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Article abstract

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Demand for Money in Greece After Euro Area and Policy Uncertainties

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This study examines the asymmetric effects of uncertainties in monetary policy on the demand for money in Greece. In doing so, it introduces and uses the monetary policy uncertainty (MPU) index, which can probably be a very appropriate and robust explanatory variable in demand-for-money models. Therefore, this study with this index differs from previous empirical studies that use conventional uncertainty-based independent variables. Empirical findings of both models indicate that changes in the MPU index have significant effects on Greek money demand. Additionally, compendious inferences of the nonlinear model for the Greek people's financial preferences are as follow as: (i): Greek people invest more in alternative financial instruments and/or spend their money rather than hold (demand) it when the MPU index increases, (ii): Greek people's money demand in both increases and decreases in the MPU index is predominantly determined by longer-term bond rate changes.

Keywords: Monetary Policy Uncertainty (MPU) index; Greek Government Bonds; Demand for Money

JEL Classifications: E00; E40; E41

1 Introduction

Rising economic uncertainty may change the patterns of economic behavior of consumers-investors, such as, less demand on goods-services, investing in more secure and short-term financial instruments-obligations, etc. For some consumers-investors, the best option may be to keep only cash in their portfolios. This means that uncertainty may play a determining role for the level of demand for money. According to Friedman (1984), increasing volatility of money supply leads to increasing the level of uncertainty and, thereby, to increasing the demand for money. Following Friedman (1984), many scholars added the concept of 'uncertainty' of

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various forms to certain conventional independent variables (income, exchange rate, inflation rate and interest rate) in their demand-for-money models for different countries. However, the effects of following these different forms of uncertainties (independent variables) on demand for money vary from one study to another. For instance, Klein (1977) used inflation uncertainty (applied time series analysis) for the US and found positive effects, which means that increases in inflation uncertainty lead to increasing demand for money in this country (positive effects = changes of variables in the same direction). Longstaff and Schwartz (1993) used bond rates uncertainty (Longstaff and Schwartz model) for the US and found negative effects, which means that increases in bond rates lead to decreasing demand for money (negative effects = changes of variables in the opposite direction). Choudhry (1999) used interest rate uncertainty (Johansen multivariate cointegration tests and error correction model) for the US and found positive effects on demand for money. Nicholas (1999) used inflation uncertainty (ARCH: autoregressive conditional heteroscedasticity model) for Greece and found negative effects on Greek money demand. Choi and Oh (2003) used output and monetary uncertainties (dynamic error correction model). They found negative and positive effects for output uncertainty and monetary uncertainty, respectively, for US money demand. Arize et al. (2005) used inflation uncertainty (cointegration and error correction model) for eight less-developed countries and found negative effects on demand for money in these countries. Bahmani-Oskooee (2013) used exchange rate uncertainty (bound testing approach) for some less-developed countries and found positive and negative effects in these countries. Bahmani-Oskooee and Bahmani (2014) used monetary uncertainty (error-correction model) for South Korea and found positive effects on money demand. Ho and Iyke (2017) also used monetary uncertainty (autoregressive distributed lag bounds testing approach) for Ghana and found negative effects on demand for money in this country. Aworinde (2018) used output and monetary uncertainties (nonlinear autoregressive distributed lag) for Nigeria and found positive effects on demand for money.

It should be noted that the concept of uncertainty in all above-mentioned forms of independent variables is based on volatilities and are, thereby, scaled-measured by each scholar individually in this manner. However, in most recent demand-for-money models, the Economic Policy Uncertainty (EPU) index[1], newly created by Baker et al. (2016) is used (Bahmani et al., 2015 for the UK; Bahmani et al., 2016 for the US; Bahmani and Nayeri, 2018 for Korea; Ivanovski and Churchill, 2019 for Australia). This news-based index scans and counts the frequencies of certain predetermined words, which correspond to uncertainties in economic policies, in leading newspapers. These are ‘uncertainty’, ‘uncertain’, ‘economic’, ‘economy’, ‘congress’, ‘deficit’, ‘Federal Reserve (the FED)’, ‘legislation’, and ‘regulation’. While some of these words correspond to uncertainties caused by fiscal policy implementation, some

[1] For technical information, see Baker, S.R., Bloom, N. and Davis, S.J. (2016).

correspond to uncertainties caused by monetary policy implementation. This index also includes reports by the Congressional Budget Office and forecasts by the FED. Hence, the EPU index can be interpreted (to some degree) as a combination of fiscal and monetary policy-based uncertainties. However, we assume that the level of demand for money is mostly determined by monetary policy-based uncertainties. This is because the effects of monetary policy implementation by central banks are expected to be seen firstly-quickly and more directly on demand for money through money supply processes. Therefore, changes in this form of uncertainties (monetary policy uncertainties: MPU index) can explain changes in demand for money better than the EPU index and may give more accurate results in money demand models. Furthermore, our assumption above makes our study different from the previous empirical studies which use previously mentioned uncertainty-based variables (including the EPU index) in demand for money models.

This study examines potential asymmetric effects of changes in monetary policy uncertainties (MPU) on demand for money in Greece. To this aim, besides the linear ARDL model, we apply the nonlinear ARDL (Auto Regressive Distributed Lag) model developed by Shin et al., (2014). The contribution of this study is threefold. First, we believe that we use a more appropriate and robust explanatory (variable) index (MPU), instead of the EPU index, in our model. Second, we also believe that Greece is one of the unique sample countries to examine the effects of uncertainties on demand for money. This is because, according to Hofstede (2001)'s Uncertainty Avoidance Index[2] (UAI), Greek people have the highest score for uncertainty avoidance and seek stability and security more than any nation. Therefore, it can be easily said that uncertainties may play a key role in their investment decisions in financial markets including holding cash (demanding money). The third, namely, the nonlinear ARDL model, enables us to separately monitor the effects of increases and decreases in the MPU index on demand for money in Greece. The main aim of applying the nonlinear model is that, under rising uncertainties, economic actors may exhibit more asymmetric (nonlinear) behaviors. Therefore, this methodology may create a big advantage for understanding whether the relationship between independent variables and the dependent variable are symmetric (linear) or asymmetric (nonlinear). Furthermore, this methodology may capture these asymmetric results more easily. In the related literature, a few studies have used this new categorical MPU index for different dependent variables (Ongan and Gocer, 2021- demand for money; Husted et al., 2017- firm investments; Park et al., 2020- exchange rates).

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[2] Hofstede (2001) ranks nations/countries according to their tolerance for uncertainty and ambiguity.

2 The Construction of the MPU index

In this section of the study, we examine the construction of the MPU index[3]. This index was constructed only based on monetary policy-related uncertainties, in demand-for-money models. For the case of Greece, this index, created by Hardouvelis et al. (2018), scans leading Greek newspapers "Ta Vima", "Ta Nea", "Naftemporiki" and "Kathimerini". Their methods follow "the EPU index by Baker et al. (2016). They seek and count the frequencies of some special words which can correspond to the uncertainties in Greek monetary policies such as interest rate, cost of money, monetary policy, quantitative easining, currency appreciation, currency depreciation, national currency, monetary union, Grexit (exit-Greece) and Bank of Greece etc. The construction of this index can be shown in the following steps and formulas (Hardouvelis et al. (2018); Baker et al., 2016; Čižmešija et al., 2017):

a. Scan-count above words and get the series of scaled MPU frequency (X_{it}) for newspaper $i = 1, 2, \ldots, N$ in month t. N is number of newspapers. N is 4 (4 Greek newspapers)

b. Calculate the times-series variance (σ_i) of X_{it} for the sample time period for each Greek newspaper.

c. Standardize the series with $Y_{it} = \frac{X_{it}}{\sigma_i}$

d. Take the cross-sectional average of the standardized series across the newspapers by $Z_t = N^{-1} \sum_{i=1}^{N} Y_{it}$.

e. Finally, calculate the mean (M) of Z_t in the sample period, multiply Z_t by (100/M) for all t as ($TPU_t = \frac{Z_t}{M} * 100$) and get the normalized MPU time-series index.

3 Empirical Model-Methodology

We add the monetary policy uncertainty (MPU) index, as a new independent variable, to the following standard money demand function model in logarithmic regression form:

$$LogMD2_t = \beta_0 + \beta_1 LogMPU + \beta_2 GBR_t + \beta_3 LogIPI_t + \varepsilon_t \quad (1)$$

In Eqn.1, *MD2* is the real money balance for broad money (*M2*)[4] deflated by the CPI, *MPU* is monetary policy uncertainty index of Greece, *GBR* is both 10-year and 20-year Greek

[3] For technical information, see Baker, S.R., Bloom, N. and Davis, S.J. (2016), Hardouvelis et al. (2018)

[4] In this study, Greece's monetary aggregate (*M2*) refers to the so-called "*Greek Contribution (GC)*" to the *Euro Area* aggregates since This Country joined the *Euro Area* in January 2002. Hovewer, the European Central Bank (ECB) adjusted the series of *M2* for pre-January 2002, as well. The *GC* is

Government Bond rate and IPI is the Industrial Production Index as a proxy for income. The reason for using this index[5] instead of the GDP is that we wanted to study with monthly data since GDP data are not collected and released monthly, only quarterly and yearly. Another reason for using monthly data and the IPI index is that financial transactions in today's modern financial markets are open 24 hours. Any disruption in a country's stock easily affects the other countries stock exchanges quickly. Therefore, at this point, even monthly data may have difficulty capturing the impact of many shocks in financial markets. According to our expectations, the sign of β_1 is to be positive or negative. This means that increases and falls in the MPU index may increase or decrease demand for money. The sign of β_2 is to be negative. This means that higher government bond rates lead to lower demand for money. Finally, the sign of β_3 is to be positive since increases in income should lead to increase in demand for money (transaction motive). ε_t is the stochastic error term. In this study, for Greek Government 10-year and 20-year bond rates, the following two separate models were constructed in Model 1 and Model 2, respectively. The data set of the study is presented in the Appendix.

$$\text{Model 1: } LogMD2_t = \beta_0 + \beta_1 LogMPU + \beta_2 GBR10_t + \beta_3 LogIPI_t + \varepsilon_t \quad (2)$$

$$\text{Model 2: } LogMD2_t = \alpha_0 + \alpha_1 LogMPU + \alpha_2 GBR20_t + \alpha_3 LogIPI_t + e_t \quad (3)$$

In Eqns. 2 and 3, $GBR10$ and $GBR20$ are 10-year and 20-year bond rates, respectively. The empirical methodology of this study is based on the nonlinear ARDL model. With this model we can decompose changes in the MPU index into its increases (MPU^+) and decreases (MPU^-) as two new series. Hence, we get the chance to examine the separate effects of MPU index increases and decreases on demand for money. However, the nonlinear ARDL model is the asymmetric (nonlinear) form of the linear ARDL model. Therefore, first, we present the linear form of the ARDL model. To this aim, we apply bounds testing to cointegration within the ARDL model by Pesaran et al. (2001). Hence, we obtain the following Eqn. 4 in error correction

defined by the ECB in the three following manners. It equals to: (*a*) the deposits held by Greek and other *euro area* countries' residents in Greek monetary financial institutes (MFIs); (*b*) the banknotes put into circulation by the Bank of Greece (BoG); (*c*) debt securities issiued by Greek MFIs minus the debt securities issued by all *euro area* MFIs. Hence, in this study, we assume that *M2* can be accepted and used as a Greek money aggregate. It should be noted that the empirical findings of this study should be considered and interpreted within this assumption. The term *euro area is* used to describe the member countries of the European Union (EU) that use the *Euro* (€) as their national currency.

[5] This index is used in a wide range of studies (Bahmani-Oskooee and Saha (2017); Bahmani-Oskooee and Durmaz (2020); Ongan and Gocer (2020); Ongan and Gocer (2021b).

format for both 10-year and 20-year bond rates in Model 1 and Model 2 in Eqns.2 and 3, respectively.

$$\Delta LogMD2_t = \beta_0 + \sum_{j=1}^{p} \beta_{1j} \Delta LogMD2_{t-j} + \sum_{j=0}^{q} \beta_{2j} \Delta LogMPU_{t-j} + \sum_{j=0}^{r} \beta_{3j} \Delta GBR_{t-j} + \sum_{j=0}^{s} \beta_{4j} \Delta LogIPI_{t-j} + \beta_5 LogMD2_{t-1} + \beta_6 LogMPU_{t-1} + \beta_7 GBR_{t-1} + \beta_8 LogIPI_{t-1} + \varepsilon_t \quad (4)$$

In this equation, Δ is the difference operator. The short-run and long-run effects of changes in the MPU index on demand for money ($MD2$) are determined by the signs and significances of β_{2j} and β_6, respectively. β_{3j} and β_{4j} stand for *GBR* and *IPI* in short-run and β_7 and β_8 in long-run.

Following the linear ARDL model, we apply the nonlinear model for asymmetric effects of MPU index increases (MPU^+) and decreases (MPU^-) on demand for money ($MD2$). This model will show us how MPU^+ and MPU^- , in the MPU index, separately affect the *MD*2. This means that we will learn whether the effects of MPU^+ and MPU^- on *MD*2 are symmetric or asymmetric. Symmetric effects are defined by the same size and same sign decomposed coefficients (MPU^+ and MPU^-). However, the Wald test for short-run (W_{SR}) and long-run (W_{LR}) will formally give us symmetry or asymmetry decisions. Decomposed MPU^+ and MPU^- are obtained from the concept of the following partial sum process:

$$LogMPU_t^+ = \sum_{j=1}^{t} \Delta LogMPU_j^+ = \sum_{j=1}^{t} \max\,(\Delta LogMPU_j, 0) \quad (5)$$

$$LogMPU_t^- = \sum_{j=1}^{t} \Delta LogMPU_j^- = \sum_{j=1}^{t} \min\,(\Delta LogMPU_j, 0) \quad (6)$$

where MPU^+ and MPU^- are the partial sum processes of increases (+) and decreases (-) in the MPU index. Following the decomposition process, we obtain the nonlinear ARDL model in Eqn.7 for both Model 1 and Model 2, below:

$$\Delta LogMD2_t = \beta_0 + \sum_{j=1}^{p} \beta_{1j}\Delta LogMD2_{t-j} + \sum_{j=0}^{q} \beta_{2j}\Delta LogMPU^{+}_{t-j} + \sum_{j=0}^{r} \beta_{3j}\Delta LogMPU^{-}_{t-j} + \sum_{j=0}^{s} \beta_{4j}\Delta GBR_{t-j} + \sum_{j=0}^{k} \beta_{5j}\Delta LogIPI_{t-j} + \beta_6 LogMD2_{t-1} + \beta_7 LogMPU^{+}_{t-1} + \beta_8 LogMPU^{-}_{t-1} + \beta_9 GBR_{t-1} + \beta_{10} LogIPI_{t-1} + \varepsilon_t \quad (7)$$

In Eqn.7, the short-run effects of MPU^{+} and MPU^{-} on demand for money are determined by the signs and significances of β_{2j} and β_{3j}, respectively. Similarly, the long-run effects of MPU^{+} and MPU^{-} are determined by the signs and significances of normalized $-\beta_7/\beta_6$ and $-\beta_8/\beta_6$, respectively. The same is true for *GBR* and *IPI* for β_{4j}, β_{5j} in short-run and β_9 and β_{10} in long-run. Normalized coefficients of *GBR* and *IPI* are obtained via $-\beta_9/\beta_6$ and $-\beta_{10}/\beta_6$, respectively.

4 Empirical Findings

In this section of the study, we first apply the Carrion-i-Silvestre, Kim and Perron (2009) Unit Root Test with Multiple Structural Breaks to confirm whether the series are stationary or not. The results of this test are reported in Table 1.

Table 1. Carrion-i-Silvestre, Kim and Perron (2009) Unit Root Test with Multiple Structural Breaks Results

Variable	Test Statistics and Critical Values					Structural Break Dates
	PT	MPT	MZA	MSB	MZT	
$LogMD2$	12.81 (8.00)	12.19 (8.00)	-23.71 (-35.49)	0.14 (0.11)	-3.41 (-4.20)	2002:M03; 2009:M08; 2014:M12
$LogMPU$	3.87** (7.10)	3.54** (7.10)	-63.94** (-31.68)	0.08** (0.12)	-5.64** (-3.96)	2010:M04; 2013:M01; 2015:M07
$LogMPU^{+}$	5.62** (7.24)	5.49** (7.24)	-46.42** (-34.20)	0.10** (0.12)	-4.80** (-4.12)	2006:M12; 2010:M02; 2015:M06
$LogMPU^{-}$	4.59** (7.06)	4.59** (7.06)	-48.27** (-31.66)	0.10** (0.12)	-4.91** (-3.96)	2010:M03; 2012:M03; 2014:M12
$GBR10$	9.78 (7.19)	9.17 (7.19)	-24.96 (-32.09)	0.14 (0.12)	-3.53 (-3.99)	2009:M11; 2012:M02; 2014:M08
$GBR20$	26.81 (7.24)	24.81 (7.24)	-9.21 (-31.93)	0.23 (0.12)	-2.14 (-3.98)	2010:M03; 2012:M02; 2015:M06
$LogIPI$	4.08** (8.13)	4.03** (8.13)	-77.57** (-35.93)	0.07** (0.11)	-6.17** (-4.22)	2001:M12; 2008:M01; 2011:M09
$\Delta LogMD2$	2.59** (7.61)	2.47** (7.61)	-108.42** (-35.00)	0.06** (0.11)	-7.36** (-4.17)	2002:M03; 2008:M09; 2015:M05

$\Delta GBR10$	2.26** (7.04)	2.12** (7.04)	-108.43** (-32.40)	0.06** (0.12)	-7.35** (-4.01)	2009:M06; 2011:M11; 2015:M05
$\Delta GBR20$	2.10** (6.97)	1.95** (6.97)	-111.07** (-31.52)	0.06** (0.12)	-7.45** (-3.95)	2009:M10; 2011:M10; 2013:M09

Note: ** denote statistical significance at 5% level. Δ denotes the first differences of the series. The above structural break dates successfully detect the pre-post effects of 2008 Global Financial Crisis and Greece's switching to the Euro in 2002. $LogMD2$: the real broad money balance (*M2*). $GBR10$: 10-year bond rates. $GBR02$: 20-year bond rates. Critical values in this test were obtained with 1000 repetition in bootstrap.

Test results in Table 1 indicate that $LogMPU$, $Log\,MPU^{+}$, $Log\,MPU^{-}$and $LogIPI$ are I(0) and $LogMD2$, $GBR10$ and $GBR20$ are I (1). Hence, for testing cointegration relationships, we apply bounds testing developed by Pesaran et al. (2001). The results of bounds testing and structural break dates by Bai and Perron (2003), for both linear and nonlinear models, are reported in Table 2.

Table 2. Test Results of Bounds Testing and Structural Break Dates

				Critical Values							**Structural Break Dates**
				I0 Bound				**I1 Bound**			
		k	***F stat.***	***10%***	***5%***	***1%***		***10%***	***5%***	***1%***	
Linear	Model 1	3	6.74***	2.37	2.79	3.65		3.20	3.67	4.66	2005:M03; 2008:M02;
	Model 2	3	6.07***	2.37	2.79	3.65		3.20	3.67	4.66	2004:M08; 2008:M02;
Nonlinear	Model 1	4	6.13***	2.20	2.56	3.29		3.09	3.49	4.37	2007:M01; 2010:M04;
	Model 2	4	5.98***	2.20	2.56	3.29		3.09	3.49	4.37	2008:M11; 2012:M03;

Note: *k* is number of regressors. ***; denotes cointegration at the 1% significance level. Model 1: 10-year bond rates. Model 2: 20-year bond rates.

Table 3. Linear ARDL Model Estimation Results

Short-Run Coefficients			**Long-Run Coefficients**		
Variables	**Model 1**	**Model 2**	**Variables**	**Model 1**	**Model 2**
$\Delta LogMD2_{t-1}$	-0.15** (0.01)	-0.18*** (0.00)	$LogMPU_t$	-4.77* (0.08)	-1.27** (0.03)
$\Delta LogMD2_{t-2}$	-0.07 (0.25)	-0.09 (0.12)	GBR_t	-4.83* (0.08)	-0.16** (0.03)
$\Delta LogMD2_{t-3}$	-0.29*** (0.00)	-0.30*** (0.00)	$LogIPI_t$	14.75** (0.03)	4.37*** (0.00)
ΔGBR_t	-0.001** (0.04)	-0.001 (0.33)	D_{2004_t}	8.41* (0.09)	2.82* (0.05)
ΔGBR_{t-1}	-0.0009 (0.26)	-0.005 (0.77)	D_{2008_t}	-7.93* (0.09)	-3.26** (0.02)
ΔGBR_{t-2}	0.001** (0.03)	0.0004** (0.01)	D_{2011_t}	66.48* (0.08)	-
ΔGBR_{t-3}	-	0.0003** (0.02)	D_{2015_t}	-	-10.10** (0.02)
ΔD_{2008_t}	0.001 (0.90)	0.007 (0.60)			
ΔD_{2011_t}	0.02 (0.10)	-			
ECT_{t-1}	-0.0006*** (0.00)	-0.003*** (0.00)			

Diagnostic Tests					
R^2	0.99	0.99	χ^2_{FF}	0.87*** (0.34)	0.10*** (0.74)
$Adj.R^2$	0.99	0.99	χ^2_{NOR}	3.42*** (0.18)	2.76*** (0.25)
DW	2.04***	2.03***	χ^2_{HET}	21.69*** (0.29)	124.17** (0.06)
χ^2_{SC}	1.57*** (0.20)	0.76*** (0.38)			

Note: ***, ** and * denote statistical significances at 1%, 5% and 10% levels respectively. Values in parentheses are probabilities. *DW;* Durbin-Watson autocorrelation test, χ^2_{SC} is Breusch-Godfrey LM test for autocorrelation, χ^2_{NOR} is the Jarque-Bera test for normality, χ^2_{FF} is Ramsey test for functional form misspecification, χ^2_{HET} for Breusch-Pagan-Godfrey heteroscedasticity test. All model specification test results are reliable. Model 1: 10-year bond rates. Model 2: 20-year bond rates.

Test results in Table 2 indicate that the series are cointegrated at the 1% significance level, since calculated F- statistics are above the upper bounds. Hence, we can now estimate the coefficients of the linear model. Structural break dates were detected by the Bai and Perron (2003) method. These dates were added to successive analyses with dummy variables (D_{i_t}). The linear ARDL model's test results and its diagnostics are reported in Table 3.

Test results in Table 3 (above) for the linear model indicate that changes in the MPU index have negative effects on demand for money in Greece in the long run, since the coefficients of MPU in both models are significantly negative. This means that a higher MPU index leads to a fall in money demand in Greece, while a lower MPU index increases the demand for money. However, the responsiveness of demand for money to the changes in the MPU index in 10-year bond rates (-4.77) is higher than in 20-year bond rates (-1.27). This suggests that increases in the MPU index reduce demand for money more for changes in shorter-term bond rates than in longer-term bond rates. This may mean that Greek people hold far less money in the face of rising uncertainty when the maturity of alternative investments (Greek Government bonds) gets shorter (10-year bond rates). Furthermore, a higher income (*IPI*) leads to increases in demand for money, as expected, for both 10-year and 20-year bond rates. On the other hand, Greek people hold far less money (-4.83) when shorter-term bond rates rise than with increase in the longer-term bond rates.

The nonlinear ARDL model test results and its diagnostics are reported in Table 4 below. The normalized long-run coefficients in the nonlinear model in Table 4 indicate that MPU index increases (MPU^+) and decreases (MPU^-) have significantly negative effects on demand for money (*MD2*) in Greece for both Models 1 and 2. While increases in the MPU index lead to lower demand for money, decreases in the MPU index lead to higher demand. It should be noted that Ongan and Gocer (2021a) found the same negative relationship between demand for money and the MPU index for Japan. Furthermore, the effects of both MPU index increases and decreases on demand for money are higher for the 20-year bond rates (-0.16, -0.16) than for the 10-year bond rates (-0.10, -0.11). Increases in income (*IPI*) lead to higher demand for money (as expected) for both 10-year and 20-year bond rates. Higher bond rates lead to slight decreases in demand for money. Furthermore, the sign of normalized long-run coefficients of

2015's structural break date (D_{2015_t}) for both models are significantly positive. This indicates that demand for money in Greece increased with the third bailout package for Greece by the EU in 2015, suggesting that this package increased the stability in Greek economy and thereby money demand.

The Wald tests in Table 4 formally confirm asymmetric effects of MPU index increases (MPU^+) and decreases (MPU^-) on the demand for money for 10-year bond rates in the long-run (Model 1). It is because, $W_{LR} = 0.004^*(0.09)$ for *GBR10*. On the other hand, the same test results for 20-year bond rates confirm symmetric effects in the long-run. It is because, $W_{LR} = 0.02(0.67)$ for *GBR20* (Model 2).

Table 4. Nonlinear ARDL Model Estimation Results

Short-Run Coefficients			**Normalized Long-Run Coefficients**		
Variables	**Model 1**	**Model 2**	**Variables**	**Model 1**	**Model 2**
$\Delta LogMD2_{t-1}$	-0.18*** (0.00)	-0.11** (0.02)	$LogMPU_t^+$	-0.10** (0.02)	-0.16** (0.03)
$\Delta LogMD2_{t-3}$	-0.14*** (0.00)	-0.17*** (0.00)	$LogMPU_t^-$	-0.11** (0.02)	-0.16** (0.02)
$\Delta LogMD2_{t-4}$	0.53*** (0.00)	0.53*** (0.00)	GBR_t	-0.01*** (0.00)	-0.003** (0.01)
$\Delta LogMPU_t^+$	-0.02*** (0.00)	0.01** (0.01)	$LogIPI_t$	0.93** (0.01)	0.59** (0.03)
$\Delta LogMPU_{t-1}^+$	-	0.01*** (0.00)	D_{2008_t}	-0.04 (0.20)	-0.10* (0.07)
$\Delta LogMPU_t^-$	0.01*** (0.00)	-0.02*** (0.00)	D_{2013_t}	-0.14* (0.09)	0.02 (0.67)
$\Delta LogMPU_{t-1}^-$	0.01*** (0.00)	-0.008* (0.08)	D_{2015_t}	4.51*** (0.00)	0.23*** (0.00)
ΔGBR_t	0.009*** (0.00)	-			
ΔGBR_{t-1}	0.001*** (0.00)	-			
ECT_{t-1}	-0.003*** (0.00)	-0.02*** (0.00)			
Diagnostic Tests					
R^2	0.68	0.68	χ^2_{NOR}	60.22* (0.09)	108.84* (0.05)
$Adj.R^2$	0.66	0.65	χ^2_{HET}	38.73*** (0.31)	35.40*** (0.84)
DW	1.80*	1.84*	W_{LR}	0.004* (0.07)	0.0017 (0.50)
χ^2_{SC}	3.11*** (0.41)	5.75*** (0.41)	W_{SR}	-0.04*** (0.00)	-0.03*** (0.00)
χ^2_{FF}	0.33*** (0.56)	0.44*** (0.50)			

Note: ***, ** and * denote statistical significances at 1%, 5% and 10% levels respectively. Values in parentheses are probabilities. W_{LR} and W_{SR} are long and short-run Wald tests. DW; Durbin-Watson autocorrelation test, χ^2_{SC} is Breusch-Godfrey LM test for autocorrelation, χ^2_{NOR} is the Jarque-Bera test for normality, χ^2_{FF} is Ramsey test for functional form misspecification, χ^2_{HET} for Breusch – Pagan - Godfrey heteroscedasticity test. All model specification test results are reliable. Model 1: 10-year bond rates. Model 2: 20-year bond rates.

5 Conclusion

This study examines the asymmetric effects of uncertainties in monetary policy on the demand for money in Greece. In doing so, it introduces and uses the MPU index as a very appropriate and robust explanatory variable for demand for money models. The reason for using this index is based on our assumption that demand for money is mostly determined by monetary policy-based uncertainties. This is because the effects of monetary policy implementation by central banks are expected to be seen first, quickly and more directly on demand for money through money supply processes. Therefore, this assumption makes our study different from the previous empirical studies which use previously mentioned uncertainty-based variables (including the EPU index) in demand for money models. Empirical findings of this study, through the linear and nonlinear models, indicate that changes in MPU index have significant effects on demand for money in Greece. Therefore, it is believed that this index can be conveniently used in demand for money models, as an additional, successful, explanatory variable.

Additionally, the nonlinear model provides more detailed findings about the Greek people's demand for money preferences. Greek people demand less money when the MPU index increases and more money when this index falls. This leads to the interpretation that *when uncertainty increases, Greek people invest more in alternative financial instruments and/or spend their money rather than hold (demand) it (when uncertainty decreases, they invest less and/or do not spend)*. The effects of both MPU index increases and decreases on demand for money are much higher in 20-year bond rates than in 10-year bond rates. This means that *Greek people's money demand during both MPU index increases and decreases is predominantly determined by longer-term (20-year) bonds, which yield lower interest rates than 10-year bonds*. Hence, this leads to the interpretation that the effects of MPU index increases and decreases on the demand for money are higher on lower bond rates in Greece.

In conclusion, it is believed that the empirical findings of this study may help first the economic actors, including (investors) in Greece but also Greek policymakers and the Bank of Greece (BoG), to be more proactive if they understand the mechanism between the Greek monetary policy uncertainty and the Greek real money balances. This study also reveals the need for more empirical studies, which will use this index or alternative ones for future studies. These may help us better understand the actual relationships between changing uncertainties and demand for money in the related literature.

Appendix

The monthly data of the *MD2* and *GBR* were obtained from the data set of the Bank of Greece (BoG) and IMF Financial Statistics. The *IPI* and *CPI* were obtained from the data set of the Federal Reserve Bank of St. Louis. The *MPU* index was obtained from the website of www.policyuncertainty.com. The sample period of the study is between 2000M1-2019M1.

Greece joined the *euro area* in January 2002. Hovewer, the European Central Bank (ECB) adjusted the series of Greece's *M2* for the period before January 2002, as well. This data set was used for the sample period.

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