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Precautionary Demand for Money and Economic Uncertainty: Evidence from Toda-Yamamoto Long-run Causality Method

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ABSTRACT

A notable feature of empirical studies on government unknown or uncertain policies influencing the economy that lead to the precautionary demand for money among economic agents is that very few studies put emphasis on causality inference, cross-country comparisons, and the integration of behavioral factors. To prevail over this shortcoming, this study examines the long-run causal relationship between the precautionary demand for money and economic uncertainty and the fear factor, without neglecting the roles of income and the interest rate in the money demand function in 28 economies. The empirical results from Toda-Yamamoto long-run causality method indicate that economic uncertainty and the fear factor demonstrate significant explanatory power for the precautionary demand for money, which policy maker could utilize in fine-tuning the liquidity provision for improved macroeconomic stability.

Keywords: Precautionary, Money Demand, Economic Uncertainty, Toda-Yamamoto, Long-run Causality
JEL Classifications: C23, E41

1. INTRODUCTION

Precautionary demand for money refers to the desire to hold liquid monetary assets as a safeguard against unforeseen economic events.[1] This concept was first introduced by Keynes (1936) in his seminal work, *The General Theory of Employment, Interest, and Money*. Since then, numerous researchers have explored the propensity of households and firms to hold extra cash as a buffer against economic uncertainty, employing various methodological approaches. However, much of the existing literature has focused predominantly on explaining and forecasting how economic agents adjust their liquidity preferences in response to uncertainty (Friedman and Kuttner, 2010). Despite these efforts, empirical evidence has often been limited by challenges related to causality inference, data quality, and measurement (Beckmann and Czudaj, 2013). Therefore, the question remains as to whether further research in this area could enhance our understanding of money demand and economic uncertainty, thereby contributing to the refinement of monetary theory.

A notable feature of empirical studies on government unknown or uncertain policies influencing the economy that lead to the precautionary demand for money among economic agents is that very few studies put emphasis on causality inference, cross-country comparisons, and the integration of behavioral factors; government unknown or uncertain policies may refer to the unpredictable changes of fiscal, monetary, or regulatory policies (Bordo et al., 2016). For example, Bahmani-Oskooee et al. (2015) incorporates economic policy uncertainty into the money demand

1 An unforeseen economic event means economic uncertainty (Black et al., 2012).

function using the linear autoregressive distributed lag (ARDL) technique. Their study indicates only a short-run rather than a long-run negative effect of economic policy uncertainty on money demand in the UK. In the US, by contrast, both the long-run and short-run effect of economic policy uncertainty on money demand is found to be significantly positive (Bahmani-Oskooee et al., 2016). Applying the same technique, Ivanovski and Churchill (2019) opine that economic policy uncertainty affects money demand positively in the long run while negatively in the short run with money demand in Australia. Under the linear ARDL setting, Bahmani-Oskooee and Nayeri (2020) finds neither short-term nor long-term significant effect of economic policy uncertainty on money demand in Japan.

On the other hand, using the nonlinear asymmetric ARDL approach, Bahmani-Oskooee and Maki-Nayeri (2019) demonstrate that in the US, increased economic policy uncertainty leads to significant negative effect on money demand in the long run but the decreased economic policy uncertainty does not hold a significant effect. In the UK, by contrast, Bahmani-Oskooee and Maki Nayeri (2020) find that both the increased and decreased economic policy uncertainty induce economic agents to hold more cash in both the short run and the long run. Murad et al. (2021) suggest that for India, while the linear ARDL approach supports the significant positive effect of economic policy uncertainty only on the narrow money in the short run, the asymmetric non-linear method confirms only decreased economic policy uncertainty's positive effect on money demand in the short run. Bahmani-Oskooee and Aftab (2022) shows that the asymmetric effects of economic policy uncertainty in China also exists, where only increased economic policy uncertainty induces people to hold more money both in the short run and the long run while decreased uncertainty does not, perhaps due to distrust of the public.

Other studies employ economic uncertainty proxies that do not specifically focus on economic uncertainty from policy making perspective. For example, Bahmani-Oskooee et al. (2013) reveal that in the majority of the sample emerging economies, monetary uncertainty exerts more short-run effects than long-run effects. Al Rasasi (2020) presents a long-run positive stable relationship between money demand and stock price uncertainty in Saudi Arabia while the short-run effect is not significant. Khan et al. (2023) find that people in India demand more money facing high monetary and stock market uncertainties. Gan (2019) opines that the optimal economic uncertainty index, which features key macroeconomic variables deviating from their long-run equilibriums, cointegrates with real narrow money demand for a sample of eleven countries. Akinlo (2024) finds that for Nigeria, the world uncertainty index proposed by Ahir et al. (2022) affects money demand symmetrically in the short run while in the long run, only decreased world uncertainty index significantly contribute to less holding of cash in the long run.

The study aims to examine the long-run causal relationship between the precautionary demand for money and economic uncertainty as well as the behavioral fear factor, without ignoring the roles of the scale variable (income), the opportunity variable (the interest rate) and the behavioral factor (the fear factor) in the money demand function (the precautionary motive represent economic uncertainty), such that these determinants can function as predictive indicators signaling change in the motives for hold money. In doing so, the identified causal relationship can help central banks to guide monetary policy to provide sufficient liquidity for improved macroeconomic stability. For empirical procedures, this study applies the Toda-Yamamoto long-run causality method (Toda and Yamamoto, 1995) to examine the causal relationship between money demand and its determinants.

The remainder of this paper is organized as follows: Section 2 discusses the theoretical model and methodologies; Section 3 describes data and reports empirical results. Section 4 concludes the study.

2. MODEL AND ECONOMETRIC METHODOLOGY

2.1. Theoretical Model

Keynes (1936) initially identified precautionary demand for money as one of the key motives for holding cash, particularly as a buffer against unforeseen events. However, he did not explicitly define the relationship between economic uncertainty and precautionary money demand (Weatherson, 2002). Instead, Keynes encompassed the transaction and precautionary motives under income and the speculative motive under interest rates. To address this gap, Gan (2019) proposes an augmented money demand function that reintroduces the precautionary motive, directly linking it to economic uncertainty. This augmented function is advantageous as it captures economic uncertainty without undermining the transactions motive (proxied by income) or the speculative motive (proxied by the interest rate). The equation is expressed as:

$$m_t=\alpha+\beta_1 y_t+\beta_2 R_t+\beta_3 eu_t+u_t \quad (1)$$

Where y_t R_t and eu_t represent the real income, the nominal interest rate, and economic uncertainty respectively. α is the constant term and u_t denotes the occurrence of a money demand shock that exceeds the impact caused by y_t, R_t, and eu_t. This equation presumes that m_t depends positively on y_t, but negatively on R_t and eu_t.

Considering that heightened risk aversion, triggered by the "fear factor," may prompt individuals and firms to hold more liquid assets, Carroll (1997) argues that fear of income uncertainty drives precautionary savings. Similarly, Baker et al. (2016) show that uncertain or unknown government policies can increase liquidity holdings. Guiso et al. (2018) find that the fear factor triggers risk aversion, raising demand for cash. Incorporating this fear factor into the augmented function, i.e., Eq. (1), this is given by

$$m_t=\alpha+\beta_1 y_t+\beta_2 R_t+\beta_3 eu_t+f_t+u_t \quad (2)$$

Where f_t represents the fear factor. In Eq. (2), f_t is shown as a dummy variable that takes 0 or 1. A value of 0 indicates no occurrence of emotional fear (when economic uncertainty has not emerged), and a value of 1 reflects the presence of emotional fear (when economic uncertainty is perceived).

2.2. Methodology

Consistent with the objective of this study, we intend to apply the Toda-Yamamoto long-run causality method by Toda and Yamamoto (1995) based on the augmented VAR model. The model is augmented because besides adopting the base number of lags (k), additional lags, namely, the maximum unit root degree of the variables ($dmax$) are included in the model. Then, the VAR model is augmented by using $k + dmax$ lags.

Stock and Watson (2001) argue that the augmented VAR model demonstrates powerful and reliable forecasts by capturing dynamic multivariate relationships. Stock and Watson (2005) indicate that the augmented VAR model could be used to analyze the effects of policy interventions without bothering to consider unnecessary identifying restrictions. Furthermore, the augmented VAR model can also leverage more data series to mitigate the frequently occurring problem of model misspecification (Qin, 2011; Nicholson et al., 2017). For causal inference, based on the augmented VAR model, the main advantage of Toda-Yamamoto causality method lies in its simple application, its absence of pre-testing distortions and the validity of the standard asymptotic distribution of the modified Wald test statistics regardless of the variable properties of unit roots and cointegration. (García-del-Hoyo et al., 2021; Daly et al., 2024).

An augmented VAR model with $k + dmax$ lags can be expressed as:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + . + A_{k+dmax}\ Y_{t-(k+dmax)} + \varepsilon_t \tag{3}$$

Where Y_t represents a vector of endogenous variables, A_i represents parameter matrices and ε_t represents a vector of error terms. Following Su (2017), we apply the command "varlagselect" in the software RATS 9.2 to determine k for the VAR system based on the Akaike information criterion (AIC).

Given Eq. (3), the empirical augmented VAR model can be expressed as:

$$\begin{bmatrix} lm1_t \\ ly_t \\ R_t \\ eu_t \\ f_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} lm1_{t-1} \\ ly_{t-1} \\ R_{t-1} \\ eu_{t-1} \\ f_{t-1} \end{bmatrix} + A_2 \begin{bmatrix} lm1_{t-2} \\ ly_{t-2} \\ R_{t-2} \\ eu_{t-2} \\ f_{t-2} \end{bmatrix} + \begin{bmatrix} e_{lm1} \\ e_{ly} \\ e_R \\ e_{eu} \\ e_f \end{bmatrix} \tag{4}$$

In Eq. (3), Belgium is used as an illustrative example. All the variables are in the logged form $lm1$, $lm2$, ly, $lepu$, except the nominal interest rate (R) and the fear factor (f). The selected lag length $k = 1$ and $dmax = 1$ (Table 1), which creates a VAR (2). The value of is selected as 1 because most macroeconomic series are stationary after first differencing (Stock and Watson, 1988). An $I(1)$ series should not be differenced more than once to avoid over-differencing (Burke and Hunter, 2005). Including $k + dmax$ lags enables the VAR model to imply long-run relationships among variables (Masih and Masih, 2001). In addition, this approach may help mitigate the instability problem due to structural change that are widespread in low-dimensional VARs (Stock and Watson, 1996).

For the Toda-Yamamoto procedure to examine the long-run causality from the real income (ly_t), the nominal interest rate (R_t), the economic uncertainty (eu_t) and the fear factor (f_t) to the real money demand ($lm1_t$) and ($lm1_2$), we first test that y_t does not Granger cause $lm1_t$ in the first equation of the VAR system for the first k lags. In the case of the Belgium where $k = 1$, the null hypothesis is $H_0 : \alpha_{12}^{(1)} = 0$; $\alpha_{12}^{(i)}$ represents the coefficient for ly_{t-1}, $i = 1$. If the null hypothesis is rejected based on the significance level of the modified Wald statistic, then the causality from y_t to $lm1_t$ can be established. Then, similar processes can be conducted for analyzing the causality from R_t, eu_t, f_t to $lm1_t$ and to $lm1_2$ and for other 27 economies.

3. DATA AND EMPIRICAL RESULTS

3.1. Data

The empirical study is based on 28 economies, namely, Australia, Belgium, Brazil, Canada, Chile, China, Colombia, Croatia, Denmark, France, Germany, Greece, Hong Kong, India, Ireland, Italy, Japan, Mexico, Netherlands, New Zealand, Nigeria, Russia, Singapore, South Korea, Spain, Sweden, the UK and the US from 1996 Q1 to 2024 Q1. There are five variables, namely, money demand, real income, the nominal interest rate, economic uncertainty and the fear factor. Money demand is proxied by real narrow money and real broad money. The real income is proxied by real GDP. The nominal interest rate is proxied by the money market rate. Economic uncertainty is proxied by the economic policy uncertainty proposed by Baker et al. (2016). The fear factor is proxied by the dummy variable. The detailed description for each variable is as follows:

- Consumer price index (*CPI*): Data on (*CPI*) are obtained from International Financial Statistics (IFS) of the IMF.
- Real narrow money ($m1$): Data on nominal narrow money ($M1$) are obtained from IFS. $m1$ is obtained by dividing M1 by the CPI.
- Real broad money ($m2$): Data on nominal broad money ($M2$) are obtained from IFS. $m2$ is obtained by dividing $M2$ by the *CPI*.
- Real income (y): Income is proxied by gross domestic product (*GDP*). Data on Nominal GDP are obtained from the IFS. Real GDP (y) is obtained by dividing nominal GDP by the *CPI*.
- Nominal interest rate (R): The nominal interest rate (R) is proxied by the money market rate (*MMR*) from the IFS.
- Economic policy uncertainty (epu): Developed by Baker et al. (2016), epu captures a broad range of uncertainty-related keywords by news media. The index demonstrates desirable effectiveness, conforming to stock market volatility and strongly correlating with Federal Reserve System's Beige Books' references of policy uncertainty. Data on are obtained from economic policy uncertainty website. A higher epu indicates greater uncertainty and vice versa.
- Fear Factor (f): The dummy variable takes 1 for periods 1998 Q1 to 1998 Q4 (Asian financial crisis), 2001 Q1 to 2003 Q4 (the dot-come bubble burst), 2008 Q4 to 2009 Q4 (the global financial crisis), 2012 Q1 to 2012 Q4 (the EU debt crisis) and 2019 Q4 to 2020 Q2 (the covid-19 pandemic) and takes 0 for other time periods.

Table 1: Toda-Yamamoto causality test results

Economies	Variables	VAR lags (*k*+*dmax*)	MW static	Null hypothesis	Decision
Australia					
Dependent Variable: *lm1*					
	ly	10	16.937**	*ly* does not cause *lm1*	Reject
	R	10	33.484***	*R* does not cause *lm1*	Reject
	lpeu	10	40.763***	*lepu* does not cause *lm1*	Reject
	f	10	33.561***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	8	15.186**	*ly* does not cause *lm2*	Reject
	R	8	37.611***	*R* does not cause *lm2*	Reject
	lpeu	8	7.000	*lepu* does not cause lm2	Do not reject
	f	8	11.893	*f* does not cause lm2	Do not reject
Belgium					
Dependent Variable: *lm1*					
	ly	2	3.037*	*ly* does not cause *lm1*	Reject
	R	2	1.757	*R* does not cause *lm1*	Do not reject
	lpeu	2	6.139**	*lepu* does not cause *lm1*	Reject
	f	2	3.928**	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	8	13.806*	*ly* does not cause *lm2*	Reject
	R	8	12.955*	*R* does not cause *lm2*	Reject
	lpeu	8	13.610*	*lepu* does not cause lm2	Reject
	f	8	8.914	*f* does not cause lm2	Do not reject
Brazil					
Dependent Variable: *lm1*					
	ly	8	10.812	*ly* does not cause *lm1*	Do not reject
	R	8	37.053***	*R* does not cause *lm1*	Reject
	lpeu	8	11.644*	*lepu* does not cause *lm1*	Reject
	f	8	13.934**	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	14	27.106**	*ly* does not cause *lm2*	Reject
	R	14	38.823***	*R* does not cause *lm2*	Reject
	lpeu	14	35.166***	*lepu* does not cause lm2	Reject
	f	14	37.228***	*f* does not cause lm2	Reject
Canada					
Dependent Variable: *lm1*					
	ly	13	26.931***	*ly* does not cause *lm1*	Reject
	R	13	32.162***	*R* does not cause *lm1*	Reject
	lpeu	13	32.561***	*lepu* does not cause *lm1*	Reject
	f	13	44.922***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	10	37.788***	*ly* does not cause *lm2*	Reject
	R	10	49.242***	*R* does not cause *lm2*	Reject
	lpeu	10	23.355***	*lepu* does not cause lm2	Reject
	f	10	5.118	*f* does not cause lm2	Do not reject
Chile					
Dependent Variable: *lm1*					
	ly	10	26.201***	*ly* does not cause *lm1*	Reject
	R	10	65.441***	*R* does not cause *lm1*	Reject
	lpeu	10	31.586***	*lepu* does not cause *lm1*	Reject
	f	10	28.693***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	12	17.712*	*ly* does not cause *lm2*	Reject
	R	12	27.089***	*R* does not cause *lm2*	Reject
	lpeu	12	75.071***	*lepu* does not cause lm2	Reject
	f	12	61.425***	*f* does not cause lm2	Reject
China		9			
Dependent Variable: *lm1*					
	ly	9	14.585*	*ly* does not cause *lm1*	Reject

(Contd...)

Table 1: ***(Continued)***

Economies	Variables	VAR lags (k+$dmax$)	MW static	Null hypothesis	Decision
	R	9	13.711*	*R* does not cause *lm1*	Reject
	lpeu	9	41.267***	*lepu* does not cause *lm1*	Reject
	f	9	20.846***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	10	18.690**	*ly* does not cause *lm2*	Reject
	R	10	23.275***	*R* does not cause *lm2*	Reject
	lpeu	10	59.446***	*lepu* does not cause lm2	Reject
	f	10	29.674***	*f* does not cause lm2	Reject
Colombia					
Dependent Variable: *lm1*					
	ly	10	31.953***	*ly* does not cause *lm1*	Reject
	R	10	28.076***	*R* does not cause *lm1*	Reject
	lpeu	10	24.717***	*lepu* does not cause *lm1*	Reject
	f	10	22.570***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	8	44.342***	*ly* does not cause *lm2*	Reject
	R	8	27.176***	*R* does not cause *lm2*	Reject
	lpeu	8	23.206***	*lepu* does not cause *lm2*	Reject
	f	8	24.046***	*f* does not cause *lm2*	Reject
Croatia					
Dependent Variable: *lm1*					
	ly	7	11.345*	*ly* does not cause *lm1*	Reject
	R	7	15.194**	*R* does not cause *lm1*	Reject
	lpeu	7	19.643***	*lepu* does not cause *lm1*	Reject
	f	7	12.510*	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	5	26.108***	*ly* does not cause *lm2*	Reject
	R	5	46.844***	*R* does not cause *lm2*	Reject
	lpeu	5	16.357***	*lepu* does not cause lm2	Reject
	f	5	15.889***	*f* does not cause lm2	Reject
Denmark					
Dependent Variable: *lm1*					
	ly	9	14.485*	*ly* does not cause *lm1*	Reject
	R	9	15.161*	*R* does not cause *lm1*	Reject
	lpeu	9	10.938	*lepu* does not cause *lm1*	Do not reject
	f	9	15.251*	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	11	33.929***	*ly* does not cause *lm2*	Reject
	R	11	19.620**	*R* does not cause *lm2*	Reject
	lpeu	11	20.738**	*lepu* does not cause lm2	Reject
	f	11	15.421	*f* does not cause lm2	Do not reject
France					
Dependent Variable: *lm1*					
	ly	11	19.279**	*ly* does not cause *lm1*	Reject
	R	11	33.970***	*R* does not cause *lm1*	Reject
	lpeu	11	24.415***	*lepu* does not cause *lm1*	Reject
	f	11	21.563**	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	11	38.768***	*ly* does not cause *lm2*	Reject
	R	11	45.226***	*R* does not cause *lm2*	Reject
	lpeu	11	45.232***	*lepu* does not cause lm2	Reject
	f	11	20.485**	*f* does not cause lm2	Reject
Germany					
Dependent Variable: *lm1*					
	ly	5	21.060***	*ly* does not cause *lm1*	Reject
	R	5	18.820***	*R* does not cause *lm1*	Reject
	lpeu	5	23.469***	*lepu* does not cause *lm1*	Reject
	f	5	17.968***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	8	15.711**	*ly* does not cause *lm2*	Reject
	R	8	46.994***	*R* does not cause *lm2*	Reject
	lpeu	8	31.936***	*lepu* does not cause lm2	Reject

(Contd...)

Table 1: ***(Continued)***

Economies	Variables	VAR lags (*k*+*dmax*)	MW static	Null hypothesis	Decision
	f	8	28.022***	*f* does not cause lm2	Reject
Greece		8			
Dependent Variable: *lm1*					
	ly	11	24.237***	*ly* does not cause *lm1*	Reject
	R	11	18.150*	*R* does not cause *lm1*	Reject
	lpeu	11	77.430***	*lepu* does not cause *lm1*	Reject
	f	11	25.367***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	12	30.305***	*ly* does not cause *lm2*	Reject
	R	12	40.950***	*R* does not cause *lm2*	Reject
	lpeu	12	21.539**	*lepu* does not cause lm2	Reject
	f	12	55.005***	*f* does not cause lm2	Reject
Hong Kong					
Dependent Variable: *lm1*					
	ly	9	28.212***	*ly* does not cause *lm1*	Reject
	R	9	14.131*	*R* does not cause *lm1*	Reject
	lpeu	9	13.690*	*lepu* does not cause *lm1*	Reject
	f	9	24.537***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	9	27.078***	*ly* does not cause *lm2*	Reject
	R	9	19.992**	*R* does not cause *lm2*	Reject
	lpeu	9	24.183***	*lepu* does not cause lm2	Reject
	f	9	18.760**	*f* does not cause lm2	Reject
India					
Dependent Variable: *lm1*					
	ly	15	28.484**	*ly* does not cause *lm1*	Reject
	R	15	30.111***	*R* does not cause *lm1*	Reject
	lpeu	15	37.502***	*lepu* does not cause *lm1*	Reject
	f	15	27.307**	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	12	18.255*	*ly* does not cause *lm2*	Reject
	R	12	40.068***	*R* does not cause *lm2*	Reject
	lpeu	12	27.325***	*lepu* does not cause lm2	Reject
	f	12	32.647***	*f* does not cause lm2	Reject
Ireland					
Dependent Variable: *lm1*					
	ly	8	16.341**	*ly* does not cause *lm1*	Reject
	R	8	17.852**	*R* does not cause *lm1*	Reject
	lpeu	8	13.062*	*lepu* does not cause *lm1*	Reject
	f	8	27.157***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	12	39.998***	*ly* does not cause *lm2*	Reject
	R	12	56.344***	*R* does not cause *lm2*	Reject
	lpeu	12	60.478***	*lepu* does not cause lm2	Reject
	f	12	88.437***	*f* does not cause lm2	Reject
Italy					
Dependent Variable: *lm1*					
	ly	7	17.560***	*ly* does not cause *lm1*	Reject
	R	7	14.006**	*R* does not cause *lm1*	Reject
	lpeu	7	14.310**	*lepu* does not cause *lm1*	Reject
	f	7	13.169**	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	14	6.637***	*ly* does not cause *lm2*	Reject
	R	14	5.867***	*R* does not cause *lm2*	Reject
	lpeu	14	4.372***	*lepu* does not cause lm2	Reject
	f	14	4.135***	*f* does not cause lm2	Reject
Japan					
Dependent Variable: *lm1*					
	ly	11	19.767**	*ly* does not cause *lm1*	Reject
	R	11	21.651**	*R* does not cause *lm1*	Reject
	lpeu	11	28.940***	*lepu* does not cause *lm1*	Reject
	f	11	30.200***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	13	2.573***	*ly* does not cause *lm2*	Reject
	R	13	2.864***	*R* does not cause *lm2*	Reject

(Contd...)

Table 1: ***(Continued)***

Economies	Variables	VAR lags ($k+dmax$)	MW static	Null hypothesis	Decision
	lpeu	13	1.927**	*lepu* does not cause lm2	Reject
	f	13	3.099***	*f* does not cause lm2	Reject
Mexico					
Dependent Variable: *lm1*					
	ly	12	27.878***	*ly* does not cause *lm1*	Reject
	R	12	75.595***	*R* does not cause *lm1*	Reject
	lpeu	12	47.017***	*lepu* does not cause *lm1*	Reject
	f	12	38.998***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	13	2.817***	*ly* does not cause *lm2*	Reject
	R	13	12.182***	*R* does not cause *lm2*	Reject
	lpeu	13	3.163***	*lepu* does not cause lm2	Reject
	f	13	2.387***	*f* does not cause lm2	Reject
Netherlands					
Dependent Variable: *lm1*					
	ly	7	19.682***	*ly* does not cause *lm1*	Reject
	R	7	21.392***	*R* does not cause *lm1*	Reject
	lpeu	7	11.256*	*lepu* does not cause *lm1*	Reject
	f	7	11.829*	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	8	33.482***	*ly* does not cause *lm2*	Reject
	R	8	36.520***	*R* does not cause *lm2*	Reject
	lpeu	8	24.654***	*lepu* does not cause lm2	Reject
	f	8	36.486***	*f* does not cause lm2	
New Zealand					
Dependent Variable: *lm1*					
	ly	10	30.775***	*ly* does not cause *lm1*	Reject
	R	10	16.559*	*R* does not cause *lm1*	Reject
	lpeu	10	17.779**	*lepu* does not cause *lm1*	Reject
	f	10	18.941**	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	10	16.822*	*ly* does not cause *lm2*	Reject
	R	10	24.255***	*R* does not cause *lm2*	Reject
	lpeu	10	43.670***	*lepu* does not cause lm2	Reject
	f	10	16.804*	*f* does not cause lm2	Reject
Nigeria					
Dependent Variable: *lm1*					
	ly	10	19.014**	*ly* does not cause *lm1*	Reject
	R	10	18.916**	*R* does not cause *lm1*	Reject
	lpeu	10	17.530**	*lepu* does not cause *lm1*	Reject
	f	10	27.452***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	9	21.345***	*ly* does not cause *lm2*	Reject
	R	9	17.624**	*R* does not cause *lm2*	Reject
	lpeu	9	19.923**	*lepu* does not cause lm2	Reject
	f	9	20.422***	*f* does not cause lm2	Reject
Russia					
Dependent Variable: *lm1*					
	ly	13	55.120***	*ly* does not cause *lm1*	Reject
	R	13	46.617***	*R* does not cause *lm1*	Reject
	lpeu	13	24.546**	*lepu* does not cause *lm1*	Reject
	f	13	24.837**	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	14	63.963***	*ly* does not cause *lm2*	Reject
	R	14	29.852***	*R* does not cause *lm2*	Reject
	lpeu	14	35.905***	*lepu* does not cause lm2	Reject
	f	14	23.960**	*f* does not cause lm2	Reject
Singapore					
Dependent Variable: *lm1*					
	ly	14	38.024***	*ly* does not cause *lm1*	Reject
	R	14	33.487***	*R* does not cause *lm1*	Reject
	lpeu	14	25.982**	*lepu* does not cause *lm1*	Reject
	f	14	56.818***	*f* does not cause *lm1*	Reject

(Contd...)

Table 1: ***(Continued)***

Economies	Variables	VAR lags (*k*+*dmax*)	MW static	Null hypothesis	Decision
Dependent Variable: *lm2*					
	ly	12	18.423*	*ly* does not cause *lm2*	Reject
	R	12	46.831***	*R* does not cause *lm2*	Reject
	lpeu	12	40.649***	*lepu* does not cause lm2	Reject
	f	12	26.478***	*f* does not cause lm2	Reject
Korea					
Dependent Variable: *lm1*					
	ly	4	10.946**	*ly* does not cause *lm1*	Reject
	R	4	24.036***	*R* does not cause *lm1*	Reject
	lpeu	4	9.473**	*lepu* does not cause *lm1*	Reject
	f	4	6.556*	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	12	26.010***	*ly* does not cause *lm2*	Reject
	R	12	32.483***	*R* does not cause *lm2*	Reject
	lpeu	12	28.482***	*lepu* does not cause lm2	Reject
	f	12	30.663***	*f* does not cause lm2	Reject
Spain					
Dependent Variable: *lm1*					
	ly	14	27.884***	*ly* does not cause *lm1*	Reject
	R	14	27.860***	*R* does not cause *lm1*	Reject
	lpeu	14	37.674***	*lepu* does not cause *lm1*	Reject
	f	14	43.296***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	15	7.659***	*ly* does not cause *lm2*	Reject
	R	15	4.405***	*R* does not cause *lm2*	Reject
	lpeu	15	3.954***	*lepu* does not cause lm2	Reject
	f	15	9.405***	*f* does not cause lm2	Reject
Sweden					
Dependent Variable: *lm1*					
	ly	11	25.531***	*ly* does not cause *lm1*	Reject
	R	11	16.566*	*R* does not cause *lm1*	Reject
	lpeu	11	22.429**	*lepu* does not cause *lm1*	Reject
	f	11	17.153*	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	13	39.817***	*ly* does not cause *lm2*	Reject
	R	13	55.588***	*R* does not cause *lm2*	Reject
	lpeu	13	23.514**	*lepu* does not cause lm2	Reject
	f	13	36.227***	*f* does not cause lm2	
UK					
Dependent Variable: *lm1*					
	ly	10	21.047**	*ly* does not cause *lm1*	Reject
	R	10	14.960*	*R* does not cause *lm1*	Reject
	lpeu	10	22.639***	*lepu* does not cause *lm1*	Reject
	f	10	14.658*	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	13	56.560***	*ly* does not cause *lm2*	Reject
	R	13	68.756***	*R* does not cause *lm2*	Reject
	lpeu	13	35.067***	*lepu* does not cause lm2	Reject
	f	13	37.050***	*f* does not cause lm2	Reject
US					
Dependent Variable: *lm1*					
	ly	5	11.956**	*ly* does not cause *lm1*	Reject
	R	5	8.274*	*R* does not cause *lm1*	Reject
	lpeu	5	9.745**	*lepu* does not cause *lm1*	Reject
	f	5	15.974***	*f* does not cause *lm1*	Reject
Dependent Variable: *lm2*					
	ly	6	13.021**	*ly* does not cause *lm2*	Reject
	R	6	11.249**	*R* does not cause *lm2*	Reject
	lpeu	6	32.696***	*lepu* does not cause lm2	Reject
	f	6	15.981***	*f* does not cause lm2	Reject

Source: Author's calculation using the software package RATS 9.2

The symbols ***, **, * indicate the rejection of the null hypothesis of no causality at 1%, 5% and 10% level respectively. The optimal lag length *k* is based on AIC and *dmax*=1.

MW static: Modified Wald statistic

3.2. Results and Discussion

Prior to the Toda-Yamamoto method, the unit root test (i.e., Phillips-Perron test) is employed to identify the level of stationarity of variables. Results from Table 2 demonstrate that variables are a mix of I (0) and I (1) for 28 economies.

The study then applies the Toda-Yamamoto long-run causality method proposed by Toda and Yamamoto (1995) to examine the long-run causal relationship between money demand (real narrow money and real broad money) and the real income, the nominal interest rate, economic uncertainty and the fear factor for each of

Table 2: Phillips-Perron unit root test results

Economies	Variables				
	lm1	*lm2*	ly	R	lepu
Australia					
Level	−2.517 (7)	−0.601 (5)	−1.822 (7)	−3.328 (4)*	−5.802 (4)***
First diff	−11.430 (7)***	−8.966 (4)***	−8.963 (13)***	−14.213 (2)****	−25.415 (23)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (0)*	*I (0)*
Belgium					
Level	−2.058 (7)	−1.920 (8)	−3.740 (1)**	−2.790 (5)	−1.451 (0)
First diff	−10.021 (7)***	−10.727 (7)***	−16.807 (12)***	−11.483 (4)***	−11.466 (5)***
Decision	*I (1)*	*I (1)*	*I (0)*	*I (1)*	*I (1)*
Brazil					
Level	−3.353 (10)*	−1.891 (7)	−1.200 (2)	−3.522 (4)**	−7.776 (5)***
First diff	−15.717 (9)***	−9.301 (8)***	−9.852 (5)***	−8.689 (4)***	−24.928 (9)***
Decision	*I (0)*	*I (1)*	*I (1)*	*I (0)*	*I (0)*
Canada					
Level	−2.689 (9)	−2.842 (7)	−2.861 (3)	−2.869 (7)	−6.460 (6)***
First diff	−12.907 (8)***	−13.274 (6)***	−11.013 (9)***	−11.031 (6)***	−21.519 (13)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (1)*	*I (0)*
Chile					
Level	−2.168 (7)	−0.252 (7)	−1.560 (5)	−4.673 (4)***	−6.279 (8)***
First diff	−8.512 (7)***	−9.940 (7)***	−8.119 (3)***	−19.207 (17)***	−20.151 (2)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (0)*	*I (0)*
China					
Level	−2.158 (2)	−2.154 (1)	−2.683 (4)	−7.333 (9)***	−5.388 (5)***
First diff	−9.998 (3)***	−10.134 (3)***	−11.115 (5)***	−25.159 (11)***	−19.013 (12)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (0)*	*I (0)*
Colombia					
Level	−6.624 (10)***	−2.174 (10)	−2.789 (4)	−2.257 (4)	−8.570 (4)***
First diff	−23.687 (11)***	−13.741 (10)***	−10.333 (5)***	−7.209 (5)***	−69.126 (71)***
Decision	*I (0)*	*I (1)*	*I (1)*	*I (1)*	*I (0)*
Croatia					
Level	−7.311 (4)***	−2.464 (17)	−2.034 (5)	−6.696 (6)***	−5.731 (4)***
First diff	−16.411 (50)***	−7.961 (2)***	−8.690 (6)***	−12.867 (2)***	−23.261 (11)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (0)*	*I (0)*
Denmark					
Level	−1.670 (7)	−1.916 (7)	−2.617 (4)	−2.968 (6)	−1.733 (0)
First diff	−9.700 (8)***	−10.096 (8)***	−10.762 (5)***	−11.009 (4)***	−10.812 (4)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (1)*	*I (1)*
France					
Level	−2.124 (9)	−2.576 (8)	−2.893 (3)	−1.957 (8)	−6.189 (6)***
First diff	−13.781 (9)***	−19.819 (9)***	−12.367 (4)***	−12.644 (7)***	−20.016 (10)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (1)*	*I (0)*
Germany					
Level	−1.088 (6)	−1.873 (5)	−2.561 (6)	−2.210 (7)	−7.513 (6)***
First diff	−6.246 (3)***	−5.871 (1)***	−12.490 (6)***	−11.683 (7)***	−28.384 (30)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (1)*	*I (0)*
Greece					
Level	−2.246 (2)	−1.714 (7)	−1.983 (7)	−6.594 (10)***	−2.319 (4)
First diff	−9.348 (4)***	−8.103 (7)***	−12.366 (7)***	−31.027 (6)***	−11.241 (3)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (0)*	*I (1)*
Hong Kong					
Level	−0.861 (6)	−0.490 (1)	−6.660 (10)***	−4.564 (9)***	−2.476 (3)
First diff	−9.418 (7)***	−8.400 (7)***	−14.559 (12)***	−19.002 (8)***	−12.497 (5)***
Decision	*I (1)*	*I (1)*	*I (0)*	*I (0)*	*I (1)*
India					
Level	−2.796 (7)	−0.268 (5)	−4.300 (8)***	−7.910 (5)***	−2.029 (4)
First diff	−13.614 (7)***	−12.593 (8)***	−12.520 (8)***	−16.469 (5)***	−14.315 (9)***
Decision	*I (1)*	*I (1)*	*I (0)*	*I (0)*	*I (1)*

(Contd...)

Table 2: ***(Continued)***

Economies	Variables				
	lm1	***lm2***	**ly**	**R**	**lepu**
Ireland					
Level	−2.086 (4)	−1.831 (6)	−1.775 (6)	−2.752 (9)	−3.201 (7)*
First diff	−5.986 (4)***	−5.853 (5)***	−10.323 (7)***	−14.464 (8)***	−12.597 (6)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (1)*	*I (0)*
Italy					
Level	−2.217 (9)	−2.293 (9)	−2.686 (1)	−2.501 (5)	−6.938 (24)***
First diff	−14.425 (9)***	−13.770 (8)***	−11.633 (2)***	−10.419 (5)***	−12.761 (4)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (1)*	*I (0)*
Japan					
Level	−1.561 (7)	−2.462 (7)	−3.021 (1)	−11.450 (7)***	−5.840 (4)***
First diff	−10.960 (8)***	−8.660 (9)***	−13.786 (10)***	−31.357 (4)***	−19.798 (8)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (0)*	*I (0)*
Mexico					
Level	−8.017 (9)***	−2.760 (5)	−3.408 (7)*	−3.331 (3)*	−6.113 (6)***
First diff	−15.320 (9)***	−11.096 (6)***	−13.896 (5)***	−9.612 (3)***	−24.806 (20)***
Decision	*I (0)*	*I (1)*	*I (0)*	*I (0)*	*I (0)*
Netherlands					
Level	−2.218 (6)	−0.878 (4)	−2.377 (6)	−3.356 (7)*	−4.552 (3)***
First diff	−10.071 (6)***	−9.874 (7)***	−9.939 (7)***	−11.829 (6)***	−26.151 (62)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (0)*	*I (0)*
New Zealand					
Level	−2.060 (8)	−1.246 (7)	−3.019 (6)	−2.133 (3)	−4.007 (3)**
First diff	−9.185 (9)***	−9.055 (8)***	−12.138 (4)***	−11.086 (2)***	−12.888 (0)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (1)*	*I (0)*
Nigeria					
Level	−1.363 (5)	−1.289 (6)	−0.252 (11)	−5.520 (7)***	−6.017 (7)***
First diff	−10.559 (6)***	−10.248 (8)***	−12.341 (11)***	−16.896 (4)***	−53.258 (110)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (0)*	*I (0)*
Russia					
Level	−1.707 (8)	−1.296 (7)	−3.782 (10)**	−4.207 (21)***	−7.222 (4)***
First diff	−11.722 (8)***	−9.996 (8)***	−12.301 (10)***	−11.653 (81)***	−27.074 (38)***
Decision	*I (1)*	*I (1)*	*I (0)*	*I (0)*	*I (0)*
Singapore					
Level	−1.391 (6)	−1.466 (5)	−3.024 (1)	−2.693 (2)	−2.052 (2)
First diff	−6.929 (7)***	−7.590 (7)***	−8.141 (3)***	−11.844 (5)***	−12.170 (2)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (1)*	*I (1)*
South Korea					
Level	−2.206 (6)	−3.446 (7)*	−1.684 (3)	−2.653 (6)	−6.797 (5)***
First diff	−9.093 (7)***	−4.547 (7)***	−6.838 (3)***	−9.621 (15)***	−17.686 (6)***
Decision	*I (1)*	*I (0)*	*I (1)*	*I (1)*	*I (0)*
Spain					
Level	−1.848 (6)	−1.094 (7)	−2.167 (6)	−7.192 (9)***	−2.211 (3)
First diff	−9.584 (7)***	−7.574 (8)***	−12.907 (7)***	−26.568 (5)***	−14.378 (3)***
Decision	*I (1)*	I (2)	I (3)	*I (0)*	*I (1)*
Sweden					
Level	−1.690 (8)	−2.240 (7)	−2.271 (4)	−4.112 (8)***	−2.599 (2)
First diff	−7.413 (8)***	−8.610 (8)***	−10.578 (7)***	−16.720 (5)***	−6.940 (0)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (0)*	*I (1)*
UK					
Level	−0.858 (7)	−0.975 (6)	−2.409 (2)	−1.898 (9)	−3.679 (5)**
First diff	−8.179 (9)***	−9.545 (6)***	−13.636 (4)***	−16.332 (7)***	−12.788 (4)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (1)*	*I (0)*
US					
Level	−1.774 (3)	−2.585 (7)	−3.015 (4)	−2.311 (7)	−6.581 (5)***
First diff	−9.886 (3)***	−7.406 (8)***	−10.465 (7)***	−9.619 (7)***	−21.596 (11)***
Decision	*I (1)*	*I (1)*	*I (1)*	*I (1)*	*I (0)*

Source: Author's calculation using the software packages EViews 13

The symbols ***, **, * indicate the rejection of the null hypothesis of the existence of unit roots at 1%, 5% and 10% level respectively. The test uses the Bartlett Kernel with automatic Newey-West bandwidth selection. ( ) denotes the bandwidth

the 28 economies. The results of the Toda-Yamamoto long-run causality test results from Table 1 confirm that for almost all the 28 economies, the null hypotheses that y_t, R_t, eu_t and f_t does not Granger cause $lm1_t$ and $lm2_t$ are rejected, suggesting that real income, the nominal interest rate, the economic policy uncertainty and the fear factor do Granger cause the real narrow money and the real broad money demand. For the precautionary demand for money, the economic uncertainty resulting from the monetary, fiscal and regulatory policies do change the precautionary motive for economic agents to hold money.

In terms of policy implications, the identified causal relationship between the precautionary demand for money and the economic policy uncertainty and the fear factor suggest that economic policy uncertainty and the public's perceived fear due to the economic uncertainty brought about by uncertainty on policy making, can act as the signal for change in the precautionary demand for money, such that central banks could utilize in fine-tuning the money demand function to provide the most desirable liquidity for improved macroeconomic stability, because if unchecked, the liquidity problem may evolve into exogenous shocks, threatening macroeconomic stability (United Nations, 2023). Additionally, the real income and the nominal interest rate should not be neglected in adjusting the liquidity demand arising from the transactions motive and the speculative demand for money respectively.

4. CONCLUSIONS

This study examines the long-run causal relationship between the precautionary demand for money and economic uncertainty and the fear factor without ignoring the roles of the scale variable (real income) and the opportunity cost variable (the nominal interest rate) in the money demand function in 28 selected economies, namely, Australia, Belgium, Brazil, Canada, Chile, China, Colombia, Croatia, Denmark, France, Germany, Greece, Hong Kong, India, Ireland, Italy, Japan, Mexico, Netherlands, New Zealand, Nigeria, Russia, Singapore, South Korea, Spain, Sweden, the UK and the US. The estimated results from Toda-Yamamoto long-run causality method demonstrate that economic uncertainty can act as an explanatory indicator about unknown future economic events, which policy makers can utilize in fine-tuning the money demand function to provide the most desirable liquidity support for improved macroeconomic stability.

The current study has some limitations. First, the study employs a sample of 28 economies, while a similar process could be replicated in a broader geographical context. Second, the study mainly concerns the precautionary demand with respect to economic uncertainty due to monetary, fiscal and regulatory policy making. Future research could study economic uncertainty from other perspectives. Third, this study is specifically interested in the relationship between the precautionary money demand and economic uncertainty. Future research could study other potential factors affecting precautionary demand for money, such as prices of various financial assets.

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