1}} + \varepsilon_t \tag{3}$$

$$\pi_{g_t} = \propto_2 y_{g_{t-1}} + \beta_{\pi_1} \pi_{g_{t-1}} - \delta_2 e_{g_{t-1}} + \eta_t \tag{4}$$

$$e_{g_t} = \lambda_2 r_{g_t} + \upsilon_t \tag{5}$$

$$U_t = \propto_3 y_{g_t} + \beta_{\pi_2} \pi_{g_t} - \delta_3 e_{g_t} - \lambda_3 r_{g_t} + \varpi_t \tag{6}$$

$$r_{g_t} = \propto_4 y_{g_{t-1}} + \beta_{\pi_3} \pi_{g_{t-1}} - \delta_4 e_{g_{t-1}} + U_{t-1} + \zeta_t \tag{7}$$

$$L_t = \mu_{y_g} (y_{g_t})^2 + \mu_{\pi_g} (\pi_{g_t})^2 + \gamma_{r_g} (r_{g_t})^2 \tag{8}$$

where,

y_{g_t} =real output gap

r_{g_t} =real interest rate gap

π_{gt} =inflation gap

e_{g_t} =real exchange rate gap

U_t=economic uncertainty index

L_t=the loss function of the central bank

Equation 3 above is the IS curve where the real output gap is positively related with its own past value and negatively related with both the real interest rate gap and exchange rate gap. ε_t represents the demand shock. Equation 4 represents the Phillips curve where the inflation gap is positively related with both real output gap and inflation gap. η_t represents the supply shock. Equation 5 denotes the positive relationship between the real exchange rate gap and the interest rate gap. υ_t represents the real exchange rate shock. Equation 6 represents the contemporaneous function of economic uncertainty. The positive signs on both y_{g_t} and π_{gt} implies the output mitigation and the reducing inflation could reduce the economic uncertainty. The negative signs on both e_{g_t} and r_{g_t} implies that the economic uncertainty can be reduced by increasing both exchange rate and interest rate. Equation 7 is the reaction function of monetary policy. The positive signs on y_{g_t}, π_{gt} and U_t shows that the central bank can regulate the short-term interest rate to achieve stability in the real output gap, inflation gap and the economic uncertainty. The loss function of the central bank as in Equation 8 is subjected to Equation 3 until Equation 7. Note that for the details of index computation, please refer to the Gan's (2014) work.

2.2. Methodology

The methodologies apply in this paper, namely the Granger causality test and the bivariate VAR are discussed in the folowing subsection. The causality relationship between the demand for money and its determinants are examined by using the Granger causality test. The response of the demand for money is examined by using the bivariate VAR.

2.2.1. Granger causality test

Granger causality (1969) is a concept that used to determine the causality relationships between two time series. By using Granger causality test, we can know that whether the two variables affect each other or not. Suppose that there are two time series, $\{y_t\}$ and $\{x_t\}$. The series x_t fails to Granger Cause y_t if in a regression of y_t on lagged *y*s and *x*s the coefficients of the latter are zero. That is, consider

$$y_t = \sum_{i=1}^{k} \propto_i y_{t-i} + \sum_{i=1}^{k} \beta_i x_{t-i} + u_t \tag{9}$$

Then, if β_i=0 (*i*=1, 2,…,*k*), x_t fails to cause y_t. The lag length *k* is, to some extent, arbitrary.

2.2.2. Bivariate VAR

VAR methodology assumes that there are several endogenous variables in simultaneous equations. Each of the endogenous variables is described by its own lagged values and the lagged values of all other endogenous variables in the model. Each variable has to be treated symmetrically when we are not sure whether the variable is exogenous. For example, the time series y_t that is affected by current and past values of x_t and, simultaneously, the time series x_t to be a series that is affected by current and past values of the y_t series. In this case, the simple bivariate model is given as follows:

$$y_t = \beta_{10} - \beta_{12} x_t + \gamma_{11} y_{t-1} + \gamma_{12} x_{t-1} + u_{yt} \tag{10}$$

$$x_t = \beta_{20} - \beta_{21} y_t + \gamma_{21} y_{t-1} + \gamma_{22} x_{t-1} + u_{xt} \quad (11)$$

where it is assumed that both y_t and x_t are stationary, and u_{yt} and u_{xt} are uncorrelated white-noise error terms.

3. EMIPIRICAL RESULTS AND DISCUSSIONS

Four selected developed countries including Canada, Japan, Switzerland and US and five selected developing countries including Indonesia, Malaysia, Philippines, Singapore, and Thailand are used as the samples of this paper. This quarterly data are collected from 1994 quarter one to 2012 quarter four. This paper collects the data from variety of sources, namely the CD-ROM, Bank for International Settlements Statistics, International Monetary Fund and International Financial Statistics. The unit root test (i.e., Phillips-Perron test) is used to check the stationarity of the variables, namely real output gap, inflation gap, real exchange rate gap, real interest rate gap, real demand for money gap (i.e. M1 and M2) included in this paper. The results of the unit root rest are presented in Table 1. The results shows that all of the variables are integrated of zero, I(0) (i.e., the variables are stationary). This paper applies the Granger causality test and the bivariate VAR when the variables are reported to be stationary.

3.1. Granger Causality Test Results

The causality relationship between the demand for money (i.e., M1 and M2) and its determinants, namely the optimal economic uncertainty index (U), real output gap (y_g), inflation rate gap (π_g), real interest rate gap (r_g) and real exchange rate gap (e_g) for each selected countries are examined by using the Granger Causality test. Since this paper studies the relationship between the demand for money and its determinants, the Granger causality test results will only illustrates the causality of the determinants on the demand for money. The results are reported as follows:

Table 1: Summary statistics for the PP unit root test

Model	Variables					
	y_{gt}	π_{gt}	e_{gt}	r_{gt}	$M1_{gt}$	$M1_{gt}$
Developed countries						
Canada						
Level	−2.686*** [0]	−18.60*** [42]	−3.953*** [3]	−4.168*** [2]	−6.974*** [1]	−4.018*** [3]
First difference	−5.115*** [11]	−21.07*** [17]	−9.149*** [12]	−11.87*** [11]	−34.53*** [27]	−12.76*** [7]
Decision	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)
Japan						
Level	−3.304*** [1]	−11.57*** [5]	−3.618*** [4]	−10.25*** [0]	−3.779*** [5]	−3.920*** [6]
First difference	−8.077*** [3]	−68.30*** [23]	−9.375*** [1]	−50.31*** [29]	−26.68*** [73]	−10.79*** [17]
Decision	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)
Switzerland						
Level	−3.778*** [7]	−21.38*** [15]	−3.800*** [4]	−7.144*** [3]	−2.447** [0]	−2.579** [2]
First difference	−23.59*** [73]	−82.69*** [21]	−9.841*** [3]	−24.16*** [1]	−6.604*** [7]	−5.764*** [7]
Decision	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)
US						
Level	−2.515** [2]	−18.30*** [74]	−4.006*** [0]	−3.431*** [2]	−2.749*** [2]	−3.199*** [3]
First difference	−7.702*** [3]	−22.20*** [16]	−8.375*** [6]	−12.95*** [26]	−8.733*** [1]	−8.224*** [15]
Decision	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)
Developing countries						
Indonesia						
Level	−3.898*** [3]	−4.430*** [5]	−3.747*** [2]	−3.334*** [3]	−3.988*** [6]	−5.967*** [14]
First difference	−10.20*** [9]	−14.60*** [11]	−6.780*** [8]	−8.327*** [1]	−9.638*** [6]	−10.77*** [6]
Decision	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)
Malaysia						
Level	−4.121*** [7]	−8.930*** [15]	−3.284*** [1]	−4.878*** [1]	−3.657*** [2]	−2.994*** [1]
First difference	−17.50*** [39]	−31.45*** [25]	−7.306*** [8]	−12.55*** [12]	−9.101*** [6]	−8.121*** [7]
Decision	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)
Philippines						
Level	−24.18*** [49]	−7.340*** [3]	−3.981*** [1]	−6.366*** [6]	−7.091*** [5]	−5.206*** [4]
First difference	−43.66*** [13]	−28.29*** [15]	−8.874*** [5]	−21.80*** [43]	−26.86*** [20]	−12.98*** [19]
Decision	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)
Singapore						
Level	−3.009*** [0]	−5.614*** [1]	−3.525*** [1]	−3.739*** [0]	−3.803*** [3]	−2.925*** [2]
First difference	−8.674*** [5]	−13.28*** [5]	−8.951*** [2]	−9.213*** [4]	−11.11*** [20]	−7.885*** [2]
Decision	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)
Thailand						
Level	−4.901*** [18]	−7.518*** [25]	−3.866*** [5]	−3.416*** [0]	−12.84*** [19]	−16.74*** [55]
First difference	−10.48*** [30]	−21.97*** [20]	−9.243*** [16]	−7.902*** [5]	−7.757*** [12]	−4.868*** [26]
Decision	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)

Source: Author's calculations using EViews software. The sample period is taken from 1994Q1 until 2012Q4. *,**,***Represent the rejection of the null hypothesis regarding the unit root at the 10%, 5% and 1% significant levels, respectively. PP tests using the Bartlett Kernel with automatic Newey–West bandwidth selection; [ ] denotes the bandwidth. PP: Phillips-Perron

Table 2 shows that the optimal economic uncertainty index, real output, inflation rate, real interest rate and real exchange rate do Granger Cause M1 and M2 of Canada. All of the null hypotheses in Table 2 are rejected.

The results in Table 3 report that the optimal economic uncertainty index, inflation rate and real interest rate do Granger Cause M1 of Japan. However, the null hypothesis of y_g does not Granger Cause M1 and e_g does not Granger Cause M1 cannot be rejected. This implies that both real output and real exchange rate does not Granger Cause M1 of Japan. On the other hand, the optimal economic uncertainty index, real output, inflation rate, real interest rate and real exchange rate do Granger Cause M2 of Japan.

Table 4 shows that the optimal economic uncertainty index and real interest rate do Granger Cause M1 of Switzerland. However, the null hypothesis of y_g does not Granger Cause M1, π_g does not Granger Cause M1 and e_g does not Granger Cause M1 cannot be rejected. On the other hand, the optimal economic uncertainty index, real output, real interest rate and real exchange rate do Granger Cause M2 of Switzerland except for inflation. The null hypothesis of π_g does not Granger Cause M2 cannot be rejected.

The results in Table 5 report that the optimal economic uncertainty index, real output, inflation rate and real interest rate do Granger Cause M1 of US except for real exchange rate. The null hypothesis of e_g does not Granger Cause M1 cannot be rejected. On the other hand, the optimal economic uncertainty index, real output, inflation rate, real interest rate and real exchange rate do Granger Cause M2 of US.

Table 6 shows that the real output, inflation rate, real interest rate and real exchange rate do Granger Cause M1 of Indonesia. However, the null hypothesis of U_g does not Granger Cause M1 cannot be rejected. On the other hand, the optimal economic uncertainty index, real output, real interest rate, inflation rate and real exchange rate do Granger Cause M2 of Indonesia.

The results in Table 7 report that the optimal economic uncertainty index, real output, inflation rate and real exchange rate do Granger Cause M1 of Malaysia. However, the null hypothesis of r_g does not Granger Cause M1 cannot be rejected. This implies that real interest rate does not Granger Cause M1 of Malaysia. On the other hand, the optimal economic uncertainty index, real output, inflation rate and real interest rate do Granger Cause M2 of Malaysia except for real exchange rate.

Table 8 shows that the optimal economic uncertainty index, real output, inflation rate, real interest rate and real exchange rate do Granger Cause M1 and M2 of Philippines. All of the null hypotheses in Table 8 are rejected.

The results in Table 9 report that only the real interest rate does Granger Cause M1 of Singapore. However, the optimal economic uncertainty index, real output, inflation rate and real exchange rate do not Granger Cause M1 of Singapore. In line with these results, the optimal economic uncertainty index, real output, inflation rate and real exchange rate also do not Granger Cause M2 of Singapore except for real interest rate.

Table 10 shows that the optimal economic uncertainty index, real output, inflation rate and real exchange rate do Granger Cause M1 of

Table 2: Causality between M1, M2 and the optimal economic uncertainty index, real output, inflation, real interest rate and real exchange rate in Canada

Null hypothesis	*F* statistic	*P* value	Decision
M1 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M1	3.638 [2]	0.031	Reject
y_g does not Granger Cause M1	4.749 [2]	0.012	Reject
π_g does not Granger Cause M1	2.521 [2]	0.088	Reject
r_g does not Granger Cause M1	5.392 [2]	0.007	Reject
e_g does not Granger Cause M1	2.373 [3]	0.078	Reject
M2 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M2	6.495 [2]	0.003	Reject
y_g does not Granger Cause M2	4.661 [2]	0.013	Reject
π_g does not Granger Cause M2	6.553 [2]	0.002	Reject
r_g does not Granger Cause M2	7.614 [3]	0.000	Reject
e_g does not Granger Cause M2	3.270 [3]	0.027	Reject

Source: Author's calculations by using Eviews software. The sample period is taken from 1994 quarter one until 2012 quarter four. [ ] represents the lag order

Table 3: Causality between M1, M2 and the optimal economic uncertainty index, real output, inflation, real interest rate and real exchange rate in Japan

Null hypothesis	*F* statistic	*P* value	Decision
M1 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M1	6.089 [33]	0.004	Reject
y_g does not Granger Cause M1	1.388 [35]	0.387	Do not reject
π_g does not Granger Cause M1	9.819 [2]	0.000	Reject
r_g does not Granger Cause M1	10.04 [2]	0.000	Reject
e_g does not Granger Cause M1	0.023 [1]	0.879	Do not reject
M2 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M2	3.953 [1]	0.051	Reject
y_g does not Granger Cause M2	1.678 [17]	0.088	Reject
π_g does not Granger Cause M2	3.632 [2]	0.032	Reject
r_g does not Granger Cause M2	2.763 [2]	0.070	Reject
e_g does not Granger Cause M2	4.312 [1]	0.041	Reject

Source: Author's calculations by using Eviews software. The sample period is taken from 1994 quarter one until 2012 quarter four. [ ] represents the lag order

Table 4: Causality between M1, M2 and the optimal economic uncertainty index, real output, inflation, real interest rate and real exchange rate in Switzerland

Null hypothesis	*F* statistic	*P* value	Decision
M1 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M1	4.216 [1]	0.044	Reject
y_g does not Granger Cause M1	1.511 [2]	0.228	Do not reject
π_g does not Granger Cause M1	0.539 [2]	0.586	Do not reject
r_g does not Granger Cause M1	5.433 [1]	0.023	Reject
e_g does not Granger Cause M1	4.370 [3]	0.007	Do not reject
M2 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M2	4.863 [1]	0.031	Reject
y_g does not Granger Cause M2	3.245 [1]	0.076	Reject
π_g does not Granger Cause M2	0.806 [2]	0.451	Do not reject
r_g does not Granger Cause M2	7.524 [1]	0.008	Reject
e_g does not Granger Cause M2	5.967 [1]	0.017	Reject

Source: Author's calculations by using Eviews software. The sample period is taken from 1994 quarter one until 2012 quarter four. [ ] represents the lag order

Table 5: Causality between M1, M2 and the optimal economic uncertainty index, real output, inflation, real interest rate and real exchange rate in US

Null hypothesis	*F* statistic	*P* value	Decision
M1 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M1	2.242 [4]	0.074	Reject
y_g does not Granger Cause M1	8.820 [1]	0.004	Reject
π_g does not Granger Cause M1	3.184 [13]	0.002	Reject
r_g does not Granger Cause M1	8.799 [2]	0.000	Reject
e_g does not Granger Cause M1	0.991 [2]	0.377	Do not reject
M2 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M2	10.26 [1]	0.002	Reject
y_g does not Granger Cause M2	6.249 [3]	0.001	Reject
π_g does not Granger Cause M2	7.335 [2]	0.001	Reject
r_g does not Granger Cause M2	5.421 [2]	0.006	Reject
e_g does not Granger Cause M2	3.726 [3]	0.015	Reject

Source: Author's calculations by using Eviews software. The sample period is taken from 1994 quarter one until 2012 quarter four. [ ] represents the lag order

Table 6: Causality between M1, M2 and the optimal economic uncertainty index, real output, inflation, real interest rate and real exchange rate in Indonesia

Null hypothesis	*F* statistic	*P* value	Decision
M1 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M1	0.241 [2]	0.786	Do not reject
y_g does not Granger Cause M1	5.495 [4]	0.001	Reject
π_g does not Granger Cause M1	11.54 [1]	0.001	Reject
r_g does not Granger Cause M1	1.787 [9]	0.098	Reject
e_g does not Granger Cause M1	2.618 [11]	0.014	Reject
M2 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M2	2.247 [3]	0.092	Reject
y_g does not Granger Cause M2	8.826 [4]	0.000	Reject
π_g does not Granger Cause M2	5.292 [1]	0.025	Reject
r_g does not Granger Cause M2	4.691 [5]	0.001	Reject
e_g does not Granger Cause M2	10.80 [3]	0.000	Reject

Source: Author's calculations by using Eviews software. The sample period is taken from 1994 quarter one until 2012 quarter four. [ ] represents the lag order

Table 7: Causality between M1, M2 and the optimal economic uncertainty index, real output, inflation, real interest rate and real exchange rate in Malaysia

Null hypothesis	*F* statistic	*P* value	Decision
M1 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M1	2.644 [3]	0.056	Reject
y_g does not Granger Cause M1	5.462 [2]	0.006	Reject
π_g does not Granger Cause M1	3.842 [1]	0.054	Reject
r_g does not Granger Cause M1	0.996 [2]	0.374	Do not reject
e_g does not Granger Cause M1	11.70 [1]	0.001	Reject
M2 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M2	1.846 [8]	0.086	Reject
y_g does not Granger Cause M2	2.105 [5]	0.076	Reject
π_g does not Granger Cause M2	5.526 [1]	0.021	Reject
r_g does not Granger Cause M2	3.156 [2]	0.049	Reject
e_g does not Granger Cause M2	1.092 [14]	0.399	Do not reject

Source: Author's calculations by using Eviews software. The sample period is taken from 1994 quarter one until 2012 quarter four. [ ] represents the lag order

Thailand. However, the null hypothesis of r_g does not Granger Cause M1 cannot be rejected. On the other hand, the real output, inflation rate, real interest rate and real exchange rate do Granger Cause M2 of Thailand except for optimal economic uncertainty index. The null hypothesis of U_g does not Granger Cause M2 cannot be rejected.

Table 8: Causality between M1, M2 and the optimal economic uncertainty index, real output, inflation, real interest rate and real exchange rate in Philippines

Null hypothesis	*F* statistic	*P* value	Decision
M1 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M1	2.554 [3]	0.062	Reject
y_g does not Granger Cause M1	26.03 [3]	0.000	Reject
π_g does not Granger Cause M1	2.054 [6]	0.071	Reject
r_g does not Granger Cause M1	3.738 [1]	0.057	Reject
e_g does not Granger Cause M1	2.585 [2]	0.083	Reject
M2 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M2	4.795 [1]	0.032	Reject
y_g does not Granger Cause M2	7.749 [4]	0.000	Reject
π_g does not Granger Cause M2	2.143 [27]	0.039	Reject
r_g does not Granger Cause M2	5.543 [1]	0.021	Reject
e_g does not Granger Cause M2	2.273 [10]	0.030	Reject

Source: Author's calculations by using Eviews software. The sample period is taken from 1994 quarter one until 2012 quarter four. [ ] represents the lag order

Table 9: Causality between M1, M2 and the optimal economic uncertainty index, real output, inflation, real interest rate and real exchange rate in Singapore

Null hypothesis	*F* statistic	*P* value	Decision
M1 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M1	0.113 [1]	0.738	Do not reject
y_g does not Granger Cause M1	0.532 [19]	0.924	Do not reject
π_g does not Granger Cause M1	0.001 [1]	0.973	Do not reject
r_g does not Granger Cause M1	6.470 [1]	0.013	Reject
e_g does not Granger Cause M1	1.534 [2]	0.223	Do not reject
M2 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M2	0.421 [18]	0.972	Do not reject
y_g does not Granger Cause M2	0.347 [18]	0.990	Do not reject
π_g does not Granger Cause M2	1.652 [1]	0.203	Do not reject
r_g does not Granger Cause M2	6.387 [1]	0.014	Reject
e_g does not Granger Cause M2	1.837 [2]	0.167	Do not reject

Source: Author's calculations by using Eviews software. The sample period is taken from 1994 quarter one until 2012 quarter four. [ ] represents the lag order

Table 10: Causality between M1, M2 and the optimal economic uncertainty index, real output, inflation, real interest rate and real exchange rate in Thailand

Null hypothesis	*F* statistic	*P* value	Decision
M1 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M1	2.421 [2]	0.098	Reject
y_g does not Granger Cause M1	3.577 [2]	0.034	Reject
π_g does not Granger Cause M1	2.178 [4]	0.085	Reject
r_g does not Granger Cause M1	0.001 [1]	0.971	Do not reject
e_g does not Granger Cause M1	9.529 [2]	0.000	Reject
M2 with U, y_g, π_g, r_g and e_g			
U does not Granger Cause M2	1.810 [1]	0.184	Do not reject
y_g does not Granger Cause M2	3.247 [4]	0.019	Reject
π_g does not Granger Cause M2	6.672 [2]	0.003	Reject
r_g does not Granger Cause M2	2.422 [2]	0.098	Reject
e_g does not Granger Cause M2	2.654 [2]	0.079	Reject

Source: Author's calculations by using Eviews software. The sample period is taken from 1994 quarter one until 2012 quarter four. [ ] represents the lag order

3.2. Bivariate VAR results

The effects of the respective innovations on the real output gap (y_g), the inflation rate gap (π_g), the real interest rate gap (r_g), the real exchange rate (e_g) and the optimal economic uncertainty index (U) in the demand for money (i.e,. M1 and M2) are examined by using the bivariate VAR. The results are reported in Tables 11 and 12 below. The explanatory variables of the demand for money are listed in the column.

Table 11 reports the summary of the bivariate VAR model of the M1. All of the explanatory variables have the expected sign. The results show that all of the explanatory variables are statistically significant except the e_{g_t} in US. Although the e_{g_t} in US is not significant, the overall results still support the innovations in the M1 responded positively to y_{g_t} and negatively to r_{g_t}, π_{gt} and e_{g_t}.

Table 12 reports the summary of the bivariate VAR model of the M2. All of the explanatory variables have the expected sign. The results show that all of the explanatory variables are statistically significant except the y_{g_t} and U_t in Singapore. Although the y_{g_t} and U_t in Singapore are not significant, the overall results still support the innovations in the M2 responded positively to y_{g_t} and negatively to r_{g_t}, π_{gt} and e_{g_t}.

Few findings can be drawn from the analysis above. First, the optimal economic uncertainty index has negative relationship with the demand for money and this implies that higher optimal economic uncertainty index may cause the demand for money to decrease. The economic agents may prefer to substitute their money with other safer assets during higher uncertain economic conditions. Jackman (2010) also finds negative relationship between the demand for money and economic uncertainty. Second, the demand for money is positively related to the output and negatively related to the interest rate, inflation rate and exchange rate. This finding is in line with the findings from Ozturk and Acaravci (2008). In terms of policy implications, this paper suggests that the optimal economic uncertainty index can serve as an uncertainty indicator in signaling the central bank's economic policy decision making; the demand for money decreased when the optimal economic uncertainty index increased. Moreover, this paper also suggests that the central bank should consider the output, interest rate, inflation rate and exchange rate as useful indicators in economic policy decision making.

4. CONCLUSIONS

This paper examines the relationship between the demand for money and its determinants in four selected developed countries, namely Canada, Japan, Switzerland and US and five selected developing countries, namely Indonesia, Malaysia, Philippines, Singapore, and Thailand. The finding suggests that the optimal economic uncertainty index has negative relationship with the demand for money. In line with this finding, the output has positive relationship with the demand for money while other control variables, namely the interest rate, the inflation rate and the exchange rate do have negative relationship with the demand for money. Therefore, the optimal economic uncertainty index can serve as an uncertainty indicator in signaling the central bank's

Table 11: Summary of the bivariate VAR model of the M1

Selected developed countries ($M1_{gt}$ innovations in response to the innovations of y_{gt}, r_{gt}, π_{gt}, e_{gt} and U_t)					
Countries	y_{gt}	π_{gt}	e_{gt}	r_{gt}	U_t
Canada	0.453** [1]	−1.519** [4]	−0.538*** [1]	−0.710* [2]	−2.240** [2]
Japan	2.969** [32]	−1.956** [1]	−0.416* [20]	−3.272*** [2]	−5.159* [16]
Switzerland	0.904** [5]	−2.396* [8]	−0.353* [2]	−1.220*** [1]	−1.236* [1]
US	1.069*** [3]	−0.752* [8]	−0.087 [2]	−0.602** [2]	−3.376** [1]
Indonesia	0.975*** [1]	−0.676*** [1]	−0.155* [5]	−0.348* [3]	−2.826* [8]
Malaysia	0.269* [1]	−1.229* [1]	−0.379** [4]	−1.013** [7]	−1.667** [3]
Philippines	0.537*** [4]	−2.052*** [2]	−0.218* [5]	−0.646** [1]	−2.098** [2]
Singapore	0.037* [5]	−1.454* [8]	−0.777* [17]	−0.784* [1]	−2.941** [7]
Thailand	0.453** [1]	−1.519*** [4]	−0.538*** [1]	−0.710* [2]	−2.240** [2]

Source: Author's calculation by using EViews software. $M1_{gt}$ represents the dependent variable while y_{gt}, r_{gt}, π_{gt}, e_{gt} and U_t are the explanatory variables. [ ] represents the lag order of the explanatory variables. The AIC is used to select the lag length for the bivariate VAR model. *.** and *** represent the statistical significance at the 10%, 5% and 1% significant levels, respectively. The parameters for the explanatory variables have the expected sign. AIC: Akaike information criterion

Table 12: Summary of the bivariate VAR model of the M2

Selected developed countries ($M2_{gt}$ innovations in response to the innovations of y_{gt}, r_{gt}, π_{gt}, e_{gt} and U_t)					
Countries	y_{gt}	π_{gt}	e_{gt}	r_{gt}	U_t
Canada	0.191** [3]	−1.859*[10]	−0.187** [1]	−0.461** [5]	−0.879* [1]
Japan	0.214*[16]	−0.392*** [2]	−0.033* [4]	−0.226* [3]	−0.360** [6]
Switzerland	0.685*[5]	−2.582** [13]	−0.283* [2]	−1.234*** [1]	−1.051* [1]
US	0.520*** [3]	−0.638** [11]	−0.093* [3]	−0.282** [2]	−3.373*** [1]
Indonesia	0.622*** [1]	−0.507*** [2]	−0.124** [5]	−0.223** [4]	−1.562** [3]
Malaysia	0.124** [1]	−0.726** [1]	−0.187** [4]	−0.695** [11]	−0.767* [3]
Philippines	0.412*** [4]	−0.962**[12]	−0.162* [5]	−0.528* [1]	−1.463** [3]
Singapore	0.007 [1]	−1.523**[8]	−0.476* [1]	−1.525* [20]	−0.396 [3]
Thailand	0.191** [3]	−1.859*[10]	−0.187** [1]	−0.461** [5]	−0.879* [1]

Source: Author's calculation by using EViews software. $M2_{gt}$ represents the dependent variable while y_{gt}, r_{gt}, π_{gt}, e_{gt} and U_t are the explanatory variables. [ ] represents the lag order of the explanatory variables. The AIC is used to select the lag length for the bivariate VAR model. *.** and *** represent the statistical significance at the 10%, 5% and 1% significant levels, respectively. The parameters for the explanatory variables have the expected sign. AIC: Akaike information criterion economic policy decision making. This paper also suggests that the central bank should consider inflation rate and exchange rate as useful indicator for the central bank's economic policy decision making.

However, there are few limitations in this paper. First, this paper only include nine countries and five variables in the function of demand for money, namely the optimal economic uncertainty index, real output, the real interest rate, the inflation rate and the real exchange rate. Other variables such as the stock prices and other asset prices can be included for future research. Second, this paper only restricted to the Granger causality test and bivariate VAR. Other inference estimations, e.g., cointegration analysis, panel estimations, panel cointegration estimations and etc., can be applied to further research the reaction function between demand for money and the optimal economic uncertainty index.

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REFERENCES

Arango, S., Nadiri, M.I. (1981), Demand for money in open economies. Journal of Monetary Economics, 7, 69-83.

Atta-Mensah, J. (2004), Money demand and economic uncertainty. Bank of Canada Working Paper, No. 2004-25.

Bahmani-Oskooee, M., Xi, D. (2011), Economic uncertainty, monetary uncertainty and the demand for money in Australia. Australian Economic Papers, 50(4), 115-128.

Bahmani-Oskooee, M., Kutan, A.M., Xi, D. (2013), The impact of economic and monetary uncertainty on the demand for money in emerging economies. Applied Economics, 45(23), 3278-3287.

Bernanke, B.S. (2006), Monetary aggregates and monetary policy at the Federal Reserve: A historical perspective. Speech at the Fourth ECB Central Banking Conference, Frankfurt, Germany. Available from: http://www.federalreserve.gov/newsevents/speech/bernanke20061110a.htm. [Last accessed on 2014 Nov 26].

Bernanke, B.S. (2010), On the implications of the financial crisis for economics. Speech Presented at the Center for Economic Policy Studies and the Bendheim Center for Finance. New Jersey: Princeton. Available from: http://www.federalreserve.gov/newsevents/speech/bernanke20100924a.htm. [Last accessed on 2014 Nov 25].

Bloom, N., Kose, M.A., Terrones, M.E. (2013), Held back by uncertainty. Finance and Development, 50(1), 38-41.

Choi, W.G., Oh, S. (2003), A money demand function with output uncertainty, monetary uncertainty, and financial innovations. Journal of Money, Credit and Banking, 35(5), 685-709.

European Central Bank. (2012), Money and credit growth after economic and financial crises-A historical global perspective. European Central Bank Monthly Bulletin, 2, 69-85.

Gan, P.T. (2014), The optimal economic uncertainty index: A grid search application. Computational Economics, 43(2), 159-182.

Granger, C.W.J. (1969), Investigating causal relations by econometric models and cross-spectral methods. Econometrica, 37(3), 424-438.

Greiber, C., Lemke, W. (2005), Money demand and macroeconomic uncertainty. Deutsche Bundesbank Discussion Paper, Series 1, Economic Studies, No. 26/2005.

Ho, N.W. (2006), Financial innovation and its impact on central-bank policies. Monetary Authority of Macao.

International Monetary Fund. (2009), World Economic Outlook: World Economic and Financial Surveys. Washington, D.C: International Monetary Fund.

International Monetary Fund. (2010), World Economic Outlook: World Economic and Financial Surveys. Washington, D.C: International Monetary Fund.

Jackman, M. (2010), Money demand and economic uncertainty in Barbados. Central Bank of Barbados, MPRA Paper No. 29360.

Jamil, R.A., Hassan, S.R. (2014), Influence of celebrity endorsement on consumer purchase intention for existing products: A comparative study. Journal Of Management Info, 4(1), 1-23.

Keynes, J.M. (1936), The general theory of employment, interest, and money. Macmillan.

Khan, A. (2014), How does stock prices respond to various macroeconomic factors? A case study of Pakistan. Journal Of Management Info, 4(1), 75-95.

Khan, F., Yusoff, R.M., Khan, A. (2014), Job demands, burnout and resources in teaching a conceptual review. World Applied Sciences Journal, 30(1), 20-28.

Odularu, G.O., Okunrinboye, O.A. (2009), Modeling the impact of financial innovation on the demand for money in Nigeria. African Journal of Business Management, 3(2), 39-51.

Ozturk, I., Acaravci, A. (2008), The demand for money in transition economies. Romanian Journal of Economic Forecasting, 2, 35-43.

Parkin, M. (2003), Economics. United States of America: Pearson.

Qureshi, M.I., Rustum, A., Rustum, S., Omar, A.B., Zaman, K. (2013), Factors influencing customer satisfaction in banking sector of Pakistan. Report and Opinion, 5(2), 35-39.

Solans, E.D. (2003), Financial innovation and monetary policy. Speech at 38th SEACEN Governors Conference and 22nd Meeting of the SEACEN Board of Governors on 'Structural Change and Growth Prospects in Asia – Challenges to Central Banking'. Available from: http://www.ecb.europa.eu/press/key/date/2003/html/sp030213.en.html. [Last accessed on 2014 Nov 26].

Svensson, L. (2000), Open-economy inflation targeting. Journal of International Economics, 50, 155-183.

United Nations. (2012), World Economic Situation and Prospects 2012. New York: United Nations.